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Regional ^{10}Be production rate calibration for the past 12 ka deduced from two radiocarbon-dated rock avalanches at 69° N, Norway

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Cosmogenic ^{10}Be is an ideal nuclide to use for surface-exposure age-dating in natural-hazards and climate-change research in northern Norway, particularly because many landslides and glacial landforms in the region contain quartz-rich lithologies. Here, we present data establishing the first regional ^{10}Be production rate calibration for northern Norway, in the Troms county region. Systematic natural-calibration of production rates of different terrestrial cosmogenic nuclides, including ^{10}Be, was one of the main goals set by the CRONUS-EU research network, and was the driving force behind this project.

Two rock avalanches in Troms County –the Grøtlandsura and Russenes – were selected as CRONUS-EU natural cosmogenic ^{10}Be production-rate calibration sites because they (a) preserve large boulders that have been continuously exposed to cosmic irradiation since their emplacement; (b) contain boulders with abundant quartz phenocrysts and veins with low concentrations of naturally-occurring 9Be (typically < 1.5 ppb); and (c) have reliable radiocarbon ages of 11424 ± 108 yr BP and 10942 ± 77 yr BP (1-sigma; Oxcal 4.1), respectively. BP is by convention regarded as years prior to 1950, and the radiocarbon ages are thus corrected to 2006 – the sampling year – for the purposes of calculating ^{10}Be production rates in our study. Quartz samples (n=6) from these two sites contained between 4.41×10^4 and 5.10×10^4 at ^{10}Be/g when normalized to the ETH's S555 standard and scaled with Lal (1991)/Stone (2000) in CosmoCalc (Vermeesch, 2007). Determination of these ^{10}Be concentrations accounts for isostatic rebound and shielding from snow and moss cover. Using the ^{10}Be half-lives of (1) 1.36 Myr (Nishiizumi et al., 2007), (2) 1.387 Myr (Chmeleff et al., 2009; Korschinek et al., 2009), and (3) 1.51 Myr (Hofmann et al., 1987), we calculate preliminary weighted mean total ^{10}Be production rates of (1) 4.07±0.31, (2) 4.16±0.32, and (3) 4.52±0.34 at/g/yr (2-sigma), respectively. These are in agreement within uncertainty with other ^{10}Be production rates in the literature, but are nominally lower than previous average global ^{10}Be production rates. Like other studies, our research concludes that regional cosmogenic production rates should be used for determining exposure ages of landforms in order to increase the accuracy of those ages. As such, using the total 10Be production rate from our study calculated with the 1.387 Myr ^{10}Be half-life, we determine a weighted mean surface-exposure age of a third rock avalanche in Troms County (the Hølen avalanche) to be 7.5±0.4 kyr. This age suggests that the avalanche occurred shortly after the 8.2 kyr cooling event, just as the radiocarbon ages of the Grøtlandsura and Russenes avalanches confirm field evidence that those rock-slope failures occurred shortly after deglaciation.