Palaeoglaciology of the northeastern Tibetan Plateau

Jakob Heyman
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Outline

Introduction
  Palaeoglaciology
  Tibetan Plateau
  Glacial reconstructions
  Bayan Har Shan
  Aim and methods

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Paper V
Thesis summary

Conclusions
Palaeoglaciology – study of past glaciers

**Size** of past glaciers based on landform and sediment record

**Timing** of past glaciers based on physics/chemistry methods

**Challenge**
Time obscures the spatial and temporal record
Tibetan Plateau
"Roof of the world"
"Third pole"
Glacial reconstructions

- Present-day glaciers (Armstrong et al. 2009)
- Li et al. (1991)

- LGM: 20 ka

- Bayan Har stage late last glacial
- Galala stage early last glacial

- Lehmkuhl et al. (1998)
- Huanghe ice age MIS 12 (~450 ka)
- Yematan ice age MIS 6 (~150 ka)

- Zhou and Li (1998)
The NE sector: Bayan Har Shan
Aim and methodology

How extensive have past glaciers in Bayan Har Shan been and when did they exist?

**Paper I**

**Paper II**

**Paper III**

**Paper IV**

**Paper V**

Detailed glacial geomorphological maps
Glacial geomorphology of the Bayan Har sector of the NE Tibetan Plateau

Jakob Heyman, Clas Hättestrand, Arjen P. Stroeven
Department of Physical Geography and Quaternary Geology
Stockholm University
Paper II

Legend
- **Relict upland surface**
- **Fluvial landscape**
- **Glacial landscape**
- **Road**
Comparison: Relict upland surface – Huang he ice sheet

**Field data paper**

- Detailed investigations of key sites
- Active searches for glacial deposits
Comparison field data – remote sensing data
Minimum extent of maximum glaciation
Cosmogenic exposure dating

Exposure to cosmic rays produces cosmogenic nuclides ($^{10}$Be) in quartz

Glacial erosion and deposition

Sampling and $^{10}$Be measurement

Absolute measurement of exposure to cosmic rays

Exposure age
Exposure age:
- 94.7 ka
- 45.5 ka
- 19.8 ka

Deglaciation age???

Exposure

Glaciation

Shielding from cosmic rays

Exposure

Too old exposure age

Too young exposure age
Exposure age compilation

Tibetan Plateau: **1123** boulders

Palaeo-ice sheets: **615** boulders

Present glaciers: **186** boulders
Paper V
How extensive have past glaciers in Bayan Har Shan been and when did they exist?
Thesis summary

Modest cooling (2-4 K) enough to produce glaciers larger than during the LGM

3D glacier modelling

Modest cooling (2-4 K) enough to produce glaciers larger than during the LGM
Conclusions

Bayan Har Shan

• In the mountains: glacial erosion more effective than fluvial erosion
Along the plateau margin: fluvial erosion more effective than glacial erosion

• Multiple glaciations with alpine style valley glaciers and ice fields

• All dated landforms are significantly older than the global LGM

Tibetan Plateau

• Generally restricted glaciations during the LGM

• Modelling indicate modest cooling during the LGM

Cosmogenic exposure ages

• Exposure ages should, in the absence of other evidence, be viewed as minimum deglaciation ages
Take-home message
Glaciers on the Tibetan Plateau have been small for a long time
Thank you!

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