Quaternary Geochronology 35 (2016) 67–68

Contents lists available at ScienceDirect

Quaternary Geochronology

journal homepage: www.elsevier.com/locate/quageo

Schmidt hammer exposure dating (SHED): Calibration boulder of Tomkins et al. (2016)

J.M. Dortch*, P.D. Hughes, M.D. Tomkins

Department of Geography, School of Environment, Education and Development, University of Manchester, Cryosphere Research At Manchester, Manchester M13 9PL, United Kingdom

A R T I C L E   I N F O

Article history:
Available online 7 June 2016

For the Quaternary community to test and utilize the SHED curves presented in Tomkins et al. (2016) and to develop their own calibration curves, SHED R Values need be standardized. When applying SHED to undated surfaces, Schmidt hammer calibration should be undertaken on a surface with a known R Value by taking the average of 30 R Values without rejecting any values. This procedure should be used for all surfaces dated in a study and should be repeated after data collection to determine any change in Schmidt hammer functioning.

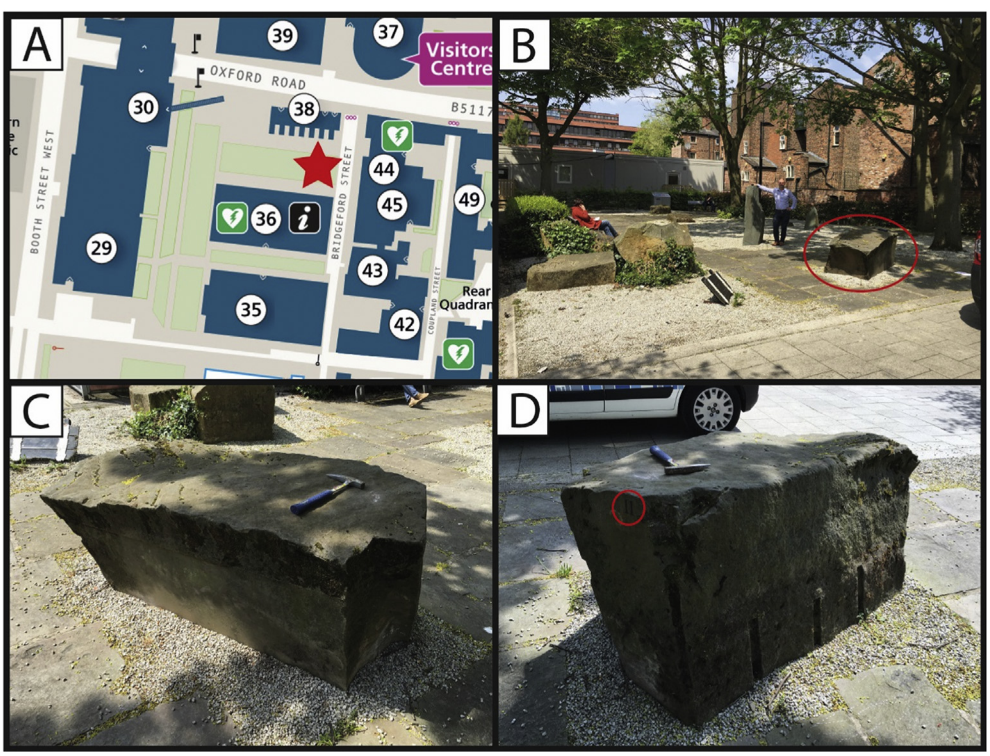

Fig. 1. A) Red star denotes the location of the rock garden. B) Location of the SHED calibration boulder. C &D) Views of the sandstone calibration boulder. Red circle shows etched #11. Rock hammer for scale. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

* Corresponding author.
E-mail address: jason.dortch@manchester.ac.uk (J.M. Dortch).

http://dx.doi.org/10.1016/j.quageo.2016.06.001

The best methods for robust calibration include:

1) The researcher calibrating a Schmidt hammer on the top surface of the University of Manchester calibration boulder (best method);
2) Mail your Schmidt hammer to the corresponding author who will send the data and Schmidt hammer back (note: this does not account for operator variance);
3) Locate one of the 98 boulder or bedrock surfaces reported in Tomkins et al. (2016) and use it as a calibration point. In this case the researcher must be confident that they are using the exact same boulder or bedrock surface from where the R Value was obtained by Tomkins et al. (2016, Table 2). Whilst this approach is feasible, we advocate caution since replicating the precise same surface may sometimes be difficult.

