Dear Martian friends,

If time is an infinite cord, we wanted to pinch it so that our tone could wave through the ages until one of you walks on the Red Planet for the first time in Human History. Maybe you will look back in the past to understand what it took to make this singular moment to happen and perhaps you will see us (and so many others)...

We were a group of people, representing eight nations, dreaming to reach Mars! We enlisted for this program hoping to make our way to the Red Planet for some of us, or to make significant progress in knowledge needed to reach it for others.

As Commander of the expeditions, I have the privilege of compiling my crewmates' memories in this letter. The lines below represent the quintessence of their thoughts, narrating our story and feelings.



The Mars 160 program was established in 2016 as an offshoot of the Mars Arctic 365 (MA365) program that was launched in 2013 with the aim of conducting an ambitious year-long Mars mission simulation in the Canadian arctic. The trend of Mars mission simulations in recent years have focused on length, seeking ultimately to measure the psychological endurance of crew members in isolation on a mission to Mars. MA365 was looking to add to that body of knowledge by adding the variable of how extreme environmental conditions affect isolation. While Mars 160 scaled back the amount of time spent in-simulation, it is not lacking in the amount of new knowledge that has been gained to help plan future missions to Mars.

[Paul Knightly, Crew Geologist]

I dreamed up the idea of the Mars 160 mission a little out of desperation. Our planned Mars 365 mission was on hold and we had this amazing crew just waiting to go, and if we didn't get them on a mission soon, they would not be able to participate. Changing that mission to one that would involve a shorter duration, but made use of both our analog stations and this team, made sense. So the Mars 160 "Twin Mission" was born.

[Dr. Shannon Rupert, Mission Director]



To my knowledge, we were the first crew to participate to a program which aimed at comparing our reactions and results to two different Mars analog environments.



Mars 160 was originally designed as two simulations of an equal length of 80 days, one performed at the Mars Desert Research Station (MDRS) in Utah, and the other at the Flashline Mars Arctic Research Station (F-MARS) on Devon Island in Canada. The mission at MDRS happened on schedule within the specified time frame, while the mission at F-MARS was shortened due to two main factors: funding and weather conditions. Rather than representing a failure of the mission by the F-MARS portion being shortened, it highlights two extremely powerful variables to performing a Mars mission simulation, both of which are tied to location: the cost of operating the simulation, and the logistics of getting to the facility.

MDRS offers the best of both worlds – providing an analog setting that is similar in many respects to a human exploration zone on Mars while also being easily accessible from a logistical standpoint. Getting to MDRS is as easy as booking a commercial flight to Grand Junction, Colorado and then making the two hour drive by car to the facility. The geological and biological areas of interest along the San Rafael Swell near MDRS have been extensively studied during mission simulations for over a decade, but few locations in the world offer a better proving ground for testing the scientific and engineering skills and technologies needed for mounting a mission to Mars. It is for this reason that adjacent portions of the desert near MDRS are a growing attraction for space agencies from around the world looking to test Mars rovers and associated hardware.

On the other hand, F-MARS offers a landscape that is as close to Mars on Earth as can be found – both in terms of local geology and climate. For half the year, F-MARS sits in polar darkness during the winter, with temperatures that are as cold as or colder than the surface of Mars. While temperatures are above freezing during the summer, the periglacial landscape revealed beneath the snow shows striking similarities to features that are observed on Mars – features that are not present near MDRS due to its more temperate location in a warm desert of the American southwest. The landscape of Devon Island, and the features surrounding the Haughton Impact Crater upon which F-MARS is located, is one of the best places to study a multitude of processes known to occur under similar circumstances on Mars. In many respects, field research on Devon Island is the next best thing to having boots or a spacecraft on Mars.

[Paul Knightly, Crew Geologist]

Going to Mars is no easy feat. Sending humans on the surface of the "red planet" should not be taken lightly. This is why Mars analogue missions, like the Mars 160 program, are paramount to the

future success of a manned mission on Mars. Mars Society is acting as a pioneer in this field of science. Mars 160 should provide valuable knowledge of what still need to be improved.

