



## **NIRB Application for Screening #125681**

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

**Application Type:** New

**Project Type:** Scientific Research

**Application Date:** 4/5/2022 10:42:37 AM

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

**Proposed Authorization:** from 0001-01-01 to 0001-01-01

**Project Proponent:** Myriam Lemelin  
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## DETAILS

### Non-technical project proposal description

English: 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 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.

French: 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 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 McGill, près d'Expedition Fiord, sur l'île Axel Heiberg. Six personnes séjourneront au camp temporaire pour une période de 17 jours, du 8 au 24 juillet 2022. L'équipe de terrain se déplacera à pied jusqu'aux affleurements locaux. Ils utiliseront des marteaux géologiques pour collecter des échantillons. Ils utiliseront également des instruments scientifiques portables pour recueillir des données directement sur les affleurements. Les travaux sur le terrain n'auront pas d'impact sur la faune locale dans cette région inhabitée du nord du Nunavut. La communauté la plus proche est Grise Fiord, sur l'île d'Ellesmere. Les données seront stockées sur des ordinateurs portables. Les données et les résultats seront publiés dans des dossiers ouverts et des articles de journaux.

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## Activities

Location	Activity Type	Land Status	Site history	Site archaeological or paleontological value	Proximity to the nearest communities and any protected areas
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

## Community Involvement & Regional Benefits

Community	Name	Organization	Date Contacted
Iqaluit	Nunatta Campus	Arctic College	2022-05-30
Grise Fiord	Dan Smith	Uminmak School	2022-05-30
Resolute Bay	Robert Filipkowski	Qarmartalik School	2022-05-30
Arctic Bay	Joan Bower	Inuujaq School	2022-05-30

# Authorizations

Indicate the areas in which the project is located:

North Baffin

## Authorizations

Regulatory Authority	Authorization Description	Current Status	Date Issued / Applied	Expiry Date
Nunavut Research Institute	Application for scientific research license to carry out fieldwork in Nunavut	Applied, Decision Pending		

## Project transportation types

Transportation Type	Proposed Use	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

## Material Use

Equipment to be used (including drills, pumps, aircraft, vehicles, etc)

Equipment Type	Quantity	Size - Dimensions	Proposed Use
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

## Detail Fuel and Hazardous Material Use

Detail fuel material use:	Fuel Type	Number of containers	Container Capacity	Total Amount	Units	Proposed Use
Gasoline	fuel	1	20	20	Liters	To power generator

## Water Consumption

Daily amount (m3)	Proposed water retrieval methods	Proposed water retrieval location
0	bucket transported manually	Local stream

# Waste

## Waste Management

Project Activity	Type of Waste	Projected Amount Generated	Method of Disposal	Additional treatment procedures
Scientific/International Polar Year Research	Greywater	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	Sewage (human waste)	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

### Environmental Impacts:

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 I1: Municipal Development**

**Description of Existing Environment: Physical Environment**

**Description of Existing Environment: Biological Environment**

**Description of Existing Environment: Socio-economic Environment**

**Miscellaneous Project Information**

**Identification of Impacts and Proposed Mitigation Measures**

**Cumulative Effects**

# Impacts

## Identification of Environmental Impacts

		PHYSICAL	Designated environmental areas	Ground stability	Permafrost	Hydrology / Limnology	Water quality	Climate conditions	Eskers and other unique or fragile landscapes	Surface and bedrock geology	Sediment and soil quality	Tidal processes and bathymetry	Air quality	Noise levels	BIOLOGICAL	Vegetation	Wildlife, including habitat and migration patterns	Birds, including habitat and migration patterns	Aquatic species, incl. habitat and migration/spawning	Wildlife protected areas	SOCIO-ECONOMIC	Archaeological and cultural historic sites	Employment	Community wellness	Community infrastructure	Human health
Construction																										
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Operation																										
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Decommissioning																										
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(P = Positive, N = Negative and non-mitigatable, M = Negative and mitigatable, U = Unknown)

Project Location



List of Project Geometries

1	point	TMARS Base Camp 2022
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