AMS measurements of cosmogenic nuclide concentrations resolve mountain landscape evolution and the glacial history in the Pamir, Central Asia

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Secondary cosmic rays interact with terrestrial materials in the atmosphere and near the Earth's surface to produce cosmogenic radionuclides. The production and accumulation of cosmogenic ^{10}Be and ^{26}Al in quartz allows geologists to investigate processes of landscape evolution such as erosion, landsliding, sediment transport and deposition on time scales of thousands to few millions of years. The Pamir mountains at the western end of the India-Asia collision zone have been in the focus of geologic research since the early 2000s. While the tectonic evolution of the Pamir is increasingly well understood, the drivers of Pamir landscape evolution remain elusive. The western Pamir is characterized by an extreme topographic relief with summit and valley elevations of 6-7 km and 2-3 km, respectively; the eastern Pamir is a low-relief plateau at ~4 km. This contrast may be attributed to higher precipitation in the western Pamir driving faster river incision and erosion compared to the arid east. Alternatively, the relief may be controlled by spatially variable, tectonically forced surface uplift. Field observations suggest that Pleistocene glaciation of the Pamir was much more extensive than modern glaciation, and that glaciation had a significant impact on the evolution of the Pamir landscape.

We use cosmogenic ^{10}Be and ^{26}Al concentrations in moraine boulders, glacially polished bedrock and glacio-alluvial sediment deposits to determine the timing and extent of past glacial stages with the goal to better understand what controls landscape evolution in the Pamir. Our results indicate that early Holocene (~10 ka) glaciation was more extensive than previously thought, and that at that time the western Pamir was much more strongly glaciated than the east. The most widespread glaciation occurred at ≥200 ka covering most of the western Pamir and possibly also much of the east Pamir plateau. These results strengthen our hypothesis that the glacial history of the Pamir had a significant impact on its landscape evolution.