[Claude-Michel Laroche, Crew Engineer]

Going to Mars will be indeed a challenging journey. Mars analog simulations will prepare us the best it can be, but no one can assert that these simulations can cover all the unexpected issues that a real mission will face. Will human be ever ready to endure the psychological effect to leave the Earth cradle and explore another world? As it seems to be the biggest fear, many simulations have focused on the psychological and group dynamic point of view.

To my opinion, this is the wrong question. "How do we make sure that the mission, as an independent entity, drives the best of the crew ability to make it successful?" is the right one. As a canvas for the Mars 160 program, it has been hypothesized that boredom is one of the biggest threat to the crew dynamic and cohesion. Therefore, I have been directed to make sure that my crewmates spent their days by conducting an unprecedented science, engineering and outreach program.

I discovered after some thoughts that written reports are essential, including logging activities or scientific reports, but too much of it will overwork the crew making them feel like doing little to no actual work besides reporting things. It is a fine tuning and a balance needs to be achieved, because a Mars mission will cost a lot, making the hourly rate impressive.

This is one of the most important findings I made: pacing is crucial. A good balance of work and rest during working days is what I think could make the difference between a successful Mars mission and a failed one. Being overwork could contribute to the degradation of social relation which could affect work output and efficiency. I discovered this by overworking myself some weeks and not being the best crew mate I could have been.

[Claude-Michel Laroche, Crew Engineer]

I had always wondered why there were so many possessed people by Mars. I never dreamed like that. But on the other hand, I got very interested in such people who would head straight for the unknown. I want to be an architect to support their life. I believe in the force of creativity. A human creativity come into existence from their attitudes towards the unknown. "What is life on extreme?" is the biggest unknown for me. I want to improve my "attitude" by an experience of real life in the unknown. This is why I have been heading toward varying exploration, like Antarctica and Himalayan expeditions, and most recently toward these Mars160 expeditions.

[Yusuke Murakami, Executive Officer]



When planning for exploration on the surfaces of Mars, the value of field trained geologists will be dependent on their ability to observe, record and interpret emerging geology and biology in extreme settings as context provided through observation is vital to multiple hypotheses, data collection and sample interpretation. Here on Earth, geological drawing in field science in Mars analogue environments is an iterative process of field work, one that emphasizes the study of authentic phenomena in context, helping us to understand how Mars was formed through terrestrial studies. Drawing helps translates our experiences in the field into thought.

As artist and hypolith research assistant on the Mars 160 team, my research addresses methodologies for adapting existing field sketching skills to the analogue Martian environment. Through an experimental practice that follows the goals of the science on EVAS, the aim is to compare the effect the spacesuit has on the performance of field work tasks through the quality of contextual observations around sampling. At the same time, fifty hours of drawing in the space suit during the Mars 160 mission allowed me to develop tools, methods, resources and protocols useful for conducting planetary field science in an extreme environment, and applicable to all future users in similar studies.

The results of field drawing research in and out of simulation are consistent. Overall, in relation to quantity of output and time constraints, productivity in drawing decreases by one fifth when wearing the space suit. All evidence indicates field drawing in the space suit to be a little slower and there is less comfort drawing in the suit but this is a manageable factor. Experiments show that the quality of the suited drawing itself is marginally less, for instance, in clarity of line or expression, but this does not impede meaning. Importantly, research concludes that whether field drawing is undertaken in or out of the spacesuit, the science return in terms of the data is basically the same. This is significant when we think about astronaut training for Mars. With the right materials, tools and protocols, extraterrestrial geologists will be able to draw and take notes in science fieldwork on Mars, just like they do here on Earth.

[Annalea Beattie, Crew Artist and Journalist]

The Utah desert was full of sun, rich red and brown colors, which led to high energy level and workaholic mood. It was an intense mission, full of learning experiences. Every day I was growing faster than in a usual world, due to 24/7 working environment. Just imagine living back to back with engineer, architect, artists, geologist and astrobiologist. To start the day as an assistant of microbiologist and finish it as a journalist. To be always alert to any kind of tricky, unforeseen and/or expected event. To always work towards being the best crewmate! The more I learned the more was the desire to continue. Multitasking became my lifestyle and even when I was back on Earth, I kept the Martian tight schedule of learning and working.



