

**Holocene Environmental Change in the Maritime Antarctic. Interactions between permafrost and the lacustrine environment**

**HOLOANTAR**



**REPORT ANTARCTIC CAMPAIGN**

**JANUARY'14**

## **Summary**

HOLOANTAR is a multidisciplinary project in which researchers from the University of Lisbon (Portugal) and the Federal University of Viçosa (Brasil) lead research activities in collaboration with other scholars from the Universidad of La República (Uruguay), University of Alcalá (Spain) and also from several Spanish research organisms such as Centro de Estudios y Experimentación de Obras Públicas (CEDEX), Instituto Geológico y Minero de España (IGME), Agencia Estatal del Consejo Superior de Investigaciones Científicas (CSIC) and Parque Natural de Peñalara.

The project is led by the Institute of Geography and Spatial Planning - Centre for Geographical Studies of the University of Lisbon through the research group Antarctic Environments and Climate Change Research Group (ANTECC). Results of HOLOANTAR project will contribute to the understanding of the landscape evolution and climate changes in the South Shetlands Islands following Holocene environmental evolution in Byers Peninsula (Livingston, Antarctica).

The South Shetlands Islands are located in the northwestern tip of the Antarctic Peninsula, one of the Earth's regions that have experienced a stronger warming signal during the second half of the 20th century. The terrestrial ecosystems in the ice-free areas of this archipelago are supported by permafrost, one of the key components of the cryosphere, as recently defined by the World Climate Research Programme, though the reaction of permafrost to climate change is still poorly known. However, in the recent years a very important effort has been conducted to monitor the thermal state and characteristics of permafrost in order to study its response to the recent warming trend. Our team is involved on several of these long-term monitoring projects (PERMANTAR, PERMANTAR-2), but HOLOANTAR, in addition, offers a new integrated approach aiming to bridge the gap between contemporary and past changes in permafrost environments.

HOLOANTAR is based on two hypotheses:

- a) A multi-proxy analysis of lake sediments will allow to reconstruct the palaeoecological and palaeoenvironmental evolution in the Maritime Antarctic and the role played in it by permafrost and active layer dynamics,
- b) The detection of activity rates, spatial patterns and geographical controls of contemporary key-geomorphic processes and permafrost distribution, will permit to define their boundary climatic conditions that will be used to interpret the sedimentary record.

## Antarctic campaign January 2014

### Participants

Jesús Ruiz Fernández (University of Oviedo) - JR

Marc Oliva (IP, University of Lisbon) - MO

### Dates

Flight to Punta Arenas:

- JR: from Oviedo (Spain) to Barcelona (Spain), 9<sup>th</sup> January
- JR and MO: from Barcelona to Punta Arenas (Chile), 9<sup>th</sup> January

Punta Arenas: from 10<sup>th</sup> to 16<sup>th</sup> January

Departure Punta Arenas-Frei: 16<sup>th</sup> January

Ary Rongel ship: 16<sup>th</sup> to 18<sup>th</sup> January

Field work: 18<sup>th</sup> January – 30<sup>th</sup> January

- Elephant Point: 18<sup>th</sup> to 27<sup>th</sup> January
- Byers Peninsula: 28 to 30<sup>th</sup> January

Aquiles ship: 30<sup>th</sup> January to 2<sup>nd</sup> February

Frei-Punta Arenas: 2<sup>nd</sup> February

Flight home: 4<sup>th</sup> February

### Logistics

Logistics was supported by the Brazilian and the Chilean Antarctic programs.

Brazil provided:

- Flight Punta Arenas-Frei.
- Accommodation and transport by ship to Elephant Point.
- Helicopter support.
- Camp equipment (tents, food, WC, fuel, etc.).
- An expert climber to support field work in Elephant Point (Ricardo Leizer).

Chile provided:

- Zodiac support.
- Accommodation and transport by ship from Byers to Frei.
- Flight Frei-Punta Arenas.

