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Constraining the temporal distribution of giant landslides in the Alps with cosmogenic nuclides: the Flimser Bergsturz

S. Ivy-Ochs (1,2), A. von Poschinger (3), H.-A. Synal (4), and M. Maisch (2)

(1) Teilchenphysik, ETH-Hönggerberg, CH-8093 Zürich, Switzerland, (2) Geographisches Institut, Universität Zürich-Irchel, CH-8057 Zürich, Switzerland, (3) Bayerisches Geologisches Landesamt, 80797 München, Germany, (4) Paul Scherrer Institut c/o Teilchenphysik, ETH-Hönggerberg, CH-8093 Zürich, Switzerland

The initial view was that many of the giant landslides (long-runout rock avalanches) in the Alps took place in the late Glacial. The idea was that valley walls were undercut by glaciers during the Last Glacial Maximum, then debuttressing following downwasting of the glaciers led to collapse of the oversteepened walls. Subsequent absolute dating has shown that many of the large landslides actually occurred in the Holocene, especially in the early Holocene, in contrast to the assumed late Glacial age. That implies that the abrupt marked temperature increases in the early Holocene led to increased slope instabilities. To fully understand cause and effect relationships of the giant landslides their ages must be known. The results of ^{36}Cl surface exposure dating presented here come from the Flims and the nearby smaller Tamins landslides (Graubünden, Switzerland). They involved the catastrophic downslope movement into the Rhine valley of 8-12 km^3 and 1.0-1.6 km^{3}of Helvetic limestones, respectively. We are investigating a suite of samples from various morphologic settings related to both slides, including boulders on top of the main landslide debris masses as well as bedrock so-called sliding planes. In addition to the more commonly seen effects that lead to a 'too young' apparent age (among others, weathering of boulder surfaces and exhumation of boulders), boulders from landslides may contain an inherited nuclide component making an apparent exposure age 'too old'. This may be related to the emplacement mechanism of long-runout slides, in detail, for example, the phenomenon of huge boulders riding on top of the slide mass. Some boulders may originate from the outermost parts of the pre-slide bedrock walls, as witnessed, for example, by the

presence of several glacially-polished boulders in the landslide deposits at Koefels (Austria). Similarly, sediment packets can be apparently scooped up and incorporated or transported “piggy-back” style by the moving landslide mass. The fact that the Flims landslide is believed to have occurred around 8200 ^{14}C yr BP gives us the opportunity to examine these possibilities. There is no independent age control for the Tamins landslide. Indeed, whether it is older, younger, or roughly the same age as the Flims slide is under debate. Surface exposure ages for both boulders and bedrock surfaces will be presented and discussed in light of possible influences on the exposure duration of the surfaces.