MDRS 43 Mission

Report

Simulating a Martian exploration

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Modifications

Release 3 modifications:

-Diagrams English version in § 4-1 and diagrams for 4 crewmembers added

-Glove prototype photos added end of § 4-6

Release 3-1 modifications:

-Minor wording modifications

Release 4 modifications:

-Additions pf CRV 73 and 74 tests photos in chapter 4-3

-Additions to the § Martian balloon dimensioning in chapter 4-4

-Addition of Manchu painting in chapter 4-4

-Addition of chapters 5-3, 5-4.

Release 5 modifications

-Addition of chapter 1-1 Mars Analog Research Stations

-Addition of § “Documentation for the mission” in chapter 1-2

-Addition of drawings and photos in chapter 5-3 and 5-4

-Addition of Hab photo mosaic in chapter 4-4

Release 6 modifications

-Addition of chapter 2-1 Simulation condition general presentation

-Addition of chapter 2-2 MDRS 43 mission chronology

-Addition of the engineering reports in chapter 2-3

-Addition of chapter 3.6 EVAs daily reports

-Addition of the sent reports table in chapter 4-1

-Addition of conclusions for Mars missions explored areas in 4-2

-New Hab area photomosaic in chapter 4-4

-Addition of photos in chapter 5-4

Release 6-1 modifications

-Minor wording modifications

Release 7 modifications

-Addition of a panoramic photo in chapter 1-1

-Correction of a mistake in EVA 16 in the table (Jeremie added) in chapter 3-1. As a consequence modification of EVA cumulated man x hour.

-Reintroduction of last lines erased in the EVA summary table in chapter 3-1

-Addition of photos giving indications on the road from Lowell highway to Lith canyon in chapter 3-4

-Addition of a Cactus Road photos and Cactus road panorama in chapter 3-4

-Addition of Candor Chasma entrance photo in chapter 3-4

-Addition of explanations about activities in chapter 4-1

-Addition of a photo of a simulated CRV operation in Victoria crater in chapter 4-3

-Addition of two engineering area photomosaics in chapter 4-4

-Addition of the 2 cave entrance photos in chapter 4-5, new presentation of cave photos, cliff panoramic photos added.

-Addition of 2 drawings in chapter 5-3

Release 8 modifications

-Addition of aerial photo maps of the Hab area at the end of chapter 1-1

-Addition of an aerial photo map on the way between Lowell Highway and Lith Canyon, an aerial photo map of the entrance to Cactus Road and a comment on the entrance to Candor Chasma in chapter 3-4

-Addition of a CRV 70 test photo (CRV down the hill) and test localisation in chapter 4-3

-Addition of CRV test 71 localisation on Stacy's Cake in the chapter 4-3 with also new photos from the test and explanations about the ropes entanglement during the test

-Addition of CRV 68, 69, 72 tests localisation in chapter 4-3

-Addition of a CRV 73 test photo in chapter 4-3

-Addition of an aerial Candor Chasma photo showing the 2 arches localisation in chapter 4-3

-Addition of a map localising the cave along Cactus Road in chapter 4-5

-Addition of habitat studies examples 3 and 4 and gathering all the examples in a dedicated 4-7-4 chapter.

Release 9 modifications

-Addition of a Hab photo in chapter 1-1

-Addition of photos extracted from the video in chapter 2-2

-Addition of a photo from Phobos Peak and aerial views of Lith Canyon South and North parts with photos data in chapter 3-3

-Modification of comments on Cactus Road entrance aerial photo in chapter 3-4 and modification of the photo; minor other corrections

-Addition of CRV retrieval photos at Stacy's cake in chapter 4-3

-Addition of pole camera operations localisation in Lith Canyon in chapter 4-5

-Addition of photos in chapter 5-4

Release 10 modifications

- Insertion of chapter 3-3 "EVAs Work Efficiency Index"
- Addition of a 3D view of the Euromars habitat in chapter 4-7-4

MDRS 43 Mission Results Executive Summary

In 2005 the Mars Society initiated a competition between the different chapters to gather funds for maintaining and improving the MDRS habitat. The MDRS (Mars desert Research Station) is one of the two planetary simulated habitats implemented by the Mars Society to conduct simulations of Mars exploration by crews during two weeks stays. The French chapter won the price which was 3 free airplane tickets to Salt Lake City. After discussion with the Mars Society president, Robert Zubrin, during the European Mars Conference in UK, it appeared interesting to organize a French speaking crew for a MDRS rotation. This is naturally not representative of the international composition of an actual Mars crew but the idea was judged attractive for French speaking media.

The mission was announced on the French chapter web site with a call for volunteers. The final crew composition was selected mid December.

The MDRS 43 mission objectives were the followings:

- A media coverage by one of the main French TV channels during one week to document the various activities which may be conducted in a Martian simulation station as well as first thoughts on how would be conducted an actual reporting from Mars.
- A study of the day to day activities of the crew (follow on to studies started during MDRS 7 on one crew member).
- Clear definition of EVA goals and EVA results and efficiency analysis.
- Experimentation on 2 of us of "no outside activities without spacesuits" during one week.

- Evaluation of astronaut in space suits observational capacities.
- New tests of the Cliff Reconnaissance Vehicle (CRV) in its configuration n° 3 with first experimentation of a context camera sending information on the vehicle situation. The CRV 3 was already tested during missions 23 (Anne Pacros), 26 (Edwin Loosveldt), 39 (crew Leonardo), 40 (crew Monalisa with Anne Pacros as commander).
- Evaluation of a pole mounted camera and a balloon mounted camera to survey the ground, cliffs walls or cliff and large boulders upper parts.
- Evaluation of various dexterity improvement devices on the gloves.
- Hab internal lay out measurements and analysis to define improvements for simulation stations as well as for actual Martian habitat.
- Survey with questions to the crew about life at MDRS
- Psychological tests of the crew to explore individual and group factors that contribute to successful team performance in extreme environments (tests elaborated by Sheryl Bishop and conducted already on teams MDRS 39 and 40).

Media coverage

Our journalist crewmember and his cameraman spent one full week sharing our life in the MDRS and using numerous occasions to interview the other crewmembers on our objectives in simulation as well as on other Martian topics. The interviews covered what could be the feelings of a first crew on Mars on unknown terrains, the Martian habitat internal ant external characteristics, the question of life on Mars and possible fossils to be found, the meteoritic craters, the future Mars crew psychological situation, the greenhab and the power system at MDRS. One EVA was conducted at Goblin Valley to get spectacular views, an other one at Upheaval Dome to document a meteoritic crater.
The media team rented a helicopter Friday February the 3 rd. The helicopter flew over the Hab during an EVA with CRV testing and a 2 ATVs trip on Lowell Highway.
The week ended on actual video shooting with a professional camera while in space suit (and using the dexterity improvements on the gloves).
The sequences shot at MDRS has been presented at the end of the mid day news on France 2 channel during five minutes from Monday February the 20 th to Friday the 24 th with different themes each day. These mid day news are witnessed by 2 or 3 million people.

Experimentation on 2 of us of “no outside activities without spacesuits” during one week.

In these conditions egresses in the virtual pressurized tunnels were forbidden because they break the feeling of being limited to the Hab volume or to EVAs in spacesuits. This also means that engineering tasks (generator, greenhab, quads) cannot be conducted by the 2 selected crewmembers. One crew member did not specially feel the need to get out of the Hab. The other one felt somehow a need to go outside. Both considered that EVAs were totally felt as being outside as if they did not wear spacesuits.

EVAs assessment

In his full report about his preceding mission (MDRS 7), Alain Souchier documented the list of EVAs performed. But this list was lacking basic and important data such as EVA preset objectives and percentage of fulfillment.
The objectives are clearly defined during the morning briefing meeting. There is no problem in documenting them. Judging of their fulfillment is admittedly rather subjective, except in situations where the results are clear-cut. Nevertheless, we tried to evaluate each EVA in real time.

Out of 27 EVAs executed, about half (15) obtained a 100 % rating. But half of those were devoted to TV filming, a non representative objective. For the more “technical” EVAs (devices testing), we note that there is an improvement of the ratio over time. This, of course, corresponds to lessons being learned in the course of the successive tests. But, should our planning process be more thorough, we should have better ascertain the risks of failure of the first rounds of testing and admit them as a potential result in itself.
The mean rating is of 82 %, which is quite satisfactory. Two of the worst results were obtained due to location identification failure, which of course would have not be the case should we have use a GPS. But will we profit of a GPS on Mars?
A few bad ratings resulted from equipment failures, but can be considered as not significant as, due to our limited resources, we tend to use on the shelf mundane hardware rather than professional and specialized one (e.g. mini-camera).
Lastly, we have to recognize also of few real mishaps (like letting a small balloon escape or forgiving a tool on the terrain). This shows that, even for a simple and unambitious terrain experiment, it is necessary to ascertain carefully every detail and to prepare procedures and check-lists if necessary.

Day to day activities

Each day we noted the time spent on 7 different types of activities for analysis (sleeping, personal, social, maintenance, internal and external operations, reporting). The idea was to characterize how time is used during the mission at MDRS, in order to propose possible improvements of the way simulations are operated. And also to compare those data with what is foreseen by NASA analysts for an actual mission (Marc Mc Cohen), in order to identify possible significant discrepancies.
A first look at the data leads to the main following observations:

-The mean sleeping time is equal to what is foreseen by NASA, but we observe two categories of crew members: one with a sleeping time around 8 hours, and another rather around 6 hours. We managed this situation softly, but this leads to constraints both in the Hab set up (acoustic isolation) and in behaviour discipline (we installed a quiet period from 11 pm to 7.30 am).

-We observe a quite stable time history for most of the crew members during the two weeks.

-There was almost no “free” time, and especially little time devoted to entertainment (movies…). Apparently, from NASA’s point of view, it is foreseen to give one free day per week, which is equivalent to 3 hours per day. The interesting fact is we felt no need for such free time or “holiday”! Is this a major weakness of the simulation, related to its very short duration, and to the fact that we were actually too busy to be representative of a long duration actual mission? This could be, but the idea of a “free day” per week is also probably questionable.

-We also have observed that we spent no time in our bedrooms other than sleep time; we felt not at all the desire to get alone in our own corner.

-“Personal” time is quoted at 7 %, which is quite low. Significantly, most of this time was devoted to get in contact with our far away families and friends through emails. All of us appreciated this communication means, and felt even that it is more valuable than telephone.

-Productive time (internal and external activities) accounts for 31 %, which compares not so bad with NASA’s view (28 %).

-Reporting time is a salient anomaly: 9 % of the time, compared with 1 hour per day for planning, reporting and communication with Ground Control foreseen in an “actual” Mars mission. This was really perceived by us as a heavy load and as the reason why we could not have more entertainment time. Several reasons to that:

-the very bad performance of the Internet link (numerous satellites errors, disconnections, lengthy waiting time…);

-the great number of reports (even more in our mission, as we have to translate the journalistic report in French);

-the fact that engineering data have to be read on the different accommodations of the Hab, whereas in reality there will be remotely and automatically acquired.

-A good surprise: the maintenance time remained reasonable: 8.6 %. In effect, we had no difficulties with the equipments (only a shutdown of the main heating system).

Evaluation of astronaut in spacesuits observational capacities

A test was conducted in the Hab vicinity on the observational capacities of astronauts in spacesuits. Twenty “strange looking” objects (forks, white caps, copper tubes elbows, screwdriver) were scattered on the field and a team of four astronauts sent in the area with lousy guidance from the crewmember who knew where the objects were localised. 10 objects were found (the biggest and more coloured). As the EVA path was not exactly following the path of scattered objects the score is probably better than 50%. When we retrieved the remaining objects out of sim later on, one crewmember indicated that he walked at less than 1 m of a 6 cm copper tube without seeing it during the morning EVA. To give more quantitative results, the game should be replayed with people out of sim. In the same way crew members who never went to Lith Canyon before, were conducted very close to the dinosaurs bones fragment without noticing, although the presence of such dinosaur bones was announced before. May be they were thinking finding larger pieces. The petrified wood areas were noticed by two crewmembers on five when going down to the floor of Lith Canyon in the area of the dinosaurs bones. The observational capabilities are surely reduced by the spacesuit, not only by the vision through the helmet but also because we are not moving around as easily as without spacesuits.
This study was a follow on to some analysis done after mission MDRS 7 about the actual surface which will be explored on Mars by astronauts during a 500 days mission (extrapolating the results from a 12 days mission in Utah!). We found that during 11 days we covered in detail 0.44 km² and more coarsely 11 km². These values are close to the values found during MDRS 7.

CRV testing

During the first testing around the Hab (CRV test n°68 and 69) we had difficulties in the context camera pictures reception. During the following test (CRV n° 70) at White rock Canyon the pictures were very difficult to see. Dedicated test the following day showed that the landscape outside is too bright for the camera. The camera was then equipped with sunglasses which solved the problem.
The White Rock Canyon test was conducted exactly at the same location as a CRV test (CRV in configuration n° 2) in 2002. During the 2002 test, the CRV retrieval was very difficult whereas the present CRV in its configuration 3 proved easy to operate. This test was documented by the media crew.
One new difficult test was then programmed for the vehicle on the “Stacy’s Cake” cliff where the CRV in configuration n°2 failed in 2002: the vehicle was stuck in the middle of the cliff (at the bottom of the vertical part of the cliff but up on a 30 degrees slope). We had to get out of sim to retrieve the vehicle, accessing by the lower side of the slope; The same thing happened to the present CRV with a lot of the difficulties coming from the transition from one to 2 and 4 supporting ropes (difficulties to go down). The picture from the context camera was received during the test. The camera was looking upwards and the picture was found not very helpful to evaluate the vehicle situation. Also the nominal operation of throwing the receiver box (secured by a rope) in the upper part of the cliff to be in direct view with the vehicle was difficult as well as the retrieval of this receiver. Solutions with the receiver on a pole have to be examined.
During CRV test n° 72 the 9th of February, a one rope supporting solution was experimented which led to yaw oscillations (predicted) which did not threatened the test. The final solution should be with a rigid part on the first metre above the CRV. Also a new position for the context camera was experimented as foreseen in the experimentation plan. The context camera was localised in a small

container 1.3 m above the CRV attached to the main rope. This position gave good views of the vehicle during its operations The experimentations will continue with this solution.
The small container is seen as a future configuration 4 for a CRV for steep cliffs. It was tested without camera on board at Candor Chasma the 10 th of February including going down 12 m in a rock crack communicating to a half cave in the cliff.

Evaluation of a pole mounted video camera and balloon mounted camera

A video camera mounted on a 4.5 m pole was experimented and is useful to map cliff layers as well as for looking above cliffs and large boulders or also down under hanging over parts. The system was also used to explore a small cave.
For views from above, a balloon was used. This technique is applied by architects to map terrains or buildings. The balloon was tested in the Hab vicinity including above the Hab itself at an altitude of 20 m. This mapping technique may typically be used for mapping at a scale of 10 to 50 m depending of the balloon altitude and camera angle. The load carried by our balloon was in the order of 0.5 kg. On Mars our balloon would have a volume 100 times bigger which is only 4.5 time larger in every dimensions. And also the payload would be miniaturized which would imply a smaller balloon.

Evaluation of various dexterity improvement devices on the gloves

Various configurations of dexterity improvements devices were experimented on the gloves. In the following lines the fingers will be designated 1 to 5 starting from the thumb.

A1 - Right glove with a small rod longer than finger 2, with an other rod shorter than finger 3 but fixed to the lower part of the finger and thus protruding only when the finger is bent. Tested by Alain
A2 - Same glove with addition of a small rod longer than finger 5. Tested by Alain, Anne, Jeremie, Loic.
A3 - Same glove without the finger 2 rod. Tested by Alain
B - Right glove with a small rod longer than finger 5. Tested by Jeremie
C - Left glove with a little 5 mm spur on the inner part of finger 2 plus a small rod longer than finger 2. Tested by Richard.
D - Right glove with a little 5 mm spur on the inner part of the finger 2. Tested by Pierre and Olivier.

Olivier and Richard tested also small pliers as a very useful help to work on difficult things (as opening a roll of adhesive tape!)
The commander found glove n°A2 very useful and found himself rather clumsy without the rod on finger 2 in configuration n°A3.

Hab internal lay out measurements and analysis to define improvements for simulation stations as well as for actual martian habitats

Detailed measurements and photos of the Hab internal lay out at level 2 were taken and detailed drawings elaborated on Autocad. A proposal of very simple lay out improvement for a bedroom has been elaborated. The lower floor has been cleaned and reorganized. Also each crew member received a list of questions about the Hab, its different rooms, the noise (systems and people), the lights, the smells, the circulation patterns of people inside the Hab, to be filled at the end of the rotation.

Psychological Tests

Before the mission we had to answer questions to elaborate our psychological profile. Then we had to answer questions the first day of our mission, then at mid mission and finally the last day of the mission, in order to analyse our evolution during the rotation. For Anne which remained with us the first week and Olivier the second week the tests were reduced to two.

1 Introduction

by Alain Souchier

1-1 Mars Analog Research Stations
1-2 MDRS 43 mission origins
1-3 Crew bios
1-4 Mission preparation and organization
1-5 Experimentations planned

1.1. Mars Analog Research Stations

(text extracted from the Mars Society website)

In order to help develop key knowledge needed to prepare for human Mars exploration, and to inspire the public by making sensuous the vision of human exploration of Mars, the Mars Society has initiated the Mars Analog Research Station (MARS) project. Mars Analog Research Stations are laboratories for learning how to live and work on another planet. Each is a prototype of a habitat that will land humans on Mars and serve as their main base for months of exploration in the harsh Martian environment. Such a habitat represents a key element in current human Mars mission planing. Each Station's centerpiece is a cylindrical habitat, "The Hab," an 8-meter diameter, two-deck structure mounted on landing struts. Peripheral external structures may be appended to the Hab as well.

Each station serves as a field base to teams of four to six crew members: geologists, astrobiologists, engineers, mechanics, physicians and others, who live for weeks to months at a time in relative isolation in a Mars analog environment. Mars analogs can be defined as locations on Earth where some environmental conditions, geologic features, biological attributes or combinations thereof may approximate in some specific way those thought to be encountered on Mars, either at present or earlier in that planet's history. Studying such sites leads to new insights into the nature and evolution of Mars, the Earth, and life.

However, in addition to providing scientific insight into our neighboring world, such analog environments offer unprecedented opportunities to carry out Mars analog field research in a variety of key scientific and engineering disciplines that will help prepare humans for the exploration of that planet. Such research is vitally necessary. For example, it is one thing to walk around a factory test area in a new spacesuit prototype and show that a wearer can pick up a wrench - it is entirely another to subject that same suit to two months of real field work. Similarly, psychological studies of human factors issues, including isolation and habitat architecture are also only useful if the crew being studied is attempting to do real work.

Furthermore, when considering the effectiveness of a human mission to Mars as a whole, it is clear that there is an operations design problem of considerable complexity to be solved. Such a mission will involve diverse players with different capabilities, strengths and weaknesses. They will include the crew of the Mars habitat, pedestrian astronauts outside, astronauts on unpressurized but highly nimble light vehicles operating at moderate distances from the habitat, astronauts operating a great distances from the habitat using clumsy but long-endurance vehicles such as pressurized rovers, mission control on Earth, the terrestrial scientific community at large, robots, and others. Taking these different assets and making them work in symphony to achieve the maximum possible exploration effect will require developing an art of combined operations for Mars missions. The MARS project will begin the critical task of developing this art.

The Mars Society has identified three prime goals to be met by the Mars Analog Research Station Project:

- The Stations will serve as an effective testbed for field operations studies in preparation for human missions to Mars specifically. They will help develop and allow tests of key habitat design features, field exploration strategies, tools, technologies, and crew selection protocols, that will enable and help optimize the productive exploration of Mars by humans. In order to achieve this, each Station must be a realistic and adaptable habitat.

- The Stations will serve as useful field research facilities at selected Mars analog sites on Earth, ones that will help further our understanding of the geology, biology, and environmental conditions on the Earth and on Mars. In order to achieve this, each Station must provide safe shelter and be an effective field laboratory.

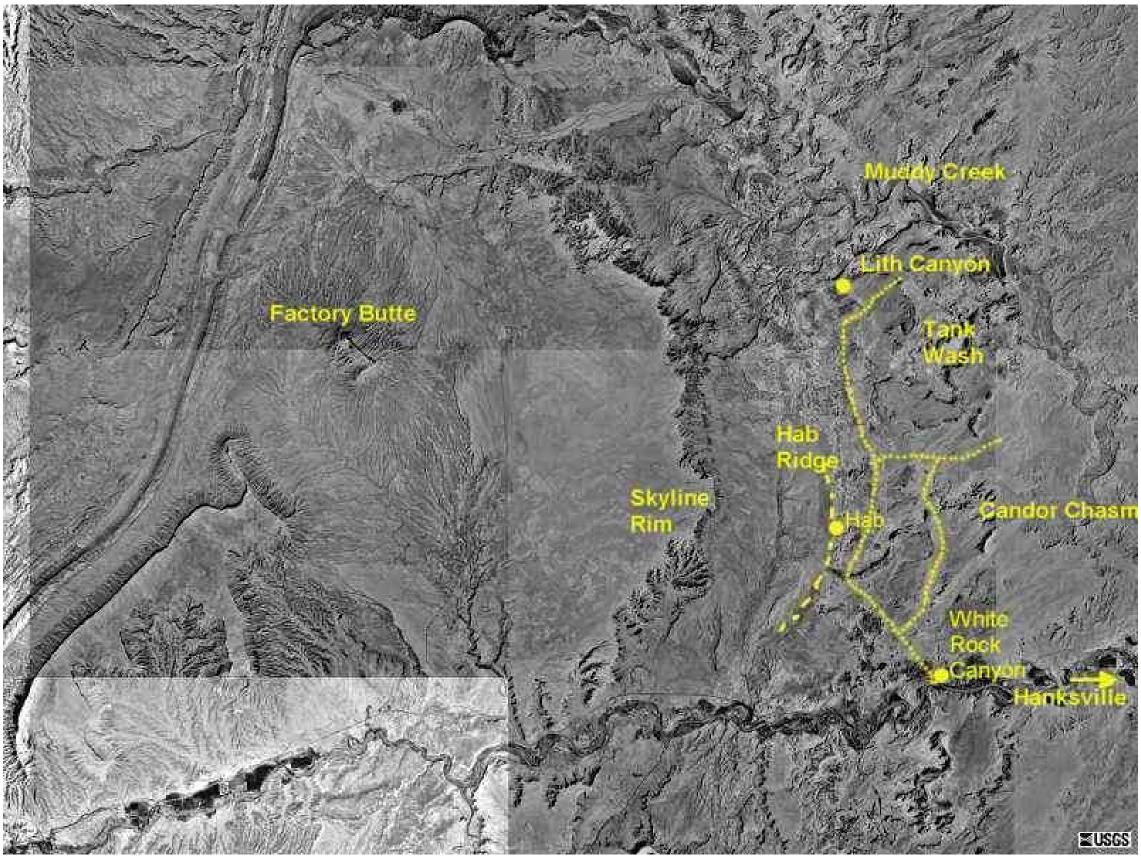
- The Stations will generate public support for sending humans to Mars. They will inform and inspire audiences around the world. As the Mars Society's flagship program, the MARS project that will serve as the foundation of a series of bold steps that will pave the way to the eventual human exploration of Mars.

Mars Analog Research Stations are operated by Mars Society researchers and are made available to NASA and selected scientists, engineers and other professionals from a variety of institutions worldwide to support science investigations and exploration research at Mars analog sites.

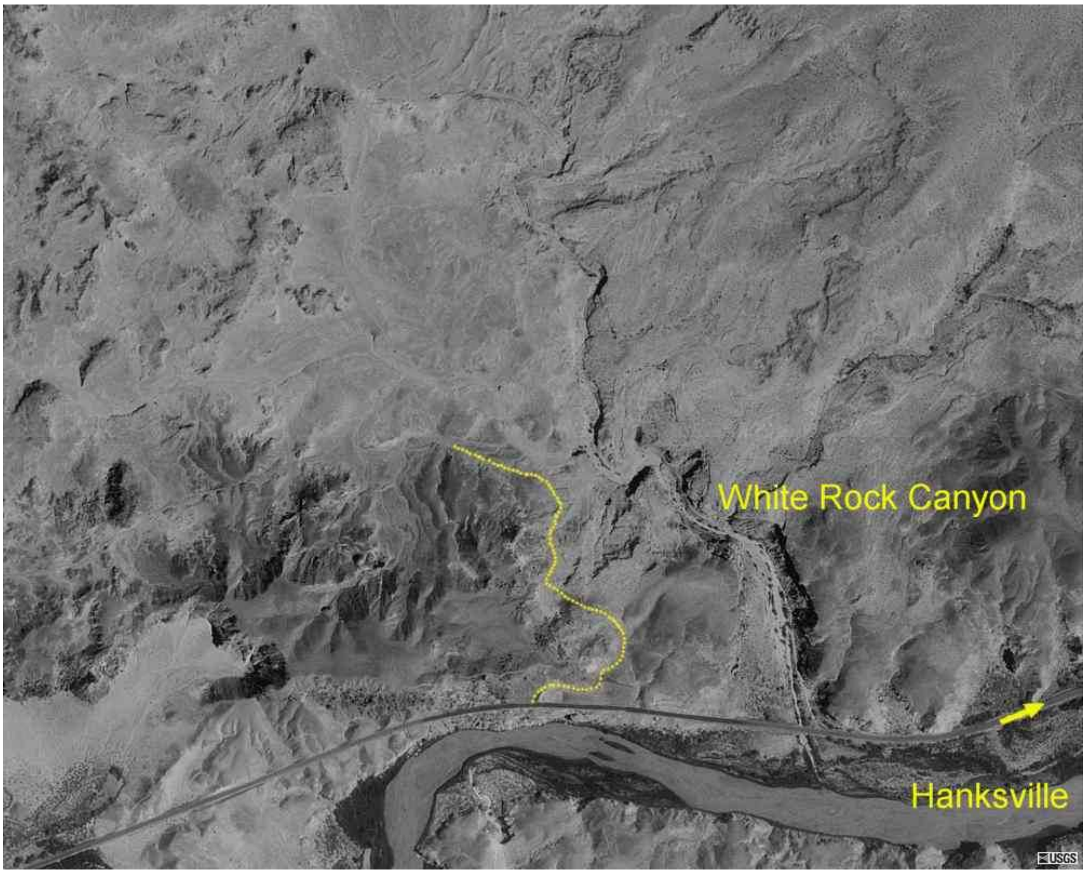
As an operational testbed, the stations serves as a central element in support of parallel studies of the technologies, strategies, architectural design, and human factors involved in human missions to Mars.

The Stations helps develop the capabilities needed on Mars to allow productive field research during the long months of a human sojourn. The facilities evolve through time to achieve increasing levels of realism and fidelity with the ultimate goal of supporting the actual training of Mars-bound astronauts.

The first step in this plan was accomplished in 2000 with the construction on Devon Island in Canada of the Flashline Mars Arctic Research Station. This station is located in a meteoritic crater, the Haughton crater. Thus the area bears similarities with the Martian grounds including permafrost in the ground. The second step was in 2001 the construction in Utah near Hanksville of the Mars Desert Research Station (MDRS). This area is a desert with grounds dating from the secondary era presenting sedimentary layers coming from past seas which also bear similarities to some Martian areas.



General aerial map of the Hab area with main characteristics areas indicated



The junction between the main road from Hanksville and the dirt track going north towards the Hab. The Hab is outside the upper part of the aerial photo.

The MDRS is located down west of the « Hab ridge ». On the right the Hab is visible on this picture from Google Earth. When the MDRS 43 mission was prepared Google Earth pictures were not yet showing the Mars Society habitat.

The MDRS area with the Hab on the left and the Lowell Highway track on the right, leading from the Hanksville road to the "Mars" area.

From left to right the observatory, the Hab and the greenhab.

1.2. MDRS 43 mission origins

In 2005 the Mars Society initiated a competition between the different Mars Society world chapters to gather funds for maintaining and improving the MDRS habitat. The French chapter won the price which was 3 free airplane tickets to Salt Lake City. After discussion with the Mars Society president, Robert Zubrin, during the EMC 5 European Mars Conference in UK, it appeared interesting to gather a French speaking crew for a MDRS rotation. This is naturally absolutely not representative of the probable international composition of an actual Mars crew but the idea sounded attractive for the

French speaking media and thus should contribute to the Mars Society outreach objectives at least in the French speaking countries.

The mission was announced on the French chapter web site with a call for volunteers. Preliminary contacts between Richard Heidmann and a TV channel had already defined that a newsman, Loic de la Mornais, would be part of the crew. However his stay at MDRS would be limited to one week for professional reasons. This opened a one week slot for an other crewmember. A first screening of the candidates by the Planete Mars administrators occurred the 6th of December where Alain Souchier was selected as the commander as he participated to the mission MDRS 7 in 2002. We then had a candidature cancellation for professional reasons. Later on we had two potential Canadian participants, a woman and a man (married couple), but they were obliged to cancel their participation also for professional reasons. We then selected two other candidates, one of which cancelled also his candidature the 22nd of December. We then solicited the participation of Anne Pacros who already attended 2 MDRS rotations. Her participation was interesting to avoid an all male crew and also because she knew already the Hab area. Thus two people, Anne and the commander, would have the capacity of leading the media crew quickly to interesting spots. This capacity was actually used to lead the media crew to the Hab Ridge, Goblin Valley, Upheaval Dome and White Rock Canyon. Unfortunately Anne was also limited to a one week participation for professional reasons but we did not open a new slot for travel costs reasons. The final crew composition was thus known the 25th of December. The MDRS 43 crewmembers bios are presented thereafter.

1.3. Crew bios

Pierre Brulhet was born in 1971 in France. He is an architect and works in an architect's office in Paris. He designed a Martian base for his diploma in 1999. Then he joined the French Chapter of the Mars Society (Association Planete Mars). In January 2002, with the participation of Planete Mars association, Pierre, Olivier Walter and their architecture students exhibited the projects of Martian bases (interactive CD, 3D films, panels) at the Palais de la Découverte in Paris. A few months later, Pierre joined the European chapters working on the Euro-Mars habitat inside lay out definition. In September 2002, he held a conference in the frame of the association at CNES Paris, about "Architecture and concepts" and "the Euro-Mars simulated habitat project; the French concept; the European project" with Olivier Walter. In 2005, Pierre realized a Martian base model (1/40) with a design school (Strate College Designer in Issy-les-Moulineaux). The model was exhibited in many different places (Le Bourget airshow at the EADS stand, Cité de l’espace in Toulouse - France).
Today a first design of Euro-Mars has been achieved. Pierre Brulhet, with Olivier Walter, gives lectures and conferences and conducts a study with a group of students from the Strate College Designer, under the direction of Francis Winisdoerfer (EADS Astrium space architect), on the Euro-Mars base project for installation in Iceland

Jérémie Geoffray was born in 1985 in France. At the age of 8, he starts looking to the Moon and the stars with his grandfather telescope, and decides some years later that he wants to have a scientific career. He aims at working on space programs, and dreams to leave the Earth one day.
In 2003 he joins the Institut Superieur d’Electronique de Paris (ISEP), an electronics engineering college. He wishes to continue his studies after ISEP with a specialization in Astronautics.
He became really thrilled by Mars at 16 when he read for the first time the K.S. Robinson’s Martian Trilogy, and joined the French Chapter of the Mars Society (Planete Mars) in April 2005.
Now he communicates his passion around him by organizing conferences about Mars and Astronomy in general.

Richard Heidmann began his career as a rocket propulsion engineer just in time to participate to the genesis of the Ariane launcher project. When this program started, he then specialized in system studies. After a few years in military applications of propulsion, he came back to launchers at the start of the Ariane 5 rocket development, as the deputy manager of liquid propulsion engineering teams of the SEP Company. Then he was in charge of Quality, and then director of programs. In 1995 he came to the headquarters of SEP (later Snecma), first as Quality auditor and then in charge of Research and Technology strategy evaluation for the Snecma group.
He retired in 2002, but still participates in various working groups about space propulsion and exploration. He is a lecturer for the International Space University.
His interest in Mars was lit by the first successful approach of the planet (Mariner 4, 1965) and reinforced by the chance of a vivid observation of the perihelic opposition of August 1971. He staid tuned to Mars discovery all along the successive space missions, waiting for the great decision. So that when Robert Zubrin convened the Mars Society founding convention in 1998, he was there (he holds

the card # 46!). He then was one of the founding members of the French chapter, which he has been leading since.

Loïc de La Mornais was born in 1974 in France. He is a journalist and works for the French national television France 2 as a reporter. After undergraduate degree in political studies at Sciences Po Paris, he graduated in journalism at the Superior Journalism School of Lille.
Interested in aviation and space since his childhood, he worked as a student in the CNES (french space agency, astronaut media operations) in 1996 and has begun his career by working for science magazines: he reported from the Star City (astronaut training), Russia, and experienced as a journalist a parabolic flight campaign in 1997.
He has been foreign correspondent in Cairo, Egypt, for two years before joining France 2 in 2000.
As a TV reporter, specialized in "hot news", he covered various situations and countries as tsunami in Sri Lanka, second Gulf War, fighting in Gaza and Israel or earthquake in Algeria, and many other reports in China, Kurdistan, Egypt, United States, Greece, Mexico, Morocco, Senegal, Mauritania, etc...
He holds a private license pilot, is a licensed scuba diver and have been sky diving captain of his university parachutism team.

Anne Pacros was born in France and has been interested in human spaceflight since high school. Her dream is to be an astronaut some day! After her undergraduate studies in Engineering at Ecole Centrale Paris, France, she obtained a Master of Science in Aeronautics and Astronautics at the Massachusetts Institute of Technology. Then she started her professional life back in France at Snecma, working on VINCI, the future upper stage engine for the Ariane 5 rocket. She joined the French Chapter of the Mars Society (Planete Mars). In the summer of 2004, she participated in the International Space University Summer Session, which was actually a Winter Session since it was held in Adelaide, Australia. That is where Mona Lisa MDRS 40 all female crew mission was born!

In January 2005, Anne left Snecma to join the European Space Agency in the Netherlands. She now works in the International Space Station Utilization Division where she is coordinating the scientific projects in the field of Fluid Physics and Heat Transfer. As such, she was given the opportunity to participate in a parabolic flight campaign.
In terms of extra-curricular activities, she holds a private pilot's licence and enjoys sports (judo, basketball, scuba diving) and dancing. She is also (trying to) sing in a choir and in a rock band!
She was a crewmember in MDRS 23 and commander for MDRS 40.

Alain Souchier was born in 1947 in Paris. Since his childhood he was interested in astronomy starting observing the sky with a home built telescope at 10. In 1957 the space race started, and Alain followed all the steps leading to the moon landing in 1969 (and launched more than one hundred little rockets himself). He graduated in engineering in 1970 with an aerospace specialization and started to work on rocket liquid propulsion the same year at SEP, which became later on part of Snecma, a company now belonging to the SAFRAN aerospace group.
Alain participated in the development of the Ariane engines and propulsion systems for the various European launcher generations Ariane 1 to Ariane 5 from 1970 to 1998. In 1986 he wrote a book on the Ariane program. In 1988 and 1990 he cumulated more than one hour of weightlessness in parabolic flights. He is presently Program Manager for future rocket engines at Snecma Space Engine Division in Vernon.
In 1999 he was one of the co-founders of the Mars Society French Chapter. In 2001 he developed and started testing a Cliff Reconnaissance Vehicle demonstrator to assess what could be the use of such a vehicle to help astronauts exploring Martian cliffs. Various versions of this vehicle have been tested at MDRS in 2002, 2004 and 2005. Alain was a crewmember in MDRS 7 in 2002.

Olivier Walter was born in 1965 in France.

He is an architect and works in Paris. He teaches architecture at the school “Paris Val de Seine” in particular in the field of “extreme environment habitat” to four year undergraduates. The Strate college designers also asked him to organize with Francis Winisdoerffer (EADS Astrium space architect) a partnership about “outer space design”.
After 3 years of university were he has been studying biology and geology, he undertook architecture studies and graduated in 1995. His diploma subject was a “permanent base on Mars”. He joined the French Chapter of the Mars Society in 2001, and since conducted a lot of cooperative work with Pierre Brulhet.
During the last 10 years, he managed a lot of Martian projects at the school of architecture, and also diplomas of architecture.
In 2004 the subject of his lectures were about the “return to the moon”, and in 2005 a development of “Mars Direct” involving Phobos as a human base.
He is presently working on concepts for Mars habitats, mainly on inflatable and underground structures.

MDRS 43 crew presentation

1.4. Mission preparation and organization

The preparation of a MDRS mission means a lot of work. For the commander the preparation was on two different levels: preparation as commander and preparation as the main experimenter of the Cliff Reconnaissance Vehicle, the CRV. (see § CRV). As an indication about the preparatory work, not for a Mars mission (!) but for a MDRS mission, the activities chronology for the commander was the following:

11-12-05: First preparatory meeting with the executive officer (Richard).

12-12-05: Interview of a MDRS 40 crewmember to get information about the operations modifications at MDRS since the previous commander mission (MDRS 7).

17-12-05: Information obtained about the way the personal communications are handled on the International Space Station (ISS) in order to use similar rules during our MDRS rotation. On the ISS the crew can send or receive personal e mails whenever they want with no limitations (excepted the workload) and without going through a capcom as in the first space missions. A phone in Ku band may even be used in some occasions. And also some astronauts brought radio amateur kits. So we deducted no restrictions would be imposed to the crew on their personal communications (excepted the 5 minutes waiting time before reading an e mail in order to simulate a 90 millions kilometres distance between Earth and Mars).

18-12-05: Four tests of the CRV 4 mechanical mock up. This configuration will be tested at Candor Chasma during MDRS 43 (see § CRV). The same day test of the GPS which will be used in Utah. This GPS has already been used during mission MDRS 7 and has kept in memory the Utah Hab coordinates. It says we are at 8254 km from the Hab which is however closer than Mars.

18-12-05: Beginning of CRV 3 reassembly. The CRV 3 was left disassembled since its return from the MDRS 40 Mona Lisa mission. A preliminary test shows that the video system is still operational, good news!

19-12-05: First sending of the MDRS Hab Operations Manual and Mission Rules to the MDRS 43 crew (excepted Loic and Richard).

21-12-05: Our two Canadian crew members inform that they will not be able to come.

22-12-05: Sending of the MDRS Hab Operations Manual to the new crew members and those which did not get it before. Second set of questions to a Mona Lisa crewmember about the Hab operations. Beginning of Hab area maps loading from the Terraserver website. The main maps were sent the following days to the crewmembers in different batches.

25 and 27-12-05: Sending of the MDRS Hab Operations Manual, December issue, to the crewmembers.

26-12-05: CRV test 66 to check the hardware. The main axis previously in steel has been replaced by a carbon fibre axis. After a shock (a two metre free fall before being stopped by the suspension ropes), the axis breaks and the CRV pieces experiment a 15 metres fall. The check show afterwards that the on board video camera and emitter are still operating. Fortunately the main camera was not on board. Repairs are started the same day.

27-12-05: As we have a crewmember changes in the middle of the two weeks stay, I propose to organize Olivier arrival before Anne departure in order to use the same rented car. There is no car rental in Hanksville so the car has to be rented in Salt Lake City and brought back there. We came quickly on a difficulty: it is not possible to rent a car with 2 drivers when one of the drivers is not there at the rental contract signature. The only legal way is to have the 2 drivers license in hand when one of the drivers rents the car. We took some days first to understand these requirements and then to define that Anne will leave her driving license to the Salt Lake City Comfort Inn for Olivier to take it and go rent the car for the two of them. This procedure could also be followed if one day the Mars Society vehicle is not available for the Salt Lake to Hanksville trip for a crew change over.

29-12-05: The CRV is operational again and we proceed with Richard to a rehearsal test (test 67).
30-12-05: Meeting between Alain, Richard and the media team leader, Loic de la Mornais.
08-01-06: As Tony Muscatello sent to the commander for information the instructions to crew 42, these instructions are dispatched also to the MDRS 43 crewmembers for their preparation.
10-01-06: Mail to Paul Graham to give the name of the on board engineer.
13-01-06: Filling of Sheryl Bishop initial psychological test.
14-01-06: General meeting of the crew in Paris (with Anne on the phone from Netherlands). The last questions concerning travel logistics are dealt with. Paper versions of the documentation are distributed. The commander documentation will finally be split in a laptop version and a full set of paper version brought to the Hab (and Olivier later on prepared large size versions of the maps available on the Mars Society website which were brought to the Hab and left there for following crews). The most important personal belongings to bring are reminded. A status of experiment preparation is conducted (and we do not know yet how we will get helium for the balloon). Also the status of personal equipments as cameras, GPS, laptops computers is conducted. The different crewmembers roles are finalized. A review of the planned experiments is done. The ones which were finally dismissed are the test of telemedicine and the management of objects localisation in the Hab. To prepare for the final report after mission redaction, the summary of this report is distributed to the crew.
The crew roles are confirmed or defined as follow:
Alain Souchier, Commander, CRV (Cliff Reconnaissance Vehicle) experimenter, gloves dexterity devices experimentation, astronauts in EVA observational capacities .
Richard Heidmann, Executive Officer, CRV experimenter, planning and reporting processes, workload analysis, EVA analysis, reporting to the Planete Mars French web site.
Pierre Brulhet, Crew Engineer and Architect, inside architecture and lay out, improvements for EuroMARS.
Anne Pacros, psychological tests and "Mars Scout" for the newcomers particularly the media team.
Loic de la Mornais, Crew TV journalist, media reporting, filming a documentary for French TV
Olivier Walter, Crew Architect, inside architecture and lay out, improvements for EuroMARS.
Jérémie Geoffray, Crew Deputy Engineer and Health Safety Officer.

15-01-06: Beginning of CRV disassembly
18-01-06: Reception of Tony Muscatello briefing to the crew.
20-01-06: The crew bios are sent to Tony. Reception of Health Safety Officer documentation sent by Tam Czarnik.
21-01-06: Olivier confirms the availability of a balloon with the associated video hardware but we have not yet defined how we will get helium in Utah. Searches are conducted on Internet to find helium providers in Salt Lake. The following days we will get help from John Barainca who will finally provide us with the helium bottle at the Comfort Inn hotel.
24-01-06: The mission logo (important !) is sent with final corrections to the bios.
26-01-06: Final correction to the logo and reception of the consumable status in the Hab.
27-01-06: Departure for a (shortened) two days trip to Mars alias Hanksville.

These are only the main steps of preparation. As seen from the commander computer, the MDRS 43 mission preparation implied the reception of 356 mails totalizing 42 Mo and the emission of 158 mails totalizing 48 Mo.

Documentation for the mission

The documentation used to prepare and conduct the mission was organized in three paper files:
-MDRS documentation
-Area maps
-Equipments users handbooks

Most of this documentation was also available on the commander personal computer (some equipments handbooks like for cameras or GPS were not digitalized).

The files structure was:
-General information
-Personal equipment list
-Hab description
-Greenhab description
-Electric power generation
-Area maps
-Mission rules
-Health Safety Officer and medical considerations
-MDRS users handbook
-Administration indications
-Equipments and experimentation handbooks and procedures

The main documents included in these chapters were:
-The MDRS HAB Operations manual – Version 8.7 December 22, 2005 (a 94 page document included in chapter "MDRS users handbook". This document is in constant evolution: the version 3 from the 19th of August 2002 used by the commander during its previous mission, MDRS 7, in 2002 was only a 21 pages document).
-The MDRS crew 43 final briefing sent by e mail by Tony Muscatello from Mission Support giving the last indications before the mission (included in chapter "MDRS users handbook")
-The MDRS Mission Rules – Version 2.0 January 25, 2005 (in chapter "Mission rules").
-The MDRS – Crewmember Safety Training Sheets (in chapter "Health Safety Officer")
-The MDRS Crew Health, Protection & Safety Manual – Version 3.0 February 04, 2005 (in chapter "Health Safety Officer" and "Administration indications").
The documents are available on the Mars Society website excepted the last two documents which are sent only to crews.
The area maps were mostly taken from Microsoft Terraserver. These maps are aerial photographs which go down to a scale where the Lowell Highway dirt road may be seen.

1.5. Experimentations planned

The MDRS 43 mission objectives were the followings:

- A media coverage by one of the main French TV channels during one week to document the various activities which may be conducted in a martian simulation station as well as first thoughts on how would be conducted an actual reporting from Mars.
- A study of the day to day activities of the crew (follow on to studies started during MDRS 7 on one crew member).

- Experimentation on 2 of us of “no outside activities without spacesuits” during one week.
- Clear definition of EVAs goals and EVA results and efficiency analysis.
- Evaluation of astronaut in space suits observational capacities.
- New tests of the Cliff Reconnaissance Vehicle (CRV) in its configuration n° 3 with first experimentation of a context camera sending information on the vehicle situation. The CRV 3 was already tested during missions 23 (Anne Pacros), 26 (Edwin Loosveldt), 39 (crew Leonardo), 40 (crew Monalisa).
- Evaluation of a pole mounted camera and a balloon mounted camera to survey the ground, cliffs walls or cliff and large boulders upper parts.
- Hab internal lay out measurements and analysis to define improvements for simulation stations as well as for actual martian habitat.
- Survey with questions to the crew about life at MDRS.
- Evaluation of various dexterity improvement devices on the gloves.
- Psychological tests of the crew to explore individual and group factors that contribute to successful team performance in extreme environments (tests elaborated by Sheryl Bishop and conducted already on teams MDRS 39 and 40).

2 Simulation conditions

2-1 Simulation conditions general presentation
2-2 MDRS 43 mission chronology
2-3 Hab, greenhouse, engineering area operations; comparison to an actual Mars mission
2-4 Psychological aspects (reclusion, life on board)
2-5 About elapsed time between mail sending and their reading

2.1. Simulation conditions general presentation

by Alain Souchier

The following tables sumarize the similarities and differences between MDRS simulation conditions and Mars conditions.

Extra Vehicular Activities (EVA)

Parameter /situation	Mars	MDRS similarity	MDRS difference
Suit doning			
	Leak test		No leak test
	Radio test	Radio test	
	ECSS test	Only ventilation verification	No ECSS in the back pack
	No pre breathing (Hab and suit pressu-res supposed to be compatible with no pre breathing)	No pre breathing	
Airlock	Airlock depressurisation	3 mn depressurisation	Only duration simula-ted; no pumps
Gravity	0.38g	Light suit + body weight under 1g =space suit +body weight on Mars	Inertia differences (230 kg on Mars, 95 kg in Utah)
Internal pressure	0.25 b	Some stiffness provided by the thick gloves; less deman-ding than actual pressurized space suit	No internal pressure; no suit stiffness lin-ked to internal pressure
Vehicles for EVA	Conf TBD for unpressurized vehicle: 1 seat; 2 seats. Probably electric engines	Vehicles available	MDRS vehicles are singles seat ATVs / quads with gasoline engines and tires; maintenance different from Mars vehicles
Autonomy in EVA	5-7 hours typical	Similar (limited by venting motor battery autonomy)	
Radio	Probably constant link	Radio	Link when "push to talk" button activated
Dust management	Dust with small size grains; toxicity TBD; stringent cleaning processes upon return to Hab or dust avoi-dance conf. ("outside spacesuits" connected to the airlock)	Dust when area dry	No dust criticality for spacesuits or airlock seals or humans. Mud when area wet which is totally different from Mars.
Thermal environment	Low temperatures; low exchanges with atmosphere linked to low pressure		Thermal fluxes proba-bly not too far from Mars (less difference temperature, higher exchanges coeff.)
	No EVA without spacesuits!!		EVA without space-suits for powerplant ops, ATV, hab, green hab maintenance.

Habitat and associated facilities

Parameter /situation	Mars	MDRS similarity	MDRS difference
Living quarters size	Typically 8m diameter and 2 floors	Identical	Internal lay out differences.. MDRS less cluttered but less functionnal
Functionnal systems		Some similar main functions: electric power, telecom to "earth" via satellite, radio com to EVA crews, solar panels (very limited)	Different power generation (gasoline power unit), partial water recycling, no automatic telemetry system monitoring, no Hab ECSS and no internal pressurisation. Water recycling system in the greenhab instead of Hab.
Greenhab	Pressurized		Unpressurized
Links between modules	Hab supposed linked by pressurized tunnel to the greenhouse and to the power generation area.		Simulated pressurized tunnel
Outside maintenance	In spacesuit		Easier for MDRS: executed without spacesuits

2.2. MDRS 43 mission chronology

by *Alain Souchier*

Every day reports are sent to the Mission Support Team and posted on the Mars Society website. These reports remain available on this web site at marssociety.com (www.marssociety.org then projects Mars Analog Research Stations then MDRS then Mars Mission Archives then Field Season 5 then Crew 43)

The typical reports sent every day are:

-The commander check in which gives the general information on the day activities and events and gives indications on the time at which the other reports will be sent to Mission Support.

-The engineering report which is devoted to all the Hab and greenhab systems as well as vehicles operations.

-The EVA report describing the extra vehicular activities executed in simulated spacesuits.

-The journalist report which tells the day to day story of the mission. This report was also written in French to be posted on the Planete Mars association web site.

Also every day a selection of the day characteristic photos is sent and is posted as the photo diary.

To give the day by day track of activities and events during the MDRS 43 simulation mission, the commander check in and the journalist report are presented thereafter. Photos extracted from Alain's video by Olivier Walter are also presented to illustrate the activities described in the reports.

Log Book for January 29, 2006
Commander's Check-In
Anne Pacros Reporting

Weather: *Partly cloudy, no wind; highs ~38F*

Crew Physical Status: *Everybody is fine except two crewmembers with small stomach problems (adjusting to American food?)*

Brief Narrative of Mission Results: *Commander Alain Souchier drove crew 42 back to Salt Lake City.Meanwhile the day was spent on training on the Hab systems:engineering, ATVs, Greenhab. The health and safety briefing wasconducted, as well as the telemedicine test. Finally the firstpsycho-sociological tests will be taken. The commander returned at18:30.*

EVA Information: *No EVA today, only ATV training.*

Report Transmission Schedule:

1. *Commander's Check-In*
2. *Engineering Report*
3. *Journalist Report*
4. *Pictures of the Day*

Maintenance: *Nothing to report.*

Inventory: *Nothing to report.*

Miscellaneous: *Nothing to report.*

Support Requested: *The Internet connection is very slow (errors 505 and 506), pleaseadvise if anything can be done on our side…*

Plans for Tomorrow: *Practice EVA; welcome media crew in the afternoon; go in sim tomorrow evening.*

Log Book for January 29, 2006
Journalist Report
Richard Heidmann Reporting

Yes, we did it, landing on Mars, MDRS station, at night! *Night was starry and, for those of us who are first time travellers, discovering the hab with its lit windows and silhouettes of crews appearing behind was really overwhelming. A moment of emotion.*

We were cheerfully welcomed by the MDRS 42 crew and, after the long trip across mountains and desert, enduring snowy roads for a great part of it, the warm beef stew was a premium. Unloading our load of luggage and food supplies (a full Ford pick-up!) took us some time, but at 11 pm, lights were put off.

With the MDRS 42 leaving at 8 am, we have had a full day to begin our operations. Even if we were sad enough not to have our commander, who volunteered to be the driver to bring back the pick-up from Salt Lake City, after releasing the outgoing crew.

The morning was devoted to setting up of installation procedures, including communications, safety, reporting formats, and so on. Then we discussed our different projects. After a quick lunch, we had an informative tour of the different facilities of the station (greenhouse, power generator, water treatment, astronomical observatory, weather station), under the direction of our yet fully instructed engineers.

And then it was time to prepare for action! First, learning to don a spacesuit and to operate properly its equipments, then training to start and drive the quads. As you can see, some patches of recent snow were still there, and their melting made some parts of the track quite muddy. Probably the best conditions to acquire proficiency and a safe driving behaviour, but quite a harsh treatment for our brave mechanical horses! Anyway, the sun was pouring warm colours on this incredible landscape where we landed, with the contrast between snow and red terrain enhancing the strangeness and wilderness of the place.

6.30 pm: a knock on the door: Alain is back! Now, only Loïc is missing (his arrival is planned for tomorrow).

2.12 VOYAGE DANS LE BLUE-CAB

The MDRS 43 story in pictures from the video: 28 th of January

WISPERING SAND

WISPERING SAND

3.01
ARRIVEE DANS
LE HAB.
REPAS

3.15
ESSAIS DE
SCAPHANDRE

4.08
DODO

Log Book for January 30, 2006
Commander's Check-In
Alain Souchier Reporting

Weather: *Sun and clouds in the morning; blue sky and sun during the afternoon*

Crew Physical Status: *Everybody in good shape*

Brief Narrative of Mission Results: *Hab internal lay out measurements for ergonomics analysis started in the morning. Test of dexterity improvements devices on the gloves in EVA 1 and 2. Spherules found on the path to the observatory are not blueberries.*

EVA Information: *EVA 1 for Anne, Richard and Alain with the ATVs along Lowell Highway to find the path to Lith Canyon (unsuccessfull). Search for blueberries towards the astronomical observatory. 2 hours. Lowell Highway very muddy. Out of sim trip to Phobos Peak summit (without ATVs) for Anne, Jérémie and Pierre. These two trips were organized to prepare expeditions with the media crew later on. Trip with the journalists crew just arrived up to the Hab Ridge (Alain, Loic and his two colleagues). EVA 2 around the Hab and till the repeater for Jérémie and Pierre who were filmed by the media team*

Plans for Tomorrow: *Priority to journalists needs weather permitting. Start of Cliff Reconnaissance Vehicule assembly. Hab lay out analysis*

Report Transmission Schedule:

1. *Commander Check-In at 7 pm*
2. *Engineering Report before 9 pm*
3. *Journalist Report before 9 pm*

4. EVAs Report before 9 pm
5. Science Report before 9 pm

Maintenance: *See engineering report*

Inventory: *Don Foutz has delivered the water tank trailer*

Miscellaneous: *Loïc de la Mornais arrival by the 2.40 pm shuttle*

Support Requested: *Starter intermittent failures on ATV No: 1 (see Engineering Report)*

Log Book for January 30, 2006
Journalist Report
Richard Heidmann Reporting

The first half of the morning *was devoted to discussion of the general schedule of the first week, including what could we propose to the TV team, and to the planning of the day. We had to interrupt the meeting to welcome Don Foutz, who was bringing a tank of fresh water. Then we had our first EVA of the rotation, with Alain, Anne and Richard acting. The aim was to scout a few possible sites where we could have the TV team filming. Driving on the muddy track proved to be not so soft, and the snow patches transformed the landscape sufficiently so that, even as they know the place, Alain and Anne had some difficulties to recognize the ideal places where to stop. We were granted with a fantastic walk in the region of Lith Canyon. Back to the base, we continued with a short pedestrian trip so that Anne could collect geological samples ("whiteberries").*

On the afternoon, we decided to scout (out of simulation) Phobos Peak, a nearby (1.4 km) elevation from which we think TV filming of the base against the scenic view of the Hab Ridge should be a must. Anne, Pierre and Jérémie made it in half an hour and confirmed the interest of the place. But the terrain is a bit too risky to climb in a spacesuit.

In the meantime, our fellows from France 2 arrived, guided by Don Foutz to the Hab, sure not so easy to find in labyrinths of the hilly desert. They were welcomed by a superb sunny weather and seemed, without any doubt, as stunned as were the newcomers of us when they discovered the Hab. In effect, what is the most startling, when you approach it, is its impressive size. What a spacecraft! And again, when you enter it, you discover a huge volume of space, as well as the cosiness of well heated and friendly living quarters, with a panoramic view through the windows. You feel as being in a closed terrestrial haven in the centre of an alien world.

The MDRS 43 story in pictures from the video: 30 th of January

4.15
PTIT DEJ

4.33
1ER SORTIE
EN
SCAPHANDRE

5.43
RENCONTRE
A2 + DON

5.54
VUE DEPUIS
LE PLATEAU

6.31
VUE DEPUIS
LE PLATEAU

6.36
PIERRE ET
JEREMIE EN
SCAPHANDRE

6.43
LE HAB.
AU TRAVAIL

7.06
DANS LE HAB
VUE D'EN
HAUT

Log Book for January 31, 2006
Commander's Check-In
Alain Souchier Reporting

Weather: *Sun and clouds in the morning; 100% blue sky and sun starting at 10 am.*

Crew Physical Status: *Everybody in good shape.*

Brief Narrative of Mission Results: *Hab internal lay out measurements for ergonomics analysis step 2 in the morning. Test of dexterity improvements devices on the gloves in EVA 3 and 4. Geology during EVA 3. Test of astronauts observational capacities during EVA 3*

EVA Information: *EVA 3 for Anne, Richard, Alain, Pierre and Jérémie around the Hab answering questions from the media team. EVA 4 for Anne, Richard and Pierre at Goblin Valley (with the media pressurized rover). At 7.05 pm the EVA 4 crew is just entering the Hab*

Plans for Tomorrow: *Phobos peak EVA (not to the top) with the media, searching for blueberries which were seen yesterday in the out of sim trip. Trip planned on the morning for the light on the Hab and Hab Ridge. The ATV will not be used (walking EVA)*

Report Transmission Schedule:

1. *Commander check in at 7.10 pm*
2. *Engineering report before 9 pm*
3. *Journalist report before 9 pm*
4. *EVAs Reports before 9 pm*
5. *Geology Report before 9 pm*

Maintenance: *Difficulties with the generator today. It was self shut when we came back from EVA 3 with the oil cap ejected. After instruction from mission support the generator was restarted at 2.55 pm. We stop the generator every hour or so to monitor the oil level. There seems to be a leak. See engineering report*

Inventory: *Nothing to report*

Miscellaneous: *Nothing to report*

Support Requested: *See the generator oil problem. We could be lacking oil tomorrow if the leak is not fixed.*

Log Book for January 31, 2006
Journalist Report
Richard Heidmann Reporting

Today was a full-up day under a beautiful sunny sky. *After the daily briefing, some time had to be dedicated to the cleaning of the spacesuits and the quads, badly mud-stained by yesterday's EVAs. We then went out for a pedestrian EVA near the hab, with two objectives. The first, proposed by our commander, is totest the ability of an explorer to distinguish remarkable objects on the terrain. To this end, he has randomly put objects like copper tube segments, some plastic parts, and even forks!*

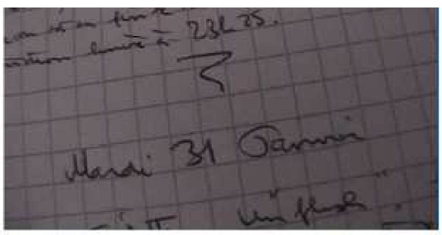
At the end of ourEVA we had found 40% of the objects, which seems to confirm Alain's observations during a former rotation. The second objective was to allow the filming of the beautiful desert plain and of typical geological terrain activities. Before returning into the Hab, we took team pictures, both in front of the main air-lock and near the Martian flag. A cheerful moment!

A few minutes later, the mood became suddenly less optimistic: Jérémie, during his routine engineering check, found the generator out, with traces of an oil leak… Refilling oil, he was able to restart it, but we still have to identify the origin of the problem. Under scrutiny, with the help of the Mission Support. At 3.30 pm we "took a rover" and drove to the scenic location of Goblin Valley (less than hour drive). There we discovered an incredible landscape of sculpted remnants of orange sandstone,enhanced by the reddish light of the declining sun; an alien world!

And a bonus for the TV team, which filmed three of us discovering this nature's treasure. No doubt that, when we will scout Mars, sites as magnificent as this one, which we cannot even imagine, will be revealed to humans. Exploration sure is science; but it is also emotion and inspiration.

The MDRS 43 story in pictures from the video: 31 st of January

7.33
MARDI
31
JANVIER



7.40
SAS
N° 2

7.51
JEREMIE
DEHORS

7.57
L'INT. DE
LA SERRE

8.48
DANS LE
HAB.

8.53
SORTIE
GEOL.

9.13
ANNE
ET SON
MARTEAU

9.19
JEREMIE
ET SON
MARTEAU

9.32
PRELEVEMENT

10.25
TROIS HOMMES
DANS LA
PAMPA

10.31
3 HOM
VERS LE HAB.

10.38
LA ZONE
TECHNIQUE

LA ZONE
TECHNIQUE

11.16
PANORAMIQUE

11.29
VUE D'EN
HAUT

11.37
OMBRE
D'ALAIN SUR
LE HAB.

11.47
FR 2
REVIENS AU
HAB.

11.50
TEST
D'OBSERVATION

Log Book for February 1, 2006
Commander's Check-In
Alain Souchier Reporting

Weather: *Cloudy in the morning; 100% blue sky and sun starting at 11 am*

Crew Physical Status: *Everybody in good shape*

Brief Narrative of Mission Results: *Hab internal lay out measurements for ergonomics analysis step 3 in the morning. Test of dexterity improvements devices on the gloves in EVA 4 and 5. Geology during EVA 4 (search for an hematite inclusion seen in the out of sim trip to Phobos Peak). Analysis of yesterday samples water content. Reconnaissance to the end of Lowell Highway, and also on the branch tomid Lith Canyon as well as on the track climbing Hab Ridge during EVA5. Analysis of the first days of activities (share between sleep, experiments, social life, maintenance….). Video footage by the France 2 TV team in EVA 5 and 6. Cliff reconnaissance vehicle assembly (not completed).*

EVA Information: *EVA 4 for Richard, Alain and Jeremie to midway Phobos Peak with the TV team. EVA 5 for Anne and Pierre along Lowell Highway (see above). EVA 6 for Alain, Richard and Jeremie around the Hab with the TV team*

Plans for Tomorrow: *EVA to be filmed from an airplane.*

Report Transmission Schedule:

1. *Commander Check-In at 7 pm*
2. *Engineering Report before 9 pm*
3. *Journalist Report before 9 pm*
4. *EVA Reports before 9 pm*
5. *Geology Report before 9 pm*

Maintenance: *The generator difficulties appear solved. After cleaning this morning, no oil leak appeared. By pushing the cap without screwing it the yesterday anomaly was reproduced. This was probably a mistake was self shut when we came back from EVA 3 with the oil cap ejected. Don Foutz came this afternoon and inspected the generator. He brought also spareparts for the shower. Electricity and hot water, there is no better dream.*

Inventory: *Nothing to report*

Miscellaneous: *Nothing to report*

Support Requested: *Nothing to report*

Log Book for February 1, 2006
Journalist Report
Richard Heidmann Reporting

Today, wake-up call at 6:30 for an EVA to Phobos Peak that was planned for the TV crew. *The sky is not as clear and the light not as beautiful as expected, but the landscape and the view over the Hab from a distance are... On the way, we collected a sample that could be hematite, from a location that was spotted two days ago. Thats it for outside activities of the morning. But, meanwhile, Pierre and Anne did not lose any time (but did they wake up that early?). Anne processed the soil samples collected yesterday to measure their humidity rate, and Pierre made a lot of progress in his survey of the Hab interior layout, using with the same skill the ruler and his CAD software.*

On the maintenance side, it turned out that the generator problem was, as suspected, only a *false alarm (loose oil cap). Pffew!*

At the end of the morning, clear blue skies were back. Sun cream was mandatory for Anne and Pierre, who left on EVA to fulfill scouting of the Lowell Highway surroundings. The snow patches which confused us at first are now completely gone, and Lowell Highway is a highway once again.

During that time, Alain and Richard started VRP (Cliff Reconnaissance Vehicle) assembly. A task that they had to quit at 4 pm to allow the TV crew to shoot a few things of "our landing on Mars" under optimal lighting conditions. We happily complied to their wishes. And our commander found the proper "historical declaration": "it was a long trip, but we made it; this may be a new Earth for mankind". At first he thought saying: a small step for February, but a giant step for Mars! But that appeared not to fit so well in the scenario of the documentary. This evening we allow ourselves moments of free time. We are going to watch "Galaxy Quest" in which some scenes have been filmed in "Goblin Valley". We feel really at home.

The MDRS 43 story in pictures from the video: 1 st of February

13.09
BALLADE
EVA
PHOBOS PIC

BALLADE
EVA
PHOBOS PIC

13.47
ALAIN

Log Book for February 2, 2006
Commander's Check-In
Alain Souchier Reporting

Weather: *Cloudy in the morning, some rain after 10 am during 2 hours, cloudy sky afterwards, partial blue sky after 5 pm*

Crew Physical Status: *Everybody in a good shape*

Brief Narrative of Mission Results: *CRV assembly completed in the morning. Video tests show that the real time system is operating. Hab internal lay out measurements for ergonomics analysis step 4 in the morning The aerial media operation has been postponed for tomorrow. A helicopter will be used. The EVA planned in the afternoon with CRV deployment at White Rock Canyon has been cancelled due to the poor weather. The muddy terrain forbidding long distance EVA, only 2 EVAs were conducted in the Hab vicinity. These EVAs were devoted to answer the video team requirements. One theme was sport on Mars and the other one was explanations on Mars modules external and internal architecture.*

EVA Information: *EVA 8 for Anne, Jérémie and Pierre (45 min) EVA 9 for Pierre (10 min)*

Plans for Tomorrow: *Double simultaneous EVA, one in ATVs to the end of Lowell Highway, the other one in the Hab vicinity, to be filmed from an helicopter by the TV team*

Report Transmission Schedule:

1. *Commander's check-in 7pm*
2. *Engineer report: before 9 pm*
3. *Journalist report: before 9 pm*
4. *EVA report: 8pm*

Maintenance: *Shower leak fixing (new joints installed)*

Inventory: *Nothing to report*

Miscellaneous: *Nothing to report*

Support Requested: *None*

Log Book for February 2, 2006
Journalist Report
Richard Heidmann Reporting

Terraforming must be well on its way: *today, we have had some rain! Not so much indeed, but sufficiently to overturn the planning of the day. Let's hope that the sun will be more generous tomorrow, for our TV team fellows have planned a filming operation which Hollywood would surely not deny!*

We profit of the mixed meteorological conditions to advance inside operations:

- *Alain, with help from Richard, ends the VRP assembly, which is to be tested tomorrow; at least if the improvement of this afternoon is continuing, for Mission Support has forbidden us to use the quads before the desert tracks have sufficiently dried out;*
- *Jérémie and Anne undertake a probably less glamorous, but how important task: the fixing of the shower. Not a very easy one, and Richard, well known as being a handyman has to join the team to get the job done. On Mars, such mundane works will also have to be carried on!*
- *Pierre finishes a questionnaire which purpose is to collect the crews commentaries about the Hab interior layout; to be filled out at the end of our rotation.*

As for the TV team, they use this sunny weather disruption to shoot a certain number of sequences near or inside the Hab which do not necessitate optimal conditions. Their goal is to show different aspects of the life in the base: domestic tasks, maintenance and entertainment activities…

Tonight, second run of psychological tests managed by Sheryl Bishop, performed online. The goal is to determine the evolution of the group behaviour along the mission. Actually, it is the last day for Anne. Olivier will arrive tomorrow.

The MDRS 43 story in pictures from the video: 2 nd of February

13.58
RICHARD
BRICOLE

14.08
VRP SUR
LA TABLE

14.20
ANNE ET FR2
EXPLICATION
EVA

16.26
VRP SUR
LA TABLE

16.31
LE GANT DE
RICHARD

16.34
PIERRE DANS
LE
SCAPHANDRE

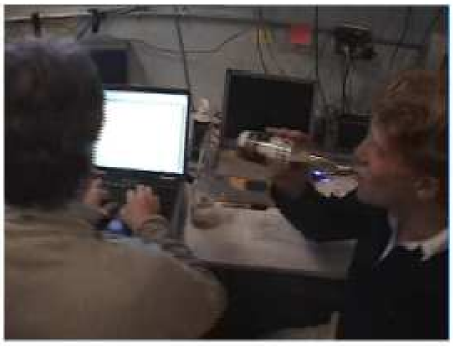
17.10
DANS LE SAS

17.44
JEREMIE
FERME LA
PORTE

17.50
FOOT DEHORS

21.37
C LA FETE

21.57
BEUVERIE
DANS LE
HAB.



Log Book for February 3, 2006
Commander's Check-In
Alain Souchier Reporting

Weather: *Sunny all day*

Crew Physical Status: *Everybody in good shape*

Brief Narrative of Mission Results: *Geological sampling Location of dinosaurs bone in Lith Canyon found (fossils left in place) Helicopter arrival above the Hab at 2.30. Very nice shots seen a short time later because the helicopter landed at Hanksville airport and left the TV crew there. Anne and an other TV crewmember took the helicopter back to Brice Canyon to bring the TV car back to Hanksville.*

EVA Information: *EVA 10 (Richard and Jeremie) and 11 (Pierre and Alain) started around 2pm. EVA 11 ended at 5.05 pm.*

Plans for Tomorrow: *CRV EVA at White Rock canyon in the morning; Trip in pressurized rover to Upheaval Dome in the afternoon for a geological EVA including our newly arrived crewmember Olivier Walter.*

Report Transmission Schedule:

1. *Commander report at 7 pm*
2. *Journalist report at 9 pm*
3. *EVA report at 9 pm*
4. *Engineering report*

Maintenance: *Nothing to report*

Inventory: *Nothing to report*

Miscellaneous: *Olivier Walter arrival with Don Foutz at 1.45pm so we had a HabCom during the double EVA. Anne Pacros left 15 min later*

Support Requested: *None*

Log Book for February 3, 2006
Journalist Report
Richard Heidmann Reporting

This morning, our briefing has to be particularly in-depth; *at stakes, the climax of the TV operation: a filming sequence from helicopter! A first, if Don Foutz has to be believed. And an operation that requires a very precise timing: our fellows meet the pilot at Bryce Canyon (a more than 3 hours drive) and we must be on the terrain, acting, when they arrive on site.*

While they are on the road, Olivier arrives, driven - an absolute necessity - by Don Foutz. It is time for Anne to depart (she will get to Salt Lake City with the car rented by Olivier). A quite short stay for her! In his luggage, Olivier brings the small helium balloon that we intend to test as an auxiliary equipment to document the terrain.

At 2 pm, we exit the Hab for a 4 persons EVA. Olivier is immediately hired as Cap Com, in charge to survey the sortie. We first come to a small elevation near the Hab, in order to allow a shot of explorers near the base. In the meantime, we start a check test of the CRV, in order to verify its operation procedures and its equipments.

15 minutes later, there comes out of the horizon the helicopter! Above all, ignore it! Even when the wind of its rotor blows fiercely, while it hovers over you. According to the scenario, Alain and Pierre then come back to the base and, taking quads, speed away on the Lowell Highway, towards Lith Canyon, providing vivid material for other shots. Everything proceeds as planned, and under optimal weather conditions. After almost half an hour, the white Bell 206 disappears… Well done!

When they are back, our friends share with us the impressions of their amazing ride and show us some of their most spectacular rushes. Great!

Alain and Pierre continue their EVA and walk down to the bottom of Lith Canyon, a wild and *totally alien location. Alain, who was yet there once, proceeds to the testing of Pierre's terrain screening ability, by asking him to uncover fossils (petrified wood, dinosaur bones, not to be taken!).*

In the Hab, Olivier, meanwhile, inflates the balloon and tests its mini-camera; tomorrow, provided there are no wind gusts and no technical glitches, we will proceed to real tests.

The MDRS 43 story in pictures from the video: 3 rd of February

22.50
PTIT DEJ.
LE MATIN

23.47
LES
CHAMBRES

24.06
EVA

24.38
SITE DES
DINO

25.13
LITH
CANYON

26.11
RETOUR EN
QUAD

26.38
BALLON
EN TEST

Log Book for February 4, 2006
Commander's Check-In
Alain Souchier Reporting

Weather: *100% sunny in the morning; 100% cloudy in the afternoon.*

Crew Physical Status: *Everybody in a good shape.*

Brief Narrative of Mission Results: *Experimentation of the dexterity improvement provided by the 3 rods equipped glove by our TV team crewmember CRV 3 experimentation on a cliff in White Rock Canyon where the preceding vehicle CRV 2 experienced retrieval difficulties in 2002 (see MDRS 7). No difficulties for the new one in 4 trips along the cliff. The real time video transmission monitor is very difficult to see in the sunshine even with the long sunshade. Geology oriented EVA to the Upheaval Dome meteoritic crater this afternoon with the TV team pressurized rover (we are forecasting a late return around 9pm).*

EVA Information: *EVA 12 for Jérémie, Loic, and participation of Arnaud (Hab vicinity). EVA 13 for Richard and Alain (White Rock Canyon). EVA 14 for Olivier, Pierre and Jérémie (Upheaval Dome). To be confirmed after they return.*

Plans for Tomorrow: *Departure of the TV team. We will be operating at 5 crewmembers till the end of our rotation.*

Report Transmission Schedule:

1. *Commander Check-In: 7pm (release 1) / 7:40 pm (release 2)*
2. *Journalist Report: 9pm*
3. *EVA Report: 9 pm*
4. *Engineering Report: 9 pm*

Maintenance: *The Hab heating system has been off since mid afternoon and we were unable to get it started. Thanks to mission support indications the heater was restarted at 7.20 pm*

Inventory: *Tin opener broken since 2 days (but we succeeded in opening one tin today)*

Miscellaneous: *Nothing to report*

Support Requested: *None since the heater has restarted.*

Log Book for February 4, 2006
Journalist Report
Richard Heidmann Reporting

Today is the last day for the TV crew. *They have to speed up! But, they first badly need to experience an EVA by themselves. Jérémie is their guide for their sortie. For them, who have been with us in this incredible environment for a week, this is a unique experience: "walking in the landscape in a spacesuit is totally different and astounding."*

But we have to proceed. Alain and Richard, again with the reporters, aim for the White Rock Canyon cliff where Gilles Dawidowicz and Alain, on the occasion of previous missions, had tested earlier versions of the CRV. The goal is to verify if the present third version is able to pass through the obstacles of the cliff without any problem, which was not the case for the preceding ones. And also to test the two installed video systems. A success! Only problem: in full sun light, seeing the monitor images is almost impossible. But yet Alain thinks of a solution.

Then, it's time for the "rover" to depart for Upheaval Dome, a meteoritic crater of utmost interest for Mars explorers. Pierre, Jérémie and Olivier are the crews of this EVA, of course escorted by the reporters. A two and a half hour drive, but a worthwhile effort, even if the beautiful light of the last days is not there this afternoon with the team. On this site, explorers proceed to test two concepts of scene context imaging: a mini-balloon and a long portable post (15 feet).

In the mean time, Alain and Richard, being the Hab attendants, have to face a major system failure: the main heating system refuses to restart! On a planet where the mean temperature is really polar (-50 °C) and even, more seriously, in this high altitude desert where it is freezing at night, you really need to react swiftly. The solution to the problem comes with an email from Mission Support. The mighty sound of the hot air blower, so reassuring, is again singing in their ears, to their greater relief.

Log Book for February 5, 2006
Commander's Check-In
Alain Souchier Reporting

Weather: *Windy in the night; sunshine all day.*

Crew Physical Status: *Everybody in good shape.*

Brief Narrative of Mission Results: *Hab internal lay out studies (continued). Test of the CRV monitor and hazcam. The landscape is too bright for the camera which explains the poor picture obtained yesterday. Successful operation of the pole supported mini camera in EVA 15. Evaluation of a small spur on a finger for dexterity improvement. Geological oriented EVA at Lith Canyon with "astronaut" observational capabilities evaluation.*

EVA Information: *EVA 15 in the morning for Pierre and Olivier on the Hab Ridge. EVA 16 in the afternoon for Richard, Jeremie and Alain at Lith Canyon.*

Plans for Tomorrow: *EVA for pole supported camera testing. EVA for CRV testing.*

Report Transmission Schedule:

1. *Commander Check-In: 7pm*
2. *Engineer Report: 9pm*
3. *Journalist Report: 9pm*
4. *EVA Reports: 9pm*

Maintenance: *One new fuse in the back pack 2*

Inventory: *Nothing report*

Miscellaneous: *Nothing to report*

Support Requested: *None*

Log Book for February 5, 2006
Journalist Report
Richard Heidmann Reporting

Now begins the second phase of our mission. *It surely will evolve in a somewhat different atmosphere. Effectively, the France 2 TV team just left us (very) early this morning, after a last shooting sequence which ended past midnight. This exceptional media operation is now over (for us), and the corresponding stress is relaxing. Furthermore, we now stay only 5 of us, instead of 7 (if we include the cameraman).*

But we stay on the same tempo! At the morning briefing, we decide to have two EVAs on this beautiful day. On the morning, Pierre and Olivier climb on the elevation behind the Hab (Hab Ridge), and proceed to the test of their post-mounted camera, as well as to that of a glove equipped with a new ergonomic helping device. The post test proceeds softly, except that it proves quite impossible to see the laptop monitor in full light, even under the protection of a cover.

But the two guys are yet thinking of an improvement.

