

$\gamma_b \Delta^c \dot{\gamma} \Pi \sigma^b \quad \Lambda c_n \nabla^{\gamma_b} \gamma \sigma \nabla n \nabla^a L^a \sigma^b$

Recent evidence obtained through orbital radar sounding indicates the presence of subglacial lakes ~800 meters below Mars' southern ice cap. Such subsurface saline water bodies may support active microbial ecosystems. Considerable evidence has also been found in the last decade to support the existence of large cold, salty oceans under the ice covers of the icy moons, Europa and Enceladus. The main goal of this project is to characterize a unique terrestrial analogue environment of these icy worlds: the recently discovered hypersaline lake complex under the Devon Ice Cap of Nunavut, Canada. The Devon Island subglacial lakes consist of 3 lakes lying beneath 560-740m of ice; modelling indicates temperatures of -12°C and high salinities of ~ 15% salt. Due to their hypersaline nature, the Devon subglacial lake complex is a particularly tantalizing analogue for brine bodies inferred to exist on Europa, Enceladus, and Mars, and make it a compelling site to address fundamental questions about how life persists at terrestrial extremes of darkness, temperature, salinity, and pressure. Our 3-year CSA FAST application is the first step to access the Devon Island lakes directly by testing and optimizing an ice drilling system, collecting ice samples overlying the lakes for microbiological analyses and optimizing 2 biosignature detection prototypes, and to further constrain geomorphological parameters of the system. We are requesting a summer trip (7 days) for 2022 between July 1 – July 31 with Brady O'Connor (PhD Student), Dr. Lyle Whyte (Professor), Dr. Kris Zacny (Honeybee Robotics) and Dr. Leo Stolov (Honeybee Robotics) to Devon Island. In 2022 we plan to visit the location overlying the subglacial lakes on the Devon Island ice cap. The 2022 trip is primarily for local reconnaissance of the Devon Island surface on top of the subglacial lakes to determine optimal sites for future drilling and sample collection for future field seasons in 2023 and 2024. For July 2024, we will be staying at the PCSP Resolute Facility and will take 1 or 2 half-day trips to the top of the Devon Ice Cap above the subglacial lakes. There will be no field camp on top of the ice cap and we will be on the surface for ~ 4-5 hours. In addition to site reconnaissance, we will collect near surface ice samples (1 – 2 m) for analyses of the microbial communities inhabiting the ice back at my lab at McGill University in Montreal. This will include culturing of microbes inhabiting the surface ice and genomics analyses to better understand the diversity and metabolic potential of the microbial communities. We will test whether the ice-inhabiting microbes are active or in a dormant state. The samples will also be tested using the prototype MICRO Life Detection Platform, which can characterize microbial communities and will demonstrate the platforms usefulness as a biosignature detection platform for future planetary missions.

▷ ΔΑΝΟΤ: N/A

[illegible]

Inuinnaqtun: N/A

Personnel on site: 4

Days on site: 2

Total Person days: 8

Operations Phase: from 2022-06-15 to 2024-07-31

$\Lambda \subset \mathbb{N} \triangleleft \mathbb{N} \hookrightarrow \mathbb{D} \sigma \triangleleft^{\mathfrak{q}_b} \mathbb{D}^c$ [illegible]

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မေ့ဇာတ်နိဂုံး	အချိန်	မေ့ဇာတ်နိဂုံး	မေ့ဇာတ်နိဂုံး
Information is not available			

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$a^b r^c \Delta_{\sigma} \Delta_{\tau} \Delta_{\rho} \Delta_{\delta} \Delta_{\gamma} \Delta_{\alpha} \Delta_{\beta}$

North Baffin

[illegible]

