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Geological study and mapping of hydrothermal deposits and gossans at Expedition Fiord, Axel Heiberg Island, Nunavut, as analogues for Mars

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New

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Scientific Research

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Period of operation: from 0001-01-01 to 0001-01-01

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ᐃᓴᓂᓕᓴᓂᐃᓪᐅᓕ:

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Project Summary: 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. Fieldwork will take place for a period of 17 days from July 8 to 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 data will be stored on portable computers. The data and results will be published in open files and journal articles.

▷ΔΛΠ◁: Les chapeaux de fer sont des dépôts superficiels qui se forment par l'altération chimique et physique de la roche-mère. Ils peuvent être préservés pendant des milliers d'années dans le pergélisol. Dans la région du fiord Expedition sur l'île Axel Heiberg, au Nunavut, les chapeaux de fer sont associés à d'anciens dépôts hydrothermaux qui contiennent des minéraux que l'on trouve également sur la planète Mars. Ces minéraux peuvent préserver des traces de vie microbienne mais leur origine est inconnue. Il est important de noter que les chapeaux de fer de la région du fiord Expedition pourraient faire partie d'un réseau de fractures dans lequel des fluides hydrothermaux circulent depuis des millions d'années. Il est possible que ces chapeaux de fer aient été formés suite à 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 chapeaux de fer dans la région du fiord Expedition 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 la planète Mars. Les objectifs spécifiques sont les suivants : 1. Cartographier la région du fiord Expedition et détecter les chapeaux de fer à l'aide d'images satellitaires. 2. Étudier la signature spectrale, la composition et les biosignatures potentielles des chapeaux de fer et des dépôts hydrothermaux. 3. Réaliser des études spectroscopiques, compositionnelles et biologiques détaillées sur les échantillons retournés dans nos laboratoires universitaires. Les recherches seront menées à partir d'un camp de base situé à quelques kilomètres au nord de la station de recherche arctique de

[illegible]

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

$\Lambda \subset \mathbb{N} \triangleleft \mathbb{N} \hookrightarrow \Sigma \triangleleft^{\text{qb}} \mathcal{C}$ [illegible][illegible]

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ᐃᑦᑲᐅᐃᑦ	Nunatta Campus	Arctic College	2022-05-30
ᐱᐅᑦᐃᑦᑭᑦ	Dan Smith	Umimmak School	2022-05-30
ᑦᑲᐅᑦᐃᑦᑭᑦ ᑖᑦᑭᑦ	Robert Filipkowski	Qarmartalik School	2022-05-30
ᐃᑦᐱᐱᑦᑭᑦ	Joan Bower	Inuujaq School	2022-05-30

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$a^b r^c \Delta$ $\Lambda c_n d_n^e \Delta D \sigma d^{fb} J^c$ $n n f^g \omega^f:$

North Baffin

[illegible][illegible]

Project transportation types

Transportation Type	How to Access	Length of Use
Air	Helicopter for transportation of field crew to and from the TMARS base camp	
Water	Water will be retrieved with buckets from local streams near camp	
Land	Foot traverses	

Project accomodation types

Temporary Camp

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Scientific/International Polar Year Research	ᐃᐱᑕᑦ ᐱᑕᑦ 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	ᑲᑲᑕᑦ 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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Miscellaneous Project Information

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

Cumulative Effects

Impacts

$\omega_{\Delta} \sigma^{\alpha} \Gamma^C$ $\Delta^{\alpha} \sigma^{\beta} \Gamma^C$ $\Delta^{\alpha} \sigma^{\beta} \Gamma^C$

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

1	point	TMARS Base Camp 2022
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