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Can subglacial processes reset the luminescence of basal sediment?

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Analysis of the natural luminescence of basal sediment from Haut Glacier d'Arolla, Switzerland (Swift et al., under revision) has revived speculation that erosion and/or sediment transport in the subglacial environment may constitute effective luminescence resetting mechanisms. The plausibility of these resetting mechanisms rests on the presumption that luminescence signals can be reset if sediment grains are exposed to sufficient stress. The ice-bedrock contact zone of active glacial systems and the shear zones of active fault systems have been cited as environments where shearing has the potential to reset luminescence; however, laboratory studies that have investigated the effects of shearing on luminescence have produced conflicting results. We present the first results from a laboratory-based project that aims to determine the efficacy of resetting in the subglacial environment by shearing sediment under conditions representative of the ice-bedrock contact zone of active glacial systems. Preliminary luminescence data will be shown from an initial experiment that aims to quantify the effect of shearing on the luminescence of quartz. Homogenous medium-sand was obtained for the experiment from relict dune systems that possess substantial natural luminescence (we anticipate that glacial sediments with a wider range of grain sizes will be used in later experiments). Shearing was conducted using a state-of-the-art ring-shear apparatus using an imposed normal stress of 50 kPa at a shearing rate of 1 mm per minute for a distance of $\sim$ 1200 mm, with samples for luminescence analyses taken from the shearing zone at pre-defined intervals. It is anticipated that further experiments using a range of imposed normal stresses and further analyses of changes in the luminescence and surface microtexture of grains in specific grain-size fractions will elucidate and quantify the specific nature of the resetting mechanism.

Swift, D.A., Sanderson, D.C.W., Nienow, P.W., Bingham, R.G. and Cochrane, I.C. Under Revision. Luminescence investigation of subglacial sediment at Haut Glacier d'Arolla, Switzerland. Quaternary Geochronology.