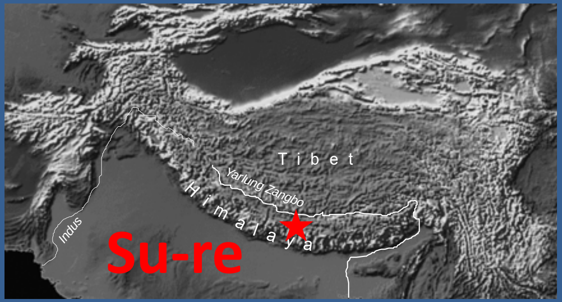
Direct dating of lithic surface artefacts using luminescence and application potential in geomorpholoy

Michael C. Meyer* & Luke Gliganic (University Innsbruck, Austria)

Jan-Hendrik May (University Melbourne, Australia)

*Michael.Meyer@uibk.ac.at

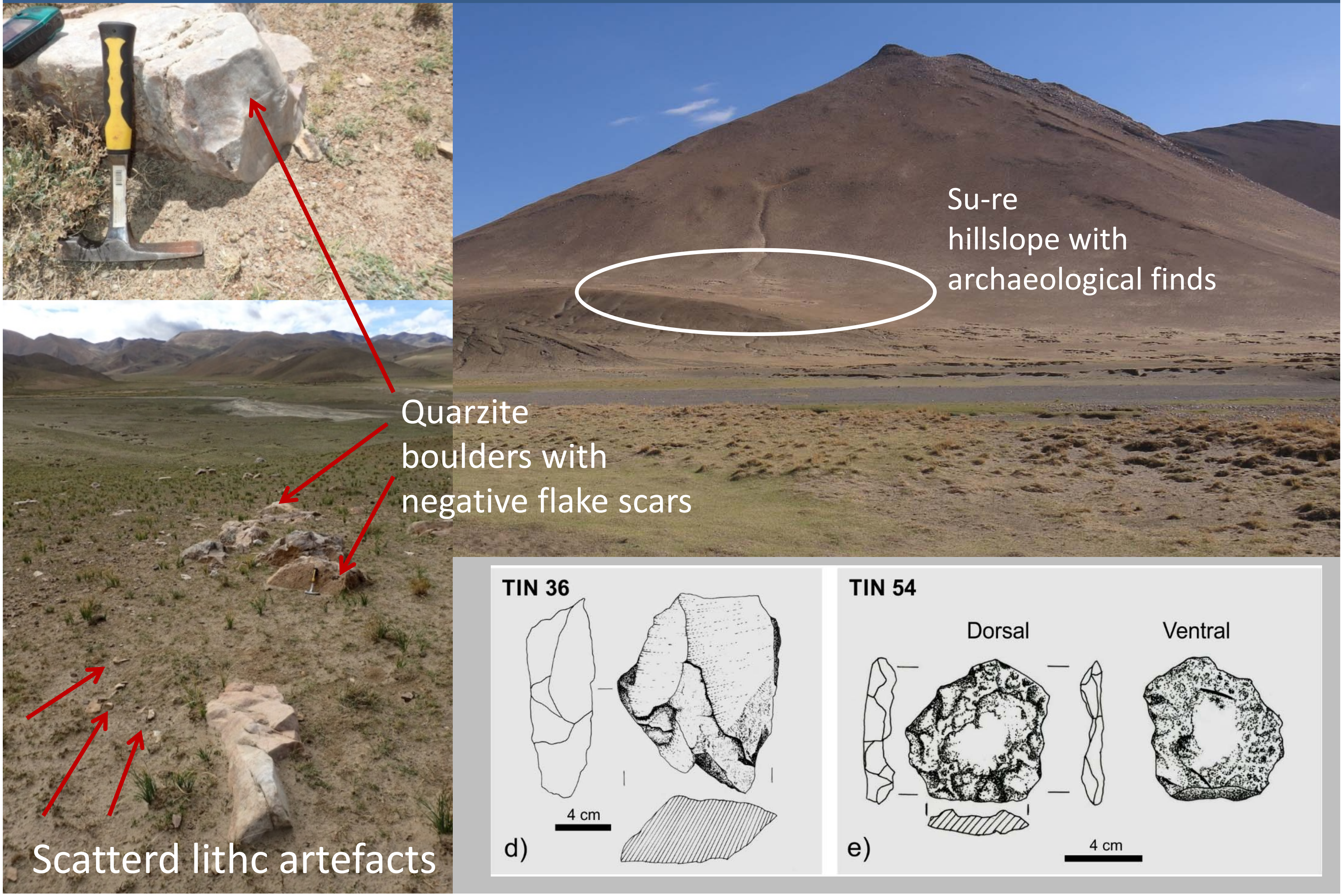
We have investigated a site that is charactized by archaeological surface finds and known as Su-re, situated in southern Tibet (4450 m asl.) within sight of Mount Everst & Cho Oyu



the lithic surface artefacts occurr on a hill slope that shows evidence for perglacial hillslope processes

