Constraining the glacial chronology of Bayan Har Shan, NE Tibetan Plateau

Cosmogenic exposure dating of boulders, surface pebbles/cobbles and sediment depth profiles

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Introduction and aim

The glacial chronology of the Tibetan Plateau is still elusive, with several questions to be untangled. Here we present the first terrestrial cosmogenic nuclide (TCN) exposure ages from Bayan Har Shan, holding an ampel glacial geological record of multiple glaciations, on the northeastern Tibetan Plateau.

The aim is twofold:

1. To constrain the glacial chronology of Bayan Har Shan.
2. To compare the TCN results from three different sample types; boulders, surface cobbles/pebbles and sediment depth profiles.

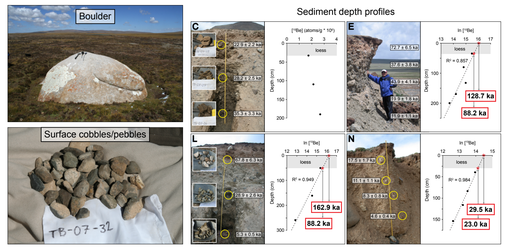
TCN dating

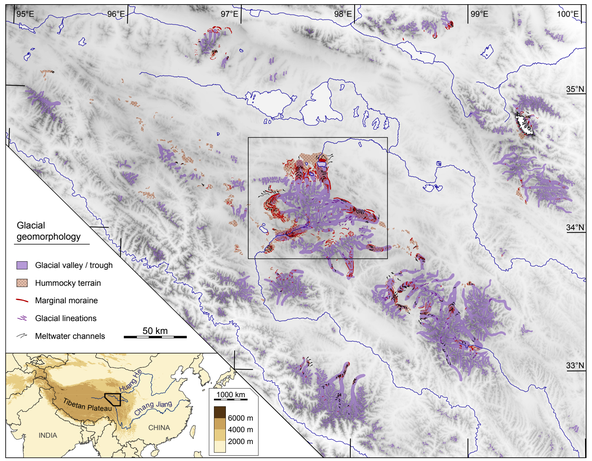
We have used ^{10}Be measurements of three different sample types from glacial deposits:

- Boulders
- Collections of surface pebbles/cobbles
- Sediment depth profiles

All TCN ages have been calculated using the CRONUS online cosmogenic-nuclide calculator (Balco et al. 2008) version 2.2. The exposure ages presented are derived from the Lal/Stone scaling scheme.

Analysed sample types and results for the four sediment depth profiles. The ages in the sample section photos are the exposure ages assuming no shielding by overlying sediments. The ages in red squares are the interpolated present day surface exposure age and an exposure age assuming loess shielding over the last 10 ka. The reversed order of ^{10}Be concentrations in section C are possibly the result of cosmogenic nuclide inheritance or mixing of the upper sediments. However, it could also be due to sampling of disturbed sediments fro mthe road pit.





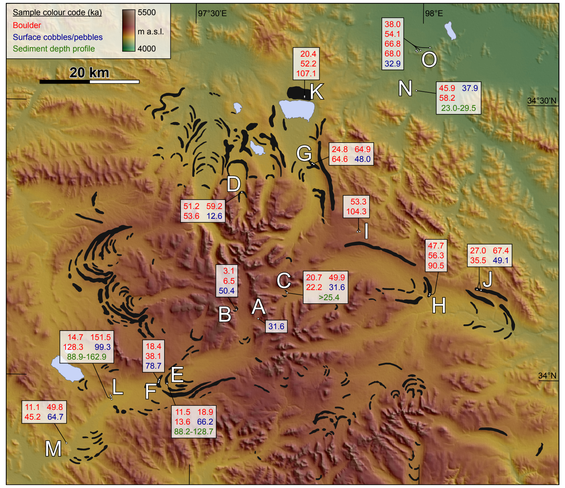
Bayan Har Shan in the northeastern corner of the Tibetan Plateau with an ample record of former glaciations. Glacial geomorphology from Heyman et al. (2008).

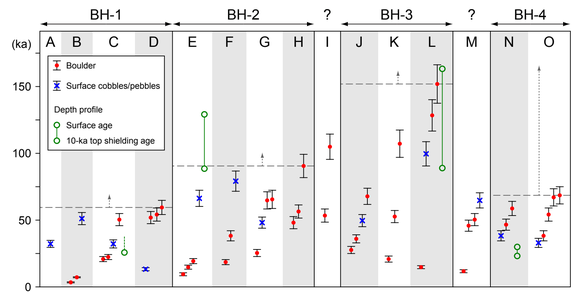
Results

51 ^{10}Be measurements from boulders and surface cobbles/pebbles yield apparent exposure ages ranging from 3 to 152 ka with wide age spreads within groups of samples that have been collected from one glacial deposit.

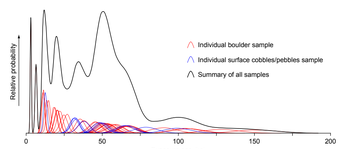
Three sediment depth profiles have ^{10}Be concentrations decreasing exponentially with depth in agreement with theoretical cosmogenic nuclide depth curves, indicating insignificant cosmogenic nuclide inheritance.

Central Bayan Har Shan with TCN samples and ^{10}Be exposure ages.





^{10}Be exposure ages for sample groups and morpho-stratigraphic units BH-1 to BH-4.



Probability density functions for all boulder and surface cobbles/pebbles samples.

Interpretations

The maximum age of each group of samples constrain a minimum time since formation. This is based on analysis of large data sets of TCN ages indicating sample exhumation/erosion (Putkonen and Swanson 2003; Heyman et al. 2009) and a lack of indications for cosmogenic nuclide inheritance.

Dividing the samples into four morpho-stratigraphical groups based on altitude and distance from center of glaciation yield minimum ages of c. 60 ka, 90 ka, 150 ka and 70 ka.

Conclusions

- **Very restricted glaciation** (with glaciers <10 km long) is indicated for at least the last 60 ka in central Bayan Har Shan, implying that the ample glacial geological record of Bayan Har Shan is mainly derived from prior glaciations.
- **Two larger glacial extents** have minimum ages of 90 ka and 150 ka.
- **The timing of the most extensive** and presumably oldest glaciation of Bayan Har Shan is not well constrained, with TCN ages close to the ages of the most restricted glaciation.
- **TCN dating of boulders, surface cobbles/pebbles and sediment depth profiles** are broadly in agreement and complement each other.

References

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