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Fieldwork report. Permit n° 2018-03

Lake coring and monitoring

in Nuup Kangerlua (Kapisillit) and Kangerlussuaq.

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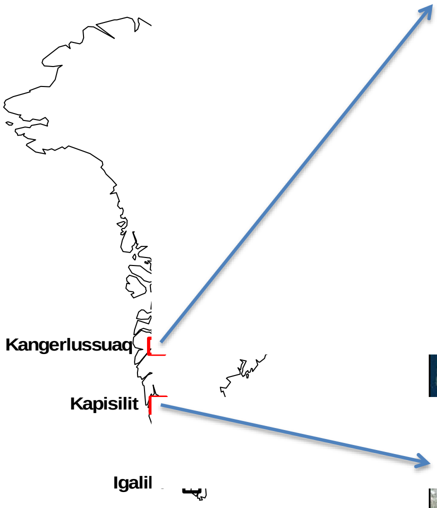
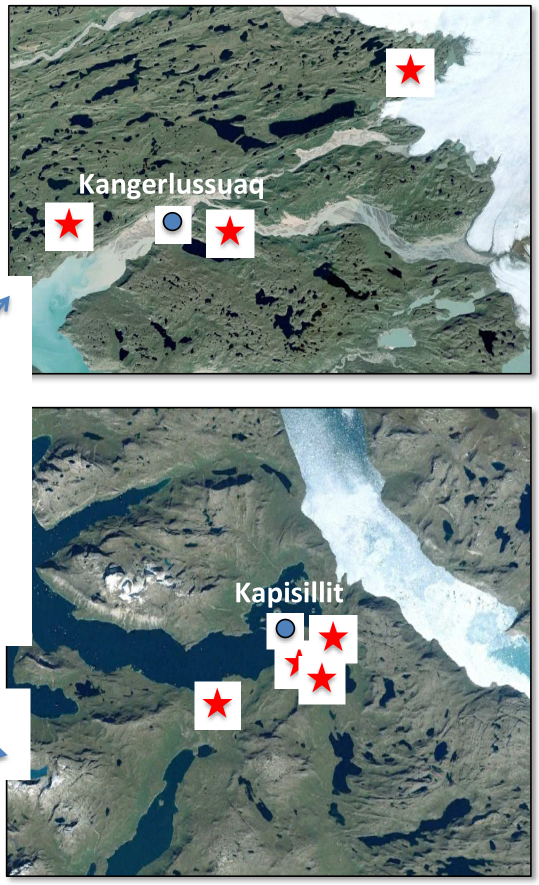
Arctic and Subarctic lakes are known to be important components of the global carbon cycle. The balance between carbon sources and sinks in lakes is sensitive to global forcing (climate change and atmospheric nitrogen deposition, e.g. Lundin et al. 2015; Heathcote et al. 2015) and local conditions (land use, e.g. Anderson et al. 2014). In high latitude lakes, low biodiversity is linked to increased vulnerability to climate warming, which is expected to be amplified in the Arctic zone (Serreze and Francis 2006). This effect is also associated with the socio-economic shift that is partly triggered by the changing environment. Changes in the lake carbon cycle are especially significant because high organic carbon accumulation can lead to anaerobic processes of organic carbon degradation that produce biogenic methane, one of the most powerful greenhouse gases (Rudd and Hamilton 1978; Ravinet et al. 2010). The variety of modern conditions and human practices over time covered by the InterArctic lake dataset offers the opportunity to assess the legacy of past human activities on the vulnerability of lakes to the effects of climate change in the present and in the future.
In this task, we propose to document the following: 1) how the carbon-sink service of lakes is impacted by controlling factors (i.e., climate, nitrogen atmospheric depositions and local land use), 2) how the biodiversity (both taxonomic and functional) of benthic macro-invertebrate communities is impacted by changes in lake carbon sequestration, and 3) the relationship between organic carbon sequestration, macroinvertebrate biodiversity and the appearance of methane-related food webs in different environmental conditions. To achieve these objectives, we propose to develop a multiproxy study of sediment cores taken from each study area that encompass the past millennium. The sediment indicators will be studied on the same levels (after sub-sampling) to enable direct comparison of the results. The thickness and the distribution of the samples will ensure a subdecadal time resolution for the last 150 years and a sub-centennial resolution for the older period. The research plan can be divided into several steps: a) reconstruction of the quantity and sources of organic carbon in lake sediment, b) assessment of the spatial and temporal variations of the expected controlling factors on organic matter sequestration, and c) evaluation of the impact of organic carbon sequestration on benthic biodiversity and methanogenesis and methanotrophye. The fieldwork will benefit from the strong skills and expertise of the project partners in coring in remote areas. The cores of the Interarctic project will undergo the following logging chain: 1) high resolution pictures, density and magnetic susceptibility measurements on the Multi-Sensor Core Logger (MSCL Geotek, Chrono-Environnment lab), at 0.5cm resolution, 2) elemental analysis by X-ray Fluorescence (Avaatech XRF core scanner, Edytem lab, Univ. of Savoie Mont-Blanc), at 0.250cm resolution, 3) determination of sediment color bearing component by hyperspectral imaging (camera SWIR & VNIR SPECIM, Univ. of Rouen/M2C), (4) the analysis of chironomids, diatoms, pollen and non-pollen palynomorphs analysis (5) analyses of organic carbon, organic nitrogen and carbon stable isotope (δ13C) in bulk sediment, (6) carbon stable isotope (δ13C) analysis in chironomid and cladocera remains.

