THE PERMAFROST IN THE IMURUK LAKE BASALTIC FIELD (ALASKA) AS A MARTIAN PERMAFROST ANALOGUE.

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Introduction: Permafrost is probably the current main water reservoir of Mars [1]. At circumpolar latitudes, the martian permafrost is continuous and an active layer is absent. At middle latitudes, permafrost is continuous but a thin active layer may exist, especially if salts are present to depress the melting point. In the tropical zone, ground temperatures exceed 273 K in the summer, and annual mean temperatures indicate that continuous permafrost exists, but ice is absent or patchy at best due to hyperaridity [2]. Recently, *Mars Odyssey* data has defined the periennial underground ice stability zone from latitudes higher than 60º [3, 4]. From the astrobiological perspective, permafrost is important not just because of water's geological role and its paleoclimatic indications, but it might be a potential habitat for microorganisms (or preserving biomolecular tracers of past life) since it acts as a thermally stable shelter, is a source of moisture, and is a shield against radiations [5].

Future Mars mission planning includes subsurface exploration. On the basis of geologic and geomorphologic studies and the known presence of water ice at middle to high latitudes, it is expected that subsurface exploration will encounter permafrost similar to the Earth's in regions such as Alaska.

We are studying the permafrost in the Imuruk lake volcanic field area (Alaska) from an Astrobiological perspective, in order to reach three main objectives: 1) Define preservation patterns of biosignatures in cold environmens that may be used in future space exploration missions; 2) develop new instrumentation for detecting life in situ or remotely, and 3) develop new instrumentation for detection and mapping of permafrost niches where life (or biochemical tracers of past life) may be preserved. These aims will be achieved by permafrost characterization using geophysical sounding and drilling, sampling different levels of the rock cores and analyzing their mineralogy, geochemistry and microbiology.

Imuruk lake volcanic field: Imuruk is a volcanic area centered at 65.6ºN, 163ºW. The central part of the area is characterized by monogenetic volcanoes, active from late Paleogene. Five volcanic formations have been distinguished, among which mantles of windblow silt with different extent and thickness have been deposited [6]. Permafrost developed in these materials is especially interesting due to the analogies to the important martian landforms and materials. Ice-rich permafrost of this area is primarily continuous and hundreds of meters thick except under and near the major lakes and rivers. In addition, parts of the lava flows interrupt the permafrost, thus allowing groundwater circulation.

Field work made during the 2005 expedition was made in the eastern part of the Imuruk lake between the Nimrod Hill and the lake itself (Fig. 1). This area is characterized by the named Imuruk volcanic formation, which is dominated by basalts and basaltic andesite lava flows overlain by 1-6 m of windblow silt. A cover of peat is present at the top. Surrounding the volcanic hill some lake sediments, gravel, sand, silt and peat of intermediate terraces have been already mapped [6].

Work elsewhere in the region, including in 2005 on the opposite lake shore where the youngest lava flow in the region occurs, has highlighted significant roles of permafrost in affecting volcanism (Kargel et al. this conference, and [8]).

Geophysical survey: In order to map the permafrost underground, electric tomography sounding was performed. A *Syscal KID Swich-24* equipment was used for the measurements. Thirteen parallel lines from the Imuruk lake coast up to the hill of Imuruk formation were accomplished. Each tomographic line was 48 meters long, using 2 meters as the separation between a pair of electrodes. The space between lines was around 15 meters, depending on the dificulty of the topography for settling the electrical lines.

Resulting tomographic data indicate that the permafrost of the studied area is at a mean depth of 0.50 meter from the surface, sometimes even shallower. The presence of peat materials at the top of the stratigraphic column acts as an insulator layer, mantaining the low temperature of below very well. Vertical heterogenities in electrical resistivity were observed in all the profiles, which have been interpreted as the edges of the polygonal terrains (Fig. 2).

Drilling survey: A portable small driller *Cardi E-400* working with fuel was used in this expedition. It used 0.5 meter bits that joint each other to complete 5 meter long as maximum. The diameters of the bits and the recovery core were 50 mm and 40 mm respectively. No refrigerant substances were applied in order to preserve the area from contamination.