View towards SW over the archaeolgoical site of Su-re. The High Himalaya is visible in the background

At Su-re local quarzite boulders have been quarried and stone tools prepared, leaving negative flake scars on the boulders and surface artefacts scattered on the ground



The negative flake scars of Su-re were investigated by us previously via an OSL rock surface <u>exposure</u> dating approach:

Contents lists available at ScienceDirect

Quaternary Geochronology

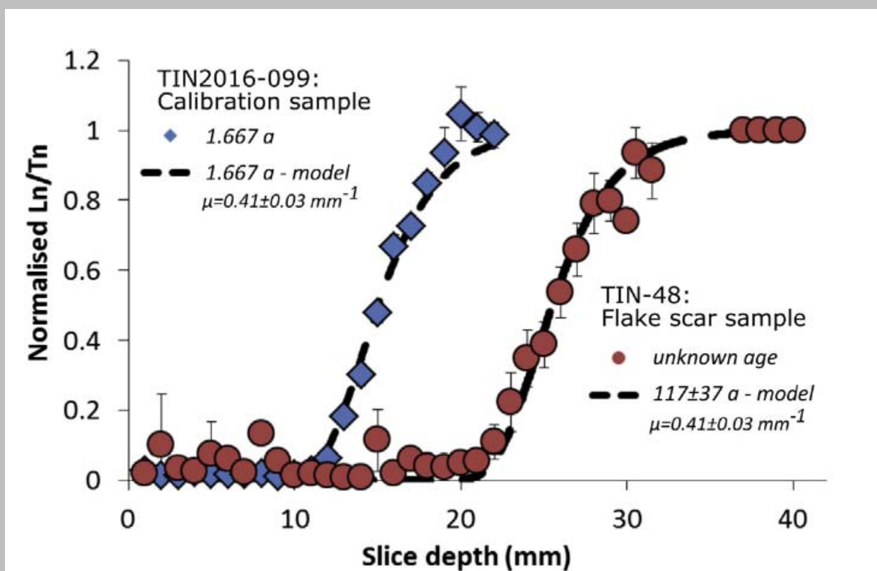
journal homepage: www.elsevier.com/locate/quageo

Research paper

OSL surface exposure dating of a lithic quarry in Tibet: Laboratory validation and application

L.A. Gliganic[a,*], M.C. Meyer[a], R. Sohbati[b], M. Jain[b], S. Barrett[a]

[a] Institute for Geology, University of Innsbruck, Innrain 52, 6020 Innsbruck, Austria
[b] Center for Nuclear Technologies, Technical University of Denmark, DTU Risø Campus, Roskilde, Denmark



The landscape evolution and human-environment interactions in the wider Su-re area has also been described and published recently:

Quaternary Science Reviews 229 (2020) 106127

Contents lists available at ScienceDirect

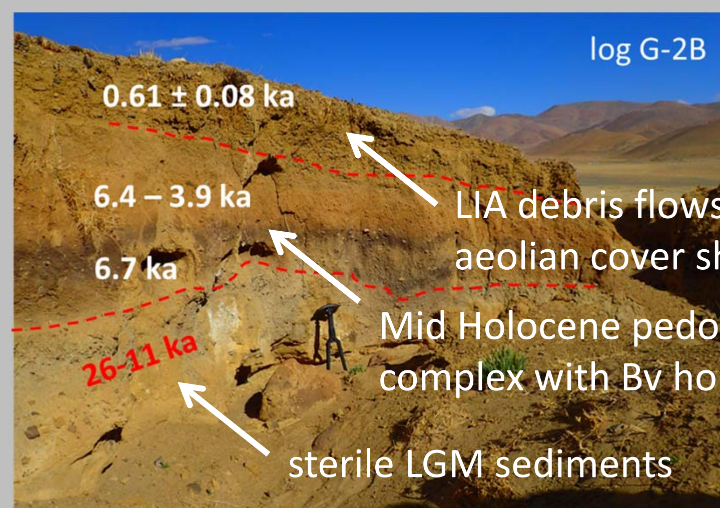
Quaternary Science Reviews

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

Landscape dynamics and human-environment interactions in the northern foothills of Cho Oyu and Mount Everest (southern Tibet) during the Late Pleistocene and Holocene