We were 4 researchers participating in this fieldwork : Laurent Millet (DR, CNRS), Damien Rius (CR, CNRS), Natasha Roy (postdoctoral fellow) from the Chrono-Environment lab/University of Franche-Comté), and Simon Belle (postdoctoral fellow) from the Swedish University of Agricultural Sciences, Uppsala.

The fieldwork campaign took place from July 10th to 27th.

2 area surveyed
-Kapisillit (Western setlement)
-Kangerlussuaq
 => Latitudinal gradient
 => variability in human impact and ecological settings





- **3** lakes
- **6** cores
- Physico-chemical monitoring

- **4** lakes
- **7** cores
- Physico-chemical monitoring

July 10 : Flight from Paris to Reykjavik

July 11 : Flight from Reykjavik to Nuuk

July 12 : Boat trip from Nuuk to Kapisilit

July 13 : Coring of « Pingu lake »

Two 1m long cores were retrieved from the center and deepest part of the lake, at *ca* 28m depth.

Physico-chemical profile along the water column using a multi-parameter sonde (O^2, T°, Conductivity, Chla, pH)
Sampling of lake water for chemistry (N, P)
Sampling of zooplancton in the water column

July 14 : Coring of « Iversen lake »

Two 1m long cores were retrieved from the center and deepest part of the lake, at *ca* 4m depth.
Physico-chemical profile along the water column using a multi-parameter sonde (O^2, T°, Conductivity, Chla, pH)
Sampling of lake water for chemistry (N, P)
Sampling of zooplancton in the water column

July 15 : Coring of « little Kapisilit lake »

One 120cm long cores were retrieved from the center and deepest part of the lake, at *ca* 4m depth.
Physico-chemical profile along the water column using a multi-parameter sonde (O^2, T°, Conductivity, Chla, pH)
Sampling of lake water for chemistry (N, P)
Sampling of zooplancton in the water column

July 16 : Bad weather, rest day

July 17: Coring of « Itinera lake »

Two 120cm long cores were retrieved from the center and deepest part of the lake, at *ca* 4m depth.
Physico-chemical profile along the water column using a multi-parameter sonde (O^2, T°, Conductivity, Chla, pH)
Sampling of lake water for chemistry (N, P)
Sampling of zooplancton in the water column

July 18 : Packing of material and retrieved cores

July 19 : Boat trip back to Nuuk
We initially planned to core two lakes in the Nuuk area. Due to uncertainties in weather forecasting we had to ship the toolboxes (containing coring devices and rubber boat) by plane to Kangerlussuaq the day of our arrival. It was the most secure option in order to be able to work in the Kangerlussuaq area, but it leave us without any technical means to perform the planned coring.

July 20-21: Stay in Nuuk at the Greenland Institute of Natural Ressources

July 22 : Flight from Nuuk to Kangerlussuaq

July 23 : Coring of « Russell Lake » and « Kelly lake »

Two cores were retrieved from the center and deepest part of the lake, at *ca* 4m depth.
Physico-chemical profile along the water column using a multi-parameter sonde (O^2, T°, Conductivity, Chla, pH)
Sampling of lake water for chemistry (N, P)
Sampling of zooplancton in the water column

Two cores were retrieved from the center and deepest part of the lake, at *ca* 4m depth.
Physico-chemical profile along the water column using a multi-parameter sonde (O^2, T°, Conductivity, Chla, pH)
Sampling of lake water for chemistry (N, P)
Sampling of zooplancton in the water column

July 24 : Coring of « Salty lake »