On the afternoon, Alain goes back to Lith Canyon, this time as a guide for Jeremie and Richard, in search for fossils and remarkable geological formations. Not so easy for untrained laymen, even if they are kindly put at the very location… True, limits to the mobility and to the visual field induced by the spacesuit reduce seeing agility.

In the mean time, Olivier and Pierre had continued the measurement of the Hab internal set up. On the occasion, Olivier cleaned and rearranged properly the biology and geology workbenches.

Back in the Hab, we find an email from our young friends of the French "Space Club", in Savoie, with which we are in contact. They sent us a nice drawing, as well as a list of smart questions about our simulation, to which we will answer promptly.

The MDRS 43 story in pictures from the video: 5 th of February

27.07
DIMANCHE
5/02

27.11
EVA
PIERRE/OLIV.

27.40
TEST
ORDI/GANT

28.14
EVA
PIERRE/OLIV
S'EN VONT

28.30
LE MURET
A COTE DU
HAB.

28.48
JEREMIE
VA LAN-
CER LE
GENERA-
TEUR

28.56
JEREMIE
AU
GENERA-
TEUR

28.59
EVA
LITH CANYON

31.31
LA PERCHE

34.40
LA PERCHE

35.30
LA PERCHE.

35.47
PLIAGE DE LA
PERCHE

Log Book for February 6, 2006
Commander's Check-In
Alain Souchier Reporting

Weather: *Sunshine all day*

Crew Physical Status: *Everybody in good shape*

Brief Narrative of Mission Results: *Hab internal lay out studies (continued) Successful operation of the pole supported mini camera in EVA 17 at Bob Rocks Garden Tentative of CRV testing at Stacy's Cake (near the entrance of Candor Chasma) during EVA 18 but we lost a lot of time finding the way and the test was cancelled. Ascent to Stacy's Cake and upper part of Candor Chasma reconnaissance.*

EVA Information: *EVA 17 in the morning for Pierre and Olivier at Bob Rocks Garden operating the pole mounted camera. EVA 18 in the afternoon for Richard, Jeremie and Alain at Stacy's Cake and entrance to Candor Chasma through Cactus Road.*

Plans for Tomorrow: *CRV testing at Stacy's Cake (again). EVA with the pole mounted camera at Lith Canyon*

Report Transmission Schedule:

1. *Commander Check-In: 7pm*
2. *Engineer Report: 9pm*
3. *Journalist Report: 9pm*
4. *EVA Report: 9pm*

Maintenance: *Lab cleaning and reorganizing*

Inventory: *Nothing to report*

Miscellaneous: *Since Saturday evening two of us are in total sim which means no trip out of the Hab even in the "pressurized tunnels"*

Support Requested: *None*

Log Book for February 6, 2006
Journalist Report
Richard Heidmann Reporting

The weather is even more beautiful today, *but the temperature is dropping quite low at night (minus 4C at 8 am!). But, quite as for the Hab on Mars, we don't care about the exterior temperature; we feel so fine in our tower of warmth and life lost in the vastness of the Martian plateau where we have landed.*

For safety reasons, it is impossible to have a totally faithful simulation concerning outside operations (for instance, we have to tend the generator without a spacesuit). Nevertheless, it is possible to have, let's say, 2 of us totally restrained from exiting the Hab without doning their suit. So we had decided that, after the end of the TV reporting phase, Pierre and Richard will be exempted from those maintenance tasks and stick to a rigorous sim. We think it will be interesting to note if they experience any significant difference compared to the situation of last week. Personally, after two days, I don't feel any displeasure about that; I simply have checked, during my two EVAs in between, that being outside in the Mars suit is simply being outside, and enjoying it even more! Interesting.

This morning, Pierre and Olivier have to continue their experimentation of the post-mounted camera. We think that the most convenient place to do so is Bob's Rock Garden, a location not very far by quad and where a chaos of rocks provide an excellent terrain to verify the operational advantage of the device. In order to solve the problem encountered yesterday with the monitor, they have devised a sun shading box and increased the size of the screen characters and icons. Everything goes perfectly this time, and they come back with one hundred recorded pictures. Indeed, in this kind of jumbled terrain, the possibility to look down from above looks quite interesting. Nevertheless, a post of about 10 m, rather than 4.5 m, would probably prove more effective.

On the afternoon, Alain, Richard and Jeremie undertake an EVA with two objectives: scouting of the access to Stacy's Cake, a scenic cliff very demanding for the CRV, and proceeding to tests of the present version of the vehicle (the preceding one has failed the test there). Unfortunately, we do encountered some difficulties to make correctly our way to some recently washed parts of the landscape and arrived lately on site. To late to proceed to the tests; will have to be replanned for tomorrow. We profit of the situation to have a short walk in the direction of Candor Chasma and scout the way to enter into it.

Coming back, we find Olivier in the middle of the titanic task of reorganizing and refitting the lower deck. He seems to be quite speedy. We only hope he will not depressurize the hab by drilling a hole in the shell...

Answers to their questions (and images) had been sent to the young French pupils.

Log Book for February 7, 2006
Commander's Check-In
Alain Souchier Reporting

Weather: *Sunshine all day.*

Crew Physical Status: *Everybody in good shape.*

Brief Narrative of Mission Results: *Some improvements in the Hab. CRV test on Stacy's Cake in EVA 19. Operation of the pole supported mini camera in EVA 20 at Lith Canyon*

EVA Information: *EVA 19 in the morning for Richard, Jérémie and Alain at Stacy's Cake to test the CRV ending with the CRV stuck in the slope. Retrieval out of sim. EVA 20 in the afternoon for Pierre, Olivier and Alain at Lith Canyon using the pole mounted camera to take close up views of the various layers in some cliffs*

Plans for Tomorrow: *CRV repairs. New EVA with the pole mounted camera*

Report Transmission Schedule:

1. *Commander check in: 7pm*
2. *Engineer report: 9pm*
3. *Journalist report: 9pm*
4. *EVA report: 9pm*

Maintenance: *Some minor improvements (shower curtain, wires in the Hab computer corner)*

Inventory: *The can openers have been delivered by the Don Foutz shuttle*

Miscellaneous: *Nothing to report*

Support Requested: *None*

Log Book for February 7, 2006
Journalist Report
Richard Heidmann Reporting

This morning, we ought to succeed where we were unable yesterday, *so that the first EVA is again devoted to the testing of the CRV on the threatening Stacy's Cake cliff. At 10 am, Alain, Jérémie and Richard aim to this site. A 15 minutes drive only, but then they have to ascend a somewhat steep slope. In a spacesuit, with the load of the CRV and of its accessories, under an already strong sun, they have to take some breath. Of course, Jérémie is the first on the top table which hangs over the desert landscape. A nice viewpoint, with the Hab far away, shinning white in front of the reddish Hab Ridge.*

Alain seems happy to choose the fiercest conditions to test his device, for the descent (lazy *stops on platforms) as well as for the ascent back (jamming by overhangs). By shaking it a little, we manage for a certain time to overcome the difficulties. But, in the end, the main problem comes from the hanging ropes: on these coarse and fissured rocks, they tend to get stuck. After 10 minutes or so, we have to admit the situation: the CRV is blocked at the base of the rock wall, up to the top of the debris talus. Stacy's Cake is out of its operational capacities. It's time for Alain and Jérémie to get out of sim in order to climb the slope safely. Richard waits observing them as he is under rigorous simulation conditions, not allowed to quit his Mars suit.*

On the afternoon, Alain goes again for an EVA, this time with Pierre and Olivier, with the goal to try out a new operational mode for the mast-mounted camera: the imaging of rock walls. They aim to Lith Canyon, which has the advantage to offer a variety of walls, easy to access. They come back satisfied and convinced by their device's usefulness.

Within the Hab, Jérémie and Richard's activities are sure less glamorous: untangling cables, fixing the shower curtain, door's handfuls, a back-pack... But this will be life on Mars, also.

Log Book for February 8, 2006
Commander's Check-In
Alain Souchier Reporting

Weather: *Sunshine all day*

Crew Physical Status: *Everybody in good shape*

Brief Narrative of Mission Results: *Internal lay out studies (continued). Experimentation on balloons in the morning EVA 21 in front of the Hab. We lost our balloon in the sky. Successful operation of the pole supported mini camera in EVA 22 at Lith Canyon to document vertically a small cliff. CRV repairs*

EVA Information: *EVA 21 in the morning for Jérémie and Olivier in front of the Hab to test the lift of our balloon and a home made balloon (plastic bag). EVA 20 in the afternoon for Pierre, Olivier and Richard at Lith Canyon using the pole mounted camera to document the various layers of a small cliff.*

Plans for Tomorrow: *VRP testing. Balloons testing*

Report Transmission Schedule:

1. *Commander Check-In: 6pm*
2. *Engineer Report: 7pm*
3. *Journalist Report: 8pm*
4. *EVA Reports: 8pm*

Maintenance: *N/A*

Inventory: *We have started the food inventory for the next crew.*

Miscellaneous: *Nothing to report*

Support Requested: *None*

Log Book for February 8, 2006
Journalist Report
Richard Heidmann Reporting

Yesterday we decided to have a movie and choose "Forbidden Planet." *We managed to get to the end of it, but admittedly almost asleep!*

This morning, Jérémie and Olivier had a short near-Hab EVA to test balloons inflating and to measure net lift obtained. No special problem with a small balloon. But apparently Olivier decided that the bigger one deserved freedom in the blue sky of Utah desert! Bye-bye, nice silver balloon. After this loss, Olivier decided to take his revenge and to try to make up a bigger envelope with a mylar sheet, sealed by two-faces adhesive. But we are not sure to obtain a sufficient tightness to conserve helium long enough. That has to be tested.

The afternoon, Richard, Pierre and Olivier go back to Lith Canyon for a new test session of the mast-mounted camera. After the successful yesterday try, their goal is now to actually document a rock wall, by producing a series of regularly spaced pictures along the height of the wall. By the same token, we understand better the difficulties to operate the apparatus under more realistic conditions, i.e. on a slope at the base of a rock wall. We learn so the procedures that should have to be set. The test proceeds as foreseen but, back in the Hab, it's quite a disappointment: it appears that the camera has somehow become out of focus since yesterday. As it is practically impossible to verify the focus of images in full sun light, the ideal solution would be to have an auto-focus camera. Anyway, we will try again.

Alain, in the mean time, is fixing the CRV after its bad experience of yesterday, and configuring the contexte camera in a different position.

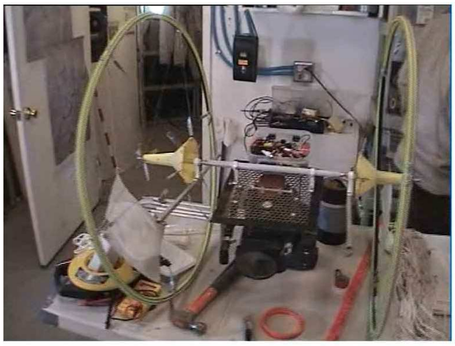
The MDRS 43 story in pictures from the video: 8 th of February

00.00
8/02/06

00.04
BALLON

00.06
EN BAS
LE VRP EST
CASSE

LE VRP EST
CASSE



00.30
OLIVIER
TESTE DES
SACS POUR
AIDE AU
BALLON

8.51
REPAS
TEST DU
FROMAGE

9.54
SORTIE
EVA VUE DU
HAB.

10.05
RETOUR DES
QUADS

10.41
DANS LE SAS

DESHABILLAGE

13.48
TEST DU
BALLON

14.05
OLIVIER ET
ALAIN
BRICOLENT

Log Book for February 9, 2006
Commander's Check-In
Alain Souchier Reporting

Weather: *Sunshine all day*

Crew Physical Status: *Everybody in good shape*

Brief Narrative of Mission Results: *Experimentation of our home made Mylar balloon in the morning during EVA 23 around the Hab. The balloon carries the CRV camera and transmits real time video pictures which are recorded. Some views of the Hab from above have been recorded.*

EVA 24 for CRV testing on the small hill in front of the Hab. Test of a single supporting rope configuration and context camera localized in a small container looking to the CRV from above. Good views of the CRV situation in the slope. EVA 25 again with the balloon at sunset. The balloon carries a mini DV camera which records views of the Hab and surrounding terrains. Nice views of the Hab also recorded from above

EVA Information: *EVA 23 in the morning for Olivier and Pierre (with Alain out of sim in case of difficulties with the home made mylar balloon). EVA 24 in the afternoon for Jérémie and Alain for CRV testing on the small hill close to the Hab. EVA 25 for Richard, Pierre and Olivier with the home made balloon (with Jérémie out of sim in case of difficulties with the balloon).*

Plans for Tomorrow: *VRP testing. Pole mounted camera or balloon mounted camera* *testing testing. Final psychological tests. VRP disassembly*

Report Transmission Schedule:

1. *Commander Check-In: 7pm*
2. *Engineer Report: 8pm*
3. *Journalist Report: 8pm*
4. *EVA Reports: 8pm*

Maintenance: *Nothing to report*

Inventory: *The food inventory has been sent*

Miscellaneous: *Nothing to report*

Support Requested: *None*

Log Book for February 9, 2006
Journalist Report
Richard Heidmann Reporting

Today, we were awoken *(except Pierre, no surprise!) at 6.30 am by the low-battery alarm. Jérémie and Alain get out to start the generator; no problem. Now, we know that we have only two operational days left (Saturday will be devoted to cleaning and rearranging the Hab and to welcoming the following crew). So, we have to hurry to complete the foreseen remaining activities.*

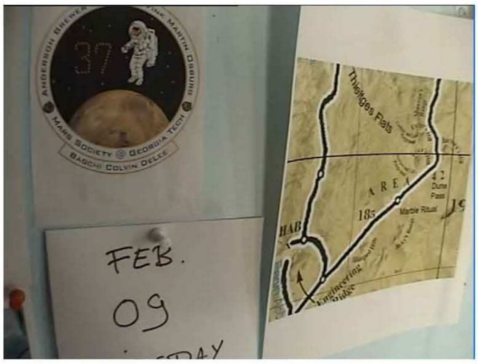
On the morning, Olivier is devising the systems to secure our new home made Mylar balloon and to attach the camera to the envelope. Sure that he had thought about that a large part of the night (according to the time records collected daily by Richard, he is by far the one of us who needs less sleeping!). At 11 am, everything is ready and he goes in EVA with Pierre, together with Alain, out of sim for safety reasons. In effect, it is absolutely mandatory not to have the balloon escaping if we don't want to set off an UFO alert in Utah! To this end, it is secured to both operators' bodies, and Alain is there to monitor inflation, camera set-up and envelope release operations, in case of any difficulty. The test performs smoothly. We feel exhilarated when our beautiful and weightless aerostat rises slowly against the blue sky, gold-shining. Whoopee! After a short trip across the near-by plain, its mentors return and push it back into the air lock. But, again, like yesterday with the mast-mounted camera, we di cover a problem of over-exposition of the camera (in fact designed for in-door operation). It is decided to replace it with a mini-DV camera (after checking that its weight will be acceptable by our deserving aerial fellow).

Meanwhile, Alain has modified the CRV and, around 3.30 pm, the device is ready for a new test. As we want to be able to have two EVAs this afternoon, we limit ourselves to the vicinity of the Hab, to save time. Fortunately, there is a quite convenient small hill, just over the engineering zone, and Jérémie and Alain aim to it. From the Hab, across a window, we see their silhouettes detaching against the light of the sky, a quite fascinating scene. Their tests perform well. It appears that putting the context camera aligned with the traction rope, behind rather than inside the vehicle, gives a much more clear view of the situation during the descent and ascent.

At 5 pm, after a speedy activity in the lab to set up the balloon with the new camera (and tightening a leaking part), we are ready for a new test. This time, Pierre and Olivier get out with Richard, while Jérémie is the out of sim safety guy. The hour is perfect for the show, with a reddish landscape and long shadows from the rocks and us. And slowly lifts our balloon in the sunset light, brave and beautiful! All works perfectly. The movie is perfect, even if, without the help of a stabilizing device, the hanging camera is somewhat turning on itself. We have pictures of the roof of our home and, more interesting, a movie of a 20 minutes walk across the terrain. On Mars, sure, such a balloon will have to be more impressive, but not so much (for the same lift, the dimensions will be less than 5 times greater). Probably an effective means to document geological sorties.

The MDRS 43 story in pictures from the video: 9 th of February

15.44
9 FEVRIER



15.57
L'ESCALIER

16.00
OLIVE
GONFLE LE
BALLON

16.14
PREMIERE
SORTIE
DU BO
BALLON

22.01
PIERRE/OLIVE
REVIENNENT
VERS LE HAB.

22.14
LA TELE
D'ALAIN

22.30
P ET O
RECOMMENCENT
LES TEST

LE MATERIEL

LE MATERIEL

LE MATERIEL

23.00
LE SAS DU
RETOUR

23.12
2eme SORTIE
AVEC LE
BALLON

2eme SORTIE
AVEC LE
BALLON

2eme SORTIE
AVEC LE
BALLON

Log Book for February 10, 2006
Commander's Check-In
Alain Souchier Reporting

Weather: *Sunshine all day but windy*

Crew Physical Status: *Everybody in good shape*

Brief Narrative of Mission Results: *EVA 26 to Candor Chasma in the morning. CRV configuration 4 preliminary testing. EVA 27 with the pole mounted camera*

EVA Information: *EVA 26 in the morning for Richard, Jérémie and Alain at Candor Chasma. Two tests of the CRV configuration 4. EVA 27 for Pierre and Olivier in the afternoon with the pole mounted camera to map a cliff and a small cave along Cactus road in the wash between Lowell Highway and Stacyâ€™sCake.*

Plans for Tomorrow: *Cleaning! And a blue truck shuttle flight to Salt Lake. Crew 44 arrival*

Report Transmission Schedule:

1. *Commander Check-In: 7pm*
2. *Engineer Report: 8pm*
3. *Journalist Report: 8pm*
4. *EVA Report: 8pm*
5. *Mission Summary: 9pm*

Maintenance: *Nothing to report*

Inventory: *Nothing to report*

Miscellaneous: *Nothing to report*

Support Requested: *None*

Log Book for February 10, 2006
Journalist Report
Richard Heidmann Reporting

Today it is too windy to have another balloon test. *Our nice helium-filled aerostat stays stuck against the ceiling of the Hab lab.*

In the morning, Alain, Jérémie and Richard perform an EVA to North of Candor Chasma. The first objective is to scout the best quad approach to a precise location where there is a spectacular overhanging. The second one is to proceed to the first preliminary test of a brand new version of a CRV, which Alain thought of, and which should be particularly adapted to vertical rock walls and over hangings. From Cactus Road, driving then left in the desert, it is quite easy to find a place to park the quads, and after a ten minutes walk, here we are, just on the rim of the scenic Candor Chasma canyon. What a place! The test proceeds smoothly, and yet it is time to get back.

On the afternoon, Pierre and Olivier drive to Cactus Road, where we have spotted very convenient small cliffs for testing their mast-mounted camera. The goal is to at last obtain good pictures. The camera has been reset and thoroughly checked. They are able to document the full height of the wall and, even, to obtain internal views of a small cave in the middle. Quite interesting!

In the Hab, there is now a new feeling. It is time to wrap up! First, we have to write, above all the other ones, a synthesis report. Then, we know we have had today our last EVAs, as tomorrow is devoted to sweeping and tidying up the Hab. I will personally have to leave at dawn tomorrow to drive the truck to SLC, where the following crew will pick it. Tonight, a chilling wind blows on our desert. Hope only our Blue Truck will accept to start up!

The MDRS 43 story in pictures from the video: 10 th of February

23.36
EVA
YELLOW
SUBMARINE

EVA
YELLOW
SUBMARINE

26.48
RETOUR EN
QUAD

Log Book for February 11, 2006
Commander's Check-In
Alain Souchier Reporting

Weather: *Sunshine all day; no wind.*

Crew Physical Status: *Everybody in good shape*

Brief Narrative of Mission Results: *Richard Heidmann left for Salt Lake with the blue truck this morning around 6am and arrived at 11:15. New test of the balloon this morning with the video camera on board but out of sim. Nice pictures of the Hab and observatory. Out of sim trip to Candor Chasma with the three ATVs in the afternoon.*

EVA Information: *No more EVA in spacesuits. Out of sim EVA with the balloon around the Hab for Pierre and Olivier. Out of sim EVA to Candor Chasma for Pierre, Olivier and Jeremie.*

Plans for Tomorrow: *Leaving for Salt Lake with the blue truck with the four remaining crew 43 members*

Report Transmission Schedule:

1. *Commander Check-In: 7pm*
2. *Engineer Report: 8pm*

Maintenance: *One failure of the gas heater to start. Cycling the breaker solved the problem as last time. And big cleaning of the Hab, the suits, boots...*

Inventory: *Nothing to report*

Miscellaneous: *Nothing to report*

Support Requested: *None*

2.3. Hab and engineering area operations; greenhab operations; comparison to an actual Mars mission

by Alain Souchier

The Hab, greenhab and engineering area operations require a lot of time from the on board engineer. However related to the full crew time it amounted only to 8.2 % (see § 4-1) which seems acceptable. On a six members crew this means 12 man x hours a day. Most engineering operations were conducted by Jeremie Geoffray who was formally our on board deputy engineer.

General view of the MDRS facilities. In the upper part from left to right: the astronomical observatory, the Hab with the main entrance to airlock n°1 and the greenhab. In the middle: the power generator with its gasoline brown tank on a tower, the ground water tank on the left, the water tank brought weekly to feed the previous one, and the horizontal grey propane tank for Hab heating. In front: the waste and unused hardware “Antartica” style.

The engineering area from ground level with the power generator and its gasoline tank on the left. The ground water tank is located behind the tank tower. In the middle, the trailer with the water tank brought weekly from Hanksville.

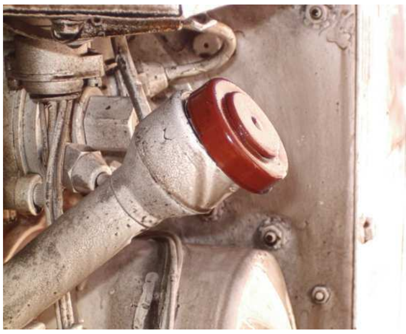
In the Hab and engineering area, the main tasks are the operation of the electric power generator which is only operated some hours per day to load the batteries. This was a difference to the MDRS 7 operations where the power unit was in permanent operations and stopped only once a day for refueling and oil level control. During MDRS 43 when we operated on battery power a periodical monitoring of the battery load was regularly conducted. Fortunately this could be done from inside the Hab whereas the power generator needed a trip to the engineering area out of sim. Furthermore this trip for safety reasons was conducted by two of us which meant two people breaking sim. The trip to the generator was also used to monitor the propane level and the water tanks levels and to operate the electric pump which transfers water from the tank located on the trailer to the ground tank. The trailer is taken by Don Foutz roughly once a week and brought back full. The periodic monitoring of the water recycling system in the greenhouse implied also a out of sim short trip to the greenhab at least once a day. There also, a two people trip was considered as mandatory for safety reasons.

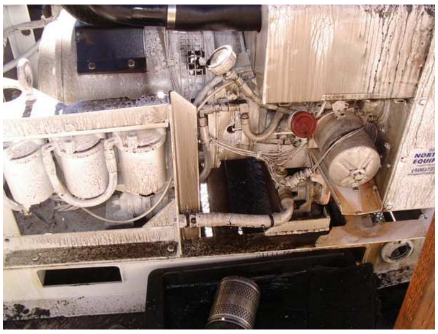
Zoom on the operational part of the engineering area. In the upper left corner the electric power generator, and its gasoline tank on a tower. In the upper right the ground water tank (the water level is visible) which is fed from the tank on the trailer by an electric pump periodically manually connected. The trailer is also used to collect the garbage bins (covered to avoid spilling by animals). In the lower part the horizontal propane tank used to heat the Hab (and for cooking).

We finally had very few system failures compared to other crews:

-We had an emergency shut down of the power generator the 31st of January around 11 am while we were in EVA 3. It ended up that it was our fault: after an oil level monitoring, the oil tap was not properly repositioned which ended in an ejection followed also by oil ejection and depletion. Fortunately a safety system in the power unit shut off the unit. We did not understand the failure mode at once and feared for nearly 24 hours that a big oil leak internal to the generator may be the root cause. The 1st of February, when restarting the generator, the oil cap was ejected and oil started to spill with witnesses around. We understood then that the oil cap was not properly positioned and that this was the cause of the previous day shut off. From then, everything went smooth. However during all the two weeks rotation we had to cope with a gasoline leak at the generator inlet, retrieving the leak in various buckets.

The oil cap as found after the emergency shut down and oil spilled on the generator





-We had also a gas heater unit restart failure the 4th of February. We remained some hours (not too much) without heating before we had instructions from Mission Support which allowed the restart. In this occasion we experimented the quick support which can be provided by Mission Support: we had the answer from Mission Support with the procedure to restart the heater only 47 mn after our emergency mail. The explanations about the various types of alarms (i.e. different types of red led blinking on the heater) were on the heater door internal side. The door was not on the heater itself but flat on the floor supporting the heater. The restart procedure implied opening during 60 s the

circuit breaker n° 18 on the general breakers box, closing again the breaker and the heater restarted. We had an other identical heating system restart failure later on. As we had already the restart procedure, the problem was quickly solved.
We experienced also some electric emergency modes triggers where all the power is cut in the Hab excepted for the main computer and emergency lights. Half of them were by purpose (or at least knowing that we were at risks of triggering the emergency mode) to check at what voltage level the emergency procedure was self triggered. The data concerning these events is:

Day	2-2	3-2	4-2	9-2	11-2
Time	11.10	8.30	7.30	6.15	7.00
Voltage	21.8	21.6	-----	22.2	22.0

The 9th of February event was quite a surprise, knowing at what level the emergency mode was triggered the previous times. The 11th of February was half awaited after the 9th of February event.

The water consumption amounted to 365.5 gallons between the 29th of January and the 10th of February. It is difficult to calculate the consumption per man day because the number of people in the Hab varied strongly at least during the first week. We were nominally 8 during the day: the crew plus the cameraman plus the sound recording technician who left at night. During some far trips (Upheaval Dome Crater; helicopter renting and flight), the number of people in the Hab was reduced. The evaluation leads to a number of 72 man x day during the 12 days which gives a mean consumption of 5.08 gallons per man x day (or 19.2 liters). On the second week when the number of people was stable at 5, the total consumption was 124.1 or 4.14 gallons per man x day (or 15.6 liters). But it is not true that, as Jeremie quoted in one of his engineering reports, we ate dry frozen food without water to reduce our consumption !

The greenhab

The greenhab operations are described in the following lines extracted from the data provided by the Mars Society on its website:

"Gray water from the sinks and shower drains via gravity through the piping which exits the hab into two holding tanks. The first tank is a double coned 100 gallon grease and sediment trap where the water exits the bottom of the tank into the 110 gallon outdoor holding tank, which are both in the ground and located to the northeast of the habitat. This grey water is then pumped from the 110 gallon tank into the southern GreenHab treatment area.

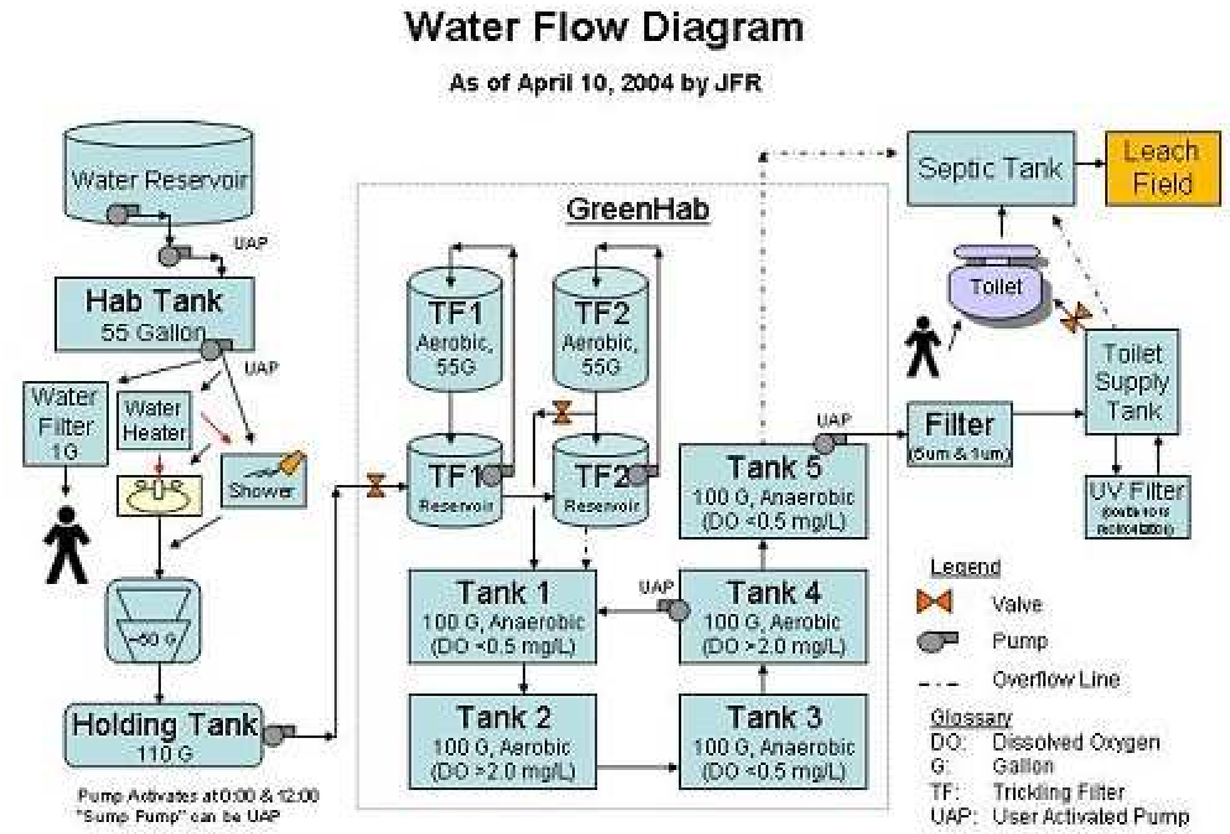


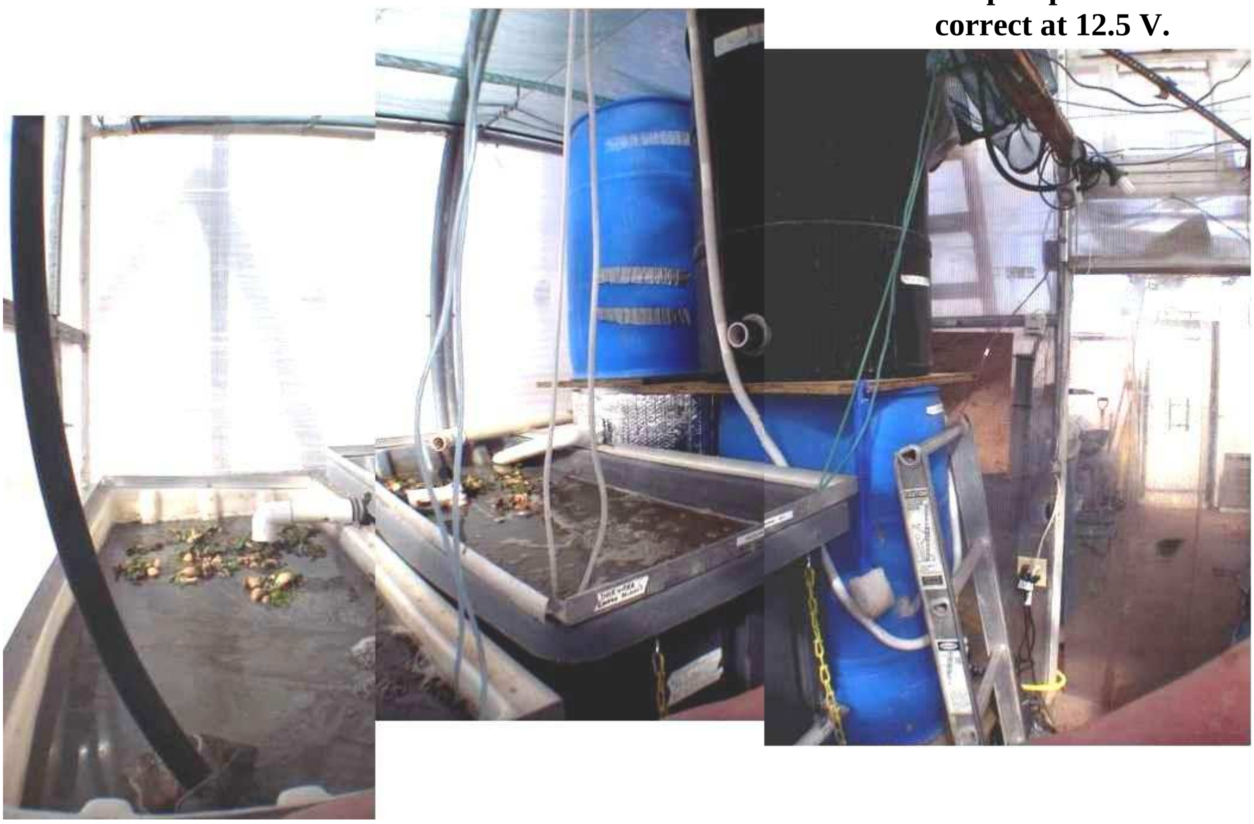
Figure based upon David Blesch flow diagram.

The southern green habitat contains a series of two trickling filters with reservoirs and five tanks with several different points for potential recycling. The grey water enters the system into the 55 gallon barrel reservoir of the first trickling filter. Water in the reservoir is continuously pumped up to the trickling filter barrel filled with bioballs. The bacteria (or algae if not properly covered) on the bioballs aerobically oxidizes the grey water components. This process continues until the water in the reservoir reaches the overflow level which allows the water to travel to the second trickling filter. In the second trickling filter the process continues in a same fashion, with the exception that the water either flows from the overflow port into Tank 1 or flow can be directed after one pass of the upper filter directly into Tank 1.

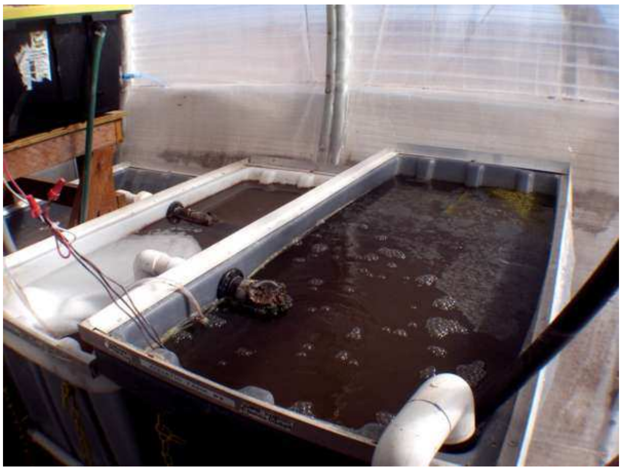
The water now enters five 100 gallon aquatic tanks, with water flowing by gravity from 1 to 5 via overflow ports at the top of the tanks. Tanks 1, 3 and 5 are not aerated, which allows for denitrification while Tanks 2 and 4 are aerated for nitrification and additional carbon breakdown. On top of the water in Tanks 2 and 4 plants, such as water hyacinths and water lettuce grow by taking up the nitrate and other nutrients from the water. To continue water moving through the system in order to limit algae growth, the recirculation pump transfers water from Tank 4 back to Tank 1 based upon the GreenHab operators discretion.

Finally, the treated water is pulled by a pump from Tank 5 through a 5 micron filter (and a 1 micron filter) into the toilet supply tank".

On the left, the system in which the gray water starts its circulation in the greenhab. The TF1 and TF2 tanks are under the TF1 and TF2 trickling tanks in which the gray water should be sprayed on the bioballs to be oxidized by bacteria or algae. But the 5th of February during the system weekly maintenance the spraying pumps were found inoperative. However the voltage at the pumps inlet seemed correct at 12.5 V.

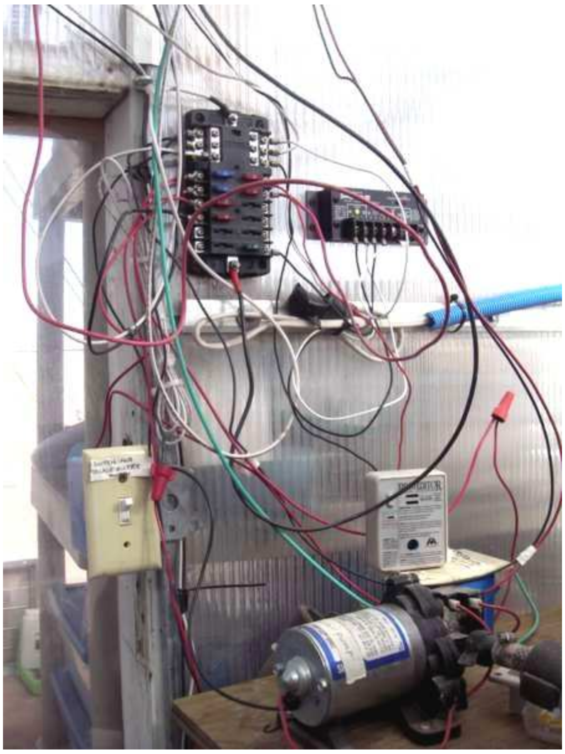


This photo shows, on the right, the entrance door to the greenhab in the greenhab north side, in the middle right the 4 tanks (TF1 and TF1 trickling above, TF2 and TF2 trickling above), in the middle left the tank 1 and on the left the tank 2.

Left photo: on the other side of the greenhab from right to left may be found the tank 3, the tank 4, the tank 5 and, above in black, the toilet supply tank. The right photo shows the tanks 3 and 4

On the left, in front of the tank 5, the panel displays on the right the 2 blue cartridges filtering the water at tank 5 inlet (two 100 microns filters), in the middle the black cylinder of the UV sterilizer, and on the left the blue cartridge holding a 10 microns filter. The UV sterilizer and the 10 microns filter are operating in loop on the toilet supply tank (black tank above)



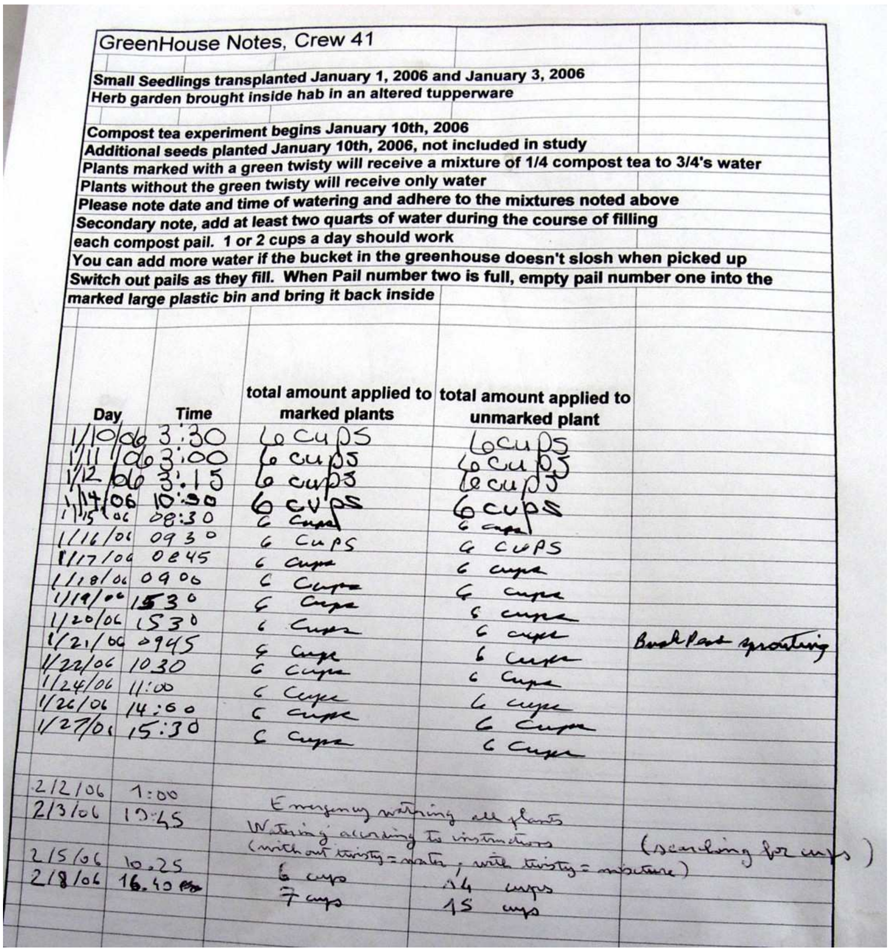
The photo lower part shows the pump which feeds the toilet tank in the Hab from the black toilet supply tank in the greenhab.

The main greenhab operations consisted in connecting manually the power to the electric pump sending the grey water from the underground tank (“Holding Tank” in the diagram above) to the greenhab purification system. The pump activation was roughly 3 mn. It was possible to check the result, observing the water trickling from one tank to an other in the greenhab. The other operation was to monitor the 2 flow meter indications. One flow meter gives the inlet flow and the other one the outlet flow. After the 6th of February we had doubts about the measurements given by the greenhab inlet flow meter. As the outlet flow meter was fully operational, the amount of gray water used has been measured at 245 gallons or 926 liters from the 30th of January to the 11th of February (13 days). If we compare to the clean water consumption during the same period (1154 liters), the reduction in water consumption brought by the greenhab recycling system is 44%.

The other operations which were conducted in the greenhouse were the cares to the plants which was an experimentation started by crew 41. We had a rather quick briefing from crew 42 the evening of our arrival because crew 42 had to leave early in the following Sunday morning. One of our crewmember had a short briefing on how to take care of the plants but we had not a clear indication if the plants care was a mandatory experiment or only something we had to pursue only to add fresh salads and vitamins to our current food. Also the written indications were minimal and half of the plants were infested by insects. The briefed crewmember did not consider this experimentation as mandatory and thus our attention was attracted on the plants as being an experiment to conduct, only the 2nd of February when our engineering report indicated: ”the plants are slowly dying” which was somehow exaggerated. We had then from Mission Support the instruction to quickly water the plants which was done during the night. An other watering was conducted the 2nd of February with pure water as in the night. The instructions indicating that some plants had to be watered with pure water and some others (with a green stick) had to be watered with a mixture of water and compost juice were followed the 3rd. As everybody lacked time the job of chief gardener was taken by the commander and the plants were watered according to the instructions the 3rd, 5th, 8th and 11th of February. At least one cleaning of the leaves from the insects with tissue paper and water was conducted during the stay but in the end the insects number seemed the same or even larger.

On the left: second plants emergency watering the 2 nd of February during the day.

Under: plants status on the 2nd of February



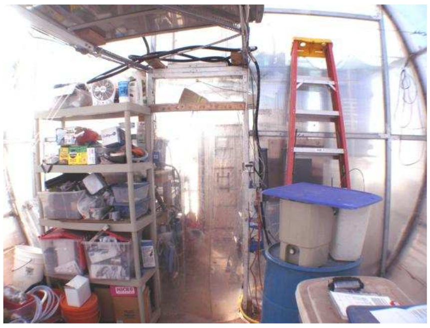
GreenHouse Notes, Crew 41

Small Seedlings transplanted January 1, 2006 and January 3, 2006
Herb garden brought inside hab in an altered tupperware

Compost tea experiment begins January 10th, 2006
Additional seeds planted January 10th, 2006, not included in study
Plants marked with a green twisty will receive a mixture of 1/4 compost tea to 3/4's water
Plants without the green twisty will receive only water
Please note date and time of watering and adhere to the mixtures noted above
Secondary note, add at least two quarts of water during the course of filling
each compost pail. 1 or 2 cups a day should work
You can add more water if the bucket in the greenhouse doesn't slosh when picked up
Switch out pails as they fill. When Pail number two is full, empty pail number one into the
marked large plastic bin and bring it back inside

Day	Time	total amount applied to marked plants	total amount applied to unmarked plant	
1/10/06	3:30	6 cups	6 cups	
1/11/06	3:00	6 cups	6 cups	
1/12/06	3:15	6 cups	6 cups	
1/14/06	10:30	6 cups	6 cups	
1/15/06	08:30	6 cups	6 cups	
1/16/06	0930	6 cups	6 cups	
1/17/06	0845	6 cups	6 cups	
1/18/06	0900	6 cups	6 cups	
1/19/06	1530	6 cups	6 cups	
1/20/06	1530	6 cups	6 cups	
1/21/06	0945	6 cups	6 cups	Basil Plant sprouting
1/22/06	1030	6 cups	6 cups	
1/24/06	11:00	6 cups	6 cups	
1/26/06	14:00	6 cups	6 cups	
1/27/06	15:30	6 cups	6 cups	
			6 cups	
2/2/06	1:00	Emergency watering all plants		
2/3/06	12:45	Watering according to instructions (without twisty = water, with twisty = mixture)		(searching for cups)
2/5/06	10.25	6 cups	14 cups	
2/8/06	16.40	7 cups	15 cups	

The plants care instructions we had. The last watering was conducted the 11th of February (not yet indicated at the time of the photo). The green stick plants received 8 cups of mixture and the non marked plants received 15 cups of pure water. A sequence of plants watering took 25 mn.



The greenhab first compartment where the plants were grown (left).

Insects on the plants the 2nd of February (left) and the 11th (right)

The compost buckets. The one on the left was used to tap some juice to be added to water before watering the plants marked with green sticks. Two cups of water were added to each of the three buckets the 5th of February.

Taping the « tea » juice to produce the ¼ tea + ¾ water mixture to water the green sticker marked plants.

Two cups of water were added to each of the three compost pails the 5th of February. Only the first one was used to tape some "tea" compost juice during the stay. We had no instructions on how (and with which type of food wastes) to fill the pails. And as we had no instructions about composting, we were unable to give any indications to crew 44. Anyhow as the first pail was enough to produce the compost juice we did not need any more compost production during our rotation. When we asked to Don Foutz if we had to separate the wastes, the answer was that everything should go in the same bin on the trailer in the engineering area outside. Looking at the crew 44 mails to the Mission Support team after our rotation, we have seen that the composting question gave rise to a lot of exchanges. The recycle/compost question was asked by crew 44 commander the 13th of February. Answers indicated that "you compost all food scraps that don't have excessive fat and add the Bokasi mixture to it". This type of information was not available during our stay. And the Bokasi mixture was unknown to us. Did we miss some written information left somewhere in the Hab? Anyhow these instructions were not in the documentation (which is already very good) which may be found on the TMS website or was sent to us before our rotation. One e mail to crew 44 indicated "there is no recycling at present" which was in line with our information. An other one said that one composting bin should be in the kitchen whereas we found the three composting bins in the greenhab. Probably crew 41 who initiated the plants growth and the comparison experiment between plants growth with pure water and plants growth with water including compost "tea", had not enough time to write the full procedure. As an improvement in the preparation of MDRS rotations it would be useful not only to have the procedure but also an evaluation of time to be devoted to the experiments which have to be conducted on successive crew rotations. This would allow to define prior to the mission the crewmember who would be in charge.

The plants the 2nd of February (left) and the 11th of February (right and after)

Tank 1 the 2nd of February (left) and the 11th of February (right)

Tank 2 the 2nd of February (left) and the 11th of February (right)

Tank 3 the 2nd of February (left under) and the 11th of February (right).

The day to day activities and events concerning the Hab and greenhouse systems during the MDRS 43 simulation mission are well described by the engineering reports which are presented thereafter.

Log Book for January 29, 2006
Engineering Report
Pierre Brulhet Reporting

Hab Systems (as of 18:30 MST)

Generator/Electricity:
8:00 - Started Generator
12:00 - Generator stopped
28.2 VDC bulk
Hobbs 2054.3
14:17 - Generator On
16:15 - Generator stopped
Float
Hobbs 2056.2

Fuel Status (as of 20:00):

Diesel: *1/2 full*

Propane Tank: *34 %*

Gasoline: *None used*

Oil: *Full*

Water Status:

Outside potable water tank level: *no change*
Inside water tank: *Presently 31 gallons remaining*
Water meter reading: *5906.1 gallons*
Showers: *not yet*
Sponge Baths: *none*

GreenHab: *Low level*
Estimated Grey Water Used: *6 flushes*

Transportation:

ATV 1: *Used (45 min.)*
ATV 2: *Used (45 min.)*
ATV 3: *not used*
Blue: *Used (10 hours)*

Mars Surface Suits: *No problem.*

Computers/Networking Infrastructure: *All laptops successfully connected; very low connection speed and connection errors is slowing work. DirecWay system status:degraded.*

GreenHab: *Low water level. Two showers will be taken tonight.*

General Notes/Comments: *Big thanks to preceding crews for the excellent general condition of the Hab.*

Log Book for January 30, 2006
Engineering Report
Jérémie Geoffray Reporting

Hab Systems:

Generator/Electricity:

Wendy: *at 17:10*
Hobbs Meter: *2059.6 hrs*
Oil Level: *checked and full*
Oil Pressure: *40 PSI*
Water Drained: *done yesterday*
Notes/Comments: *Wendy started at 17:10 and running.*

Xantrex Inverter/Dynasty Batteries:
Time - 17:20
Voltage (Temp Comp) - 26.2
Temp - 12
Load - 07

Notes/Comments: *all working very well*

Fuel Status (as of 17:10):

Diesel: *Approximate reading 1/2.*

Propane Tank:
11:25 32-33%
17:00 31-32%

Notes/Comments: *I will do regularly checks of the propane tank to see if it's really dropping are if it's temperature effects*

Gasoline:
Quantity: *all full*
Consumed: *0 gal*
Notes/Comments: *I will count the cans tomorrow*

Oil:
GenSet Quantity remaining: *4 quarts*
ATV Quantity remaining: *4 quarts*
Blue Quantity remaining: *4 quarts*
Notes/Comments: *all perfect*

Water Status:

Outside potable water tank level: *40 cm from the base.*
Trailer potable water tank level: *35 cm from the base.*
Water meter reading: *5966.4*
Consumed: *60 gal*
Estimated Grey Water Used: *5 gal*
Flushes: *5*
Showers: *2*
Sponge Baths: *0*

Notes/Comments: *The estimations are till yesterday mid afternoon. We had a big leak in the shower for a few hours following manipulations to stop another one. The big leak is stopped. But we still have a little but constant leak in the shower.*

Transportation:

ATV 1: *Used - Y*
Oil Check: *Y*
Tank: *3/4 Full*
Tire Status: *Good*

ATV 2: *Used - Y*
Oil Check: *Y*
Tank: *3/4 Full*
Tire Status: *Good*

ATV 3: *Used - Y*
Oil Check: *Y*
Tank: *3/4 Full*
Tire Status: *Good*

Blue: *Used - N*
Oil Check: *N*
Fuel Consumed: *0 gal*
Tire Status: *Not checked*

Notes/Comments: *ATV 1 start button did not start when leaving the hab this morning but worked when returning to the hab.*

HVAC: *All working well*

Mars Surface Suits: *We've just repaired a helmet as we can, waiting to find where the screws are*

Computers/Networking Infrastructure: *All working well, internet still slow and showing a degraded status*

GreenHab: *All working well*

Data Logger: *I decided to do a weather daily report; here are the first data:*

January 29 - 1800:
Pressure (mbar): *866*
Temperature (C): *4*
Wind Speed (m/s): *1.2*

January 30 - 1100:
Pressure (mbar): *869*
Temperature(C): *1.2*
Wind Speed (m/s): *1.7*

January 30 - 1800:
Pressure (mbar): *862.5*
Temperature(C): *5.4*
Wind Speed (m/s): *1.3*

Upgrade Work: *none*

General Notes/Comments: *I spent part of the day exploring the documentation about everything and where is what in the hab. I think I get used to the hab systems and all the check up I have to do. Reports should become better tomorrow.*

Log Book for January 31, 2006
Engineering Report
Jérémie Geoffray Reporting

Hab Systems:

Generator/Electricity:

Wendy: *at 07:30*
Hobbs Meter: *2063.7 hrs*
Oil Level: *fluctuating*
Oil Pressure: *35 PSI*
Water Drained: *Y*

Notes/Comments: *We had around 11:00-11:30 the whole oil inside the generator and the generator oil tank which had spray all around the generator. After some discussions with Mission Support I decided to try a new start. I full the oil tank with two cans, so the tank was nearly full again and start the generator again at 12:50. An Hour later we stop it. And check the oil half an hour later. The tank was midway between "full" and "add oil" At 0730, the oil level was a quarter of he tank, nearly on the inscription add oil. I didn t start it again and hope very much that the battery will hold the night.*

Question: *How much does the oil tank contains (we had nearly 2L) and how much does the oil circuit in the generator contains? (I try to see if there is a leak). We use 2 of the 4 oil cans we have… I will ask for some advice.*

Xantrex Inverter/Dynasty Batteries:
Time - Voltage (Temp Comp) Load - Temp
0720 - 23.6 - 03 - 12
0920 - 23.3 - 04 - 12
1000 - 23.1 - 06 - 12
1025 - GENSET ON
1035 - 25.7 - 06 - 12
1115 - 26.1 - 06 - 12
GENSET OUT AROUND 1130
1305 - 23.5 - 07 - 14
1450 GENSET BACK!!
1500 - 25.7 - 05 - 12
1600 - GENSET STOP
1600 - 24.3 - 04 - 14
1635 - GENSET ON
1640 - 26.2 - 05 - 14
1740 - 27.8 - 06 - 15
1820 - GENSET STOP
1825 - 24.9 - 07 - 17
1930 - 24.3 - 07 - 15

Notes/Comments: *Hopefully we had no problem with it. And I m really very happy of it!!!!*

Fuel Status (as of 07:30):

Diesel: *Approximate reading 1/2.*

Propane Tank:
10:30: *32-33%*
07:30: *31%*
Notes/Comments: *That seems all right*

Gasoline:
Quantity: *all full*
Consumed: *0 gal*
Notes/Comments: *There are 8 cans*

Oil:
GenSet Quantity remaining: *2 quarts*
ATV Quantity remaining: *4 quarts*
Blue Quantity remaining: *4 quarts*

Notes/Comments: *Well, we had this oil problem you know about.*

Water Status:

Outside potable water tank level: *37.5 cm from the base.*
Trailer potable water tank level: *50 cm from the base. I filled it up when it was at 10cm*
Water meter reading: *6000.4*
Consumed: *34 gal*
Estimated Grey Water Used: *10 gal*
Flushes: *13*
Showers: *0*
Sponge Baths: *0*

Notes/Comments: *The stress of the generator problem made us do more flushes… I m not sure about Grey Water and I don t have the will to go out again and check. I ll do that tomorrow morning…*

Transportation:

ATV 1: *Used - N*
Oil Check: *Y*
Fuel Tank: *3/4 full*
Tire Status :*good*

ATV 2: *Used - N*
Oil Check: *Y*
Fuel Tank: *3/4 full*
Tire Status:*good*

ATV 3: *Used - N*
Oil Check: *Y*
Fuel Tank: *3/4 full*

Tire Status:*good*

Blue: *Used - N*
Oil Check: *N*
Fuel Consumed: *0 gal*
Tire Status:*not checked*

Notes/Comments: *We cleaned the ATV of much of the mud the had, and there was a lot. One of the ATV have a plastic bit broken, I will took pictures tomorrow, today I focused on the generator.*

HVAC: *All working well*

Mars Surface Suits: *We really need some screws and bolts for the helmets, but I didn't manage to find some in the hab. There is also one helmet without radio fix system. I look for a spare one but didn t found one. Is may be really bad to have one person with no radio for an ATV (we tried this morning, believe me it is)*

Computers/Networking Infrastructure: *Internet shut down 2 hours this afternoon. Still errors (satellite link outage errors 505, and 506 from time to times for the pleasure). I follow the web acceleration status, it doesn t seem to have any relation with people surfing.*

GreenHab: *In fact I don t know anything about the GreenHab, but it's still there so I think it s all right.*

Data Logger:

January 31 - 0800
Pressure (mbar): *859*
Temperature(C): *-0.6*
Wind Speed (m/s): *0*
Sky: *mostly cloudy*

January 31 - 1800
Pressure (mbar): *861*
Temperature(C): *7.4*
Wind Speed (m/s): *2.7*
Sky: *Perfectly clear*

Upgrade Work: *none*

General Notes/Comments: *We have long days and plenty work to do!! Happy mission on Mars.*

Log Book for February 1, 2006
Engineering Report
Jeremie Geoffray Reporting

Hab Systems:

Generator/Electricity:

Wendy: *at 06:40*
Hobbs Meter: *2073.6 hrs*
Oil Level: *full*
Oil Pressure: *40 PSI*
Water Drained: *Maybe by Don, but not by me.*

Notes/Comments: *All is going perfectly well. It s a miracle !!!*

Xantrex Inverter/Dynasty Batteries:
Time - Voltage (Temp Comp) Load - Temp
0845 - 23.8 - 13 - 15
1015 - 23.8 - 06 - 15
1115 - 23.4 - 07 - 14
1220 - 23.2 - 11 - 14
0635 - 22.7 - 04 - 12
0900 - GENSET ON
0900 - 24.7 - 05 - 12
1000 - 25.6 - 04 - 12
1055 - GENSET ON
1100 - 23.8 - 05 - 14
1200 - 23.3 - 06 - 14
1215 - GENSET ON
1220 - 25.4 - 06 - 14
1400 - 27.0 - 07 - 15
1450 - 28.1 - 07 - 17
1500 - GENSET STOP
1510 - 24.5 - 06 - 17
1215 - GENSET ON
1735 - 28.6 - 20 - 17
1840 - GENSET STOP
1845 - 24.0 - 20 - 19

Fuel Status (as of 06:40):

Diesel: *Approximate reading 1/2.*

Propane Tank:
10:55 - 31-32%
03:00 - 32%
06:40 - 31%
Notes/Comments: *That seems all right*

Gasoline:
Quantity: *all full*
Consumed: *0 gal*

Oil:
GenSet Quantity remaining: *1 quart*

ATV Quantity remaining: *all quarts*
Blue Quantity remaining: *all quarts*

Notes/Comments: *I mismatch between quarts and quarter... oups*

Water Status:

Outside potable water Tank: level: *350 cm from the base.*
Trailer potable water Tank: level: *10 cm from the base.*
Water meter reading: *6044.9*
Consumed: *44 gal*
Estimated Grey Water Used: *35 gal*
Flushes: *11*
Showers: *3 and a half*
Sponge Baths: *0*

Transportation:

ATV 1: *Used - Y* ***Oil Check:*** *Y* ***Tank:*** *half full* ***Tire Status:*** *good*

ATV 2: *Used - Y* ***Oil Check:*** *Y* ***Tank:*** *1/3 full* ***Tire Status:*** *good*

ATV 3: *Used - Y* ***Oil Check:*** *Y* ***Tank:*** *half full* ***Tire Status:*** *good*

Blue: *Used - N* ***Oil Check:*** *N* ***Fuel Consumed:*** *0 gal* ***Tire Status:*** *not checked*

HVAC: *All working well*

Mars Surface Suits: *I checked, two screws and bolts really missing*

Computers/Networking Infrastructure: *Nothing more to report.*

GreenHab: *I don t know... the plants are slowly dying...*

Data Logger:

January 31 - 1015
Pressure (mbar): *861.5*
Temperature(C): *4.8*
Wind Speed (m/s): *0.6*
Sky: *mostly cloudy*

January 31 - 1400
Pressure (mbar): *858*
Temperature(C): *711.4*
Wind Speed (m/s): *0.5*
Sky: *mostly cloudy*

Upgrade Work: *Try to work on the first airlock inner door, but didn t manage to do much... will try more tomorrow.*

General Notes/Comments: *We have fun*

Log Book for February 2, 2006
Engineering Report
Jérémie Geoffray Reporting

Hab Systems:

Generator/Electricity:

Wendy: *at 06:40*
Hobbs Meter: *2079.6 hrs*
Oil Level: *full*
Oil Pressure: *32 PSI*
Water drained: *no*

Xantrex Inverter/Dynasty Batteries:
Time - Voltage (Temp Comp) - Load - Temp
0045 - 23.7 - 05 - 17
0715 - 22.4 - 03 - 14
0915 - 22.3 - 06 - 12
1110 - Battery off, at 21.8
1115 - GENSET ON
1225 - GENSET STOP, battery shows float
1225 - 23.6 - 06 - 14
1350 - GENSET ON
1545 - 26.2 - 08 - 15
1715 - 28.2 - 08 - 17
1820 - 29.6 - 09 - 18
1840 - GENSET STOP
1900 - 24.6 - 08 - 19

Notes/Comments: *the electricity shut off when the batteries where at 21.8 so, clever as we are, we started the generator. An hour later the batteries where saying to us that they were full. To see if they weren't lying to us we stopped the generator... I deeply think they were not full...*

Fuel Status (as of 06:40):

Diesel: *Approximate reading 1/2.*

Propane Tank:
11:15 - 31-32%
06:40 - 31%
Notes/Comments: *What a perfect reading*

Gasoline:
Quantity: *6 1/2*
Consumed: *one quart and an half*

Notes/Comments: *we used one quart and a half to fill up the ATV*

Oil:
GenSet Quantity remaining: *1 quart*
ATV Quantity remaining: *6 quarts*
Blue Quantity remaining: *I don t know, is there some?*

Water Status:

Outside potable water tank level: *around 325-350 cm from the base.*
Trailer potable water tank level: *20 cm from the base.*
Water meter reading: *6082.2*
Consumed: *38 gal*
Estimated Grey Water Used: *20 gal*
Flushes: *11*
Showers: *0*
Sponge Baths: *0*

Transportation:

ATV 1: *Used - N*
Oil Check: *Y*
Tank: *full*
Tire Status: *good*

ATV 2: *Used - N*
Oil Check: *Y*
Tank: *full*
Tire Status: *good*

ATV 3: *Used - N*
Oil Check: *Y*
Tank: *full*
Tire Status: *good*

Blue: *Used - N*
Oil Check: *Y*
Fuel Consumed: *0 gal*
Tire Status: *not checked*

HVAC: *All working well*

Mars Surface Suits: *Nothing new to report*

Computers/Networking Infrastructure: *Nothing new to report*

GreenHab: *We are giving water*

Data Logger:

February 2 - 0800
Pressure (mbar): *859*
Temperature(C): *-0.2*
Wind Speed (m/s): *0.8*
Sky: *clouds around the horizon*

February 2 - 1230
Pressure (mbar): *875.5*
Temperature(C): *10*
Wind Speed (m/s): *6*
Sky: *grey clouds, rain*

February 2 - 1800
Pressure (mbar): *861*
Temperature(C): *5*
Wind Speed (m/s): *still some clouds, but living*

Upgrade Work: *We fixed the shower!! the Crew 43 will be a crew long remembered send you pictures of the sas for advices*

General Notes/Comments: *Great thanks to Chopin, who helps us a lot for the reports But we started a hard music and became mad... lessons are learned at our mental health peril. Following in an other mail, a lot of pictures (GreenHab, shower, airlock door). There is a procedure for the weathers reports, tell me what you think of it: Objective: To check the weather two or three times a day with Boxcar and send a report to Mission Support.*

Presentation:
1 - Hour
2 - Outside Temperature
3 - Wind Speed
4 - Sky Aspect

2, 3 and 4 can be check with Boxcar on the yellow laptop. Take a watch for the hour and use your eyes for the sky aspect.

Log Book for February 3, 2006
Engineering Report
Pierre Brulhet & Jérémie Geoffray Reporting

Hab Systems:

Generator/Electricity:

Wendy Hobbs Meter: *2085.1 hrs*
Oil Level: *full*
Oil Pressure: *32 PSI*
Water Drained: *no*

Xantrex Inverter/Dynasty Batteries:
Time - Voltage (Temp Comp) - Load - Temp

0035 - 23.6 - 05 - 17
0735 - 22.5 - 04 - 14
0830 - Battery off, at 21.6
0835 - GENSET ON
835 - 25.0 - 06 - 14
1010 - 26.1 - 06 - 15
1100 - 26.6 - 06 - 17
130 - GENSET STOP
1130 - 24.5 - 06 - 17
1255 - 24.0 - 04 - 17
1345 - 23.7 - 07 - 17
1540 - 23.5 - 05 - 15
1700 - GENSET ON
1700 - 25.4 - 05 - 15
1850 - 27.6 - 20 - 17 (electric heater)
1935 - GENSET OFF
1940 - 24.4 - 04 - 18

Fuel Status (as of 07:40):

Diesel: *Approximate reading 1/2.*

Propane Tank: *Still around 31%.... that's marveillous*

Gasoline:
Quantity: *6 1/2*
Consumed: *no*

Oil:
GenSet Quantity remaining: *1 quart*
ATV Quantity remaining: *6 quarts*
Blue Quantity remaining: *I don t know, is there some?*

Water Status:

Outside potable water tank level: *300 gal* ***Trailer potable water tank level:*** *60 units*
Water meter reading: *6118.5*
Consumed: *36 gal*
Estimated Grey Water Used: *30 gal*
Flushes: *10*
Showers: *4 short showers*
Sponge Baths: *0*
Notes/Comments: *we have a very nice shower*

Transportation:

ATV 1: *Used - N*
Oil Check:*Y*
Tank: *3/4*
Tire Status:*good*

ATV 2: *Used - Y*
Oil Check:*Y*
Tank: *3/4*
Tire Status:*good*

ATV 3: *Used - Y*
Oil Check:*Y*
Tank: *3/4*
Tire Status:*good*

Blue: *Used - Y*
Oil Check:*N*
Fuel Consumed: *I don t know*
Tire Status:*not checked*

Notes/Comments: *none*

HVAC: *All working well*

Mars Surface Suits: *nothing more to say*

Computers/Networking Infrastructure: *Nothing more to report*

GreenHab: *we are giving water to the plants*

Data Logger:

February 2 - 0800
Pressure (mbar): *867*
Temperature(C): *-1.5*
Wind Speed (m/s): *0*
Sky: *light clouds all over the sky*

February 2 - 1840
Pressure (mbar): *868*
Temperature(C): *6*
Wind Speed (m/s): *0.2*
Sky: *two clouds didn' t want to leave*

Upgrade Work: *I'm afraid not today*

General Notes/Comments: *It's a sad engineering day tomorrow.... nothing happened else than that we ran out of battery this morning because of the toaster. But even like that we have fun.*

Log Book for February 4, 2006
Engineering Report
Jérémie Geoffray Reporting

Generator/Electricity:

Wendy Hobbs Meter at 08:30: *2092.5 hrs*
Oil Level: *full*
Oil Pressure: *35 PSI*
Water Drained: *no*

Xantrex Inverter/Dynasty Batteries:
Time - Voltage (Temp Comp) - Load - Temp
0105 - 23.3 - 04 - 15
0730 - Battery off
0730 - GENSET ON
0815 - 25.6 - 05 - 15
0945 - 26.3 - 05 - 17
1115 - 28.1 - 05 - 18
1120 - GENSET STOP
1120 - 24.7 - 03 - 18
1220 - 23.9 - 09 - 18
1630 - GENSET ON
2020 - 29.4 - 07 - 21
2025 - GENSET OFF
2030 - 25.1 - 08 - 21

Fuel Status (as of 08:20):

Diesel: *Approximate reading 1/2.*

Propane Tank: *30%*

Gasoline:
Quantity: *6 1/2*
Consumed: *no*

Oil:
GenSet Quantity remaining: *1 quart*
ATV Quantity remaining: *6 quarts*
Blue Quantity remaining: *none*

Water Status:

Outside potable water tank level: *250 gallons.*
Trailer potable water tank level: *60 cm from the base.*
Water meter reading: *6147.5*
Consumed: *29 gal*
Estimated Grey Water Used: *21 gal*
Flushes: *7*

Showers: *none*
Sponge Baths: *0*

Transportation:

Blue: *Used - Y*
Oil Check: *N*
Fuel Consumed: *I don't know*
Tire Status: *not checked*

Kawasaki ATV-1: *Used - N*
Oil Check: *N*
Fuel Tank: *3/4*
Tire Status: *good*

Kawasaki ATV-2: *Used - Y*
Oil Check: *Y*
Fuel Tank: *2/3*
Tire Status: *good*

Kawasaki ATV-3: *Used - Y*
Oil Check: *Y*
Fuel Tank: *2/3*
Tire Status: *good*

HVAC: *All working well*

Mars Surface Suits: *They are really nice indeed*

Computers/Networking Infrastructure: *Nothing more to report*

GreenHab: *We are giving water to the plants*

Data Logger: *none today*

Upgrade Work: *I have to check the blue truck, the TV crew reported to me a problem, I will repair tomorrow.*

Log Book for February 5, 2006
Engineering Report
Pierre Brulhet & Jérémie Geoffray Reporting

Generator/Electricity:

Wendy Hobbs Meter at 06:30: *2097.2 hrs* ***Oil Level:*** *full* ***Oil Pressure:*** *32 PSI* ***Water Drained:*** *no*

Xantrex Inverter/Dynasty Batteries:
Time - Voltage (Temp Comp) - Load - Temp
2155 - 24.7 - 06 - 21

0030 - 23.9 - 05 - 19
0745 - 22.8 - 04 - 14
0830 - 22.7 - 04 - 14
0855 - 22.6 - 04 - 14
0900 - GENSET ON
0900 - 25.1 - 04 - 14
1000 - 26.8 - 04 - 15
1220 - 27.6 - 06 - 18
1710 - 23.6 - 05 - 15
1710 - GENSET ON
1840 - 29.3 - 18 - 17

Notes/Comments: *last to days I've been to the limits of the batteries, I try to be less stressing now*

Fuel Status (as of 06:30):

Diesel: *Approximate reading a little less than 1/2.*

Propane Tank: *30%*

Gasoline:
Quantity: *6 1/2 Gal*
Consumed: *no*

Oil:
GenSet Quantity remaining: *1 quart*
Kawasaki ATV Quantity remaining: *6 quarts*
Blue Quantity remaining: *none*

Water Status:

Outside potable water tank level: *205,3 gallons*
Trailer potable water tank level: *40 cm from the base.*
Water meter reading: *6165.4*
Consumed: *18 gal*
Estimated Grey Water Used: *25 gal*
Flushes: *7*
Showers: *0 (two just after I ve done my engineering tour, so it will be count tomorrow)*
Sponge Baths: *0*

Transportation:

Blue: *Used - N*
Oil Check: *- N*
Fuel consumed: *I don t know*
Tire Status: *not checked*
Notes/Comments: *see below in upgrade work*

Kawasaki ATV 1: *Used - Y*

Oil Check: *- Y*
Fuel Tank: *a little less than 1/2*
Tire Status: *good*

Kawasaki ATV 2: *Used - Y*
Oil Check: *- Y*
Fuel Tank: *1/2*
Tire Status: *good*

Kawasaki ATV 3: *Used - Y*
Oil Check: *- Y*
Fuel Tank: *2/3 (in fact I've just read 3/4 but it s impossible because we didn't fill it up... maybe a Martian did)*

HVAC: *All working well*

Mars Surface Suits: *Since Friday I m wondering what in heck could be the name of those suits, and it's writing there! Backpack 2 was broken just when we decide to go in EVA... So we took another one. I looked at it, and found it was a broken fuse. Then it was a real challenge: find a fuse in the hab!! I finally succeed and repaired it. It s now working very well the next crew should bring two bungee cords of around 1 foot for the two helmets that don t have one (It is really much more comfortable)*

Computers/Networking Infrastructure: *Nothing more to report*

GreenHab: *Our mission commander spent nearly an hour in the GreenHab, and did all that is needed at 10:15am:*

- *Flowmeter from Green Hab to the Hab: 384.0*
- *Flowmeter from the Hab to Green Hab: 279.7*
- *The spray pumps in Trickling filter 1 and 2 are not operating. The voltage on the electrical lines is 12.5 V*
- *The plants were watered with water and the recommended mixture at 10.40 am today, at 7.30 pm the 3rd and there was an emergency watering all plants with pure water- the preceding day.*

Data Logger:

February 5 - 0830
Pressure (mbar): *866*
Wind Speed (m/s): *1.2*
Temperature (C): *2.5*
Sky: *clear*

February 5 - 1900
Pressure (mbar): *869*
Wind Speed (m/s): *between 4 and 9 (yesterday evening we had gust to 11 and more)*
Sky: *clear*

Upgrade Work: *I looked at the blue truck gear lever, the screw that hold it was dead and the* *gear lever could have stay in our hands at any time. I find a healthy screw a little bigger but not enough so I wasn't able to fix it with a bolt. Conclusion the screw is going freely in the bore (the bore thread is dead too) but it s still a big progress, it's safer (if we can use this word about the blue truck.) It would be good if someone could bring a longer screw and a bolt to fix it. In fact, in the hab screws and bolts are really something that are missing a lot*

General Notes/Comments: *Well, not much to report today. I begin to like Wendy pretty much.*

Log Book for February 6, 2006
Engineering Report
Pierre Brulhet & Jérémie Geoffray Reporting

Generator/Electricity:

Wendy Hobbs Meter at 1805: *2103.0 hrs*
Oil Level: *full*
Oil Pressure: *32 PSI*
Water Drained: *yes*

Xantrex Inverter/Dynasty Batteries:
Time - Voltage (Temp Comp) - Load - Temp
2025 - GENSET OFF
2025 - 24.8 - 07 - 19
2200 - 23.8 - 13 - 18
2335 - 23.7 - 10 - 17
0020 - 23.8 - 04 - 17
0735 - 22.4 - 13 - 12
0820 - 22.6 - 04 - 12
0940 - 22.2 - 05 - 12
1000 - GENSET ON
1000 - 24.9 - 10 - 12
1100 - 25.6 - 07 - 14
1215 - 26.4 - 06 - 15
1315 - 27.5 - 06 - 17
1320 - GENSET OFF
1325 - 24.3 - 05 - 17
1705 - 23.5 - 06 - 15
1705 - GENSET ON
1710 - 25.6 - 07 - 15
1805 - 27.4 - 18 - 15
1815 - 27.6 - 23 - 15

Fuel Status (as of 1805):

Diesel: *Approximate reading a little less than 1/2.*

Propane Tank: *29%*
Notes/Comments: *well it's going down a lot... nights are very cold*

Gasoline: *Quantity: 5 1/2*

Oil:
GenSet Quantity remaining: *1 quart*
ATV Quantity remaining: *6 quarts*
Blue Quantity remaining: *none*

Water Status:

Outside potable water tank level: *192 gallons* ***Trailer potable water tank level:*** *35 cm from the base.* ***Water meter reading:*** *6204.8* ***Consumed:*** *40 gal* ***Estimated Grey Water Used:*** *24 gal* ***Flushes:*** *8* ***Showers:*** *the 2 of yesterday* ***Sponge Baths:*** *0* ***Notes/Comments:*** *well yes I know. I will look closer to the water used...*

Transportation:

Blue: *Used - N*
Oil Check: *N*
Fuel Consumed:
Tire Status: *not checked*

Kawasaki ATV 1: *Used - Y*
Oil Check: *Y*
Fuel Tank: *nearly full*
Tire Status: *good*

Kawasaki ATV 2: *Used - Y*
Oil Check: *Y*
Fuel Tank: *nearly full*
Tire Status: *good*

Kawasaki ATV 3: *Used - Y*
Oil Check: *Y*
Fuel Tank: *nearly full (this time I filled them up, I'm sure.)*
Tire Status: *good*

HVAC: *All working well*

Mars Surface Suits: *all working well*

Computers/Networking Infrastructure: *Nothing more to report*

GreenHab: *We will do it later tonight, after the reports... so the news are for to*

Data Logger:

February 6 - 0815
Pressure (mbar): *876*
Wind speed (m/s): *0*
Temperature (C): *-4*

Sky: *clear and bright*

February 6 - 1900
Pressure (mbar): *874.5*
Wind Speed (m/s): *0*
Temperature: *2.5*
Sky: *plenty of stars*

Upgrade Work: *The "in GreenHab" water meter isn't working well, the little wheel wedge and so doesn't count anymore the water entering the GreenHab. Is it possible for me to try to open it to have a look, or will it explode?*

General Notes/Comments: *Very bad news, my Chopin disc is scratch, and we get used to do all our report with this music. I don t know if we ll survive. We discussed it and we are happy to sacrifice ourself for the Mars exploration. Maybe you could think about building a monument to our memory out there...*

Log Book for February 7, 2006
Engineering Report
Jérémie Geoffray Reporting

Generator/Electricity:

Wendy Hobbs Meter at 1815: *2111.3 hrs*
Oil Level: *full*
Oil Pressure: *32 PSI*
Water Drained: no

Xantrex Inverter/Dynasty Batteries:
Time - Voltage (Temp Comp) - Load - Temp
1930 - 29.6 - 12 - 18
2015 - GENSET OFF
2030 - 24.5 - 07 - 19
2330 - 24.1 - 04 - 18
0100 - 23.6 - 09 - 17
0735 - 22.7 - 04 - 12
0840 - 22.5 - 05 - 12
0935 - 21.6 - 05 - 12
0945 - GENSET ON
0945 - 25.2 - 10 - 12
1245 - 27.2 - 06 - 15
1415 - GENSET OFF
1425 - 24.8 - 05 - 17
1610 - 24.1 - 06 - 17
1630 - GENSET ON
1750 - 29.5 - 12 - 18
1815 - 29.6 - 13 - 18
1815 - GENSET OFF

Fuel Status (as of 1815):

Diesel: *Approximate reading a little less than 1/2 (it may be less, but I had no light so I will check tomorrow morning)*

Propane Tank: *27-28%*
Notes/Comments: *still going down (the opposite would have surprised me a lot)*

Gasoline: *Quantity: 5 1/2*

Oil:
GenSet Quantity remaining: *1 quart*
ATV Quantity remaining: *6 quarts*
Blue Quantity remaining: *none*

Water Status:

Outside potable water tank level: *400 gallons*
Trailer potable water tank level: *15 gallons.*
Water meter reading: *6223.0*
Consumed: *18 gal*
Estimated Grey Water Used: *13 gal*
Flushes: *7*
Showers: *0*
Sponge Baths: *0*
Notes/Comments: *the gallons written on the tank and those of the water meter aren't the sames at all. We ve done better for the water but it only because we didn t take showers, yet...*

Transportation:

Blue: *Used - N*
Oil Check: *N*
Fuel Consumed:
Tire Status: *not checked*

Kawasaki ATV 1: *Used - Y*
Oil Check: *Y*
Fuel Tank: *1/2*
Tire Status: *good*

Kawasaki ATV 2: *Used - Y*
Oil Check: *Y*
Fuel Tank: *1/2*
Tire Status: *good*

Kawasaki ATV 3: *Used - Y*
Oil Check: *Y*
Fuel Tank: *3/4*
Tire Status: *good*

HVAC: *All working well*

Mars Surface Suits: *working well, some begin to be a little used and will need to be refit*

Computers/Networking Infrastructure: *Nothing more to report*

GreenHab: *All going very well, the plants are very healthy*

Data Logger:

February 6 - 0815
Pressure (mbar): *876*
Wind Speed (m/s): *0*
Temperature (C): *-3.5*
Sky: *clear and bright*

February 6 - 1830
Pressure (mbar): *872*
Wind Speed (m/s): *1.3*
Temperature: *-5.4 (we are currently loosing one degree per hour)*
Sky: *clear*

Upgrade Work: *Richard repaired the shower curtain. I fixed various door s hanful, cleaned up the internet and LAN cables Repared with adhesive tape the plastic box of backpack 6 (and hope it wild hold long...). We'll have to be carefull with this one or we ll have to put a new box. We try without any success, Richard and I, to repair the cupboard s door next to the shower. So there is still a 20 degrees angle between the door and the cupboard.*

General Notes/Comments: *Olivier s report will come a little later this evening, he is a bit longer and I want to send tgis report early.*

Log Book for February 8, 2006
Engineering Report
Jérémie Geoffray Reporting

Generator/Electricity:

Casper: *not used*

Wendy:
Hobbs Meter: *2115.3 hrs*
Voltage: *120 VAC*
Frequency: *61 Hz*
Oil Level: *full*
Oil Pressure: *32 PSI*
Water Drained: *yes*

Xantrex Inverter/Dynasty Batteries:
Time - Voltage (Temp Comp) - Temp - Load - Generator Running?
1925 - 24.2 - 18 - 0.7 - n

2300 - 23.5 - 17 - 10 - n
0015 - 23.6 - 17 - 05 - n
0735 - 21.8 - 12 - 04 - n
0750 - 19.3 - 12 - 04 - n
0855 - 25.6 - 14 - 05 - y
1035 - 26.8 - 15 - 08 - y
1150 - 29.4 - 17 - 05 - y
1330 - 24.1 - 18 - 05 - n
1545 - 23.9 - 17 - 05 - n
1700 - 23.8 - 17 - 04 - n
1730 - 23.1 - 17 - 19 - n
1805 - 25.6 - 17 - 20 - y

Fuel Status (as of 1800):

Diesel: *Approximate Reading: 1/2*

Propane Tank: *Approximate Reading: 27% (280 gal / 1000.0 gal) = (1059.912 L / 3785.4 L)*

Gasoline:
Consumed Today: *1.3 gallons*
Quantity Remaining: *27.5 gallons*

Oil:
GenSet Quantity: *1 quarts*
ATV Quantity: *6 quarts*
Blue Quantity: *0 quarts*

Water Status:

Outside Potable Water Tank Level: *390 gallons = 1476.306 L*
Trailer Potable Water Tank Level: *35 cm from the base*
Water Meter Reading: *6238.6 gallons = 23615.59644 L*
Water Consumed: *16 gallons = 60.5664 L in last 24 hours*
Grey Water Used: *16 gallons = 60.5664 L in last 24 hours*
Flushes: *8*
Showers: *1*
Sponge Baths: *0*
Notes/Comments: *We are eating freeze-dry food without water, not to consume too much*

GreenHab:
Crops Watered: *yes*
Crop Condition: *They have little insects on them.*

Transportation:

Blue: *Used? - no*
Oil Checked: *no*
Fuel Consumed: *0 gallons = 0 L*
Tire Status: *NA*

Kawasaki ATV 1: *Used? - yes*
Oil Checked: *yes*
Fuel Consumed: *1/3 gallons = 3.7854 L*
Tire Status: *good*

Kawasaki ATV 2: *Used? - yes*
Oil Checked: *yes*
Fuel Consumed: *1/2 gallons = 3.7854 L*
Tire Status: *good*

Kawasaki ATV 3: *Used? - yes*
Oil Checked: *yes*
Fuel Consumed: *1/2 gallons = 3.7854 L*
Tire Status: *good*

Notes/Comments: *The three keys are 'spined' (if that word exist, but you have the idea). We tried to take pictures, but the camera doesn't have two eyes so it can t see it.*

HVAC: *Nothing further to report.*

Mars Surface Suits: *Nothing further to report.*

Computers/Networking Infrastructure: *It didn't work too bad today.*

Appliances: *Nothing further to report.*

GreenHab: *All tanks are full. The water meter stopped completely, and I didn't succeed in starting it again. It's completely stuck.*

Data Logger:

February 8 - 0800
Pressure (mbar): *874.5*
Wind Speed (m/s): *0*
Temperature (C): *-4.5 (0800) -2.5 (0830)*
Sky: *clear*

February 8 - 1830
Pressure (mbar): *870*
Wind Speed (m/s): *0*
Temperature (C): *7.4*
Sky: *clear*

Upgrade Work: *Nothing further to report.*

General Notes/Comments: *We may be saved, I used the polish for the helmets on the disc and it s better. It does not stop reading like before, but only have sounds stops. Will try another time tomorrow.*

Log Book for February 9, 2006
Engineering Report
Jérémie Geoffray Reporting

Generator/Electricity:

Casper: *not used*

Wendy Hobbs Meter: *2122.2 hrs*
Voltage: *120 VAC*
Frequency: *59 Hz*
Oil Level: *7/8*
Oil Pressure: *32 PSI*
Water Drained: *yes*
Notes/Comments: *It is so nice with us, but every morning I hesitate to start it because of the silence... it's so impressing. I'm afraid I won't do it one a few morning that remain.*

Xantrex Inverter/Dynasty Batteries:
Time - Voltage (Temp Comp) - Temp - Load - Generator Running?
1945 - 29.2 - 18 - 12 - y
2120 - 23.8 - 18 - 06 - n
0010 - 23.4 - 17 - 05 - n
0615 - 22.2 - unknown - unknown - n
0820 - 26.1 - 15 - 05 - y
1135 - 24.1 - 17 - 06 - n
1400 - 23.6 - 17 - 05 - n
1650 - 25.6 - 15 - 06 - y
1800 - 27.2 - 17 - 07 - y

Notes/Comments: *We had a strange problem with the batteries this morning. They should have long all the night but they don t. They stopped at 0615 and the emergency batteries started to 'bip-bip'. As had to started the generator unless it would not have stopped bip-biping... I checked the batteries before starting the generator and the voltage was at 22.2.*

For comparison the batteries cut off is estimated between 21.6 and 21.8 and last morning I started the generator when they were at 19.3 and still running! I think there was a problem to because they were up to 22 half an hour before nothing was running and the voltage was still going down. I have no explication to this... we'll see tomorrow what'll happen.

