

Underground warmed environments at cold regions. The case of *Cerro Caliente* in Deception island, Antarctica

O. Prieto-Ballesteros, F. Gómez, M. Moreno, G. de Diego, M. Fernández-Sampedro, M.P. Martín-Redondo and V. Parro. Centro de Astrobiología, INTA-CSIC. Torrejón de Ardoz. Madrid 28850. Spain (prietobo@cab.inta-csic.es)

Abstract

Hydrothermal and cold environments constitute two extremes for life and are relevant to evaluate the present or past life on Mars. Deception Island (Antarctica) is an excellent place to study the cold and warm underground habitats and their interfaces. They are extreme environments that have interest as terrestrial analogues to Mars. *Cerro Caliente*, a 107 m high hill has been selected because the geothermal activity present at its summit. Some drills at the same ground materials but with different thermal regimes were performed at this place. Samples from the cores are being studied to understand the interactions between the cold and warm environments. The description of the area and the preliminary results of the sample analysis will be presented during the session.

1. Introduction

Antarctic underground environments are natural laboratories especially motivating for astrobiologists.

Deception Island is a stratovolcano located in the Bransfield strait, between the Antarctic Peninsula and the South Shetlands islands (Fig. 1). The island is volcanically active at present, being the last eruptions in 1967, 1969 and 1970 [1, 2].

Hot and cold environments interact in this island producing particular features that are interesting for comparative planetology. There are extensive glaciated areas, where volcanic materials are imbedded between the ice layers. Periglacial landforms may be recognized over young effusive deposits. The permafrost is discontinuous due to thermal anomalies, mostly associated to faults. Taking advantage of the open fractures, there are gas releases, mostly of CO₂ and H₂S. One area where the

hot/cold interaction is visible is *Cerro Caliente*, which is located at the west side of the island, near the Argentinean base (Fig. 1). At the top of the hill there is a narrow band of 40 m long in which the temperature may reach 100°C in some patches. The warmed summit rock is altered by the fluids along the fracture. Precipitation of carbonates occurs when the fluids rise, impregnating the porous volcanic strata. Green mats containing fungi and cyanobacteria are covering some of the warm patches at the top of the *Cerro Caliente*.

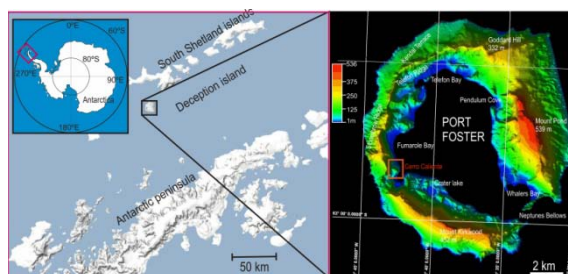


Figure 1: Location map of Deception island, and Cerro Caliente site.

The combination of high thermal gradients on the ground and cold environments at the surface may help to understand potential martian habitats. Hot spots in this planet may have had importance in epochs when the climate was getting cold.

2. Operations on the hot and cold *Cerro Caliente* site.

During the austral summer of 2012, a field work campaign was performed at Deception Island in order to complete the studies started in 2010. In the first campaign we studied the permafrost environment at Crater Lake area [3]. The second campaign has been

dedicated to study the geothermal areas at high latitudes. These studies has been done at *Cerro Caliente* because the present activity of its summit ridge.

We have done four boreholes of 1-2 meters along the summit ridge (Fig. 2). Perforation was done using an electrical driller. In order to avoid contamination, the diameter of the drill tubes used was big enough to take the sample from the center of the cores. We have perforated several sites with different surface temperature, from 100°C to <0°C on the top of *Cerro Caliente*. Cores were sampled for microbiology, mineralogy and geochemistry analysis.

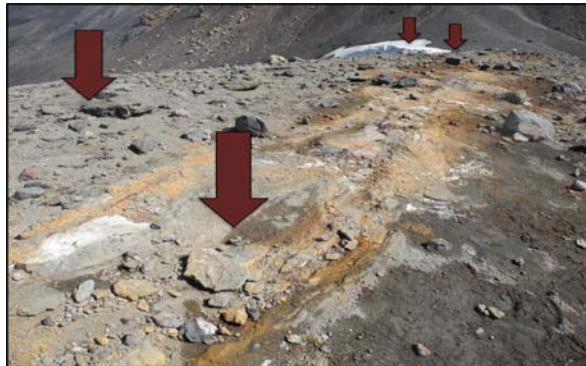


Figure 2: Top of Cerro Caliente. Red arrows indicate the location of the drills.

Acknowledgements

We thank to the personnel of the Spanish Antarctic Base “Gabriel de Castilla”, head by Commandant Antonio Casals for their invaluable help. This work has been funded by the Spanish Ministry of Economy and Competitivity, Subdirección General de proyectos de investigación, granted project AYA2008-04013-E

References

[1] Baker, P.E. and McReath, I.: 1970 volcanic eruption at Deception island. *Nature Physical Sci.* 231: 5-9, 1971.

[2] Baker, P.E., Buckley, F., and Rex D. C.: Cenozoic volcanism in the *Antartic*. *Phil. Trans. R. Soc. London B*, 279: 131-142, 1977.

[3] Blanco Y. et al.: Prokariotic communities and operating metabolisms in the surface and permafrost of Deception Island (Antarctica). *Environ. Microbiol.* 2012