Geophysical Research Abstracts,
Vol. 11, EGU2009-9215, 2009
EGU General Assembly 2009

Conceptual design and first results of a combined electrical resistivity and induced polarization monitoring at the Aiguille du Midi rock permafrost summit (Mont Blanc Massif, French/Italian Alps)

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Monitoring of systemic changes in high mountain rock permafrost proves to be of increasing significance. The association with ongoing and future climate change raises the need for monitoring schemes to enable modelling of future scenarios. Due to the high degree of tourist utilisation and the good accessibility via cable car, the Aiguille du Midi represents the ideal premises to establish a long-term monitoring site. At 3842 m a.s.l. the steep granite summit offers access to all aspects in combination with persistent ice in the rock face and different rock mechanical settings. The geophysical monitoring presented here integrates into the framework of the French-Italian PERMAdataROC project and is presently considered for the EU co-funded project PermaNET (Permafrost long-term monitoring network: www.permanet-alpinespace.eu).

ERT and IP were conducted along three transects at the Aiguille du Midi in December 2008. Two transects were installed along galleries and in the rock faces that are accessible from the public platform at 3770 m a.s.l.. A further transect was installed by abseiling from the summit to the steep north and south face. The southern limb of the transect goes past the meteorological station installed in a vertical rock section. All transects were measured with a Syscal Pro device with high voltages of 800 V and we applied 48 steel electrodes per transect placed firmly in drilled holes. For optimum coverage we developed a high-resolution ERT protocol with approximately 3000 dipole-dipole measurements per array and 200 cross-borehole type measurements. Time domain IP was measured alongside to check chargeability of clefts with fine-grained fillings. Simultaneously, a survey of all important clefts was made to reference chargeability values. Both ERT and IP measurements were recorded in normal and reciprocal orientation and are used to define the error levels inherent in the measurements. A smoothness-constrained Occam's inversion is then adjusted to the specific error level. A granite sample from the study site was tested in the laboratory to reveal resistivity characteristics when freezing. ERT data can thus be validated by temperature data from temperature loggers and the meteorological station. It is intended to install fix wiring next summer to enable regularly measurements without climbing.