Fuel Status (as of 21:53):

Diesel: *Approximate Reading: empty*

Propane Tank: *Approximate Reading: 26% (260 gal) = (984.2 L)*
Notes/Comments: *I really don't know why it's going down that fast. We are really not heating the hab a lot. Maybe it is because night are colder than last week.*

Gasoline:
Consumed Today: *0 gallons = 0 L*
Quantity Remaining: *0 gallons = 0 L*

Oil:
GenSet Quantity: *1 quart*
ATV Quantity: *6 quarts*
Blue Quantity: *0 quarts*

Water Status:

Outside Potable Water Tank Level: *390 gallons = 1476.306 L*
Trailer Potable Water Tank Level: *10 cm from the base*
Water Meter Reading: *6253.2 gallons*
Water Consumed: *15 gallons = 56.781 L*
Grey Water Used: *17 gallons = 64.352 L*
Flushes: *5*
Showers: *1*
Sponge Baths: *0*
Notes/Comments: *That's not to bad.*

GreenHab:

Crops Watered: *no*

Crop Condition: *The insects eating them don't seem to die, the plants aren't toxic.*

Transportation:

Blue: *Used - no*
Oil Checked? no
Fuel Consumed:0 gallons = 0 L*
Tire Status: *I don't know.*

Kawasaki ATV 1: *Used - no*
Oil Checked: *no*
Fuel Consumed:0 gallons = 0 L*
Tire Status: *I don't know.*

Kawasaki ATV 2: *Used - no*
Oil Checked: *no*
Fuel Consumed:0 gallons = 0 LB* ***Tire Status:*** *I don't know.*

Kawasaki ATV 3: *Used - no*
Oil Checked: *no*
Fuel Consumed:0 gallons = 0 L*
Tire Status: *I don't know.*

Notes/Comments: *I tried to repaired the keys. It doesn't worked to bad. Two keys oppose a* *few resistance when I tried to insert them in the keyholes, but it's running well. They are still no perfectly straight.*

HVAC: *Nothing further to report.*

Mars Surface Suits: *Nothing further to report.*

Computers/Networking Infrastructure: *Nothing further to report.*

Appliances: *Nothing further to report.*

Data Logger:

February 10 - 0910
Pressure (mbar): *869.5b*
Wind Speed (m/s): *1.7*
Temperature (C): *4.6*
Sky: *clear*

February 10 - 1845
Pressure (mbar): *863*
Wind Speed (m/s): *0*
Temperature (C): *7*
Sky: *some clouds*

Upgrade Work: *I worked on the water meter. It s know working well. I had to do all the waterproof again. There is still to leaks between the hose and the bolt (not on the blot, just under, where the bolt is fix to the hose, and only where the water come from the hose to the bolt and not the other way)*

IMPORTANT: *I ran out of Teflon tape. should we send an email to the next crew or Don can drop some here for them.*

Notes/Comments: *We all feel at home here. Even the batteries cut off this morning gave us a real fun!*

Log Book for February 10, 2006
Engineering Report
Jérémie Geoffray Reporting

Generator/Electricity:

Casper: *Not used.*

Wendy Hobbs Meter: *2128.9 hrs*
Voltage: *120 VAC*
Frequency: *61 Hz*
Oil Level: *7/8*
Oil Pressure: *32 PSI*
Water Drained: *no*

Notes/Comments: *It's windy round Wendy tonight.*

Xantrex Inverter/Dynasty Batteries:
Time - Voltage (Temp Comp) - Load - Temp - Generator Running?
2000 - 29.6 - 07 - 19 - y
2100 - 25.1 - 08 - 21 - n
2310 - 24.2 - 04 - 19 - n
0730 - 23.0 - 09 - 15 - n
1015 - 25.6 - 04 - 14 - y
1240 - 28.4 - 05 - 17 - y
1245 - 24.6 - 06 - 17 - n
1520 - 23.8 - 04 - 15 - n
1700 - 23.2 - 06 - 14 - n
1800 - 28.8 - 19 - 15 - y

Notes/Comments: *No problem this morning. This evening, one of the GreenHab heaters did not seem to work. (there was the light on flame but that's all) I put the thermostat higher and back to the original and the heater illuminate with blue flames.*

Fuel Status (as of 1800):

Diesel:
Approximate Reading: *1/2*
Notes/Comments: *I put a bucket (I found it near the generator with all the other 'stuff') under the diesel leak a the begin of the week. It's not awfully full... I will need to find another one tomorrow.*

Propane Tank:
Approximate Reading: *25% (250 gallons = 946.4 L)*
Notes/Comments: *It is really cold at night and there is a lot of wind also, that's the explanation.*

Gasoline:
Consumed Today: *6.5 gallons = 24.4 L*
Quantity Remaining: *18 gallons = 68.1 L*
Notes/Comments: *All the Kawasaki ATVs are now nearly full.*

Oil:
GenSet Quantity: *1 quart*
ATV Quantity: *6 quarts*
Blue Quantity: *0 quarts*
Notes/Comments: *We had half a quart in the Blue Alain brought when we arrived. I empty it in the Blue trying to full the tank. It s better now.*

Water Status:

Outside Potable Water Tank Level: *350 gallons = 1324.9 L*
Trailer Potable Water Tank Level: *10 cm from the base*
Water Meter Reading: *6271.6 gallons = 23740.5 L*
Water Consumed: *19 gallons = 71.9 L*

Grey Water Used: *11 gallons = 41.6 L*
Flushes: *8*
Showers: *2*
Sponge Baths: *0*
Notes/Comments: *We are really good now, maybe we could stay a little more here.....*

GreenHab:
Crops Watered: *no*
Crop Condition: *N/A*

Transportation:

Blue: *Used - yes*
Oil Checked: *yes*
Fuel Consumed: *0 gallons = 0 L*
Tire Status: *I don't know*

Kawasaki ATV 1: *Used - yes*
Oil Checked: *yes*
Fuel Consumed: *0 gallons = 0 L*
Tire Status: *good*

Kawasaki ATV 2: *Used - yes*
Oil Checked: *yes*
Fuel Consumed: *0 gallons = 0 L*
Tire Status: *good*

Kawasaki ATV 3: *Used - yes*
Oil Checked: *yes*
Fuel Consumed: *0 gallons = 0 L*
Tire Status: *bad*

Notes/Comments: *I don't know how to measure the gallons used in the ATV. With the Blue I've made around 200 meters, but the tank is nearly empty*

HVAC: *Nothing further to report.*

Mars Surface Suits: *Nothing further to report.*

Computers/Networking Infrastructure: *Nothing further to report.*

Appliances: *Nothing further to report.*

GreenHab: *The leak seems to be better than yesterday, there nearly no water going out the hoses. But the water meter didn't worked very well... I think it will be impossible to have the two working correctly.*

Data Logger:

February 10 - 0850

Pressure (mbar): *870.5*
Wind Speed (m/s): *1*
Temperature (C): *4.7*
Sky: *clear*

February 10 - 1845
Pressure (mbar): *872.5*
Wind Speed (m/s): *4.5*
Temperature (C): 3
Sky: *clear*

Upgrade Work: *Nothing further to report.*

Notes/Comments: *Looking around me, the hab does not seem to be that much deteriorated since I arrived. And I like very much all the little things that don't work. It makes all his charms. But it takes some days to discover everything, and to be in the bath, as we say in French*

Log Book for February 11, 2006
Engineering Report
Jérémie Geoffray Reporting

Generator/Electricity:

Casper: *not used*

Wendy Hobbs Meter: *2135.8 hrs*
Voltage: *120 VAC*
Frequency: *60 Hz*
Oil Level: *7/8*
Oil Pressure: *32 PSI*
Water Drained: *no*
Notes/Comments: *none (and that's great for the last day)*

Xantrex Inverter/Dynasty Batteries:
Time - Voltage (Temp Comp) - Load - Temp - Generator Running?
2000 - 24.4 - 12 - 18 - n
2115 - 23.9 - 12 - 17 - n
0700 - 22.0 - 00 - 12 - n
0700 - 25.3 - 10 - 12 - y
0945 - 26.7 - 15 - 14 - y
1640 - 25.7 - 04 - 14 - n
1815 - 29.4 - 12 - 17 - y

Notes/Comments: *The same problem this morning, but that time I expected it. As it was at 0700, I stay outside and had a beautiful sunrise, that relly great for the last day. We were really short yesterday evening, and Richard get up early to leave with the blue. that mean a few more consumption. but at 22.0 it s still a bit early*

Fuel Status (as of 18:15):

Diesel: *Approximate Reading: 1/2*

Propane Tank: *Approximate Reading: 25% (250 gallons = 946.4 L)*

Gasoline:
Consumed Today: *0 gallons = 0 L*
Quantity Remaining: *18 gallons = 68.1 L*
Notes/Comments: *all the ATV are now nearly full*

Oil:
GenSet Quantity: *1 quart*
ATV Quantity: *6 quarts*
Blue Quantity: *0 quarts*

Water Status:

Outside Potable Water Tank Level: *350 gallons = 1324.9 L*
Trailer Potable Water Tank Level: *5 cm from the base*
Water Meter Reading: *6271.6 gallons = 23740.5 L*
Water Consumed: *22.5 gallons = 85.2 L*
Grey Water Used: *18 gallons = 68.1 L*
Flushes: *6*
Showers: *0*
Sponge Baths: *0*
Notes/Comments: *the GreenHab is empty so I m going to send everybody to the shower...*

GreenHab:
Crops Watered: *yes*
Crop Condition: *good!*
Notes/Comments: *the heater does not seem to work correctly*

Transportation:

Blue: *Used - yes*
Oil Checked: *yes*
Fuel Consumed: *0 gallons = 0 L*
Tire Status: *I don t know*

Kawasaki ATV 1: *Used - yes*
Oil Checked: *yes*
Fuel Consumed: *0 gallons = 0 L*
Tire Status: *good*

Kawasaki ATV 2: *Used - yes*
Oil Checked: *yes*
Fuel Consumed: *0 gallons = 0 L*
Tire Status: *good*

Kawasaki ATV 3: *Used - yes*

Oil Checked: *yes*
Fuel Consumed: *0 gallons = 0 L*
Tire Status: *bad*

Notes/Comments: *I didn t find the thing for the tire... Do you have an idea so I can tell the next crew ?*

HVAC: *Nothing further to report.*

Mars Surface Suits: *All cleaned*

Computers/Networking Infrastructure: *The next will have the pleasure of sattellite's errors*

Appliances: *The hab heater stopped again today. We restarted it without any difficulties*

Data Logger:

February 11 - 0800
Pressure (mbar): *880*
Wind Speed (m/s): *0*
Temperature (C): *-6*
Sky: *clear*

February 11 - 1830
Pressure (mbar): *877*
Wind Speed (m/s): *1*
Temperature (C): *2*
Sky: *clear*

Upgrade Work: *we did a bit of a cleaning.*

Notes/Comments: *Well,what else to say than I had a lovely and extraordinary mission here. Hope to be here again, in contact mission support soon.*

Log Book for February 11, 2006
Engineering Summary
Jérémie Geoffray Reporting

The following engineering report summarizes and presents the accomplishments and difficulties in the activities conducted by the Engineer of Crew 43 with the assistance of Mission Support during the rotation.

Accomplishments: *During the rotation of Crew 43 the following accomplishments were reported to and acknowledged by Mission Support:*

- *Build a new Shower*
- *Made some arrangements of the first airlock inner door.*
- *Repaired two backpacks*
- *Fixed (temporarily) the blue truck gear level*
- *Cleaned and put in order the first floor*

- *Fixed a GreenHab water meter (but there is still some leaks)*
- *Made a beautiful shower curtain*
- *Fixed all the door's handful*
- *Cleaned the internet cables*

Future Recommendations: *For the improvement and further expansion of the MDRS initiative the Crew 43 engineering team identified the following as observations that will help the accomplishment of the vision and purpose of the Mars Society.*

I think that having the telescope fully operationnal is the major thing. It my deepest regret not to have used it (and I'm not the only one to think that). To repower it, and put the line to make possible the utilisation inside the hab is the best thing that can happen here.

And I would love come back to get this done. There is also a lot of little things that don't work correctly, but that's part of the fun here.

Comparison to an actual Mars mission

All the operations described above are far from the similar ones which will be conducted on an actual Mars mission. We spent 8.2 % of our time to these activities which is probably under the % devoted to actual planetary bases facilities maintenance. At MDRS we have facilities which have the same functions as in an actual planetary base: Power production, water recycling, waste treatment, communication system (to the earth and between astronauts in EVA), space suits, vehicles. But the technical solutions used for these systems are more or less far from actual systems. Also the water recycling system would be located inside the Hab and not in a outside facility. Some other systems are missing: air production and treatment, pressurization control. Some actions we have to do, as measurements and measurements reporting, or power generator start up and shut off (and technical solutions would be different), would be conducted automatically.

Briefings from one crew to the next

Usually the crew reaches the Hab Saturday in the evening and the briefing is conducted the Sunday morning. We arrived at the Hab at 8.30 pm and after the dinner prepared by the preceding crew, we quickly started the briefing and the facilities inspection because crew 42 had planned to leave early the following morning. Thus the explanations were reduced in time to less than two hours which is a little short mainly taking into account that all the outside explanations were given in the night (and cold) with torch lights. However this short briefing had no consequences excepted that the plants experimentation details and objectives were not fully understood by crew 43. In particular it seems that we did not get information about the way to produce the compost which was used to produce the “tea” for a part of the plants. This lack had no consequences because there was enough “tea” to water the plants during our stay. But we were not in position to explain the compost process to the following crew.
Naturally the information transmission for the main systems is somehow easier when the Hab documentation has been read before, which was the case for our crew.
For information transmission from crew 43 to crew 44, we had more time because our objective was only to be in Salt Lake Sunday evening, planes leaving for Europe the next morning. We used 2h45mn in Sunday morning to transfer all the information to crew 44, including explanations on the failures or difficulties encountered on the equipments during our stay. The briefing ended at 10.45 am when everything seemed to have been said. From the messages sent afterwards by crew 44, it seems that

information was not well understood or not accurate enough concerning the mailing list to mission support as well as the details for message titles or means of photos transmission. Also question were asked on the garbage management, questions we had also asked to Don Foutz at the beginning of our stay. The information transmission seems however satisfactory providing that, if something has been missed in the direct information by one crew to the next one, mission support is able to answer any question (providing that the new crew is aware that a question has to be asked on something). It is naturally very helpful to have in a crew one or two members who participated already to previous missions.

2.4. Psychological aspects

by Richard Heidmann

It is obvious that, despite the impression given by the environment of “being really on Mars”, the psychological conditions of this simulation are far from an actual mission. Mainly because two of the dominant aspects of the great voyage, duration and isolation, are not replicated.
That’s not to say that there is no value or lessons to be learnt from such an experience. On the contrary, for people considering the conditions and constraints to be taken into account in the design of the mission, the Mars Society habitat analogs certainly permit a better understanding of numerous aspects of the question. Some of these aspects are specifically covered in this report, in particular through the vision of the architects imbedded in the crew. Here we report various observations we made about the conditions experienced during the simulation and their psychological significance.

Being in the Hab

The first striking impression we had when arriving on site and entering the hab was that it is really big and spacious. The cultural image, due to historical reasons, is that a spacecraft is something cramped. This sure is not the case for the Mars habitation module, with its 8.4 meter diameter [1], its two stories and its habitable surface of about 100 m². Seen from outside, it stands as an impressive, sturdy and reassuring piece of hardware, a kind of stronghold inspiring confidence. Entering the living quarter, we realize there that is a lot of free space. This impression is reinforced by the perspective of the large circular wall and of the spherical ceiling. We feel that this will really be a mighty mission, where means will be properly dimensioned, and that the module is adequate for a two-year occupancy. The only apprehension we could have was about the size of the bedrooms, which is quite minimum; but in fact, it stood that this was not a problem: even if the value of this impression is questionable due to the short duration of the simulation, the bedroom was mainly used as a sleeping place, not as a place where to enjoy privacy, which indeed we did not need so much. It was felt as a warm and secure retreat where it was good to fall asleep.
Surprisingly - even if that was not so clearly felt by all the crew members - the technical noises inside the hab provided rather a sense of coziness, safety and warmness. That shows that the module is mentally perceived as a home, a haven in the middle of the uninhabited landscape. This was quite a surprise for those of us which usually are rather disturbed by street and neighbors noises in normal life.

Being outside

Due to safety considerations while executing outside maintenance tasks and to the presence of the TV team during the first week, it was not possible to observe strict simulation conditions for outside operations. Nevertheless, during the full second week, two of the crewmembers did not get out without a spacesuit. This resulted in no frustration for them. It appears that what is important while getting out

[1] Which is the Heavy Lift Vehicle launcher size.

is to be walk, ride and work in the light of the landscape, no matter being with or without a spacesuit. The main ergonomic factors which can enhance (or hamper) this favorable psychological condition are, by rank of decreasing importance:

-clarity of vision and a wideness of the field of view, which depends on the quality and cleanliness of the helmet screen, as well as on its lateral reach;

-precise tuning of fresh air venting of the face, just to give the sensation of being in the open air;

-dexterity permitted by the gloves, as the lack of it, even to execute the most trivial manual tasks, acts as a reminder about your actual condition;

-mobility permitted by the spacesuit.

Being outside in a spacesuit gives a similar feeling as being outside without spacesuit when you are otherwise confined to remain inside the Hab

The MDRS gloves are much less high-performance than actual space gloves are (but on the opposite there is no pressure inside which facilitates manipulations). Considering the importance of this factor for the simulation and for the verification of explorers field capacities, it is recommended to procure more realistic ones.

That taken apart, the only really handicap is the spacesuit in itself, in that moving and working becomes more tiring, and agility is restricted. The fact that the accomplishment of the simplest movements becomes demanding is probably the main stress factor in an EVA, especially when we fail in a task and have to retry.

-For feelings in EVA and simulated spacesuits description see also § 3-6

Working outside

The EVA planning and preparation procedures, as well as the conditions procured by the simulated spacesuits (except for the gloves) appear quite representative. On the other hand, there was probably not a sufficiently clear consideration of reliability and safety constraints which would be imposed during actual EVAs [2]. This resulted on some occasions in a kind of misunderstanding between the team members, some of them feeling that others were "overstressed". The question that arises if we do want to simulate an actual EVA is: even when everything goes smoothly, to what extent could we allow us to "relax", considering the unforgiving environment where we are supposed to be and the possible consequences of an apparently minor mistake or unplanned operation? True, we saw Apollo astronauts jumping and singing on the Moon, without a reaction from Mission Control…

Whatever the balanced attitude is, it must be explicitly stated and equally well understood by all crew members. Different kinds of behavioral "good practices" could be experienced, but each commander should define them and make them accepted from the beginning.

[2] Full attention being of course given to the simulation operations safety.

Communicating with "the Earth"

Communication with Mission Control and with our families and friends was through emails (texts and images), with the due interplanetary lag. In an actual mission, there will be less-limited communication, such as video messages, which is not possible at the MDRS due to the Internet link rate. But even like that, we felt very comfortable.

On the operational side, exchanging data, reports and directives through emails, with a delay, seems quite appropriate; it procures a better feeling of autonomy than if we were directly speaking with controllers; it also allows to better secure and make clear what is sent, as we have more time to prepare the answers.

On the personal side, we observed also a kind of emotional strengthening in sending something (emails, images) than just having a phone conversation. Nevertheless, what we missed to get a realistic simulation was video messaging. No doubt that this will be even more emotionally loaded, especially when crossing hundreds of millions of miles of empty space, than an email! But it could pose some problems: while you can read an email almost privately, what about seeing a video message? We can question if this will not tend to loosen the community feeling among the crew.

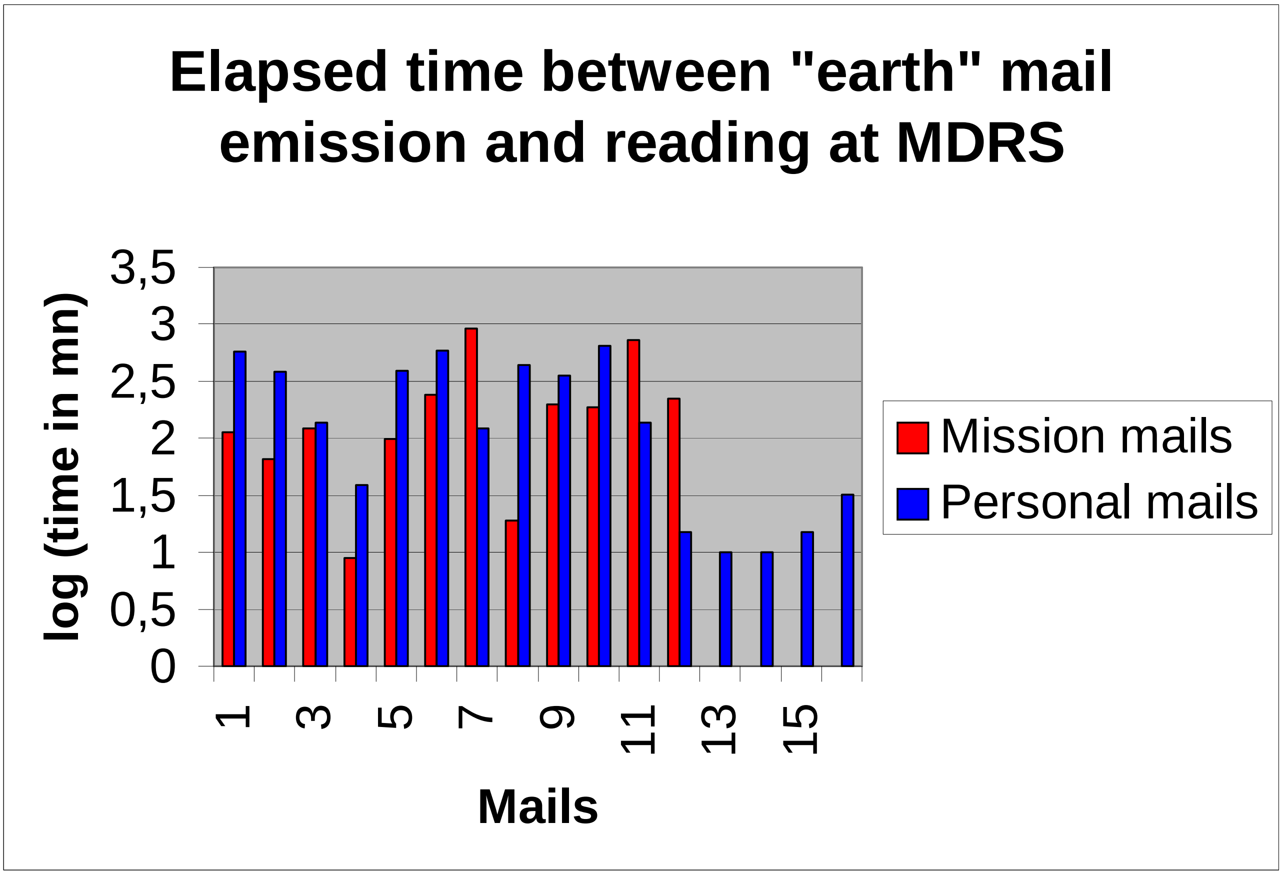
It is so recommended to install such a capacity in the MDRS.

2.5. About elapsed time between mail sending and their reading

by Alain Souchier

The recommended elapsed time between an email sending and the reading by the addressee is 5 minutes to simulate the time lag which occurs in communications between Earth and Mars. This time lag is applied for emails reaching the MDRS as well as for emails leaving the MDRS. As the distance between Earth and Mars varies from 50 to 370 millions kilometres, the time taken by radio signals to transit between the two bodies varies from 2mn 45s to 20 mn. When at MDRS it is difficult to know when our emails were read but we can have a look at the duration between emails sent to MDRS and the time when we read these emails. Statistics on my emails give a mean value of 243.5 mn + or – 251 mn at one sigma which indicates a wide scattering. This statistics comes from 28 messages reading between the 30th of January and the 10th of February. In 16 cases the time of reading has been recorded in my note book. In the other cases the time of reading has been calculated by the answer emission time from which 7 mn have been subtracted. This value represents the time needed to write and send an answer according to the data available when the reading time has been noted. I have nearly exactly the same mean value for the elapsed time in reading 16 personal emails than in reading mission related emails: 243.5 mn for the first category and 243.4 mn for the second category. The one sigma values are also close: 234 mn for the personal emails and 284 for the mission emails.

The elapsed time history is presented in the diagram below for mission related and personal emails.



For comparison the log of elapsed times for transmission between Earth and other planets are:
- Mars: 0.47 to 1.34
- Jupiter: 1.5 to 1.7
- Saturn: 1.9
- Uranus: 2.2
- Neptune: 2.4

In most cases we could have been around Jupiter and have handled our communications in the same way. This result was also found after the MDRS 7 rotation.

Concerning the personal communications, the time difference between Utah and Europe (8 hours) dictates some of the conditions for mails exchanges. A mail we send between 5 and 11 pm reaches Europe at a local time between 1am and 6am and is read in the morning. The answer, if sent the morning between 8am and 12am, reaches the MDRS between midnight and 4 am and is read there in the morning. This shows that for personal communications the respective martian time and Earth time will be a driver for the rate of exchanges. For mission communications one may expect that earth mission support will operate 24 hours a day and time difference between martian and Earth time will not be a factor.

As indicated in the preceding chapter, exchanging personal emails gives a sensation of proximity with the relatives. In my two MDRS missions I had far more exchanges with relatives than in professional trips to the US where I get the feeling of being “far from home”. The web cams which were not installed during my MDRS 7 mission, increase the proximity sensation. I received once an email saying “Hi, I can see you on your computer” which reduces instantaneously the psychological distance between you and your family. The rate of personal mails sending was for me 2.5 a day and the rate of reception 1.2 a day.

During this MDRS rotation, I experienced a mail discussion with one of my sons with nearly the minimum duration between messages. This sequence involved 9 messages exchanged during 2 hours and 2 minutes giving the impression of a dialogue. As you cannot wait for messages and anyhow have a lot of things to do, I was meanwhile working on my computer which nearly cancelled the feeling of duration between messages. Furthermore the messages analysis shows that our conversation was in fact two different conversations (two different topics) conducted in parallel. To illustrate let define as A the messages related to one topic and B the messages related to the other topic. The conversation was as follows:
Message A1 to MDRS
Message B1 from MDRS
Answer B2 to MDRS to B1
Answer A2 from MDRS to A1
Answer B3 from MDRS to B2
Answer A3 to MDRS to A2
Answer A4 from MDRS to A3
Answer B4 to MDRS to B3
Answer B5 from MDRS to B4
I was not conscious during this conversation that we were dealing alternatively with two topics. Compared to the exchange rate possible with a one topic discussion and alternate messages and answers, the rate of exchanges is multiplied by two for two topics. When man will be exploring Jupiter or Saturn satellites will we be conducting four or five conversations simultaneously ?

3 EVAs

3-1 Summary
3-2 EVAs efficiency analysis
3-3 EVAs Work Efficiency Index
3-4 EVAs localisation
3-5 Analysis of the difficulties to find our objective during some EVAs
3-6 Comments on operations and feelings in EVAs
3-7 EVAs daily reports

3.1. Summary

by Richard Heidmann

The following table gives an overview of all the EVAs conducted by the MDRS 43 crew.

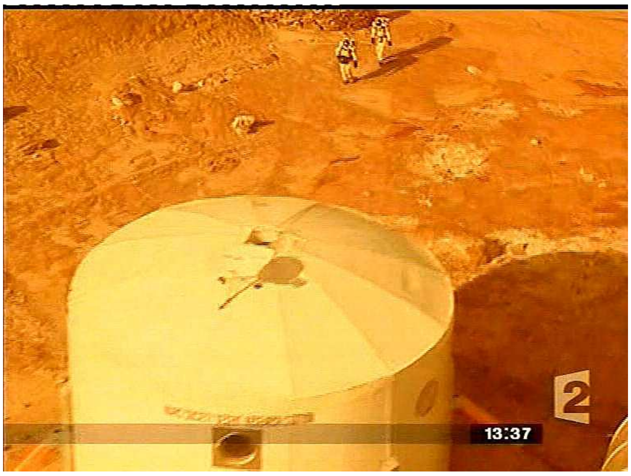
N°	Date	Duration(min)	Site	Mobility *	Crews **	Objectives	Fulfil-ment	Notes
1	30-janv	135	Lowell Highway to Lith Canyon	Q	Al/An/R	Sites Scouting / Glove dexterity devices testing / Geolog.sampling	33%	Unable to identify sites / Glove tested / Spherical concretions collected
2	30-janv	40	Radio repeater	F	J/P	EVA training / TV filming	80%	3 falls, due to too sloppy and muddy terrain
3	31-janv	135	Near the Hab	F	Al/An/R/P/J	Objects finding test / Shots for TV	100%	One crew simulating radio failure
4	31-janv	120	Goblin Valley	R	An/P/R	TV filming	100%	Superb landscape & light conditions
5	1-févr	140	Phobos Peak	Q, F	Al/J/R	TV filming / Geolog.sampling	100%	Found one suspected "blueberry" specimen
6	1-févr	165	Lith Canyon, end of Lowell Highway, Brahe Highway	Q, F	An/P	Sites Scouting	100%	
7	1-févr	60	Near the Hab	F	Al/J/R	TV filming	100%	
8	2-févr	45	Near the Hab	F	An/P/J	TV filming, sports	100%	
9	2-févr	10	Near the Hab	F	P	TV filming	100%	
10	3-févr	90	Near the Hab	F	J/R	TV filming, CRV check-test	50%	Haz cam encountered intermitent power disruptions; 2 tools forgotten on terrain!
11	3-févr	180	Lith Canyon	Q, F	Al/P	Scouting, fossils spotting	90%	ATV safety rope forgotten
12	4-févr	70	Near the Hab	F	L/J	Press EVA	100%	Arnaud Pacari in space suit too
13	4-févr	150	White Rock Canyon	Q, F	Al/R	CRV test & TV filming	75%	4 CRV descents ; image transmission OK but screen invisible in sunshine
14	4-févr	90	Upheaval Dome Crater	R/F	P/J/O	TV filming / first test of contextual imagery devices	50%	Balloon deflated during transfer; post-mounted camera out of focus
15	5-févr	120	Hab Ridge	F	P/O	2nd test of post-mounted camera/ geological sampling	60%	Computer set-up and utilization not satisfactory / One small item lost
16	5-févr	150	Lith Canyon	Q/F	Al/R/J	Fossils and old flow patterns spotting / Site scouting	100%	
17	6-févr	130	Bob's Rock Garden& Hab Ridge	Q/F	P/O	3rd test of post-mounted camera/ Retrieving lost item on EVA 15	100%	Computer utilization problem solved. Images acquired. Lost item retrieved
18	6-févr	180	Stacy's Cake & upper end of Candor Chasma	Q/F	Al/J/R	CRV test & Sites scouting	40%	Cactus road not identified at first; arriving late à Stacy's Quake; no time for test
19	7-févr	150	Stacy's Cake	Q/F	Al/J/R	CRV test on very harsh cliff	50%	Test executed. Unable to have the CRV back. Retrieving it from below, out of sim
20	7-févr	190	Lith Canyon	Q/F	Al/P/O	4th test of post-mounted camera	100%	
21	8-févr	45	Near the Hab	F	P/O	Balloon test	50%	Lift measured. One balloon lost!
22	8-févr	165	Lith Canyon	Q/F	R/P/O	5th test of post-mounted camera: Cliff stratigraphy	50%	Bad light setting of the camera
23	9-févr	80	Near the Hab	F	P/O	First Home made Mylar Balloon test	80%	Lift to max rope length. Images captured, but saturated. Alain accompanying
24	9-févr	60	Near the Hab	F	Al/J/R	CRV test on a smooth cliff	100%	Outside context camera satisfactory. Guiding by 1 rope OK. Jeremie accomp.
25	9-févr	40	Near the Hab	F	P/O/R	Second Home made Mylar Balloon test	100%	Full inflation. Full rope ascent. Video acquired in good conditions.
26	10-févr	120	Candor Chasma	Q/F	Al/J/R	First preliminary test of CRV Mk4 Scouting Candor Chasma access	100%	
27	10-févr	120	Cactus Road	Q	P/O	6th test of post-mounted camera: Cliff stratigraphy	100%	Full success; camera setting problem has been overcome
Total EVA time:		**49,7**	**hours**			**Main fulfilment:**	**82%**	

** F: foot / Q: quad / R: rover - ** P: Pierre / L: Loic / J: Jeremie / R: Richard / An: Anne / Al: Alain / O: Olivier*

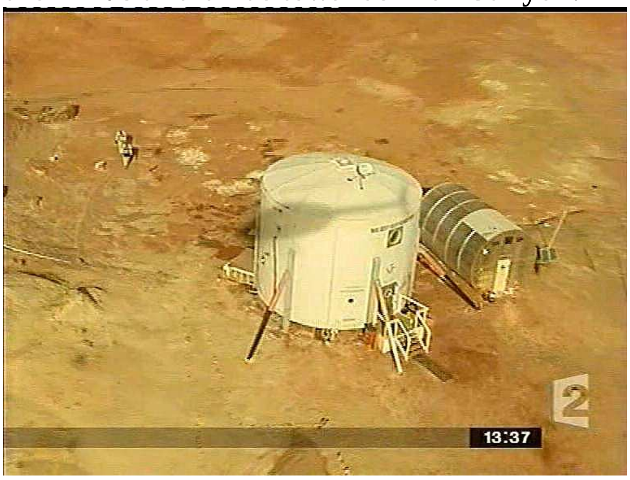
The cumulated duration is 49.7 hours and the cumulated man x hours amounts to 134.9 . For comparison, during the MDRS 7 mission the cumulated EVA duration was 35.7 hours and the cumulated man x hours in EVA 98. Our MDRS 43 crew “efficiency” in EVA was thus 30 % better. When we cumulate all the duration spent by “Planete Mars” association members since Charles Frankel participation in an FMARS in 2001 we obtain 26 weeks, a little less than a half stay on Mars (which will amount to a total of 70 weeks).

Coordinating EVA 10 and 11 with the helicopter arrival. First MDRS EVA to be filmed from the air?

CRV test 68 on the Hab ridge by EVA 10 and 11 crews together. Then EVA 10 crew separates from EVA 11 crew.



EVA 10 crew leaves the CRV experimentation to EVA 11 crew and goes back to the Hab to start the ATVs and drive towards Lith Canyon.



EVA 10 in ATVs on Lowell Highway going to Lith Canyon

End of EVA 11 seen from the helicopter

3.2. EVAs efficiency analysis
by Richard Heidmann

In his full report about his preceding mission (MDRS 7), Alain Souchier documented the list of EVAs performed. But this list was lacking basic and important data such as EVA preset objectives and percentage of fulfillment.
During the MDRS 43 mission, the objectives were clearly defined during the morning briefing meeting. There was no problem in documenting them. Judging of their fulfillment was admittedly rather subjective, except in situations where the results were clear-cut. Nevertheless, we tried to evaluate each EVA in real time.
Of 27 EVAs executed, about half (15) obtained a 100 % rating. But half of those were devoted to TV filming, a non representative objective. For the more "technical" EVAs (devices testing), we note that there is an improvement of the ratio over time. This, of course, corresponds to lessons being learned in the course of the successive tests. But, should our planning process be more thorough, we should have better ascertain the risks of failure of the first rounds of testing and admit them as a potential result in itself.
The mean rating is of 82 %, which is quite satisfactory. Two of the worst results were obtained due to location identification failure, which of course would have not be the case should we have used a GPS. But will we profit of a GPS on Mars?
A few bad ratings resulted from equipment failures, but can be considered as not significant as, due to our limited resources, we tend to use on the shelf mundane hardware rather than professional and specialized one (e.g. mini-camera).
Lastly, we have to recognize also of few real mishaps (like letting a small balloon escape or forgiving a tool on the terrain). This shows that, even for a simple and ambitious terrain experiment, it is necessary to ascertain carefully every detail and to prepare procedures and check-lists if necessary.

3.3. EVAs Work Efficiency Index

by Alain Souchier

In the document “Exploration Systems Mission Directorate – Lunar Architecture Update” – AIAA Space 2007 September 20, 2007, chapter “Extravehicular Activities (EVA) and Pressurized Rovers, Mike Gernhardt from NASA Johnson Space Centre analyses EVAs efficiency using a Work Efficiency Index (WEI) which is the ratio between EVA duration and the total duration of preparatory activities and activities post EVA. The EVA duration is defined as the time spent out of the spacecraft or in case of an EVA on a planetary ground as “boots-on-surface” which means that time in the airlock is not taken into account.

$$\text{TOTAL EVA Work Efficiency Index} = \frac{\text{EVA Time}}{\text{(Total EMU/A/L Prep + Prebreathe + A/L Depress + A/L Repress + Total Post EVA)}}$$

The preparatory activities include the oxygen prebreathing phase which is necessary to avoid decompression sickness in the shuttle and ISS based EVAs.

The various phases and corresponding WEI for shuttle and ISS EVAs are indicated below.

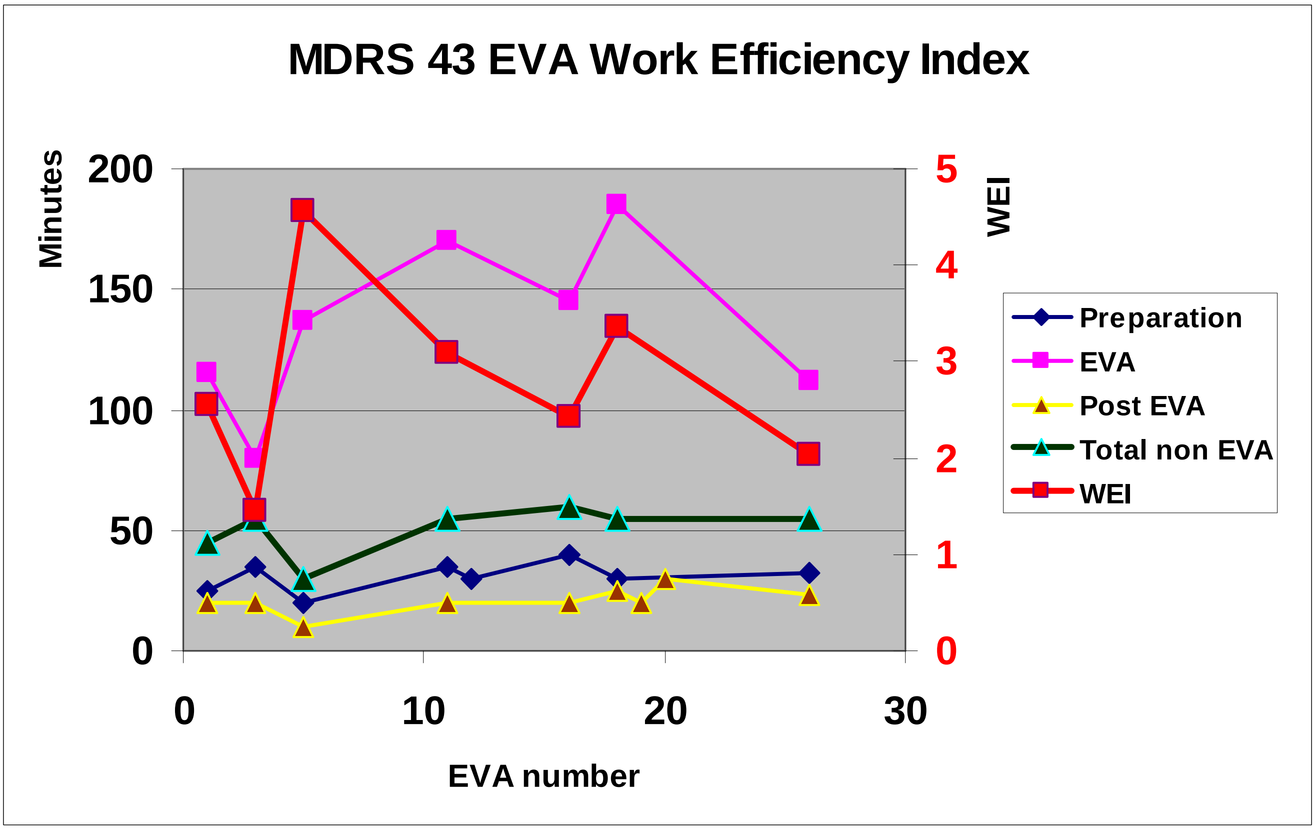
Total Suit/Airlock Overhead

PREBREATHE PROTOCOL	Shuttle 10.2 Staged Decompression (12 hrs at 10.2)	ISS: 4 hour In Suit	ISS CEVIS Exercise (Using ISS O2)
EVA Overhead Activities	TIME IN MINUTES	TIME IN MINUTES	TIME IN MINUTES
Suit checkout	115	185	185
REBA powered hardware checkout	25	25	25
SAFER checkout	30	30	30
Airlock config	95	90	90
Consumables Prep	60	120	120
EVA prep - prebreathe related	60	0	80
EVA prep - EMU related	30	30	30
Suit donning & leak check	60	60	60
SAFER donning	Completed during Prebreathe	Completed during Prebreathe	Completed during Prebreathe
Purge	8	12	12
Prebreathe	75	240	60
Airlock depress	15	30	40
Airlock egress	15	15	15
Airlock ingress	15	15	15
Airlock repress	15	15	15
Suit doffing	25	25	25
SAFER doffing & stow	10	10	10
Post EVA processing	105	90	90
TOTAL	**758**	**992**	**902**
EVA WORK EFFICIENCY INDEX	**0.51**	**0.39**	**0.43**

Naturally, as the preparation and post EVA durations are the same whatever the EVA duration, the WEI value depends directly on the EVA duration. The preceding table WEI values are given for EVAs lasting 386 minutes or 6 h 26 mn.
The NASA document indicates that the professional divers WEI are between 3 and 10, that WEIs above 3 are the objectives for lunar exploration, going as high as 9 if possible for EVAs lasting 3 h 15 mn or 195 mn. It is interesting to compare these values to the ones experienced during MDRS 43. We had simulated spacesuits which are easy to don and doff, with also minimal functional testing (no leak tests, no ECLSS tests and so on). We knew that the EVAs preparation and post EVAs operations were far too short compared to actual EVAs ones. But finally it appears that we were rather in line with the NASA objectives for exploration. Even if we did not intent initially to monitor these activities, the activities global monitoring (see chapter 4-1) and the commander personal habit of writing the time for a lot of events, has enabled to quantify EVAs preparation and post EVAs operations for 7 EVAs out of the 26 conducted and have partial data on others. The following table and graph indicate the preparation duration, the post EVA duration, the total preparation + post EVA duration, the EVA duration ("boots-on-surface") and the WEI for the EVAs for which data is available.

EVA	1	3	5	11	12	16	18	19	20	26
Preparation	25	35	20	35	30	40	30			32
EVA	115	80	137	170		145	185			112
Post EVA	20	20	10	20		20	25	20	30	23
Total non EVA	45	55	30	55		60	55			55
WEI	2,55	1,45	4,57	3,09		2,42	3,36			2,04

Durations in minutes

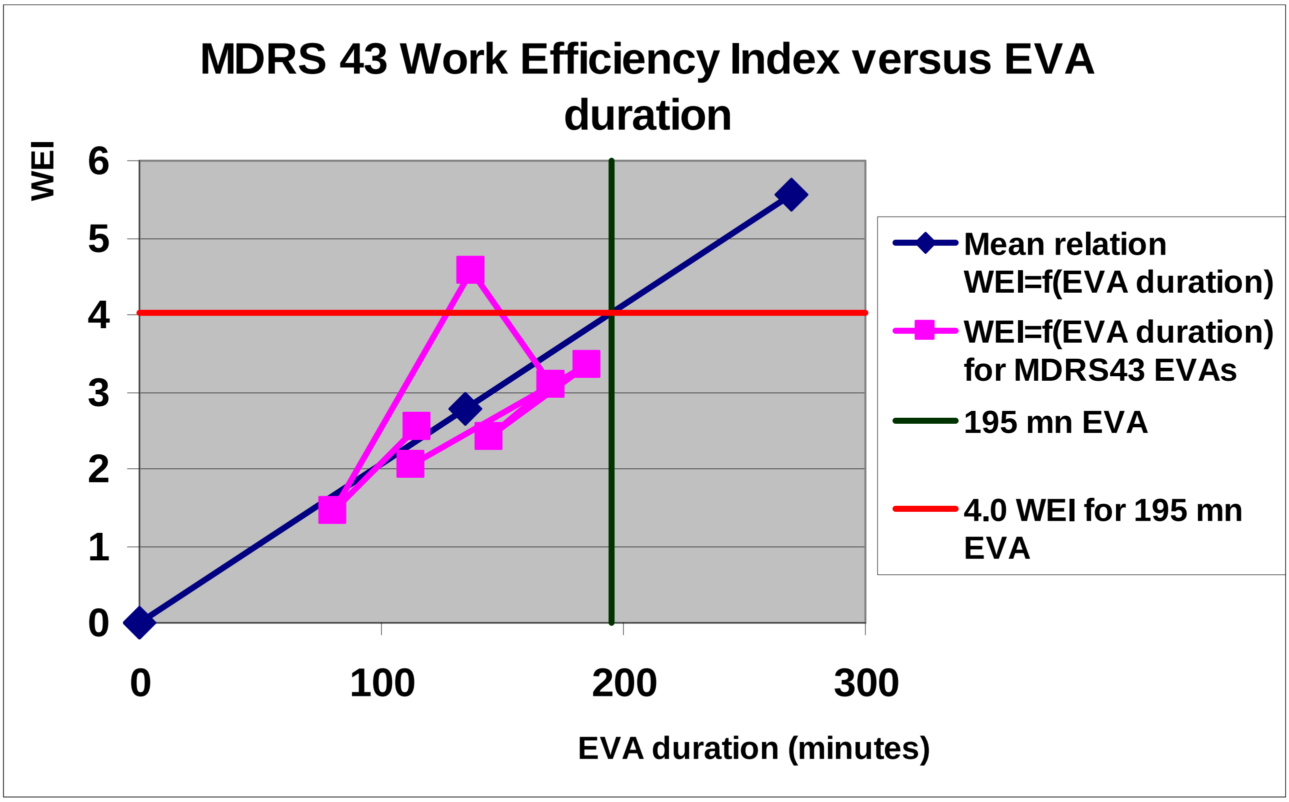


The mean values for the different parameters are:

- Preparation: 30.9 mn + or - 6.2 mn
- Post EVA: 20.9 mn + or – 5.3 mn

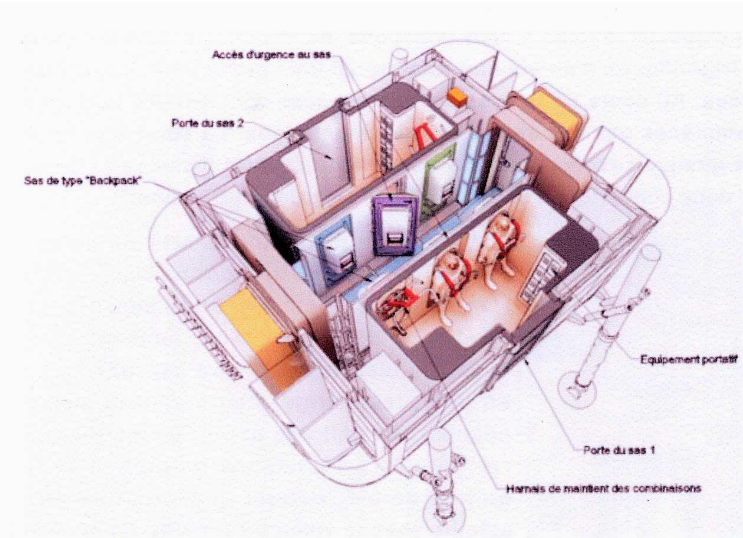
- Total preparation + post EVA: 50.7 mn + or – 10.2 mn
- EVA: 135 mn + or - 36 mn
- WEI: 2.78 + or – 1,0

The preparation and post EVAs durations do not seem to evaluate during our stay.
The WEI values depend on the EVA duration as already indicated.

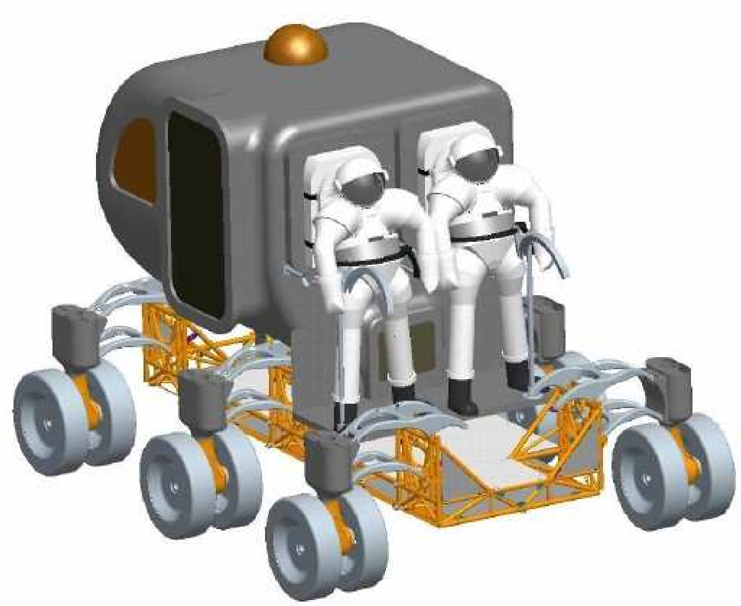


For a 195 mn EVA presented as nominal lunar EVA in the NASA document, the WEI would be 4.02, which means that our EVAs were representative of what NASA is aiming at for Space Exploration activities.
The NASA document indicates 15 mn as the objective for EVA preparation including 10 mn suit doning for EVAs conducted from a rover. There is no airlock depressurization time because the proposed solution is to have outside mounted spacesuits in which the astronaut enters through a back door as for the actual Russian Orlan spacesuit (which is however not stored outside the station). Our preparation time was 31 mn including a short airlock depress during 3 mn. We did not simulate any oxygen prebreathing or slow decompression assuming that Hab pressure and suit pressure would be compatible with no decompression sickness risks. On the moon Apollo spacesuits were at the same pressure (0.25 bar) and with the same atmospheric composition (pure oxygen) as the lunar module cabin. No decompression was necessary. Planete Mars conducted an evaluation of the pressure solutions and atmospheric compositions which would allow direct EVAs without prebreathe or progressive decompression. In the Hab the objective is to have the higher possible pressure with the maximum content of nitrogen to limit flammability risks. A low total pressure, even with the right content of oxygen, implies some disadvantages for the astronauts (less heat evacuation from the body, colder sensation after a shower with quick water evaporation, boiling temperature under 100 °C to cook or prepare hot drinks) and also for the electronic equipments (less natural cooling). To limit decompression sickness risks the ratio between nitrogen partial pressure and the total pressure inside the spacesuit (saturation coefficient) has to be under 1.4. This allows a solution as a total pressure of 0.57 bar with 0.26 bar of oxygen and 0.31 bar of nitrogen in the Hab for a 0.26 bar pure oxygen

pressure in the spacesuit. The saturation coefficient is then at 1.2. The oxygen % in the Hab is then still at a high 46% value which necessitates a special non flammability certification for the different materials. If a 30% oxygen content is required to use, for example, the materials which were certified for use in the shuttle, an other solution is possible: a 0.69 bar Hab atmosphere with 0.48 bar of nitrogen and 0.21 bar of oxygen and a spacesuit rated at 0.4 bar. The spacesuit will be stiffer at the EVA beginning but the pressure could be progressively decreased during the EVA ("decompression during EVA") in order to provide a more easy to operate spacesuit in the same time as the astronaut fatigue is growing. For all these solutions the airlock stay time is only dictated by the pumping process which is necessary to minimize air losses outside of the Hab. Or solutions with spacesuits stored outside and ingress through the suit back door are possible. For all these reasons we used a short 3 mn stay in the airlock considering this duration would be representative of future operational conditions.



2006 study of a Martian habitat by the architects D. Gautheron and Y. L. Bassing, showing dorsal quick access spacesuits located in the airlock

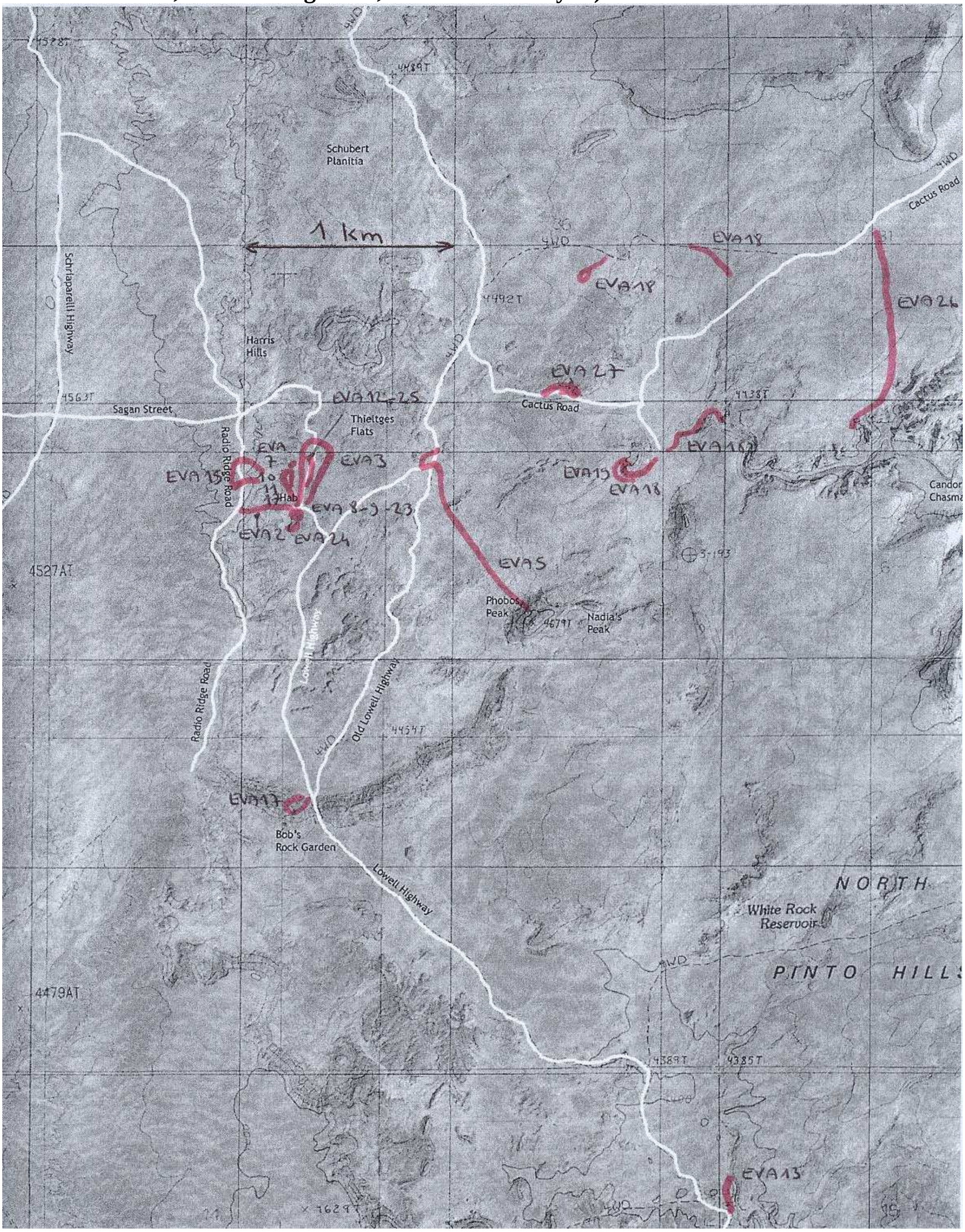


2007 NASA study for a pressurized lunar rover showing dorsal quick access spacesuits located externally on the airlock

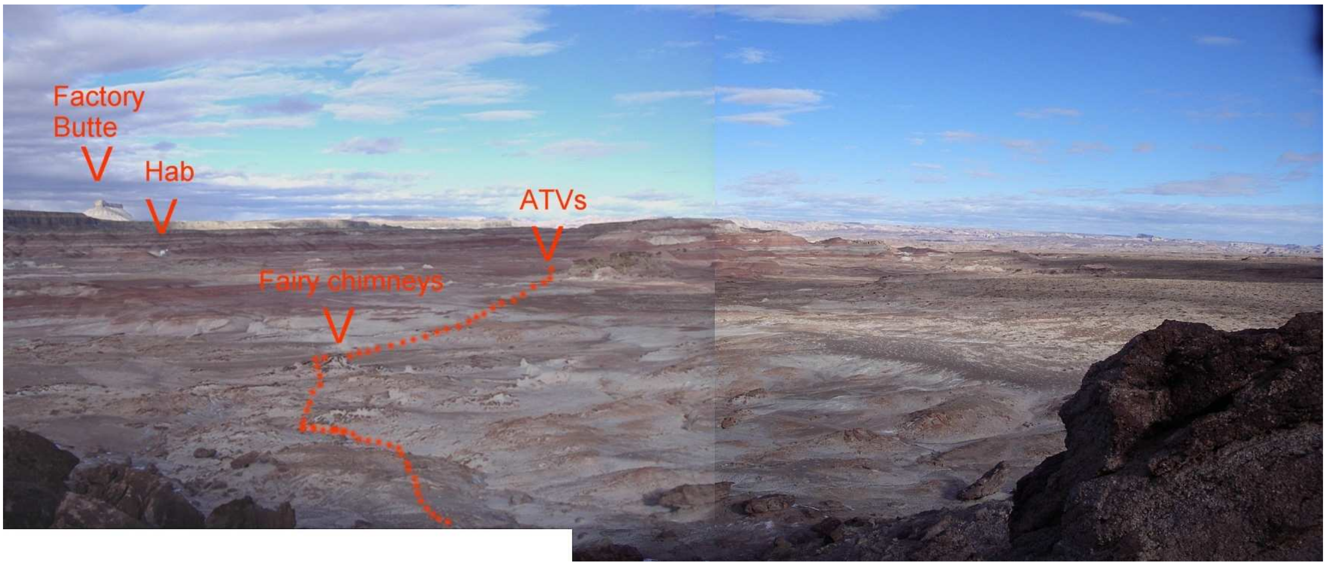
3.4. EVAs localisation

by Alain Souchier

General map of the EVAs conducted in the Hab area (Hab vicinity, Cactus road, Phobos Peak, Candor Chasma, Bob Rocks garden, White Rock canyon)



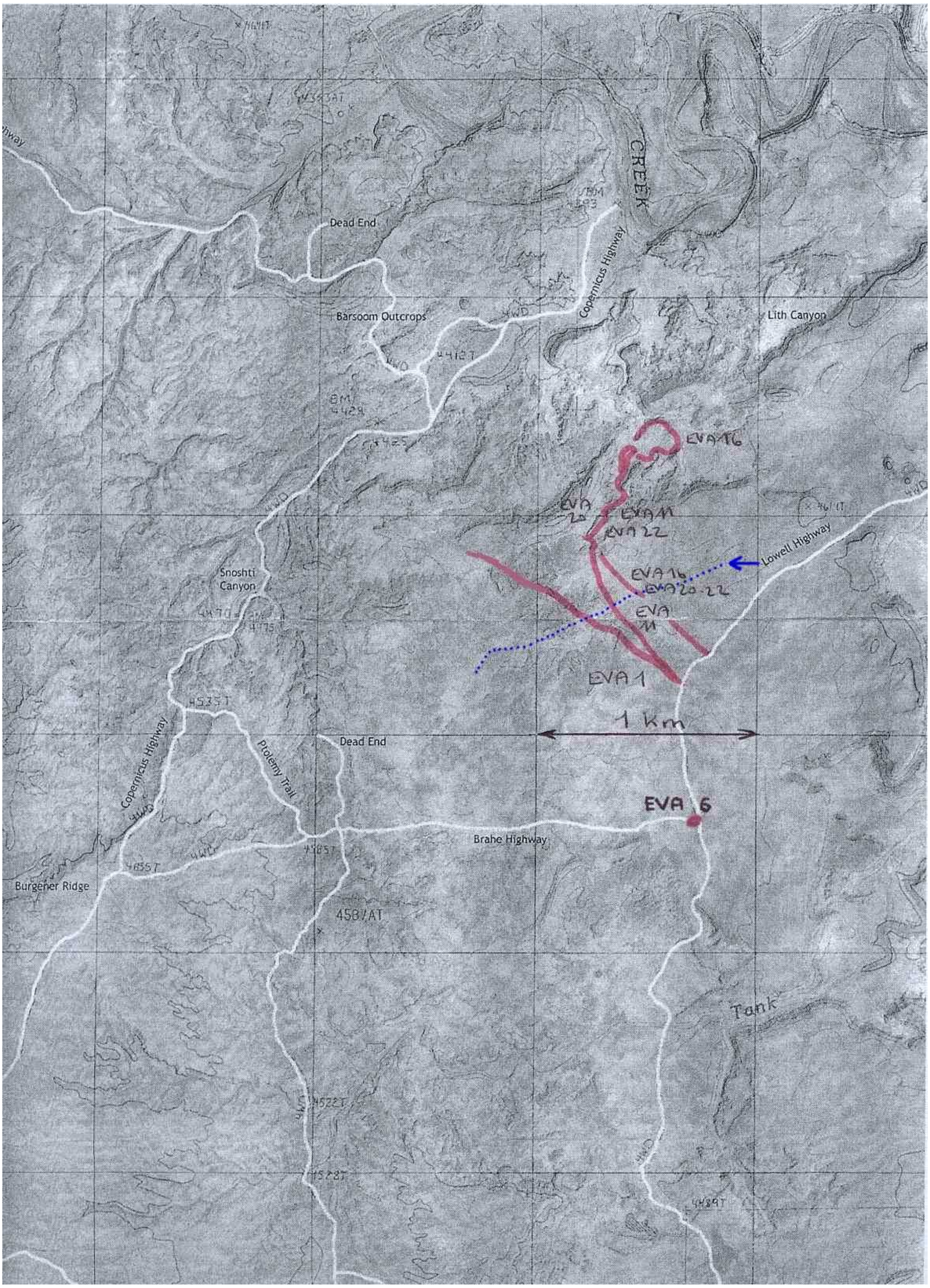
EVA 5 from Lowell Highway to Phobos Peak



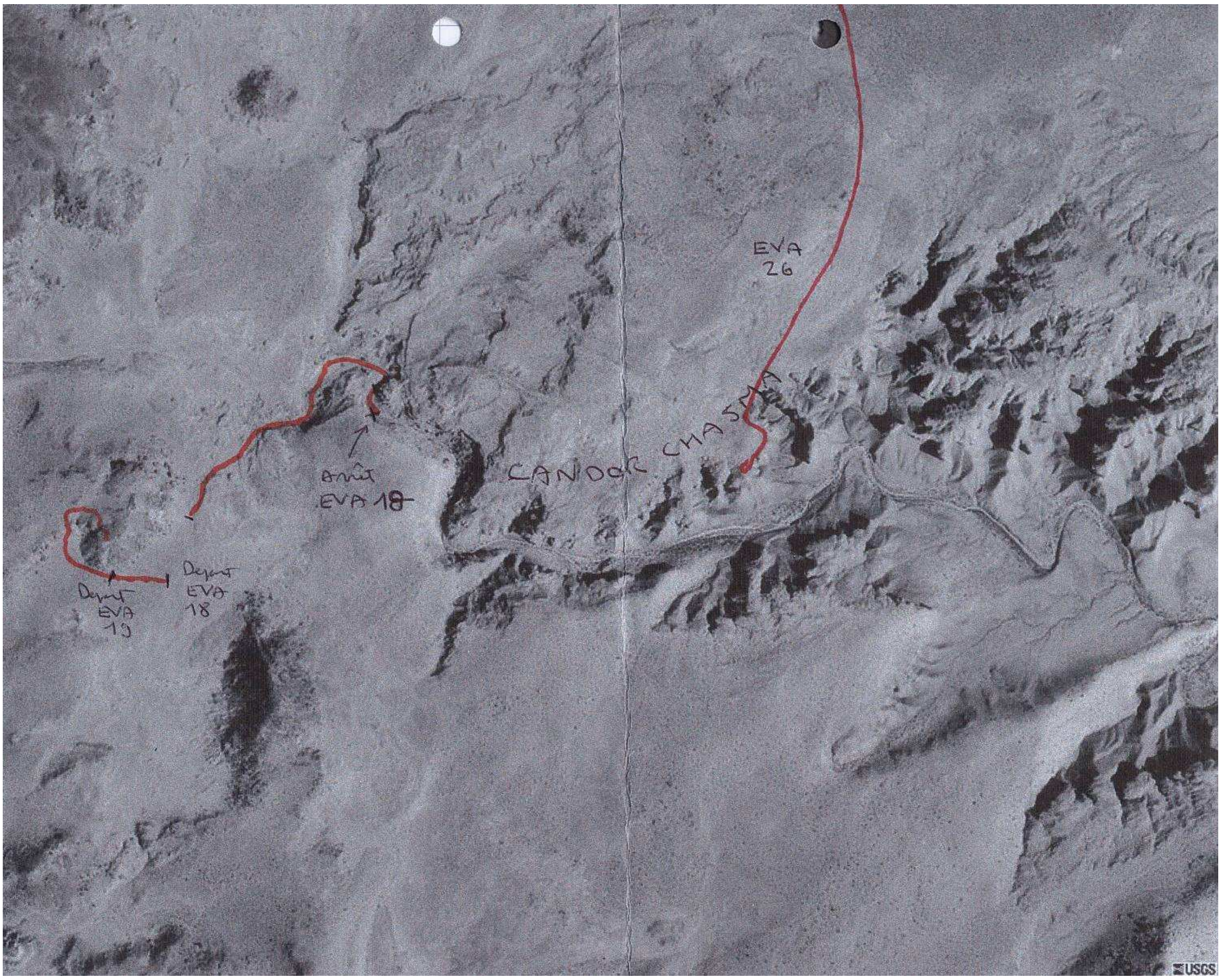
To shorten the EVA, the ATVs were used from the Hab to a location on Lowell highway as close as possible from Phobos Peak. The 3 ATVs are visible from Phobos Peak on the photo on the right.

General map of the EVAs conducted in the Lith Canyon area (north of the Hab)

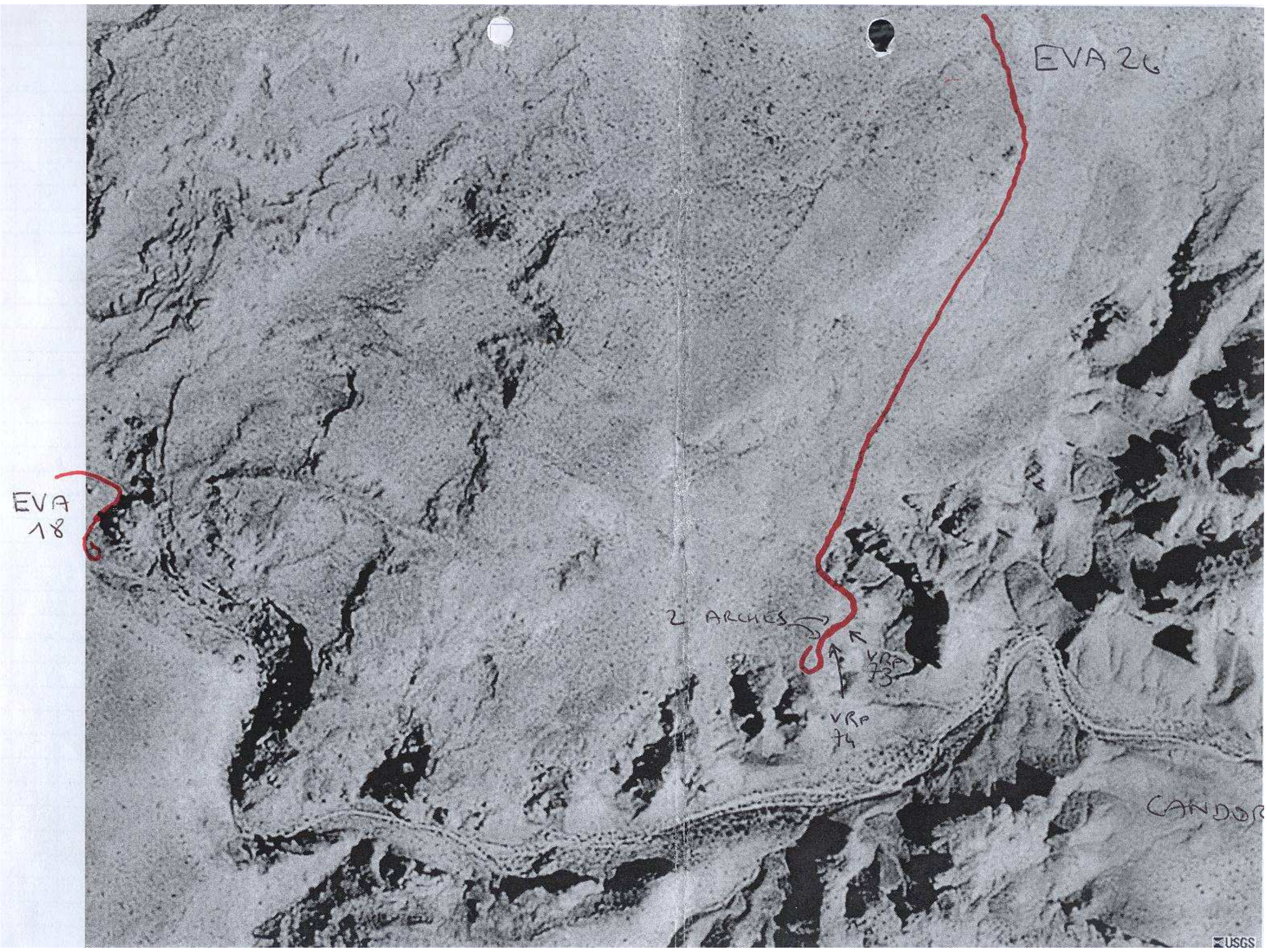
Analysis of aerial photographs shows that the Lowell Highway drawing on this map is wrong: The curve close to Lith Canyon is 400 m more north west. This is confirmed by the walk duration to reach Lith Canyon which was rather short. The actual Lowell Highway position is indicated in dotted blue. The EVA tracks are represented from the wrong road position and have not been corrected.