Two cores were retrieved from the center and deepest part of the lake, at *ca* 4m depth.
Physico-chemical profile along the water column using a multi-parameter sonde (O^2, T°, Conductivity, Chla, pH)
Sampling of lake water for chemistry (N, P)
Sampling of zooplancton in the water column

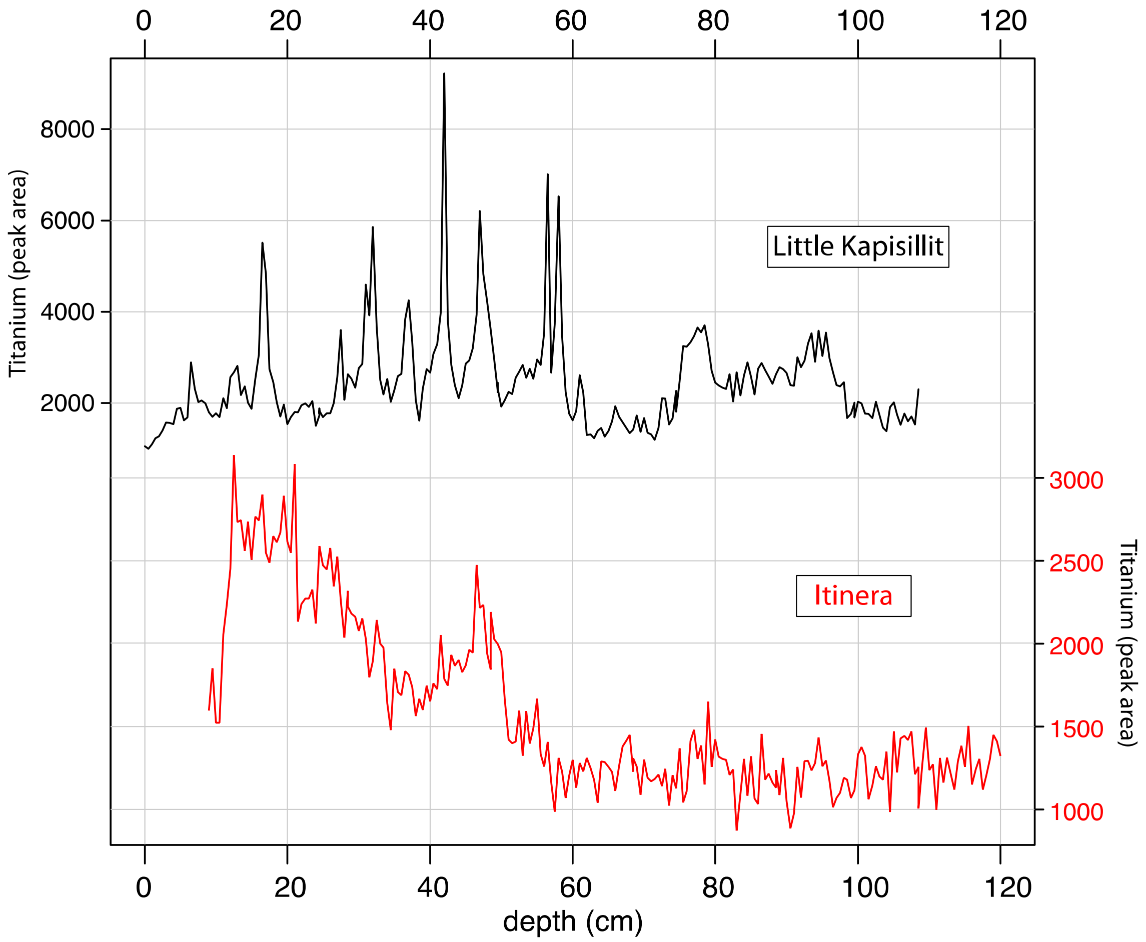
July 25 : Packing of material and retrieved cores

July 26 : Flight from Kangerlussuaq to Copenhagen

July 27 : Flight from Copenhagen to Paris

First results

All the cores were open at Chrono-Environnement Lab. The first analyses are focused on Little Kapisillit and Itinera lakes (a Master Student will start on these 2 records end of January 2019) and consist on preliminary logging of cores on a Xr-F core scanner for determining sediment elemntal composition. The first C14 dates and Pb210/Cs137 measurements will follow up quickly .



The figure above shows the Titanium (a proxy for terrigenous inputs, *i.e.* erosion) measurements from Little Kapissilit and Itinera lakes. Marked increases *ca* 60 and 50 cm respectively, indicating may correspond to changes in human activities within the watershed, which needs to be confirmed by chronology.