The rocky side of IceBio

Exploring subglacial nutrient release and rock crushing

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ICEBIO

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IceBio – A Doctoral Network to explore biogeochemical and microbial aspects of the Glacier Biome

Background & Aim of IceBio

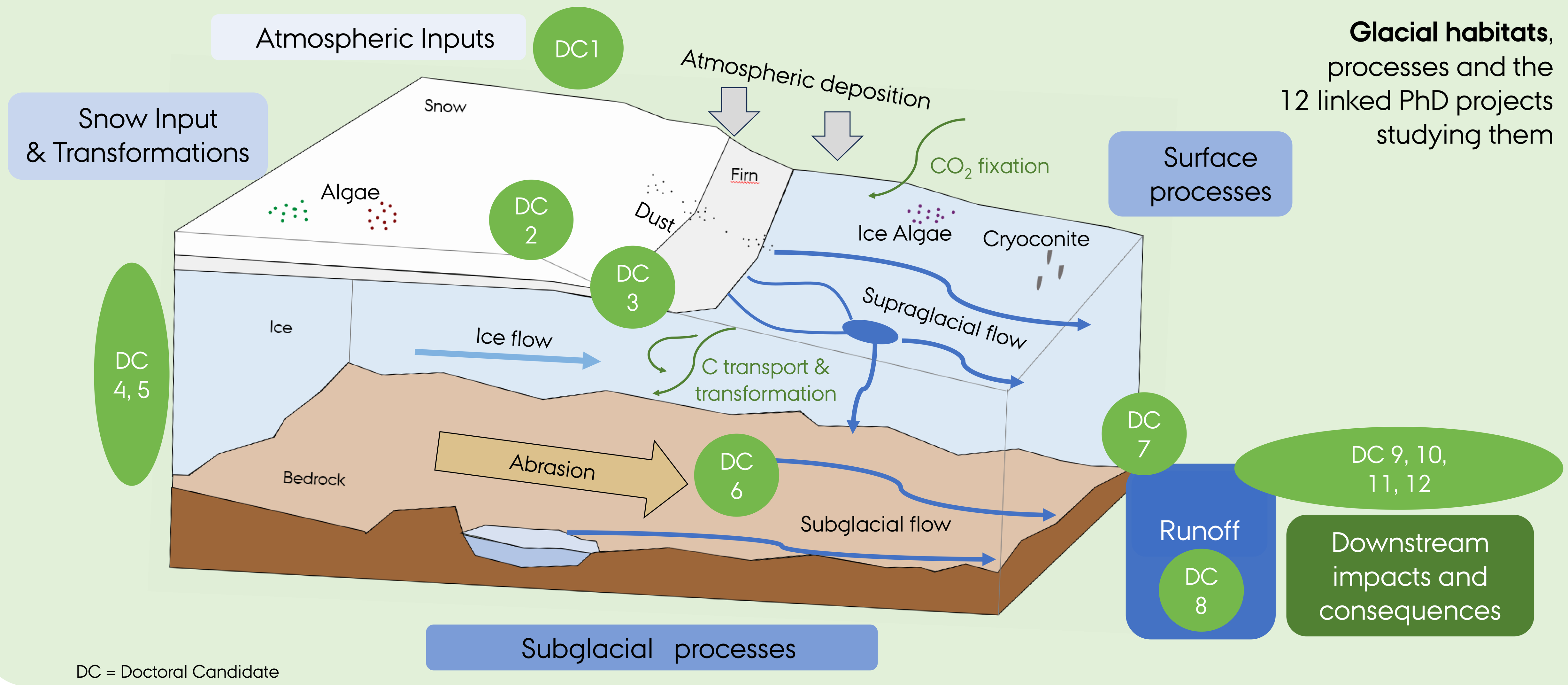
- Vision: Create the first Centre of Glacial Biome Research
- Study microbiology and bio-geochemical processes and include studies on positive and negative feedbacks that the cryosphere might have on global warming
- Include biotechnological studies as unique metabolic pathways of microbial communities in icy environments may offer new opportunities
- Aim to deliver a framework and database of the functional diversity and potential of the glacier biome

Beneficiaries:

GFZ Helmholtz-Zentrum Potsdam; Aarhus University; Universität Innsbruck; University of Tromsø; CNRS; Hydreka (A Halma company); Dr. Brill + Dr. Steinmann

The Glacial Biome

- Distinct interactions and feedbacks between the biological communities and their physical and chemical environment.[1]
- One of Earth's Biomes[1]
- Microbially driven ecosystem [1]
- Wet habitats in/on glaciers and ice sheets (snow, surface ice, cryoconite holes, englacial and subglacial systems) can host active microbial communities [1]
- Notable similarities evident between glacial habitats worldwide (especially for primary producers and ecosystem engineers) [1]



DC = Doctoral Candidate

DC 6 – Glacial flour, grinding and nutrient release

#1 Study area

Subglacial Environment

- Characterized by cold temperatures and high pressure, isolated from atmosphere, limited external organic input[2]
- Host active microbial system despite these harsh conditions[2]
- Glacial outflow provides source of nutrients such as iron, silicate, phosphate and nitrate to adjoining ecosystems[2]

