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

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We have investigated a site that is characterized by archaeological surface finds and known as Su-re, situated in southern Tibet (4450 m asl.) within sight of Mount Everest & Cho Oyu.
At Su-re local quartzite boulders have been quarried and stone tools prepared, leaving negative flake scars on the boulders and surface artefacts scattered on the ground.

Quartzite boulders with negative flake scars

Su-re hillslope with archaeological finds

Scatterd lithc artefacts

TIN 36

TIN 54

Dorsal

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

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

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

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Here we focus on dating the lithic surface artefacts via an OSL rock surface burial 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 Al2O3 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).
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 lithic 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.
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.