Reconstructing former glacial extent of the NE Tibetan Plateau
combining remote sensing and field data of glacial geology

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Introduction and background

The Tibetan Plateau is a key global topographic feature, with regional and global climatic significance. Still, the paleoglaciology of the plateau is elusive, with constrasting glacial reconstructions.

The Bayan Har Shan in the NE corner of the plateau is characterized by an extensive low relief plateau surface at ~4300 m a.s.l. with mountain blocks rising 1000-2000 m higher and steep fluvial valleys along the plateau surface margins (Stroeven et al. in press). Three widely different paleo-glacial configurations have been proposed for this area:

1. **Plateau-scale ice sheet glaciation** (Kuhle 2004)
2. **Regional ice sheet glaciation** - the Huang He ice sheet (Zhou and Li 1998)
3. **Restricted alpine style glaciation** (Lehmkuhl et al. 1998)

The Tibetan Plateau with the study area in the northeastern corner

Aim

We present a glacial geological record of the northeastern Tibetan Plateau comprising glacial landforms and glacial deposits. We are aiming towards a robust paleoglaciological reconstruction and the glacial geological record forms a basis for reconstructing the extent of former glaciers.

Methods

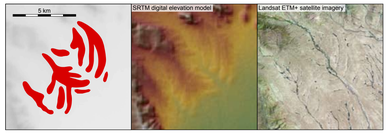
Two principle methods have been used to record the glacial geology:

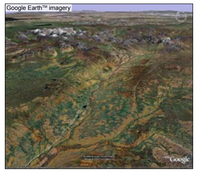
1. **Remote sensing** enabling extensive and complete coverage mapping of large- and medium-scale glacial landforms
2. **Field studies** enabling detailed point observations of glacial deposits

Remote sensing

The glacial geomorphology of a 136.500 km² area has been mapped from the SRTM 90 m resolution digital elevation model (DEM) and Landsat ETM+ 15/30 m resolution satellite imagery. For 3D visualisation we have frequently used Google Earth™ software.

Remote sensing for mapping of large- and medium-scale glacial landforms

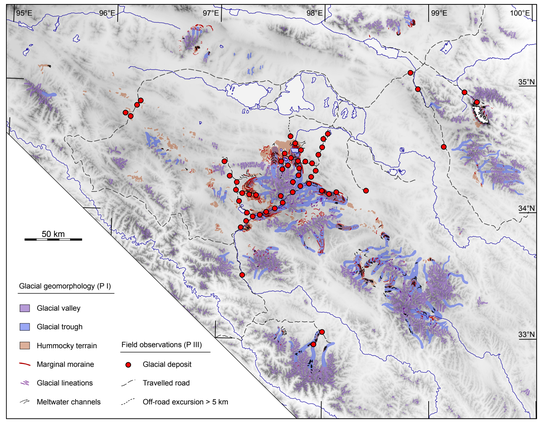




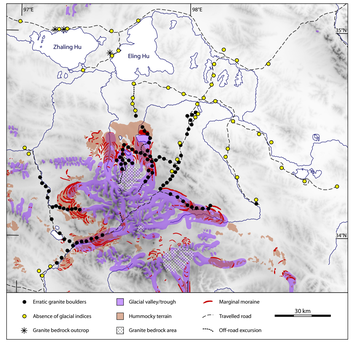
Field studies

Field investigations of glacial deposits have been performed 2005, 2006 and 2007. To identify glacial deposits, and distinguish glacial from non-glacial deposits, we have used the presence of robust glacial indices. We have mapped the occurence of glacial deposits and we have recorded areas with an absence of glacial indices.

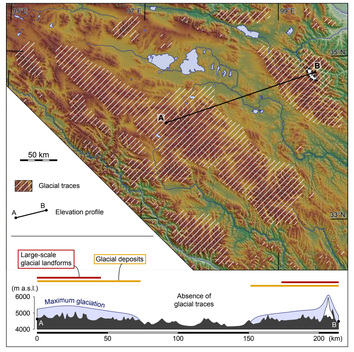
Field studies with robust glacial indices used to identify glacial deposits



Glacial landforms and deposits



Distribution of erratic granite boulders and locations with an absence of glacial indices in central Bayan Har Shan



Distribution of glacial traces (minimum extent of maximum glaciation)

Results

Glacial landforms occur frequently in elevated mountain areas, but are absent in extensive low-lying plateau areas. There is a noteworthy lack of ice sheet-scale glacial landforms, such as glacial lineation swarms, ribbed moraines and eskers.

Glacial deposits occur frequently in elevated mountain areas marked by a glacial imprint, but also some distance outside mapped glacial landforms, in an absence of large-scale glacial geomorphology. Still, in low-lying plateau areas there is an absence of glacial deposits.

Conclusions

- **Alpine style glaciation** ranging from cirque glaciers to valley glacier networks is evident from the glacial geomorphology.
- **Icefield/ice cap glaciation**, presumably pre-dating more restricted glaciation(s) with valley glaciers around the highest mountain blocks, is indicated by glacial deposits distributed some distance outside large- and medium-scale glacial landforms.
- **There is no support for ice sheet glaciation**, neither a plateau-scale ice sheet nor a regional Huang He ice sheet.
- **The most extensive glaciation** is recorded in point form only by field observations of glacial deposits, indicating insignificant erosion by the most extensive former icefield/ice cap.

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