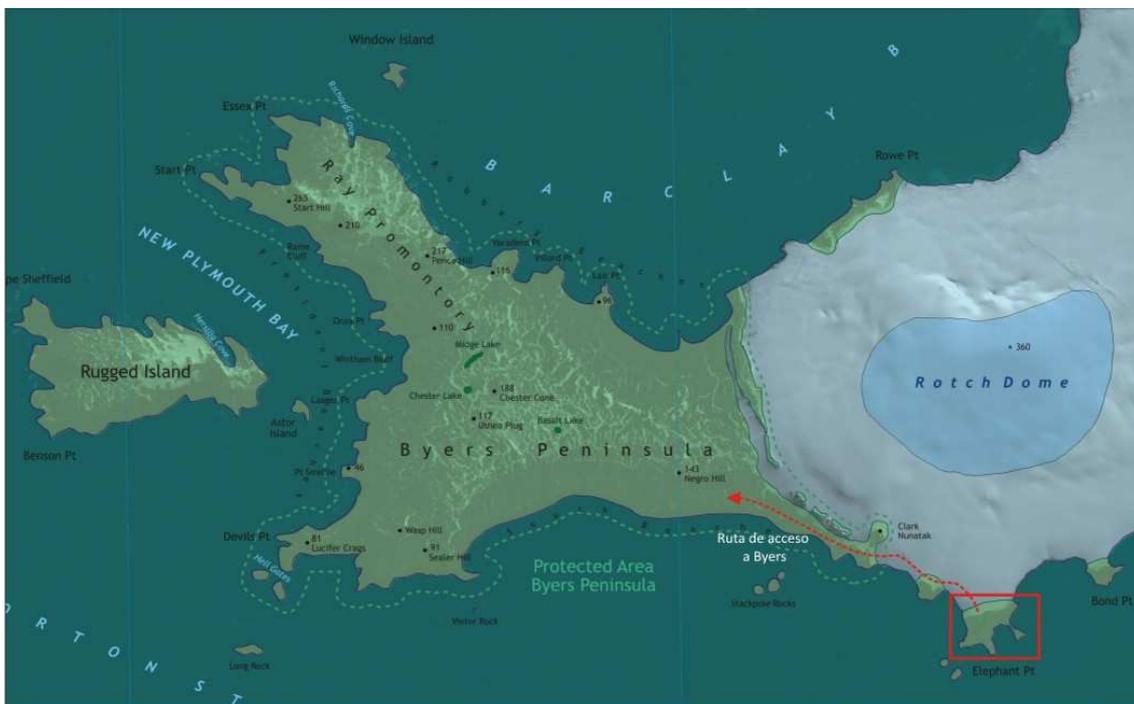
## Study area

Our research was centred on Elephant Point and Byers Peninsula, in the westernmost tip of Livingston island (South Shetland Islands, Maritime Antarctica).

During the first part of the campaign we stayed in a Brazilian camp in Elephant Point, a small ice-free area of ca. 2 km<sup>2</sup> at the east of Byers Peninsula.

During the last days of our campaign we crossed the southern fringe of the Rotch Dome glacier and stayed in Byers Peninsula, the largest ice-free area in the South Shetland Islands. It is a protected area in Livingston Island with the largest biodiversity in Antarctica (Toro et al., 2007). Byers has a relatively flat relief with more than 110 lakes/ponds (López Martínez et al., 1996) that started to originate during the Early Holocene, from ca. 8300 cal. years BP to 450-500 BP (Bjorck et al., 1996; Toro et al., 2013). All the activities carried out in Byers were framed within the Management Plan for Antarctic Specially Protected Area No. 126 (Byers Peninsula, Livingston Island).

Here, we stayed with Chilean researchers that installed a camp in the southern beaches. The camp was close to the Spanish igloos, which facilitated field work activities and our daily stay in Byers.



Map of the westernmost part of Livingston island with the distribution of Byers and Elephant Point.

## **General framework of the campaign**

MO and JR arrived at Punta Arenas on 10<sup>th</sup> February. Due to bad weather conditions in Frei we only flew to Antarctica on the 16<sup>th</sup> February, which reduced four days our time for field work activities.