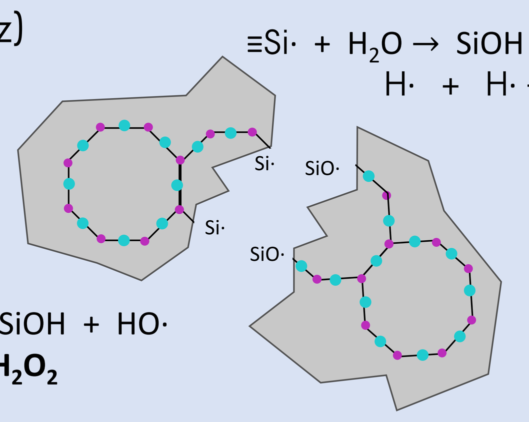
Subglacial Nutrients

- Sources: Rocks and Sediment, limited supraglacial sources
- Subglacial weathering triggered by glacial meltwater: rock dissolutions allows minerals to enter the aqueous phase[3]
- Often accompanied by physical erosion of the bedrock, a coupled process in which further dissolution of the rock enhances erosion and vice versa[4]

Mechanochemical Weathering

- Mechanochemical reactions triggered by glacial abrasion: breaking of covalent bonds in minerals[4]
- Subglacial nutrient and energy source
- Example for Silicates: (e.g. Quartz)

$\equiv Si\cdot + H_2O \rightarrow SiOH + H\cdot$
$H\cdot + H\cdot \rightarrow \mathbf{H_2}$



$\equiv Si{-}O\cdot + H_2O \rightarrow SiOH + HO\cdot$
$HO\cdot + HO\cdot \rightarrow \mathbf{H_2O_2}$

#2 Research Questions

→ What is the nutrient content in different parts of the subglacial environment: the flour, pore water, and basal debris?

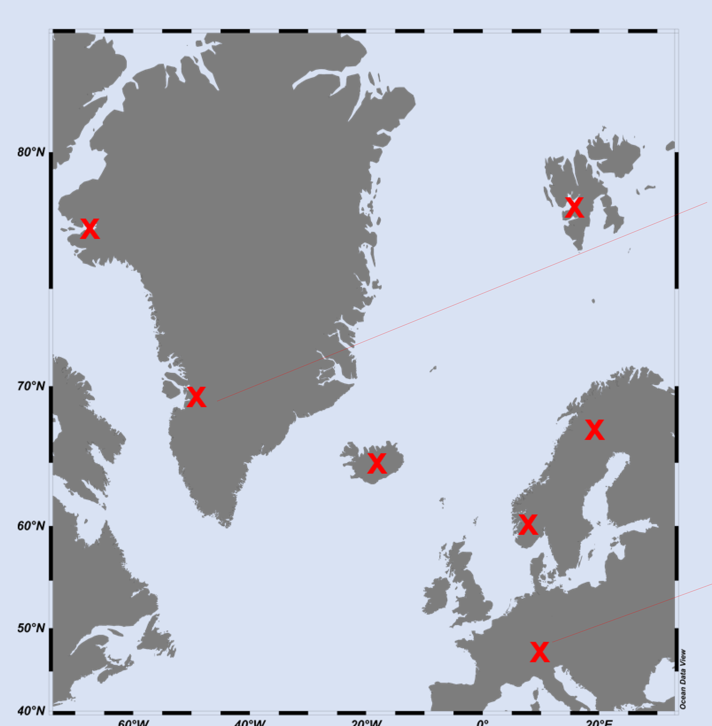
→ What is the contribution of released nutrients to the subglacial nutrient budget during rock crushing?

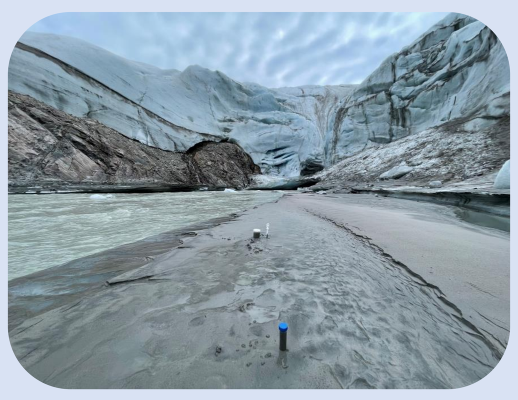
→ How do nutrients released differ with different bedrock types?

#3 Samples

› Sediment and rock samples from 7 different areas

› Nutrient analysis for pore water, sediment extraction and crushing experiments

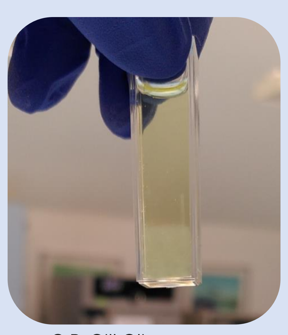




Sediment Samples from Greenland, 2022 (© M. Skidmore)

Rock samples from the Austrian Alps, 2023 (© K. Köhler)

#4 Lab set-up



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› Using colorimetric method to determine nutrient concentration

› Analyzed nutrients: NO_2, TON, NH_4, PO_4, Fe, $Si(OH)_4$ + organics

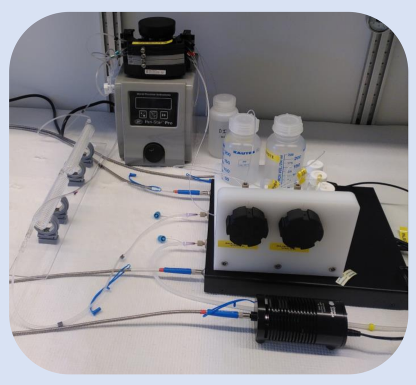
Discrete Analysis:

- Pipettes a discrete amount of sample and reagent into a cuvette
- Measures absorbance of the developed color complex
- Concentration Range: µM

Gallery Aqua Master Analyzer, by ThermoFisher Scientific (© K. Köhler)

Throughflow Analyzer

- Continuos flow of sample and reagents
- Measures absorbance of the developed color complex
- Concentration Range: nM (used for P and N)



Throughflow Analyzer for P and N analyses (© B. Gill Olivas)

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