<p> ሲቪል ሰርቪስ ግልጽ ሆኖ ማረጋገጥ ሲቪል ሰርቪስ ግልጽ ሆኖ ማረጋገጥ ሲቪል ሰርቪስ ግልጽ ሆኖ ማረጋገጥ ሲቪል ሰርቪስ ግልጽ ሆኖ ማረጋገጥ </p>	<p> ክፍል ፩ ስርዓት ሲቪል ሰርቪስ ግልጽ ሆኖ ማረጋገጥ ሲቪል ሰርቪስ ግልጽ ሆኖ ማረጋገጥ </p>	<p> ሲቪል ሰርቪስ ግልጽ ሆኖ ማረጋገጥ ሲቪል ሰርቪስ ግልጽ ሆኖ ማረጋገጥ </p>	<p> ፎቶ ግራፍ / ፎቶ ግራፍ ፎቶ ግራፍ ፎቶ ግራፍ </p>	<p> የሲቪል ሰርቪስ የሲቪል ሰርቪስ የሲቪል ሰርቪስ የሲቪል ሰርቪስ </p>
<p> ሲቪል ሰርቪስ ግልጽ ሆኖ ማረጋገጥ </p>	<p> We have completed the NPC application and once this NIRB application is submitted we will be waiting on confirmation of the NRI license. </p>	<p>Active</p>		

Project transportation types

Transportation Type	ᐱᓇ ᑕᑭᓂᐅᔪᐃᓄᑦ	Length of Use
Air	Helicopter or twin otter transportation from Resolute Bay (PCSP) to the top of the Devon Island ice cap	

Project accomodation types

Temporary Camp

Λ⁹δ^c Δ⁹ρ²Δ⁹ Δ⁹σ⁹Δ⁹σ⁹Δ⁹ Δ⁹Δ⁹Δ⁹, Γ⁹Δ⁹Δ⁹, Δ⁹Δ⁹Δ⁹, Δ⁹Δ⁹Δ⁹

በበፍጥረቱ ላይ ስለሚገኝ ምርት ለማሳደግ ለሚያስፈልግ የሚሆኑትን ምርቶች ለማግኘት ለሚችልበት ሁኔታ ለማረጋገጥ ሲሆን፣

ΔL^{9b} ΔC^{9b} CΔ^{9b} ΔL^{9b} ΔC^{9b}

$\mathcal{D}^c \rightarrow \mathcal{C} \dot{\Gamma}^{\mathfrak{f}_b} \mathcal{A} \mathcal{D}^{\mathfrak{f}_b} \mathcal{C} \mathcal{D} \sigma \mathcal{A}^{\mathfrak{f}_b} \mathcal{D}^{\mathfrak{f}_b}$	$\mathfrak{f}_b \rightarrow \mathfrak{f}_b \Delta \Gamma^{\mathfrak{f}_b} \mathcal{C}^{\mathfrak{f}_b} \mathcal{C}^{\mathfrak{f}_b} \sigma \mathcal{A}^{\mathfrak{f}_b} \mathcal{C}^c$	$\mathcal{A}^{\mathcal{P}^c} \Delta \Gamma^{\mathfrak{f}_b} \mathcal{C}^{\mathfrak{f}_b} \mathcal{C}^{\mathfrak{f}_b} \sigma \mathcal{A}^{\mathfrak{f}_b} \mathcal{C}^c$
0	Snow melt/bring from PCSP Resolute	PCSP Resolute

$\triangleleft^b C d^c$
$$\Delta^b C d_{\sigma} \sim \Delta^{\epsilon} \sigma^{\epsilon b}$$

ለፍትህ ምርመራ ማስፈጸም ለፍትህ ምርመራ ማስፈጸም	ፍጥነት ማስፈጸም ፍጥነት ማስፈጸም	ፍጥነት ማስፈጸም ፍጥነት ማስፈጸም	ፍጥነት ማስፈጸም ፍጥነት ማስፈጸም	ፍጥነት ማስፈጸም ፍጥነት ማስፈጸም
Camp	ፈጣኔ ፈጣኔ ማስፈጸም	50 liters	Transport back to and disposal at PCSP Resolute.	N/A
Camp	ፍጥነት ማስፈጸም	50 liters	Transport in sealed containers back to PCSP Resolute for proper disposal.	N/A

$$4^a 6^b 7^c 8^d 9^e 10^f 11^g 12^h 13^i 14^j 15^k 16^l 17^m 18^n 19^o 20^p 21^q 22^r 23^s 24^t 25^u 26^v 27^w 28^x 29^y 30^z$$