The goal of the project was to carry out geomorphological and monitoring activities in Byers Peninsula within the HOLOANTAR project. Access to Byers this year was extremely difficult due to the fact that Spain had no ship support in Antarctica. As a last chance to go to Byers, we finally got support from the Brazilian Antarctic Programme to go with Prof. Dr Andres Zarankin and his team (archaeologists) to their camp in Elephant Point, an ice-free area close to Byers Peninsula. During the last days of December we knew that a team of Chilean researchers would stay in Byers from the 25<sup>th</sup> to 1<sup>st</sup> February. Our idea was to stay with the Brazilian until the 27<sup>th</sup> and then to move to Byers with the Chilean until 1<sup>st</sup> February.

The initial plan was to go through the glacier from Elephant Point to Byers and come back to the Brazilian camp during the first part of the campaign. However, we got less support than expected from the climber (Ricardo Leizer) due to trouble with the authorization of the Antarctic Brazilian Programme. We tried to cross to Byers along the beach alone but it was too dangerous because of the steep glacier fronts. We stayed in Elephant Point until the 27<sup>th</sup> January carrying our geomorphological mapping, measurements of the active layer and soil sampling.

On the 25-26<sup>th</sup> we contacted the Aquiles ship trying to receive support to go by zodiac to Byers, but it was not possible. On the 27<sup>th</sup> we decided to cross the glacier with the help of Ricardo Leizer and Mike, an Australian researcher. After an exhausting trip, we were at the beginning of Byers Peninsula, with more than 100 kg to be transported 7 km away to the Spanish igloos.

We set up our tent in a raised beach at the foot of Cerro Negro in order to install the equipment in both lake basins the following days. On the 29<sup>th</sup> we moved everything to the Spanish igloos where our Chilean colleagues were doing their field work research. From there we conduct the rest of activities until we were picked up by the Aquiles ship.

## Tasks conducted

### Elephant Point

- Geomorphological mapping of the peninsula.
- Mapping of the geoecological units
- Measurements of active layer thickness along three different transects.
- Collection of soil samples in 10 sites along a transect glacier-coast.
  - o PVC tubes (7 x 12 cm)
  - o Individual samples (3 in each site)
- Collection of samples for dating purposes:
  - o C14: bones of whales.
  - o Cosmogenic: boulders.

### Byers Peninsula

- Geomorphological sketch of Escondido basin.
- Geomorphological mapping of Cerro Negro basin.
- Geomorphological mapping of Domo basin.
- Installation of air, interface air-soil and snow depth loggers in Escondido.
- Installation of air, interface air-soil and snow depth loggers in Cerro Negro.
- Installation of air, interface air-soil and snow depth loggers in Domo.
- Shallow drilling (80 cm depth) for active layer monitoring in Escondido.
- Shallow drilling (80 cm depth) for active layer monitoring in in Cerro Negro.
- Shallow drilling (80 cm depth) for active layer monitoring in Domo.
- Collection of soil samples in the three monitoring sites.
- Collection of subaquatic mosses in Escondido, Cerro Negro and Chester lakes.



## Activities

We arrived to Frei on 16<sup>th</sup> February with a Hercules from the Brazilian Air Force. A zodiac picked us at Frei and transported us to the Ary Rongel ship. From 16<sup>th</sup> to 18<sup>th</sup> February we were on this ship heading to Elephant Point.

Report of activities done in Elephant Point/Byers:

### **Day: 18/01/2014**

**Weather:** Cloudy, moderate wind and snow at the evening, 1 to -1°C

**Start time:** 10 h

**End time:** 19 h

**Activities:** We disembark in Elephant Point. We start at 10 h and stop at 15 h due to strong winds. We set up two big tents and sleep all in one of them the first night.

### **Day: 19/01/2014**

**Weather:** Snowing all day, temperatures slightly positive, moderate winds.

**Start time:** 9 h

**End time:** 19 h

**Activities:** We continue with the operations and organization of the camp.

### **Day: 20/01/2014**

**Weather:** Snow mixed with rain, moderate winds.

**Start time:** 8 h

**End time:** 20 h

**Activities:** “Maria day” for JR and MO. We prepare breakfast, lunch and dinner for everyone. In the afternoon we collect the first soil samples from the raised marine terraces close to the camp.

