

ᐃᓴᓐᓇᐃᓐᓇᓐ: 1 819-821-8000, ᓴᓐᓇᓐᓇᓐ:

Geological mapping and study of hydrothermal deposits and gossans at Expedition Fiord, Axel Heiberg Island, Nunavut, as analogues for Mars. Myriam Lemelin, Département de géomatique appliquée, Université de Sherbrooke Gossans are surficial deposits that form through the chemical and physical weathering of bedrock. They can be preserved for thousands of years in the permafrost. In the Expedition Fiord area of Axel Heiberg Island, Nunavut, gossans are associated with ancient hydrothermal deposits that contain minerals also found on Mars. These minerals can preserve traces of microbial life but the way they formed is still unknown. Importantly, gossans in the Expedition Fiord area could be part of a network of fractures through which hydrothermal fluids have been circulating for millions of years. It is possible that these gossans have been formed through the interaction between the metal-rich bedrock and ancient deposits formed in a hydrothermal system. If such, this would have important implication in the search for life on Mars. It is highly probable that hydrothermal systems were active on Mars billions of years ago. These systems are key places to look for signs of ancient microbial life on Mars. Our main objective is to study gossans in the Expedition Fiord area as indicators of ancient hydrothermal systems on Mars at various spatial scales in the context of current and future Mars exploration missions. The specific objectives are as follows: 1. Map the Expedition Fiord area and detect gossans using satellite imagery. 2. Investigate the spectral signature, composition, and potential biosignatures in the gossans and hydrothermal deposits. 3. Conduct detailed spectroscopic, compositional, and biological studies on the returned samples in our university laboratories. The research will be conducted from a base camp located a few kilometers north of the McGill Arctic Research Station, near Expedition Fiord, Axel Heiberg Island. 6 people will be staying at the temporary camp for for a period of 17 days from July 8 to July 24, 2022. The field crew will travel by foot traverse to local outcrops. They will use geological hammers to collect samples. They will also use portable scientific instruments to collect data directly from the outcrops. The fieldwork will not impact local wildlife in this uninhabited region of northern Nunavut. The closest community is Grise Fiord, Ellesmere Island. The data will be stored on portable computers. The data and results will be published in open files and journal articles.

ΔΔΛΝΔ: Cartographie géologique et étude des dépôts hydrothermaux et des gossans de l'expédition Fiord, île Axel Heiberg, Nunavut, comme analogues pour Mars. Myriam Lemelin, Département de géomatique appliquée, Université de Sherbrooke Les chapeaux de fer sont des dépôts de surface qui se forment par l'altération chimique et physique du socle rocheux. Ils peuvent être conservés pendant des milliers d'années dans le pergélisol. Dans la région d'Expedition Fiord sur l'île Axel Heiberg, au Nunavut, les gossans sont associés à d'anciens dépôts hydrothermaux qui contiennent des minéraux que l'on retrouve également sur Mars. Ces minéraux peuvent préserver des traces de vie microbienne mais la façon dont ils se sont formés est encore mal connue. Il est important de noter que les chapeaux de fer de la région d'Expedition Fiord pourraient faire partie d'un réseau de fractures dans lequel des fluides hydrothermaux circulent depuis des millions d'années. Il est possible que ces gossans aient été formés par l'interaction entre le socle rocheux riche en métaux et d'anciens dépôts formés dans un système hydrothermal. Si tel est le cas, cela aurait une implication importante dans la recherche de la vie sur Mars. Il est très probable que les systèmes hydrothermaux étaient actifs sur Mars il y a des milliards d'années. Ces systèmes sont des endroits clés pour rechercher des signes de vie microbienne ancienne sur Mars. Notre objectif principal est d'étudier les gossans dans la région d'Expedition Fiord en tant qu'indicateurs d'anciens systèmes hydrothermaux sur Mars à différentes échelles spatiales dans le contexte des missions actuelles et futures d'exploration de Mars. Les objectifs spécifiques sont les suivants : 1. Cartographier la zone d'Expedition Fiord et détecter les gossans à l'aide de l'imagerie satellitaire. 2. Étudier la signature spectrale, la composition et les biosignatures potentielles des gossans et des dépôts hydrothermaux. 3. Réaliser des

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Operations Phase: from 2022-07-08 to 2022-07-24

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TMARS Base Camp 2022	Scientific/International Polar Year Research	Crown	The site is located approximately 4 kilometers north of the McGill Arctic Research Station.	N/A	N/A

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ΔᑦᑲᐅΔᑦ	Nunatta Campus	Arctic College	2022-05-30
ᐱᐅᑦᐱᑦᑭᑦ	Dan Smith	Umimmak School	2022-05-30
ᑦᑲᐅᑦᐱᑦᑭᑦ ᑖᑦᑭᑦ	Robert Filipkowski	Qarmartalik School	2022-05-30
Δᑦᐱᐱᑦᑭᑦ	Joan Bower	Inuujaq School	2022-05-30

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North Baffin

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ᓂᓐᓂᓐᓂᓐ ᓂᓐᓂᓐᓂᓐ ᓂᓐᓂᓐᓂᓐ	Application for scientific research license to carry out fieldwork in Nunavut	Applied, Decision Pending		

Project transportation types

Transportation Type	ᓂᓐᓂᓐᓂᓐ ᓂᓐᓂᓐᓂᓐ	Length of Use
Air	Helicopter for transportation of field crew to and from the TMARS base camp	
Land	Foot traverses will be carried by the five participants.	

