LOCALIZED CEMENTATION OF CARBONATE-LITHIC ROCKSLIDE DEPOSITS: PREREQUISITE TO $^{234}U/^{230}TH$ PROXY-DATING THE MASS-WASTING EVENT

Diethard Sanders[1], Christoph Prager[2], Marc Ostermann[1], Jan Kramers[3], and Ulrich Haas[4]

[1] Institute of Geology and Palaeontology, University of Innsbruck, A-6020 Innsbruck, Austria.
[2] alpS Center for Natural Hazard Management Innsbruck, Grabenweg 3, A-6020 Innsbruck, Austria.
[3] Institute of Geological Sciences, University of Berne, CH-Baltzerstr. 1-3, Switzerland
[4] Bayerisches Landesamt für Umwelt, Lazarettstr. 67, D-80636 München, Germany

Carbonate-lithic rockslide deposits are locally lithified by calcium carbonate cements that can be used for $^{234}U/^{230}Th$ proxy-dating the mass-wasting event.

Age determination of rockslides traditionally is done by ^{14}C-dating of organic remnants that (1) are present in sediments overridden by the rockslide (maximum 'half-bracket age' of event), (2) are trapped within the rockslide debris (proxy for event age), and (3) that were deposited in rockslide-dammed backwater deposits or lakes situated atop the rockslide mass (minimum 'half-bracket age' of event). Since the last 10–15 years, surface exposure dating of detachment scarps and rockslide boulders by cosmogenic radionuclides (CRN) provides an ideal method to directly date the mass-wasting event. Ages deduced by CRN are analytically laborious and, in some cases, still are fraught with substantial 2σ-error ranges. During investigation of the Fern Pass rockslide, Austria (Prager et al., 2006a), portions of the deposit were found cemented by aragonite and calcite. An early aragonite cement was dated to 4150 ±100 yrs by the $^{234}U/^{230}Th$ disequilibrium method (Ostermann et al., 2007). For the Fern Pass rockslide, two ^{36}Cl exposure data of the detachment scar fully overlap with this age (Prager et al., 2006b). For this rockslide event, the determined $^{234}U/^{230}Th$ age is the most precise proxy age thus far. Combining the 'directness' of exposition dating with the precision, rapidity, comparatively low cost and easy field sampling of U/Th dating may be ideal to achieve better age determination of mass-wasting events.

Localized cementation is fairly common in carbonate-lithic sturzstrom deposits. Carbonate-rock flour produced by dynamic disintegration during rockslide movement undergoes vadose dissolution, followed by nearby reprecipitation as cement in near-surface levels of the rockslide mass. Because rock flour is most abundant and most reactive immediately after the event, the U/Th age of early-formed cements should be close to event age in most cases. Alternatively, the rockslide mass is percolated deeper within by groundwater, resulting in precipitation of cement in deeper levels in the deposit. Both styles of cementation are not mutually exclusive. The approach to proxy-date rockslides by the U/Th method seems promising. Excavation of comparatively small cement-bearing samples for U/Th dating is easy, and dating can be conducted fairly rapidly and inexpensive. The U/Th approach thus may be particularly suited for proxy-dating carbonate-lithic rockslides of remote locations.

Ostermann, M., Sanders, D., Prager, C. & Kramers, J., 2007, Aragonite and calcite cementation in 'boulder-controlled' meteoric environments on the Fern Pass rockslide (Austria): implications for radiometric age-dating of catastrophic mass movements. – Facies, DOI 10.1007/s10347-006-0098-5 (Springer, Berlin).

Prager C., Krainer K., Seidl V. & Chwatal W., 2006a, Spatial features of Holocene sturzstrom-deposits inferred from subsurface investigations (Fernpass rockslide, Tyrol, Austria). – Geo.Alp, 3, 147–166 (Innsbruck).

Prager, C., Patzelt, G., Ostermann, M., Ivy-Ochs, S., Duma, G., Brandner, R. & Zangerl, C., 2006b, The age of the Fernpass rockslide (Tyrol, Austria) and its relation to dated mass movements in the surroundings. – Pangeo Austria 2006, Innsbruck Univ. Conf. Series, 258–259 (Innsbruck).