Surface exposure dating of large landslides in the European Alps: Wildalpen (Styria, Austria)

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We are surface exposure dating boulder and bedrock surfaces from large prehistoric landslides in the Alps. In addition to determining the ages for landslides whose ages are unknown, we are examining cosmogenic nuclide production rates based on results from landslides with independent age constraints. We focus on ^{10}Be, ^{26}Al in crystalline regions with abundant quartz, while ^{36}Cl is used in areas underlain by calcareous rocks. Potential complications include pre-exposure, post-slide rock fall, and shielding by soil or snow, as well as weathering of boulder surfaces. Here we focus on the Wildalpen landslide in the Hochschwab region of Styria (Austria). The Wildalpen landslide involved the movement of about one cubic kilometer of Wettersteinkalk, with a run-out of 12 km. Radiocarbon dating of trees entrained in the slide point to an age of about 6 ka cal BP [1]. We sampled and analyzed ^{36}Cl in ten boulders from three different parts of the slide mass. ^{36}Cl exposure ages and production rates calculated based on the formalism presented by Alfimov and Ivy-Ochs [2] will be discussed.

[1] van Husen and Fritsch (2007) *Jahrbuch der geologischen Bundesanstalt* **147**, 201-213. [2] Alfimov and Ivy-Ochs (2009) *GCA*, this volume.

$\delta^{53}Cr$ mixing, fractionation and exchange in contaminant plumes

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Cr (VI) concentrations in contaminant plumes in alkaline, oxic aquifers in the Mojave Desert near Topoc, Hinkley, and El Mirage, Calif., were as high as 6,600, 2,600 and 330 µg/L, respectively. $\delta^{53}Cr$ compositions from more than 50 samples collected within these plumes ranged from near 0 per mil to almost 4 per mil near the plume margins. Assuming only reductive fractionation of Cr (VI) to Cr (III), apparent fractionation factors (α) for Cr-52 and Cr-53 isotopes were 0.993 within the Topoc and Hinkley plumes, and only the El Mirage plume had an α value similar to the laboratory derived value of 0.9965. One possible explanation for the difference in fractionation factors is advective mixing near the plume margin prior to reductive fractionation. All three plumes show evidence of mixing of native and contaminated ground water near the plume margin and subsequent reductive fractionation. Only the El Mirage plume had significant Cr (III) concentrations, comprising as much as 20 percent of the total dissolved chromium, within the core of the plume that were indicative of chromium reduction prior to mixing with native ground water. In addition to advective mixing of native and contaminated water, $\delta^{53}Cr$ data suggest that exchange of dissolved Cr (VI) with Cr (VI) sorbed to the surfaces of the mineral grains altered the $\delta^{53}Cr$ composition of the sorbed chromium. As a consequence of exchange reactions, $\delta^{53}Cr$ compositions near 0 per mil were present in areas having low (background) Cr (VI) concentrations that had been previously exposed to contaminated water.