An evaluation of multiple working hypotheses to explain cosmogenic exposure age data from glacial deposits in the Bayan Har Shan, NE Tibetan Plateau

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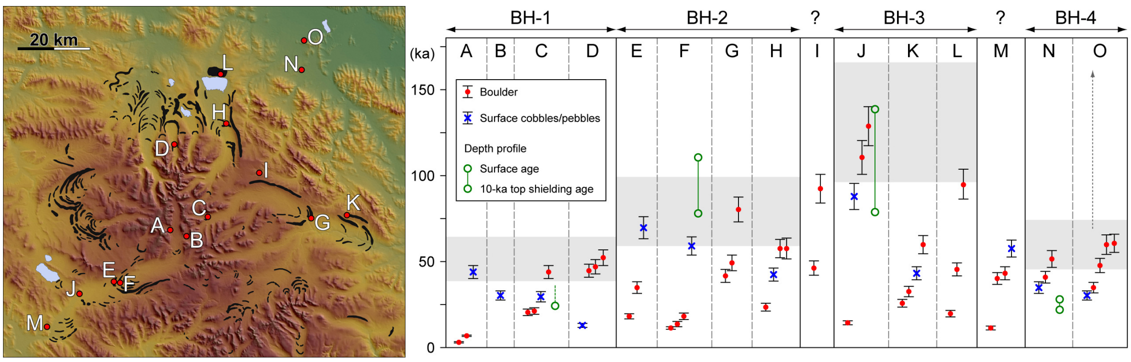
Many questions remain unanswered regarding the Quaternary glaciations of the Tibetan Plateau. We have used terrestrial cosmogenic nuclide (TCN) exposure age dating of glacial deposits to examine the style, extent, and timing of past glaciations of the Bayan Har Shan, a mountain region on the northeastern Tibetan Plateau. This area lies within a transition zone between the dry interior of the Tibetan Plateau and the wetter eastern margin affected by the Asian monsoon. Bayan Har Shan has many glacial landforms and deposits that provide evidence for former glaciation ranging from cirque and valley glaciers to ice-fields and ice caps.

In an attempt to constrain the timing of glaciations in Bayan Har Shan, we have performed TCN exposure dating on 65 samples in central Bayan Har Shan from glacial deposits. ^{10}Be measurements on surface boulders (39 samples), on surface pebbles/cobbles (12 samples), and on pebbles in sediment depth profiles (14 samples from four profiles) allow us to examine the timing and extent of glaciations in this area. As is often the case, there are some challenges in interpreting the range of TCN apparent exposure ages that is found in data from several samples and sample types on a single deposit and from samples taken at various sites. Thus we evaluate multiple working hypotheses to explain apparent exposure ages on glacial deposits, which in this case range from 3 ka to 129 ka. We consider three different hypotheses; 1) some samples have erroneously old exposure ages due to inheritance, 2) samples have been preserved under cold-based, non-erosive ice, and 3) samples have experienced only post-glacial shielding. Only when we adopt a hypothesis that assumes no prior exposure, and thus that maximum apparent exposure ages constrain the minimum age of formation of a feature (working hypotheses 3), do we find broad consistency between apparent exposure ages from different sample types (erratic boulders, surface pebbles/cobbles and pebbles from depth profiles). This leads to the conclusion that all of the sites of former glaciations we examined are at least 50ka in age, and that there has been no large-scale expansion of glaciers in the central Bayan Har Shan over the last 50ka.



Bayan Har Shan moraine distribution (black morphology on map), sample locations and TCN apparent exposure ages. The exposure ages are calculated using the CRONUS-Earth online calculator (http://hess.ess.washington.edu/) and the Lal/Stone time-dependent ^{10}Be production rate scaling scheme. The grey regions on the age plot mark minimum ages for four glaciations. They are based on the oldest boulder exposure age for BH-1 to BH-4 and include the oldest and youngest exposure ages plus uncertainties of five different ^{10}Be production rate scaling schemes.