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Isotopic analysis and multi tracer tests to study groundwater circulation in a landslide in Southern Alps

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Understanding groundwater circulation in landslides is often necessary to assess their dynamics and forecast movements. Fontana landslide is placed in Canton Ticino, its main body is constituted by gneiss, that is covered by moraine and other deposits related to the mass movements like debris flows and, rock fall. Gneiss that originally has low hydraulic conductivity increases their aquifer properties due to weathering and fracture presence. In fact several springs are present in across the landslide some of them having discharge up to 1 m3 S-1.

To study groundwater circulation in the landslide body, a multi tracer test was designed and water samples taken. 3 tracers (Naphtionate, Sulphorhodamine B and Uranine) were injected underground. Injection mass was calculated by using EHTD (EPA, 2003), 2 field fluorimeters were placed in springs considered to be the main water discharge of the system for continuous monitoring. Other springs with smaller discharge scattered along the landslide body were monitored by using charcoal bags. Water samples also were taken for chemical and stable isotopes analysis. The tracers' presence was also monitored in the river crossing the area collecting surface flow from snowmelt and springs.

Even if the landslide has a small area, isotopic composition of water from springs shows clear differences. All samples plot close to the local meteoric water line, and an altitude effect is visible. Chemical composition is relatively uniform however some differences can also be seen. Concerning tracers the only that arrived at monitored points was uranine, and it was detected in the charcoal bags. Considering tracer concentration in ppm, in the charcoal and travel times to restitution points was possible to have conceptual model for groundwater flow across the landslide. Circulation is rapid and recharge controlled by snowmelt in spring and precipitation in late spring to autumn. Snow accumulates at the top of the landslide where an elongated topographic basin is present filled by blocks infiltrates and feed the springs located at lower altitude but close to the basin. Those springs not originally considered for discharge monitoring, are draining the water from the basin and could be better correlated to landslide movement, respect to other springs with similar discharge rates but farther from the concentrated infiltration area represented by the topographic basin.