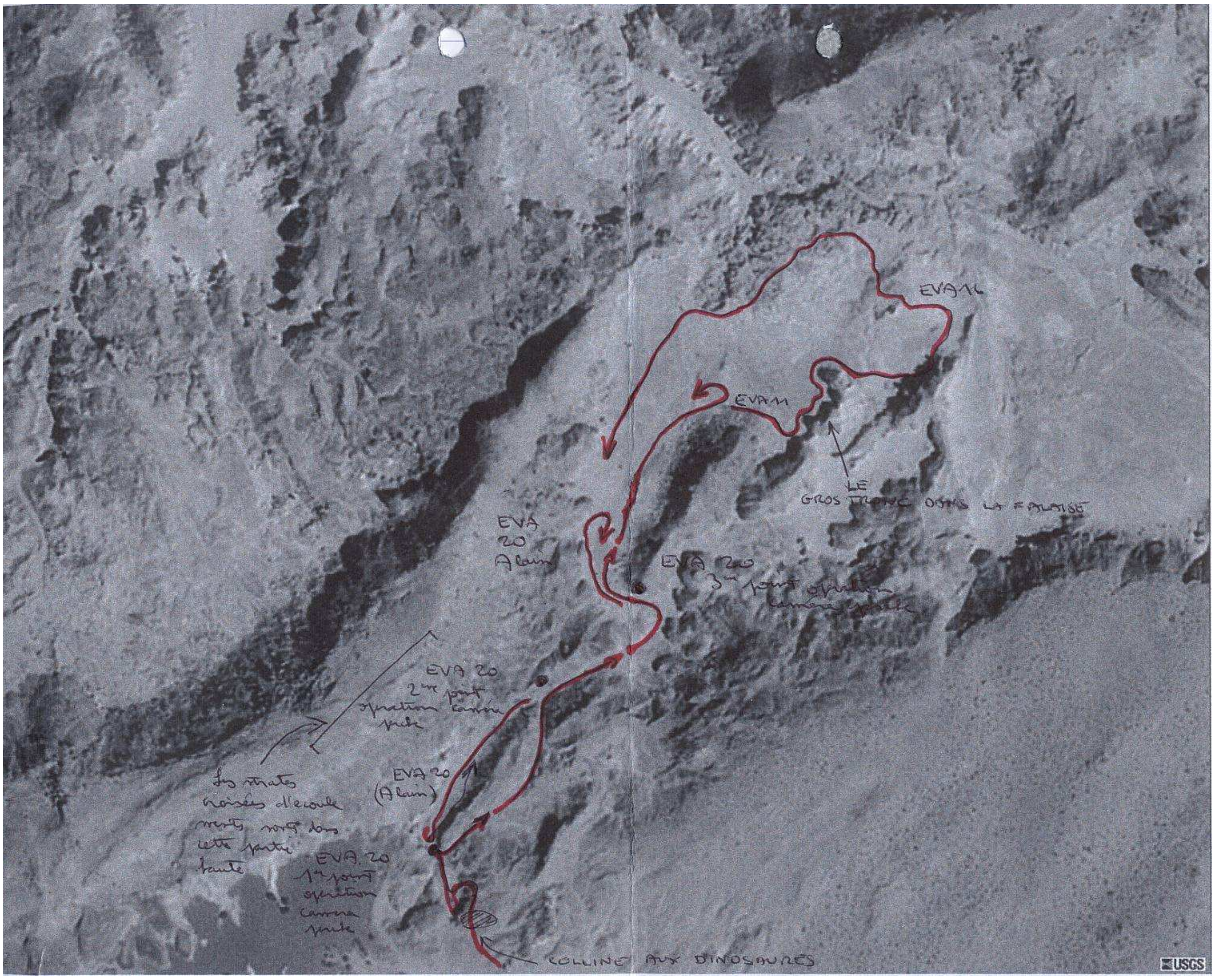
Detailed map of the EVAs in the Stacy's Cake and Candor Chasma area



Detailed map of the EVAs in the Candor Chasma area



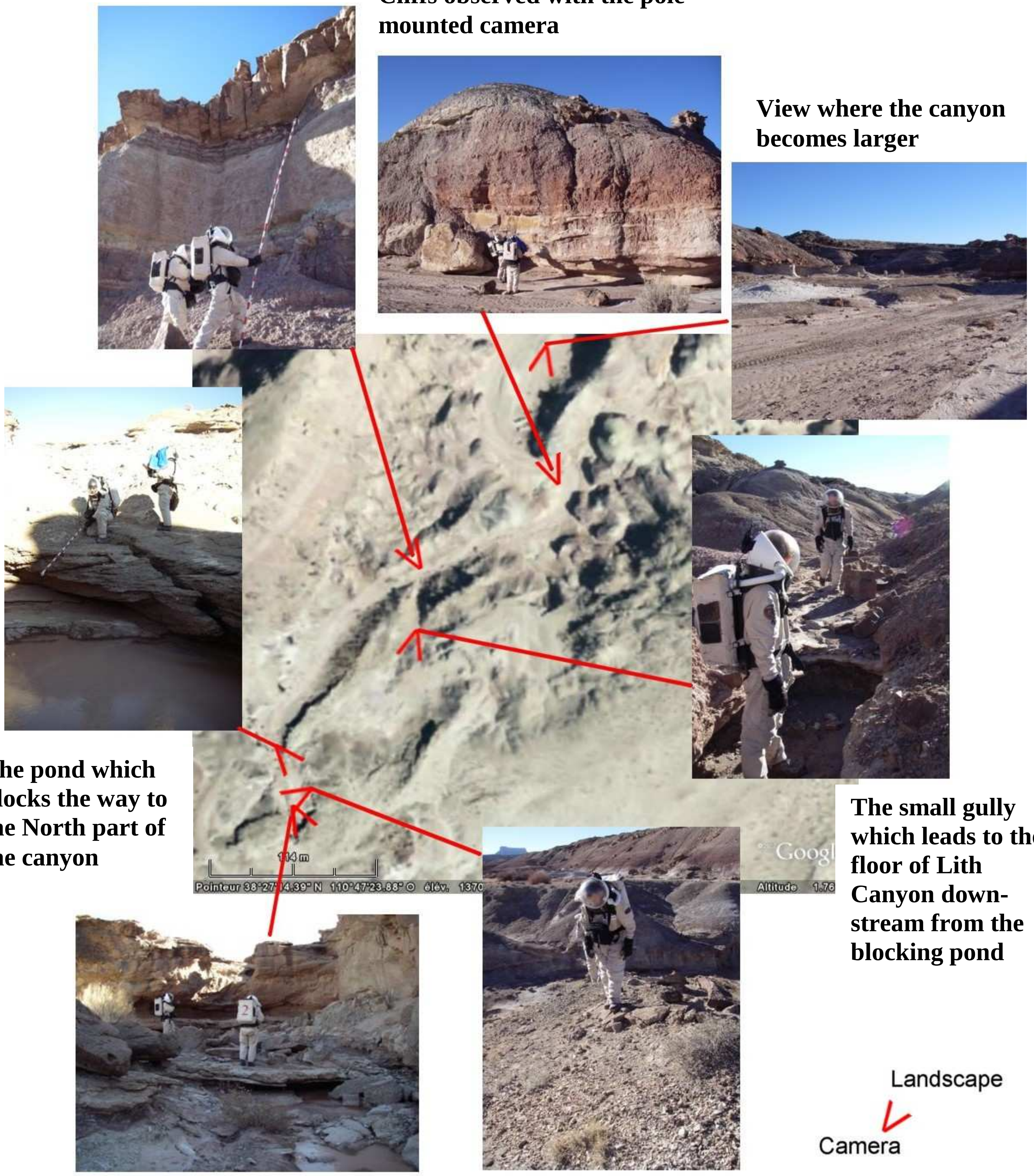
Detailed map of the EVAs in Lith Canyon



Localization of some specific areas in Lith Canyon South part

Cliffs observed with the pole mounted camera

View where the canyon becomes larger



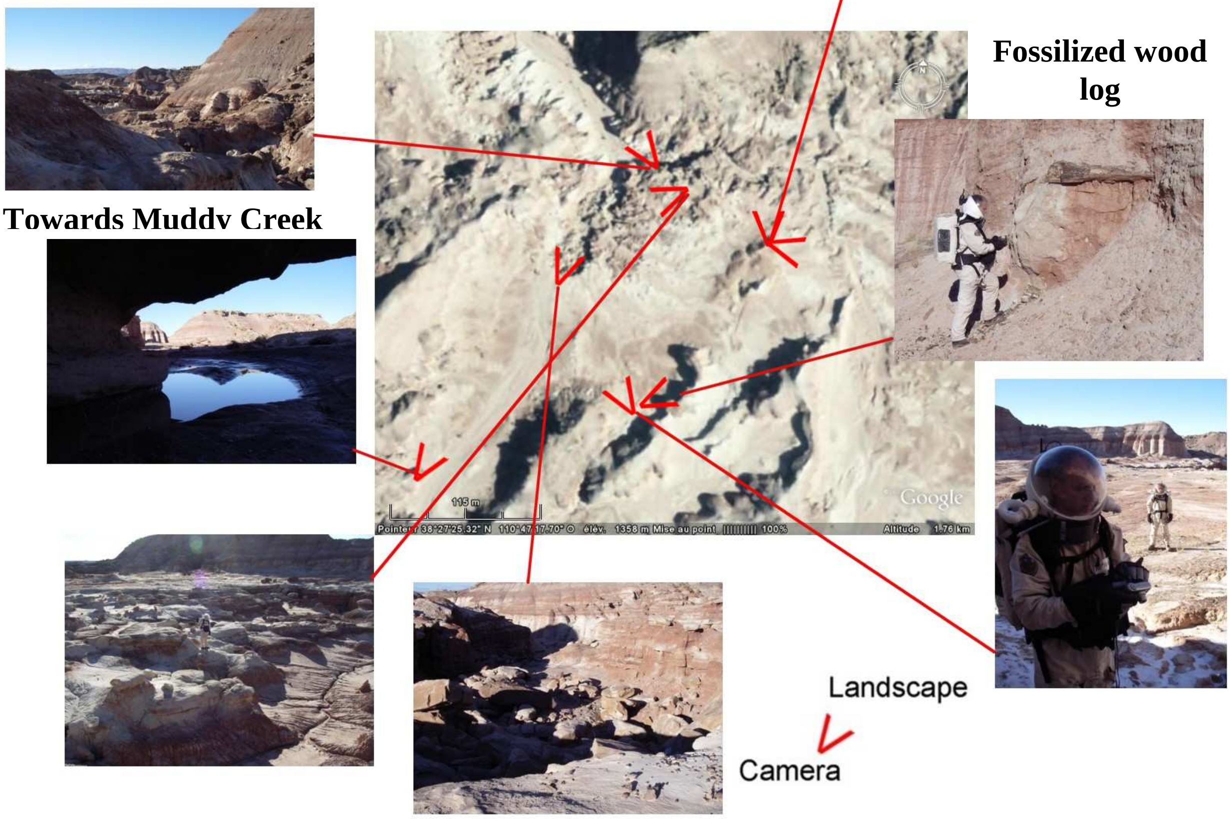
The pond which blocks the way to the North part of the canyon

The small gully which leads to the floor of Lith Canyon down-stream from the blocking pond

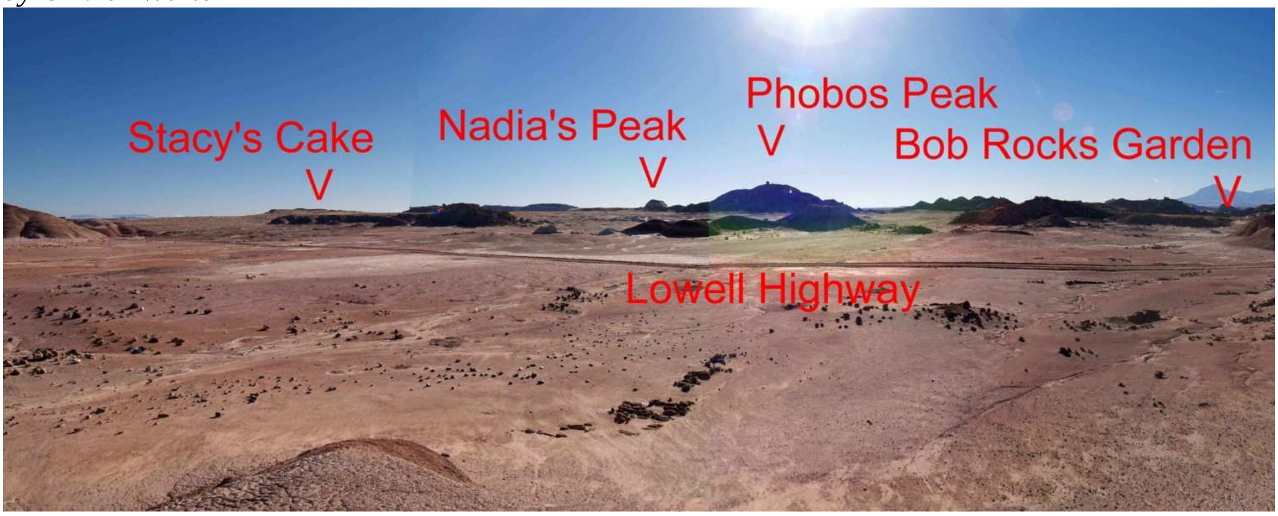
The canyon upper part (South) which presents fossilized logs in the cliff and fossilized roots in the wash

The slope leading to the canyon upper part floor scattered with bits of fossilized wood

Panorama towards Northwest



360 degrees panorama from a location between the Hab and Lowell Highway
by Olivier Walter



Candor Chasma is located behind Stacy’s Cake

3.5. Analysis of the difficulties to find our objective during some EVAs

by Alain Souchier

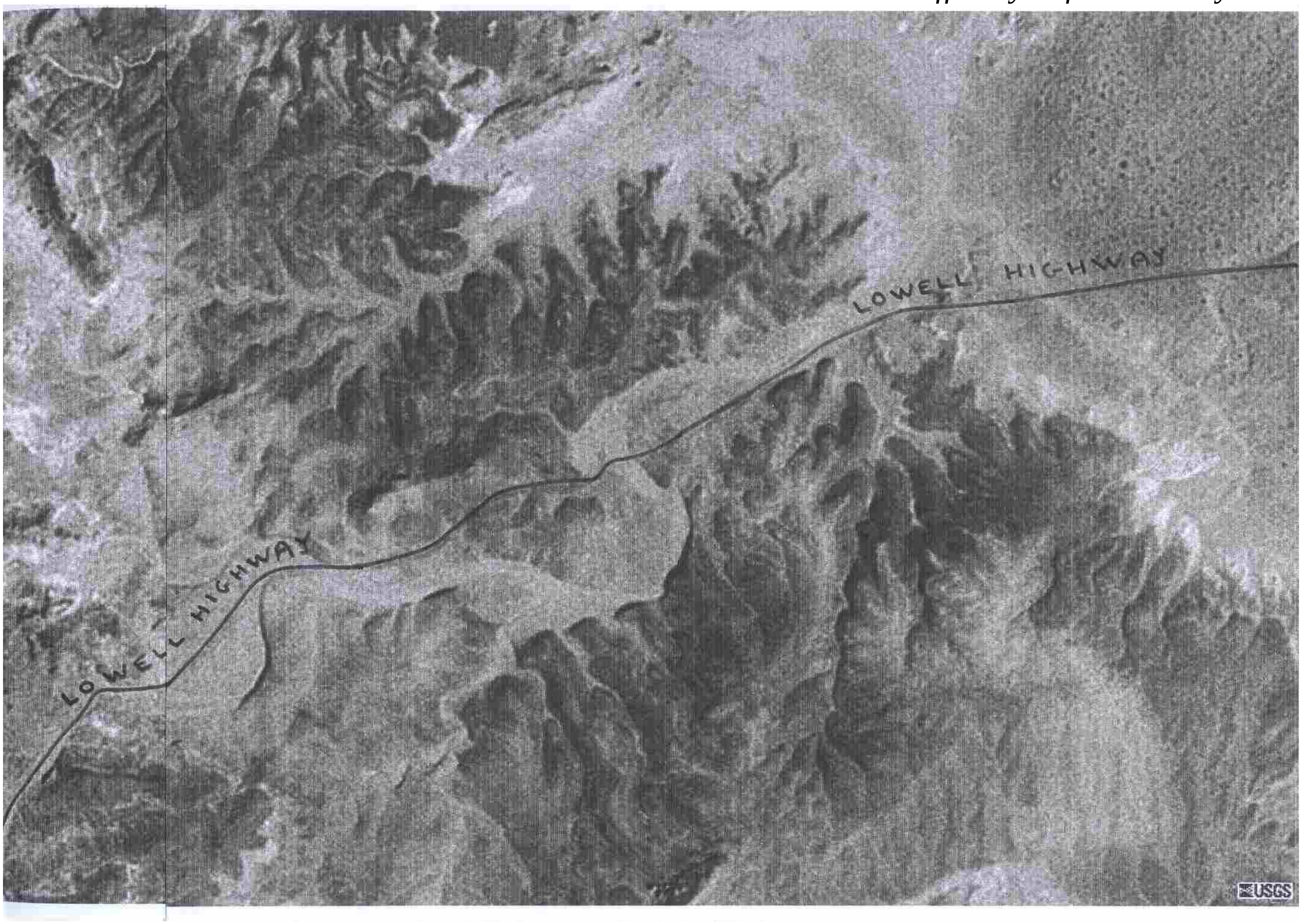
EVA 1 where we missed Lith Canyon

During EVA 1 we wanted to reach the beginning of Lith Canyon to have more than one crewmember (the commander) knowing the path to that canyon in order to be able to lead the media crew to this interesting and scenic area later on. The knowledge we had from the area was far better than before mission MDRS 7 thanks to the numerous aerial photographs which were gathered before the mission. The Y double valley configuration indicating the beginning of Lith Canyon was well located before the mission and the EVA, but its GPS coordinates were not known. In the commander memory the way to reach this Y valley was straightforward, the departing point from Lowell Highway was around the general curve where Lowell Highway changes from a north orientation to a north east orientation. In 2002 some ATV tracks in a shallow wash were also showing the way. By driving a little farther than the curve we identified fairly well the curve location, went back to this location and left the ATVs walking in a north west direction using the sun as a reference orientation in this landscape of shallow hills. One orientation was also given by the cliff which is bordering Lith canyon on its north west side. During EVA 1 a thin layer of snow covered the ground which contributed somehow to some disorientation compared to 3 years old memories. We had only 40 mn available for this EVA when we left the ATVs, in order to be back at the Hab at the 1 pm time announced for the EVA end. So after 20 mn we headed back to the ATVs without finding Lith Canyon. I took a photo of the hills north to be able to compare to old 2002 photos in order to identify our position compared to Lith Canyon. The following day I conducted an analysis of EVA 1 comparing photos, evaluating the distance we walked, re-examining the aerial photographs and coming to the conclusion that we headed north west during EVA 1 whereas we should have gone north. We were probably 250 m west south west of the canyon entrance. By the way the canyon orientation is such that you can miss it going too much "left" and necessarily find it if you go too much "right". So during EVA 11 we started from the same point along Lowell Highway and had no difficulties finding the Y valley where the canyon starts. The whole process was interesting because not far from actual situations in planetary explorations were only a satellite photo would be available to reach a target. With no magnetic field on the moon or Mars, with no GPS satellite network, the photo may be the primary way of finding its way. Other solutions would be to implement guidance beacons on surrounding hills or using a small inertial measurement unit.

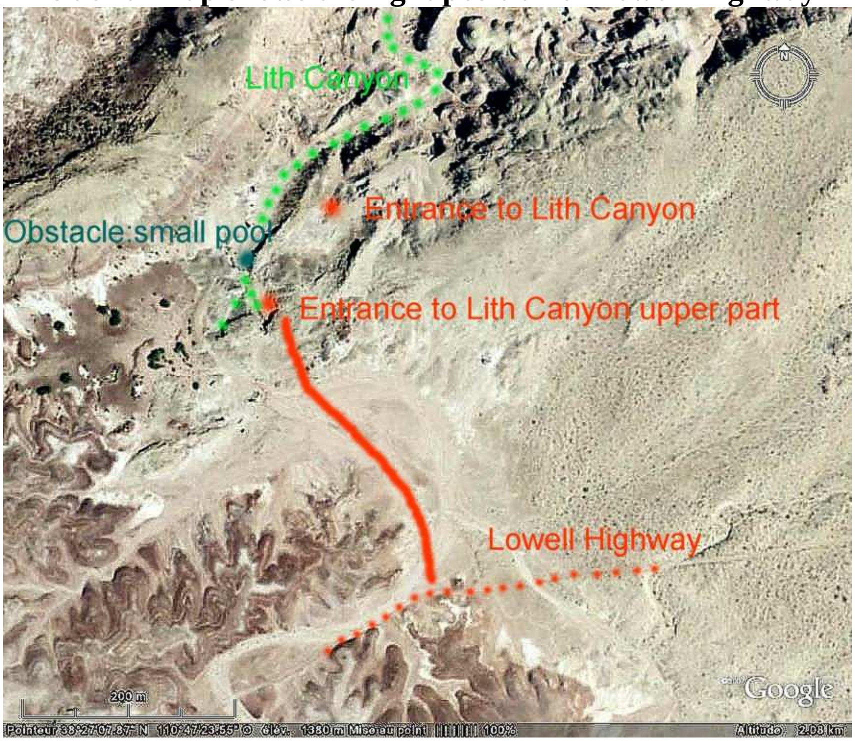
Searching unsuccessfully for Lith Canyon in a snow covered landscape (EVA 1)

Lowell Highway close to Lith Canyon

The aerial photographs show most of the time Lowell Highway. The map we used seems wrong in the area of Lith Canyon. The map indicates 800 m between the road and Lith Canyon whereas the distance is somehow less than 400 m. This has also contributed in the difficulty to find the canyon.

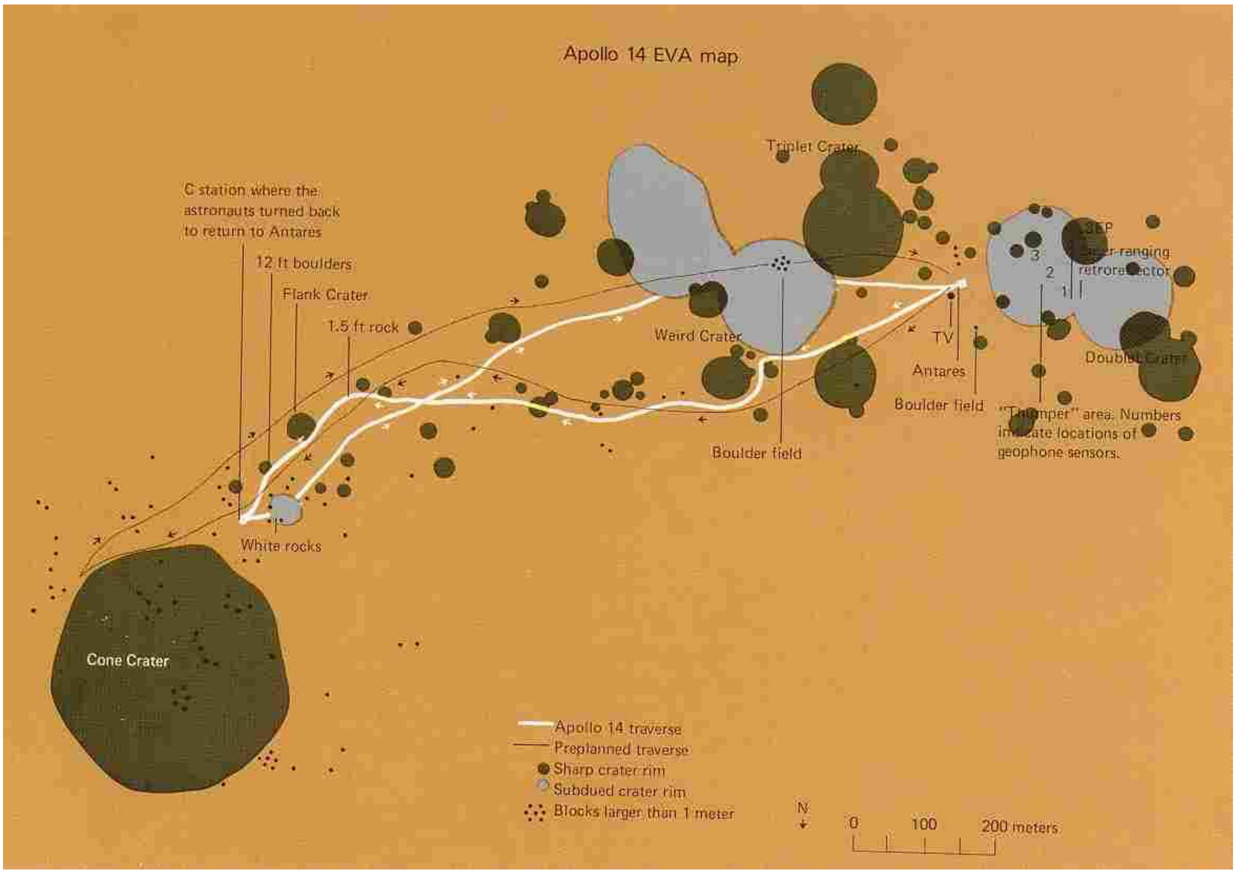


This aerial map shows the right position of Lowell Highway in Lith Canyon vicinity.

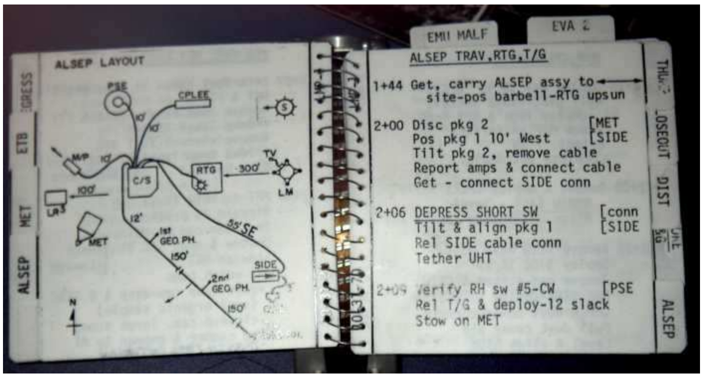


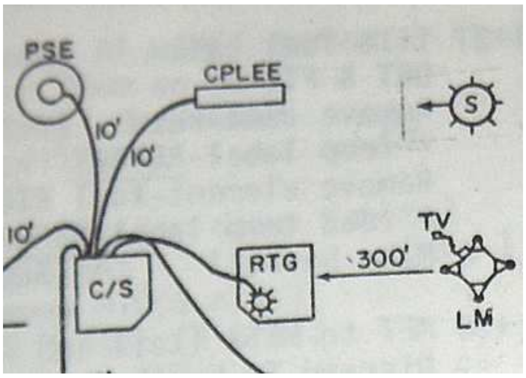
The right way from Lowell Highway to Lith canyon . When entering the upper part of Lith canyon, the trip down is blocked by a 1m rocky step and a small pond. The pond was small enough in 2002 to cross on one side; it was an obstacle in 2006 and the entrance to the canyon main part was through an adjacent gully not far to the north as shown there.

The Apollo astronauts on the moon used maps to find their way and reach interesting points which were determined before their flight with scientists. They relied on these maps and a thorough preparation on the ground (which meant they had “stored” the map in their minds) to conduct the EVAs. It happened sometimes that they also had difficulties in finding their objectives. Alan Shepard who led the mission Apollo 14 and conducted two EVAs on the moon with Edgar Mitchell tells as follows the story of their attempt to reach the rim of Cone crater: “Another problem was that the ruggedness and unevenness of the terrain made it very hard to navigate by landmarks, which is the way a man on foot gets around. Ed and I had difficulties in agreeing on the way to Cone, just how far we had travelled, and where we were. We did some more sampling, and then moved on toward Cone, into terrain that had almost continuous undulations, and very small flat areas…And then came what had to be one of the most frustrating experiences on the traverse. We thought we were nearing the rim of Cone, only to find we were at another and much smaller crater still some distance from Cone. At that point, I radioed Houston that our positions were doubtful, and that there was probably quite a way to go yet to reach Cone… Later estimates indicated we were perhaps only 30 feet or so below the rim of the crater, and yet we were just not able to define it in that undulating and rough country.”

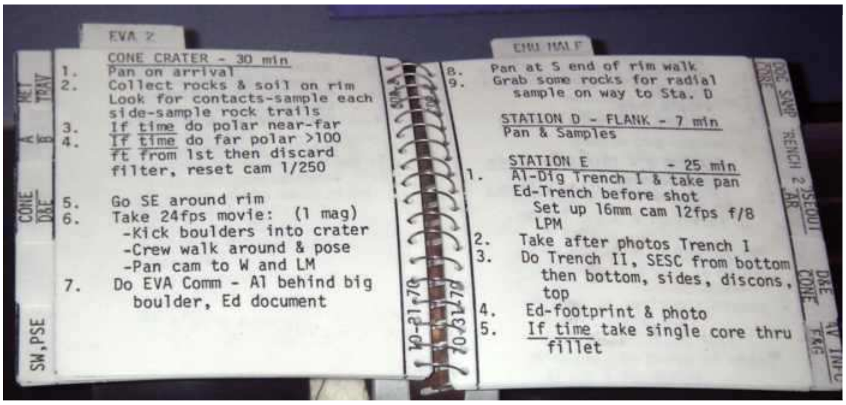


Exemple of Apollo 14 EVA prepared track (black) and actual followed track (white).





These photos of the actual notebook used on the Moon by Apollo 14 astronauts show that sketches indicating the sun orientation are an easy way of providing orientation. During Lith Canyon search in EVA 1, we used the sun orientation to walk in a straight line.



As shown in this note book, each actions in an Apollo EVA were carefully scheduled before flight on the ground. Will the martian EVAs be prepared in such a detailed way by ground teams? During our Utah EVAs we surely had not this level of preparation.

On later missions were the astronauts had the lunar rover, they had an indication of the Lunar Module direction and its distance to help them in their localisation. Without magnetic field on the Moon and without GPS (as on Mars) these indications were provided from gyros and measured distance.

The lunar rover displays indicated the orientation and distance to find the Lunar Module

The three photos (above and left) show the approach to Lith Canyon from the south west (heading north east from Lowell highway) during EVA 11. The cliff behind is a good guide mark. On the left photo we are at Lith Canyon entrance.

From this white rock on the side of Lowell highway the trip to Lith Canyon is shorter and practically heading north (side opposite to the photo orientation).

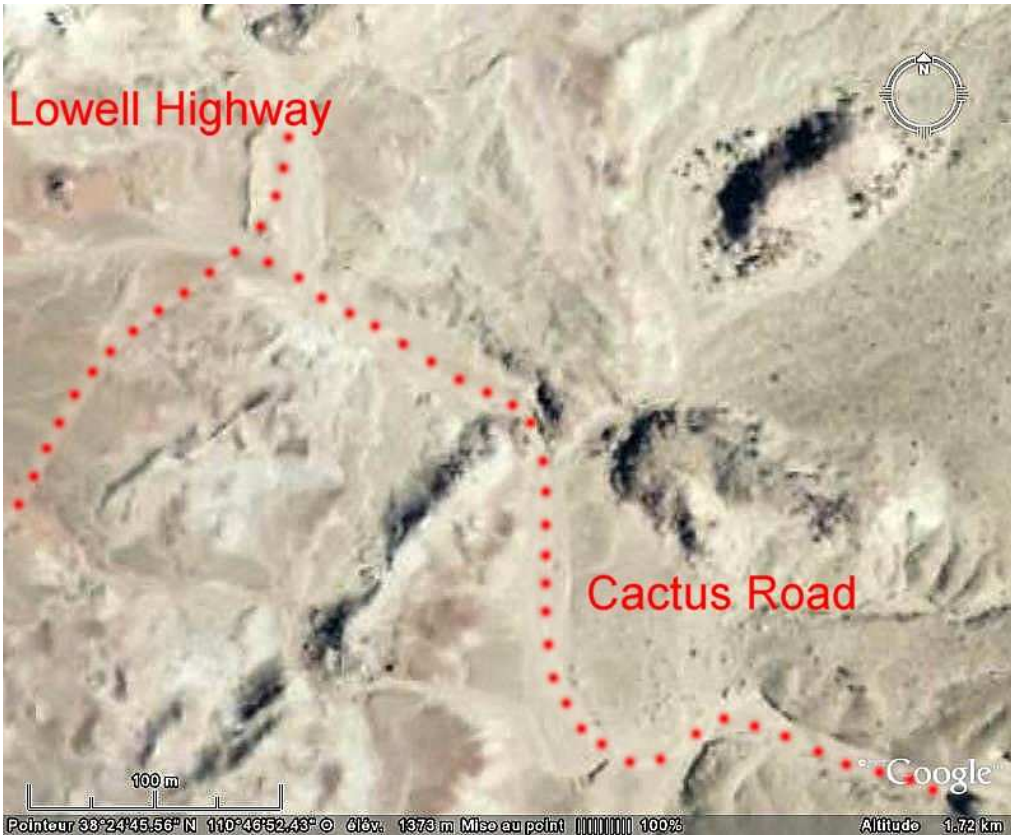
This stone on a white pillar is a good guide mark towards Lith Canyon from Lowell Highway (EVA 16).

EVA 18 where we spent a long time searching for Cactus Road

During EVA 18 we took a road north of Cactus Road (indicated 4WD on the maps) when we wanted to take Cactus Road. This mistake came from 2 causes. First during the mission preparation the aerial photos were studied by the commander in order to have a better knowledge of the area. The “4 Wheels Drive” was clearly visible including in its junction with Lowell Highway. This road was thought the best way to go to the north rim of Candor Chasma as well as, by bifurcating south towards Stacy’s Cake. This part from Stacy’s Cake to Candor Chasma was used during mission MDRS 7 but not the junction to Lowell Highway. During MDRS 7 we were going to Stacy’s Cake using a track leaving Lowell Highway south of Bob Rocks garden. On the available map Cactus Road was well indicated as more south than the 4WD road (but this 4WD road merged east in Cactus road). When we went north on Lowell Highway searching for the east way we drove past Cactus Road without noticing or more precisely we saw a wash going east without thinking it could be the way. Only Richard made a remark about the fact it could be the track. Then we found the 4WD and followed it eastward. The road climbed slowly during one kilometer. At the top of the road we turned right only to find that Stacy's Cake was still far towards south, then went back to the 4WD road and started descending the slope which leads to the Candor Chasma area. This road should have led to Cactus Road but unfortunately the 4WD tracks disappeared in the way down. As I was sure that Cactus Road was someway in front not to far I did a short walk trying to spot the road. As nothing was visible we headed back to Lowell Higway, found some light ATV tracks entering the wash (which is the main wash feeding Candor Chasma) and followed cautiously those tracks. The ground was rather soft in some areas from the rain we had some days before but definitively this was the road!

EVA 27 : going towards Stacy's Cake on Cactus road in the wash, not far from the entrance from Lowell Highway.

EVA 18 : Cactus road in the wash



Lowell Highway on the left upper corner and the beginning of Cactus Road.

The first part of Cactus Road in the wash and the 4WD road which leads to nowhere some 500 m north.

Then around Stacy's Cake we had some difficulties finding the way south. We passed in front of the junction without noticing. Fortunately I knew for sure that the road existed on the east side of Stacy's Cake otherwise we would have probably stopped searching there. We did some driving around and finally found the road. We followed the road north on 100 m to find where the junction was: a short steep climb on the side of the wash. We were finally at Stacy's Cake but too late for a CRV test.

The small steep climb which leads from Cactus road in the wash to Stacy's cake area. On the left as seen from the wash (not so easy to find when there is no ATV tracks like here, after we drove several times in this path).

In these photos the steep slope is seen from above towards Cactus road in the wash. These pictures were taken the last Saturday when we went out of sim and Olivier and Pierre conducted a trip to Candor Chasma

The area where the Cactus road wash becomes larger north of Stacy's Cake (EVA 27)

The junction from Cactus Road to the track east of Stacy's Cake: a steep climb on the right side of the wash. Cactus road to the north is not so easy to find either. On the right the beginning of Candor Chasma.

We used the remaining time to climb to Stacy's Cake top and to explore the beginning of Candor Chasma which starts at the foot of Stacy's Cake. The entrance to Candor Chasma has been identified on the aerial photographs but it was not known if this entrance could be walked through or not (steep slopes, waterfalls,…). It appeared that the walking trip down is feasible even if we did not go far. From the aerial photos no more obstacles seem to exist between the spot we reached and the downside of the canyon. But in the upper part we crossed an area which does not seem driveable with the ATVs.

The entrance to Candor Chasma not far from Stacy's Cake

During EVA 26 to Candor Chasma north rim we followed Cactus Road north. With only slight ATV tracks in the wash during 200 m, the road is not so easy to define and then becomes well marked.

3.6. Comments on operations and feelings in EVAs

by Alain Souchier

After my first rotation at MDRS in 2002, I described the feelings in EVA with the following words:

"*During all these EVAs, we learned how to conduct operations in spacesuits. Those spacesuits are accurately simulating some difficulties which are encountered by astronauts (weight, limited field of view, outside autonomy limited to a few hours, communications problems, manual dexterity limited by the gloves) but some other difficulties are not simulated (stiffness, thus muscles fatigue linked to internal pressure, doning and operations complexity, inertia).*

The spacesuits are said to weigh between 15 and 20 kg but no measurement was conducted on the spot. My total mass with a spacesuit may have been around 90 kg which on Mars would have implied a 170 kg suit. Naturally such a suit inertia was not present.

The spacesuit gives an impression of being at the same time in and out the world. A part of the isolation sensation comes from the eyes with the scratches or spots on the helmet face plate which increase the feeling of being in a bubble. The other part come from the ear because external noises are damped and internal noises are increased.

We quickly had problems with the radio links. The radios are rather difficult to operate . As we are not in a permanent communication mode, we have to push the « emit » switch to talk and it is not possible to reliably push the switch with the absence of feeling feed back linked to the glove thickness and the radio is suspended to a tether not far under the helmet out of sight. Furthermore, to push on the emit switch, we have to take the radio between the forefinger and the thumb, and in this configuration the forefinger has large chances to push another switch which modifies the operating conditions (channel modification,…). To avoid mistakes it is wishable to unstrap the radio and have a visual control on the operated switch. Unstraping the radio ends in pulling on the ear plug and sooner or later even with the tape holding the ear plug to the ear, the ear plug falls in the helmet. When we were in the lower area at the same level than the hab, the communications were interrupted as soon as the distance reached 300 m because of the various hills and obstacles, and in spite of a radio repeater up the hab ridge. Finally the number of operational radio sets decreased rapidly to two and we stopped using them around EVA 5. Robert Zubrin did tell us that sounds can propagate in the thin 7 *mb Martian atmosphere so we finally had no worries in front of the simulation rules to communicate at loud voice at less than 1 m from each other or by signs when we were farther. Personally I borrowed many signs to the scuba diving signs language."*

During MDRS 43 I had less the impression of isolation from the outside world during EVAs. May be first, the memory of past MDRS 7 experience was still present and being in a spacesuit seemed less new and strange than the first time. Also the new radio system without earplug to ear the communications and an easy "push to talk" button in front of the helmet made it easier to use 100% of the time the radio communication means. Hearing your crew EVA fellow members chatting between themselves or talking to you is also a way of opening the psychological volume of the spacesuit. On Mars it would be interesting to check if an outside microphone transmitting with some amplification the outside noises inside the helmet would be useful at the same time to increase the awareness of what is happening outside and to increase the feeling of being free outside and not in a spacesuit. In this same field, the start of the helmet ventilation has always this spectacular effect of enlarging the perceived close volume of the helmet, shifting the feeling from "trapped" to "outside" situation.
The elastic bands pulling the helmet towards the back pack are also a plus compared to MDRS 7 configuration, by avoiding the helmet pressure on the back of the head. For the gloves operations the topic is developed in a dedicated chapter afterwards as it was a planned MDRS 43 experiment. More than during MDRS 7, I felt the inconvenience of the various scratches on the helmets. May be they were a little more scratched than in 2002.
Contrary to MDRS 7 rotation we did not use the gaiters during our EVAs this time, mainly to shorten the doning time. Also when the weather was hot some of us did not use the caps inside the helmets which brings some risks of little bruises on the head. In case the caps were used and when they were sliding on one side or an other, pushing the helmet on the cap and moving the head was a easy solution to reposition the cap in the right position as already experimented during MDRS 7. Also the drink tube inside the helmet could be used to push on the glasses in order to reposition them on the nose. Some of us used sun glasses. Personally I did not. The drinking bags were not used at all during MDRS 43 whereas we always had them during MDRS 7 EVAs. But our EVAs were short and the need did not arise.

Simulated spacesuits configuration and operations

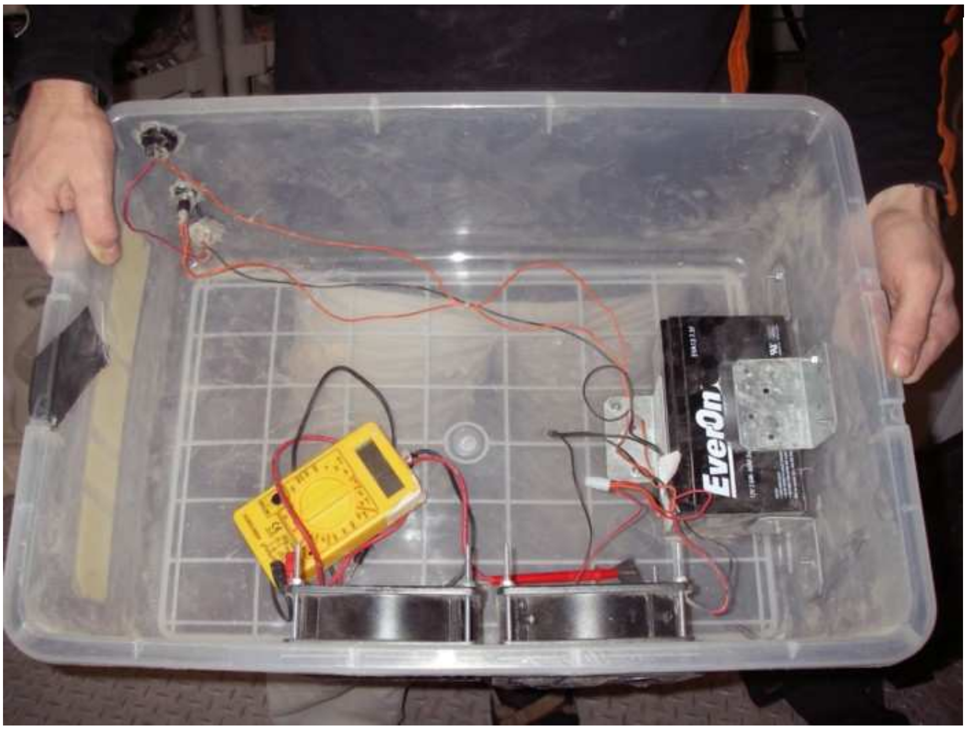
The main components of the Mars Society simulated spacesuit, outside the suit itself, the boots and gloves, are the back pack, the helmet and the radio located on the back side of the helmet. The back pack contains a battery and two fans. The fan inlets are located on the pack right side. The fans feed fresh air to the helmet through two pipes on the left and right. In the upper part of the suit is fixed a collar which fits to a similar collar in the helmet lower part. The two collars are linked together by a spur behind and two clamps in front.

Right side view of a pack showing the straps linking the pack box to the dorsal harness with the waist band on the left and the junction collar to the helmet in a 45° position on the right.

The pack collar which is fixed to the helmet by two clamps. On the ground the pack waist band is visible.

The pack plastic box upper side under the covering cloth. The large Velcro band is used to fix the drinking water plastic bags when needed.

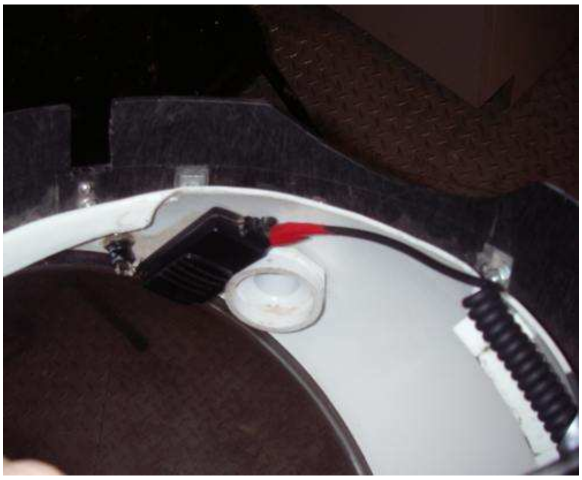
The battery loading connector and fuse location in red.



Inside view of a pack box taken when we had to check the malfunctioning of one of the packs. On the right (which is the lower part when the pack is worn by the crewmember) the battery. In the lower part the two fans. In the upper left corner the battery charge interface and the fuse. The pipes feeding air to the helmet interfaces are located on the cover and not visible here.

Helmet lateral view. The "push to talk" button is in the lower left, left of one of the air inlet interfaces.

Helmet front view. The "push to talk" is on the lower right (it is red on this helmet). The two clamps interfaces are visible in the lower collar. Right and left the air inlets are equipped with laterally oriented injectors. The black horizontal band in the upper part is the fixation of the radio bag. The wire connecting the radio to the microphone and the "push to talk" button is visible on the right.



A view from under showing the microphone inside the helmet.

Photo taken during EVA 17 showing the microphone, the red "push to talk" button and the laterally oriented air injection. Some droplets of water are condensed in the lower helmet visor which has no consequences on the visibility.

The radio location behind the helmet.

The helmet and pack racks in the spacesuits room. The pack are stored in this location also while loading the batteries.

Richard had no radio during the Goblin Valley EVA and the procedure of communicating with direct helmet to helmet contact was experimented.

3.7. EVAs daily reports

by Alain Souchier

In the following pages are presented the daily raw EVAs reports which were sent to mission support and were posted on the Mars Society website

Log Book for January 30, 2006
EVA Reports
Alain Souchier Reporting

EVA-1 Report:

EVA Duration: *135 min starting at 11 am*
EVA Crew: *Anne Pacros, Richard Heidmann, Alain Souchier*

EVA Goals: *Reconnaissance to Lith Canyon to prepare media visit an other day. Time permitting reconnaissance towards Tank Wash and the Hab ridge (just the beginning of the roads). First test of the gloves dexterity improvement devices. “Blueberries” search.*

EVA Description: *Trip with the ATVs along Lowell Highway to the turn in the track in the vicinity of Lith Canyon. The search for the canyon based on visual clues (Alain was there before in 2002) remained unsuccessful and was cut short because we wanted to return to the Hab at 1 pm as indicated before the EVA. The snow was still covering the area at 80%. Lowell Highway was rather muddy and the ATV and the lower parts of the spacesuits took some mud. We were in the Hab vicinity at 12.55 pm and started searching for blueberries in the astronomical observatory area. Spherules were found but are not blueberries.*

Samples: *Spherules on the way to the observatory*

Lessons Learned: *Difficulties to find a site on map indications without an operating GPS (we had difficulties in satellites acquisition on the GPS) , even if you have been there before.*

EVA-2 Report:

EVA Duration: *40 min starting at 3 pm*
EVA Crew: *Pierre Brulhet & Jérémie Geoffray*

EVA Goals: *First EVA for Pierre and Jérémie. First EVA filmed by the media crew.*

EVA Description: *Climbing of the ridge behind the Hab towards the repeater where the media crew was located (low slopes but difficulties in muddy zones in general located in the shadowed areas)*

Log Book for January 31, 2006
EVA Reports
Alain Souchier & Anne Pacros Reporting

EVA-3 Report:

EVA Duration: *120 min starting at 10.55 am for team one (Anne, Richard, Pierre) 100 min starting at 11.20 am for team two (Jérémie and Alain) Two teams were necessary owing to the airlock dimensions but after egress the EVA was conducted in a single team.*

EVA Goals: *Test of astronauts observational capacities. Geological samples collection for* *gravimetric test.*

EVA Description: *First experiment was to see how much strange objects could be detected by an astronaut walking in the vicinity. 20 objects (fork, caps, copper bowls...) were disposed on a 150 m long area behind the Hab (airlock two side). 8 objects were detected. Then the EVA leadership shifted from Alain to Anne for geology experiments involving samples collection in surface and 20 cm deep in order to measure later on the water content. Then the EVA continued with general samples collection. A small coral fossil was found.*

Samples: *See above.*

Lessons Learned: *One of the helmet was not equipped with radio which proved difficult for one crewmember.*

EVA-4 Report:

EVA Duration: *90 min starting at 3:25 pm*

EVA Crew: *Pierre Brulhet, Richard Heidmann and Anne Pacros*

EVA Goals: *Long distance EVA to Goblin Valley, with film crew.*

EVA Description: *Exploration of the Valley of the Goblins.*

Log Book for February 1, 2006
EVA Reports
Pierre Brulhet & Anne Pacros Reporting

EVA-5 Report:

EVA Duration: *140 min starting at 7.45 am (Jeremie, Richard and Alain)*

EVA Goals: *Excursion to Phobos Peak with the TV team; interviews and search for blueberries detected during the out of sim trip last Monday.*

EVA Description: *We left the Hab with the ATV and stopped not too far on Lowell High to shorten the EVA walking distance. On the side of Lowell Highway, in a red landscape scattered with blocks, we were filmed by the TV team. Then we headed to the base of Phobos Peak were we found a blueberry (to be confirmed) among fairy chimneys. We stopped climbing at mid heigth where the Hab is in view.*

EVA-6 Report:

EVA Duration: *180 min starting at 14.10 pm (Anne, Pierre)*

EVA Goals: *Road reconnaissance for ATV*

EVA Description: *We left the Hab and took Lowell Highway until the end of the road. On the return trip, we marked intersections of Lith Canyon and Brahe Highway roads, with stones. We made pictures to document the intersections.*

Samples: *3 fossils (possibly Gryphaea)*

Lessons Learned: *None*

EVA-7 Report:

EVA Duration: *60 min starting at 4 pm (Jeremie, Richard and Alain)*

EVA goals: *Airlock egress and "first steps on Mars" for the crew with historical declaration. The right glove with three dexterity improvement devices was used on EVA 5 and 6*

Log Book for February 2, 2006
EVA Reports
Anne Pacros & Alain Souchier Reporting

EVA-8:

EVA Duration: *45 min in the Hab vicinity. Anne, Jérémie and Pierre*

EVA Goals: *Experimenting what could be done as outside recreation games on Mars: playing soccer, frisbee, volley-ball, juggling, dancing (filmed by the TV crew)*

EVA-9:

EVA Duration: *10 min in the Hab vicinity.*

EVA Goals: *Explanations on Mars modules external and internal architecture*

Log Book for February 3, 2006
EVA Reports
Alain Souchier & Pierre Brulhet Reporting

EVA-10 Report:

EVA Duration: *90 min starting at 14.00 pm (Alain, Pierre, Jeremie, Richard)*

EVA Goals: *CRV operation*

EVA Description: *EVA 10 started at 2. While waiting for the helicopter, we did a rehearsal test of the CRV (objective video validation); a bad contact appeared somewhere in the transmitter box and led to intermittent picture; helicopter arrival during the final preparation.*

20 min trekking and second CRV testing.

Samples: *None*

Lessons Learned: *VRP operation with gloves*

EVA-11 Report:

EVA Duration: *180 min starting at 14.00 pm (Alain, Pierre)*

EVA Goals: *Road reconnaissance for ATV*

EVA Description: *Geological sampling. Location of dinosaurs bone in Lith Canyon found (fossils left in place). EVA 11 started at 2 (with EVA 10). Helicopter arrival above the Hab at 2.30. Very nice shots seen a short time later because the helicopter landed at Hanksville airport and left the TV crew there. Anne and an other TV crewmember took the helicopter back to Brice Canyon to bring the TV car back to Hanksville.*

Samples: *Four petrified wood fossils*

Lessons Learned: *VRP operation with gloves.*

Log Book for February 4, 2006
EVA Reports
Crew 43 Reporting

EVA-12 Report:

EVA Duration: *70 min for Jérémie and Loïc with Arnaud participating Started at 8:55am.*

EVA Goals: *Souvenir photos and film shooting for the TV crew. Test of the heavy professional camera and sound recorder in space suits.*

EVA Description: *Walking EVA in the Hab vicinity under a low morning sun.*

Lessons Learned: *The bulky professional hardware can be activated with the glove equipped with 3 rods. Actual video footage has been taken.*

EVA-13 Report:

EVA Duration: *150 min for Richard and Alain starting at 10.15 am*

EVA Goals: *CRV 3 tests on the same cliff at White Rock Canyon where the CRV 2 experienced retrieval difficulties in 2002 (see mission MDRS 7) and test of the real time hazcam video transmission to monitor the vehicle situation. Filming by the TV team.*

EVA Description: *Two quad EVAs to the entrance of the dirt road (at the fence). Walk transporting the CRV to the near by cliff. On the quad we used the CRV transportation device built by the Leonardo crew in 2005. Return to the Hab when the next team is leaving. The EVA was filmed by the TV crew.*

Lessons Learned: *The CRV 3 did 4 trips down and up the cliff with one temporary blockage which was solved by a slight down motion. No overturn was experienced. The hazcam real time transmission operated properly but the picture was barely usable in the sunny weather conditions even with the one foot long sunshade. Too much light enters through the observer helmet to the monitor. We will have to reuse the old photographers solution (a large black blanket covering the head).*

EVA-14 Report:

EVA Duration: *150 min for Jérémie, Pierre and Olivier*

EVA Goals: *Geology and Mars analogy oriented EVA at the Upheaval Dome meteoritic crater filmed by the TV crew. First test of the helium balloon brought by Olivier. Test of the 4.5 m rod supporting a camera sending pictures to a computer*

EVA Description: *Three hours trip to the crater with the TV team pressurized rover. Climbing to the crater rim from the parking. Helium balloon test with difficulties (slightly deflated during the trip and balloon rope failure). Successful test of the rod supported camera. The team came back to the Hab et 8.30 pm*

Lessons Learned: *The rod supported camera system seems stiff enough to be used on the quads. Helium balloon deflates rather quickly.*

Log Book for February 5, 2006
EVA Reports
Pierre Brulhet, Olivier Walter & Alain Souchier Reporting

EVA-15 Report:

EVA Duration: *120 min starting at 11.00 am (Pierre, Olivier)*

EVA Goals: *Second test of the 4.5 m rod supporting a camera sending pictures to a computer.*

EVA Description: *EVA 15 started at 11.00 am. Pierre and Olivier went until the Hab Ridge top to test the rod supported camera. We took pictures of the terrain around us.*

Samples: *5 stones*

Lessons Learned: *Successful test of a glove equipped with a spur on the forefinger for taking photos and small tools to enhance manual ability.*

EVA-16 Report:

EVA Duration: *150 min starting at 2.30 pm (Richard, Jeremie and Alain)*

EVA Goals: *Geological oriented EVA to Lith Canyon with evaluation of astronaut observational capability. Training two new crew members to find the upper part of the canyon.*

EVA Description: *A little less than 20 min in quad to reach the Canyon proximity followed by a ten min walk. Nice wood fossil logs before the canyon and in the canyon cliffs. Dinosaurs bones fragments. Fossil roots in the wash floor. Intersecting flow patterns layers. And a beautiful landscape in the late afternoon, walking along our long shadows.*

Log Book for February 6, 2006
EVA Reports
Pierre Brulhet, Olivier Walter & Alain Souchier Reporting

EVA-17 Report:

EVA Duration: *130 min starting at 10.20 am (Pierre, Olivier)*

EVA Goals: *Third test of the 4.5 m rod supporting a camera sending pictures to a computer.*

EVA Description: *EVA 17 started at 10.20 am. Pierre and Olivier went until the Bob's Rock Garden top to test the rod supported camera. We took pictures of the terrain around us and 5 meter's high rock. Because the mission was validate quickly, we returned to the spot of yesterday (Hab Ridge) and we recovered a part of the rod supported camera.*

Samples: *1 green stone*

Lessons Learned: *Successful test of sun shading prototype for the laptop. Dexterity test with gloves (small tools).*

EVA-18 Report:

EVA Duration: *180 min starting at 2 pm (Richard, Jeremie and Alain)*

EVA Goals: *CRV test on Stacy's Cake, a difficult cliff where the preceding CRV (configuration n2) was stuck in 2002 (MDRS 7). Test of the hazcam to define the CRV situation when it is out of sight. Reconnaissance of the beginning of Candor Chasma which is not far from Stacy's cake*

EVA Description: *The search for Stacy's Cake was very long because we took the 4WD road which is North of Cactus Road. We crossed a pass and then going down to the other side of the hill the road disappeared. We went back to Lowell Highway and found Cactus road which follows the floor of a wash. We reached Stacy's Cake around 3.35 pm, too late for the CRV testing. We climbed Stacy's Cake where there is a view on the Hab on one side and Candor Chasma on the other side. Olivier and Pierre from the Hab were able to spot us on* *the horizon. Then we went down to check if the beginning of Candor Chasma at the foot of Stacy's Cake can be walked through. No obstacles were found and this seems a path to Candor Chasma floor.*

Lessons Learned: *In most cases, time lost to find a not well identified area (or in this case a known area through a new road) will shorten too much the time devoted to experimentation and will lead to cancellation.*

Log Book for February 7, 2006
EVA Reports
Alain Souchier & Pierre Brulhet, Olivier Walter Reporting

EVA-19 Report:

EVA Duration: *135 min starting at 10.15 am (Richard, Jérémie, Alain)*

EVA Goals: *CRV testing on a slope where the preceding CRV(configuration 2) was stuck in November 2002. Test of the real time video transmission to evaluate the CRV situation in the slope*

EVA Description: *EVA 19 started at 10.15 am. We were very quickly to Stacy's Cake by Cactus Road through the Wash. We climbed the slope with the CRV and installed the safety pole to which the CRV is secured in exactly the same position as in November 2002. The small pile of stones installed in 2002 was still there. Numerous difficulties were encountered with the ropes more than with the vehicle itself. The ropes get entangled in the very irregular rock layers shapes and cracks. The video emission from the CRV was well seen on the monitor screen. The picture shows well the vehicle position and the ropes just above the CRV but is useless to understand the ropes general situation. We had to stop the experimentation and climb down the slope. Jérémie and Alain went out of sim to retrieve the vehicle. We were back to the Hab at the planned time 12.30.*

Lessons Learned: *A solution with one single rope should be tested one day. The present configuration has 4 ropes between vehicle level and 4m above, then 2 ropes on 4 more meters then one rope. This lay out is intended to facilitate recovery from over hanging cliff areas.*

EVA-20 Report:

EVA Duration: *190 min starting at 02.15 pm (Alain, Pierre, Olivier)*

EVA Goals: *Fourth test of the 4.5 m rod supporting a camera sending pictures to a computer.*

EVA Description: *EVA 20 started at 02.15 pm. Alain, Pierre and Olivier went to Lith Canyon to test the rod supported camera. We took pictures of the terrain around us as well as of the rock walls.*

Samples: *Stones, wood fossils.*

Lessons Learned: *None.*

Log Book for February 8, 2006
EVA Reports
Olivier Walter & Pierre Brulhet Reporting

EVA-21 Report:

EVA Duration: *45 min starting at 11.00 am (Olivier, Jérémie)*

EVA Goals: *1st Test of an helium balloon. Testing of the procedure, and of the weight support by two sort of balloon, one small, and one medium.*

EVA Description: *Olivier was conducting the test of the balloon, while Jérémie was filming. The first operation of inflating, and then releasing the small balloon succeed. This small one was only able to lift 20 g. To enhance the lift we decided to take the second balloon. This one was test inside the hab before, and was able to lift 150g (a small camera and a battery). But the experience fail, because the balloon take off while the link was not safe.*

Lessons Learned: *It show us that the balloon is a very interesting tools, but difficult to control with the gloves. Sure link must be ready before inflating.*

EVA-22 Report:

EVA Duration: *165 min starting at 02.20 pm (Pierre, Olivier, Richard)*

EVA Goals: *Fifth test of the 4.5 m rod supporting a camera sending pictures to a computer.*

EVA Description: *EVA 22 started at 02.20 pm. Pierre, Olivier and Richard went to Lith Canyon to test the rod supported camera. We took pictures of a rock wall.*

Samples: *None.*

Lessons Learned: *None.*

Log Book for February 9, 2006
EVA Reports
Pierre Brulhet & Alain Souchier Reporting

EVA-23 Report:

EVA Duration: *75 min starting at 11.15 am (Olivier, Pierre)*

EVA Goals: *Second test of an helium balloon. Testing our home made Mylar balloon with camera.*

EVA Description: *Olivier and Pierre were conducting the test of the Mylar balloon, while*

Alain was filming. Successful operations of the Mylar balloon which ascended at 20 meters (full rope length) but there was too much light for the camera (black and white CRV context camera which was however already equipped with sunglasses).

Lessons Learned: *We need a better camera for shooting colours pictures.*

EVA-24 Report:

EVA Duration: *60 min starting at 3.40 pm (Jérémie, Alain)*

EVA Goals: *CRV test #72. Test of a single rope configuration which would be better in a cliff configuration similar to Stacy's Cake where the transition from 1 to 2 ropes and 2 to 4 ropes get stuck in the rocks when going down. Test of a new position for the context camera. It is localised in a container 1.3 m above the CRV looking down to the CRV. Digital recording of the context picture with Pierre recorder.*

EVA Description: *Two and half trip down and up the cliff which is 15 m high. The signal is lost when there is to much earth between the receiver and the CRV. The signal is reacquired again when the vehicle is down the hill. Last trip down and up is conducted with the receiver down the hill.*

Lesson Learned: *The new context camera position is very well suited to evaluate the CRV situation in the slope. The single rope attachment leads to plus or minus 40 degrees yaw oscillations (as foreseen). This should be corrected with a 1m rigid pole on the CRV.*

EVA-25 Report:

EVA Duration: *40 min starting at 05:00 pm (Olivier, Pierre, Richard)*

EVA Goals: *Third test of an helium balloon. Testing our home made Mylar balloon with a new camera (little DV camera).*

EVA Description: *Olivier and Pierre were conducting the test of the Mylar balloon, while Richard was shooting pictures. Jérémie followed the EVA out of sim in case of difficulties with the balloon. Successful operation of the Mylar balloon which ascended till 20 meters (full rope length) and very good colours pictures of the terrain and the top of Hab were taken.*

Lessons Learned: *Stabilise the camera to have better shots.*

Log Book for February 10, 2006
EVA Reports
Alain Souchier & Pierre Brulhet Reporting

EVA-26 Report:

EVA Duration: *120 min starting at 10.40 am (Richard, Jérémie and Alain)*

EVA Goals: *Reconnaissance to Candor Chasma Test of the CRV in configuration 4 (the container used yesterday to house the context camera looking to the CRV from above). The idea is to have a very simple device to explore steep cliffs which do not need a vehicle on wheels.*

EVA Description: *We found easily the part of Cactus road after Stacy's Cake. For 300 m there was no tracks of quads (in the wash) and then Cactus road was again very visible. We walked south to find Candor Chasma in a location explored by crew 7 in 2002.*

We then proceeded to two tests of the CRV in configuration n°4. The device was not equipped with a camera for these tests. The objective was only to assess mobility and difficulties in going down or up. The CRV 4 was tested in a rock crack communicating with a half cave in the Candor Chasma cliffs. It went down 12 m (test 73). Then a new test was conducted on a half cave not far from the first one. The CRV 4 was sent down 22 m and retrieved without difficulties (test 74).

(the report included there the Cactus road cliff stratigraphy analysis)

EVA-27 Report:

EVA Duration: *120 min starting at 02.20 pm (Pierre, Olivier)*

EVA Goals: *Sixth test of the 4.5 m rod supporting a camera sending pictures to a computer.*

EVA Description: *EVA 25 started at 02.20 pm. Pierre and Olivier went to Cactus Road to test the rod supported camera. We took pictures of a rock wall and a little cavern.*

Samples: *None.*

Lessons Learned: *None.*

4 Experimentations

4-1 Activities planning, duration and typology analysis (comparison to NASA analysis)
4-2 Observational capabilities and explored area
4-3 CRV testing
4-4 Balloon carried cameras operations and results
4-5 Pole carried camera operations end results
4-6 Dexterity improvement devices on gloves (or others)
4-7 Hab lay out analysis, improvement and optimization
4-8 Psychological tests
4-9 Geology

4.1. Activities planning, duration and typology analysis (comparison to NASA analysis)

by Richard Heidmann

Each day we noted the time spent on 7 different types of activities for analysis (sleeping, personal, social, maintenance, internal and external operations, reporting). The idea was to characterize how time is used during the mission at MDRS, in order to propose possible improvements of the way simulations are operated. And also to compare those data with what is foreseen by NASA analysts for an actual mission (Marc Mc Cohen, NASA Ames, AAS 95-491), in order to identify possible significant discrepancies.
A first look at the data leads to the main following observations:

-The mean sleeping time is equal to what is foreseen by NASA, but we observe two categories of crew members: one with a sleeping time around 8 hours, and another rather around 6 hours. We managed this situation softly, but this leads to constraints both in the Hab set up (acoustic isolation) and in behaviour discipline (we installed a quiet period from 11 pm to 7.30 am).

-We observe a quite stable time history for more of the crew members during the two weeks.

-There was almost no “free” time, and especially little time devoted to entertainment (movies…). Apparently, from NASA’s point of view, it is foreseen to give one free day per week, which is equivalent to 3 hours per day. The interesting fact is that we felt no need for such free time or “holiday”! Is this a major weakness of the simulation, related to its very short duration, and to the fact that we were actually too busy to be representative of a long duration actual mission? This could be, but the idea of a “free day” per week is also probably questionable.

-We also have observed that we spent no time in our bedrooms other than sleep time; we felt not at all the desire to get alone in our own corner.

-“Personal” time is quoted at 7 %, which is quite low. Significantly, most of this time was devoted to get in contact with our far away families and friends through emails. All of us appreciated this communication means, and felt even that it is more valuable than telephone.

-Productive time (internal and external activities) account for 31 %, which compares not so bad with NASA’s view (28 %).

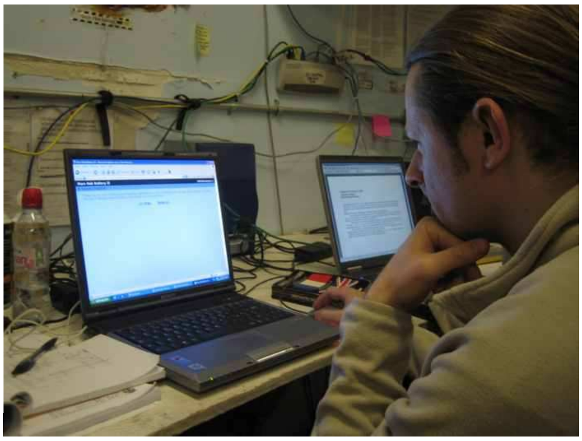
-Reporting time is a salient anomaly: 9 % of the time, compared with 1 hour per day for planning, reporting and communication with Ground Control foreseen in an “actual” Mars mission. This was really perceived by us as a heavy load and as the reason why we could not have more entertainment time. Several reasons to that:

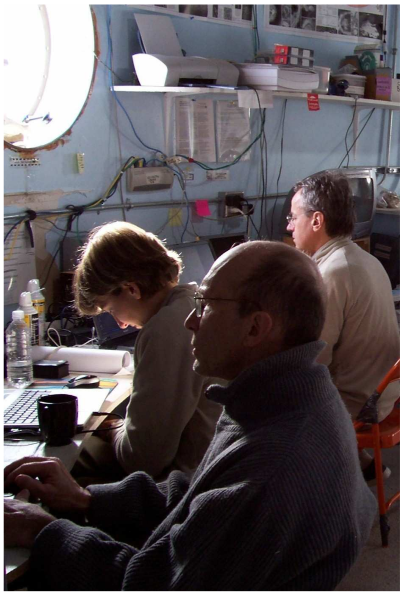
-the very bad performance of the Internet link (numerous satellites errors, disconnections, lengthy waiting time…);

-the great number of reports (even more in our mission, as we have to translate the journalistic report in French);

-the fact that engineering data have to be read on the different accommodations of the Hab, whereas in reality there will be remotely and automatically acquired.

Reports, reports, reports. Too much reports compared to a probable actual Martian situation in which a lot of data will be sent directly to earth ? What is the right repartition of data post processing between Mars and Earth ?





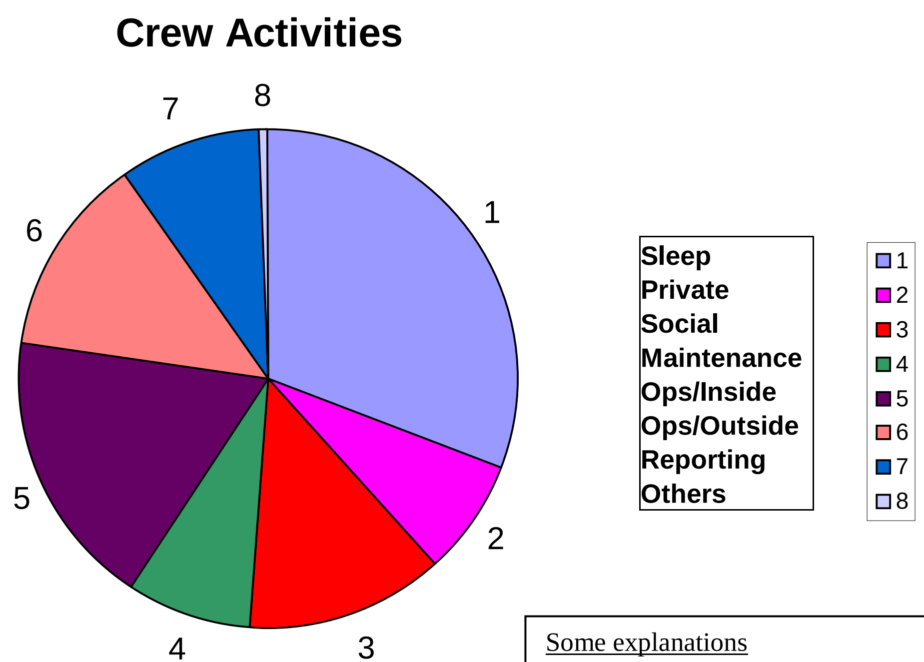
Reports sent during the mission:

Reports Date\	Photo Diary	Commander Check in	Engineering Report	EVA report	Journalist Report	Journalist Report (french)	Others
January 29	X	X	X		X	X	
January 30	X	X	X	X	X	X	Science Report
January 31	X	X	X	X	X	X	Geology Report
February 1	X	X	X	X	X	X	Geology Report
February 2	X	X	X	X	X	X	
February 3	X	X	X	X	X	X	
February 4	X	X	X	X	X	X	Health Safety Report
February 5	X	X	X	X	X	X	
February 6	X	X	X	X	X	X	
February 7	X	X	X	X	X	X	
February 8	X	X	X	X	X	X	
February 9	X	X	X	X	X	X	
February 10	X	X	X	X	X	X	
February 11	X	X	X			X	Mission Summary Report Health Safety Summary Report Engineering Summary Report

-A good surprise, the maintenance time remained reasonable: 8.2 %. In effect, we had no difficulties with the equipments (only a shutdown of the electric power generator linked to a procedure mistake and a shutdown of the main heating system).