Project accomodation types

Temporary Camp

◁▷ℒ▷σ◁⁹⁶▷⁹⁶

Λ⁹δ^c Δ⁹ρ²Δ⁹ Δ⁹CDσ²Δ⁹Δ⁹ Δ⁹ρ²Δ⁹Δ⁹ Δ⁹Δ⁹Δ⁹, Γ⁹Δ⁹Δ⁹Δ⁹, Δ⁹Δ⁹Δ⁹Δ⁹, Δ⁹Δ⁹Δ⁹ Δ⁹Δ⁹Δ⁹

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Dome tent	2	12 feet diameter	Kitchen tent and office tent
Eureka tent	6	6 feet long	One tent for each field participant
Honda 1000 generator	1	1 foot long	Power for electronic equipment
VHF radio	1	10 inches	communication with PCSP Resolute
Shovel	2	4 feet	Collect loose soil around gossans
Geological hammers	6	10 inches	Collect rock samples

$\Pi \cap \langle D^{\text{fb}} \rangle = \langle D^{\text{fb}} \rangle$

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0	bucket transported manually	Local stream

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Scientific/International Polar Year Research	ᐃᐱᐃᑦ ᐱᑕᑦ ᐱᑕᑦ ᐱᑕᑦ	less than 0.01 cubic metre a day	Greywater waste will be disposed of at least 50 m away from base camp and from streams.	N/A
Scientific/International Polar Year Research	ᑕᑦ ᐱᑕᑦ ᐱᑕᑦ	less than 0.005 cubic metres a day	Sewage will be collected in sealed containers that will be transported by helicopter to the McGill Arctic Research Station for incineration.	N/A

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There are no projected environmental impacts that would result from the proposed fieldwork on Axel Heiberg Island. The site will be cleaned up and left exactly as found once the scientific project has been completed.

Additional Information

SECTION A1: Project Info

SECTION A2: Allweather Road

SECTION A3: Winter Road

SECTION B1: Project Info

SECTION B2: Exploration Activity

SECTION B3: Geosciences

SECTION B4: Drilling

SECTION B5: Stripping

SECTION B6: Underground Activity

SECTION B7: Waste Rock

SECTION B8: Stockpiles

SECTION B9: Mine Development

SECTION B10: Geology

SECTION B11: Mine

SECTION B12: Mill

SECTION C1: Pits

SECTION D1: Facility

SECTION D2: Facility Construction

SECTION D3: Facility Operation

SECTION D4: Vessel Use

SECTION E1: Offshore Survey

SECTION E2: Nearshore Survey

SECTION E3: Vessel Use

SECTION F1: Site Cleanup

SECTION G1: Well Authorization

SECTION G2: Onland Exploration

SECTION G3: Offshore Exploration

SECTION G4: Rig

SECTION H1: Vessel Use

SECTION H2: Disposal At Sea

SECTION 11: Municipal Development

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L^ae d'Ennòc' b'mΔ^c)^cnDσ^b: ΔmC nσ^fj^biL^c-Λ^dC dV C nσ^fj^biL^c

Miscellaneous Project Information

$a \rightarrow b^c$ $b^c \rightarrow c^d$ $c^d \rightarrow d^e$ $d^e \rightarrow e^f$ $e^f \rightarrow f^g$ $f^g \rightarrow g^h$

Cumulative Effects

Impacts

$\omega_{\Delta} \Delta^{\epsilon_b} C D \sigma^{\epsilon_c} \Gamma^c$
 $\Delta^{\epsilon_c} \Pi \Gamma D C \dot{\sigma}^c \dot{\gamma}^c$
 $\Delta^{\epsilon_b} \gamma^{\epsilon_b} C D \Gamma L \dot{\gamma}^c$

[illegible]
$$(P = \langle b \rangle \dot{\cup} P \cap \langle a \rangle^c, N = \langle b \rangle \cap P \setminus \langle \langle a \rangle^c \rangle^c \setminus \langle \langle a \rangle^c \rangle^c \setminus \langle \langle a \rangle^c \rangle^c, M = \langle b \rangle \cap P \setminus \langle \langle a \rangle^c \rangle^c \setminus \langle \langle a \rangle^c \rangle^c, U = \langle b \rangle \cap L \setminus \langle \langle a \rangle^c \rangle^c)$$

1	point	TMARS Base Camp 2022
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