We predict minimal environmental impact to the field site. In 2022 we only plan to spend up to 10 hours on the ice cap over the course of two days. No equipment and/or waste will be left in the field. All waste will be collected in waste containers and transported back to PCSP at Resolute Bay for disposal in the proper manner. For 2023 and 2024, we plan to camp at the field site for 4 - 5 days. During this time, human waste will be collected in sealed buckets and transported back to PCSP Resolute for proper disposal. All other waste material will be stored in trash bags and brought back to PCSP Resolute for proper disposal. We foresee causing very little impact on the field site. We perceive NO impact to Eskers and other unique or fragile landscapes, unlike what is stated in the form below, which will not save as such.

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

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The Devon Island ice cap is a large ice cap situated on the eastern side of the island. The ice cap has a maximum depth of ~900 meters. The top layer of the ice cap where the study will take place is mainly composed of firn and snow. Crevasses in the ice cap are also known.

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There is no vegetation on the ice cap and to the best of our knowledge, there are no animal populations which reside on the ice cap.

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The site is far from any community. Devon Island is uninhabited. We perceive it highly unlikely to encounter archaeological or culturally significant sites on the ice cap. There is no land or resource use on the ice cap.

Miscellaneous Project Information

Please see attached PCSP application form for details on training and measures used to mitigate emergencies while in the field. Please see attached document for our comprehensive spill prevention/plan. Our confirmation of application to the NPC is also attached.

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We perceive very little impact to the site. The only lasting impact to the site will be shallow bore holes in the top of the ice cap and one up to 100 meters deep by year 3 of the project. These boreholes are small in diameter (approximately 15 cm wide) and we expect them to fill in naturally after one Arctic winter/spring thaw. These boreholes will also be localized to an area of only 20 to 30 meters, minimizing their impact on the surrounding environment. All impacts on the site from human activity will be minimized by containing all waste materials and fluids in sealed containers which will be transport back to and disposed of properly at PCSP Resolute. No materials will be left at the site once work is completed.