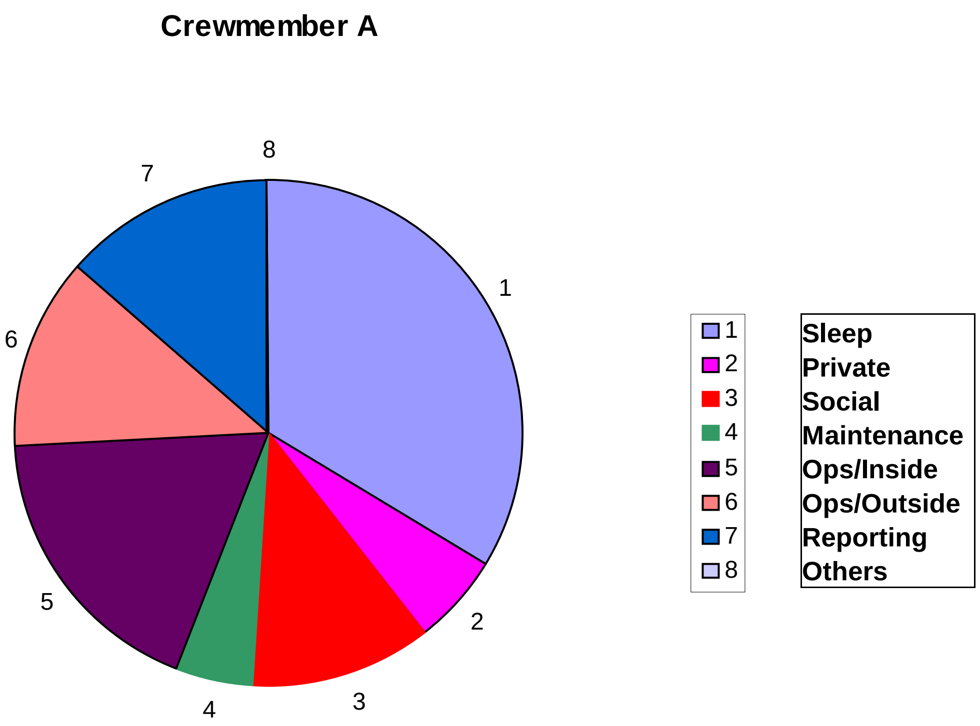
Crew MDRS 43 activities typology analysis

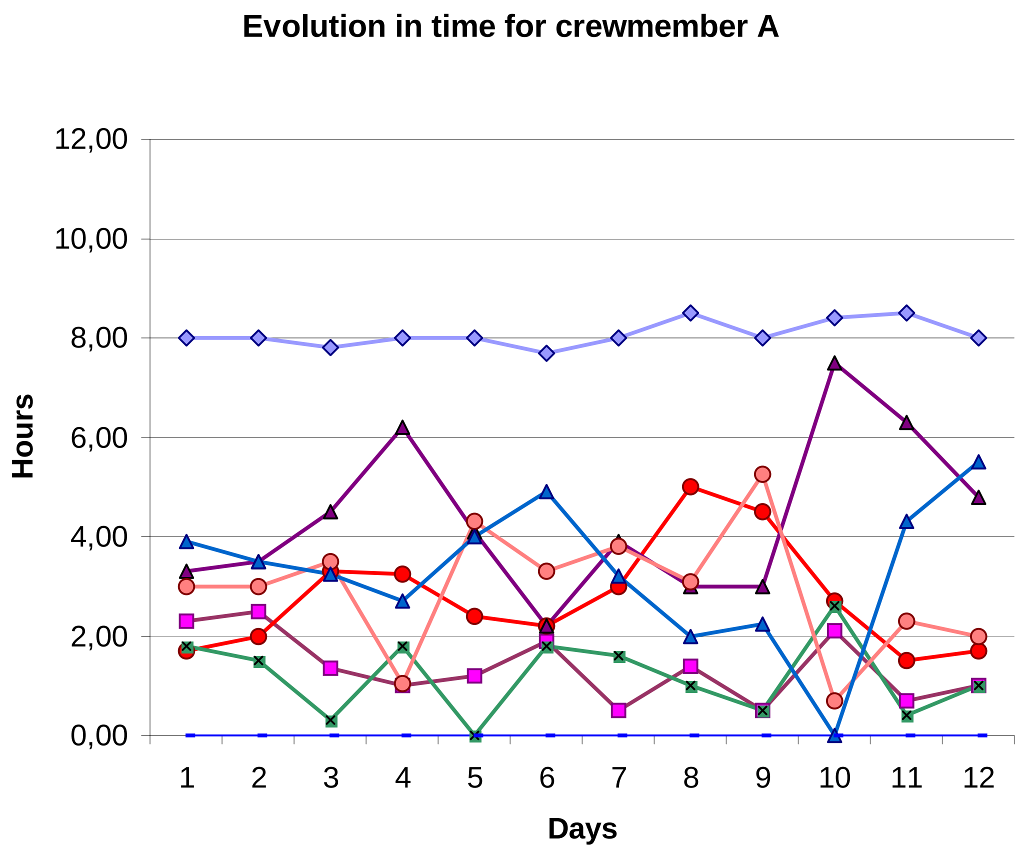
Synthesis	Hours	Percentage
Sleep	437,43	30,9%
Private	105,78	7,5%
Social	180,29	12,7%
Maintenance	115,63	8,2%
Operational/Inside	255,63	18,1%
Operational/Outside	185,01	13,1%
Reporting	126,96	9,0%
Others	9,27	0,7%
Total	*1416,00*	*100,0%*



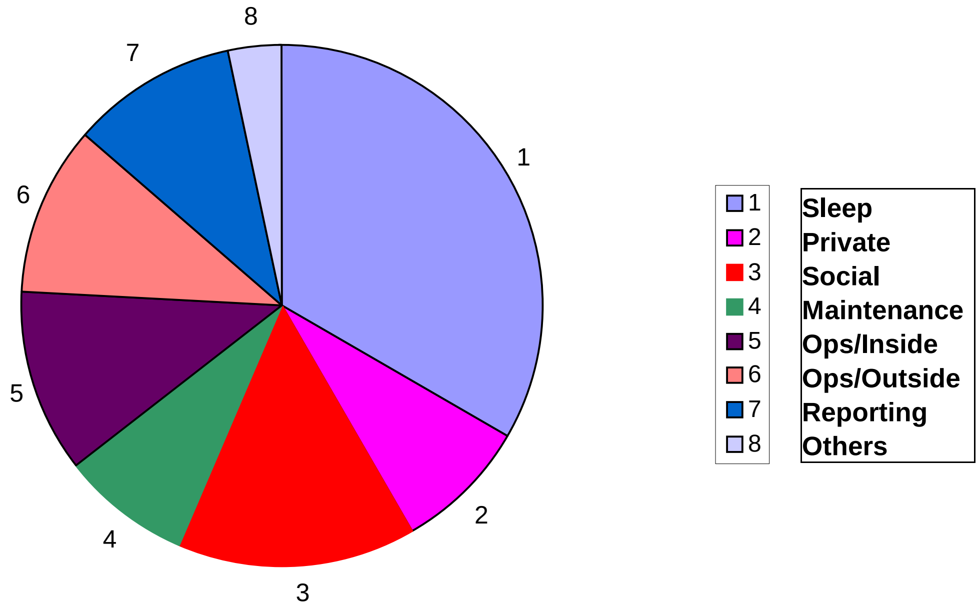
Some explanations
- Social : Common life activities as meals and meals preparation,…
- Ops inside: EVA or experimentation preparation, daily briefings, psychological tests,…

The values given above are mean values for the crew excepted Loïc and for the period from the Monday 31st January to the Friday 10th of February. Thereafter are presented the values for 4 crew members designated anonymously A, B, C, D.

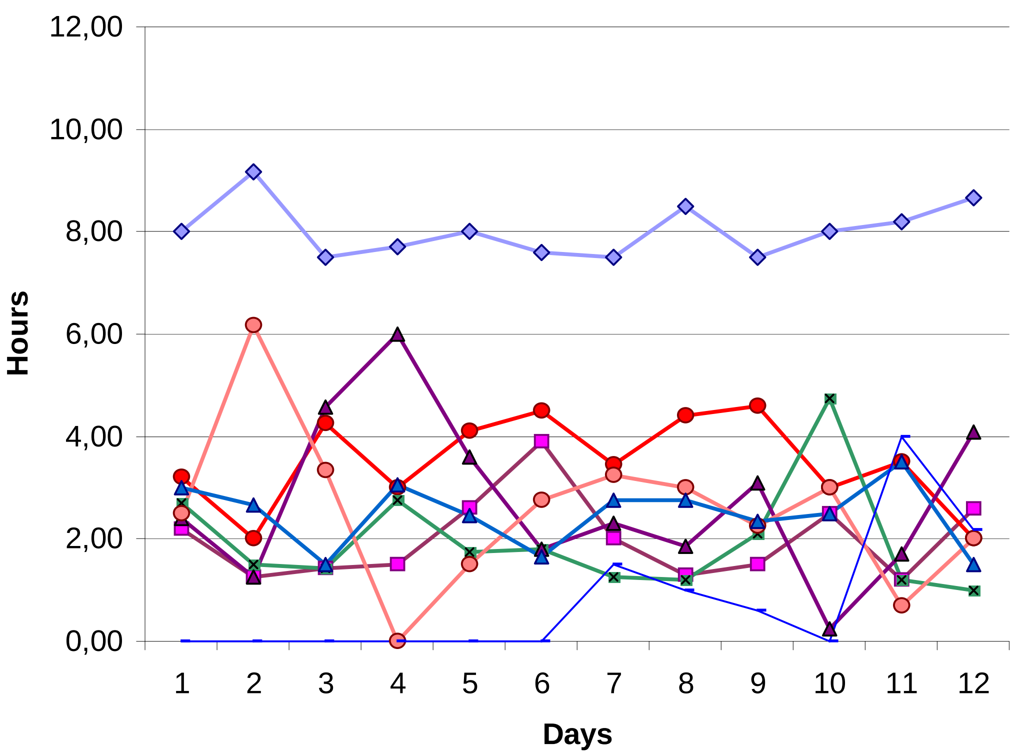


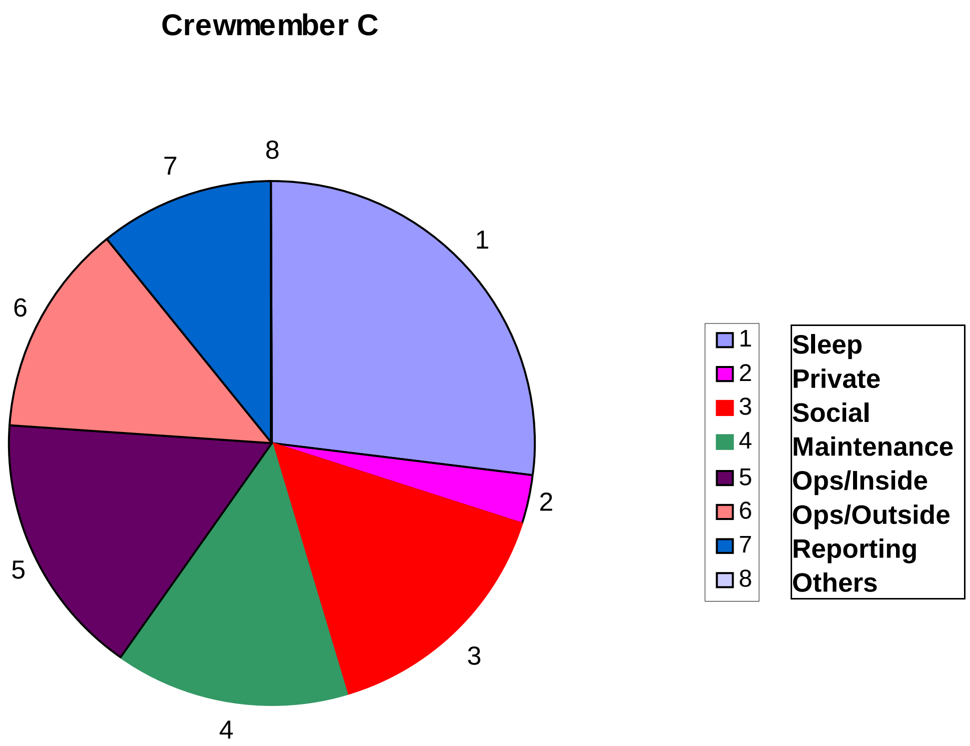


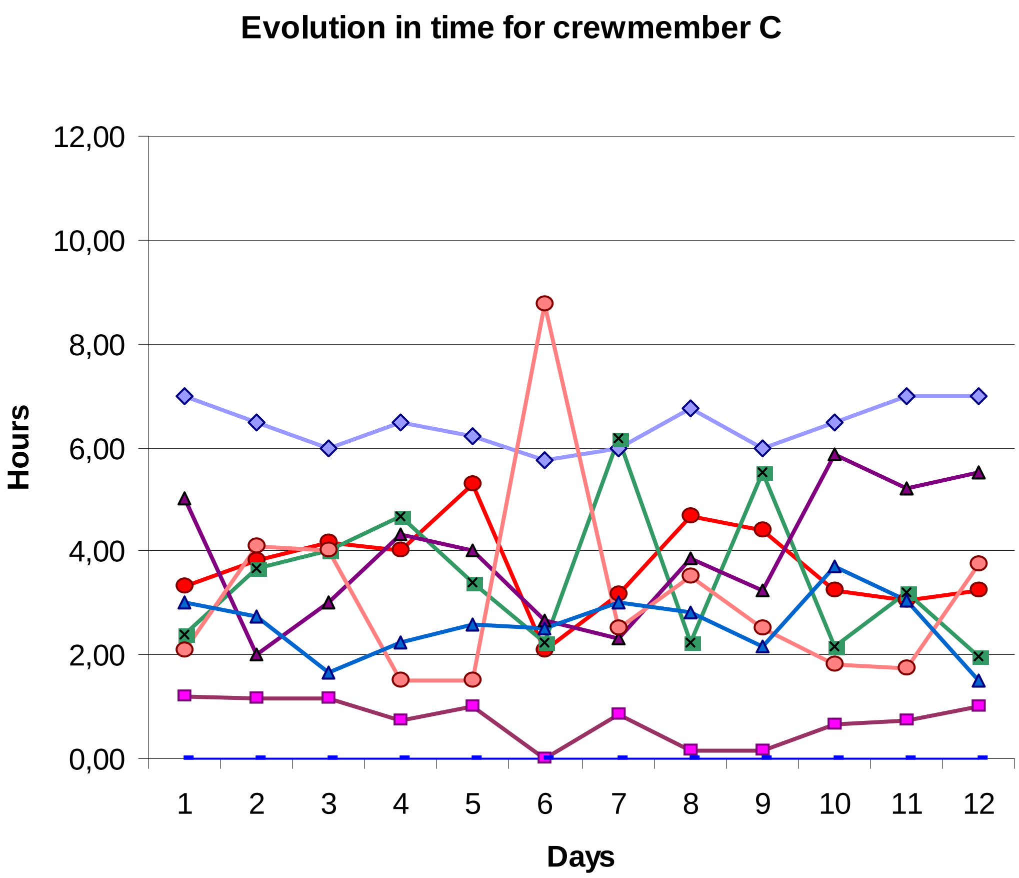
Crewmember B

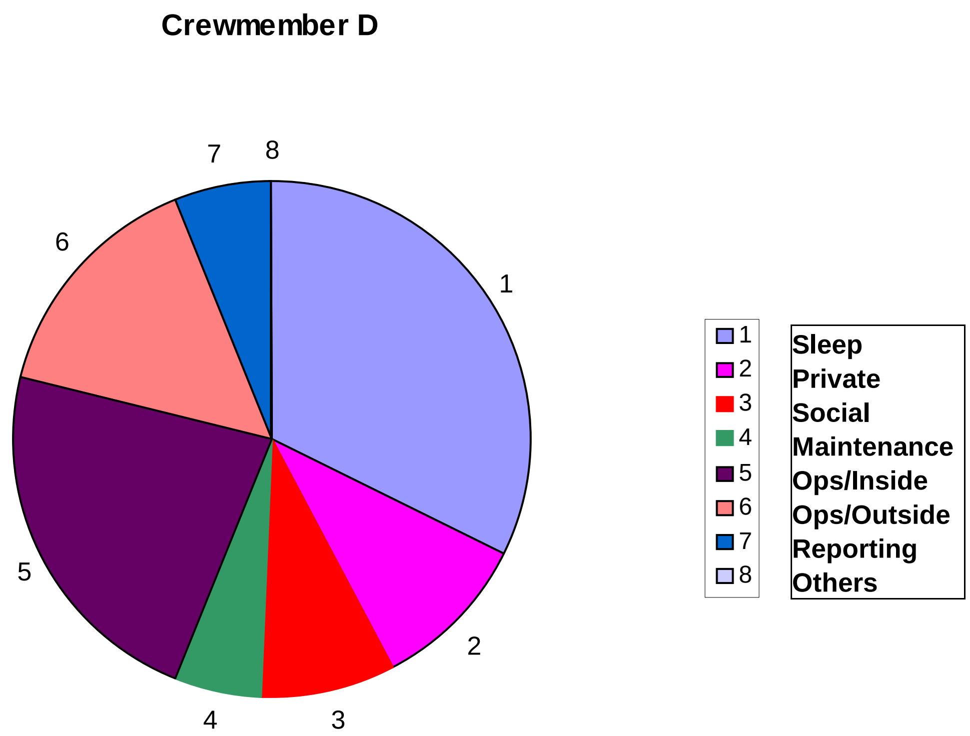


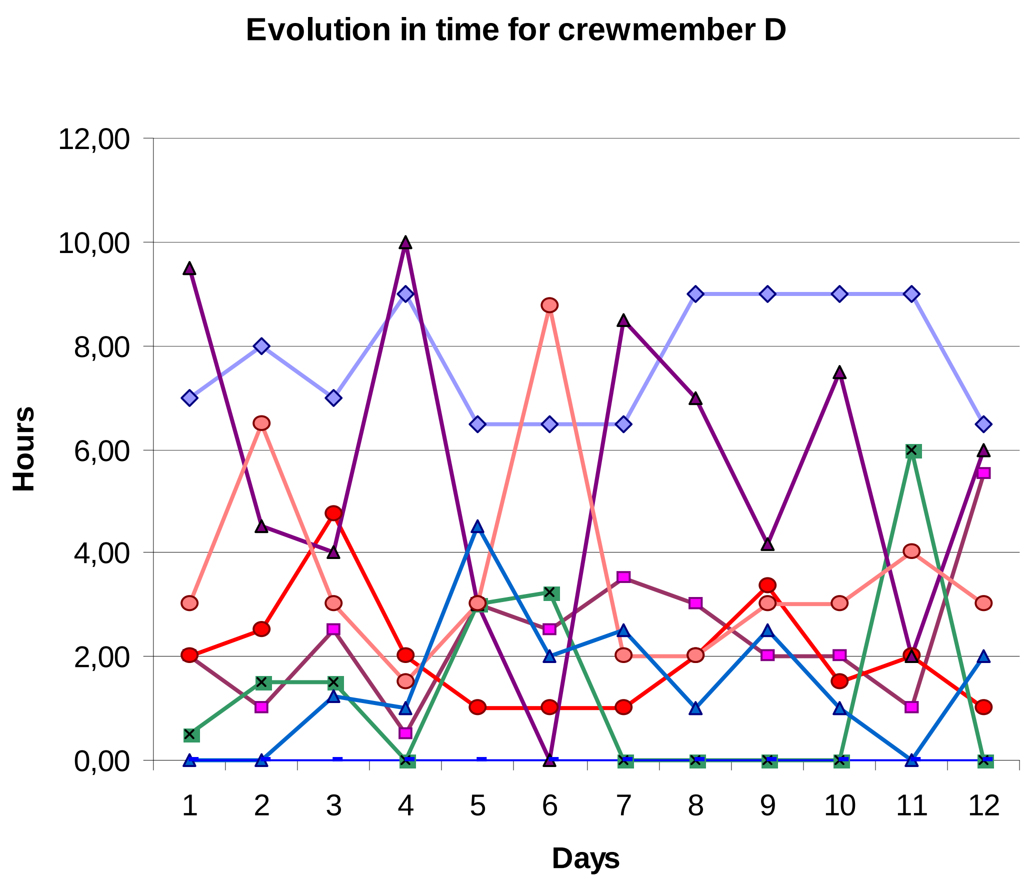
Evolution in time for crewmember B




Crewmember C
8
7
1
6
2
5
3
4
1
2
3
4
5
6
7
8
Sleep
Private
Social
Maintenance
Ops/Inside
Ops/Outside
Reporting
Others


Evolution in time for crewmember C
12,00
10,00
8,00
6,00
4,00
2,00
0,00
Hours
1
2
3
4
5
6
7
8
9
10
11
12
Days


Crewmember D
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
8
Sleep
Private
Social
Maintenance
Ops/Inside
Ops/Outside
Reporting
Others


Evolution in time for crewmember D
Hours
12,00
10,00
8,00
6,00
4,00
2,00
0,00
1
2
3
4
5
6
7
8
9
10
11
12
Days

4.2. Observational capabilities and explored area

by Alain Souchier

To predict how much surface will be explored on Mars by future astronauts during their 500 days stay, it is interesting to analyse how much surface we covered during our two weeks simulated martian stay. This analysis is concentrated on the exploration around the Hab excluding Upheaval Dome and Goblin Valley excursions. Under these conditions we conducted 11 equivalent exploration days. The distance covered in ATVs vehicles is roughly 20 km, counting only one way for a trip from the Hab to a spot and back, and counting also only one time for a trip we did two times or more. In the same way a trip conducted by two or three quads simultaneously is only taken as one trip. In walking EVAs (see the charts in § EVAs localisation) the distance covered is 11 km in the same calculations conditions (one way taken for a trip to a spot and return if the track followed is the same, one track taken for a group if the explorers remain together, and two or more trips in the same area are counted for one). Starting from these values we may have an idea of the explored area. This exploration is more or less detailed according to the travel mean used. When walking you can spot details between 1 and 20 cm in a band of plus or minus 20 m around your path, but naturally it does not mean that every detail in this range will be seen.. An observation efficiency coefficient should be taken into consideration . This coefficient depends on the observer alertness linked also to the other tasks conducted in parallel ; it depends also on the contrasts and the quantity of objects per square meter. One black stone on 100 m2 will be easily identified when among one thousand others it will be more difficult to spot. During MDRS 7 in 2002, when I found a 7 by 9 cm indian carved flint stone (Fremont civilisation, 750-1250 after J.C.), 100m from the rim of Candor Chasma, this flint was some meters distant but rather isolated on a flat area with no other objects.

When on a vehicle, the objects seen will be more around 10 cm to 2 m in a plus or minus 200 m band around the path.

Observational capabilities

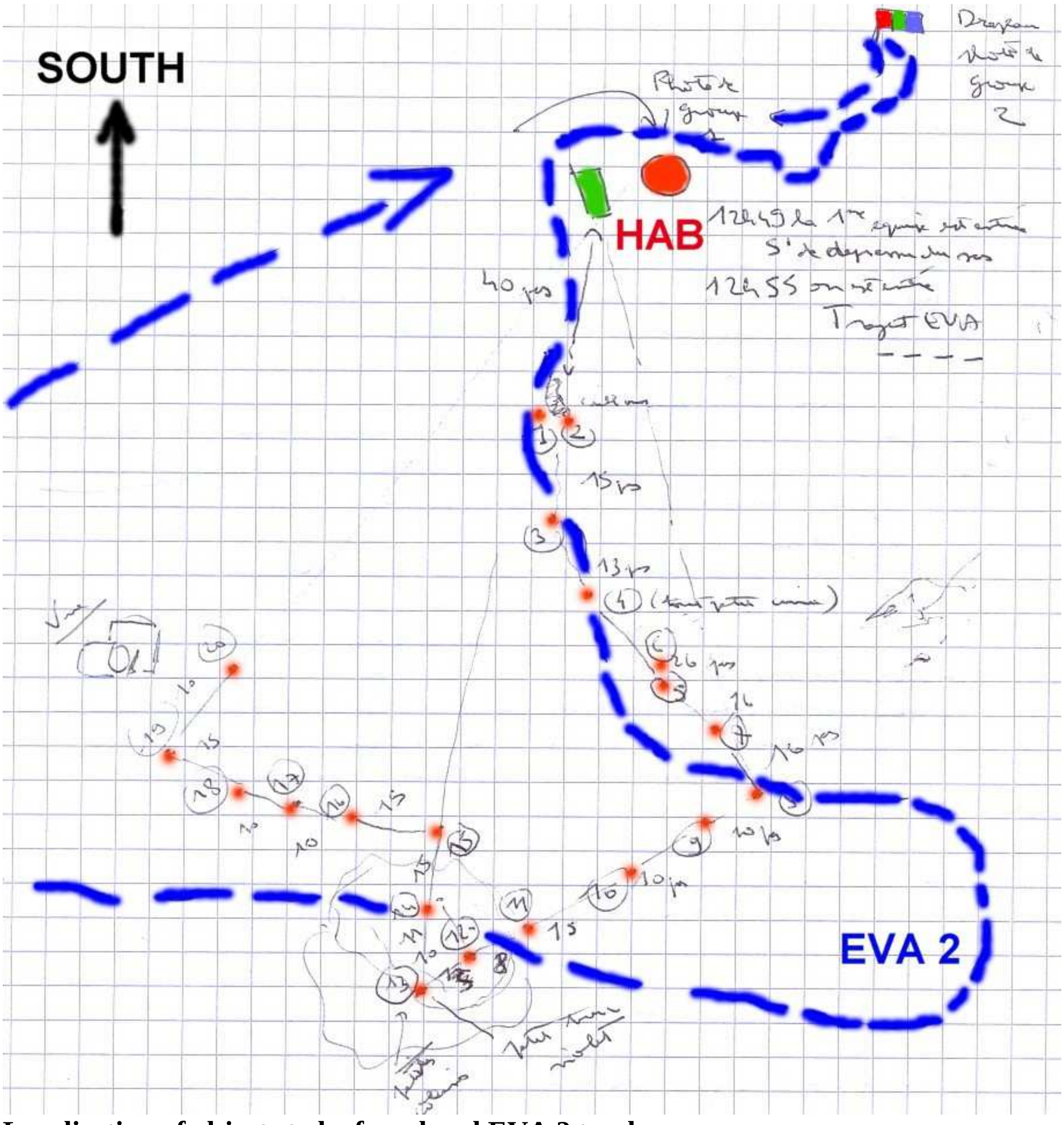
No observational tests were conducted when driving an ATV but during EVA 3 a test was conducted to start assessing the observational capabilities of an astronaut walking on the field: Twenty various objects were scattered before the EVA on a 45° wide sector extending north of the Hab on a distance of approximatively 120 m. The EVA was conducted with 5 people. The EVA leader knew where the objects were located (he placed those objects himself), the other EVA crewmembers, excepted one, knew that the goal was to find strange looking objects. The EVA was conducted loosely around the areas were the objects were located. Nine objects were found. Thus the raw result is 9 on 20. But the EVA track did not cover exactly the objects location area. Around 6 objects were probably at more than 10 meters from the track. The corrected note is probably 9 on 14 which is equal to 13 on 20. The photo comparing the objects found to the objects which were not found, shows that the objects found are the largest and are white or “flashy” in colours. In general the copper objects were not found. Their colour is closely matching the soil colour around the Hab. They are difficult to spot if there is not sun reflection. After the EVA when we were retrieving the remaining objects, one of the EVA crewmember remembered walking 1 m from a 6 cm copper tube without seeing it.

Preparing the field for the observation test in EVA 3. On the right a fork.

The EVA 3 team searching for strange objects

Jeremie finds a white spoon

A visible one (it was found) Anne has found pliers



Localisation of objects to be found and EVA 2 track

The 13 on 20 score does not indicate by itself the reduction of observational capacity by a man in a spacesuit compared to a man without spacesuit. When we retrieved the objects left after the EVA, even with the map indicating the objects position, we had difficulties finding the 11 remaining objects. It even seems that one has not been recovered. We had to cover 3 times the area following closely the map to find 10 out of 11 objects.
This was naturally a first rough experimentation. A better "scientific" approach would be to have circular patches ranging from 1 to 10 cm, with different colours. Probably the astronauts should follow a very well defined path with each object distance from this track being identified. The experimentation should be conducted three times and restarted also with people without spacesuits to evaluate the reduction in observational capacity linked to the spacesuit.

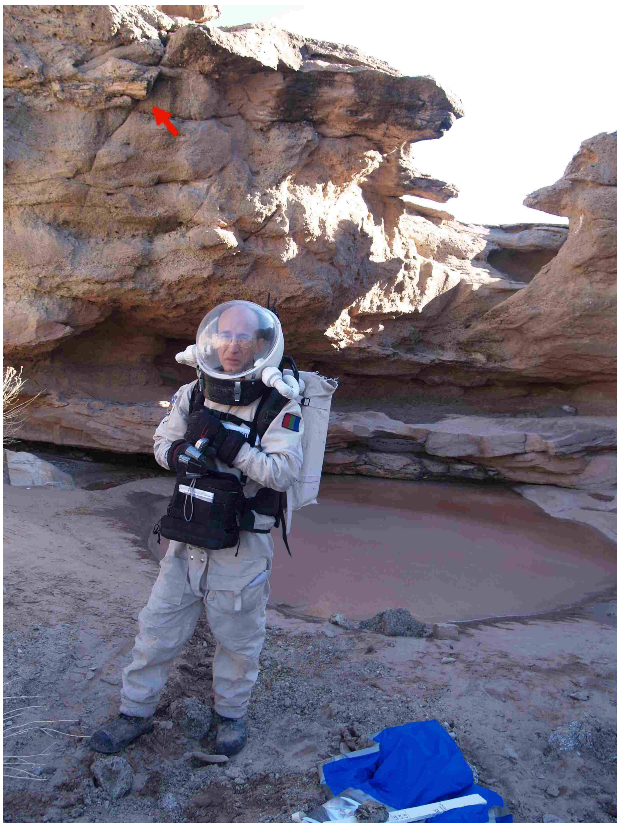
Objects to be detected in the field by EVA 3. Nine out of twenty were found.

The astronauts observational capability was also assessed during EVAs to Lith Canyon were interesting objects are located like dinosaur bones and petrified woods. Four interesting location were taken as a reference: the dinosaur bones fragments in 4 to 5 two meters wide spots on a small hill located at the Lith Canyon upper inlet, a five to two meters area full of petrified wood bits (probably location of a destroyed tree log) in the slope going down to the floor of Lith Canyon in the south east branch of the Y by which the canyon is starting, a fossil log protruding from the cliff 5m high in the Y south east branch and the fossil tree roots located in the canyon floor in the same area. The EVA leader who knew already the fossils position conducted the EVAs members very close to the interesting points telling that fossils were to be seen. This small experimentation was conducted during EVA 11 (EVA leader + one crewmember), EVA 16 (EVA leader + two crewmembers), EVA 20 (EVA leader + two crewmembers, one being already there and the other one discovering the area) totalizing a number of 4 crewmembers on which the experimentation was conducted..
The dinosaur bones were never found probably because the crewmembers were expecting objects looking more like bones and not fragments which are in general 5 cm wide. The fragments colour was however conspicuous: grey blue on a light pink soil.

Typical dinosaur bones fragments (left) and macro photography of a dinosaur bone (under)

The dinosaurs bones have a distinctive colour but have to be looked at carefully to see the fibrous structures demonstrating that they are indeed bones.

Two crewmembers spotted the petrified wood fragments in the slope to Lith Canyon floor.
One crewmember found the petrified log in the cliff in the upper part of Lith Canyon and found even an other one not far from the first one. This crewmember which also saw the petrified wood fragments has a special interest in geology and is probably more trained to search for interesting geological features than others. The EVA crewmembers observational capacities are naturally strongly dependant on their training and field of expertise.



On the left the field of petrified wood fragments in the slope going down to Lith Canyon floor. On the right a photo showing the petrified wood log (red arrow) in the Lith Canyon upper part cliff.

Nobody found the petrified wood roots in the Lith Canyon wash floor. Otherwise we spotted some previously unknown features as a small log in a wash just up on the flats above Lith Canyon and a very large log in a cliff, detected from 50 m away further down in Lith Canyon.

The petrified tree roots in the Lith Canyon wash floor were unnoticed (left) but a distinctive feature as the fossile log in the cliff is seen from far probably because of its color and shape (under).

Explored area

Bearing in mind that in an area covered at a small scale in a walking EVA or at a larger scale from a vehicle, is not covered at 100%, the areas we covered during 11 days are the following:

- Detailed coverage (walking EVAs): 11x 0.04 = 0.44 km²
- Coarse coverage (ATVs): 20 x 0.4 = 8 km²

The walking EVAs are also allowing coarse exploration 200 m around the track followed, but the length to be taken into account is smaller because the tracks followed are often less than 200 m from each other. The distance covered without 200 m overlap is evaluated at 7 km. Thus finally the coarse explored area may be evaluated at:

- Coarse coverage (ATV + Walking EVAs) = 27 X 0.4 = 11 km²

During mission MDRS 7 the evaluated values were for 12 days:

- Detailed coverage (Walking EVAs): 0.4 km²
- Coarse coverage (ATVs + Walking EVAs): 13 km²

The MDRS 7 values are very close to the MDRS 43 values.

As a comparison the area limited to the South by road 24, to the East by Candor Chasma to the North by Lith Canyon and to the West by Skyline Rim, extends on 80 square km. Then the question is which percentage of such an area has to be coarsely explored and which percentage has to be explored in detail to consider that the area has been « correctly » covered. The local geology and particularly the presence of layers, also the similarities in fossils for the same layer, gives to the ground a fractal characteristic which means that you can pretend to know the globality while knowing only a part. May we suppose that a 100 % area coarse knowledge combined with a 10 % detailed coverage would be a very good result ? In this case we would have needed 80 days (MDRS 43 results) or 74 days (MDRS 7) to cover coarsely the 80 square km defined above and 200 days (MDRS 43 results) or 240 days (MDRS 7) to cover in detail 10 % of the area.

For a 500 days typical Mars mission, the coarse coverage would be thus in the order of 500 km² and the detailed coverage of 20 km².

4.3. CRV testing

by Alain Souchier

Picture NASA - Pat Rawlings

On Mars as well as on earth or other telluric planets, cliffs and steep slopes are areas where the ground provide direct access to layers and rocks which have been produced by hundreds of million years of geological , meteorological and biological (eventually) history. With exploration lengths in the order of 100 m in the line of slope, crossing the various layers, a lot of information may be gathered on a planet history.

To be able to observe a ground which is not obstructed by debris, the slopes to be explored have to be between vertical (90°) and around 45°. A rover using wheels for propulsion cannot travel along this type of slope. One solution is to use a cable suspended rover. This rover may be entirely autonomous with a up hill anchorage provided by an other rover or be operated with more or less autonomy by astronauts operating on the up hill side. Some Mars exploration artist views are showing astronauts in space suits suspended to ropes and exploring a vertical cliff. If such a difficult operation is ever attempted, it will be only because a cliff exploration rover will have found a worthwhile feature to be observed , analysed or retrieved !

Starting from the above considerations and acknowledging that the cliff rover problems have seemingly not been addressed by space agencies or organisms, Planete Mars Association members decided in summer 2001 to explore the difficulties of mobility along a steep slope for a cable suspended rover. Main requirements were the ability to operate on slopes between 90 and 45°, the ability to deal with the highest possible obstacles on the way down or up and particularly to be able to be retrieved and brought back up the hill in those obstacles conditions and even in case of over hanging parts in the cliff. A secondary requirement was to test what would be visible with a camera on board and devices to measure the size of features visible in the camera field.

The CRV 1 before a test in Vernon

CRV 1 general configuration

The Cliff Reconnaissance Vehicle, or CRV in short (VRP in French), is by no way a vehicle designed for actual operations on planetary grounds but only a demonstrator to test the best configurations to fulfil the above requirements. The geometrical configurations experimented as well as the size bear probably a strong similarity to a future operational vehicle but other (lighter) materials would be used as well as smaller space qualified equipments. Also the assembly process to build or deploy in the field the vehicle would be much more simplified. The CRV in its present configuration has no autonomous mobility and is lowered and brought back up manually suspended to a rope. An operational vehicle would surely be operated with an electric windlass. The operating process implies that the cliff or slope has to be accessible from above.
The CRV main payload is a camera although other payloads may be envisioned.

Three different Cliff Reconnaissance Vehicle (CRV) configurations have been tested at the MDRS since 2002: CRV 1 was tested during MDRS 2 by Gilles Dawidowicz (February – March 2002). CRV2 was tested during MDRS 7 by Alain Souchier (November 2002). CRV 3 was tested during MDRS 23 by Anne Pacros (February 2004), during MDRS 26 by Edwin Loosveldt (March 2004), during MDRS 39 by the Leonardo crew (April 2005) and during MDRS 40 by Anne Pacros and her Monalisa crew colleagues. Thus MDRS 43 was the seventh experimentation in Utah for the CRV vehicle family.

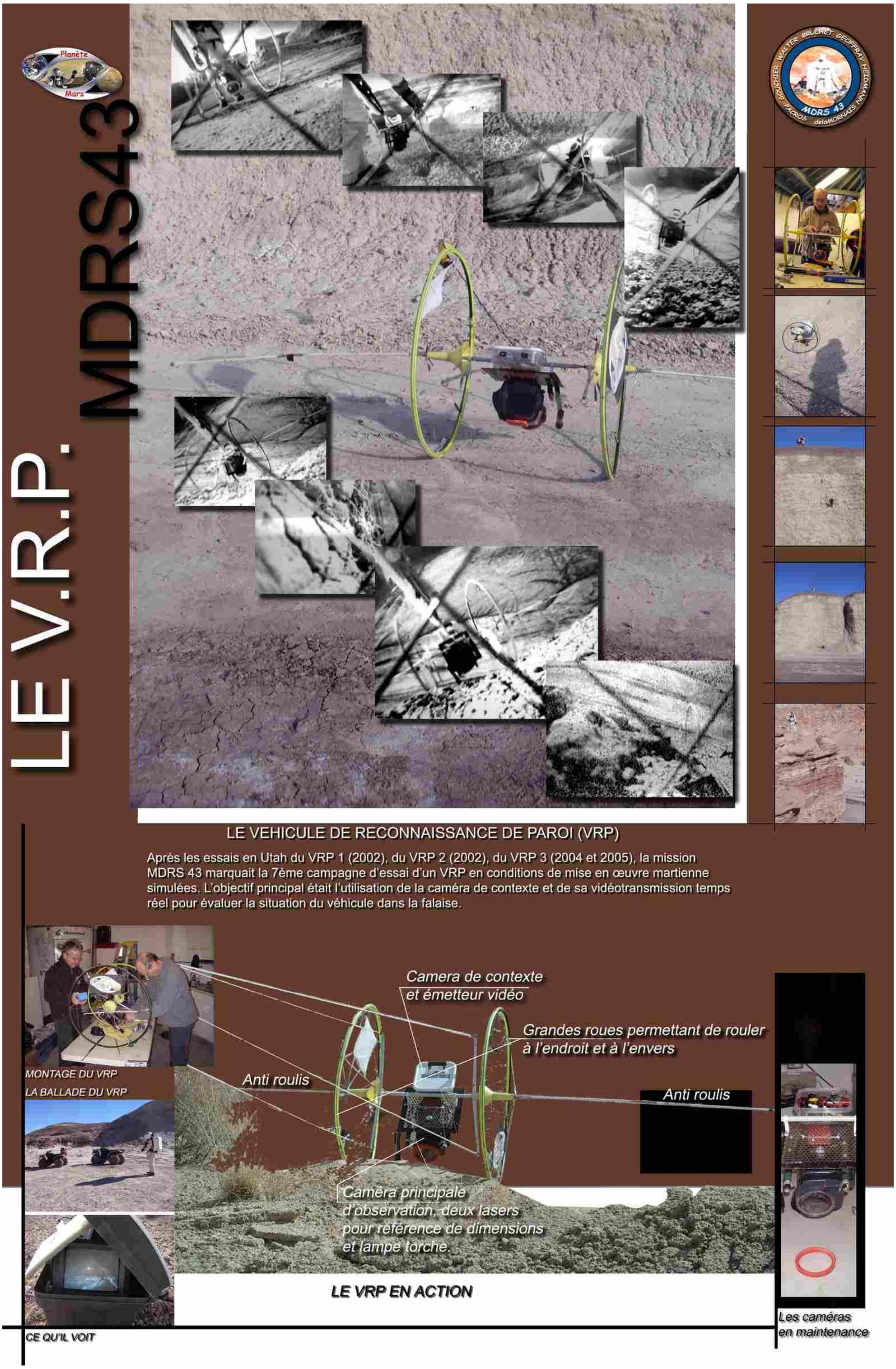
The CRV 1 was a 4 wheel configuration, with a mass of 8 kg. When upside down the vehicle was designed to slid on ski type structures. The CRV 2 had the same general configuration with the use of some lighter structures. It was 5 cm larger than the CRV 1 and had a real time video transmission to send to a receiver up the hill the picture taken by a context camera (or hazcam) or by the main camera looking at the ground. The mass was increased to 8.5 kg. The CRV 3 is a totally new design based on 2 big wheels. The vehicle rolls on these wheels even when it is upside down. The vehicle mass is 4.075 kg (including the main camera loaded with video tape and battery). Without the video emission box, the mass is reduced by 0.555 kg. The configuration without the emission box was used for missions MDRS 23 and 26. The emission box was on the vehicle during MDRS 39 and 40 but was not used by the crews. Missions MDRS 23, 26, 39 and 40 thus concentrated on mobility demonstrations. The CRV objective for MDRS 43 was the context camera use optimization. In the nominal configuration the context camera located on the vehicle is looking upwards to give the operators information about the obstacles above. This may be useful to ease the vehicle retrieval. Also the upward view may bring information on the ropes situation (entanglement, twists, …). The context camera is linked to the emitter by a long wire. Thus the camera can be installed elsewhere on the vehicle looking to other directions. A small container was also provided since mission MDRS 39 to house this camera somewhere along the ropes for example looking downward to the vehicle from a position located some meters above. The search for an optimum location was one of the CRV MDRS 43 mission objectives. The other one about context camera use optimization, was to see how the information from this camera could be used by the operating astronaut to facilitate the vehicle operations. And naturally mobility demonstrations were also an objective. Particularly as the operating crew member had experimented the CRV 2 during MDRS 7, the CRV 3 could be used on exactly the same locations as the CRV 2 to demonstrate improved mobility (or not).

During the mission preparation phase in December the CRV was reassembled for some testing. The reassembly time was measured at 5 hours and 50 minutes including the repairs (the preceding tests were the one conducted during MDRS 40). Subtracting the repairs duration, the assembly time was 2 hours and 20 minutes. During MDRS 43 the assembly started the 1st of February working partly at two people (3h25mn cumulated), continued the 2nd (2h28 cumulated) and ended the 3rd (10mn) cumulating

6 hours. This includes video testing and also the final EVA preparation which implies batteries charging, adhesive tape bands preparation (pre-cut bands with 3 cm tips fold parts to allow catching with heavy gloves), anti roll rods, safety pole and hammer conditioning in a configuration ready for the trip.

Cliff Reconnaissance Vehicle n°3 main features (CRV test 70 at White Rock Canyon).

CRV experimentation general presentation (black and white pictures from test 72 on the hill south of the Hab transmitted by the context camera).



CLIFF RECONNAISSANCE VEHICLE TESTS DURING MISSION MDRS 43

TEST N°	DATE	LOCALI-SATION	HEIGHT	DIS-TANCE	COMMENTS
68	3 Feb	Small hill north of the Hab down the Hab ridge	5 m	8 m	EVA 10-11. First test to check the real time video transmission; probable battery loading problem: picture reception only when the context camera box is opened. Media helicopter arrival just before the test. Main operator:Alain
69	3 Feb	Same	Same	same	EVA 10. Operators: Richard and Jeremie
70	4 Feb	White Rock Canyon	8 m	8 m	EVA 13. Same location as test 12 (CRV 1 - 2002) and 24 (CRV 2 - 2002). 4 trips along the cliff (same track). No difficulties where difficulties were encountered for test 24. Test filmed by the media crew. Picture reception but nearly no details visible. Tests afterwards have shown too much light for the camera. Main operator: Richard.
71	7 Feb	Stacy's Cake	10 m	10 m	EVA 19. Same location as test 29 (CRV 2 - 2002). Difficulties in positionning the receiver (suspended to a rope: hard to change position in the very rough configuration of the cliff). Difficulties to lower the vehicle: the transition points from 4 to 2 ropes then 2 to 1 are entangled in the rocks. Same difficulties to rise the vehicle. Strong deformation of one of the wheels. Retrieval out of sim from the bottom of the cliff (as in 2002). Video signal received during the whole test. Clear picture (context camera equiped with sunglasses) but the camera looking up does not give useful informations on the CRV situation. Operations by Richard, Alain and Jeremie.
72	9 Feb	Hill south of the Hab;west side.	12 m	15 m	EVA 24. Test of a modified configuration: only one rope tied to the vehicle (following precedent tests results) and context camera located in a container 1.3 m above the vehicle along the rope (preplaned experimentation). The received picture depicts well the CRV situation. It is recorded on Olivier's hard drive recorder. No reception in the middle of the track (obstacle by the ground on this round hill) then the picture is acquired again when the CRV reaches the bottom of the hill. + and - 40 °yaw os cillations (as foreseen) linked to the one rope configuration. Two and a half trip down the hill. Operations by Jeremie and Alain.
73	10 Feb	Candor Chasma. North rim. 870 m from the west side entrance.	12 m	12 m	EVA 26. Mobility test of a preliminary configuration of CRV 4 which will be optimized for quasi vertical cliffs. The vehicle is the small container used in the preceding test to house the context camera. 4 tests already conducted before the mission. The CRV 4 is sent through a 1.5 foot wide crack communicating with a half cave in Candor Chasma cliff. Operators: Jeremie and Alain.
74	10 Feb	Same location. 50 m south.	22 m	22 m	EVA 26. Same configuration. Test along an other half cave in Candor Chasma cliff. Two trips down.

Tests CRV 68 and 69

During the first testing around the Hab (CRV test n°68 and 69 the 3rd of February) we had difficulties in the context camera pictures reception. The picture was acquired only when the context camera box cover was opened. There is no clear explanation to that. Tests conducted in the Hab afterwards have shown a bad contact around one of the switches but finally it seems that battery one was not well charged or discharged for an unknown reason. In this weak charge situation, the operation is sensitive to a better contact anywhere. The battery final charging was conducted the day before and some difficulties were encountered at that time. The CRV underwent its final preparation the third of February between 12.15 and 12.25. Normally the final preparation implies testing the video transmission but the notes taken this day does not allow to tell that this testing was done or not.
Use of the CRV during EVA 10 and 11 was decided at the morning briefing. The main objective of EVA 10 and 11 was to have an EVA going on at the time when the media helicopter would fly above the Hab area. So the rehearsal experimentation of the CRV was decided as a way to have an EVA busy for some time around the Hab. The helicopter was awaited at 14.45 and, for margins, the EVA was aimed beginning at 14.15. This EVA schedule was followed and the helicopter arrived around 14.40 when we were just ready for a CRV testing. We conducted the CRV test 68 to be filmed from the helicopter and then Pierre and Alain left to go back to the Hab and drive the ATVs along Lowell Highway also under filming from the helicopter. Tests 69 was conducted by Richard and Jeremie. The CRV tests 68 and 69 were conducted on an easy slope and no special difficulties were encountered in mobility.

The helicopter arriving during test CRV 68

CRV test 68 on the lower part of the Hab ridge as filmed from the helicopter.

Test 70

During the following test (CRV n° 70) at White rock Canyon the 4th of February, the pictures were very difficult to see. A dedicated test the following day showed that the landscape outside is too bright for the camera. This was not visible in testing at Vernon under winter lighting conditions. For test 71 the camera was equipped with sunglasses which solved the problem.

The White Rock Canyon test was conducted exactly at the same location as an other CRV test (CRV in configuration n° 2) in 2002. During the 2002 test the CRV retrieval was very difficult (blockage of the biconical device at the transition level between the two ropes and the single rope in a cleft, blockage of a rear deflector on a local overhanging) whereas the present CRV in its configuration 3 proved easy to operate. This test was documented by the media crew. Four up and downs trips were conducted on the same path during test CRV 70.

CRV test 70 at White Rock (

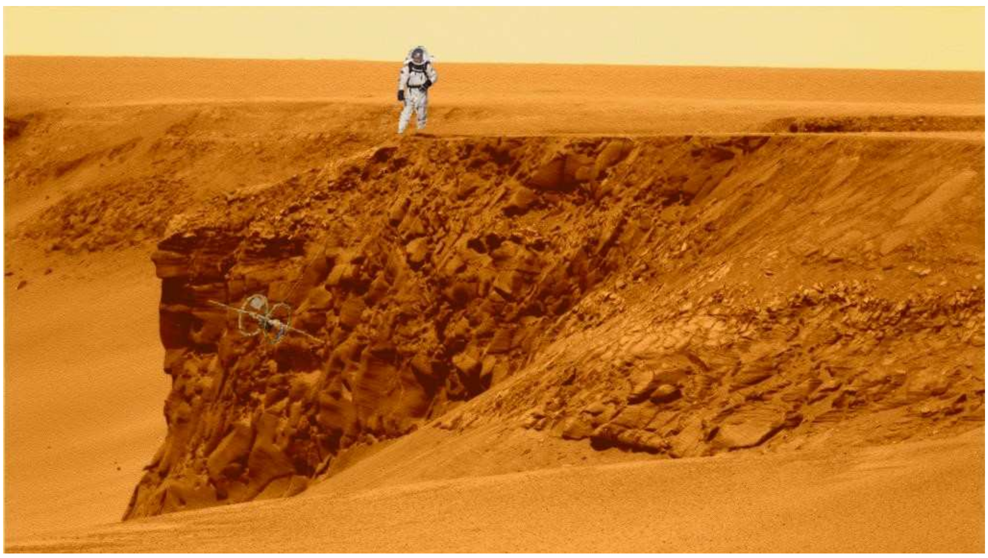
Picture taken on board the CRV

On the right: Richard operating the CRV and Alain looking at the pictures sent from the CRV on the TV monitor.

The CRV down the 8 m high cliff. **The cliff localisation**

End of CRV retrieval on the right. From left to right: the ropes roller box in Richard hands, the blue video receiver box on the ground, the monitor and battery box with the sun shade and the CRV itself.

Photos taken on board the vehicle during CRV 70 test are presented at the end of this chapter.



CRV test 70 transposed on a Martian cliff in Victoria crater respecting astronaut, CRV and cliff size (NASA photograph by Opportunity)

Test 71

One new difficult test was then programmed for the vehicle the 7th of February on the “Stacy’s Cake” cliff where the CRV in configuration n°2 failed in 2002. The vehicle was then stuck in the middle of the cliff (at the bottom of the vertical part of the cliff but up on a 30 degrees slope). We had to get out of sim to retrieve the vehicle, accessing by the lower side of the slope. We conducted the test 71 exactly from the same point as test 29 in 2002. The pile of stones used in 2002 to consolidate the safety pole fixation in the ground was still there. The same blockage happened to the present CRV with first a lot of difficulties coming from the transition from one to 2 and 4 supporting ropes (difficulties to go down). The picture from the context camera was received during all the test however only 5 s every 10 s owing to an uncontrolled change on the monitor command (introduction of an automatic sweeping between inlet channels one and two). The mishap was explained in post test verification. In test 71 the context camera was looking upwards and the picture was found not very helpful to evaluate the vehicle situation. Also the nominal operation of throwing the receiver box in the upper part of the cliff to be in direct view with the vehicle was difficult as well as the retrieval of this receiver. Solutions with the receiver on a pole have to be examined.

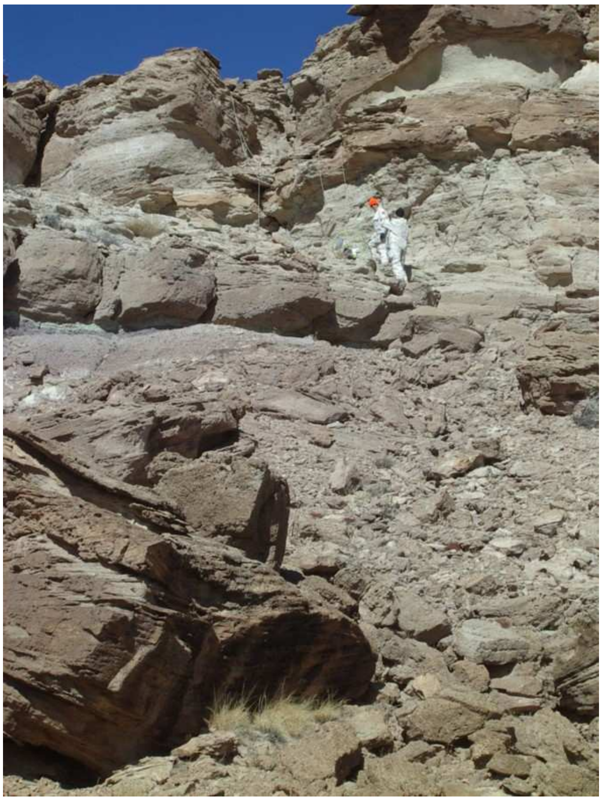
Localisation of the CRV 71 test. This localisation was purposely the same as test 29 in 2002 which was conducted with the CRV 2.

Down the first vertical part of the cliff the vehicle went side way with a 90° yaw angle on a small very rough slope and the attempts to bring it back were unsuccessful. The right wheel suffered a strong deformation as well as the anti roll rods. We had to go down, get out of sim (Alain and Jeremie while Richard under a one week strict simulation rule kept full sim), climb the slope (knowing from MDRS 7 experience that it could be done) and reach for the vehicle. It appears that the transition from one rope to 2 then 4 ropes may be a cause of entanglement in rocks. This configuration aims at facilitating the ride up the hill, mainly when there are overhangs from which the vehicle could come on its side. The area with 2 ropes selects upright or upside down position when coming up from an overhang and eliminates lateral positioning. In this case it was an obstacle on the ride down and one rope solutions should be experimented when no overhangs are encountered on the cliff.
In the post test examination the CRV main axis was found bent on one side (11 mm on 200), one of the spokes had to be replaced, 3 reinforcements at the attachment points between the spokes and the hub had to be reglued on the right wheel. But as indicated in the vehicle description at the beginning of this chapter, the materials used are not pretending to be “space flight type advanced materials”.

Stacy's Cake: a very difficult cliff for the CRV. On the left the vehicle is still under control. On the right the vehicle as found by the retrieval team. The right wheel is deformed, the anti roll rods are bent.

Alain and Jeremie, out of sim, climbing Stacy's Cake to retrieve the CRV.



On the left Alain and Jeremie reaching the CRV. Under, the CRV situation as found by the team. The ropes are entangled in the rocks. This is the ropes area were the single rope has transitioned to 2 then to 4 ropes in order to position the vehicle on its wheels when coming back up from an overhang. In this case the transition between 1, 2 and 4 ropes has been an obstacle to a smooth ride down.

Localisation of the CRV 71 test on the Stacy's Cake cliff with indication of the retrieval spot

The bent left wheel after test 71

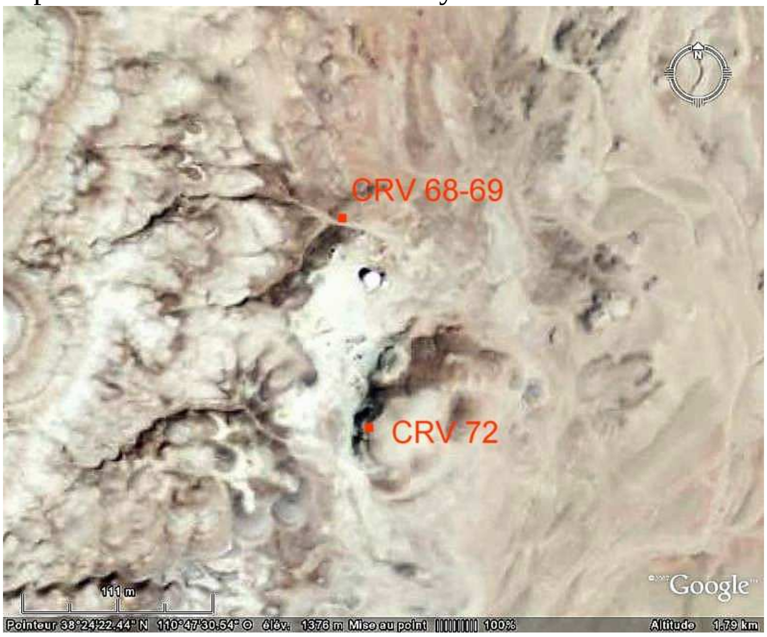
The bent right wheel after test 71

The bent main axis after test 71

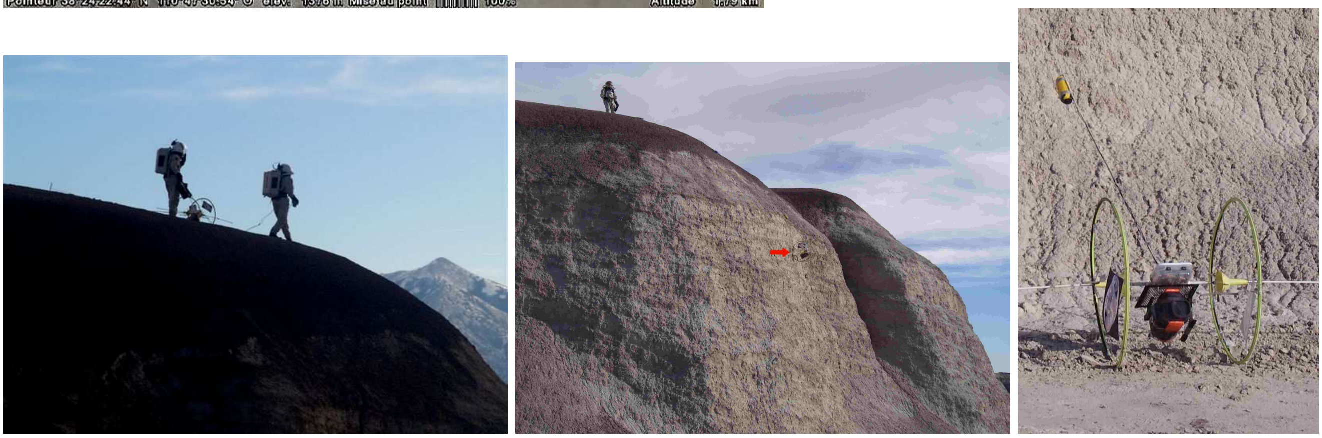
Photos taken on board the vehicle during CRV 71 test are presented at the end of this chapter.

Test 72

After the post test 71 repairs, some modifications were tested the 9th of February on the small hill south of the Hab: first a one rope supporting solution was experimented which led to yaw oscillations (predicted) at around + or – 40° which did not threatened the test. The final solution should be with a rigid part on the first metre above the CRV. Thus the yaw oscillations should be reduced. Also a new position for the context camera was experimented as foreseen in the experimentation plan: for test 72 the context camera was localised in a small container 1.3 m above the CRV attached to the main rope. This position gave good views of the vehicle during its operations. The experimentations will continue with this solution. The hill on which test 72 was conducted is very smooth so no difficulty was experienced in the vehicle mobility.



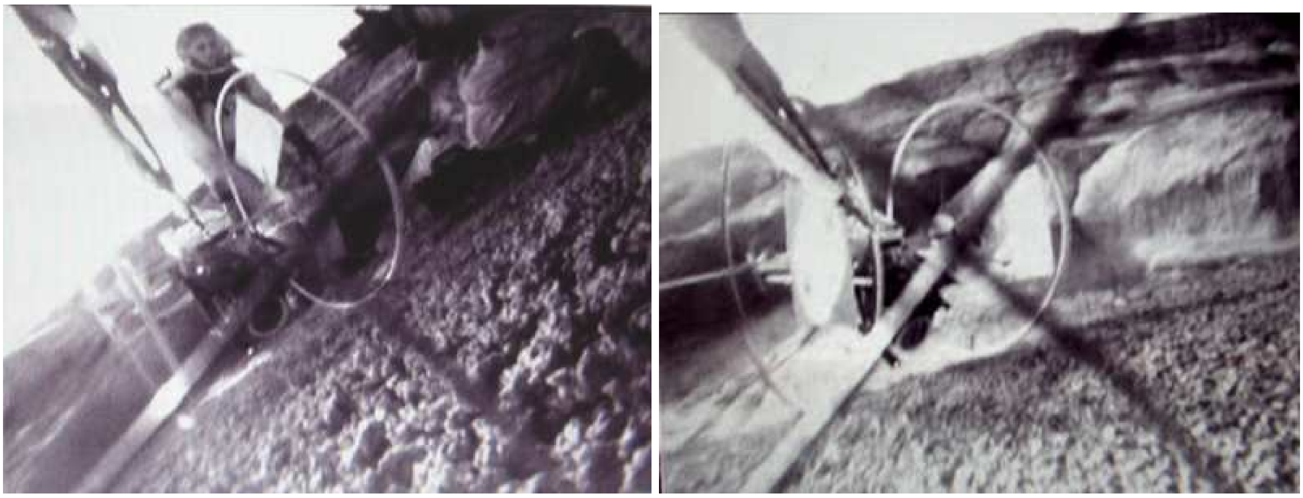
CRV 72 test localisation. CRV 68 and 69 tests localisation also indicated



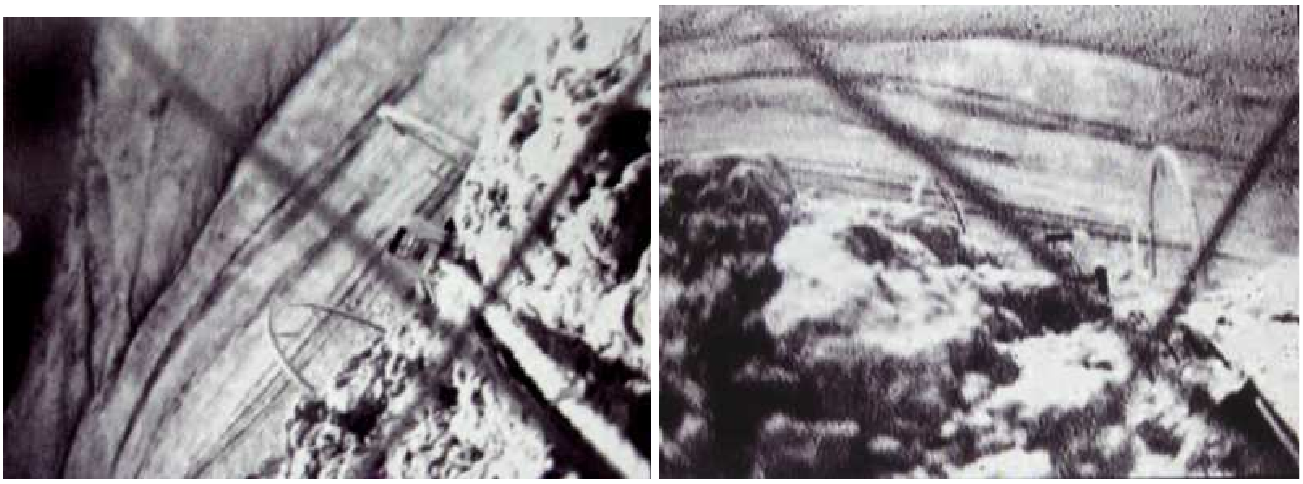
The round shape of the hill stops the video signal reception after some meters. The context camera is located in the yellow cylinder 1.3 m above the CRV (right).

As the slope transitions progressively from horizontal to vertical there is rapidly a thick layer of soil between the emitter and the receiver and the video signal is lost. When the vehicle reaches the bottom of the hill the receiver is again direct line of sight from the emitter and the video signal is again received. During all the test the video signal was recorded on Olivier’s hard drive Arcos recorder. A half down and up trip (8m) was first conducted (quick verification that the loss of signal was only the result of ground absorption) then 2 down and up trips on the full cliff length (15 m) were conducted.

The picture received up the hill (left) from the context camera and recorded (middle) on the hard drive. The X cross is the grid protecting the camera lens. On the right the CRV and 1.3m on its right the context camera yellow container.



On the left preparation of CRV test 72 seen by the context camera. On the right one of the + or 40 ° yaw oscillations of the vehicle linked to the single rope attachment point solution.



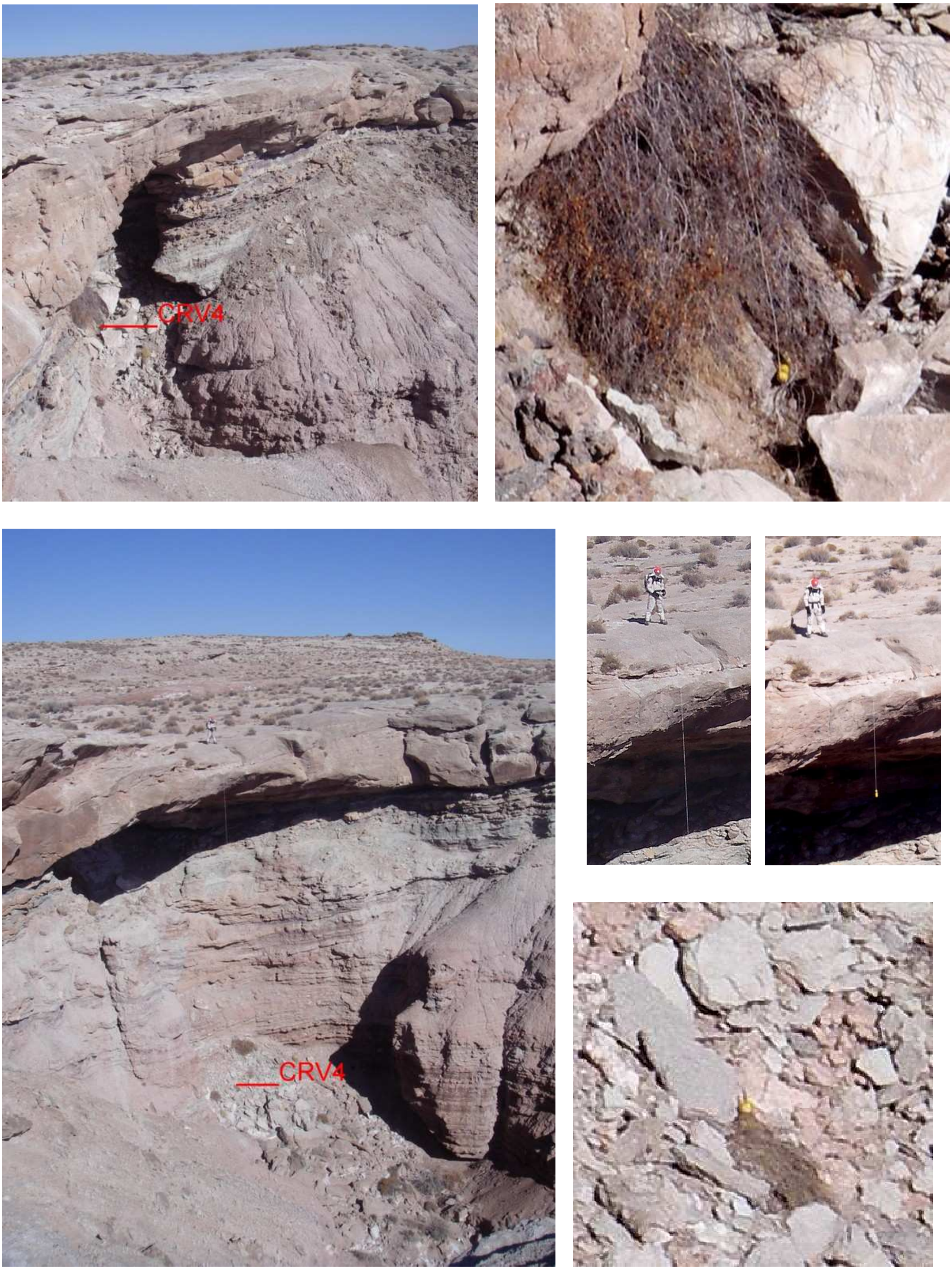
The vehicle on a change of slope which leads to a transmission black out when there is too much soil between the emitter and the receiver. On the right the transmission is degraded.

The transmission is good again when the vehicle is down the hill in direct sight from the receiver. On the right, back to the top, the CRV is portraying the operator, Jeremie.

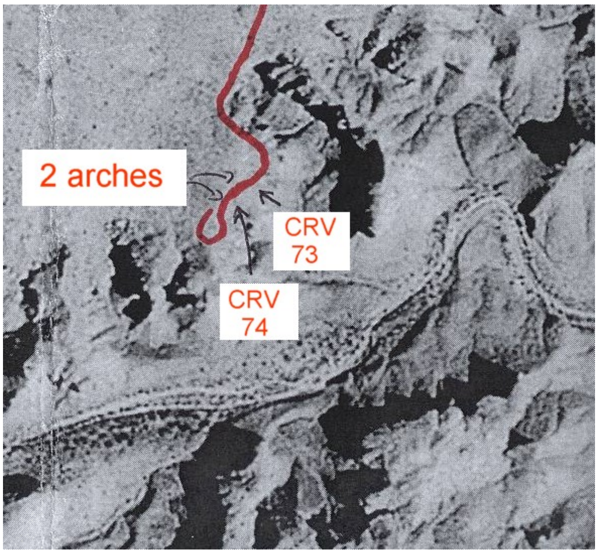
Test 73 and 74

The small container in which the context camera was located during test 72 is seen as a future configuration 4 for a CRV for steep cliffs where wheels are not needed. This configuration was tested already in France (mobility tests 62 to 65 the 18^{th} of December). The CRV 4 is only in a mock up configuration (no camera inside, only a representative weight). This configuration was tested at Candor Chasma the 10 th of February. During test 73 the CRV 4 mock up was sent down in a 50 cm wide crack in the ground communicating with a half cave (arche) in the Candor Chasma cliff. The CRV 4 went down 12 m in this test (measured from the indications along the rope) before reaching the ground. Fifty meters farther south, an other half cave is located in the Candor Chasma cliff. The CRV 4 was sent without difficulties at a depth of 22 m till the cave floor. Three down and up trips were conducted.

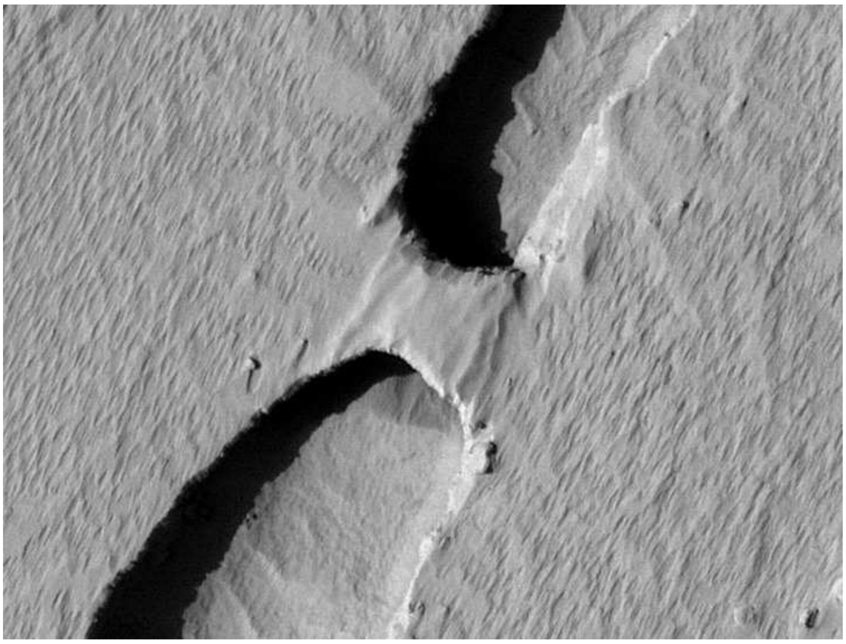
CRV test n° 73 down 12 m in a crack till the bottom of a half cave in the cliff.



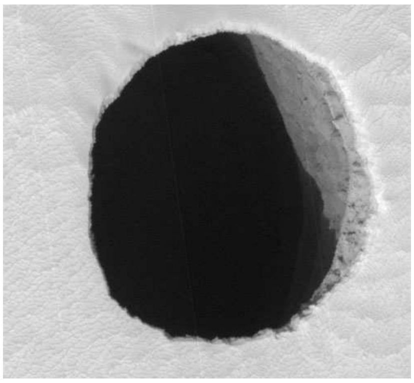
CRV test n° 74 down 22 m along a Candor Chasma cliff arche.



The southern arch **The arches localisation in Candor Chasma cliff**



These last years photos have been obtained showing interesting Martian features with steep slopes and even caves or arches as shown there. This structure in Tartarus Colles is a lava tube with a collapsed ceiling excepted in one location which remains as a large arch. This arch has roughly the same dimensions as the one in Utah Candor Chasma. It is 40 m wide and 20 m deep. (NASA/JPL/UofA - Mars Reconnaissance Orbiter)



In 2007 Mars Reconnaissance Orbiter took pictures of deep pits with vertical parts and probable overhangs: On the left on Arsia Mons (150 m in diameter), in the middle and right in Tharsia (250 and 170 m in diameter). (NASA/JPL/UofA)

Various comments on the CRV operations

For CRV transportation on the ATV we reused the device built by the team Leonardo MDRS 39 in 2005. We had to re-screw the main supporting rods in some occasions.

The CRV supporting device built by crew 39. It includes a box to carry the receiver box, the anti roll rods, the safety pole, the hammer. Velcro is used for main axis fixation with tape redundancy.

The CRV operations on the field were facilitated by the dexterity improvement devices implemented on my right glove (see dedicated chapter). The two halves of the anti roll rods have to be secured by adhesive tape. Before each CRV EVA, various lengths of tape were prepared with 3 cm of tape end overturned and stick on itself. These tapes were stored on the reception box cover. Thus for securing the anti roll rods or for any other needs, these tapes were available and could easily be grasped with the thick gloves used with the space suits.

Pre-cut strips of tape ready to be grasped with thick gloves on the receiver box cover.

There is four main batteries to operate the CRV system (plus batteries in the 2 lasers and in the torch light. Two 6 V batteries are in the emitter box on the CRV, one in the main camera, and one 12 V battery in the receiver box. When fully charged the 12 V battery has an autonomy of only 40 mn (in continuous mode and more in intermittent mode) because the TV monitor has a rather high consumption (15W / 1.2 A). The others 6 V batteries have a far longer autonomy. The CRV operations

check list indicates that after initial testing the monitor should be off when the context camera picture is not needed. This procedure was used and no power shortage was noticed during CRV operations on the field.
Globally the testing conducted on the CRV during mission MDRS 43 have been improvement tests (either in the vehicle configuration or operations) and also mobility tests. This is not representative of what would be the operations of a CRV type vehicle on Mars where it would be used to spot interesting areas. We have not used in our simulation the vehicle for this purpose. We could have done it, choosing cliffs for their geological interest and then analysing the pictures to detect interesting features but our objective was mainly to improve the vehicle behaviour and operations not to check its usefulness. However videos were taken during tests 70 (White Rock Canyon) and 71 (Stacy's Cake). They are presented in the next §.
Also what was representative of a true martian situation is the vehicle operations which were conducted in full simulation. There was no special difficulties during these operations whereas it has to be considered that a true operational vehicle would have a better operability than our prototype demonstrator.

MDRS 43 CRV pictures presentation

The on board camera was activated during tests 70 and 71. Photos captured from the video are presented thereafter for those two tests.

- CRV test 70 at White Rock Canyon:

On the left the camera has just been started (at T0+ 00.13 in mn and s) . On the right the two operators seen by the vehicle at the beginning of the descent (T0+8.40) .

On the left the two laser spots, 20 cm apart, to give a size reference for objects in the field of view, may be seen in the picture upper part (T0+8.58). During this CRV 70 test, the left laser stopped operating at the beginning of the descent. On the right: looking under an overhanging (T0+ 9.18).

On the left just under the overhanging appears the vehicle shadow (T0+9.19). On the right, as the platform supporting the camera is free in pitch oscillations, the camera is momentarily looking upwards under the overhanging part of the cliff (T0+9.20).

On the left, alternate layers of sandstone and clay (T0+11.36). On the right the picture shows thin white layers: salt or quartz? (T0+12.41).

On the left, in the lower part of the picture a green area of clay is visible. The right laser spot may be seen in the upper right (T0+20.22). On the right a harder sandstone layer is protruding from the cliff (T0+39.29).

Looking temporarily sideways the CRV sees the bottom of White Rock Canyon (T0+ 39.40).

At T0+40.30 the vehicle is again at the top of the cliff. The camera is stopped at T0+50mn.

The pictures taken on board may be assembled to build a photographic map of the cliff as presented thereafter.

These photos show the first 1.5 meter of the White Rock cliff from the upper part (flat rock upper left) to the overhanging (down right). The pictures clarity is somehow reduced by a black streak coming from something stuck on the container porthole and from the vehicle shadow which position is changing from one photo to the other .

Overhanging

An other vertical panorama of the White Rock Canyon cliff with the blue receiver box at the top.

Overhang

Alternative layers of clay and sandstone

- **CRV test 71 at Stacy's Cake:**


Beginning of the test at T0+53.50 (arbitrary time reference). The cliff at T0+54.18.

The two laser spots visible in the upper quarter of the picture are 20cm apart (T0+54.30).


At T0+54.34 arrival on a small platform


Very rough terrain (T0+1.03.01)

Small overhanging (T0+1.03.02)

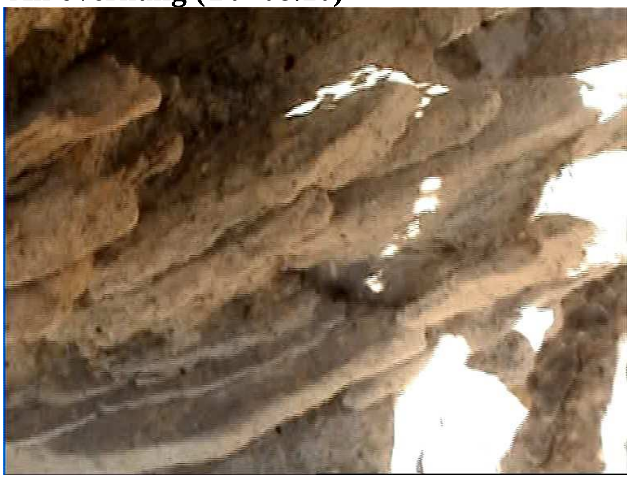
On the left one half anti roll rod separated from the vehicle (T0+1.03.30)


Loss of the plastic circle around the camera container porthole (T0+1.04.36 and 38). The vehicle is stuck at the same place and will not move a lot despite various attempts.


The suspension ropes (T0+1.04.39)


An overhang (T0+08.10)


A half anti roll rod on the left (T0+1.12.02).


Layers at T0+1.12.40


View opposite to the cliff towards Henry Mountain (T0+1.19.04)


The cliff above (T0+ 1.30)

Retrieval intervention out of sim (T0+1.43.12)

4.4. Balloon carried camera operations and results

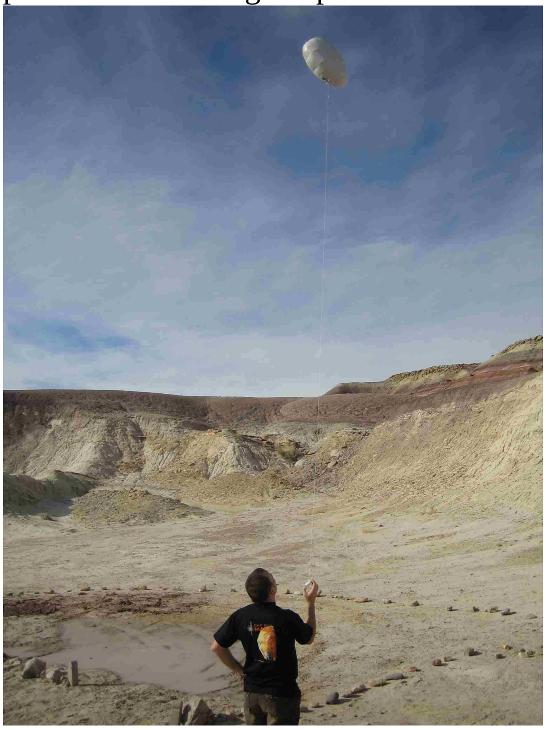
by Olivier Walter and Alain Souchier

Starting from his personal experience as architect, Olivier Walter proposed using a balloon carrying a camera to map the terrain during EVAs as well as monitoring crew activity. In the architecture area of activities, such a device is used to map areas which are not flat or difficult in access or having already buildings on them.

