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Luminescence rock surface profiles from moraine boulders: useful for dating and transport histories

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The dating of moraine deposits presents a challenge to the readily available methods; cosmogenic nuclide (CN) or radiocarbon dating suffer from problems of inheritance, intermittent cover/exposure and/or lack of suitable (organic) material. Rock surface Luminescence burial Dating (RLD) offers an alternative approach, and has considerable potential in the dating of moraines. In RLD large cobbles or boulders are targeted, rather than the sand-sized or smaller grains normally used in luminescence dating. The principle advantage of this approach is that large consolidated clasts internally record the degree of bleaching prior to burial; this can be unambiguously identified by the shape of the luminescence-depth profile and provides confidence in the degree of signal resetting prior to deposition.

For the technique to be practical, a sufficiently large fraction of moraine boulders must be exposed to enough light to completely reset the surface layer(s), so that there is an acceptable probability of sampling such clasts. Field criteria for increasing this success rate are also very desirable. The main factors influencing the suitability of boulders for dating will include (i) the length of the pre-burial exposure to daylight, and (ii) the possible subsequent erosion of the profile, either during transport or after deposition. These factors are presumably linked to their transport path in the glacial environment and hereby to a specific shape of the clast (1)

In this study we sampled a broad selection of mostly granitic boulders of various sizes and shapes (e.g. different angularities and sphericities) from the Vimmerby moraine, a prominent and fairly accessible feature in southern Sweden that has been dated using CN to 14.4 $\pm$ 0.9 ka (2). This sampling was designed to test whether these characteristics can be used to discriminate in favour of the most light-exposed boulders, and so minimize measurements of non-exposed boulders. Despite the apparently successful CN study, the luminescence-depth profiles measured in the buried surfaces of the sampled clasts indicate that >50% of these moraine boulders were exposed to light before final deposition, implying some (presumably small) CN inheritance; 9 of the 15 boulders identified as light exposed were sufficiently bleached to be useful for RLD, amounting to >30% of the sampled material. Here we discuss the correlation of luminescence signal bleaching with boulder size and shape. The potential of rock surface luminescence profiles to explore glacial transport pathways are also outlined.

1 S. Lukas et al., Earth-Science Reviews. 121, 96–116 (2013).
2 T. F. Johnsen, H. Alexanderson, D. Fabel, S. P. H. T. Freeman, Geografiska Annaler, Series A: Physical Geography. 91, 113–120 (2009).