Oddly enough, the behavior not only of one human, but of the whole crew transformed when the environment changed. Devon Island was full of rain, fog, grey and white colors, wet and moldy, but still with its own bizarre beauty. As an effect – melancholy, peacefulness and inaccessibility. The relationship in the crew changed from strictly working to 100% trustable family environment. It takes a lot of learning experience, mistakes and effort to be able to separate work from personal feelings. Yes, you can have an argument about how the things should run at the station. Yes, you can make the mistakes and be told off by the commander. But nothing of it makes sense to take it personally. To me, it is the biggest discovery of Mars Arctic part of the mission.

[Anastasiya Stepanova, Health and Safety Officer]

Clothing was one of the three main constraints to science operations. In both halves of the mission we did a mix of suited and unsuited EVAs. Some of the unsuited EVAs were done under inclement weather conditions, requiring multiple layers of warm clothing beneath wind and waterproof outer shells. Working under these constraints was almost as great as the simulated EVA suits themselves. The less the impedance from clothing, the more effectively we were able to work in the field. For suit design this means that gloves have to be as flexible and thin as possible, helmets have to excellent ventilation (much better than at present) to allow hard physical work and prevent fogging. The helmets have to be safe so that they do not injure the wearer if they fall. The backpacks also have to be comfortable, secure and safe so that the wearer will not be injured if they fall. Safe equipment increases the confidence of the wearer on steep and/or rocky surfaces.

Science equipment was the second major factor in science operations. We were promised a wide range of science equipment that did not in the end eventuate. The need for equipment to analyze samples and sites is keep to better inform evolving research programs in the field. The importance of this equipment increases with the duration of the surface stay. The equipment must be simple, deliver results quickly, and cover the essentials. As a geologist a mineralogy and a geochemistry



[Dr. Jon Clarke, Crew Geologist]

instrument would have been both useful. During the first part of the mission in Utah I was able to measure soil properties such as moisture content, salinity (conductivity), and pH. This required a balance, oven, and a conductivity and pH meter. These were not full available in the Arctic part of the mission, the equipment was either missing or not able to be used because of power issues.

Time was the last major constraint on science. Mars surface missions can be considered short and long stay, short stay missions being typically one month, long stay missions 12 months or more. The Arctic part of our mission was a good approximation of a short stay Mars mission, the Utah part highlighted some of the issues that might appear on a long stay mission. Long stay missions are less vulnerable to delays caused by establishment of the station (in our case pre-sim cleaning and maintenance tasks) and weather. They also offer more potential for long range exploration as competency increases, follow up visits to sites of particular interest ("super sites"), and therefore more on site analytical capabilities.

But for us it was much more than a very intense and hard work! We were living and working together 24/7. That brings much more connections among the crew than a strict working relationship. The relationships fluctuate from a strict chain of command to loving friendship as all the spectrum is required to deal with all kinds of situations during simulations. But if a feeling has been mostly shared by all crewmembers, is certainly this unconditional love to each other.

It was a testbed for those things I had observed over almost two decades of analog experience. Crews did best when they had worked with AND knew each other prior to the mission. The Mars 160 crew and Earth-based support team was made up of people who knew each other in multiple ways. Most both knew and had worked with each other in the past. I do not think the challenges of this mission would have been met by a less interconnected team. It was this shared sense of who we all were, and what we were doing, that made it a success.

I have also observed that some people who are very talented in either teamwork or fieldwork or isolation didn't always fair best at MDRS or F-MARS. It was the person who is able to handle all three of these things competently will flourish. Often it is this person who is the person to pull everyone through a particularly rough situation. So if that were true, how would the same crew change their dynamics in two different environments? We don't have all the answers yet as we have only begun to look at the data, but I imagine we will discover that in all the planning for every contingency who cannot plan for who will be the person to step up and set the pace for success in every situation.

[Dr. Shannon Rupert, Mission Director]



Mars 160 was a fantastic opportunity for me to explore synergies between art and science, a unique learning experience and a challenge, not only for art-based research in science operations and for my practice as an artist with an interest in Mars, but personally, as a member of the Mars 160 team. Off Earth, in vulnerable micro-societies living in isolated, controlled surroundings in extreme environments under constant surveillance, concepts of community will play a definitive role. On Mars, where the weight of daily activity is geared towards negotiated duties, safety and survival, one's quality of life might easily be diminished. How we understand a sense of community through our crew family is an important thing to consider when we are preparing for extraterrestrial settlement.