We had naturally to provide a helium bottle in Salt Lake City. John Barainca from Salt Lake very kindly organized the operation and brought the bottle to the Comfort Inn where we found it at our arrival, thus sparing a lot of time for the start of our mission. The bottle was brought to MDRS with the first trip of the crew in the Mars Society blue truck. Olivier Walter arrived at the MDRS the 3rd of February carrying the balloon, the camera, the receiver and the hard drive Arcos recorder. Testing started the same day inside the Hab including inflating the (small) balloon. However it appeared soon that there was a defect probably in the camera which has also a built in emitter. A picture was seen briefly on the recorder screen but we were not able to get it again. The reception on the CRV receiver and monitor was attempted but, after some picture indications, the same negative results were obtained.

First test of the balloon (left) and unsuccessful test of picture reception on the receiver and hard drive recorder (right).

The following day, during EVA 14, the balloon was carried to the rim of Upheaval Dome Crater for first in sim tests. However a small deflation of the balloon did not allow lifting the load of the camera and as the helium bottle was not carried in the trip the re-inflation was not possible. The EVA then proceeded to testing the pole mounted camera.



The balloon in good shape before EVA 14 (left) and in a poor shape at Upheaval Dome (under).

The balloon experiment came to its lowest point during EVA 21 the 8th of February. As the only way found to have an operational camera was to use the context camera box from the CRV we needed extra lift. The CRV context camera box has a mass of 500 g mainly because of the batteries mass. The EVA 21 had the objective of measuring the main balloon lift as well as looking at the possibility of adding the extra lift of large plastic bags to the main balloon. The main balloon lift force was found at 150 g (1.5 N) and the plastic bags lift force was found at 20 g. A large cluster of plastic bags would have been needed to complement the main balloon in order to lift 500 g! Anyhow during the EVA the main balloon was lost. What went on afterwards, to finally succeed in taking pictures from a balloon, is a good example of what can be achieved by using available materials and some creativity at MDRS and this lesson probably applies too to actual future planetary explorations. As we had two Mylar safety covers we decided to build a new balloon by bonding together the two covers with an adhesive tape with two bonding sides. Olivier built the new balloon the 8th of February and inflation tests were conducted in the evening.

EVA 21 tested the lift capacity of the balloon and a plastic bag (left).
Under, it is not the moon, but the main balloon escaping to an unexpected exploration on its own of the upper atmosphere

Olivier building a new balloon from Mylar sheets (under). The 8th in the evening (9.45 pm) the new balloon is ready (right). The CRV is in the forefront.

The new balloon was ready for EVA 23 the 9th of February in the morning. The EVA was conducted by Olivier Walter and Pierre Brulhet with Alain Souchier out of sim in order to step in the process in case of difficulties. The payload was the CRV context camera and emitter box which amounts to 500 g mass. The context camera was equipped with sunglasses following the lessons learned from the CRV testing. The payload was attached by two ropes at the balloon lower corners but with only one attachment point at the box level. This allowed for a rotation of the box around the vertical axis which was disturbing for pictures viewing and still captures. The pictures were received on the CRV black and white monitor as well as recorded on Olivier's Arcos hard drive connected on the "out" port of the video monitor. The balloon was secured by 2 ropes, one attached to one of the lower corners and the other one to one of the upper corners. We left the Hab with the balloon already inflated. Two astronauts and the balloon could hold inside the airlock rather easily. This would not be the case for an actual martian balloon which would need a volume 77 times bigger (so 4.25 times bigger in every dimension) . The calculation shows easily that the balloon volume has no relation with the gravity but is only proportional to the atmospheric specific density. Naturally the payload could be miniaturised and reduced from the 500 g we had to around probably 100 g. In this case the balloon volume needed would be only 15 times the volume we had, and the dimensions would have to be only 2.5 times bigger. Anyhow the inflation would have to be done outside.

Two astronauts and a balloon in the airlock (not possible on Mars, the volume would be far bigger). On the ground the CRV box.

The balloon and the CRV box as payload On the left the two ropes, one linked to the upper part, the other to the payload support lines. The balloon is slightly deflated.

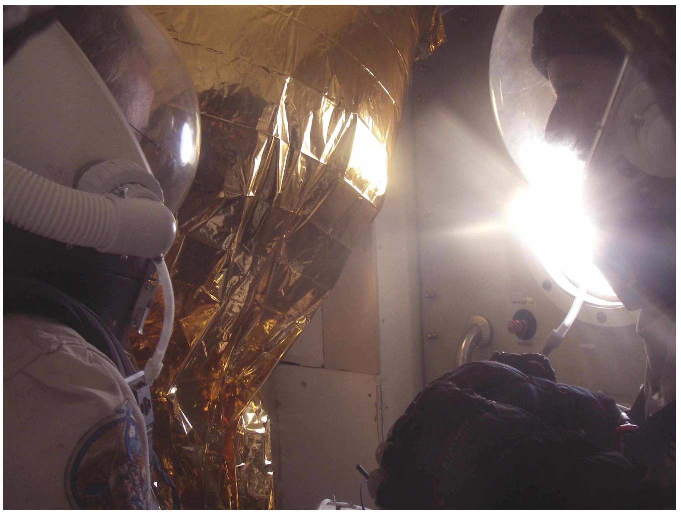
We needed a total of four inflations during the EVA. We quickly discovered a hole in the mylar not far from the inlet tube. This hole came from the flutter in the mylar skin during the inflation. We used one of the pre-cut adhesive tapes which were on the CRV receiver box to close the gap. After a second inflation, we discovered an other hole at the same location but on the balloon opposite side. The same remedy was applied. After a third inflation the balloon was guided by the two crewmembers in simulated spacesuits to fly over the Hab. After a third inflation a trip was conducted in the flats around including a trip of the balloon above the observatory.

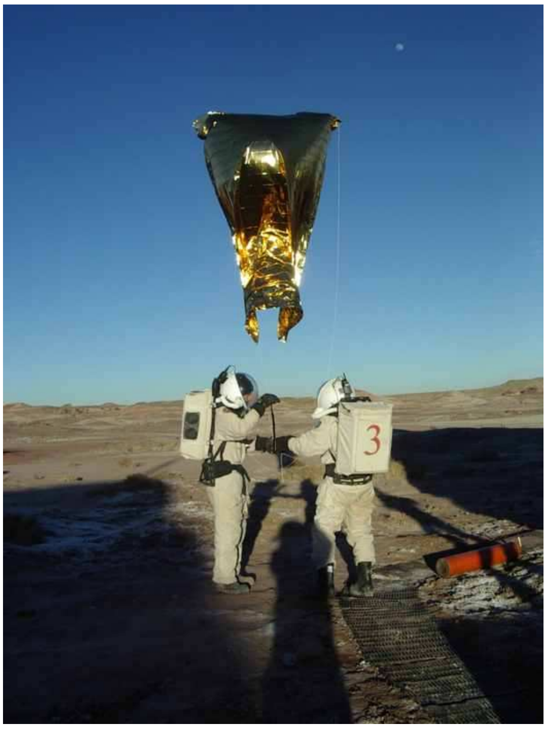
 

After the EVA the picture examination showed that the pictures were still a little too bright. It was decided to take as a payload for the next test, Pierre’s mini DV video camera. The camera would be started before the flight. No emitter would be used, the video being analysed after the EVA. Also using the mini DV camera had the advantage of acquiring colour pictures whereas the camera used during EVA 23 sent black and white pictures.

After a new leak repair the balloon was ready for EVA 25 which started at 5 pm in the sunset. The operators were, as in the morning, Pierre Brulhet and Olivier Walter. Richard Heidmann was also in the EVA team in spacesuit and Jeremie followed, out of sim, to step in the operations in case of difficulties. The three astronauts and the balloon (partially inflated) could fit in the airlock; However one of the astronauts was sitting on the airlock ground during the depressurization simulation. The balloon and payload attachment points were the same as in the morning EVA. As the payload was attached in single point, rotations of the camera box were also experienced. Pictures of the Hab roof were taken and a total of 20 mn of video were recorded.

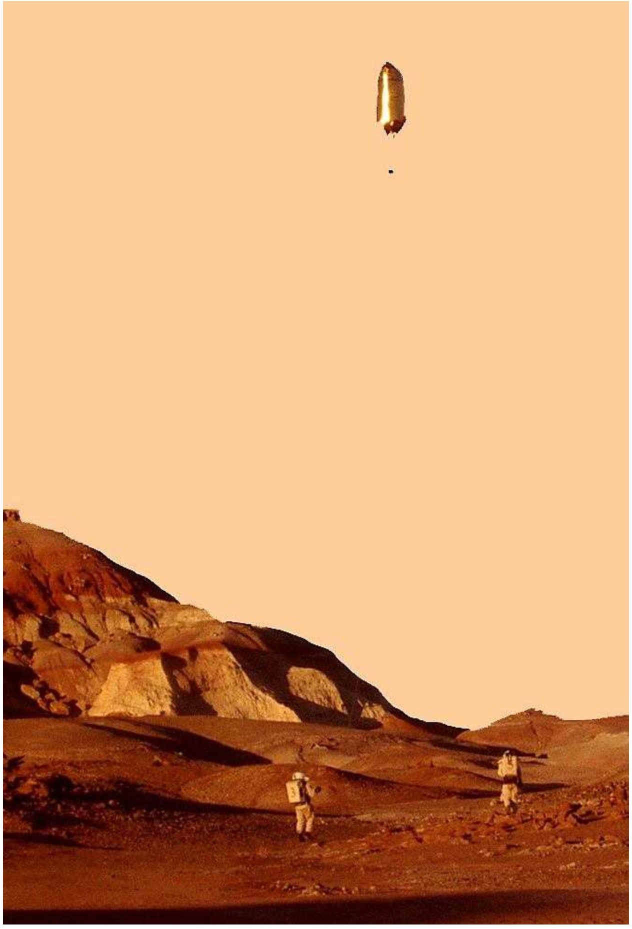
Three in the airlock with a partially inflated balloon. One of the crewmember has to sit on the airlock ground.



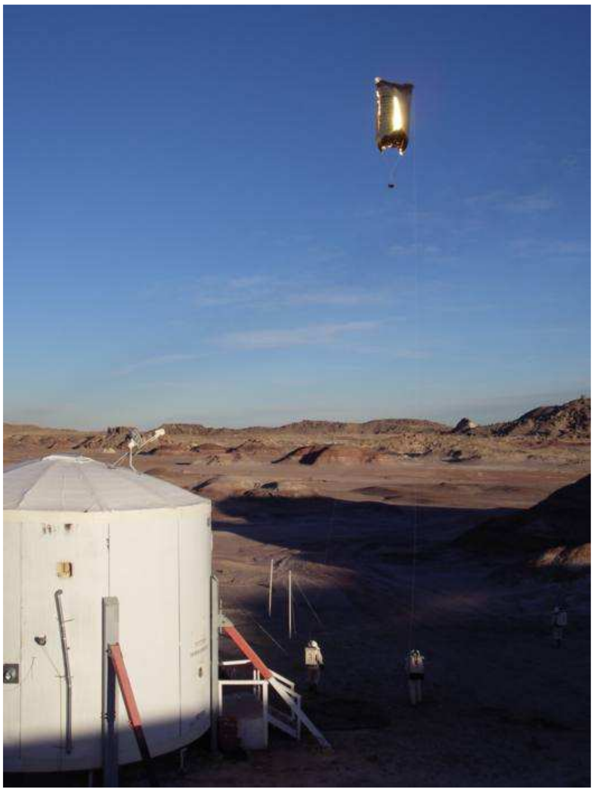


Preparation for inflation (left). The red helium bottle is on the right. Balloon inflation in spacesuit (under).

The balloon and payload attachment in the same configuration as in the morning EVA but with a mini DV camera as payload.



The balloon and its operators in a Martian light



The balloon altitude was limited to 20 m by the ropes (left). Picture obtained when flying above the Hab (under).

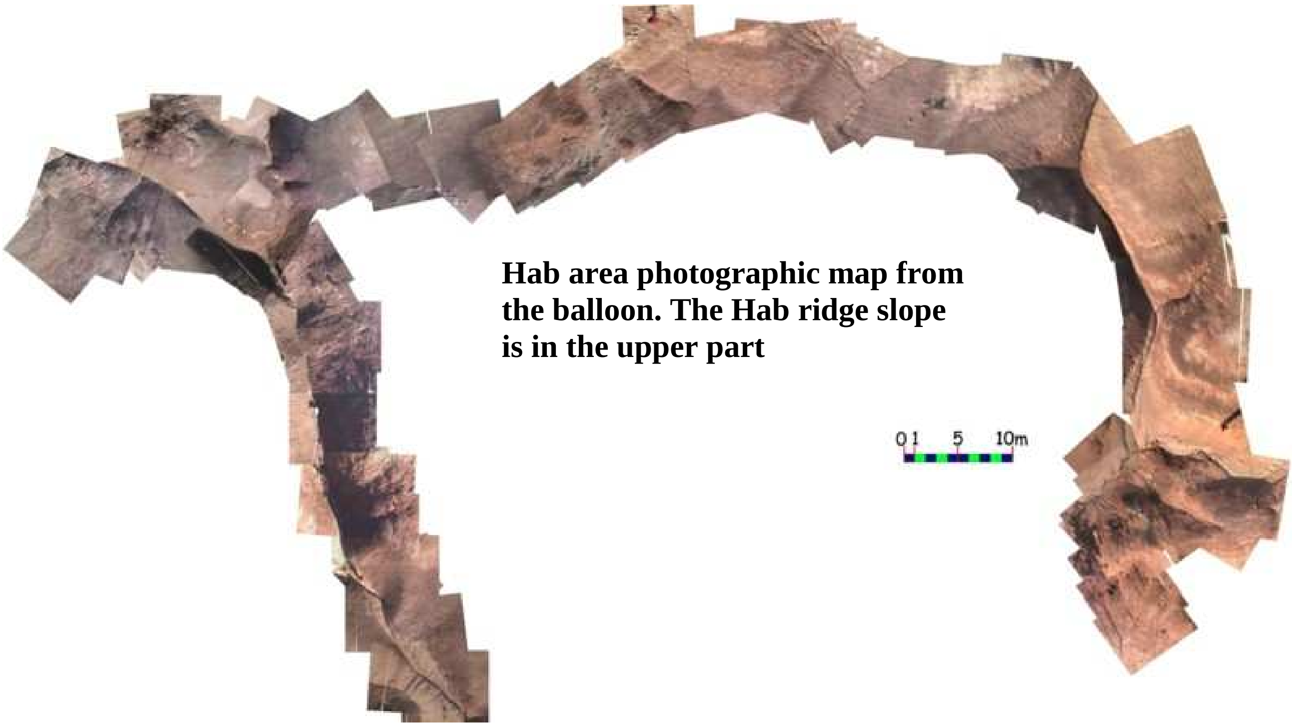
The 10 th of February the weather was too windy to allow a balloon oriented EVA. The final improvement which we wanted to test was the camera box stabilisation in rotation. The 10th was used to prepare the new suspension device for the camera box: two ropes at the two lower balloon corners linked to an horizontal rod supporting the camera box in its middle.

The new camera box fixation to avoid rotation around a vertical axis.

The 11th of February was a “out of sim” day because we started cleaning the Hab and the spacesuits. So a “out of sim EVA” was conducted by Pierre Brulhet and Olivier Walter around the Hab. The balloon was driven along the following path: above the Hab, the dirt road near the Hab, back to the Hab and ATVs, the observatory, the flats near the Hab, a small valley in the Hab ridge, the flats around the Hab, back to the dirt road, the ATVs, the engineering zone, and back to the Hab. 35 mn of video have been taken including 25 mn in altitude. The video has been used to produce nice pictures which has been assembled in photographic maps (see thereafter).

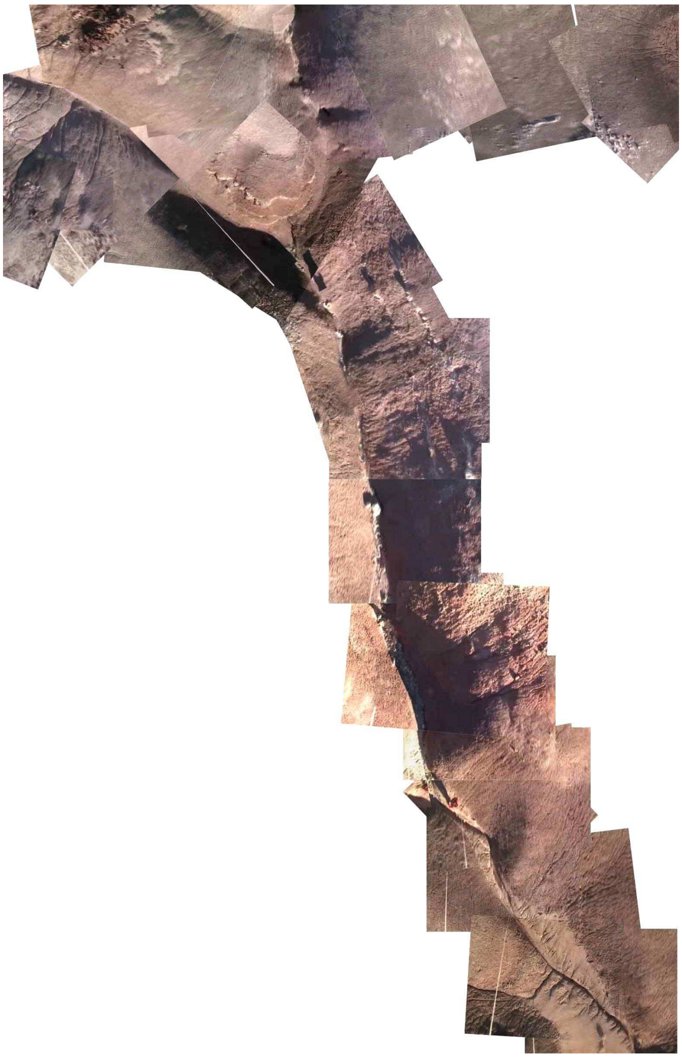
The astronomical observatory

The Hab as seen from above at 20 m altitude (left). Some pictures of gullies around the Hab (under). In most cases the picture scale cannot be guessed. Same type of landscape could probably be photographed with field of views of some square kilometres whereas the field sides are here at around 10 to 20 m.



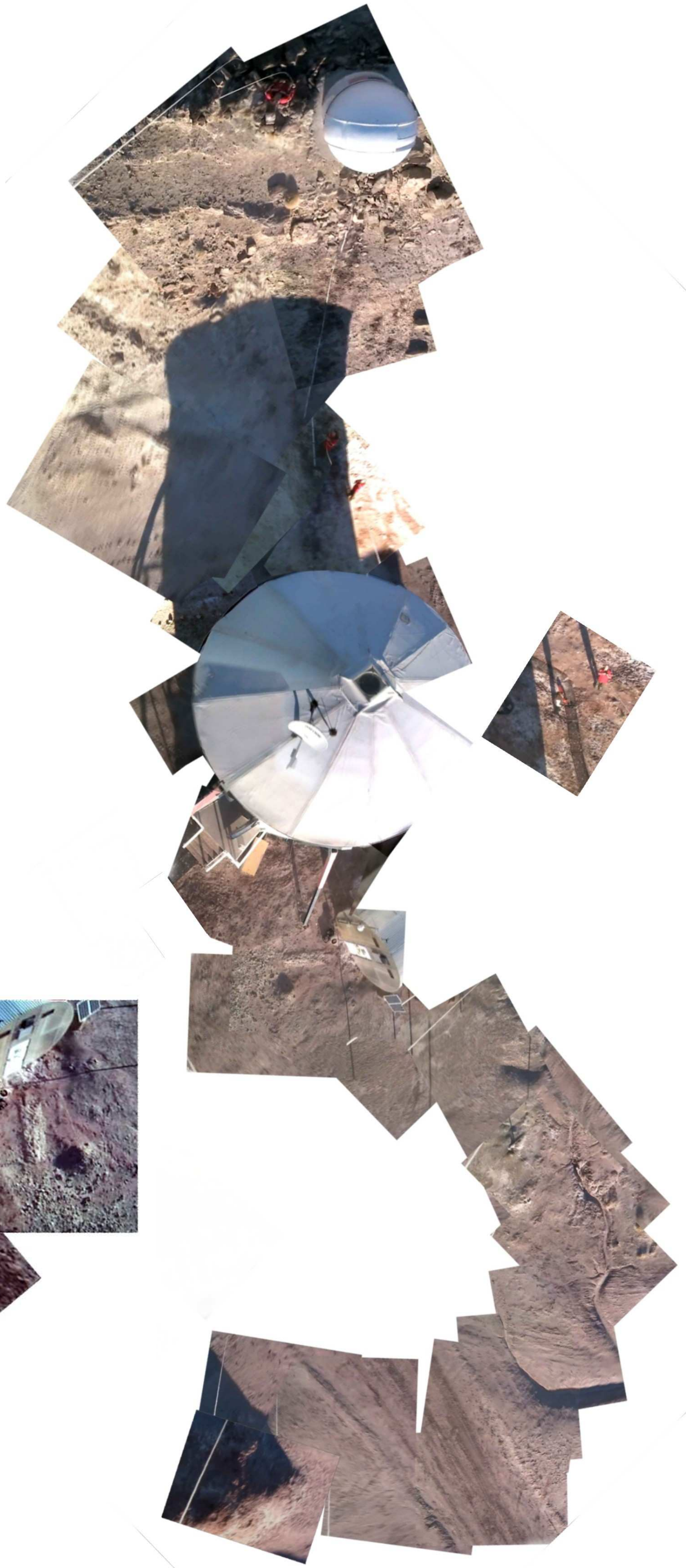
Hab area photographic map from the balloon. The Hab ridge slope is in the upper part

Zoom on the left gully.



Zoom on the right gully.

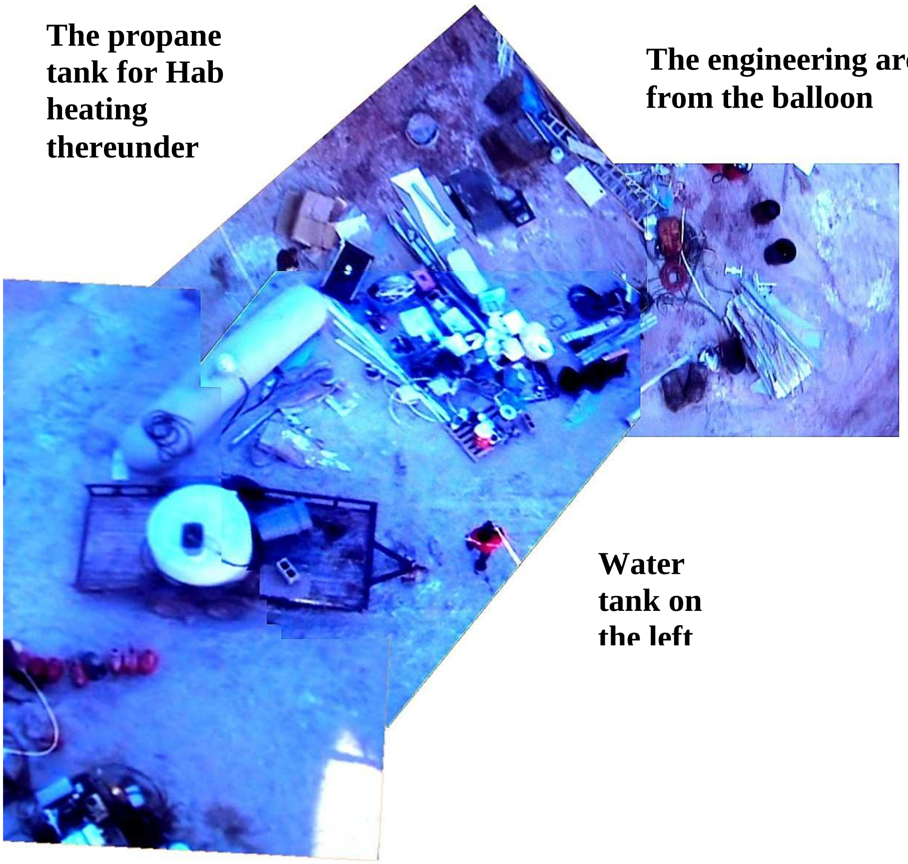
The Hab area: from the astronomical observatory to the dirt road towards Lowell Highway



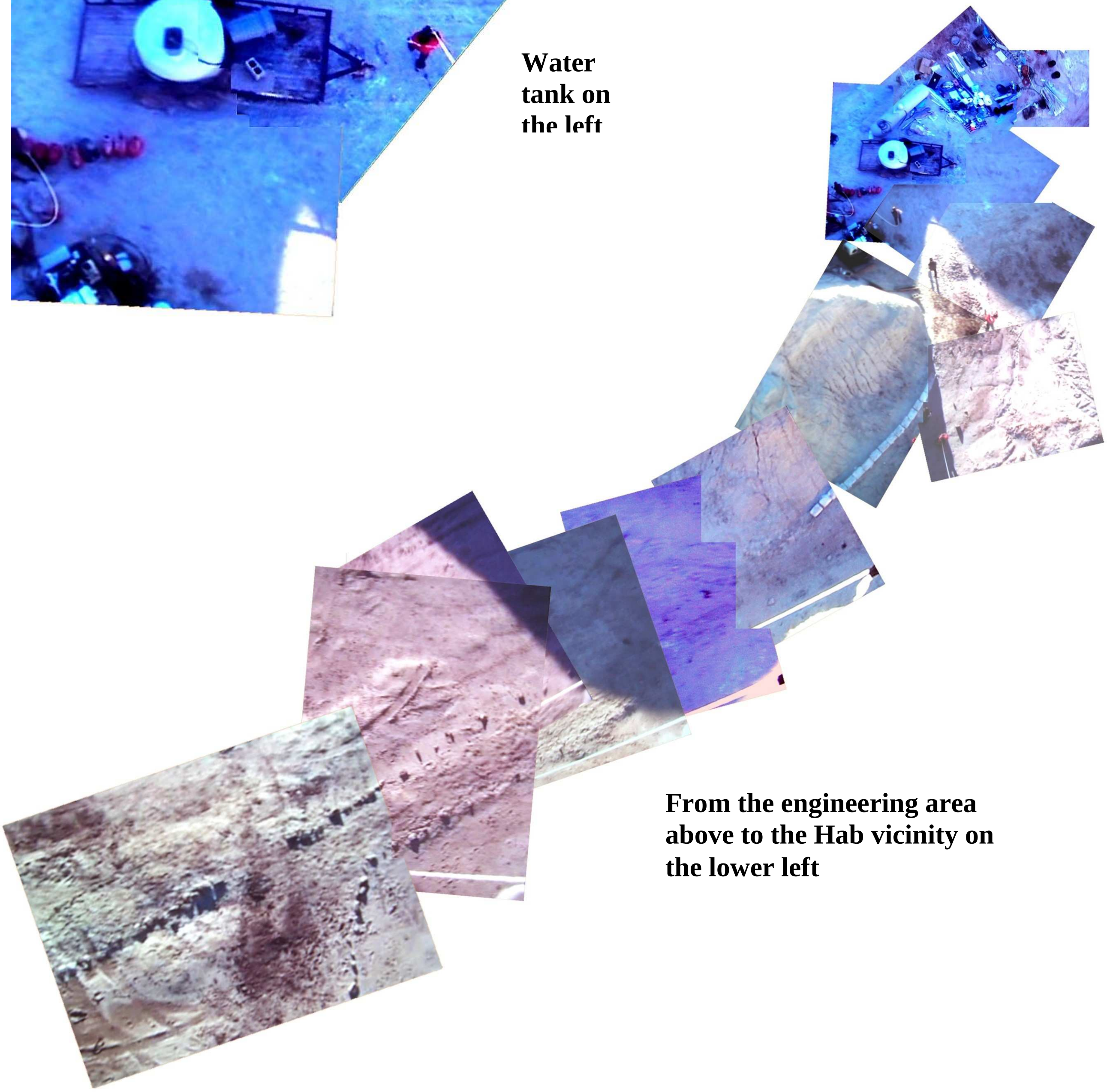
The Hab and the green house

The propane tank for Hab heating thereunder

The engineering area from the balloon

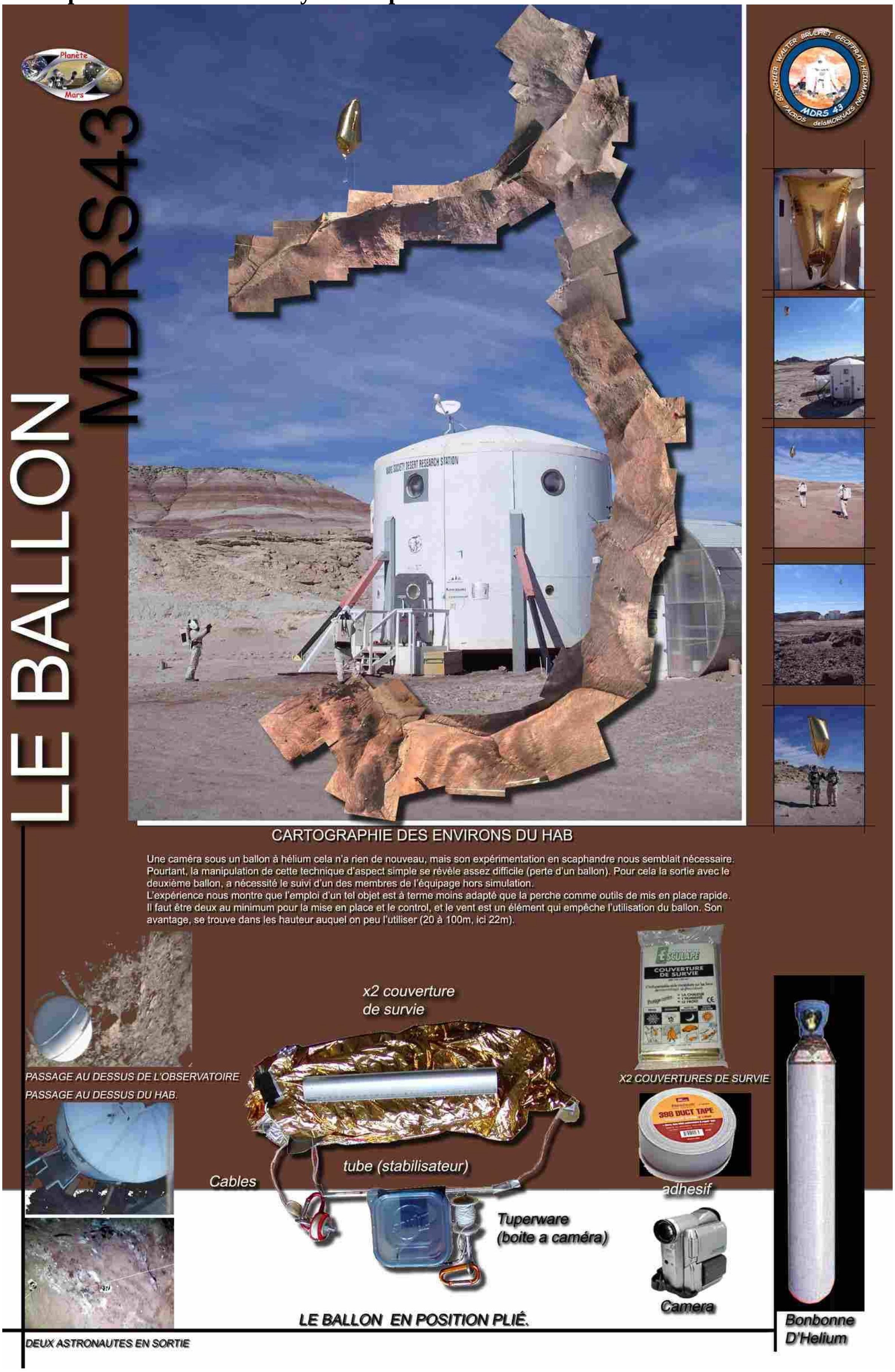


Water tank on the left



From the engineering area above to the Hab vicinity on the lower left

Balloon experiment at MDRS – Synthetic presentation



The Martian balloon dimensioning

Painting by Manchu

Ve = Balloon volume on earth
ge = Earth gravity
Roa = Specific mass of air on earth at 283 K and 1 bar
Rohe = Specific mass of helium on earth at 283 K and 1 bar
m = Payload mass

Vm = Balloon volume on Mars
gm = Mars gravity
Roc = Specific mass of CO2 on Mars at 243 K and 0.007 bar
Rohm = Specific mass of helium on Mars at 243 K and 0.007 bar

On earth, equalizing weight and balloon lift:
m. ge = (Roa-Rohe).ge.Ve and Ve = m/(Roa-Rohe)

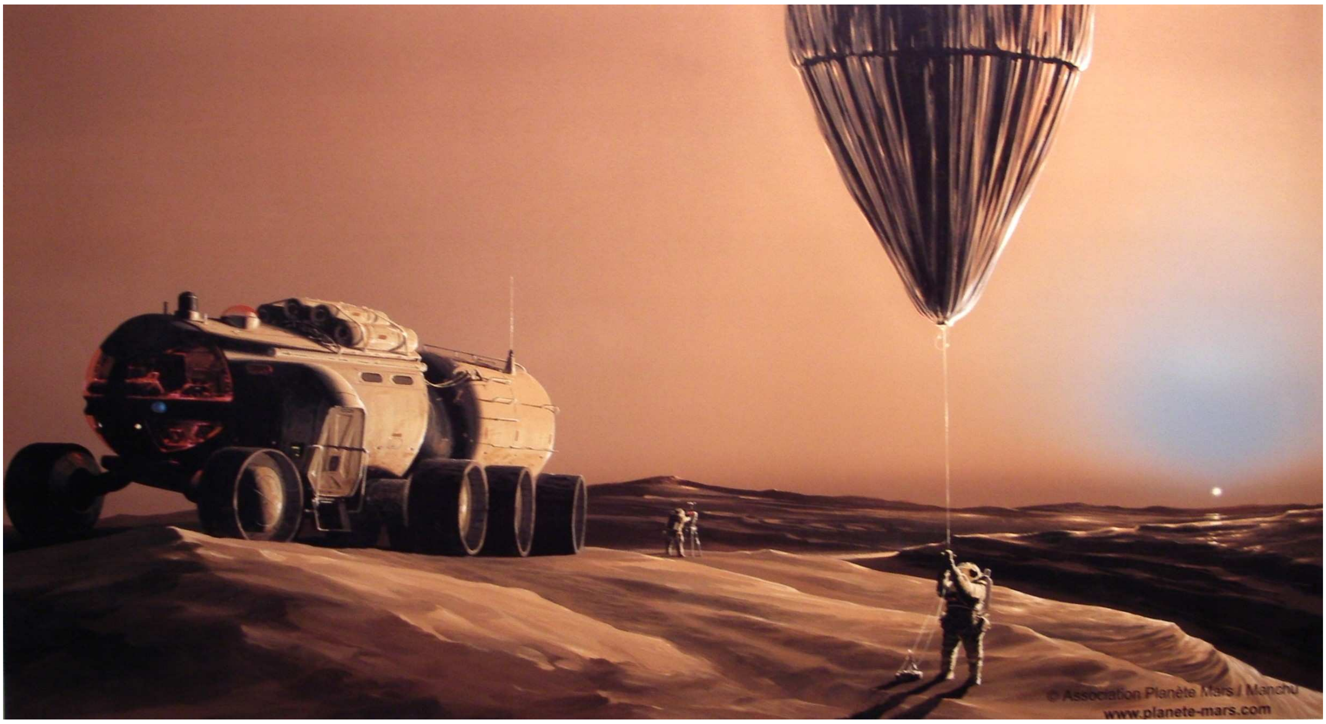
The specific mass of air at 273 °K and 1 bar is 1.293 kg/m3
Thus: Roa = 1.293 . 273/283 = 1.247
In the same way Rohe = (4/22.4). 273/283 = 0.172kg/m3
And Ve = m/1.075 = 0.93 m

On Mars: m.gm = (Roc-Rohm). gm.Vm and Vm = m/(Roc-Rohm)
As on earth, gravity has no influence on the solution. The main factor defining the balloon volume is the atmospheric density. The atmospheric pressure divides the specific mass by roughly 140 and the CO2 specific mass being 1.5 higher than the air specific mass, the balloon volume will have to be multiplied by 140/1.5 roughly 100, temperature being a secondary correction factor:
Roc = (44/22.4).(7/1000).(273/243)=0.0154 kg/m3
Rohm = (4/22.4).(7/1000).(273/243)=0.0014 kg/m3
Thus: Vm = m/(0.0154-0.0014) = 71.4 m

And finally Ve = 76.8 Vm

The Martian balloon will be 77 times bigger in volume than the earth balloon lifting the same load. Its dimensions will be 4.25 larger.
We may assume that the payload carried by a true Martian version of the balloon will be miniaturized. In our last configuration the recording was done on board. On an operational device, the recording will be conducted on the ground. Thus a 100 g payload may be a good assumption and in this case the balloon volume will be only 15 time bigger than our MDRS 43 balloon which means only 2.5 times larger in every dimensions. Our MDRS 43 balloon was built from two 1.4 by 2.2 m mylar covers. A Martian balloon for a light payload could be built from two 3.5 by 5.5 m mylar sheets.

Our balloon experimented inspired the following painting by Manchu, a renowned science fiction and Martian landscapes painter.

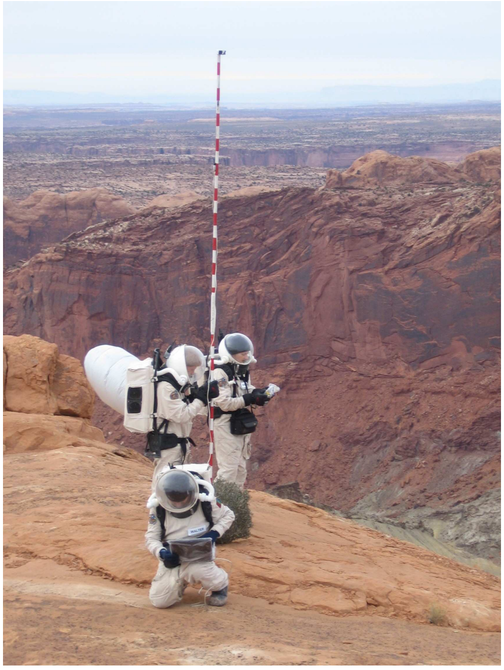


4.5. Pole carried camera operations and results

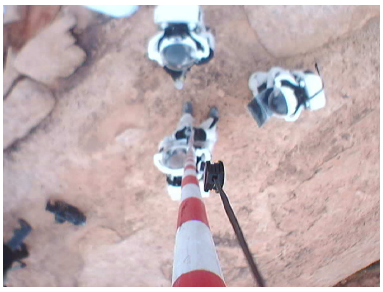
by Alain Souchier and Olivier Walter

Olivier Walter proposed using a camera carried on a 4.5 m pole in order to explore inaccessible areas like small cliffs or large boulders upper part. Also this system could be used on an ATV to map the ways which are followed during EVAs. This experimentation was not conducted.

The first test of the pole carried camera was conducted by Olivier and Pierre during EVA 14 the 4th of February on the Upheaval dome meteoritic crater rim. The camera pictures are directly recorded on a laptop.



First pole carried camera test during EVA 14 on the rim of Upheaval Dome meteoritic crater.

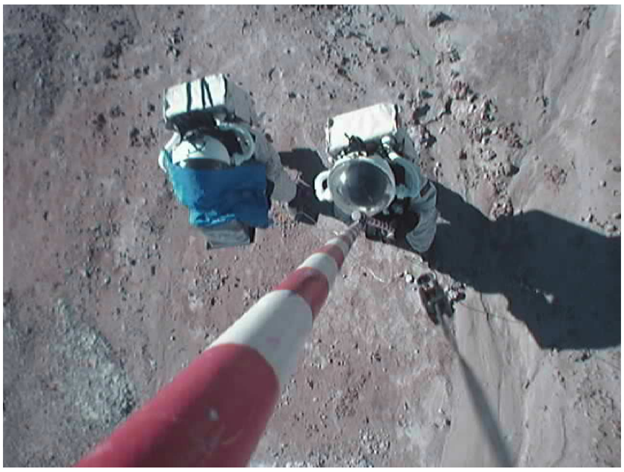


The second test occurred the following day during EVA 15. Olivier and Pierre climbed the Hab Ridge and operated the system up the Ridge. The lap top screen was difficult to observe so a sun screen was built for the following EVA.

EVA 15 on the Hab Ridge

The 6th of February Olivier and Pierre went to Bob Rocks garden during EVA 17 to benefit from an interesting landscape with cliffs and boulders. Around one hundred photos were taken. The sunscreen proved very efficient. Also the screen characters and icons were enlarged to present a better visibility.


EVA 17 at Bob Rocks Garden

Looking on the upper side of a large boulder.

The 7th of February during EVA 22, Olivier, Pierre and Alain went to Lith Canyon to test again the pole carried camera.

In Lith Canyon during EVA 22

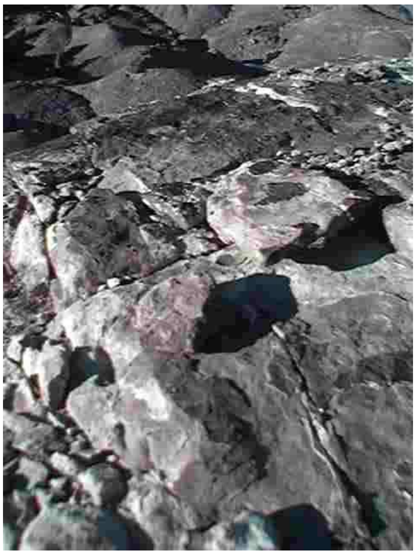
The sun screen box used to observe the laptop screen during the pole mounted camera operations

Main localisation of pole mounted camera operations in Lith Canyon during EVA 22

The 8th of February a new EVA was conducted to Lith Canyon to operate the system. The crew consisted in Richard, Olivier and Pierre. A rock wall was documented. The camera went a little out of focus and the picture observation on the laptop screen through the helmet was not accurate enough to detect this anomaly. The pictures are however useable.

Observation of a transition zone between layers with the pole mounted camera in Lith Canyon.





A cliff top as seen by the pole mounted camera.



Other pictures from the pole mounted camera.

Back to the ATVs.

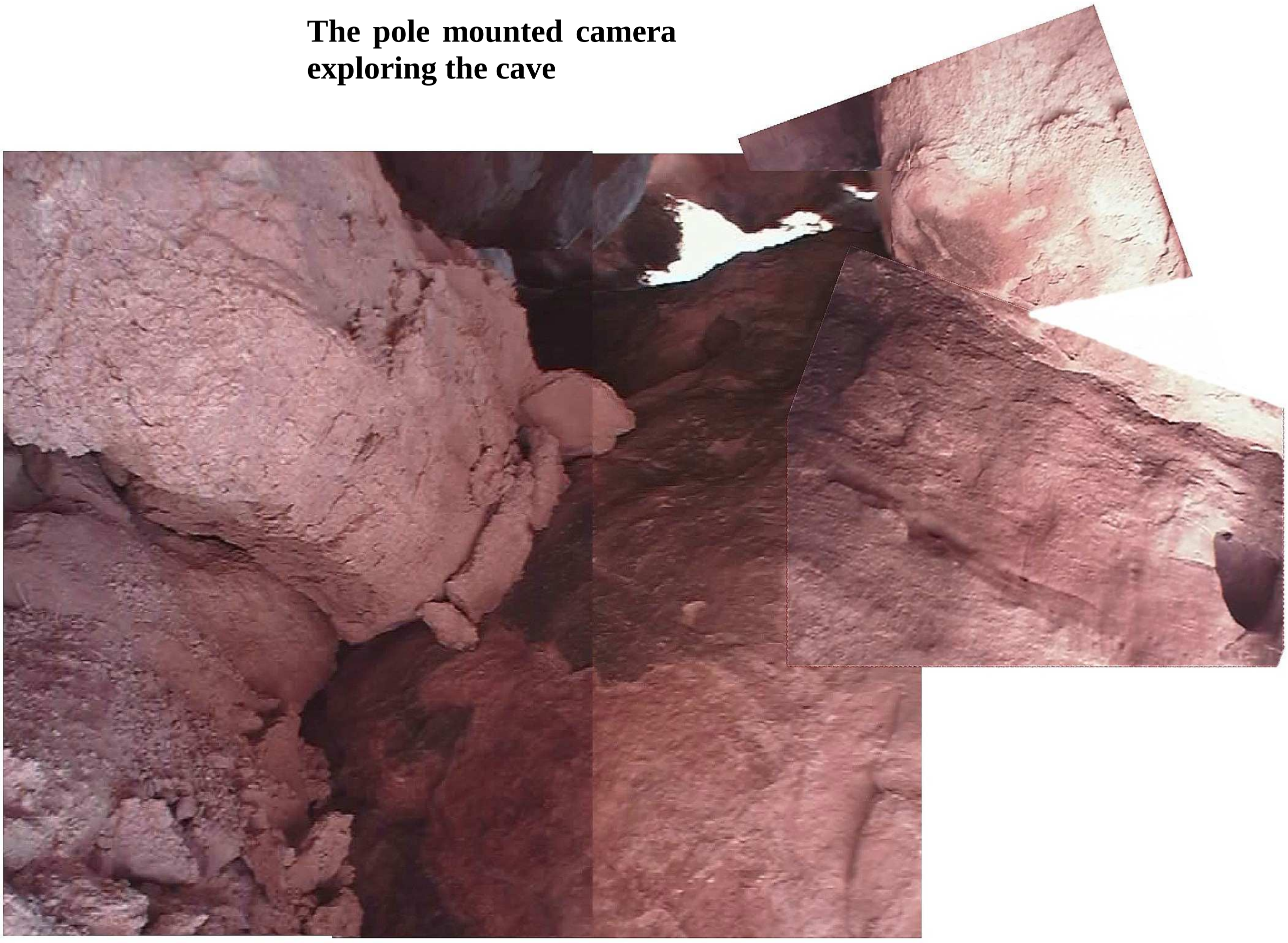
The 10th of February during EVA 27, Olivier and Pierre, benefiting from the identification of interesting cliffs in preceding EVAs in Cactus Road in the wash leading to Candor Chasma, experimented again the system and were able to send the camera looking in a small cave up on a cliff. A cliff cartography was elaborated afterwards using the Autocad software brought initially for the Hab drawings.

Cliff in the Cactus Road wash which was mapped with the pole mounted camera including exploration of a cave (arrows).

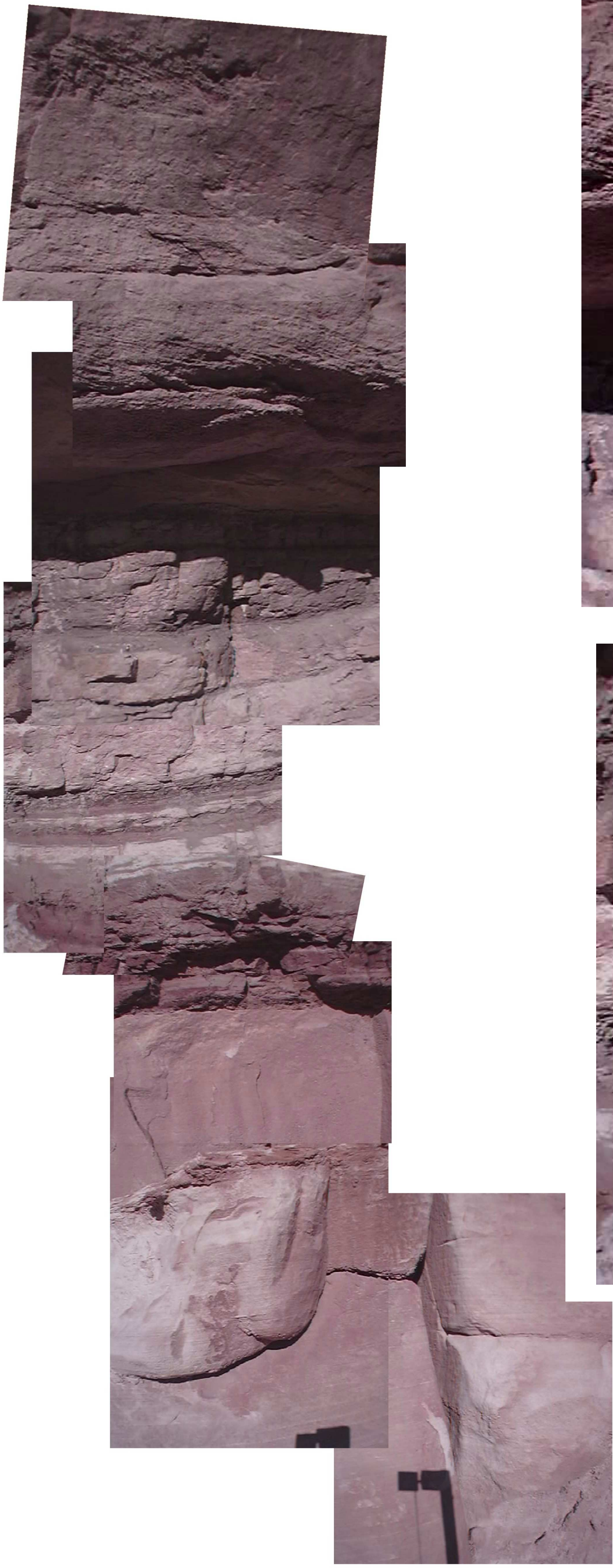
Cave localisation in a cliff along Cactus Road on the wash left bank

The cave entrance seen from outside

The pole mounted camera exploring the cave

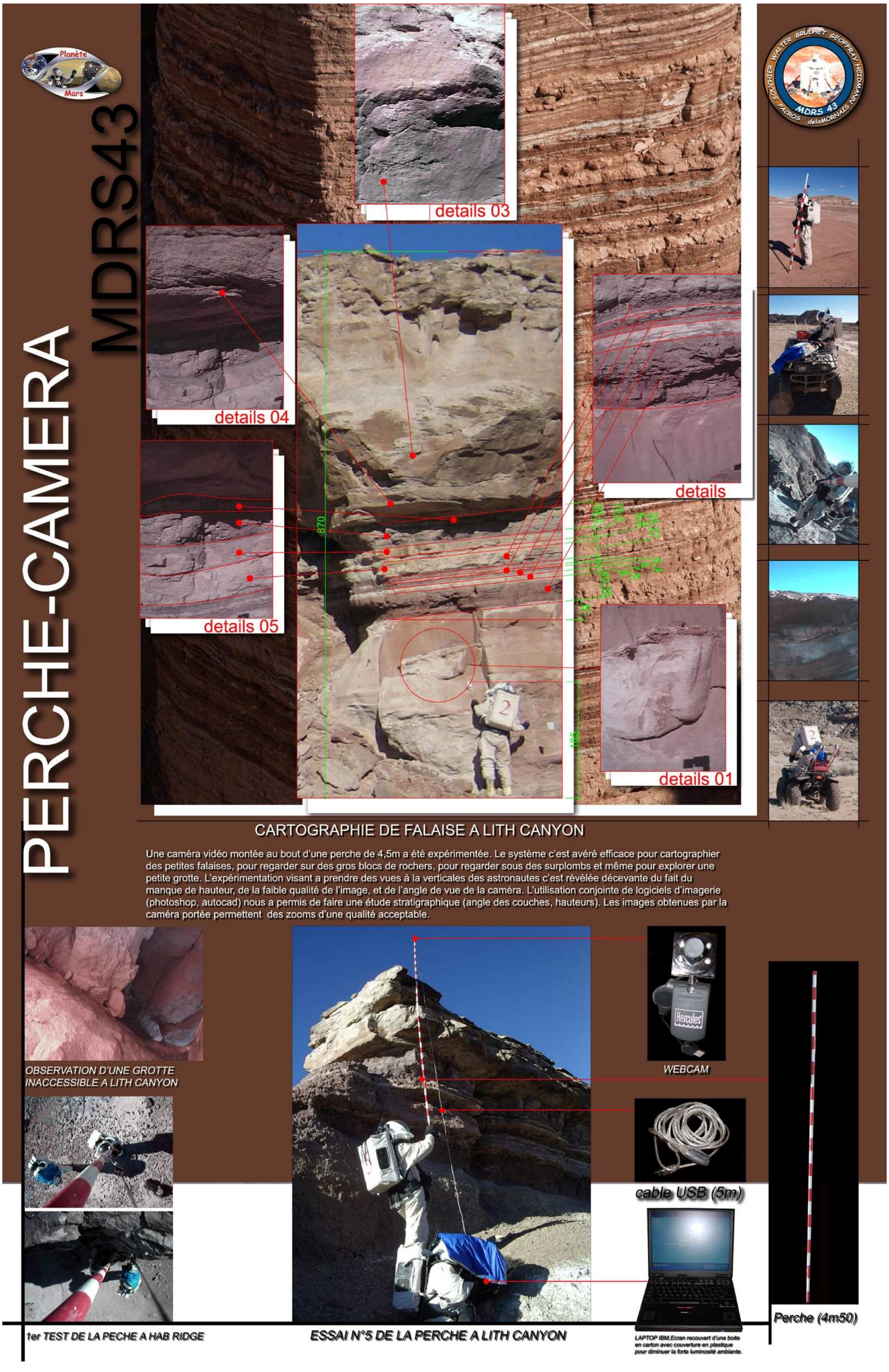


The pole mounted camera exploring the cave



Cliff vertical panorama on the cave right side

Stratigraphy dimensional analysis
Pole carried camera experimentation – Synthetic presentation



4.6. Dexterity improvement devices on gloves (or others)

by Alain Souchier

Various configurations of dexterity improvements devices were experimented on the gloves. In the following lines the fingers will be designated 1 to 5 starting from the thumb:

- Right glove (A1) with a small rod longer than finger 2, with an other rod shorter than finger 3 but fixed to the lower part of the finger and thus protruding only when the finger is bent. Tested by Alain the monday 31st of January.
- Same glove with addition of a small rod longer than finger 5 (A2). Tested by Alain, Anne, Jeremie, Loic.
- Same glove without the finger 2 rod (A3). Tested by Alain in EVA 24 and 26.
- Right glove (B) with a small rod longer than finger 5. Tested by Jeremie
- Left glove (C) with a little 5 mm spur on the inner part of finger 2 plus a small rod longer than finger 2. Tested by Richard.
- Right glove (D) with a little 5 mm spur on the inner part of the finger 2. Tested by Pierre and Olivier.

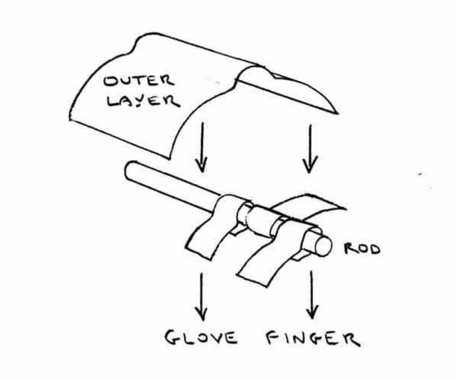
Olivier and Richard tested also small pliers as a very useful help to work on difficult things (as opening a roll of adhesive tape!)

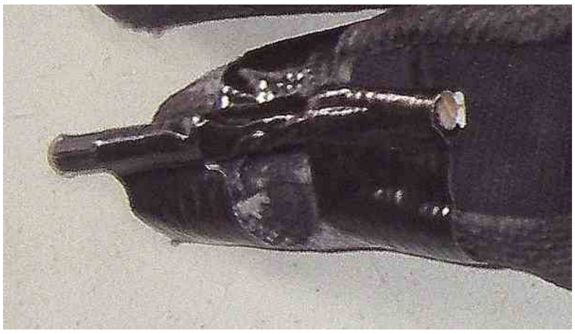
First rods fixation layer (black tape)

Second rods fixation layer (silver tape)

Glove A in configuration A1 with rods only on finger 2 and 3. Owing to the angle under which the photo is taken, the rod on finger 3 appears longer than the glove finger. It is not the case. The rod is slightly smaller. The objective was to compare the ergonomics of a rod longer than the finger on finger 2 but rigidly linked to the glove finger, to a rod on finger 3 which protrudes only when the glove finger is bent. In some cases the rod longer than the finger 2 could hook accidentally on objects. This has not happened during the EVAs. This glove was used by Alain on EVA 1.

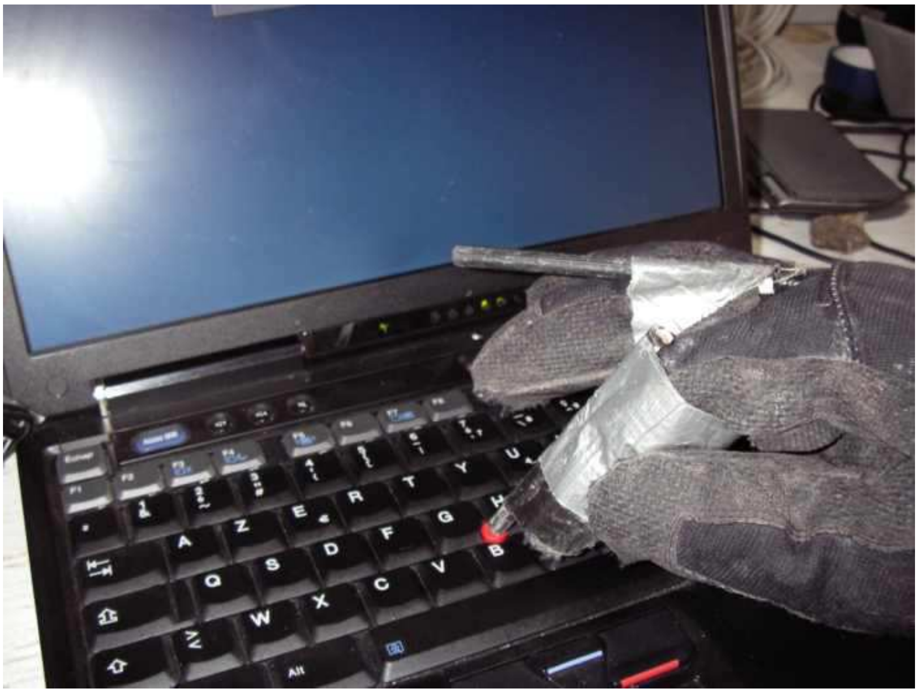
The drawing on the left explains the way the rod for finger 2 was fixed to the glove (photo on the right) in order to avoid the slippage which could occur if the rod was only fixed by a single layer of adhesive tape. Only 2 adhesive bands were used for the other fingers.





Addition of another rod on finger 5 the 31st of January (configuration A2). The final silver adhesive tape on finger 5 is not yet installed. This glove has been used by Alain from the 31st of January to the 7th of February included.

Left: glove in configuration A2 used by Anne at Goblin Valley during EVA 4. The difference between finger 2 where the rod is rigidly fixed all along the finger glove and the finger 3 where the rod is only fixed at the root of the finger, is clearly visible. Right: Same glove used for CRV operations during EVA 10.



The A2 configuration is used here in a test to control a lap top.
When in EVA, the commander found that the rod on finger 3 was very useful to hook things from his front bag like the digital camera small lanyard.

Loïc using the A2 glove during EVA 12 with the finger 3 rod on the left and finger 2 rod on the right.

Glove in configuration A3 without rod on the finger 2. The objective was to see if regaining the bending capacity for finger 2 was more interesting than the rod. Operations needing a rod rigidly attached to the glove finger would have to be done with finger 5. Finger 3 could also be used. The conclusion after using this glove in EVA 24 and 26 was that the A2 configuration is better.

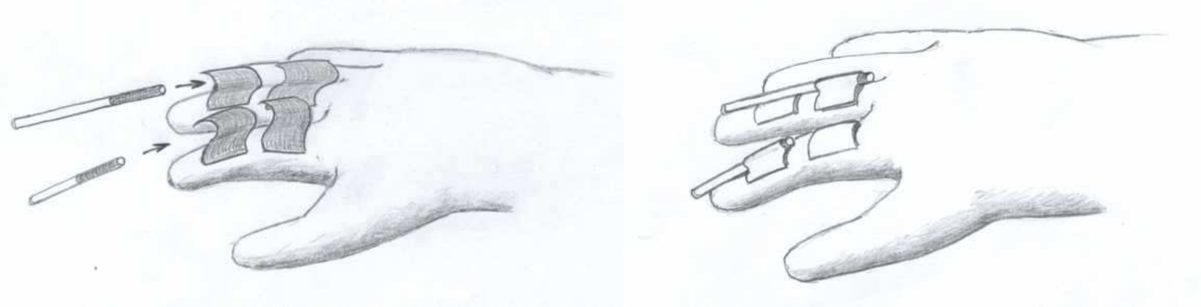
Glove configuration B used by Jeremie with a rod on finger 5

Glove in configuration C with a small spur on left finger 2 as well as a protruding rod used by Richard.

Glove in configuration C

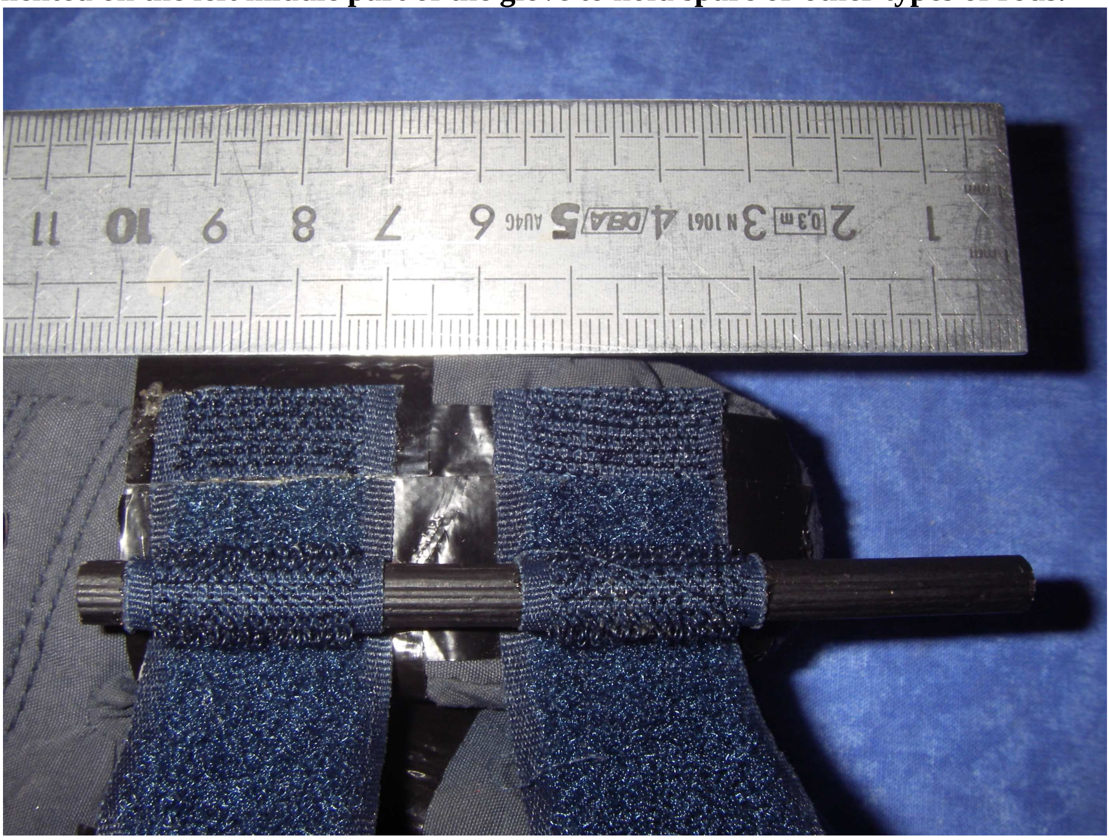
Under : Glove in configuration D with a small spur on the right finger 2 as used by Olivier and Pierre. They also carried small pliers in order to be able to have an accurate “claw” function, for example to unroll adhesive tape.

For operational applications, devices using Velcro could be used. Strips of Velcro attached to the glove fingers could be used to fix the rods (themselves with a Velcro part)and easily change the rods configuration. Two strips of Velcro could be implemented on each finger, one at phalanx 1 level, the other one at phalanx 2 level. When not in use the Velcro strips are stick flat on themselves. This configuration is presented on the drawings below.



Velcro strips can be used to adjust rods to the needs and to the astronaut wishes. On the right is presented the configuration used by Alain during MDRS 43 for fingers 2 and 3.

A prototype of glove with easily reconfigurable rods positions using Velcro fixations, according to the precedent drawings, has been realized in October 2006. This glove is shown here in a configuration similar to the A2 configuration used during MDRS 43. Velcro strips could be implemented on the left middle part of the glove to hold spare or other types of rods.

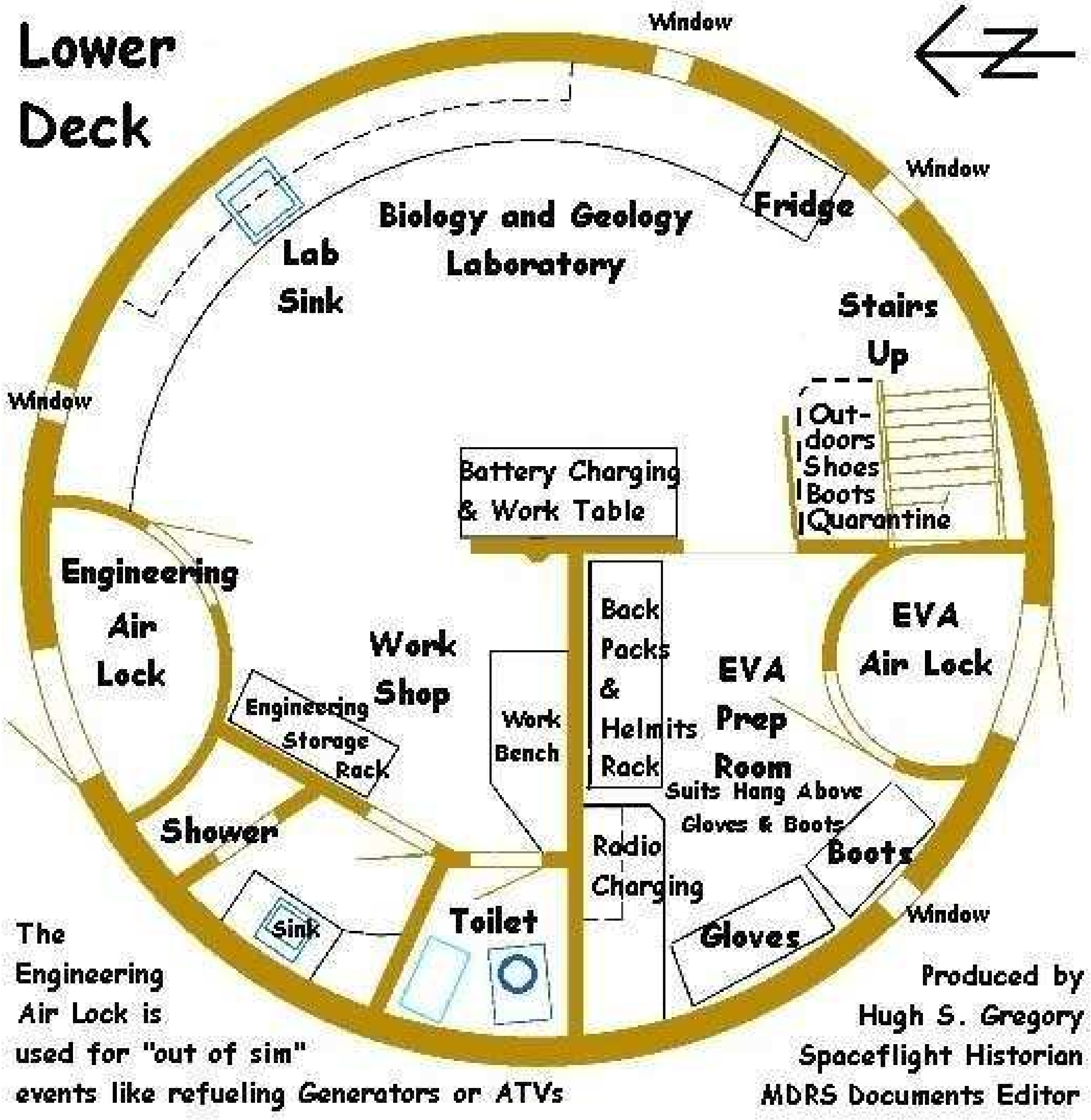


Detail view of the rod and rod Velcro fixation strip on finger 2.

4.7. Hab lay out analysis, improvement and optimization

by Pierre Brulhet, Olivier Walter and Alain Souchier

Detailed measurements and photos of the Hab internal lay out at level 2 were taken and detailed drawings elaborated on Autocad. Also each crew member received a list of questions about the Hab, its different rooms, the noise (systems and people), the lights, the smells, the circulation patterns of people inside the Hab, to be filled at the end of the rotation.



MDRS Floor Plan Lower Deck (TMS drawings)

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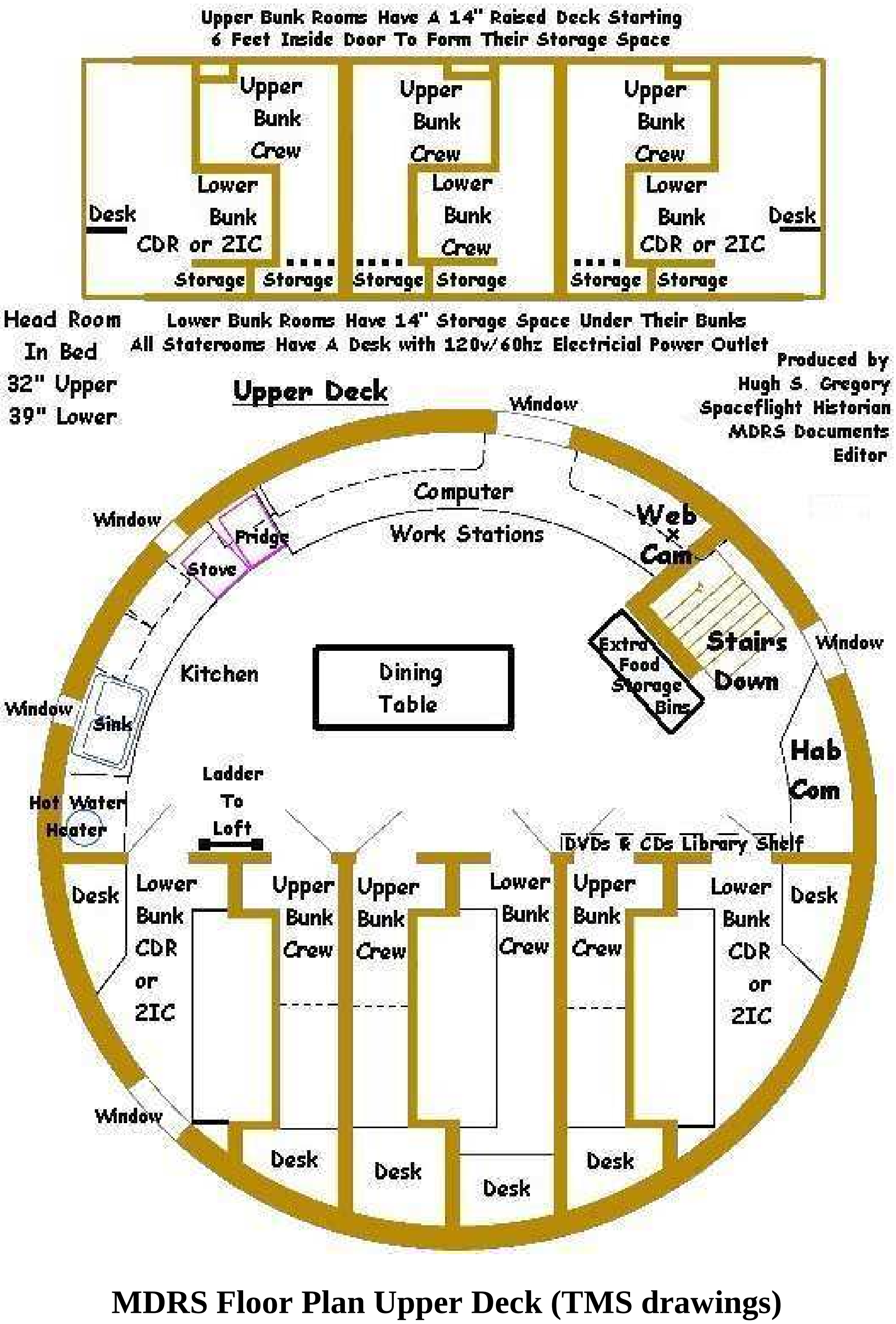


MDRS Floor Plan Upper Deck (TMS drawings)

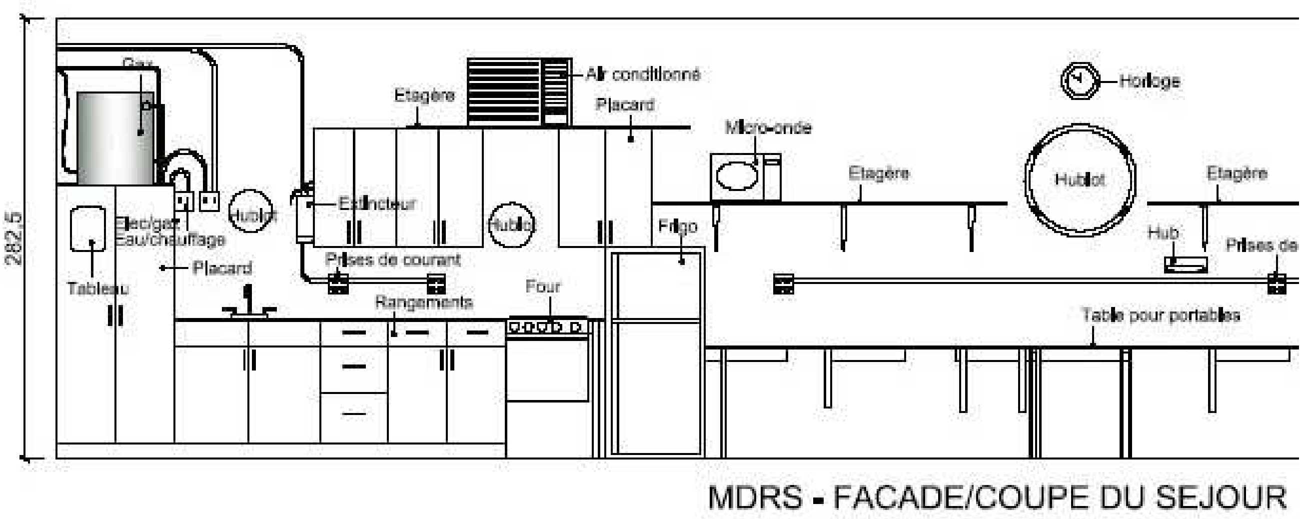
Hab synthetic presentation

Upper floor studies

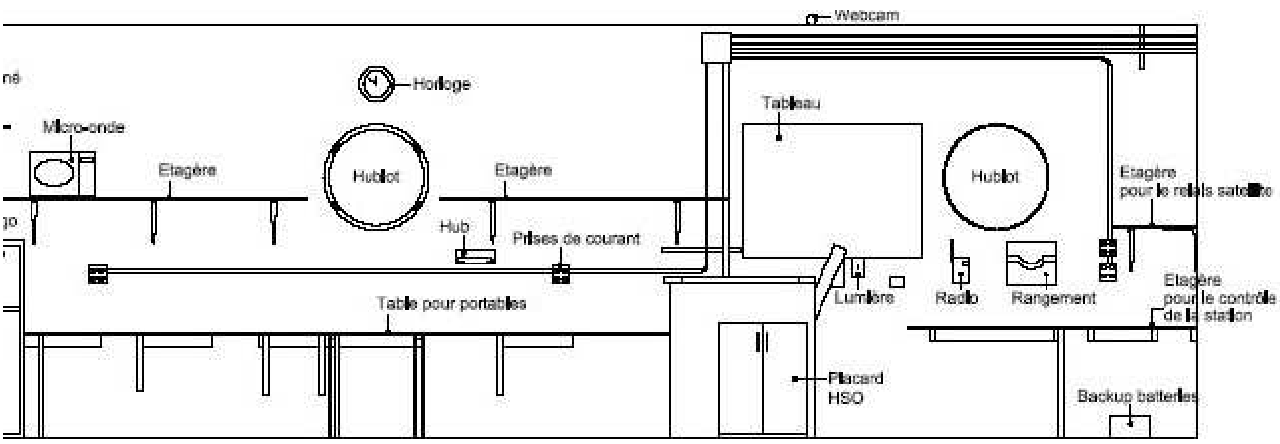
The drawings made by Pierre Brulhet during MDRS 43 are presented thereafter together with photos of the corresponding areas.