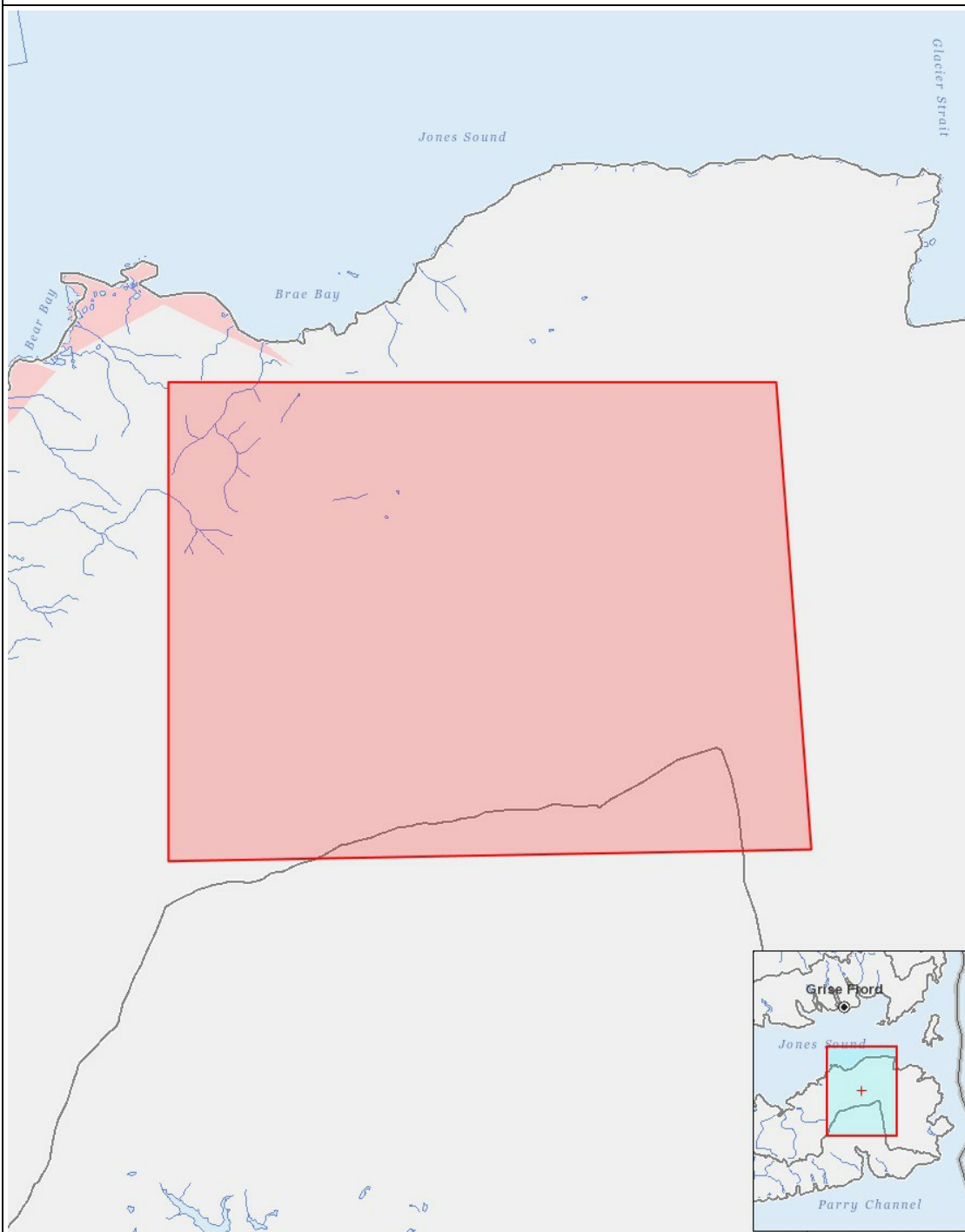
Cumulative Effects

Aside from seasonal melt on top of the ice cap, the Devon Island ice cap is relatively unchanging year over year. We plan not to leave any evidence of our presence or work beyond a few localized shallow boreholes. These boreholes are predicted to fill naturally within one year, therefore we do not foresee any cumulative effects from our work on the environment.

Impacts

$\mathcal{L}(\mathcal{D}) = \mathcal{L}(\mathcal{D}^{\text{train}}) \cup \mathcal{L}(\mathcal{D}^{\text{test}})$

[illegible]
$$(P = \langle b \rangle_{\mathcal{A}} \mathcal{P} \cap \mathcal{A}^{\perp} \mathcal{A}^{\perp})^{\perp}, N = \langle b \rangle_{\mathcal{A}} \mathcal{P}^{\perp} \mathcal{C} \mathcal{D} \mathcal{A}^{\perp} \mathcal{A}^{\perp})^{\perp} \langle \mathcal{C} \mathcal{D} \mathcal{P}^{\perp} \mathcal{P}^{\perp} \rangle^{\perp} \mathcal{C} \mathcal{D} \mathcal{A}^{\perp} \mathcal{A}^{\perp})^{\perp}, M = \langle b \rangle_{\mathcal{A}} \mathcal{P}^{\perp} \mathcal{C} \mathcal{D} \mathcal{A}^{\perp} \mathcal{A}^{\perp})^{\perp} \langle \mathcal{C} \mathcal{D} \mathcal{P}^{\perp} \mathcal{P}^{\perp} \rangle^{\perp} \mathcal{C} \mathcal{D} \mathcal{A}^{\perp} \mathcal{A}^{\perp})^{\perp}, U = \mathcal{A}^{\perp} \mathcal{D} \mathcal{L} \mathcal{A}^{\perp} \mathcal{A}^{\perp})^{\perp})$$



List of Project Geometries

1	polygon	Devon Island Subglacial Lakes Region
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