

Deep-seated gravitational slope deformations in the Vinschgau (northern Italy) and their association with springs and speleothems

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Several springs along the lower section of the south-facing slope (Sonnenberg) of the central Vinschgau (Val Venosta) are supersaturated with respect to calcite/aragonite and/or iron oxyhydroxides, and carbonate precipitation occurs locally as tufas and flowstones. These springs occur along the toe of a deep-seated gravitational slope deformation (DSGSD) showing characteristic morphological features including double-ridges, trenches and counterscarps in its upper section.

The Sonnenberg DSGSD developed in a complex structural setting, involving the low-angle Schlinig normal fault. Strongly fractured orthogneisses and intercalated paragneisses constitute the host rock whose foliation dips into the slope (20-40°) and strikes NNE-SSW to E-W.

Secondary carbonate deposition is strongly connected to the presence of open fractures near the toe of the slope where calcite and aragonite flowstones formed as a result of strong evaporation (Spötl et al. 2002). These waters have mean residence times up to several decades, profoundly interacted with the strongly fractured basement rocks and are part of a large groundwater flow system controlled by the DSGSD. Recharge occurs in the uppermost area of the mass movement above ~1900 m a.s.l. and discharges near the toe of the slope and/or directly into the extensive alluvial valley fill. Recent seismic investigations show a significant displacement of the bedrock and an interdigitation with alluvial sediments up to 100 m below the surface (Maraio et al. unpublished).

U-Th dating of flowstone samples was carried out to constrain the chronology of these mass movements. Flowstone deposition along the toe of the slope started during the Late Glacial period (from ca. 14.2 ka BP) and occurred continuously throughout the Holocene. Thus, gravitational displacements likely commenced soon after the deglaciation. This is consistent with observations from the nearby Mt. Watles DSGSD, where radiocarbon dates suggest a similar timing of the onset of these movements (Agliardi et al. 2009).

Agliardi, F., Crosta, G.B., Zanchi, A., Ravazzi, C., 2009: Onset and timing of deep-seated gravitational slope deformations in the eastern Alps, Italy. *Geomorphology*, 103, 113–129.

Spötl, C., Unterwurzacher, M., Mangini, A., Longstaffe, F.J., 2002: Carbonate speleothems in the dry, inneralpine Vinschgau Valley, northernmost Italy: Witnesses of changes in climate and hydrology since the Last Glacial Maximum. *Journal of Sedimentary Research*, 72, 793–808.