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Age-dating of rockslides: Methods and limitations

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Age-dating of deposits of catastrophic rockslides is prerequisite to unravel the potential relation between the frequency of mass-wasting events with climatic change or earthquakes. In the Alps, about 250 rockslides exceeding 10^6 m^3 in volume are known, but the age as yet is determined only for a comparatively small number of events. For age determination of rockslide events, different methods are available (e. g. Lang et al., 1999).

Radiocarbon Dating

In the past few decades, rockslide deposits commonly were proxy-dated by ^{14}C age determination of organic remnants preserved (a) in glacial, fluvio-glacial sediments overridden by the rockslide, (b) within the rockslide mass, or (c) in rockslide-dammed backwater deposits or lakes situated atop the rockslide mass. In each case, the ^{14}C age provides a different constraint on the age of the rockslide event: in case (a), the ^{14}C age represents a maximum age of the event; in case (b), which is quite rare, the ^{14}C age is generally considered as a good proxy of the event age; in case (c) the ^{14}C age represents a minimum age for the rockslide event. Unfortunately, radiocarbon dating often cannot be applied because of absence of suited deposits or exposures thereof, lack of organic remnants or of remnants suited for age-dating, and/or because determined ^{14}C ages are substantially biased.

Optically Stimulated Luminescence (OSL)

Proxy-dating of rockslide events by OSL can be applied to silt- to sand-sized quartzose sediments present (a) directly below, (b) within, or (c) above/laterally aside a rockslide mass. For each case (a) to (c), the determined ages are subject to the same constraints as outlined for radiocarbon dating. Unfortunately, situations allowing for application of OSL to rockslide event dating are comparatively rare, and the resulting ages tend to have a wide error range.

Surface Exposure Dating with cosmogenic radionuclides

Surface exposure ages can be determined for rock samples taken from the sliding planes at the rockslide scarp, and/or taken from boulders accumulated at the surface of rockslide deposits. Surface exposure dating is the only 'direct' approach to determine the age of a rockslide event. To date, however, exposure dates are fraught with comparatively large error ranges.

$^{234}U/^{230}Th$ Dating

U/Th dating of diagenetic carbonate cements formed within rockslide masses represents a new method for proxy age determination. Breccias formed by precipitation of carbonate cements within rockslide deposits are fairly common. U/Th dating of the diagenetic cements can provide a good proxy of rockslide event age. U/Th ages are cementation ages, not event ages; to minimize the error, it is thus important to detect petrographically early cement, and (if necessary) to produce multiple U/Th ages from different samples. A major advantage of U/Th dating of cement is rapid, easy extraction of numerous samples of comparatively small size. Combined with other methods of numerical age determination, U/Th dating of cements in lithified rockslide deposits thus provides an indepedent check of correctness, and may enhance the overall precision of determination of event age (Ostermann et al., 2007, Prager et al., 2009).

Lang, A., Moya, J., Corominas, J., Schrott, L. & Dikau, R., 1999: Classic and new dating methods for assessing the temporal occurrence of mass movements. Geomorphology, 30, 1, 33-52.

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