Highly adaptive and hardy, the Mars 160 crew was a skilled, interdependent team performing very complex functions in a challenging environment. Shared norms around the goals of the mission and the work it entails, a communal orientation ensured that our team functioned in a way that met the rigor of an extensive science research mission, while managing with limited resources and living together in close proximity in isolation over long periods.

On our mission, good problem solving capacities combined with cross-disciplinary and cross-cultural competence all contributed to the development of a healthy balance between autonomous motivation and conscientious teamwork. Clear communication skills from our commander and a flexibility around leadership roles enabled the crew to engage with daily directives and long term objectives. Courage, stamina, a tolerance for new situations and a common openness to new

experiences led our strong team performance. Mars 160 was a team of explorers. At the same time, our crew family valued human-centered outcomes, – we all cared for each other. Empathy, warmth, listening to others, helping, shared exercise, common routines and good food all contributed to group solidarity and the emotional stability of our crew.

[Annalea Beattie, Crew Artist and Journalist]

The expectations of mission planners (and the crew) must be realistic, and grounded in what the crew can realistically achieve in the time available. Allowance must be made for human (the need for rest and recreation), technical (engineering down time), and environmental (such as weather) limits. Expectations must be grounded in realism. The mission schedule must also be realistic, allowing



adequate time for setting up, packing up, sleeping, eating and, for an extended mission, rest days (the biblical one day every seven works well). Both over and under work can be an issue, but with motivated mission planners and crews over work is perhaps more likely. Adequate allowance must be built in for bad weather and technical problems.

Unreasonable expectations from mission support was the biggest greatest source of tension on the mission. There is a clear need on crewed missions to Mars for the roles of the crew and mission support to be clearly demarcated and understood, and that mission support needs to understand that its role is support, not control. Rules need to be well understood, agreed to, and not arbitrarily changed.

Crew interaction is the cause of much speculation and both popular and technical commentary. Dire predictions of conflict, mental illness, social dysfunction, and aberrant behavior are common. Mixed gender and international crews are often regarded as being particularly susceptible to such issues. The Mars 160 missions shows that selection of the right people can keep such conflicts to a minimum and that the gender and cultural diversity part of ensuring positive crew performance. For me, most conflict came from outside the crew, not inside. I would have no hesitation doing another long duration missions with the same crew again. A good crew of compatible, hardworking people who are good, respectful friends makes all things possible.

[Dr. Jon Clarke, Crew Geologist]

Having spent about five months in a Mars simulation mission, if there is a word that defines my journey then it is: reinvention. I joined this mission as a Crew Biologist having the sole objective in mind to explore the hidden extreme niches of two disparate Mars analogs and understand how life sustains. But, this simulation is also a matter of your own sustainability. I did not know that until I spent this long time inside our cylindrical home, completely isolated from my loved ones, and being effortlessly merged into a new life regime with my crewmates. So, along with the science I did spending hours in uncomfortable condition of EVAs, it's also about the science of subtle emotions

acknowledging themselves inside the Martian habitat. I think my notes at Sol 92 at the MDRS can describe this intellectual evolution better:

"Living in this place, sometimes you feel that you are getting interviewed by your own sensibilities. You think that you are searching Mars, but instead, Mars searches you. I say this because it showed me a new me. You learn to stabilize your emotional fluctuations by inevitably diving into the situational intricacies. But, while witnessing all these nuances of living on Mars, something else dawns on to you. You come to know that Mars limits your extensions in so many ways. As sometimes you feel helpless in absence of required supplies, breakdown of a system, inconsistencies in the communications and coordination with the Earth-based team, merciless weather preventing you from exploration and many more. Because it is Mars, not Earth. It will pose its extremeness on you in some way or the others. You may think that we do have similar limitations on Earth, but they may not be curbed as swiftly and feasibly on Mars as on Earth. Encountering these limitations is also part of this process of humans going beyond the human frailties. You rise. This transition is important. When you are on Mars, it may not be a perfect picture. And when it is not, you have to live with it."

