Geophysical Research Abstracts,
Vol. 10, EGU2008-A-05158, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-05158
EGU General Assembly 2008

Geochemical evidence for groundwater-charging of slope sediments: The Nice airport 1979 landslide and tsunami revisited

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In October 1979, a period of heavy rainfall along the French Riviera was followed by the collapse of the Ligurian continental slope adjacent to the international airport of Nice, France. A body of slope sediments, which was shortly beforehand affected by construction work south of the airport, was mobilized and traveled hundreds of kilometers downslope into the Var submarine canyon and, eventually, into the deep Ligurian basin. As a direct consequence, the construction was destroyed, seafloor cables were torn, and a small tsunami hit the Gulf of Antibes shortly after the failure.

Several hypotheses have been put forward to explain the trigger mechanism of the landslide. They include (i) construction of an embankment south of the airport added extra load on the slope sediments, (ii) failure of a layer of sensitive clays within the slope sequence, and (iii) excess pore fluid pressures from charged aquifers in the underground. Over the previous decades, both the sensitive clay layers and the coarse-grained sand and gravel layers of high permeability were sampled. One layer of gravel is particularly critical, since its pore water chemistry showed significant freshening.

During recent RV Meteor cruise M73-1 (summer 2007), the landslide scar and adjacent slopes were revisited for high-resolution mapping and sampling systematically. Results from half a dozen gravity and push cores in the shallow slope area reveal that the zone of freshening (i.e. groundwater influence) is very limited in extension. Along strike of the margin, an only 100-250 m wide zone shows pore waters with salinities of 5-50% SW concentration and depletion in other constituents (e.g. Cl, Fe, sulfate).

Cores east or west of the landslide scar in the undisturbed slope show regular seawater (SW) profiles. Most interestingly, the three cores inside the landslide scar hint towards two potential source areas for the groundwater, because two cores show extremely high concentration of Cr (0.2-0.25 mg/l) whereas the third core shows SW Cr concentration. Ongoing analyses try to identify other elements that allow us to distinguish between the different sources of groundwater. The understanding of the aquifer system, possibly aided by water analyses from onshore wells, may help assess the risk of future slope failure in the Var estuary/Nice airport area.