Evaluating the timing of former glacier expansions in the Tian Shan, Central Asia

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Abstract

Reconstructing the dynamics of past glaciation across Central Asia has over the past 10 years received an increased research interest because glacier change provides a proxy for past climate change. However, observed large scatter in [10]Be surface exposure data hampers the reconstruction of accurate glacial chronologies. The aim of this study is to evaluate new and existing [10]Be data from glacial moraines across the Tian Shan and to assess whether these can be used to provide robust glacial chronologies for regional correlation. In order to quantify the robustness of the dating control, we compile, recalculate, and perform statistical analyses on sets of [10]Be surface exposure ages from moraines. Our methodology includes; assessment of boulder age scatter, dividing boulder groups into quality classes and rejecting boulder groups of poor quality. This has allowed us to distinguish and correlate robustly dated glacier limits resulting in a more conservative chronology than advanced in previous publications. Our analysis shows that only one regional glacial stages can be reliably correlated across the Tian Shan marine oxygen isotope stage (MIS) 2 (15 - 28 ka) (Figure 1).

There exists, however, reliable glacial stages during MIS 3 (36 – 47 ka) in eastern Chinese Tian Shan and during MIS 5 (71 – 85 ka) in the central Kyrgyz Tian Shan (Figure 1). These are apparent exposure ages because we do not account for erosion. Paleoglacier extent during MIS 2 was mainly restricted to valley glaciation. Local deviations occur, for example in the central Kyrgyz Tian Shan where paleoglaciers were more extensive and formed a composite ice tongue filling the nearest depression, and we propose that the topographic context explains this pattern. Correlation between glacial stages prior to late MIS 2 is unreliable, because of the low number of samples and/or the poor resolution of the dating control. With the current resolution and spatial coverage of robustly-dated glacier limits we advise that paleoclimatic implications for the Tian Shan glacial chronology beyond MIS 2 should remain speculative and that continued work towards robust glacial chronologies is needed to resolve questions regarding drivers of past glaciation in the Tian Shan and Central Asia.
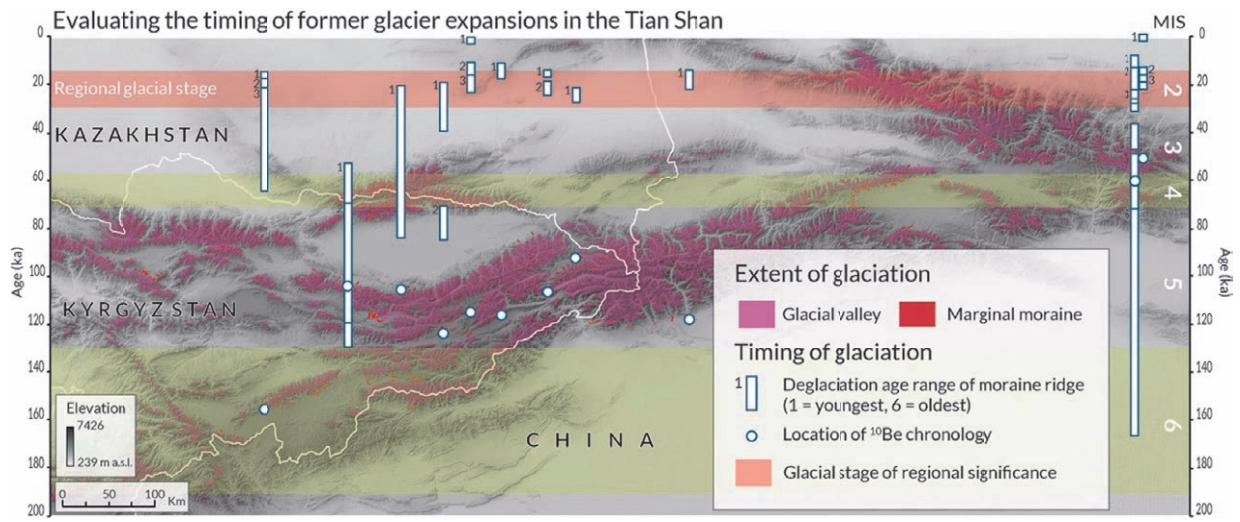
Figure 1. *Timing of former glacier expansions across the Tian Shan.*