M.C. Meyer[a,*], L.A. Gliganic[a], J.-H. May[b,c], S. Merchel[d], G. Rugel[d], F. Schlütz[e], M.S. Aldenderfer[f], K. Krainer[a]

[a] Institute for Geology, University of Innsbruck, Innrain 52, 6020, Innsbruck, Austria
[b] School of Geography, University of Melbourne, Carlton, VIC, 3053, Australia
[c] Institute of Earth and Environmental Sciences, University of Freiburg, 79104, Freiburg, Germany
[d] Helmholtz-Zentrum Dresden-Rossendorf, D-01328, Dresden, Germany
[e] Lower Saxony Institute for Historical Coastal Research, D-26382, Wilhelmshaven, Germany
[f] School of Social Sciences, Humanities, and Arts, University of California, Merced, CA, 95343, USA



Here we focus on dating the lithic surface artefacts via an OSL rock surface <u>burial</u> approach.

Methods & Approach

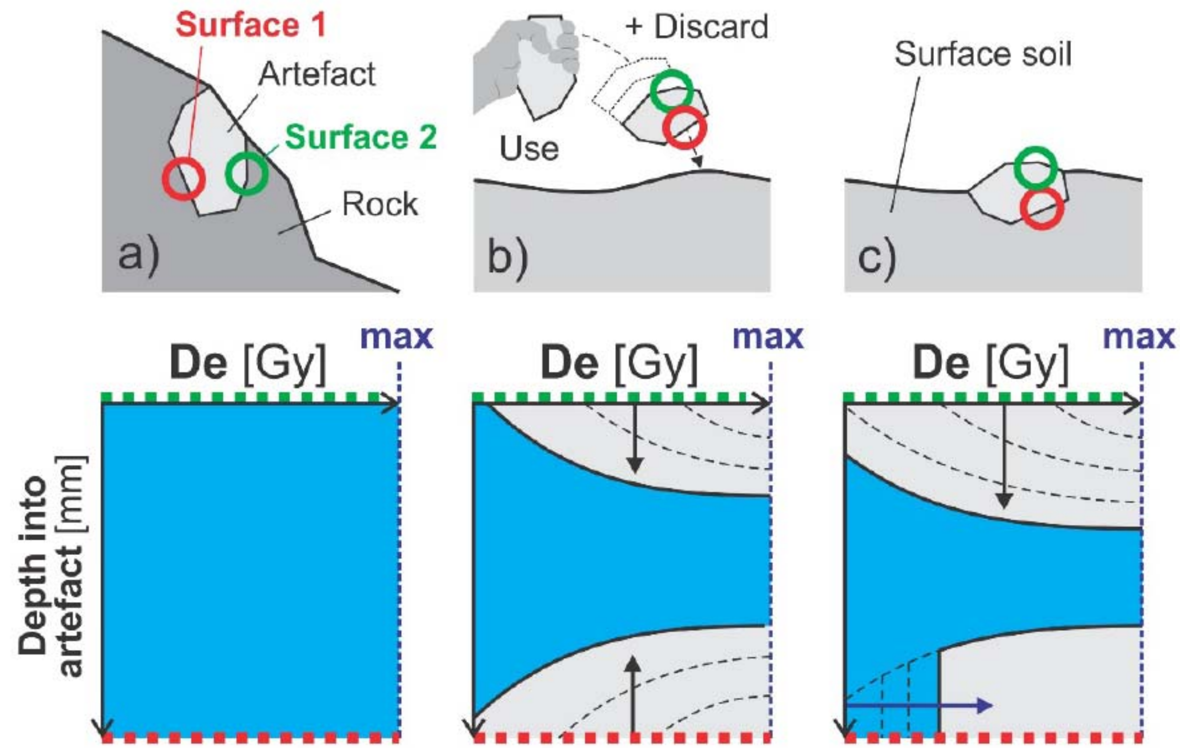
Sampling: Six lithic artefacts (large primary decortication flakes) collected from semi-embedded sedimentary surface contexts → were not recently moved or flipped by natural processes.

Dosimetry: Sediment directly underlying the artefact collected for environmental dose rate (dr) measurements; dr determined via a combination of TSAC, beta counting, modelling (Aitken, 1985), in-situ Al_2O_3 chips → Spatially relevant dose rates for each slice.

De measurements: buried face of each artefact cored and ~10 mm diameter cores sliced in 1 mm increments; each slice crushed and 90-250 µm grains mounted on stainless steel discs (5mm aliquots, ~5 discs per slice); De measurements via SAR (post-IR-blue OSL, 220°C Ph) on a Risø TL/OSL DA-20 reader. All standard SAR criteria and dose recovery test (1.01 ± 0.02, n=24) ok. → De value and OSL age for each slice.

