Tema (ponencia) núm. 1_. Se propone como presentación: __ oral / _X poster (marcar con X)

Geophysical survey carried out in the Hansbreen glacial front (Hornsund, SW Spitzberguen): Surface Nuclear Magnetic Resonance (SNMR), Magnetic Susceptibility of rocks and Electrical Resistivity facies: Permafrost identification and subglacial aquifers

Valenti TURU i MICHELS [(1)] & Xavier ROS VISÚS [(2)]
(1) Marcel Chevalier Foundation, Andorra la Vella, Principat d'Andorra, igeofundacio@andorra.ad
(2) GEO3 SL, Av. Príncep Benlloch 66, AD 500, Andorra la Vella, Principat d'Andorra

Key words: Geophyisic Survey, Magnetic Resonance Sounding, Electrical Resistivity, Permafrost, Subglacial Aquifer, Tidewater Glacier

We present here the results form a geophysical survey carried out on the front of a subpolar polythermal calving glacier in Spitzberguen (Hansbreen in Isbjörnhamna 77º00'N, 15º40'E). Spitzberguen is the main island of the Svalbard archipelago at the Arctic Ocean in front of Norway. A grant stancy at the Polish Polar Station by the Polish Academy of Science make possible the geophysical survey. Hansbreen glacier is a medium size (56 sq. Km) Svalbard tidewater glacier located in Hornsund. Vertical Electrical Soundings (VES) and Magnetic Resonance Soundings (MRS) were carried out in august-september 2009 (Turu 2012) on the ablation zone of the glacier.

In Hansbreen it has been observed that the ablation depends on daily mean and maximum air temperatures, but also in wind speed conditions (Migala et al. 2006) so the water flow through crevasses and moulins can change quickly from one day to other on the first 20 m depth; such water drains down until the glacier bottom through porous media (aquifer) or runoff to the glacier snout by interconnected cavities and subglacial tunnels. The goal of this study was to test MRS technique to identify aquifers beneath the glacier, nevertheless some conclusions can also be obtained about the frozen terrains in the glacier front from VES data.

Six electrical vertical soundings with an ABEM device (courtesy of the Faculty of Earth Sciences, Silesia University) were done on the glacier margins. One of them far away to test the resistivity of the basement rock out of the glacier influence. Also two resistivity measurements directy on the Hans glacier surface. In that sense the ice on the glacier front has an electrical resistivity six times lesser than the cold ice at the inner part of Hans glacier (12 Mega Ohms meter).

Permafrost at six meters depth has been recognized in the basement rock by the electrical resistivity data (200 – 400 Kilo Ohms m) near to the Polish Polar Station in Hornsund, also an 60 cm active layer (7.6 KOhms m) between half meter depth and one meter and half. Ice core moraines where identified following the fronto-lateral complex between Hansvika bay and the Fugleberget mountain; here half meter of sediment is above melting death ice from the recent retreat of Hansbreen (1984 – 2009) in this area. Interbedded permafrost (13 KOhms m) and death ice (300 KOhms m) has been identified in the first ten meters below sea level in the calving front beach of Hansbreen. An interconnected acquifer has been identified under this resistivity body using SNMR beneath the glacier and the lateral moraines.

In all cases the resistivity behaviour is KH type ($\rho 1 < \rho 2 > \rho 3 < \rho 4$) sometimes very sharp between the two last resistivities ($\rho 3$ & $\rho 4$), much more than 45º between the surface soil resistivity and the permafrost usualy observed on frozen soils (Haeberli, 1985). Because this kind of sharp contacts are also compatible with metallic mineralizations related with sulfides in metamortphic rocks, a Magnetic Susceptibility survey has been done in 2012, nevertheless the results of such survey do not identified any magnetic anomally in the Isbjörnhamna surrounding rocks. So to explain these sharp resistivity contacts a synthetic model has been computed, the results shows that is compatible with very high resistive patched bodies (ice or non-continous permafrost) embedded in a conductive layer (unfrozen sediment or bedrock).

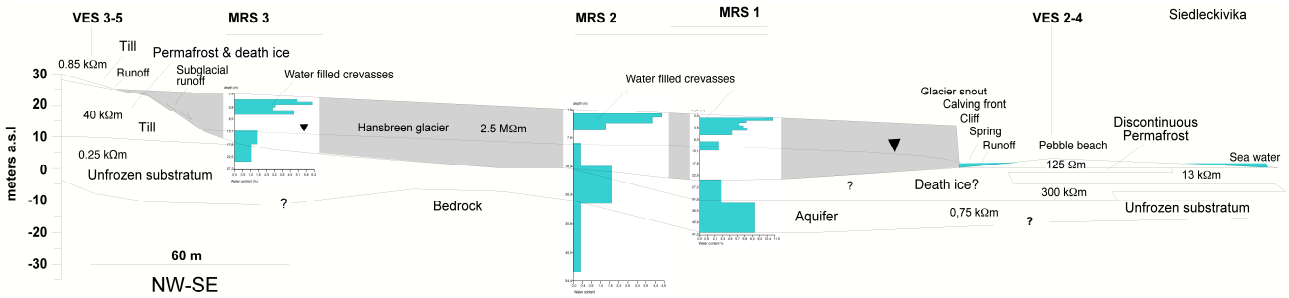

Figure 1: Interpreted profile of the western termination of the Hansbreen glacier in the Baranowskiodden cap

Haerbeli, W. (1985) *Creep of mountain permafrost: internal structure and flow of Alpine rock glaciers*. Mitt. Versuhchsanstalt für Wasserbau, Hidrologie un Glaziologie, ETH Zürich, 77, 142 pp

Migala, K.; Piwowar, B. & Puczko, D. (2006) A meterological study of the ablation process on Hans Glacier, SW Spitsbergen; *Polish Polar Research*, 27, 243-258

Turu, V. (2012) Surface NMR survey on Hansbreen Glacier, Hornsund, SW Spitsbergen (Norway); *Landform Analysis*, 21, 57-74