Drilling points were selected depending on the permafrost depth known from the tomographic data analysis. Three perforations were done all along the hill. The first core obtained, located in the tomographic line 5, was just about 1 meter deph. It consists of peat and brown silt with abundant organic matter. The permafrost started at 0.30 meters from the surface. The second core, drilled from the tomographic line 11, was 3.60 meters deph. The permafrost was taken at 0.55 meters. The peat cover was smaller. Below it, brown silt with organic matter was observed until 3.0 meters. From here to the core bottom the materials were green-yellowish silt. The third core was drilled close to the lake, and penetrated 2 meters deph. Permafrost was at 0.50 meters, the same lengh that the peat cover. Below we found the green-yellowish silt with crosswised lenses of both clean ice and organic silt. From this deph to the bottom the materials are basaltic pebbles inlayed in a silt matrix.

Samples were collected at several depths in the three holes for mineralogical, geochemical and biological analysis. They were *in situ* fixed with formaldehyde in order to be maintained till laboratory analysis were developed. Several growth fresh media were inoculated with samples from different depths in the field for microorganisms enrichment.

Acknowledgments: The 2005-expedition has been supported by Centro de Astrobiologia-INTA, Spain. We thank to the Bering Land Preserve staff (US National Parks) for their help, specially to Dr. Chris Young. OPB thanks to Alberto Lázaro Magro and Juanan for the training.

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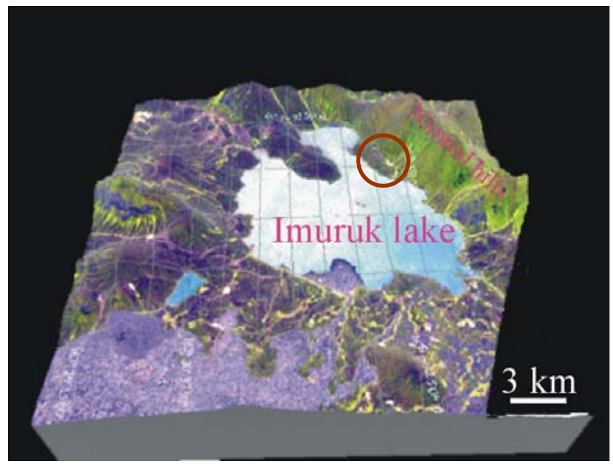

Figure 1. ASTER image from Imuk lake area. The studied area is marked by a red circle.

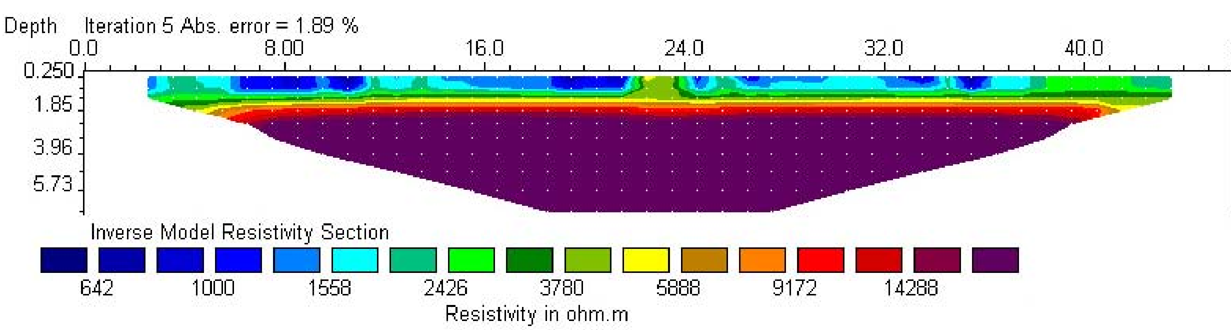

Figure 2. Tomographic line number 11. Blue colors show wet areas.Colors from green to yellow indicates low to medium material resistivities, characteric of wet sediments. Blue/green structure is related to ice-wedge polygons. Permafrost is registered from orange color around 1.5 meters. We took permafrost at lower deph drilling.