Geophysical Research Abstracts,
Vol. 11, EGU2009-12078-1, 2009
EGU General Assembly 2009

Cosmogenic exposure ages of glacial boulders from the Tibetan Plateau - Age distributions support boulder exhumation/erosion and indicate old glacial deposits

J. Heyman (1), A.P. Stroeven (1), J. Harbor (2), and M.W. Caffee (3)

(1) Department of Physical Geography and Quaternary Geology, Stockholm University, Sweden, (2) Department of Earth and Atmospheric Sciences, Purdue University, USA, (3) Department of Physics/Purdue Rare Isotope Measurement Laboratory, Purdue University, USA

Terrestrial cosmogenic nuclide (TCN) exposure dating has become the most dominant technique for constraining glacial chronologies. This is particularly true for the Tibetan Plateau because of its low frequency of organic material (limiting the possibilities to use radiocarbon dating) and high altitude (favouring TCN dating with high cosmogenic nuclide production rates), with, consequently, a large number of TCN samples processed. However, multiple samples from one glacial deposit commonly yield a wide range of TCN ages which complicates their interpretation. Two principal possibilities can cause a wide range of ages to result from one glacial deposit. First, TCN ages may exceed the true age by a varying number of years as a result of pre-depositional cosmogenic nuclide inheritance. Second, TCN ages may underestimate the true age by a varying number of years as a result of post-depositional exhumation and/or erosion. By analysing trends within a large set of TCN ages we can evaluate whether inheritance (too old TCN ages) or exhumation/erosion (too young TCN ages) has best explanatory power.

We have thus analysed 794 Be-10 TCN ages from 211 individual groups of glacial boulders collected from 30 different areas on the Tibetan Plateau. Analysis of the 211 sample group age distributions and the relationships with their maximum and minimum ages clearly reveals that older sample groups have wider age spread. This fact indicates that if inheritance is the cause of the wide age spread, older deposits have higher cosmogenic inheritance. However, the wide age spread and distinct age spread/deposition age-trend argue against this explanation. Furthermore, there is no significant inheritance in boulders from young (late Holocene) glacial deposits of the Tibetan Plateau. Exhumation/erosion of boulders, on the other hand, may explain the age distribution as a result of post-depositional shielding of samples. With degrading moraine ridges exhuming boulders and erosion of the boulder surfaces, previous shielding of the collected samples will result in TCN ages underestimating the true age to a varying degree depending on the rate and timing of exhumation/erosion. If exhumation/erosion is a continuous process, older deposits will have wider age spread due to the longer time (higher probability) of exhumation/erosion. Thus, the age distribution within groups of boulder TCN ages from the Tibetan Plateau indicates that cosmogenic inheritance is probably not an overarching problem, and that the spread in ages in glacial deposits is generally caused by boulder exhumation and/or erosion. By inference, the oldest boulder of each sample group most reliably constrains the minimum age of glacial deposition. Because the average of the 211 maximum ages is 61 ka and half of them are older than 25 ka, an important conclusion of our trend analysis is that the glacial geological record of the Tibetan Plateau to a large extent corresponds to glaciations pre-dating the global Last Glacial Maximum. Hence, the Tibetan Plateau offers a window into glaciations significantly older than is normally found in the northern hemisphere.