Detailed drawings of the upper floor (Pierre Brulhet)

Kitchen side

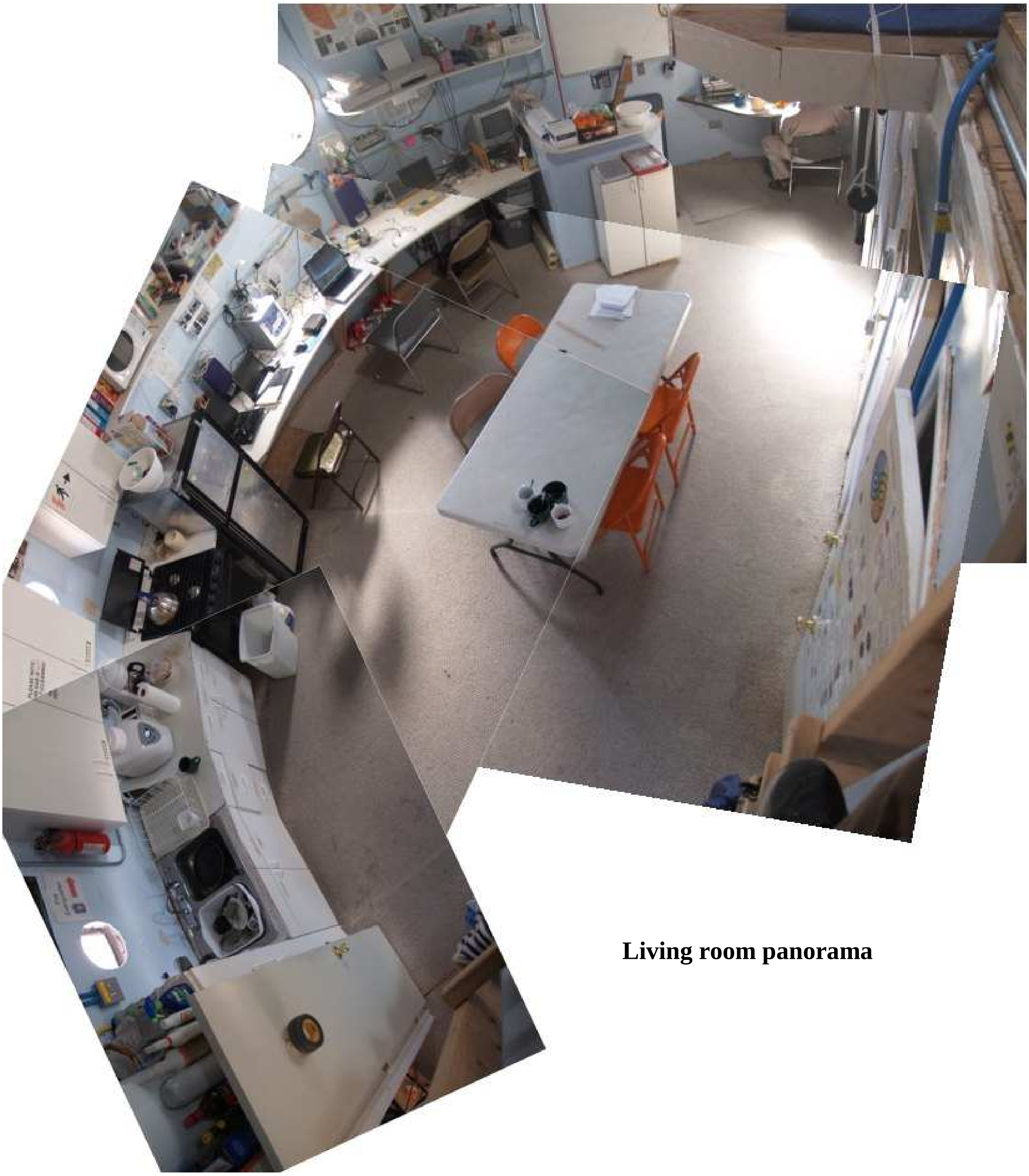


Workbench and stairs side



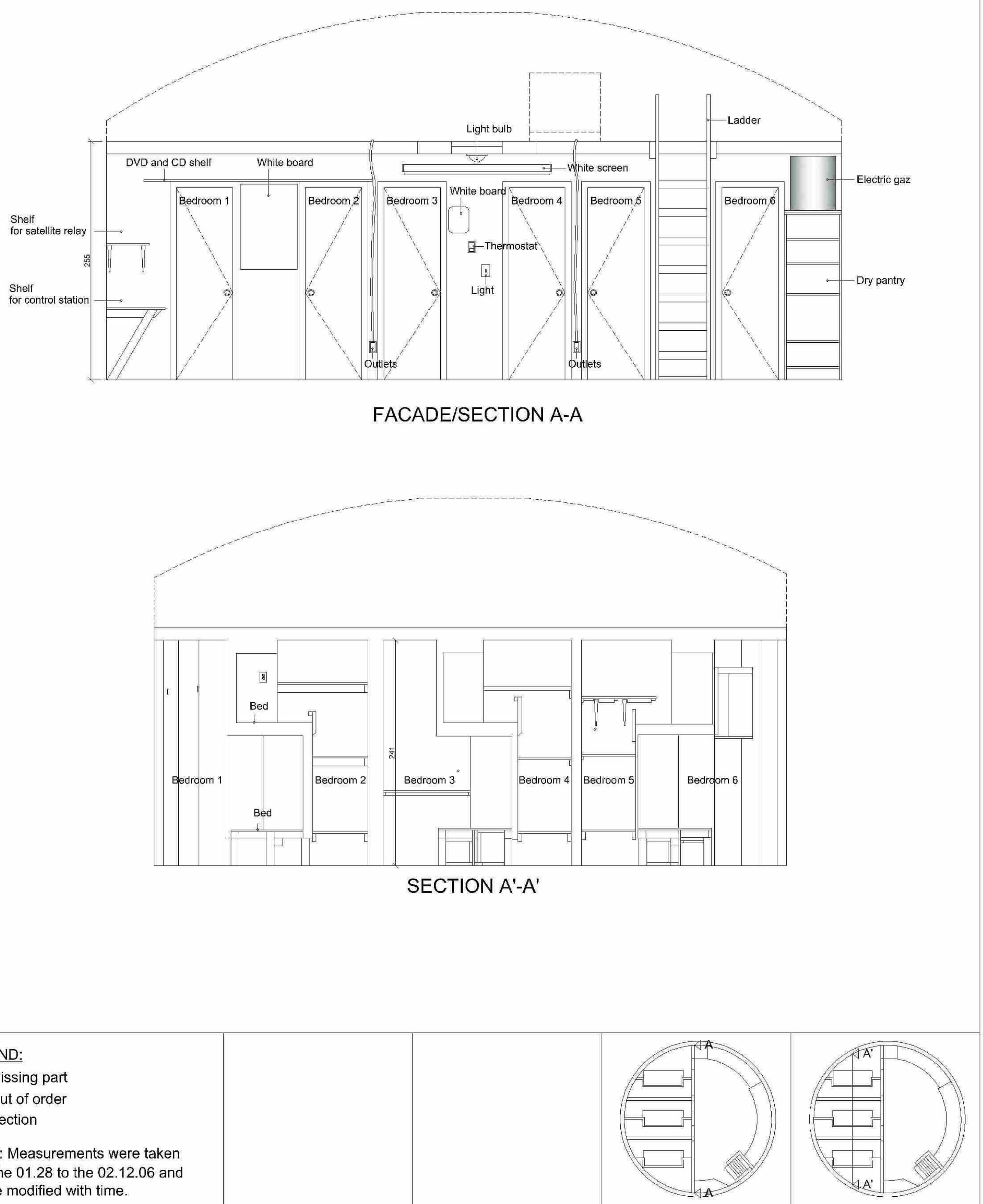
MDRS - FACADE/COUPE DU SEJOUR



Living room panorama

Bedrooms and loft side



LEGEND:

- Missing part
- Out of order
- Section

NOTE: Measurements were taken from the 01.28 to the 02.12.06 and can be modified with time.

THE MARS SOCIETY

MDRS

FACADES/SECTIONS
SECOND FLOOR
BEDROOMS

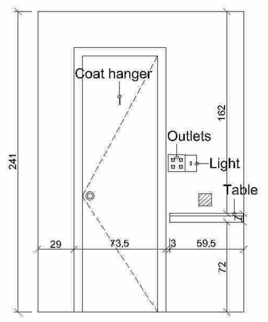
DRAWN:	PIERRE BRULHET
DATE:	02/12/06
REVISION:	
SCALE:	1/50

Planète Mars

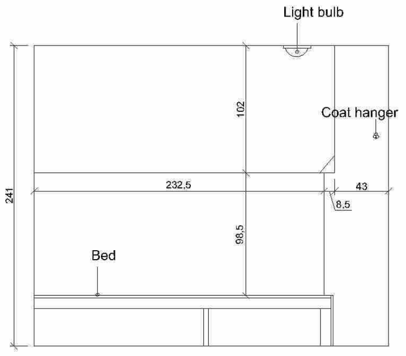
**Picture MDRS 7
2002**

Loft

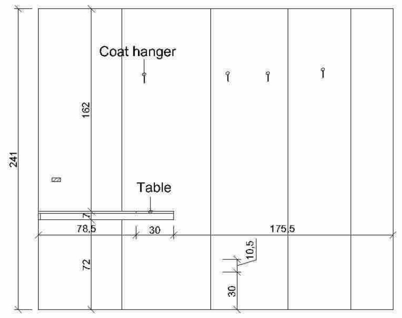
Bedroom 1



BEDROOM 1
FACADE/SECTION C-C



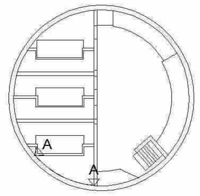
BEDROOM 1
FACADE/SECTION B-B

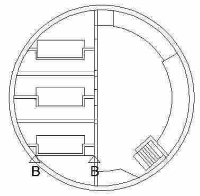


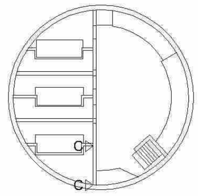
BEDROOM 1
FACADE/SECTION A-A

LEGEND:
Missing part
Out of order
Section

NOTE: Measurements were taken from the 01.28 to the 02.12.06 and can be modified with time.







THE MARS SOCIETY

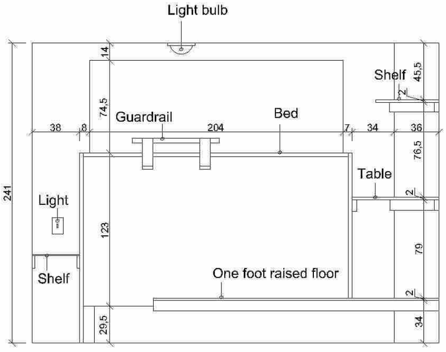
MDRS

FACADES/SECTIONS
SECOND FLOOR
BEDROOM 1

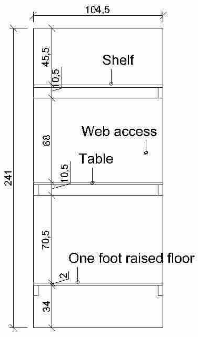
DRAWN:	PIERRE BRULHET
DATE:	02/12/06
REVISION:	
SCALE:	1/50

Planète Mars

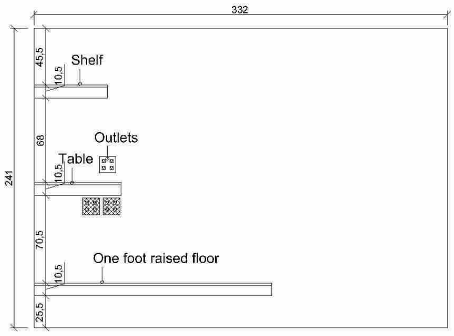
Bedroom 2



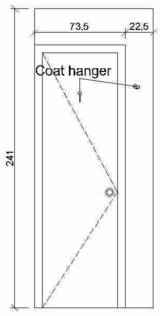
BEDROOM 2
FACADE/SECTION D-D



BEDROOM 2
FACADE/SECTION E-E



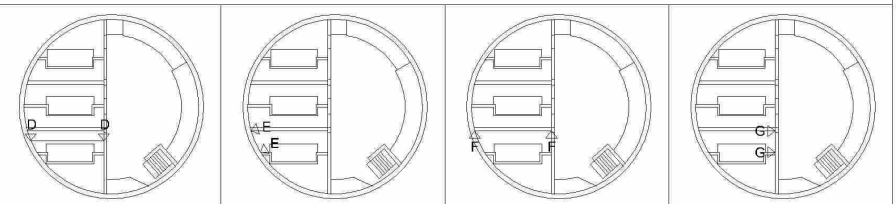
BEDROOM 2
FACADE/SECTION F-F



BEDROOM 2
FACADE/SECTION G-G

LEGEND:
- Missing part
- Out of order
- Section

NOTE: Measurements were taken from the 01.28 to the 02.12.06 and can be modified with time.



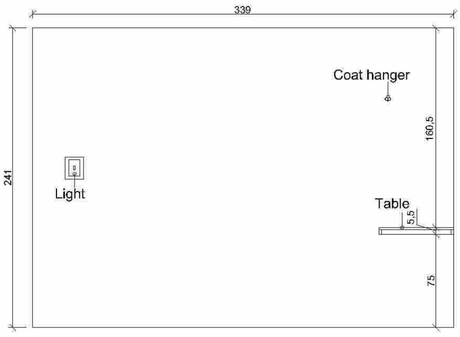
THE MARS SOCIETY

MDRS
FACADES/SECTIONS
SECOND FLOOR
BEDROOM 2

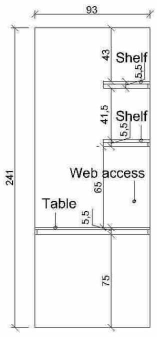
DRAWN:	PIERRE BRULHET
DATE:	02/12/06
REVISION:	
SCALE:	1/50

Planète Mars

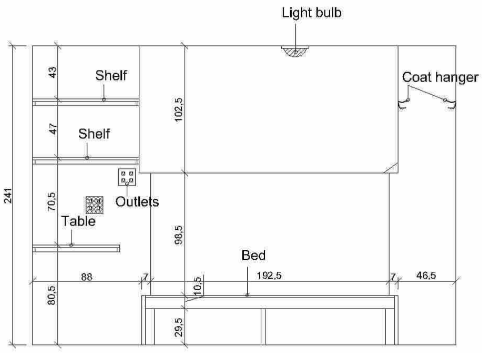
Bedroom 3



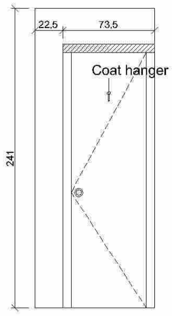
BEDROOM 3
FACADE/SECTION H-H



BEDROOM 3
FACADE/SECTION I-I



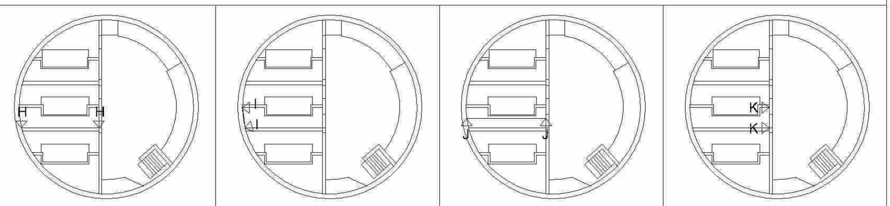
BEDROOM 3
FACADE/SECTION J-J



BEDROOM 3
FACADE/SECTION K-K

LEGEND:
Missing part
Out of order
Section

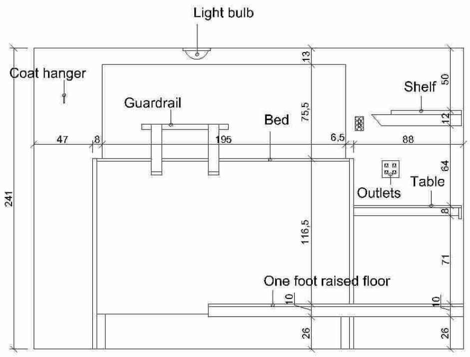
NOTE: Measurements were taken from the 01.28 to the 02.12.06 and can be modified with time.



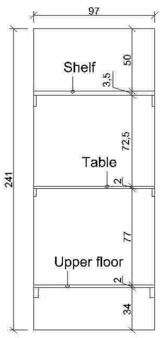
THE MARS SOCIETY

MDRS	DRAWN:	PIERRE BRULHET	Planète Mars
FACADES/SECTIONS SECOND FLOOR BEDROOM 3	DATE: REVISION:	02/12/06	
	SCALE:	1/50	

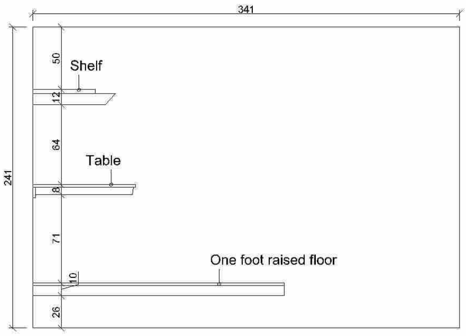
Bedroom 4



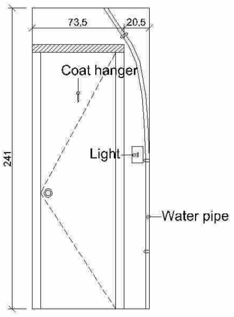
BEDROOM 4
FACADE/SECTION L-L



BEDROOM 4
FACADE/SECTION M-M



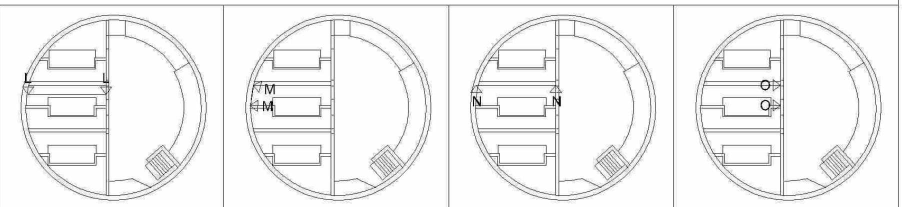
BEDROOM 4
FACADE/SECTION N-N



BEDROOM 4
FACADE/SECTION O-O

LEGEND:
Missing part
Out of order
Section

NOTE: Measurements were taken from the 01.28 to the 02.12.06 and can be modified with time.



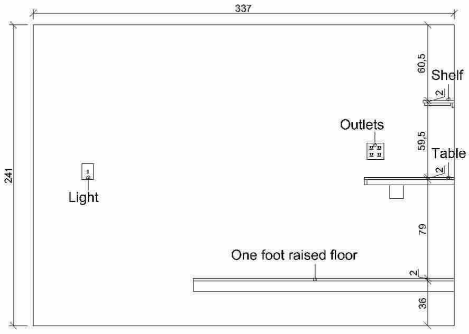
THE MARS SOCIETY

MDRS
FACADES/SECTIONS
SECOND FLOOR
BEDROOM 4

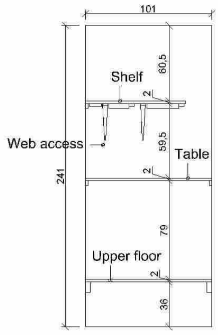
DRAWN:	PIERRE BRULHET
DATE:	02/12/06
REVISION:	
SCALE:	1/50

Planète Mars

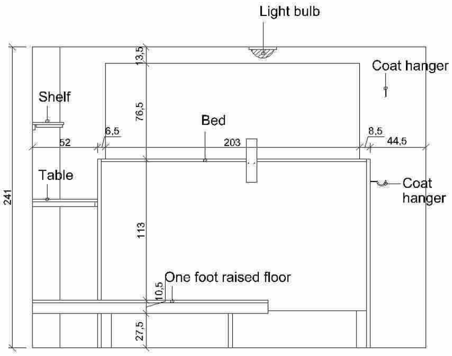
Bedroom 5



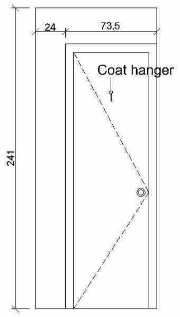
BEDROOM 5
FACADE/SECTION P-P



BEDROOM 5
FACADE/SECTION Q-Q



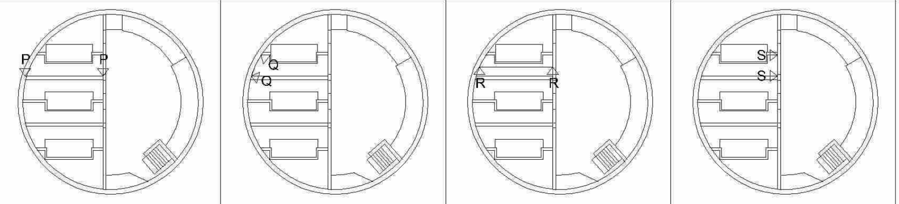
BEDROOM 5
FACADE/SECTION R-R



BEDROOM 5
FACADE/SECTION S-S

LEGEND:
Missing part
Out of order
Section

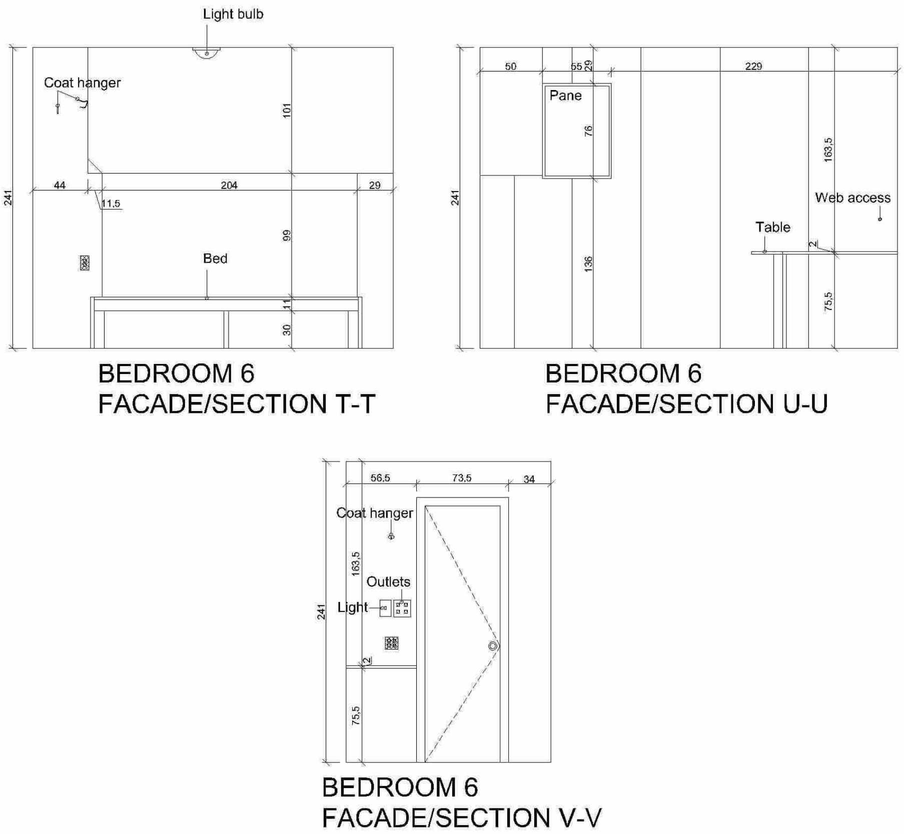
NOTE: Measurements were taken from the 01.28 to the 02.12.06 and can be modified with time.



THE MARS SOCIETY

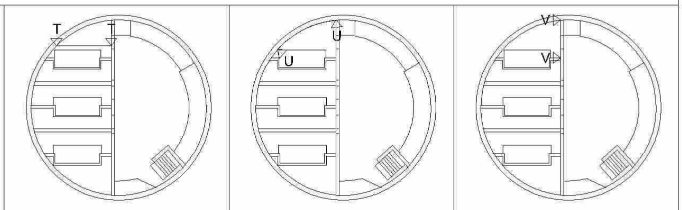
MDRS	DRAWN:	PIERRE BRULHET	Planète Mars
FACADES/SECTIONS SECOND FLOOR BEDROOM 5	DATE: REVISION:	02/12/06	
	SCALE:	1/50	

Bedroom 6



LEGEND:
Missing part
Out of order
Section

NOTE: Measurements were taken from the 01.28 to the 02.12.06 and can be modified with time.



THE MARS SOCIETY

MDRS	DRAWN:	PIERRE BRULHET
FACADES/SECTIONS SECOND FLOOR BEDROOM 6	DATE: REVISION:	02/12/06
	SCALE:	1/50

Planète Mars

Bedroom 1

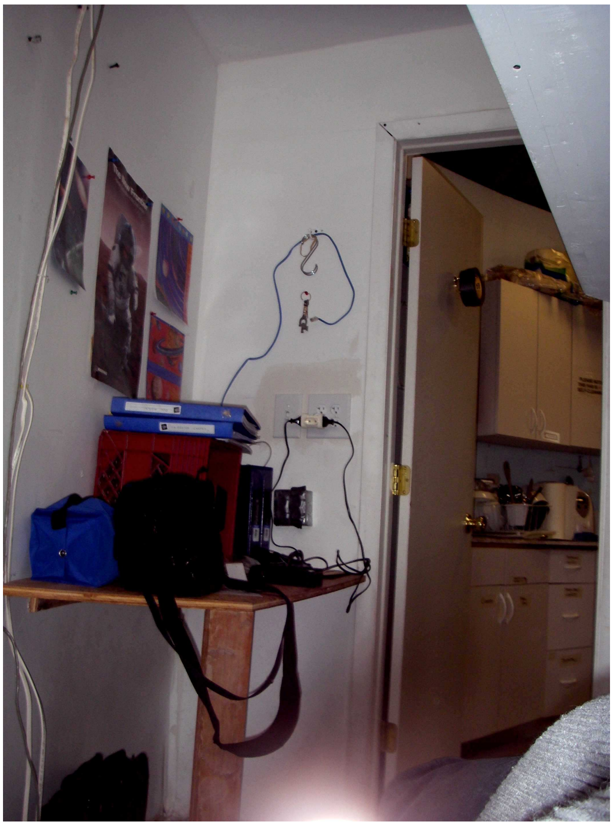
Bedroom 2

Bedroom 3

Bedroom 4

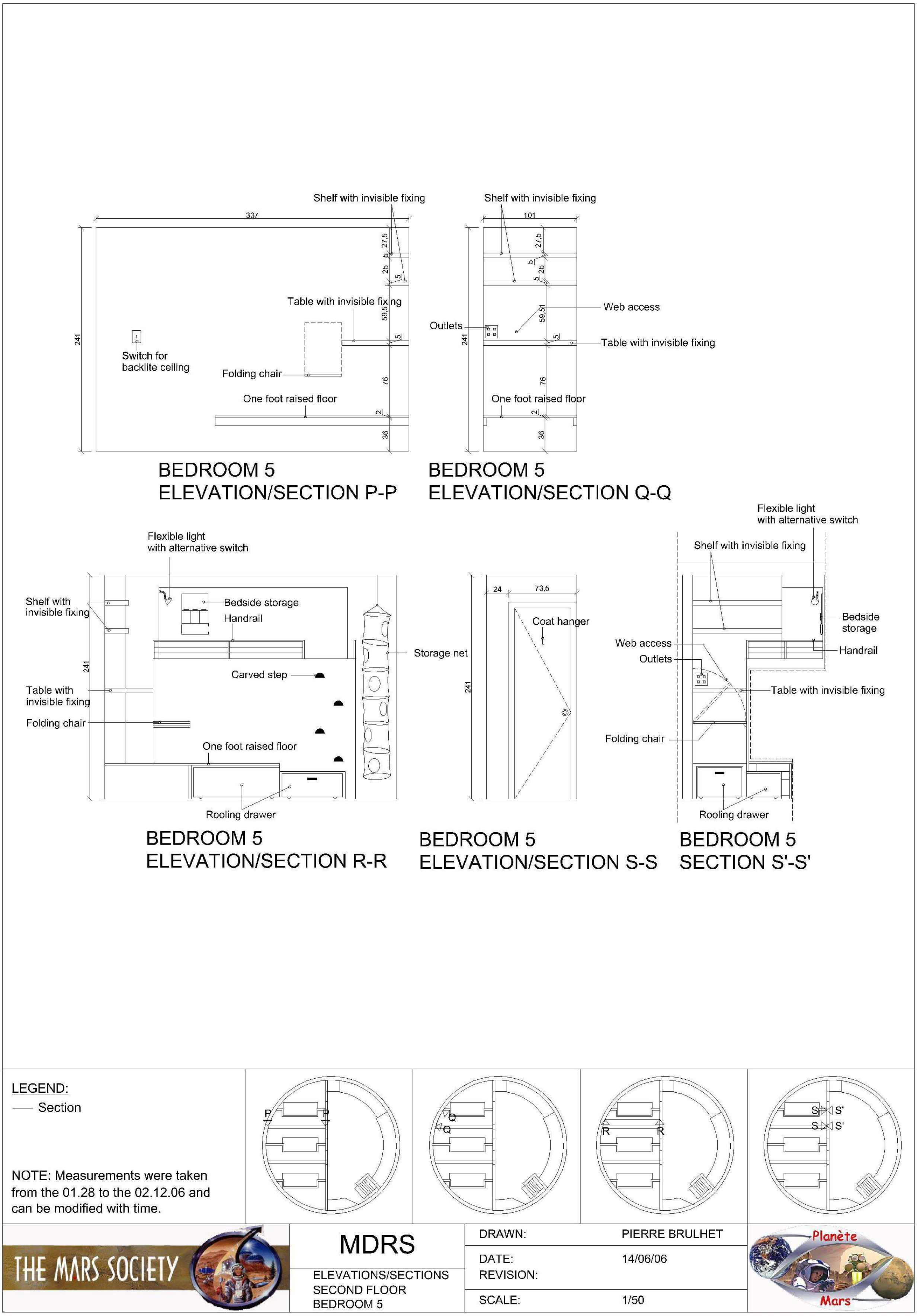
Bedroom 5

Bedroom 6 (the only one with a window, which makes it cold in winter).

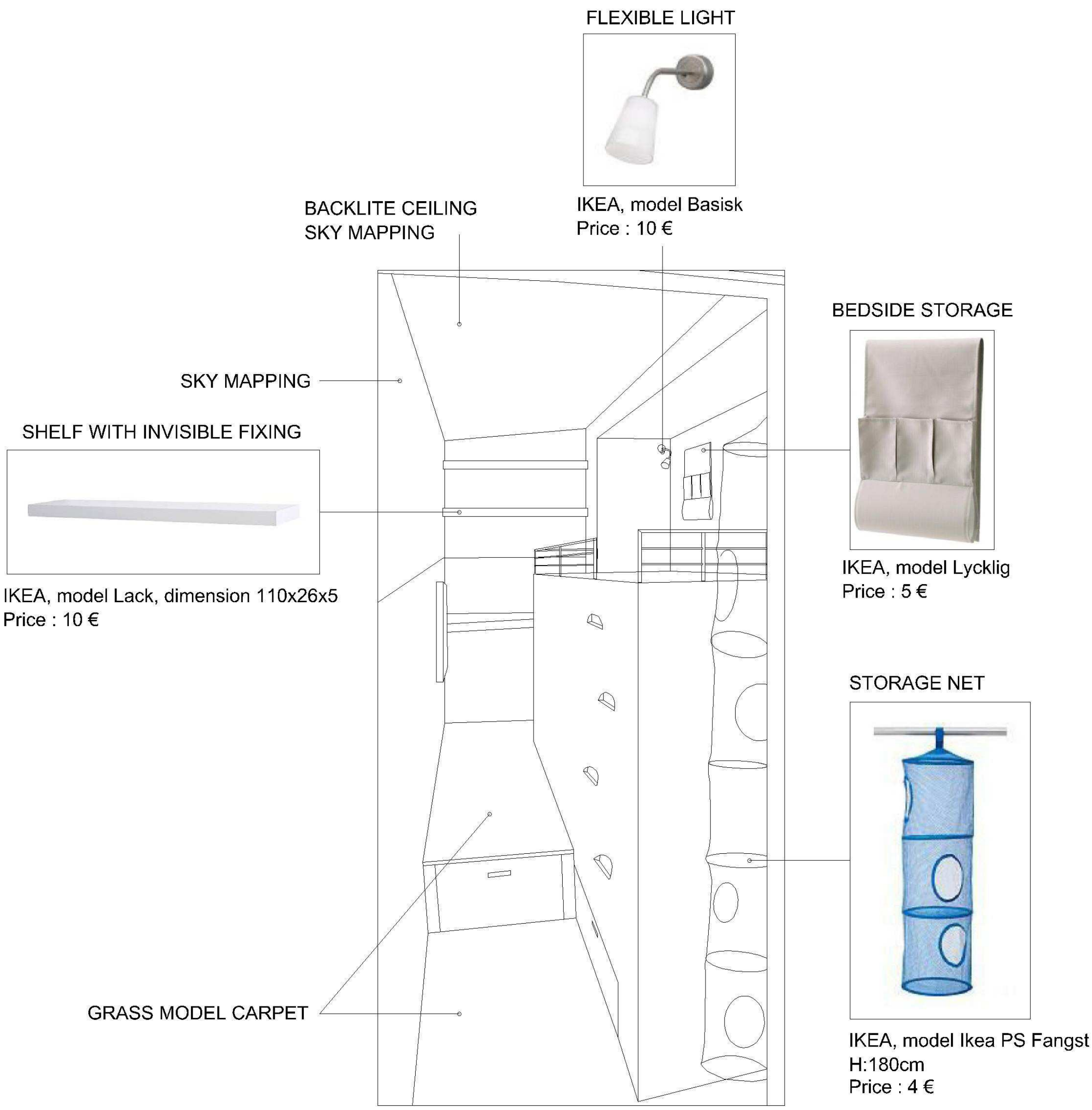


Bedroom 5 upgrading studies

After the MDRS 43 mission, Pierre Brulhet conducted a study to upgrade bedroom n°5 without modifying the bedroom general lay out. This study results are presented thereafter.



Modifications proposal drawings for bedroom n°5



THE MARS SOCIETY	DRAWN:	PIERRE BRULHET
BEDROOM 5'S VIEW DESIGN REFERENCES	DATE: REVISION:	14/06/06
	SCALE:	

Hardware for bedroom n°5 equipment

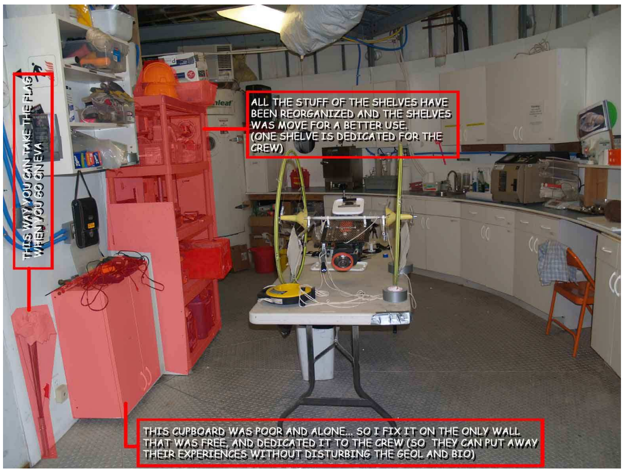
BEDROOM 5 BEFORE

BEDROOM 5 AFTER

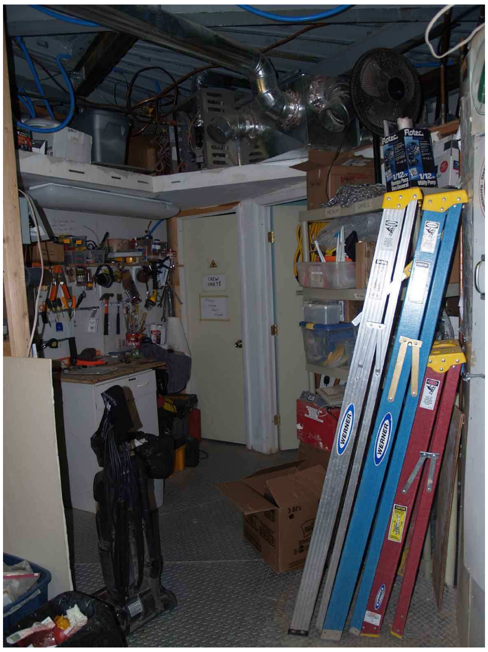
THE MARS SOCIETY	BEDROOM 5'S VIEW BEFORE AND AFTER THE PROJECT	DRAWN:	PIERRE BRULHET	Planète Mars
		DATE:	14/06/06	
		REVISION:		
		SCALE:		

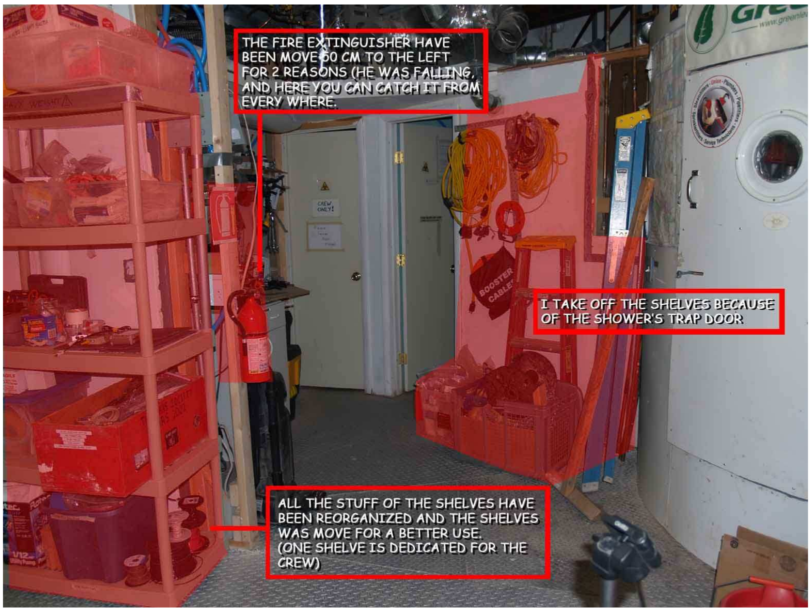
Hab first floor cleaning and organizing

Olivier Walter exerted his architect competencies to clean the first floor and to organize it in a more operational way. The results of his work are presented below with photos showing the configuration before and after.

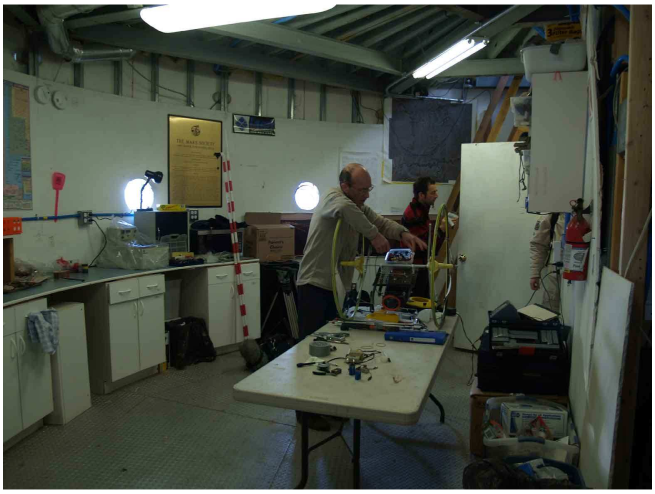


Organizing the Hab first floor.



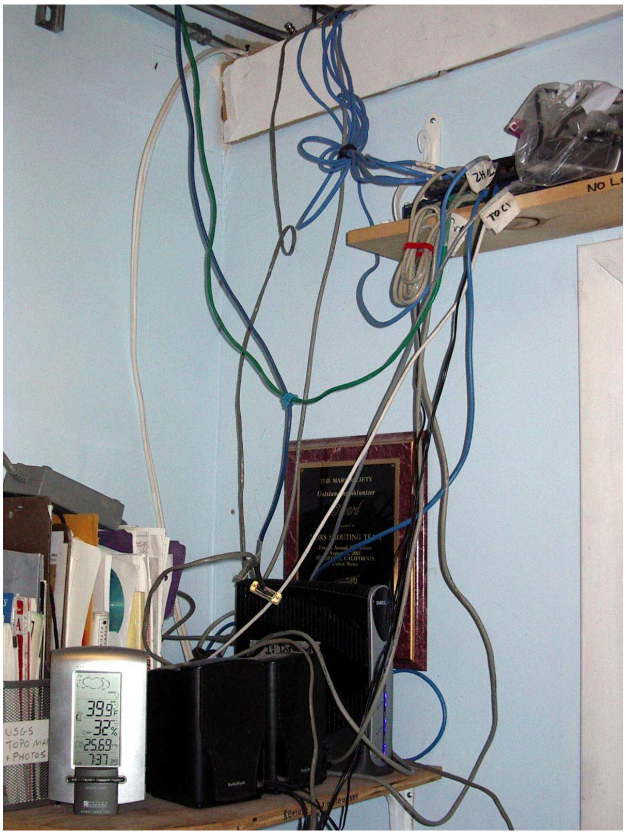


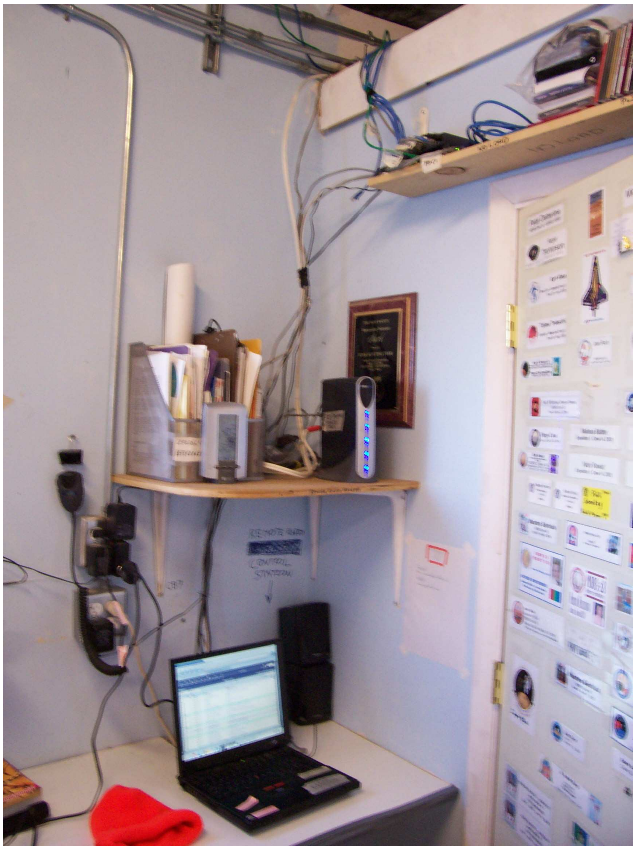
Before **After**



Before **After**

On the second floor the cable network was also better organized as shown thereafter.





Before **After**

Quality of life in the MDRS – Survey answers analysis

by Pierre Brulhet

During mission MDRS 43, a form was given to the people present in the crew with questions about the life at MDRS, asking also for any comments which could be made on the Hab. Its purpose is to improve the comfort and the environmental work quality of future crews in the simulation habitat, by improving the MDRS internal lay out and also the future European station Euromars. Three of the six people who answered the questions stayed only the first week.

Hereafter follows the list of the people who answered the survey, their profile and their function in the MDRS. For reasons of impartiality, the architects Pierre Brulhet and Olivier Walter did not answer the poll .

- **Alain SOUCHIER**, space engineer, commander.
- **Richard HEIDMANN**, space engineer, executive officer (XO) in charge of planning and reporting.
- **Anne PACROS**, space engineer, support for the EVAs and psychological tests provider (*).
- **Loïc de la MORNAIS**, TV reporter, mission reporter (*).
- **Jeremie GEOFFRAY**, student in engineering,, on board engineer and health safety officer (HSO).
- **Eric MAIZY**, cameraman, visitor (*).

(*): stayed one week

1. Lay out, organization, accessibility

The rooms are all different. Their "owners" appreciation is very contrasted. Some consider their room functional, pleasant, others deplore that it is not very practical (access to the bed in height), non flexible. One likes his room for his many storages, or on the contrary, one underlines their insufficiencies. There are however sufficient recesses (under the floor or the bed) to store the bags. One regrets the absence of a bedside lamp in the rooms.

The kitchen is perceived as roomy (even if some would wish a scheme of larger work) and one appreciates the porthole giving natural light directly. It would be more practical with the presence of a dishwasher. There is a lack of place for the arrangements, which favors mess. The wall cupboards would gain being better organized.

The shower / closet lacks storage. The shower / closet is considered to be too far away from level 2. It is necessary to cross the laboratory, in general rather dirty, to go there. The shower / closet would deserve to have a better completion and more cleanliness.

Airlocks should not be used as space of storage. It would be useful to return to operational status the small airlock (cupboard in the wall at the bottom of the staircase at level 1), which would make it possible to transfer an object which would have been forgotten inside, to the people in EVA, without having to simulate depressurization / re-pressurization of the large airlocks. In the airlocks, a wall vacuum cleaner pipe to wipe off dust would be very useful. Just as the presence of small wall hang would be practical to suspend tools for example temporarily. The external axes of the doors must be reinforced because considered to be too weak, making the doors difficult to open / close. The external platform of the 2 airlocks is well appreciated even if it is considered to be small.

In the workspace of level 1, one observes that the wall cupboards are essentially allotted to the materials bio/geology (with wall cupboards which are almost empty!). Thus storage is missing for the hardware brought by the crew. The tools bench, well provided, is poorly organized or often a tool is missing (sometimes a set of spanners is incomplete): it is difficult to find what one seeks. Level 1 lacks a central work table (with electrical connectors to prevent circulation obstruction by the wires) for the assembly and maintenance of the various hardware. One person proposes to have 2 collapsible tables (according to the needs) which could be deployed in parallel. All in all, there is the feeling that level 1 is less used than level 2 (because of the cold, of the lack of experiences?).

If the work / eating area at level 2 is appreciated for its roominess, it can prove sometimes a little small for 6 people. The desk area would deserve to be a little better organized and would gain to have more room (a little narrow when all the crew works in front of their laptops). The portholes should be put at eyes height to facilitate cleaning. One of the members proposes to have a corner living room, quite distinct from meal and work area, in order to create a resting location for the crew.

2. Noises in MDRS

There were no problems with the noises perceived during day. A good point is the localization of the power generating unit dissimulated behind a hill, sufficiently far away from the Hab which minimizes sound nuisances.

At night, there is an insufficiency sound proofing. The heating is too noisy, especially when it starts. In the same way the pressure pump is noisy when one draws water. The proximity between living room and bedrooms leads to a "sound-curfew" (11 pm). Some however were not worried by the noises during the night, but on the contrary, they found a reassuring side to them. More amusing: a remark on the impossibility of playing music during the curfew. Small originality, one of the people slept several nights on the mezzanine located above the rooms: more pleasant but noisier.

3. Perceived quality of the natural and artificial light in the habitat

Daylight coming from the portholes is well appreciated on level 2 in the living room. The area is perceived as very luminous. The porthole on the roof is seen as an original idea. A general reproach on the other hand is constant ***mist*** linked to a bad insulation on one of the port-holes and the relative dirtiness of the panes with external dust. Some regretted the absence of portholes in their rooms. The only room with a porthole was the commander's one, who complained about its lack of insulation (lets enter cold and is covered with condensation) and did not find it very useful. Level 1 misses portholes or they are too small and still dirty.

The artificial light in the evening would gain being hotter (rather than white neons in the living room), to see more filtered. It would be necessary to be able to light one of the neons by need or to save energy. The switch in the rooms is not at hand reach from the bed. One notes also the absence or the lack of an office and bedside lamp. The work table of level 1 lacks a good lighting.

4. Circulation inside the Hab

In spite of the narrowness, one circulates rather well in the rooms with the bed at the bottom. There remains an access problem for the beds located in height.

The shower / closet (level 1) is judged too far from life area (level 2).

Airlocks are good (even if one knocks one self a little with the spacesuits) but the room of EVA preparation is too small when 3 persons are equipped at the same time (currently, one overflows in the laboratory area). More space in this room would also make it possible to better manage dust (on Mars it will be absolutely necessary).

The workspace at level 1 is perceived as large. There is a good circulation flow.

In the work and eating area at level 2, the central table separates well the circulation towards the rooms. But one often knocks oneself with this table. Circulation is overall perceived as fluid.

The staircase is considered to be dangerous because too stiff (during the night and when one must go up or down with heavy or cumbersome objects). One of the members proposes the addition of a lift.

5. Intimacy perception (bedrooms, shower, closet) and community life (working space, eating area, relaxation corner):

The bedrooms are perceived as the first place of intimacy, even if they would gain to have a better sound proofing (problem of snoring raised in a neighbor room), which would make it possible for example to watch a DVD in one's bedroom without disturbing the others. They are not always appreciated for their comfort (small, not very practical access to the bed in height) but by these defects there is no trend for a crewmember to isolate oneself in the bedroom (They are used only for sleeping). One of the members thinks that it would have been more judicious to have the rooms at level 1 (quiet, more separated from the community life).

All in all, the community life works very well. Interior spaces are perceived as large (no visual obstructions), comfortable (level 1 is however considered as insufficiently heated: we work there in the cold!) and give the feeling not to be cramped one on the others. The level 2 which includes at the same time mixed areas such as working/eating/relaxation seems to support the community life largely.

6. Odors in the Hab

Concerning common areas, there is the problem of the closet smell because the mission rules prohibit to flush the water after every use. One of the persons proposes a system of artificially changing smells evoking various environments or various countries, in order to break the monotony of a confined habitat. The kitchen odors are sometimes also a problem (fried meals).

For private spaces, a general reproach is the absence of ventilation in the rooms (claustrophobia feeling ?)

7. General aspect of the habitat interior (colors, design, perceived quality, etc.)

A general criticism is made on the completion, its very rustic aspect, the choice of materials as the presence of fitted carpet on level 2 (difficult to clean), the choice of a metal ground on level 1 (cold and driver of electricity). The posters and the color of the walls are not always appreciated (colors considered to be too cold, not warm enough or not enough sharp). The ceiling's height in the living room is considered to be large but gives a feeling of space. One of the people proposes removable partitions to modulate spaces according to needs. In spite of the defects raised above, there is a feeling that the installation was made with passion and the means at hand. At last the whole inside space has a realistic as well as a do-it-yourself touch. In general, the Hab is appreciated for the impression of great spaces which it releases.

8. Others:

A reproach concerns the trend for hardware to accumulate, as in the space stations, during years, inside as outside. One would need a precise inside rules statement to follow, on the tidying up and the systematic elimination of elements not being useful anymore. With the current mess, the major elements like the urgent procedures or the instruction manuals are not accessible or directly visible. One notes also a lack of filing space (wall cupboards, racks) and offices.
Many positive notices were given on the atmosphere and the cordial, comfortable aspect of the Hab. (one of the members feels even better there than at home!). One would however like a central port-hole on the roof larger than the current one, in order to benefit more from the sky's view (perceived as a good metronome which points out the Earth). Perhaps also more house plants in the habitat.

4.7.4. Example of other habitats lay out studies

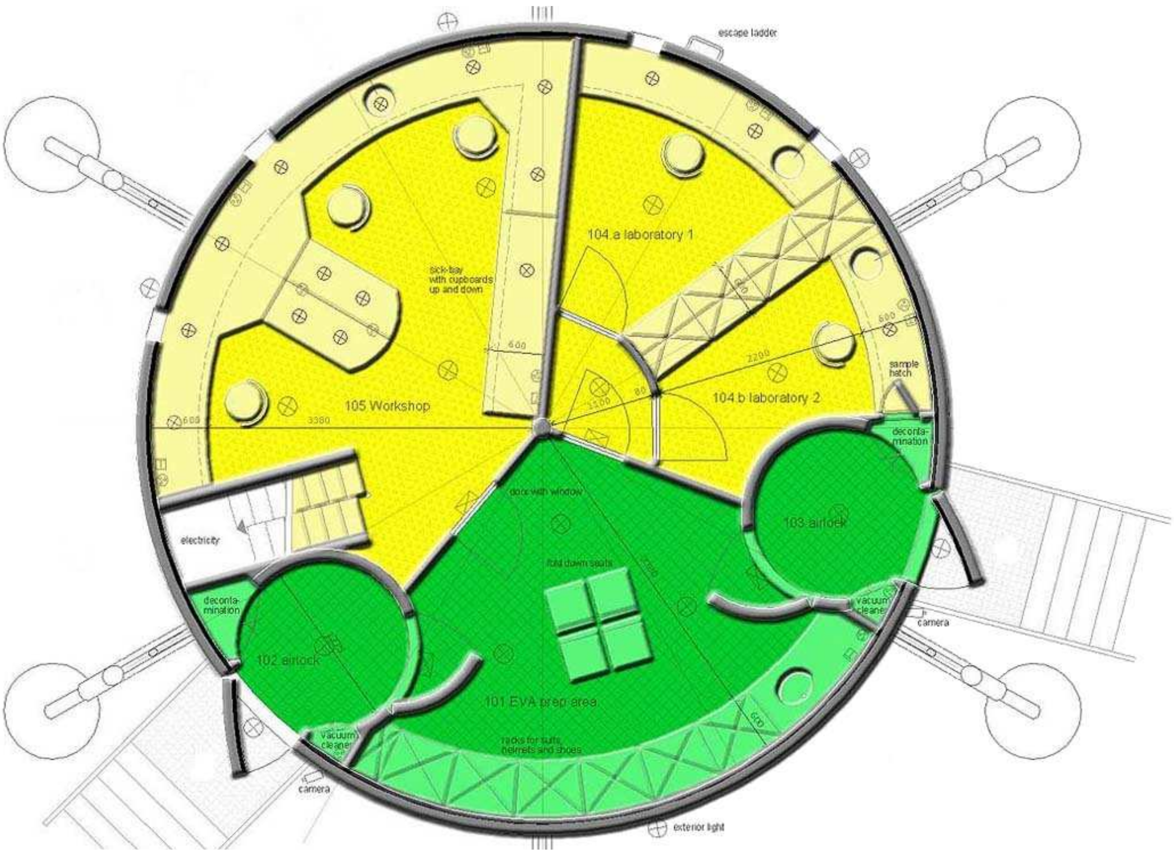
Example 1 : the Euromars Habitat

The heights of the MDRS first and second floor ceilings are high. On the first floor, areas for storage are available above the size of a human being. On the first floor one of these areas is used to house the gas heating system. On the second floor the height above the bedrooms allows for the loft location. Thus the architect who worked on the Euromars lay out considered that a three level habitat could be designed.

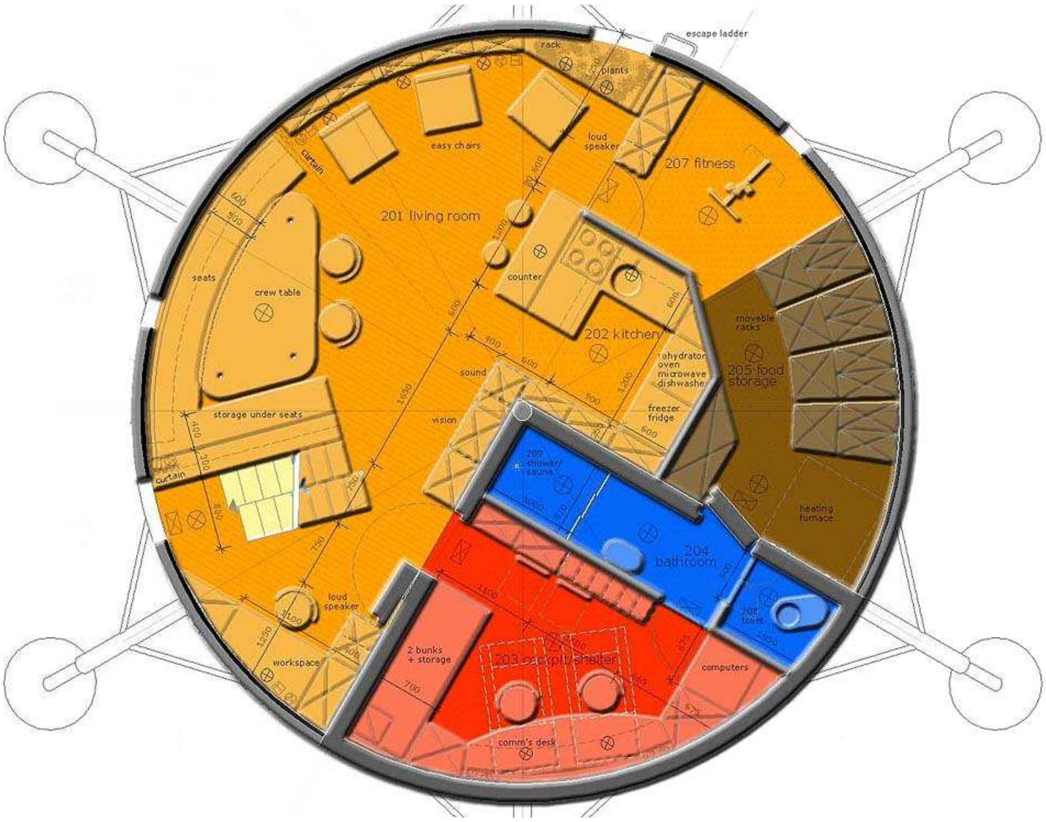
Storages areas above human height on the first floor. On the right the heating system.

The height above human size on the second floor (MDRS 7 photo).

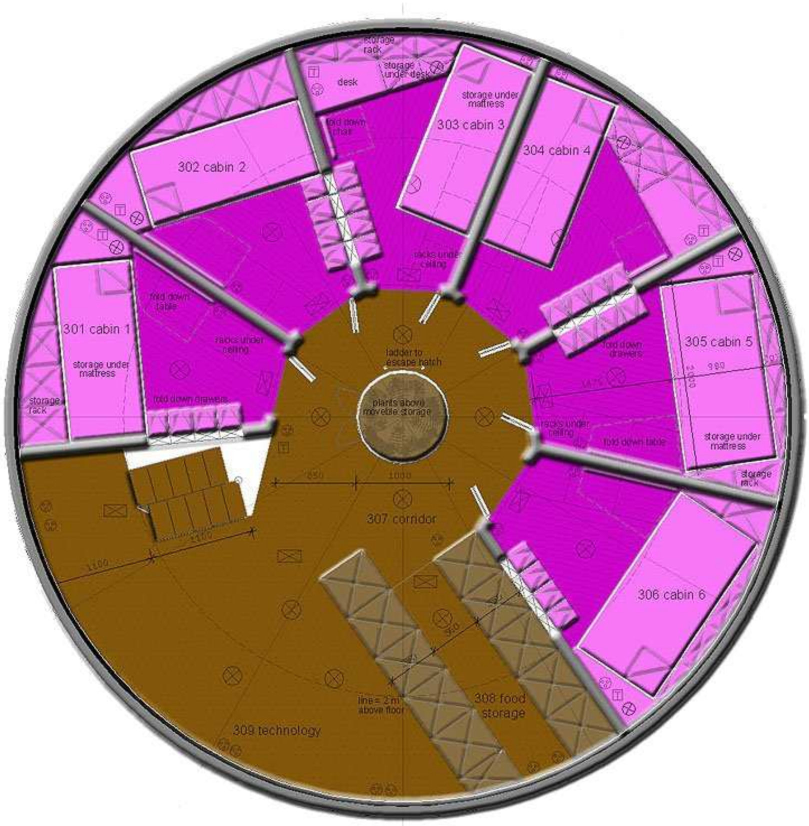
The Euromars design which is the result of Frans Block (Nederlands), Pierre Brulhet, Daniel Pouzet, Olivier Walter (France) and Klaus Totzek (Germany) work is presented thereafter.



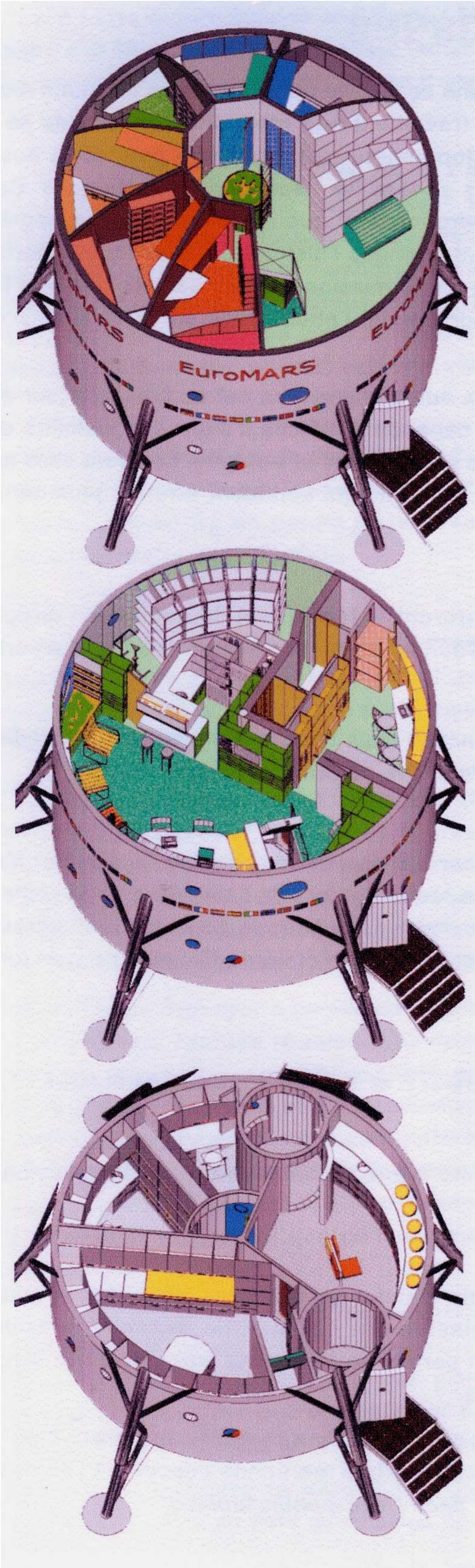
First floor



Second floor



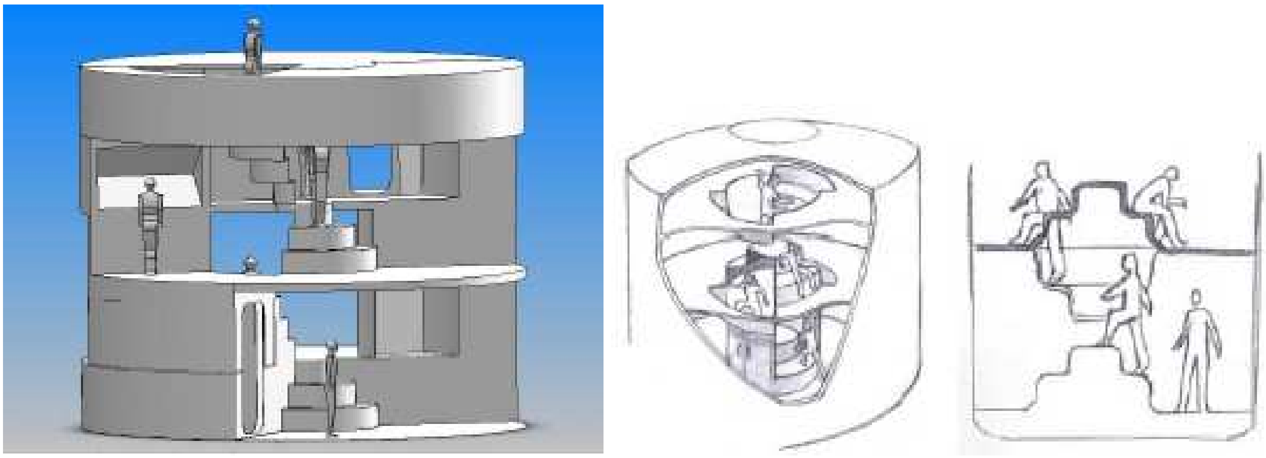
Third floor



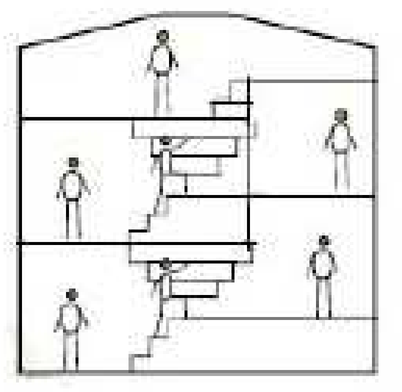
3D view of the Euromars habitat three floors

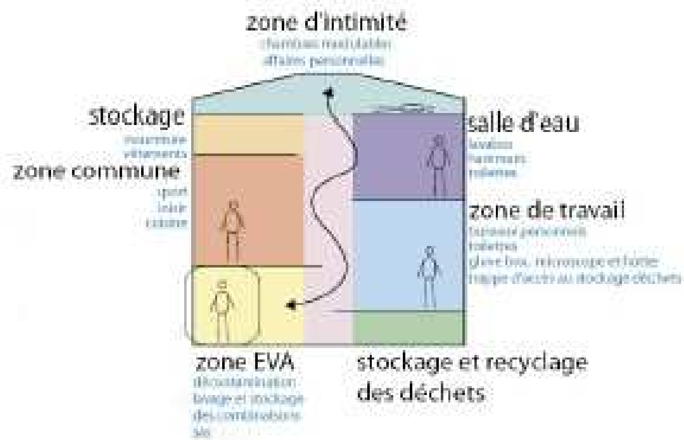
Example 2: the Strate College Designer studies for a Euromars type Habitat

Taking more into account that the Hab volume separation between multiple floors could be an interesting way of using the available space and at the same time give the feeling of a large home, the Strate College Designer students directed by Olivier Walter and Francis Winisdoerfer elaborated a new design in which six half levels are implemented inside the Hab. One of the main internal characteristics is the central stairway (with steps which may be used for sitting).



The 6 half floors design with the central stairs (Strate College Designer drawings).

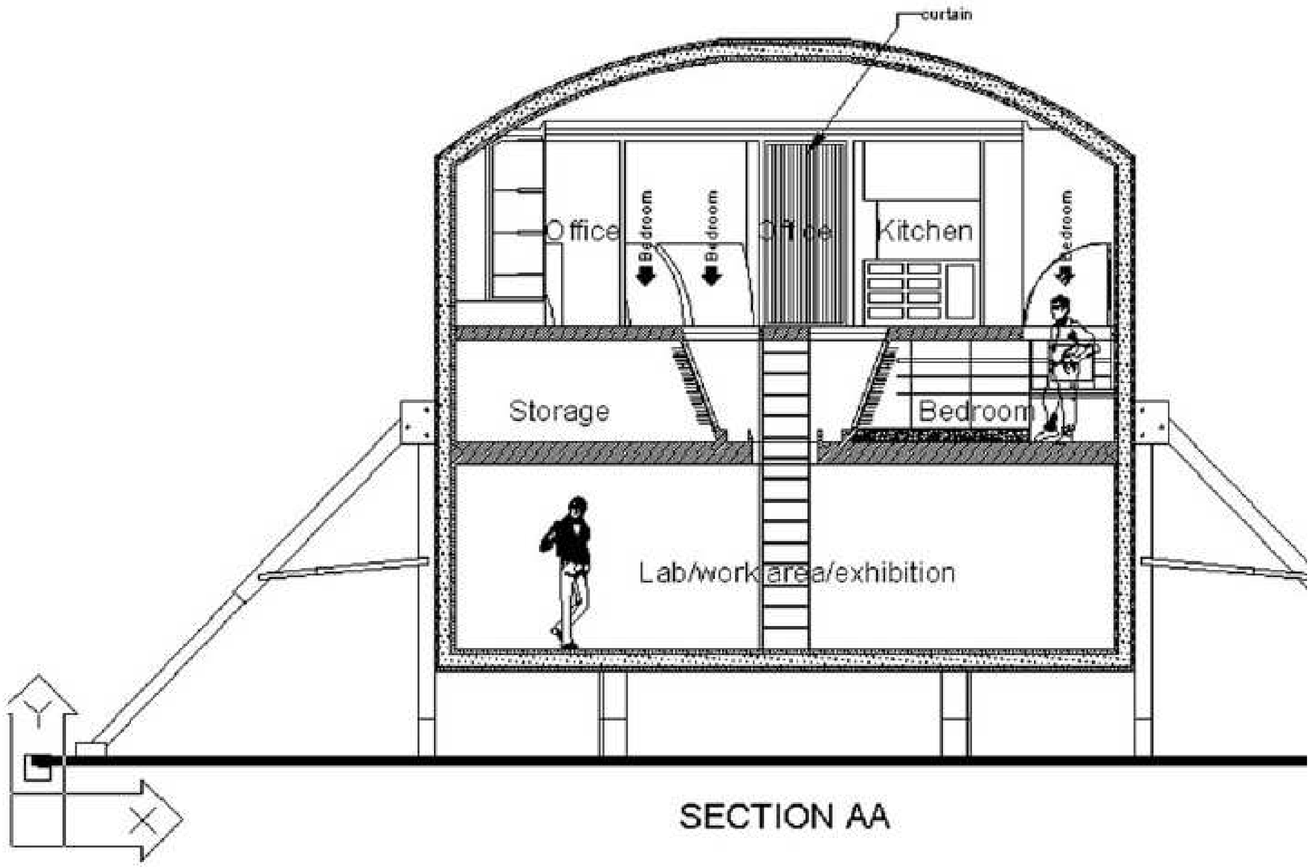




Level 1 is the EVA zone including the airlock. Level 2 is the working zone with the crew offices (separating walls which may be retracted), restrooms and laboratory. Level 3 is the living room including the kitchen. Level 4 gathers bathroom and rest room. Level 5 is a storage area in particular for food and clothes. Level 6 includes the bedrooms. As the ceiling is low in these rooms, a part of level 5 is devoted for dressing and undressing.

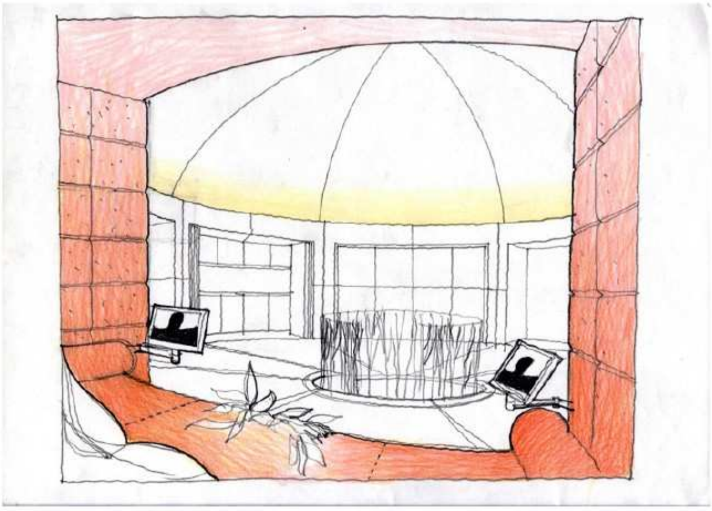
Example 3: initial studies for the Euromars habitat by the French architect team

The studies conducted by Pierre Brulhet, Olivier Walter, Daniel Pouzet and Sebastien Chauvel before the meeting which finalized a lay out for the Euromars habitat in March 2002, were centred on a two and a half floors design as shown below.

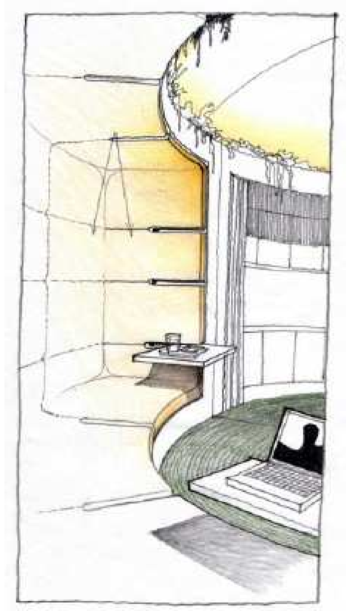


coupe *(doc P. Brulhet)*

The half floor which is 1.2 m high, is devoted to the bedrooms and storages. Two bedrooms are alternating with one storage. The access to the bedrooms is through a hatch in the upper level floor. In its open position the hatch which is linked to a curtain defines an area where the crewmember may stand up. This facilitates operations as dressing undressing. The bedrooms localisation is optimum for radiation protection with two ceilings above and storages on the sides. The lower level and upper level have the typical usage presented in all the designs. The lower level is the work area with lab, airlock, spacesuits and spacesuits maintenance, and the upper level is the living area including meeting and personal work volumes.



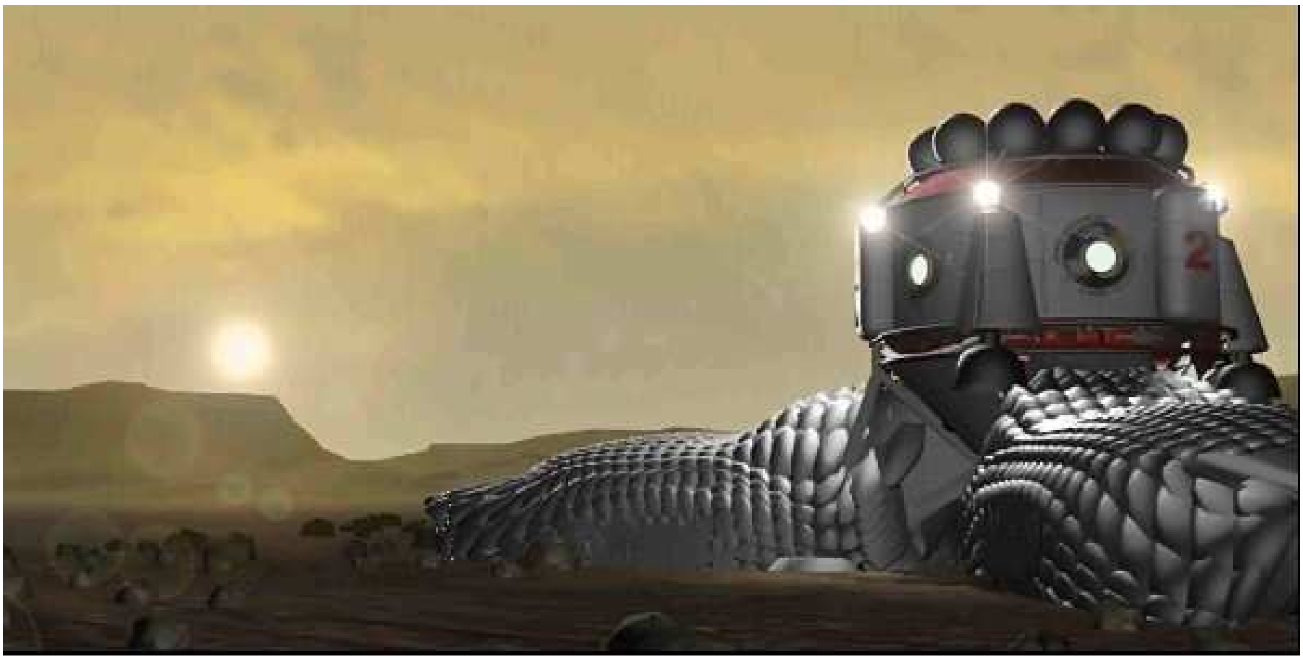
vue-bureau, niveau 2 (doc. P. Brulhet)



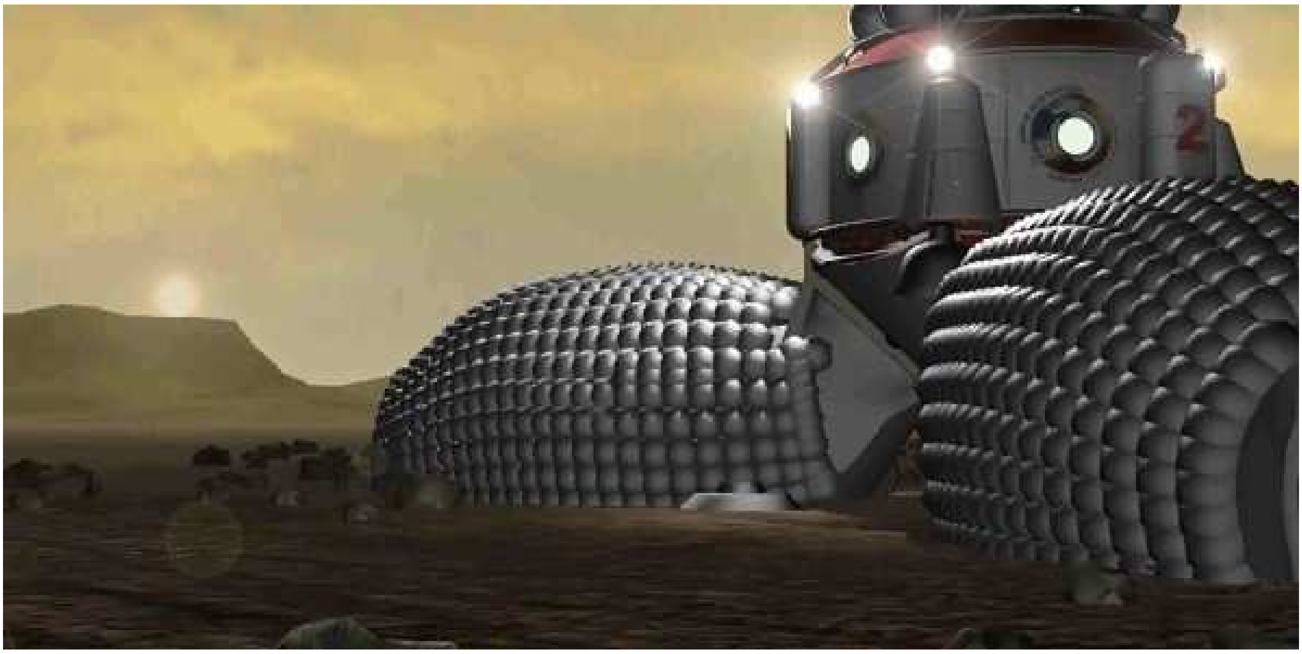
vue-bureau, niveau 2 (doc. P. Brulhet)

Example 4: habitat in a video on a Mars mission

Pierre Brulhet, Olivier Walter, Daniel Pouzet and Sebastien Chauvel studied an habitat which appears in a video from Sebastien Chauvel describing a mission to Mars. These pictures have been used in the France 2 video about the MDRS 43 mission to explain the problematic of a Mars habitat (see chapter 5-1) This habitat is also organized on a two and half floor configuration, the half stage being devoted to bedrooms.
The habitat volume is supplemented by three inflatable volumes.