The University of Manchester calibration boulder is a 1.8 m-long × 0.7 m-wide × 0.7 m-high block of Doddington Sandstone ≥340 Ma that was quarried at Doddington Hill, near Wooler in NE England, and transported to the University of Manchester c. 30 years ago (John Nudds pers.com). The boulder is located at 53°27′60.0″N, 2°14′05.9″W on Bridgeford Street between the Arthur Lewis Building (# 36 on campus map) and Waterloo Place (#38) in a rock garden and engraved as #11 (Fig. 1). The boulder is a white sandstone that is now buff to tan coloured due to urban pollution and has red streaks due to iron staining. Cross-stratification is visible on both the weathered and cut surfaces.

Acknowledgements

We would like to thank Dr. John Nudds for information on the origin of the boulder.

Reference

Tomkins, M., Dortch, J., Hughes, P.D., 2016. Schmidt hammer exposure dating (SHED): establishment and implications for the retreat of the last British Ice Sheet. Quat. Geochronol. 33, 46–60.

Quaternary Geochronology 36 (2016) 102–103

Contents lists available at ScienceDirect

Quaternary Geochronology

journal homepage: www.elsevier.com/locate/quageo

Inappropriate instrument calibration for Schmidt-hammer exposure-age dating (SHD) – A comment on Dortch et al., Quaternary Geochronology 35 (2016), 67–68

In their short note published in Quaternary Geochronology 35 (2016), 67–68, Dortch et al. state that in order to develop and use Schmidt-hammer exposure-age dating (SHD) calibration curves, R-values (rebound-values) need to be ‘standardised’. To achieve this, they advocate taking R-value measurements (sample size, n = 30, without rejecting any outliers) from the surface of a block of Doddington Sandstone located in the rock garden of the University of Manchester before and after data collection. This follows up their use of this procedure in Tomkins et al. (2016).

Their recommendation is inappropriate because it ignores well-established procedures as well as manufacturer's guidelines. They correctly recognise the need for proper Schmidt-hammer instrument calibration. Instrument calibration guidelines and procedures do, however, already exist (McCarroll, 1987, 1994; Proceq, 2004; Aydin, 2009). Furthermore, their term ‘standardised R-values’ creates confusion as it does not differentiate clearly between Schmidt-hammer calibration (i.e. instrument calibration) and converting R-values into age information when developing a SHD-calibration curve. In this context, the type, specification, and manufacturer of the instrument should have been mentioned.

Tomkins et al. (2016) used the mechanical N-type Schmidt-hammer. Proceq, the original Swiss manufacturer of these instruments, specifies that the plunger of an N-type hammer will bounce onto a rock surface with an impact energy of 2.207 Nm (Proceq, 2004). If correctly calibrated, the instrument will yield R-values in the range of 81 ± 2 when tested on the manufacturer's test anvil. Calibration tests using test anvils can be performed at certified service centres authorised by the manufacturer (where, if necessary, the instrument can be cleaned, adjusted, and repaired). Alternatively, an individual test anvil can be purchased for the use in the field. It is a well-established fact that intense use of the Schmidt-hammer requires frequent testing to ensure the hammer remains perfectly calibrated within the acceptable tolerance range given by the manufacturer. Correct calibration ensures that an instrument yields the same R-values on an identical rock surface even after hundreds and possibly thousands of impacts, independent of the rock type or the surface exposure age. Although Schmidt-hammers have been shown to be very robust and reliable instruments, after many thousands of impacts instruments may deviate from the acceptable calibration range. Such deviation needs to be addressed by correcting R-value raw data before further use. Recent applications of the Schmidt-hammer use test anvils routinely for these purposes (e.g. Shakesby et al., 2006; Rode and Kellerer-Pirklbauer, 2011; Stahl et al., 2013; Winkler and Matthews, 2014).