[Anushree Srivastava, Crew Biologist]

Sometimes during a meal time at F-MARS, we became silent spontaneously. According to a French proverb, "if no one talks around the table it means that the meal is great" said our commander. Therefore I should remain silent about this mission. If you insist, I just want to mention, we were not heroes. Surely, our life in MDRS and F-MARS were a bit stranger and lonelier than a common life. Even so, they were no different usual life. We represented all the people on the Earth, because we were ordinary people rather than special. At all times, wherever we are, "eat well, sleep well, laugh well" are everything in life. And this was our way of life during Mars 160 expeditions. Like a family. An honorable mission is merely a little spice of life.

"My dear fantastic man," a mail from my wife began from these words. I know she was feeling very lonely with me away. And yet she hearty cheered me on. So I could devote all my energy to the mission without any worry. If there were any heroes on this mission, our supporters were the very ones. Our families, friends, mission support team and many others. I very much appreciated your support!

[Yusuke Murakami, Executive Officer]



Now that the program has come to an end, we hope to see manned Mars mission becomes a reality. It is time for us to go back home, go back to our families and friends. We may live thousands miles apart to each other, we will be forever bound by friendship and this common feeling that we, all together, add our stone that may have paved the way to go to Mars a little bit further.

For me, the Mars 160 mission wasn't supposed to have an impact on any real mission to Mars, it was about science return at two different Mars analogs. But as usual, the synergy of a mission brings to the forefront questions you had never thought to ask. I knew we were putting the same crew, a

trained crew, in two separate simulations, and I was interested in the operational aspects of these two separate environments and how it changed the science, but it turned out that it also changed the crew and rest of the team in ways that I hadn't anticipated. Those changes to me were the most interesting. It means to me that no matter how we select a crew, or how we train them, or how we interconnect them with each other and with their Mission Support teams, we are not going to be able to control all the variables in a human mission to Mars, and our strength will be in ourselves, in our teams, and in our shared vision, and not in the details of the plan.

[Dr. Shannon Rupert, Mission Director]

My love for space exploration started as a naïve desire to be able to behold the face of Earth from far away years ago. This desire was actually driven by my mere imagination of the cathartic effect this event can leave on you, which I think is inexplicable. Suddenly your sense of self becomes menial or possibly unifies with the unfathomable vastness of the space, vanishing this duality. Hard to say.

I felt the similar emotional pull when I saw F-MARS from the sky. I was teary-eyed. I was awed as this single event flashed a series of events in my mind that caused me to witness this. So, what I want to say is being part of such missions significantly contributes towards building an ignited mind and heart along with professional accomplishments and trains you to work with humility and responsibility.



[Anushree Srivastava, Crew Biologist]

The wild nature of hostile planet will inspire and suppress, play with the mind, challenge the man's power, tear the concept of the human world apart and inside out. But at the end it will give to the human kind the biggest present – the chance for a new, better start! We are as close as never before to prove that we can be better, that we can be the planet of explorers, that we can be not the humans, but the Humans!

[Anastasiya Stepanova, Health and Safety Officer]

Mars 160 created positive social value for all of us, sustaining us over the many isolated months of our mission. Planning for Mars, if I could choose a long duration space crew, considering what attributes astronauts might need to build growth and resilience in a tiny frontier societies living in space in the future, the team of Mars 160 would be the one. They would be my guiding star.

[Annalea Beattie, Crew Artist and Journalist]

A mission to Mars will be unlike anything humans have undertaken before, and when it comes time to train the first crews to go, there will be little room for guesswork. We need to know how to train astronauts going to Mars before that training is required, and it is to this body of knowledge that I feel Mars 160 has contributed to the future exploration of Mars.

[Paul Knightly, Crew Geologist]

"Some say that we will not go to Mars because it would be too psychologically hard for crewmembers to handle the mission. Why cannot we expect the best from these pioneers instead of the worst? Given what is at stake, I believe that they would perform the mission more easily than one wants make us to believe."

I wrote this lines when I applied for the MA365 program. You may think that belief was naïve regarding how low my field experience was at that time. But after spending over 5 months in the field, I am more convinced than ever that a carefully chosen team will perform beautifully such adventure.

Soon enough, it will be time for me, and certainly for my Martian family as well, to embark for new journeys. Certainly in ones even more significant than the Mars 160 program may have been...



Dr. Alexandre Mangeot, Crew Commander of the Mars 160 expeditions, signing-off.

ad Astra per Espera