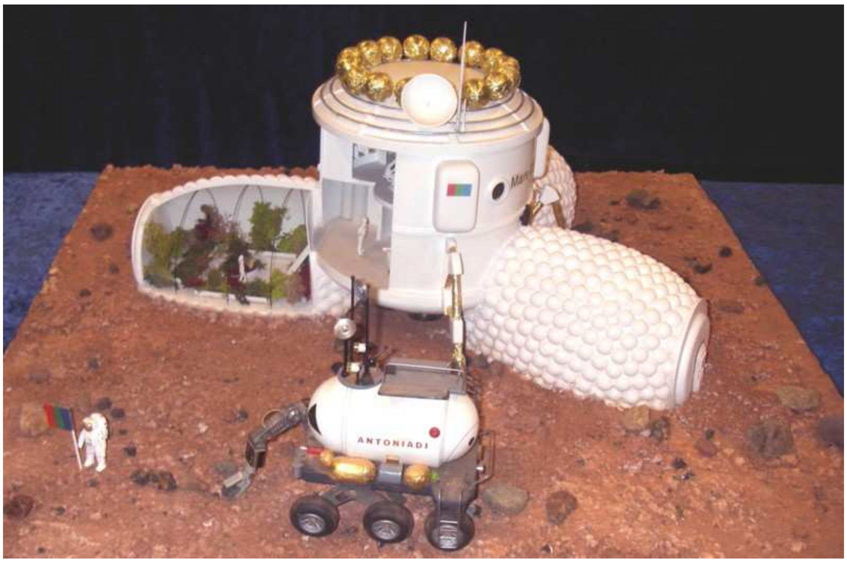


Inflation on going for the three supplementary pressurized volumes around the Hab



Inflation completed

A mock up of this habitat has been built by the Strate College, a designer school, and is used for exhibits by the Mars Society French chapter.



The habitat mock up and a pressurized rover

The Hab mid upper level is the living area including personal workstations. One original idea is to have a large central table which can be stored on the ceiling to give more room in this level when the table is not used (for example to facilitate physical exercises). The bedrooms are located in the upper level with windows looking on the living room recreating at a reduced scale the notion of a village and its central plaza.

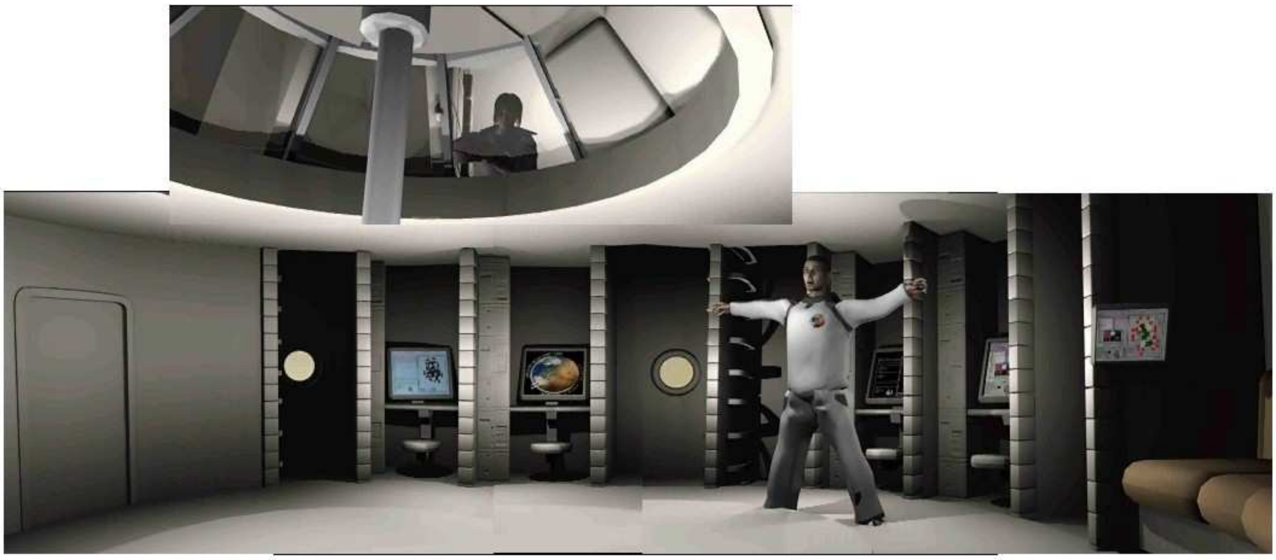
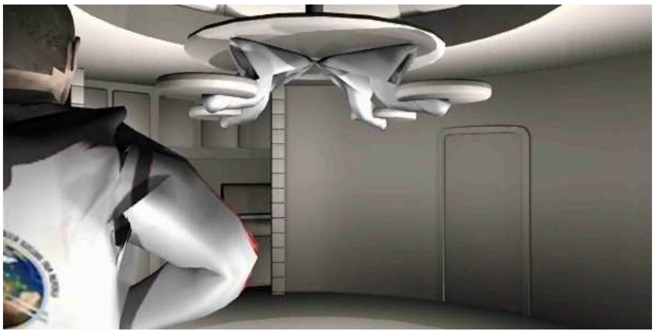


Photo mosaic presenting the upper level lay out with the bedrooms above; the living room size appears exaggerated in this view.

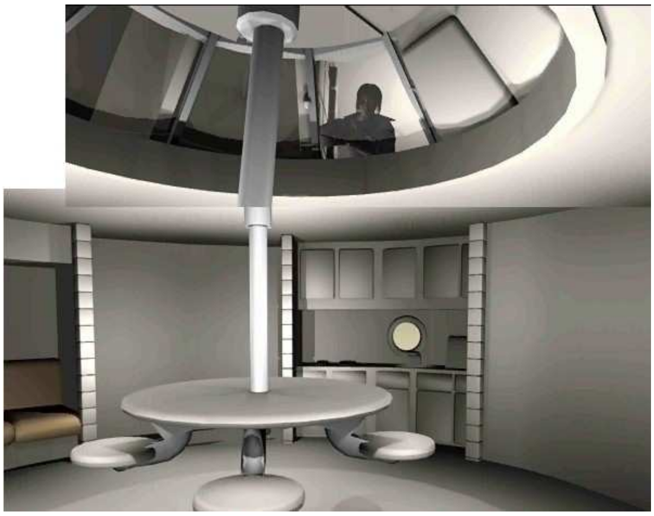
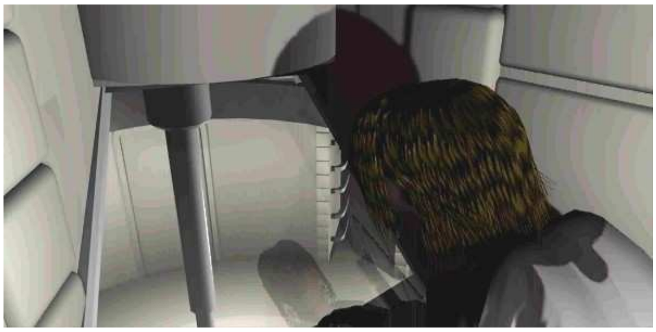
Personal workstations



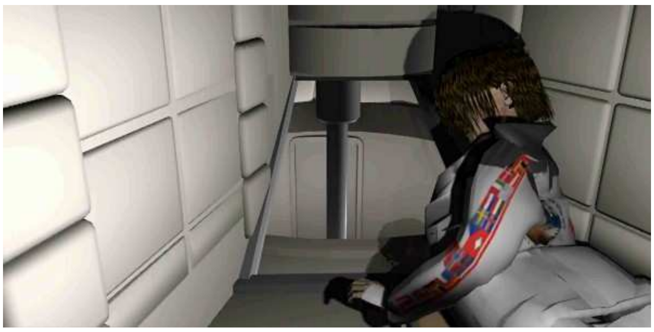
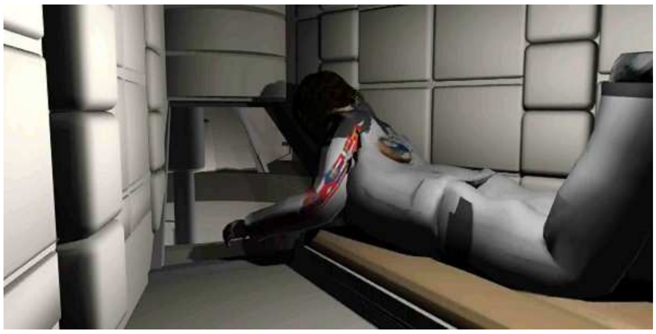
The table coming down from the ceiling

The table in its down position


Above the living room the bedrooms are equipped with down looking windows.

In the bedroom

4.8. Psychological tests

by Alain Souchier and using explanations from Sheryl Bishop tests

This experimentation is part of a research project entitled "Assessing Group Dynamics In a Mars Simulation". The purpose of this study is to explore individual and group factors that contribute to successful team performance in extreme environments. Investigations into factors that contribute to successful real world teams are typically limited to small groups in which myriad factors contribute to the outcome. The opportunity to investigate some of these factors in a simulated, controlled situation will hopefully lead to greater insight into key factors that will contribute to improved selection, training and support of teams in the future.

This research is follow on from the work done during several MDRS seasons by Dr. Sheryl Bishop (MDRS 6; Expedition One/MDRS 14; MDRS 26; MDRS 40) from the University of Texas Medical Branch in the Department of Preventive Medicine and Community Health, by Dr. Steve Dawson, Dr. Kate Reynolds, Dr. Rachael Eggins (Expedition One/MDRS 14; MDRS 26) and Dr. Paul Maruff (MDRS 26). In 2005 Sheryl Bishop organized with Anne Pacros and others, two successive rotations MDRS 39 and MDRS 40 where the same psychological tests were conducted on an all male crew (Leonardo MDRS 39) and on an all female crew (Monalisa MDRS 40). Sheryl Bishop was herself part of crew 40 who was headed by Anne Pacros. When preparing our MDRS 43 rotation we decided with Anne to propose to Sheryl to use the crew for a new set of psychological tests. As we had a modification in the crew composition in the middle of the two weeks (Anne and Loic departure, Olivier arrival), the tests were slightly adapted.

Composition variables such as personality and leadership styles, group size, cultural and gender mixes, role and power structures are frequently cited as areas that have affected group performance and impacted group functioning in the literature, by crews themselves and the support personnel around them (Kanas, 2001).

The current proposed research is based on the notion that people act as both individuals and members of groups and that they function most cohesively and cooperatively in a group if they identify with that group. This comes from two mainstream social psychological theories, social identity theory and self categorization theories (Tajfel & Turner, 1979; Turner et al., 1987; Turner, 1991). To identify with a group means that people internalize as their own the values, norms and beliefs that define the group.

The degree to which an aggregate of individuals actually functions successfully as a group is dependent on the existence of a shared group or social identity (Haslam, 2001).

The situation becomes more complex where the achievement of overall goals relies on cooperation between a number of isolated sub-groups (Haslam et al., in press; Eggins et al., 2002). Positive group outcomes depend on the alignment of sub-group goals and those of the broader mission.

Of particular interest, in the case of MDRS 43, is the impact of mid-mission crew replacements on the group.

All MDRS 43 participants have been administered the Astro-PCI, a battery of psychological questionnaires that assess various dimensions of personality prior to arrival at the habitat. Once there, participants have been asked three times (Day 1, mid mission and end mission) to complete an online questionnaire that measures:

1) Personal and Group Functioning (a range of items designed to measure various factors of group identity, decision making and goal formation);
2) A brief (10 item) self-report measure of stress (Sheldon's Perceived Stress);
3) A self-report measure of coping (assessed using a 28 item Brief Coping Questionnaire which measures 14 subscales related to coping strategies).

PSYCHOLOGICAL PROTOCOL TIME LINE SUMMARY:

FULL TIME CREW

MEASURE	SOURCE	PRE	DAY 1* BASELINE	Mid MISSION* END WK 1	LAST DAY END WK 2
Mars Habitat I	Web	X	-	-	-
Mars Habitat II	Web	-	X	X	X

ROTATION MEMBERS-Part time crew members

MEASURE	SOURCE	PRE	DAY 1* BASELINE	LAST FULL DAY End Wk1 or End Wk 2
Mars Habitat I	Web	X	-	-
Mars Habitat II	Web	-	X	X

The tests were not conducted (and were not to be conducted) on the handover days.
The handover day is the day when both incoming and outgoing teams/members are in residence, i.e., staying overnight. Day one is thus the first full day for members. For the first half, Day 1 is the same for the full time team and the first half part time members. The day one tests were conducted the 29th of January. The preceding crew had left early in the morning. The assessment was also done by the commander who had to go to Salt Lake City with the crew 42 and came back in the same day. Mid mission assessment for the full time crew was to coincide with the last day assessment for the first half part-timers. The assessment was conducted Thursday the 2nd of February. Olivier arrived the 3rd and Anne left the same day. So the 2nd was as required the last full day for the outgoing crew members prior to the arrival of replacement member.
The incoming second half replacement member have filled out Day 1 questionnaires on his first day in the Hab (the 3rd) which was not a full day (arrival at 1.30 pm and questionnaire filled at 8 pm). Anne left as soon as Olivier arrived but our media crew extended their stay and left only early the following morning.
The last day for the full time members has coincided as requested with the second assessment and last day for the second half replacement member. The tests were conducted the 10th of February. This was the last full day for all concerned, Richard left the following morning and the MDRS 44 crew arrived the following evening.

The number of subjects involved in the study has been 6 members out of the 7 assigned to the mission.

All data from the questionnaires are coded to maintain confidentiality. Although some demographic information could possibly identify specific participants, only the Principal Researcher has access to individual responses and no such identifying data will be reported in association with any particular response set. All data are coded so that specific individual responses are unlinked with identity relevant information.

We had sometimes difficulties to conduct the tests owing to the poor Internet link. In some cases after an Internet link cut off, the test could be restarted from where it was left. In an other occasion all the test had to be restarted. One of the crewmembers was not able to conduct one of the test owing to these Internet link difficulties.

About the MDRS 43 crew it is interesting to note that we had an heterogeneous crew as far as the each other knowledge is concerned. The pattern of each other knowledge was the following (designating anonymously the crew members by A, B, C, D, E, F, G):

	B	C	D	E	F	G
A	-	++	-	+	-	+
B		-	-	-	-	-
C			-	+	-	+
D				+	-	+
E					-	++
F						-

With the following meaning:
++ : Know each other well
+ : Know each other
-- : Do not know each other

The pattern shows that two crew members did not know any of the others.
We had a general meeting of the crew the 14th of January two weeks before our rotation.

Naturally as we were not trained as a crew long years before as would be the case for an actual crew, as we did not share together the difficult steps of preparation, launching and six months travel to Mars with all the involved stress, as our stay in simulation was very short, we did not have representative conditions for psychological interaction between the crew members. As a non specialist I noticed however that during our two weeks of intense activity involving some stress not linked to surrounding danger but to the will of fulfilling the objectives, the crew personalities seem to be amplified. The hyper active is more active, the methodical is more methodical, etc.

4.9. Geology

by Alain Souchier

We had no geological objectives at the beginning of our mission. We neither had geologists among us. However Olivier followed biology and geology lectures in university during three years before shifting to architecture studies.
Geology was only a peripheral objective during CRV tests (main objective was studying the vehicle mobility and operations), during pole mounted and balloon mounted camera experimentations and during the observability tests (use of petrified woods and dinosaur bones as “markers” for testing the astronauts observational capabilities). Since the beginning we were however interested in finding “blueberries” which are hematite spherules indicating the past presence of oceans like on Mars. We wanted to find fossils like stromatoliths because they could be used in the video by France 2 to demonstrate what could be the most “advanced” life forms which could eventually be found one day on Mars. Stromatoliths are the fossils remaining of living cells (cyanobacteries or “blue algaes”) with yet no nucleus (prokaryotes eubacteries) which appeared on earth at around – 3.5 billion years. There was a nice stromatolith fossil at MDRS during the MDRS 7 rotation (found by a previous crew) which was no more there during MDRS 43. Olivier found in Lith Canyon a fossil which may be also a stromatolith (see photographs).
We had also indications from Tiziana Trabucchi, a previous crewmember of MDRS 40, who is a geologist, about taking soil samples in surface and 20 cm deep to measure water content by mass comparison before and after heating in the lab oven. This sampling was conducted during EVA 3. During some EVAs at Lith Canyon we also wanted to find nice cross-bed layers which were seen during MDRS 7. These layers are characteristics of successive flows in which layers are deposited during the first flow for many years. Layers may gather small size particles indicating a quiet flow or bigger particles indicating a strong flow. Then many years later a new flow cuts through the past layers with a

small angle (which may reach 30 degrees) and new layers are deposited. Such cross-beddings were also detected on Mars by the rover Opportunity.

Upper left: sandstone slabs on the way to Phobos Peak (EVA 5) looking like some areas photographed by the rover Opportunity on Mars (upper right and left) around Erebus in Meridiani Planum

On the left, the area were the (probable) hematite "blueberry" was found at the foot of Phobos Peak. In the right a macro-photo taken in situ.

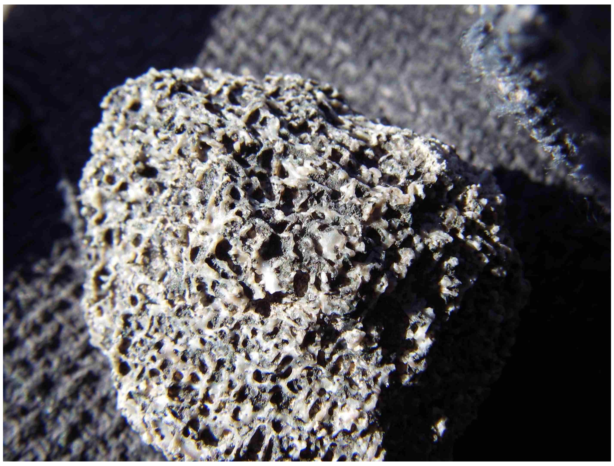
On the left the rock sample extracted with the forefinger indicating the hematite. On the right a macro photo in the Hab. This sample was unfortunately not brought back to Europe for analysis.

Fossil coral found 100 m north of the Hab

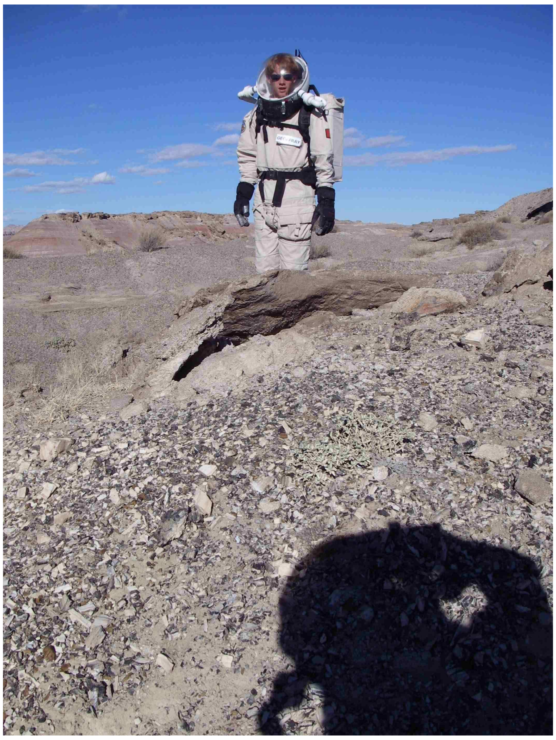
Dinosaur bones fragments at Lith Canyon

Dinosaur bones fragments at Lith Canyon

Dinosaur bone fragment macro-photo (Lith Canyon)



Dinosaur bones macro-photos (Lith Canyon)



Remains of a totally fragmented fossil wood log in an entrance slope to Lith Canyon

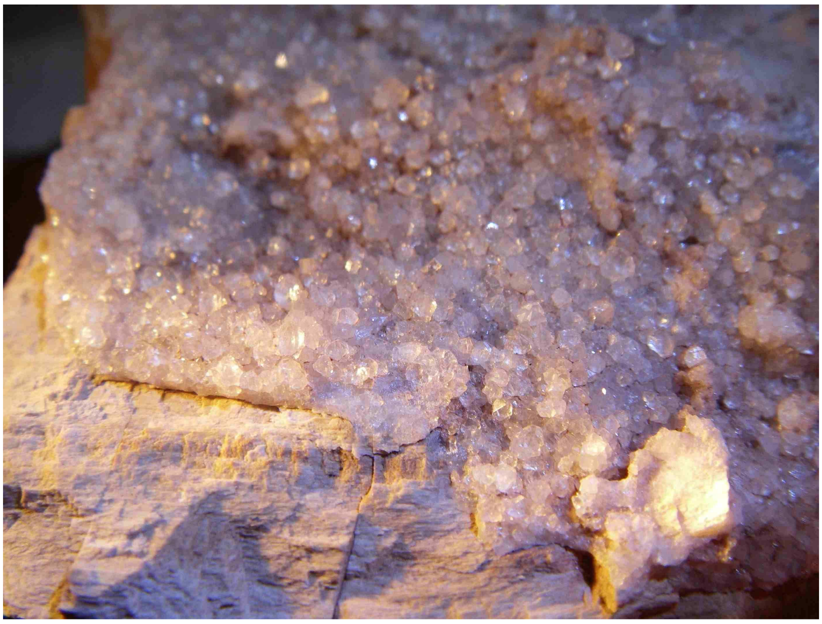
Small fossil wood log in the cliff in the upper part of Lith Canyon

Fossil tree roots in the floor of Lith Canyon

Large fossilized wood log (Lith Canyon)

Fossilized wood fragments fallen from the log shown in the preceding photo

Fossilized wood fragments



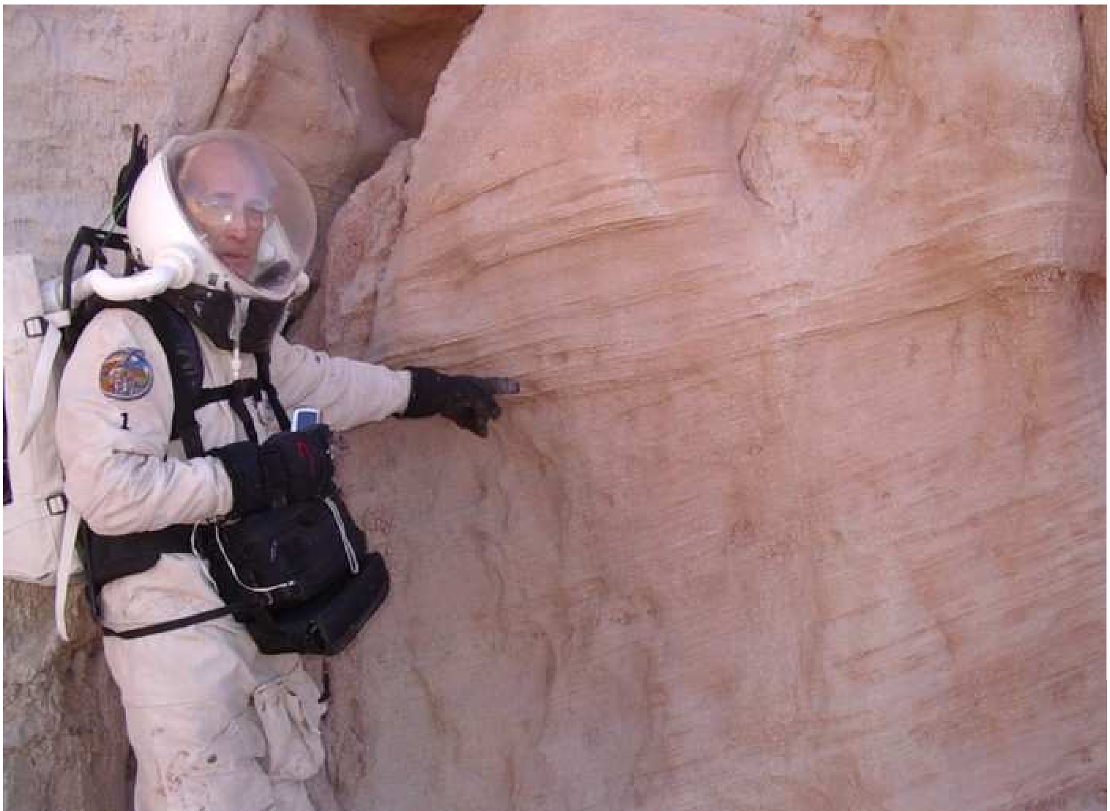
Quartz crystals on one of the fossilized wood samples

Olivier examining samples

Macro-photo of the quartz crystals

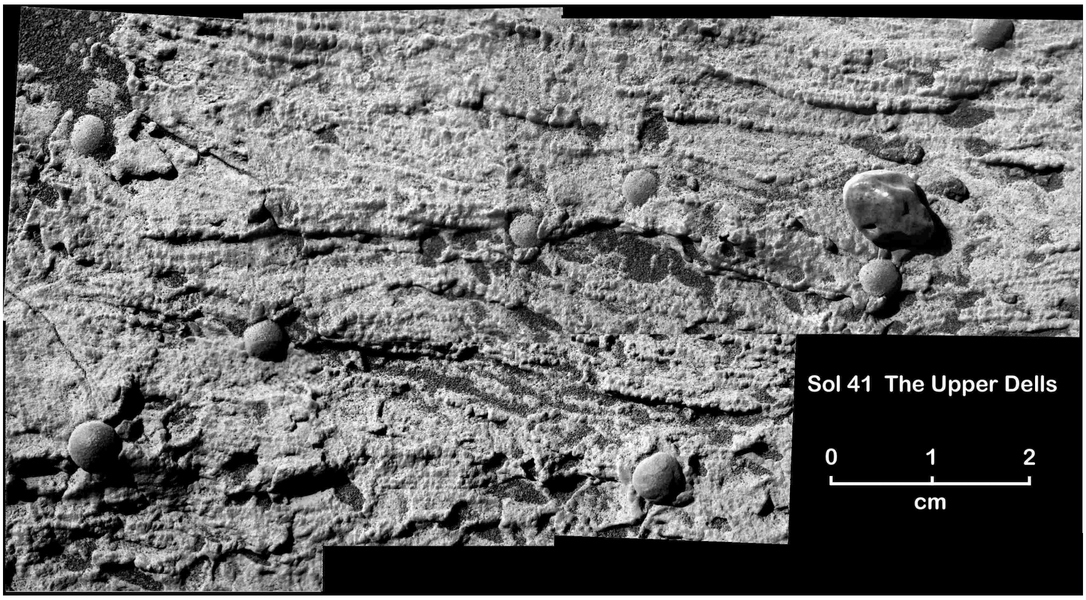
Possible Stromatoliths found during EVA 22 in Lith Canyon.

Stromatoliths present in the Hab during MDRS 7 and collected by a previous crew



Cross - bedding in the upper part of Lith Canyon

Cross-bedding layers in the upper part of Lith Canyon indicating successive flows, the newest one cutting through the layers of the oldest one. Layers with bigger particles indicate more powerful flows.



Similar type of layers photographed on Mars in Meridiani Planum by Opportunity

Salt deposits in Utah around Candor Chasma photographed during EVA 26 (left) and on Mars as detected by Spirit in the Gusev crater

Micro fairy chimneys in Lith Canyon on the left and a large one under. Photos taken during EVA 22. Such configurations linked to strong rain erosion are not possible on Mars.

5 MDRS 43 videos, photos and artworks

5-1 France 2 TV channel filming
5-2 Filming and photographying in EVAs
5-3 Artworks
5-4 Photos

5.1. France 2 TV channel filming

by Alain Souchier

The media team arrived at MDRS Monday the 30th shortly before 3 pm. We went immediately to the top of the Hab ridge to shoot some video of the Hab and the landscape, as the weather was clear, in case meteorological conditions would worsen the following days.
Loic de la Mornais was full time part of the crew and Eric Maizy, the cameraman, stayed all time with us in order to shoot video sequences "night and days". As we were 7 sleeping in the Hab during the first week, the loft was used for one of the media team member. Arnaud Pacari the sound engineer left the Hab every evening for the Whispering Sands Motel.
The briefing meeting was held nearly every day at 9 am and the media crew attended. During this meeting we defined in detail the day activities program and general orientations for the following day. During the media team week presence, we gave a certain amount of priority to the media needs and at the same time starting as much as possible the technical program. The technical objectives for EVAs were presented during the briefings (the media team was interested in filming such activities) and also we discussed the possibilities of conducting EVAs in spectacular areas. We had to bear in mind that the weather could deteriorate which meant trying to shoot the best pictures as soon as possible.

Tuesday we programmed EVA 3 (the first EVA in media team presence) around the Hab as the observability test EVA with also geological objectives (soil sampling at various depths for moisture measurements). We decided to devote EVA 4 fully to the media needs by a visit to the spectacular Goblin Valley site. For this EVA4 we benefited from Anne past experience: Anne was part of an EVA at Goblin Valley during MDRS 23. At the same morning briefing we also decided to conduct EVA 5 on the slopes of Phobos Peak the following day early in the morning. The preparation of EVA 3 observability test was filmed (lay out of odd objects in the field) as well as the search during the EVA. As we were not using the ATVs, this EVA was conducted by a team of five. During the last part of the EVA we searched for some interesting stones and fossils around the Hab. The finding of a small coral fossil allowed for explanations that, if life once existed on Mars, the fossil which could be found would not be as evolved as the one we had in hands there. We ended the EVA by group photos of the crew in front of the Hab and also in front of the Martian flag. All these operations were documented by the media team The colours of the Martian flag introduced an explanation on possible Mars terraforming. After the EVA we discovered that the generator had an emergency stop. This situation was filmed by the media team. In the afternoon the trip in Goblin Valley gave nice pictures just before sunset. We had still a partial snow cover which introduced explanations on the fact that such layers on Mars would mostly be carbon dioxide frost.

Wednesday the 1st, as planned, we conducted early in the morning an EVA towards Phobos Peak and up to the summit with the media crew. Some sequences were shot along Lowell Higway in a nice field of small boulders. On our way to Phobos Peak we were told to give our feelings as if we were actually on Mars. This Wednesday, our briefing was held at 11.20 am. Two EVAs were decided for the afternoon, one for site scouting in ATVs and one to simulate the first EVA on Mars for the media team. The commander had five minutes to imagine some historical words: "It has been a long trip but here we are, may be a new Earth for Man".

Thursday the 2nd, the 9 am meeting started on the definition of an EVA which would be filmed from the air (airplane or helicopter) by the media team. The aerial operation was planned some days before our trip to Utah, but the decision was not taken between airplane and helicopter. During the briefing Arnaud Pacari brought the information that the media team departure was postponed from Saturday to Sunday which gave one more day to conduct the operations. The idea for the EVA filmed from the air was to have two teams of two people operating around the Hab. One of the team would leave the Hab area upon airplane or helicopter arrival, heading on Lowell Highway for Lith Canyon. This EVA would be conducted around 3 pm to allow for driving to the airport and coming back by aerial means to the Hab area. At 10 am the same day the authorization to rent an helicopter arrived from the France 2 channel offices and we had a complementary briefing. The afternoon EVA was planned to be the first CRV test at White Rock Canyon filmed by the media crew. The vehicle preparation was filmed including some explanations on its objectives. Then Richard was interviewed on his crew activities analysis. Later on it started to rain and the White Rock Canyon EVA was cancelled to avoid covering the ATVs and spacesuits with mud. It was replaced by an EVA around the Hab on the theme of sports on Mars and to shoot a transition sequence where Pierre, in spacesuit, would show computer pictures of a Hab landing on Mars on a laptop. This would precede interviews on actual Habs external and internal configuration studies. The "sport" part of the EVA went well but even under the cloudy sky the light was too strong for computer screen filming. This sequence filming was postponed till 6 pm when light was dim enough to get nice pictures of the flight to Mars and Hab landing on the laptop screen as well as of the actual MDRS Hab in the same field of view.

This Thursday we held a special briefing at 10.30 pm to carefully plan the following day. The media team would leave at 10 in the morning to drive to Brice Canyon where they would rent the helicopter. The 2 teams EVA had to be around the Hab at 2.15 pm. The helicopter lift off was planned at 2 pm from Brice Canyon and its arrival above the Hab foreseen at 2.45 pm. After the helicopter first pass over the Hab, one of the team of two would go to the ATVs and drive on Lowell Highway. After the briefing Anne was interviewed on the psychological tests.

Friday the 3rd Eric Maizy shot sequences showing the Hab bedrooms ending on a commander interview. We held our morning briefing at 9 am. We decided to give an opportunity of more interesting picture from the helicopter by conducting a rehearsal test of the CRV during our waiting time before the helicopter arrival. Part of this test could be filmed from the helicopter before the departure of Alain and Pierre with the ATVs. This Friday we were waiting for Olivier Walter arrival and our only fear was to see his arrival coinciding with the helicopter fly over and filming. Fortunately Olivier arrived with Don Foutz around 1.30 pm while we were preparing for the EVA. Everything went smoothly. The two EVAs team left the airlock at 2.10 and 2.15 pm and we were testing the CRV when the helicopter arrived at 2.40. At 2.45 we started the ATVs and were followed in our progression on Lowell Highway during 5 minutes.

We decided to have an other night briefing meeting at 10 pm because the following day would be busy with EVAs, this day being the last one for the crew media. We defined three EVAs: First, early in the morning, a media team EVA around the Hab (during the preceding days none of the crew media people had tested a spacesuit), then an EVA to White rock Canyon to test the CRV (this area is interesting because views on the cliff are possible from the top, and after a short trip, also from the bottom of the Canyon) and finally an EVA along the rim of Upheaval Dome (a meteoritic crater located in Canyon Lands National Park which can be reached after some hours of driving). During this last EVA the balloon and the pole mounted camera would be tested.

Things went according to the program the Saturday. Loic de la Mornais and Arnaud Pacari donned the spacesuits. Eric Maizy elected to remain out of sim and film the EVA. Jeremie was the third EVA crewmember. Loic took the commander right glove with the three rods and was able to activate the large professional TV camera “in sim”. He also tested that he was able to activate his mobile phone with the rods (see the chapter on the dexterity improvement devices on the gloves). The following EVA was conducted by Richard and Alain driving the ATVs along Lowell Highway followed by the media four wheel drive car. The crossing of Bob Rocks Garden was filmed twice to benefit from the nice landscape. The CRV test at White Rock went well. Richard was interviewed on the importance of human presence for Mars Exploration and the media crew left the site to go back to the Hab, take with them Olivier, Pierre and Jeremie as well as the hardware for the next EVA at Upheaval dome. During this EVA the balloon was slightly deflated and rose only to some meters before falling back. As the media crew left the following day, they were not there when we conducted some spectacular EVAs around the Hab with the in house built balloon some days later. The interviews around Upheaval Dome dealt with the meteoritic craters and with the idea that Mars is only a first step in the solar system exploration. In the evening after diner, Olivier was interviewed on the MDRS Hab and future Martian Habs lay out. This interview ended at 11.40 pm.

Sunday the wake up rang at 5 am (!) for our fellow journalists and they headed for Salt Lake City some minutes later.

The videos shot during this week were shown at the end of the 1 pm news on France 2 TV channel from the Monday 20 th of February to the following Friday. This 5 mn broadcasting is systematically conducted at the end of the news and deals with the same topic during all the week. It is called the “ Week Feuilleton”. The series concerning our MDRS mission was called “ Allo Earth, here is Mars”. The mid day 1 pm news on France 2 channel are seen in general by 2 to 3 million people in France.

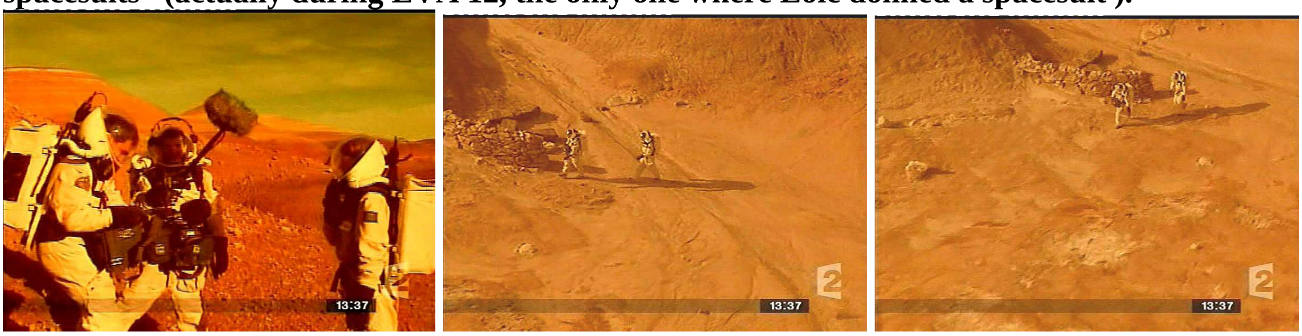
During the two first minutes in the first episode, the presentation was done as if we were actually on Mars, starting by the fierce trail of an atmospheric reentry, pictures of the Hab through smoke and vibrations and a reddish hue on the landscape. Actually the news announcer introduced the episode saying “One of our teams went to Mars” !

The main content of the five sequences presented on FR2 TV channel is presented thereafter.

Sequence 1

Sequence 1 starts "as if" we were in a true first mission to Mars by the trail of an atmospheric entry, smoke around the Hab and the first EVA (actually EVA 7). Landscape colours are reddish.

First step and historical sentence: "It has been a long trip but here we are; may be a new Earth for Man". The commentary says: "Our TV crew films these first steps with difficulties in their spacesuits" (actually during EVA 12, the only one where Loic donned a spacesuit).

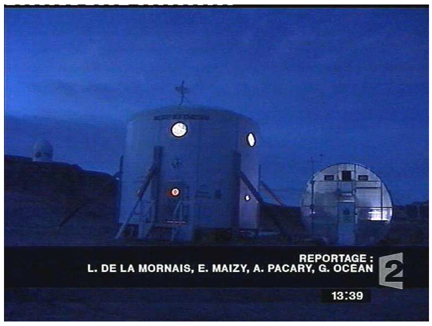


Loic interviews Jeremie. Eva 10 filmed from helicopter still with a reddish coloured picture.

When the helicopter shadow appears, the picture transitions to natural colours and the commentary indicates that we are in simulation.

The transition is accentuated by the picture of Richard sweeping the porch. Explanations follow on the simulation conditions: Anne explains the spacesuit.

The crew is presented and followed by the power generation system in the engineering area.

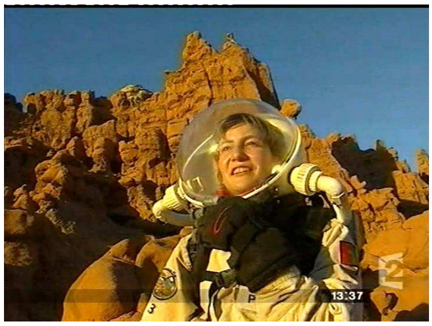


Jeremie checks the propane level and the generator is started. The first sequence ends on the Hab in the night.

« Night is falling on the imaginary spacecraft »

Sequence 2

Sequence 2 starts on some explanations on the spacesuits and the outside atmosphere on Mars.



EVA in Goblin Valley (EVA 4) was dedicated to the media needs.

Explanations are given on the frost which may be found on Mars (CO2 frost) and on the way to communicate helmet against helmet when a radio has failed.

Digging the ground during EVA 3 is used to remind that, once upon a time, Mars had also oceans. Then is documented the trip to Upheaval Dome and the presentation to the park rangers of the spacesuits in the car.

The trip to Upheaval Dome crater (on the left) during EVA 14 initiates a presentation of some Mars characteristic features (Valles Marineris, Olympus Mons,…). Also Mars is presented as the first step in solar system exploration.

Sequence 2 ends on the balloon flight attempts along Upheaval Dome crater rim. The media crew left the MDRS before our new balloon fabrication and successful flights.

Sequence 3

Sequence 3 is devoted to the Hab, greenhab and maintenance. The bedrooms are presented.

The duration of a Martian trip is reminded and other parts of the Hab are presented. The water recycling system and the plants in the greenhab are also shown.

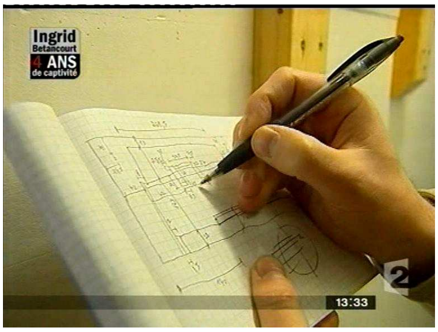
The emergency power generator shut off we had the 31st of January is documented and explanations are given by Richard on the crew necessary autonomy to solve emergencies before getting answers from Earth, owing to the communication delay between Mars and Earth. The call for help through the web cam is shown on the right.

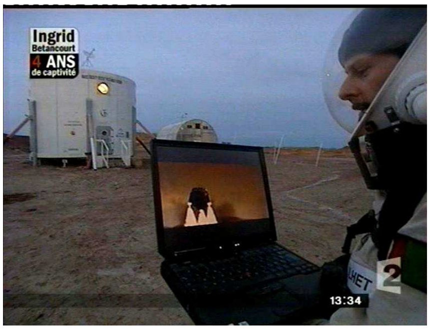
The generator emergency shut down introduces Don Foutz intervention for the maintenance. Food considerations end this sequence.

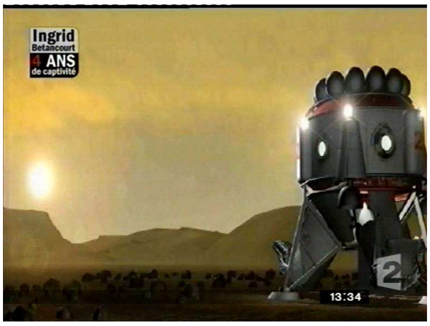
"During the night for the first Mars explorers, Earth will only appear as a simple star in the sky".

Sequence 4

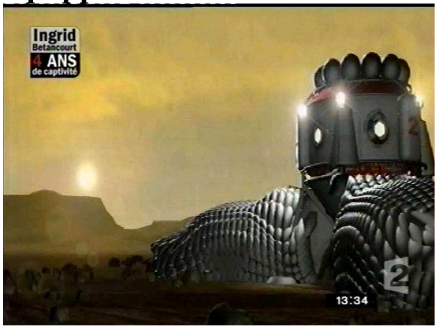
Rain outside and leaks inside: these are not Martian condition. Olivier explains what are the similarities and dissimilarities with an actual planetary habitat. This sequence n°4 is devoted to planetary habitats architecture studies.

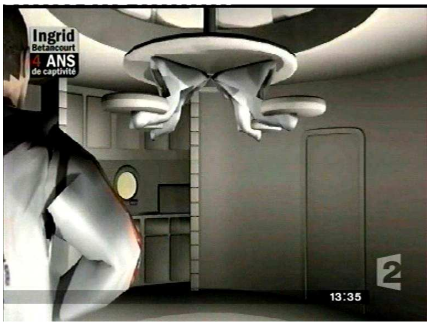






Pierre taking internal measurements and explaining outside (EVA 9) the landing of a Mars Hab equipped with inflatable structures.





Inflation going on. In the Hab table and chairs stored in the ceiling. Anne explaining the psychological tests.

The architecture solutions are important for the crew spirits. Also will there be sometimes some games even in EVA as presented in a part of this sequence n°4?

Sequence 5

Sequence 5 starts with the observability tests, mixing pictures from EVA 3 preparation (strange objects led on the field), pictures from EVA 10 filmed from helicopter, and actual pictures from EVA 3 with the EVA team searching for the objects.

EVA 3: the team searching for strange looking objects.

Some objects were clearly visible, others not.

Then the CRV preparation is presented leading to the test 70 at White Rock Canyon (EVA 13). To illustrate the trip to White Rock Canyon pictures from the actual trip as well as pictures from EVA 10 (here above) from helicopter are used. The ATV pictures are used to give some information about ATVs on Mars.

The pictures of CRV test 70 at White rock Canyon (including pictures from the on board camera) are alternated with pictures taken from helicopter of EVA 10 and 11 (coupled EVA) during which CRV test 68 and 69 were conducted on the Hab ridge slopes.

CRV test 68 on the left and 70 in the middle and on the right. Alain looks at the on board camera picture while Richard is operating the vehicle.

At White Rock Canyon Richard explains why human presence is necessary for complicated and difficult operations (as deep drilling for example). The Mars flag (actually EVA 3) introduces a short explanation on Mars possible terraforming. This last sequence ends on aerial views of EVA 10-11 including comments about the possibility for the two youngest crewmembers to be one day members of an actual flight to Mars.

On the last pictures the Utah landscape is coloured in orange to end on a Martian look.

5.2. Filming and photographing in EVAs
by Alain Souchier

Using dexterity improvement devices (see dedicated chapter) seems necessary to operate photo or video cameras which have in general very small controls. For photos I used a small digital camera which is water proof till 2m which means also dust proof. For example this camera has no outside moving part in its lens. Most of my colleagues with moving part in their camera lenses experienced one or two blockages during the two weeks, which could fortunately be cured by a strong blowing. The main difficulty in photographing and filming came from the viewer screen brightness which is barely enough in full sun. Some details may be seen on the screen and this allows to take the main subject in the frame but does not allow for a fine tuning of the frame. One solution is to bring the screen very close to the helmet and the eye but in this case the eye can no more focus on the picture and it is also difficult to fine tune the frame. I had a problem on the video camera with the zoom while filming on the ATV. The zoom changed slowly for wide to tele and this could not be seen by the operator. As during my previous MDRS 7 rotation I used a belly mounted bag held by a lanyard around the neck and around the waist. The bag could hold at the same time the small digital photo camera and the digital 8 video camera. The zipper had been modified with a large 5 by 6 cm flat band made from tape in order to facilitate the grip for opening and closing with the gloves. The lateral and under bag pockets were used to store spare parts (batteries, memory stick), an area map and the GPS.

Alain belly cameras bag with the EVA area map in the lateral front pocket during EVA 20. The right glove is in configuration A2.

The belly camera bag and the zipper grip enlarged with a 5X6 cm tape to facilitate the opening and closing (EVA 11). The right glove is in configuration A2.

In the shadow the camera viewer screen is visible (EVA 20).

On the left Olivier uses a belly mounted camera bag strapped on the suit waist band (EVA 15). Under Pierre uses a camera bag suspended around the neck (EVA 6).

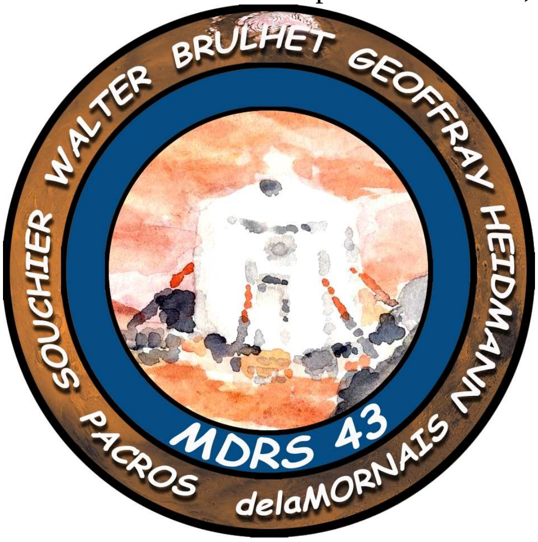
During the mission MDRS 43 a total of 3370 digital photos were shot by the crew cumulating 6.1 gigaoctets. Apart videos shot by the media team, the videos by the pole mounted camera, from the balloon and aboard the CRV, general videos were shot by Pierre and Alain cumulating 2 hours.

5.3. Artworks

by Olivier Walter and Alain Souchier

Outside photos and videos, drawings and paintings could be other nice ways of communicating the martian exploration thrills and spirits to the people on earth. It will be interesting to have astronauts on board with some capabilities in the field.

Here are some artworks produced before, during or after the MDRS 43 mission.



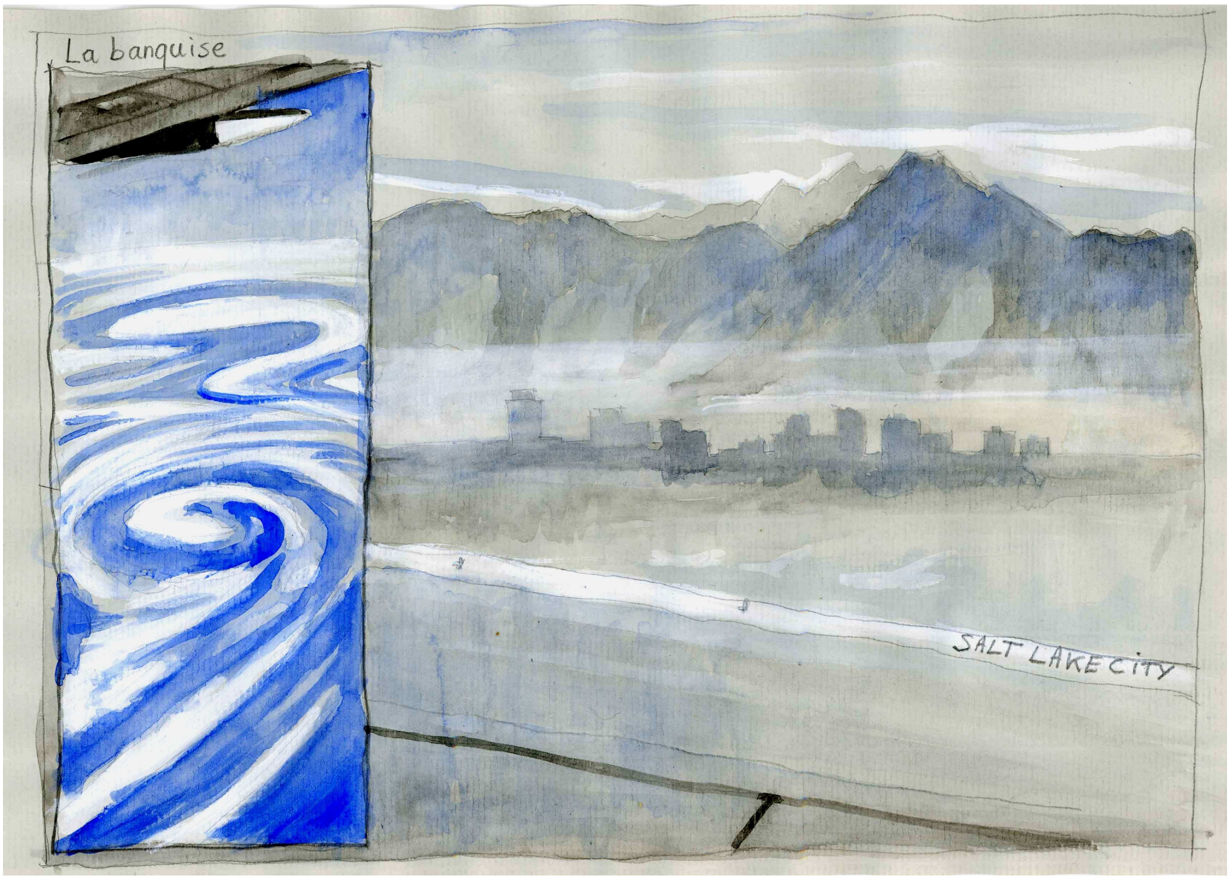
To represent the Hab, the MDRS 43 logo used a part of a watercolor painting executed on the MDRS 7 mission last day (23rd of Nov. 2002) by Alain Souchier. Other watercolor paintings from MDRS 7 executed the same day are presented thereafter.

Henry's mountain and Lowell Highway (MDRS 7)

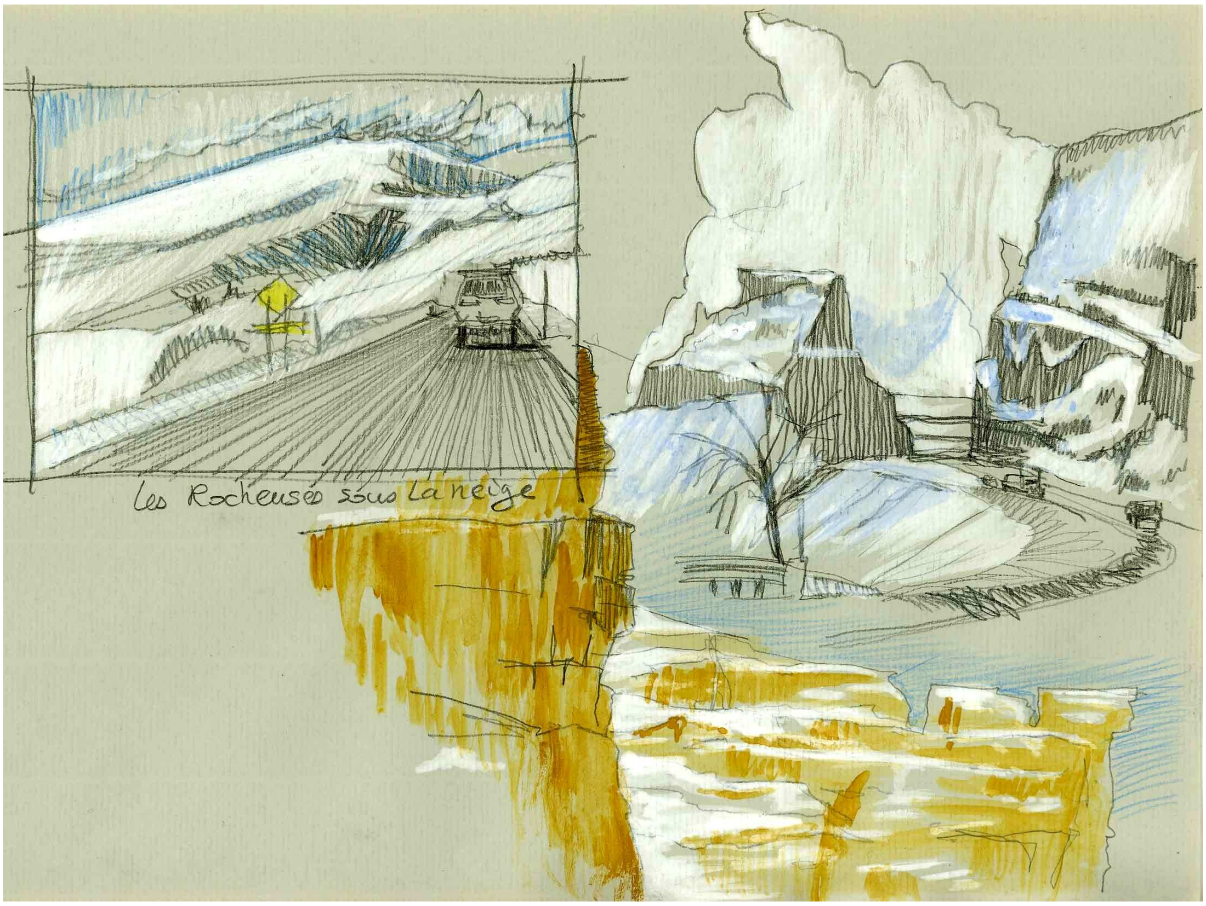
Phobos peak from the Hab porch (MDRS 7)

For fun the painting on the left was executed « in sim », including the spacesuit gloves, on the last MDRS 7 mission day

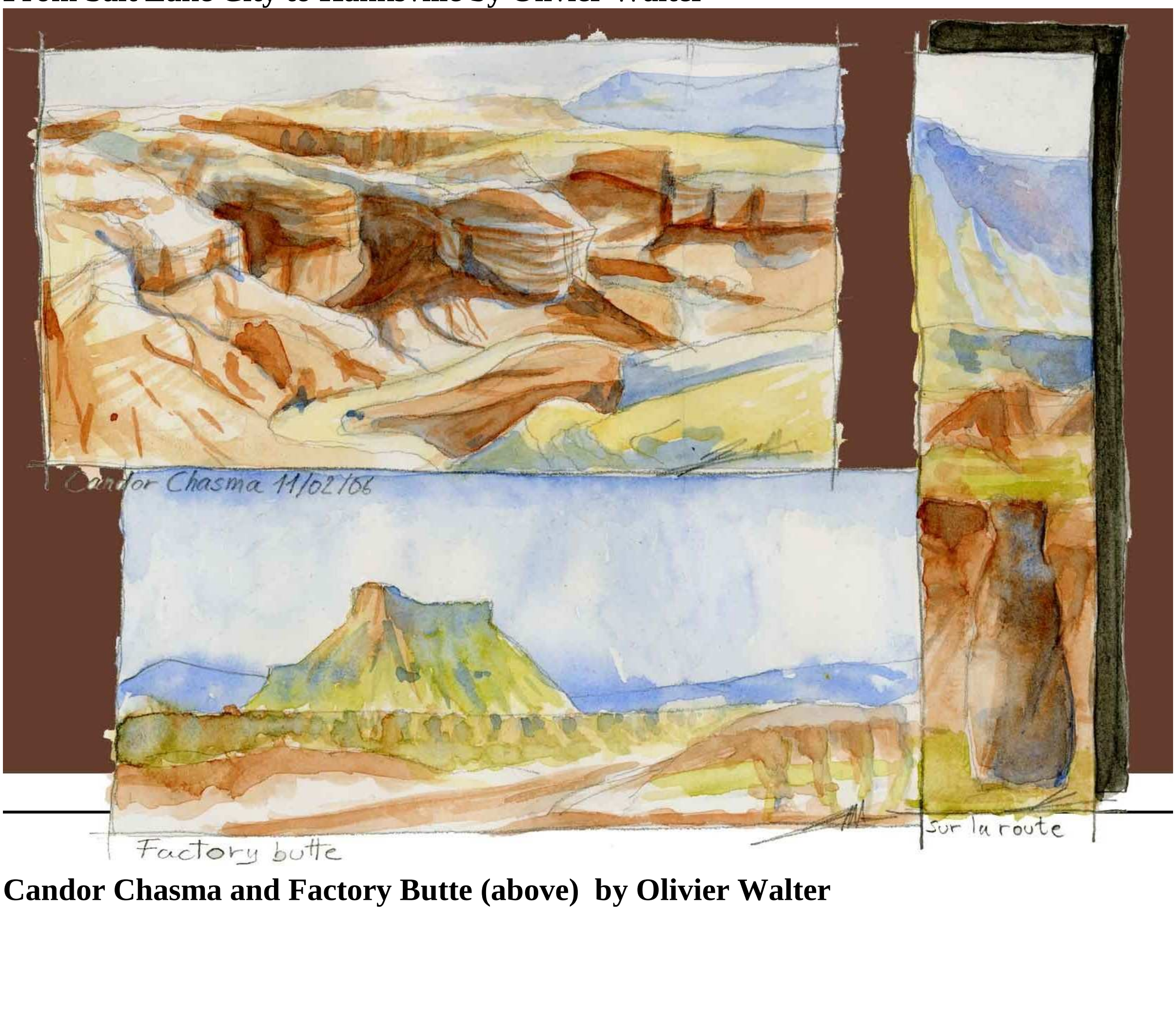
And from MDRS 43:



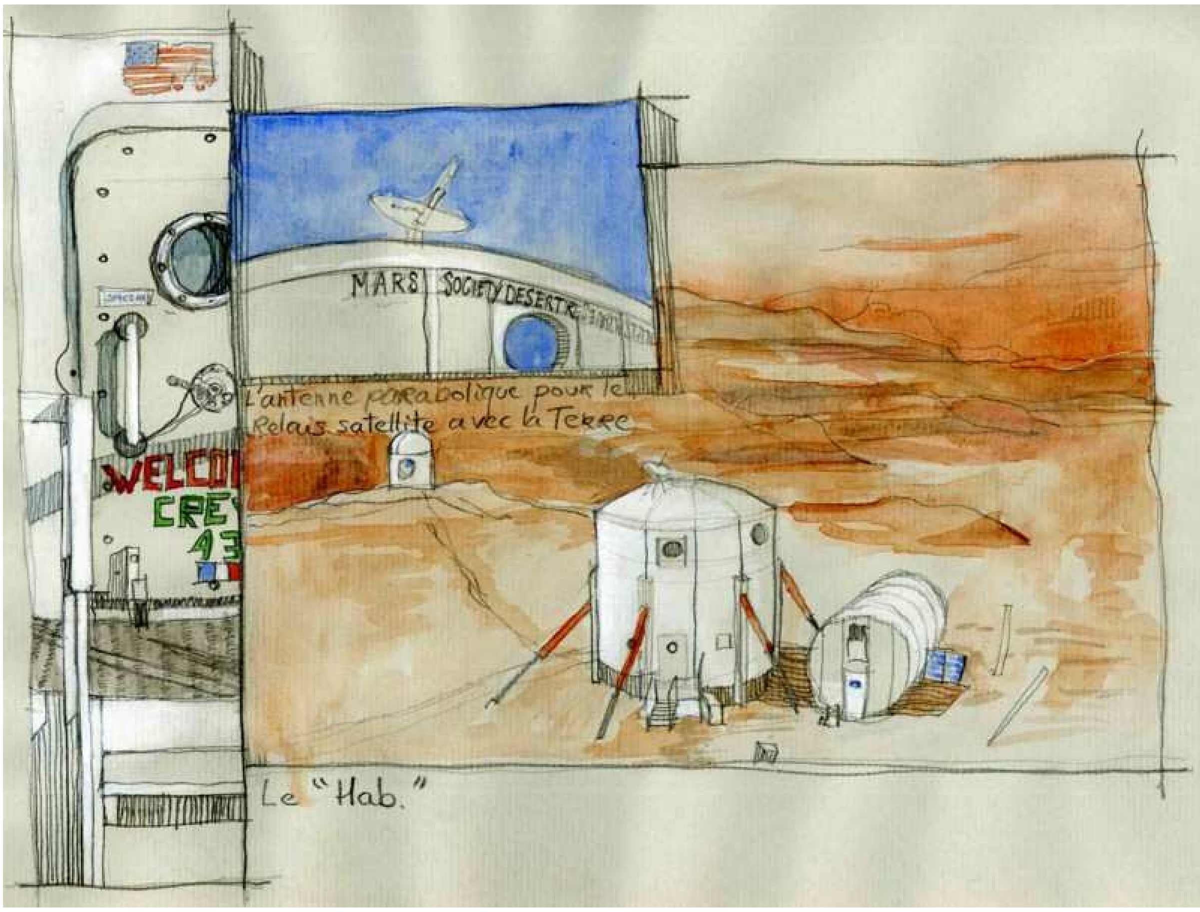
Landing at Salt Lake City by Olivier Walter



From Salt Lake City to Hanksville by Olivier Walter

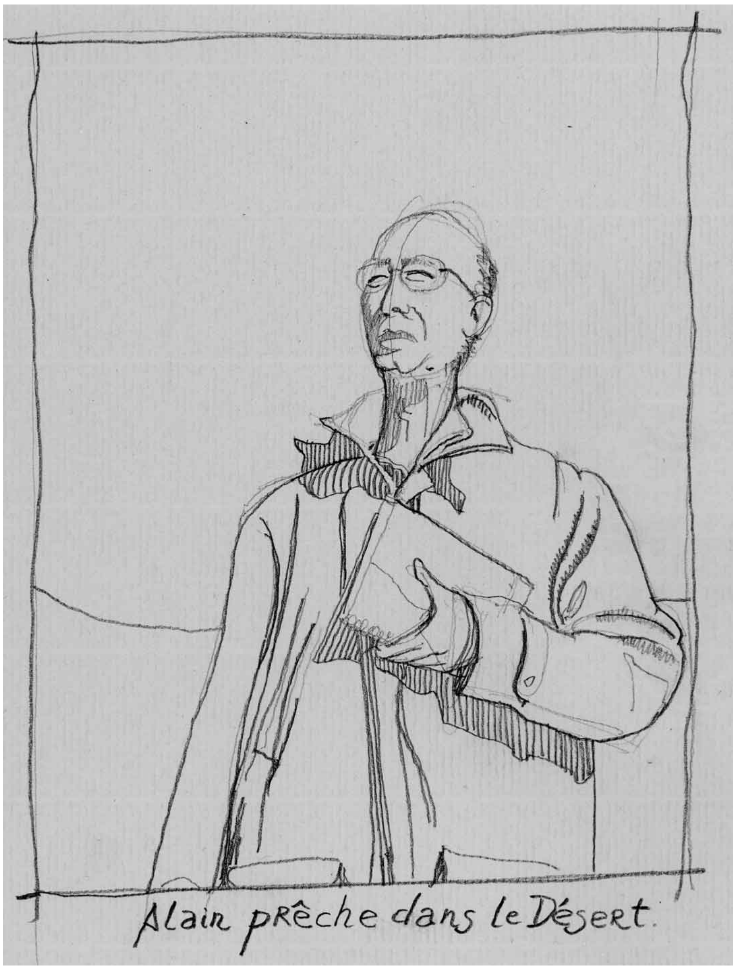


Candor Chasma and Factory Butte (above) by Olivier Walter



The Hab by Olivier Walter


Alain during EVA 3 by Olivier Walter

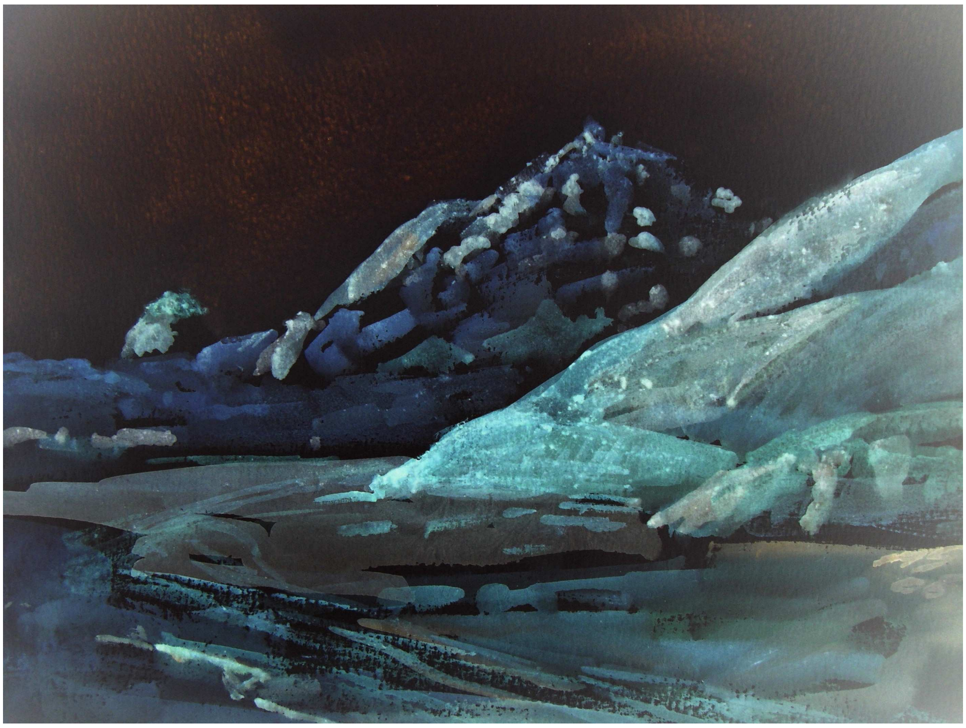


Alain preparing objects around the Hab for the search during EVA 5 by Olivier Walter

Waiting for EVA 22 return: Phobos Peak from the Hab second floor main window by Alain Souchier

Henry's mountain from the technical area by Alain Souchier.

Phobos Peak with Nadia's Peak on the left by Alain Souchier

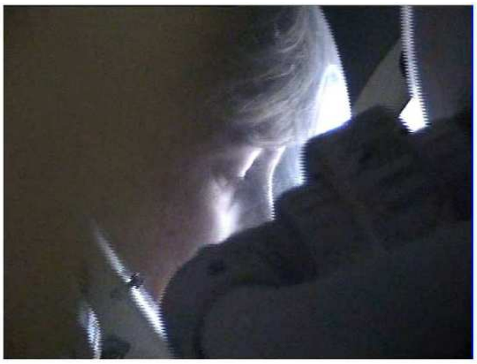


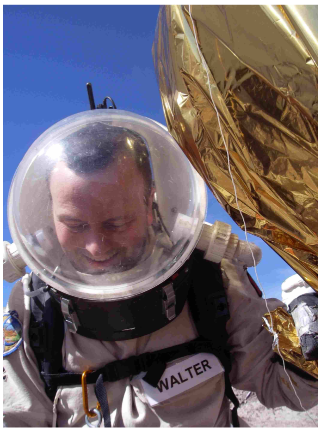
Phobos Peak under the moonlight ? No! Only the previous painting in negative colors.

5.4. Photos

Here after is presented an arbitrary selection of MDRS 43 mission best photographs.

At night : the Hab ghosts




WALTER


3

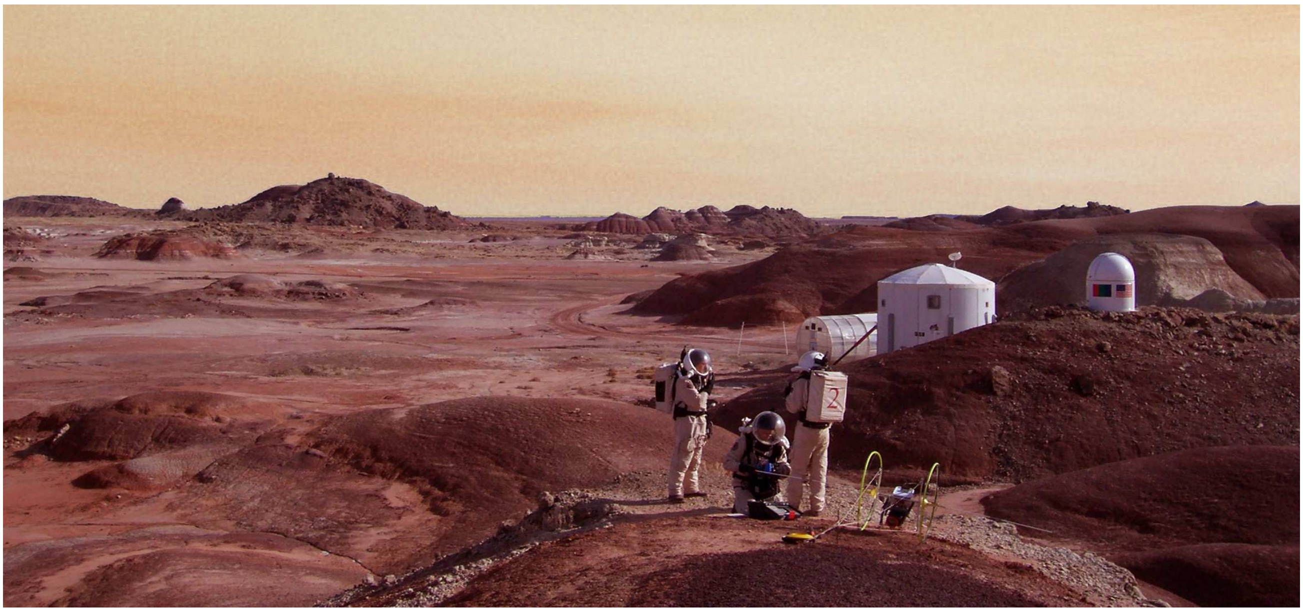
We come in peace…


2


3


GEOFFRAY


1

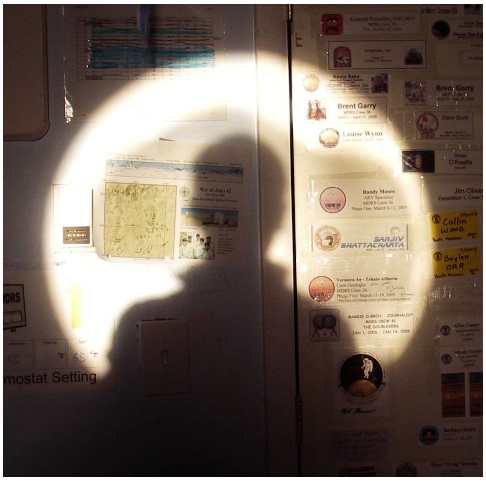

2


3
1


6
1


3


3


mostat Setting

6 Conclusions

The MDRS 43 mission has fulfilled its objectives which were the following:

- A media coverage by one of the main French TV channels to document the various activities which may be conducted in a Martian simulation station.
- A study of the crew day to day activities (type of activities, durations) and comparison to NASA evaluations for actual future planetary explorations.
- Analysis of EVA results and efficiency.
- Psychological effects of EVA only in space suits.
- Evaluation of astronaut observational capacities during EVAs and evaluation of areas explored during EVAs.
- New tests of the Cliff Reconnaissance Vehicle in its configuration n° 3 with first experimentation of a context camera sending information on the vehicle situation.
- Evaluation of a pole mounted camera and a balloon mounted camera to survey the ground, cliffs walls or cliff and large boulders upper parts.
- Evaluation of various dexterity improvement devices on the gloves.
- Hab internal lay out measurements and analysis to define improvements for simulation stations as well as for actual Martian habitat.
- Survey with questions to the crew about life at MDRS.
- Psychological tests of the crew to explore individual and group factors contributing to team performance.

Complementary themes have been added during the mission or while analysing the mission results as:

- Analysis of the difficulties to find locations in some EVAs
- Evaluation of explored area during the mission and extrapolation to a Martian stay.
- Analysis of the communications between the MDRS Hab and “the Earth”.
- Some geological activities

The MDRS 43 crew hopes that the results presented in this document will be useful for the following crews and that some of the experimentations may be conducted and improved by these following crews at MDRS or FMARS. We expect also that these results may be useful to prepare future actual planetary missions.

We had feed back data saying that the 5 mn a day TV broadcast which occurred from the 20 to the 24 th of February 2006 on one of the main French channels was found interesting and full of information by the viewers (which according to statistics were between 2 and 3 millions). May this public outreach operation shorten the time before an actual Mars human exploration. We would like to thank the media team who “plaid the game” and understood that our operations on the field are surely not yet at astronauts and agencies professional level but are also far more than amateur activities.

We also want to thank the Mars Society and the Mission Support team without which this operation would not have been possible. We understand perfectly well that the support of MDRS operations 6 months a year and the equipments maintenance or improvement to prepare the next field season necessitates a dedicated team of volunteers spending a lot of their personal time. During our stay the Mission Support was a perfect blend of telepresence when needed and at the same time letting the crew its freedom of action.