Geophysical Research Abstracts, Vol. 9, 08964, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-08964

Permafrost distribution in talus slopes located within the alpine periglacial belt

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In the context of a warmer climate, permafrost prospecting in steep sedimentary terrain is of great importance. However, talus slopes suffer from relatively few studies. In these landforms, parameters like permafrost distribution, ice contents or thermal regime are still badly known. For this reason, about 15 talus slopes of the western Swiss Alps were studied. On each landform, DC-resistivity measurements (VES and mapping) were carried out and systematically confronted with ground surface temperature measurements (BTS and year-round measurements). In most cases, permafrost was found in the lower part of the slope. At this place, electrical resistivities are the highest and ground temperatures are the coldest. The typical apparent resistivity curves display a resistive layer near the surface. Then, the resistivities decrease. A third thicker layer with higher resistivities can then be identified, before the values decrease again. The presence of a conductive layer (blocks supported by a fine-grained matrix) above the third layer is an argument to interpret this one as frozen sediments. Another argument is the shape of the curves, which is typical for permafrost in coarsy sediment terrain. It corresponds to what is generally measured on rock glaciers. The difference is the resistivity of the third layer, which is generally higher in rock glaciers than in talus slopes. Higher in the slope, permafrost is generally absent. Electrical resistivities gradually decrease, up to the disappearance of the third resistive layer. BTS values warm up and get close to 0°C. In some cases, they even get positive. Due to security reasons (blocks falls, avalanches), data is rarer in the uppermost part of the slopes. However, one can observe that, in some cases, resistivities are a bit higher than in the middle part of the slopes. In parallel, BTS values are a bit colder. This shows that permafrost may be present in the uppermost part of some talus slopes, directly at the base of the head walls. Some studies have shown that internal air circulations (chimney effect) are responsible for the overcooling of the ground and, in some cases,

for the presence of permafrost in the lower part of talus slopes located more than 1000 m below the regional lower limit of discontinuous permafrost. Numerous data of this study show that this mechanism is also active in the discontinuous permafrost belt, at different degree. This is probably one of the major factors which can explain the presence of permafrost in the lower part of the slopes and its absence in the upper part, in addition to the redistribution of snow by avalanches, that protects the ground against summer warming and the presence of coarse blocks at the foot of the talus, that favour the ground cooling.