### **Day: 21/01/2014**

**Weather:** Mostly sunny, temperatures 3-5°C, no wind.

**Start time:** 9 h

**End time:** 20 h

**Activities:** Field reconnaissance in the morning of the entire peninsula. In the afternoon we finish collecting soil samples and start the geomorphological mapping.

### **Day: 22/01/2014**

**Weather:** Mostly cloudy, temperatures 2-3°C, weak winds.

**Start time:** 9 h

**End time:** 20 h

**Activities:** hard working day. We almost finish the geomorphological mapping and carry out the measurements of the active layer along three transects covering the whole peninsula.

**Day: 23/01/2014**

**Weather:** Cloudy, strong winds, snow in the evening.

**Start time:** 9 h

**End time:** 20 h

**Activities:** In the morning we head to Byers along the beach, but we decide to go back because it is too dangerous. In the afternoon we finish the mapping of the marine terraces and collect samples for cosmogenic (boulders) and C14 datings (whale bones). In the evening we rewrite and organize all the geomorphological observations.

**Day: 24/01/2014**

**Weather:** Snow, strong winds, temp ~0°C.

**Start time:** 8 h

**End time:** 22 h

**Activities:** “Maria day” for JR and MO. We rewrite and organize all the geocological observations. We packed all our equipment and the bag which will be sent through Ary Rongel to Punta Arenas.

**Day: 25/01/2014**

**Weather:** Heavy snowfall, strong E winds, negative temperatures.

**Start time:** 9 h

**End time:** 20 h

**Activities:** waiting day. We try to contact Aquiles and Juan Carlos asking for zodiac support.

**Day: 26/01/2014**

**Weather:** cloudy, weak winds, temperatures 1-3°C.

**Start time:** 9 h

**End time:** 20 h

**Activities:** Aquiles decides not to pick us. We packed everything in order to cross the glacier tomorrow at 5 h.

**Day: 27/01/2014**

**Weather:** snow and very windy at night, turning to cloudy, with weak winds, temperatures ~1°C.

**Start time:** 11 h

**End time:** 23 h

**Activities:** We wake up at 5 h but the weather is not safe for crossing the glacier. We wait until 11 h and we leave. We cross the glacier helped by Ricardo Leizer and Mike. The snow is very soft and we decided to go south of Clark nunatak.

We arrive there around 16 h. JR and MO set up the tent near Cerro Negro making several trips carrying all the equipment until there.

**Day: 28/01/2014**

**Weather:** Mostly sunny, temperatures 2-3°C, no wind.

**Start time:** 9 h

**End time:** 23 h

**Activities:** We install the monitoring sites at Domo and Cerro Negro. We collect soil samples and make geomorphological sketches. We go back to sleep at the tent.

**Day: 29/01/2014**

**Weather:** Mostly sunny, temperatures 2-3°C, no wind.

**Start time:** 9 h

**End time:** 23 h

**Activities:** We packed all our material and transport it to the Spanish igloos (40 kg each). Extremely heavy. We go back and transport the rest of equipment from Domo to Escondido. We install the equipment here, collect soil samples and go back to the igloos.

**Day: 30/01/2014**

**Weather:** Mostly sunny becoming more cloudy in the afternoon, temperatures 0-2°C, weak winds.

**Start time:** 9 h

**End time:** 18 h

**Activities:** Ary Rongel communicates with us; they pick us today at 15 h. We go quickly to Domo and Cerro Negro lakes to launch the air logger and take the last geomorphological observations. At 18 h, after packing and transporting everything to the beach, we reach the ship after a dangerous zodiac trips with big waves. Nice shower after 15 days in the field!

We stayed at the Aquiles ship until 2<sup>th</sup> February. During these three days we organized all our data, pictures, documents, etc.

We disembarked at Frei and flew back to Punta Arenas on 2<sup>th</sup> December. We went back to our countries on the 5<sup>th</sup> February.



HOLOANTAR researchers at their arrival at Frei (left: Marc Oliva; right: Jesús Ruiz Fernández).

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