OSL age-depth curves: used to (i) estimate OSL burial ages for each artefact and (ii) identify whether the artefact experienced multiple daylight exposure and burial events since discard (i.e. reveals a multi-stepped age plateau).

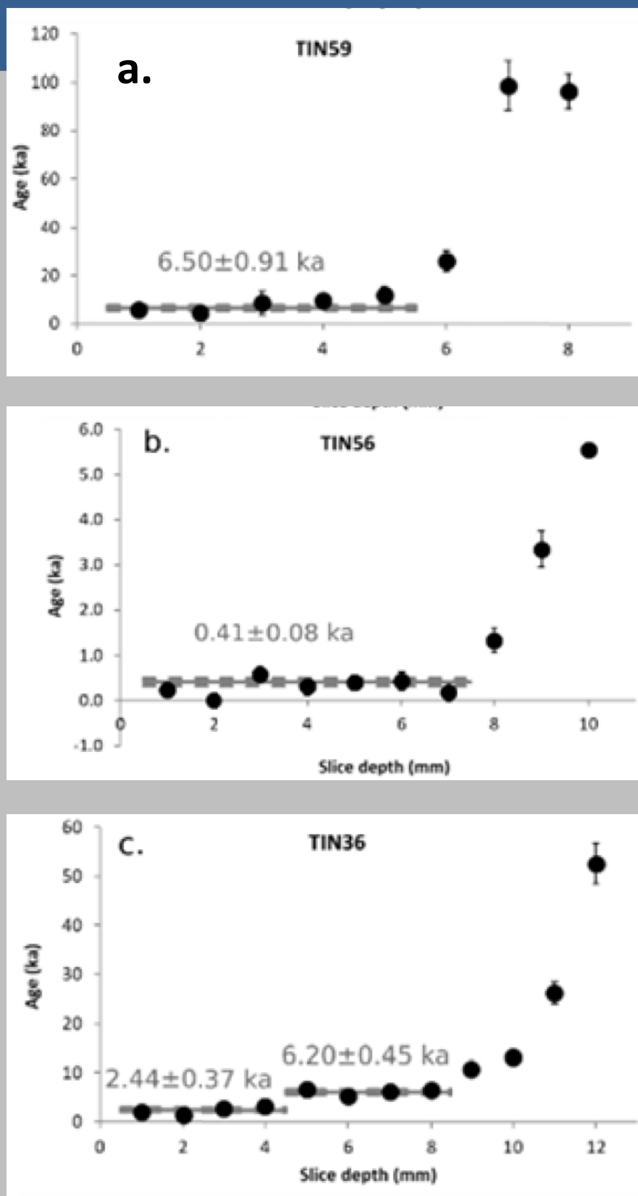
Conceptual model showing dating approach



© Gliganic, Meyer and May

a) Artefact still in its original bedrock context previous to exposure by quarrying b) artefact use and/or discard by humans leading to exposure and bleaching of the luminescence signal on all surfaces, c) artefact settling, embedding and semi-burial in the soil leading to luminescence signal build-up (red and green dotted lines indicate two opposing artefact surfaces).

Exemplary age depth profiles for three lilthic flakes



- All samples show clear age-depth profiles (solid lines; 2 σ uncertainties as dashed lines).
- Sample TIN 59 has a burial age of 6.5 ka. The most plausible explanation for this age is that this flake was last exposed to sunlight during the middle Holocene and bleached to a depth of ~6-7 mm. It has since remained buried or semi-embedded, allowing an environmental dose to accumulate on the artefact´s shielded underside.
- Sample TIN 56 has an age plateau of only 0.4 ka; This artefact was likely transported/flipped and exposed to sunlight more recently compared to TIN 59.
- Also multi-stepped profiles (sample TIN 36) can be observed, suggestive of a complex exhumation and burial history for some artefacts.

These are the first optical ages obtained directly on lithic artefacts

Discussion

1. The lithic artefacts at Su-re show two groups of age-plateaus: at 6.2 ± 0.3 ka and at 0.42 ka.
2. The 6.2 ka ages are interpreted as evidence of human presence and quarrying activity during optimal environmental conditions (i.e. during the middle Holocene, which was warm, moist & vegetated at Su-re; Meyer et al., 2020).
3. The 0.42 ka age plateaus point towards artefact remobilization and slope instability – in agreement with intensive regional landscape degradation during the Little Ice Age (Meyer et al., 2020).
4. Spatially resolved ages (plateaus) can resolve burial/bleaching history of individual clasts (number and timing of events)
5. Application potential in geomorphology e.g. to constrain surface processes such as debris flows, periglacial creep, sheet wash etc.