By contrast to this instrument calibration, construction of a calibration curve for dating purposes requires the conversion of R-values into exposure ages by using control points from surfaces of known age (independently dated) of the same local rock type. We can't see how the use of the block of Doddington Sandstone would contribute to this process in any way. “Standardisation” of R-values is irrelevant for the construction of these calibration curves because their accuracy relies on the quality of those specific control points and a consistent sampling design throughout data collection.

Finally, we wonder why neither Dortch et al. (2016) nor Tomkins et al. (2016) even mention the already well-established procedures of Schmidt-hammer calibration using a test anvil. Their suggested use of the Doddington Sandstone block is unnecessary, impractical (test anvils and authorised calibration centres are available in most countries), and less accurate (micro-scale inhomogeneity of the sandstone, potential wear following repeated impacts, etc.). The real potential of Schmidt-hammer exposure-age dating should not be undermined in this way.

References

Aydin, A., 2009. ISRM suggested method for determination of the Schmidt hammer rebound hardness: revised version. Int. J. Rock Mech. Min. Sci. 46, 627–634.
Dortch, J.M., Hughes, P.D., Tomkins, M.D., 2016. Schmidt hammer exposure dating (SHED); Calibration boulder of Tomkins et al. (2016). Quat. Geochronol. 35, 67–68.
McCarroll, D., 1987. The Schmidt hammer in geomorphology: five sources of instrument error. Br. Geomorphol. Res. Group Tech. Bull. 36, 16–27.
McCarroll, D., 1994. The Schmidt Hammer as a measure of degree of rock surface weathering and terrain age. In: Beck, C. (Ed.), Dating in Exposed and Surface Contexts. University of New Mexiko Press, Albuquerque, pp. 29–45.
Proceq, 2004. Operating Instructions Betonprüfhammer N/NR- L/LR. Proceq SA, Schwerzenbach.
Rode, M., Kellerer-Pirklbauer, A., 2011. Schmidt-hammer exposure-age dating (SHD) of rock glaciers in the Schöderkogel-Eisenhut area, Schladminger Tauern Range, Austria. Holocene 22, 761–771.
Shakesby, R.A., Matthews, J.A., Owen, G., 2006. The Schmidt hammer as a relative-age dating tool and its potential for calibrated-age dating in Holocene glaciated environments. Quat. Sci. Rev. 25, 2846–2867.
Stahl, T., Winkler, S., Quigley, M., Bebbington, M., Duffy, B., Duke, D., 2013. Schmidt hammer exposure-age dating (SHD) of late Quaternary fluvial terraces in New Zealand. Earth Surf. Process. Landf. 38, 1838–1850.
Tomkins, M.D., Dortch, J.M., Hughes, P.D., 2016. Schmidt hammer exposure dating (SHED), establishment and implications for the retreat of the last British Ice. Quat. Geochronol. 33, 46–60.
Winkler, S., Matthews, J.A., 2014. Comparison of electronic and mechanical Schmidt hammers in the context of exposure-age dating: are Q- and R-values interconvertible? Earth Surf. Process. Landf. 39, 1128–1136.

http://dx.doi.org/10.1016/j.quageo.2016.08.009

Stefan Winkler*
Department of Geography and Geology, University of Würzburg, Am Hubland, D-97074, Würzburg, Germany

John A. Matthews
Department of Geography, Swansea University, Singleton Park, Swansea, SA2 8PP, Wales, UK
E-mail address: j.a.matthews@swansea.ac.uk.

* Corresponding author.
E-mail address: stefan.winkler@uni-wuerzburg.de (S. Winkler).

27 July 2016
Available online 21 August 2016