

Antarctic permafrost studies for testing the Signs Of Life Detector (SOLID)

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Abstract

Some geological and biological studies have been conducted at Deception Island (Antarctica) in order to provide a terrestrial analog to Mars context to test SOLID operations. Both, a drill and a geophysical survey were performed in the permafrost at a basaltic planitia, south to the Crater Lake site. Cores from the drill were mineralogical and geochemically analyzed. Finally, detection biological signatures was carried out by SOLID system [1]. Here we present the characteristics of the area where detection of life was done.

1. Geological setting

Deception Island ($62^{\circ}57'S$, $60^{\circ}37'W$) is situated in the Bransfield Strait marginal basin that separates the South Shetland Islands archipelago from the Antarctic Peninsula (Fig. 1). The island is an active stratovolcano with a large collapsed caldera. The volcanic activity is recent, being the latest eruptions in 1967, 1969, and 1970. Permafrost is continuous throughout most of the island, but in some places there are fumaroles and thermal anomalies from continued volcanic activity. The active layer of the permafrost is thin, which varies from 30 to 90 cm in thickness.

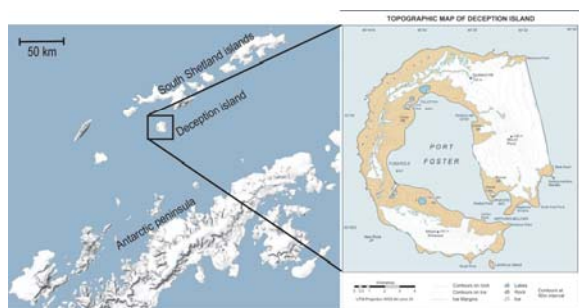


Fig. 1. Location map of Deception Island

The island is glaciated in some areas. Recent eruptions have covered many of the glaciers remains by volcanic ash and debris. Pyroclastic deposits covered snow, and buried snow is still present at some sites. On valley slopes, buried-ice with perennially frozen ice-cemented volcanic debris on top is exposed, attesting post-eruption aggradation of permafrost. At these sites, ice-cemented permafrost also occurs under the buried-ice layer.

This setting configures a valuable terrestrial analog to Mars. Permafrost in the basaltic high porosity deposits, and the periglacial geomorphology of the island are being studied because the similarities to some martian terrains. Taking advantage of the extreme conditions of the Antarctic permafrost, testing SOLID functioning was performed.

The SOLID (“Signs of Life Detector”) concept is an antibody microarray-based instrument developed by Centro de Astrobiología since several years [1,2]. It has been designed and built for the detection and identification of biochemical compounds by in situ analysis of both liquid and solid samples. SOLID3 has successfully been tested very recently in field campaigns in the Atacama Desert and Deception Island (Antarctica).

2. Characterization of the Deception island’s permafrost.

Permafrost of the area was mapped using electric resistivity (Fig. 2). Results of the geophysical data show that the permafrost is very near to the surface in the studied area. In addition, the upper centimeters have high resistivity due to the porosity of the pyroclastic deposits.

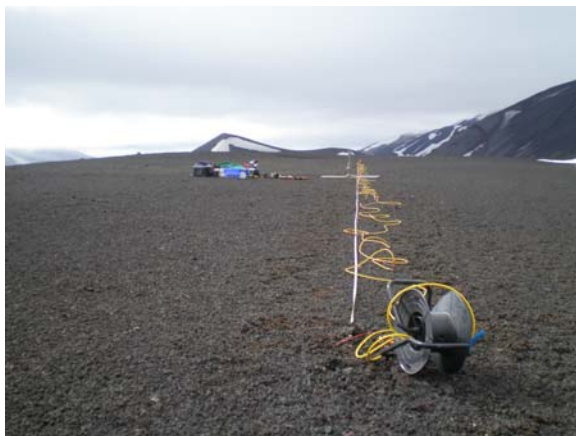


Figure 2: Crater lake area at Deception island, where the studies were performed

A 4.2 m depth drill was done. Samples were taken every 50 cm, when we add more tubing to the drill. Samples were conserved under zero degrees for later processing.

Geochemical analysis was made in the laboratory from the melted ice. We use Perkin Elmer ICP mass spectrometer and Ion Chromatographer for different ions. Concerning the anions, analyzed samples show abundances mainly in sulphates, chlorides and fluorides.

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References

- [1] Parro, V., Fernández-Calvo, P., Rodríguez Manfredi, J.A., Moreno-Paz, M., Rivas, L.A., García-Villadangos, M., Bonaccorsi, R., González-Pastor, J.E., Prieto-Ballesteros, O., Schuerger, A.C., Davidson, M., Gómez-Elvira, J., and Stoker, C.R.: SOLID2: an antibody array-based life-detector instrument in a Mars Drilling Simulation Experiment (MARTE), *Astrobiology*, Vol. 8, pp. 987-99, 2008.
- [2] Rivas, L.A., García-Villadangos, M., Moreno-Paz, M., Cruz-Gil, P., Gómez-Elvira, J., and Parro, V.: A 200-antibody microarray biochip for environmental monitoring: searching for universal microbial biomarkers through immunoprofiling, *Analytical Chemistry*, Vol. 80, pp. 7970-9.

