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^{10}Be exposure ages of large rock avalanches in the northern Tien Shan, Kyrgyzstan

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Several extremely large bedrock landslides occur in the Kyrgyz Tien Shan (Strom Korup, 2006), one of the intracontinental mountain belts linked to the India-Asia collision zone. Large rock avalanches blocked valleys and have led to the formation of landslide-dammed lakes in the past. The general observation that intense ground-shaking may induce huge landslides, combined with the fact that several historic earthquakes with a magnitude M>8 occurred in the Tien Shan (Abdrakhmatov et al., 2003) subjects the region to a considerable hazard, which remains largely unquantified due to a lack of absolute age constraints. To meet this shortcoming, we present the first 10Be exposure ages for three major granitic bedrock landslides in the Kyrgyz Tien Shan. These ages also help constrain minimum ages and extent of Late Quaternary glacier advances, because glaciers did not override the formerly river-blocking landslide deposits. Recent work suggests that glaciers reached their maximum extent during the last glaciation several ten thousand years earlier than the global Last Glacial Maximum at 20 ka (Koppes et al., 2008).

In the Alamedyn River (Kyrgyz Range, 42°36.5'N 74°40'E), we sampled four boulders from a formerly river-blocking rock avalanche with a volume of 10-15 x 10^6 m^3. The samples yielded ^{10}Be ages of 7.30±0.73, 11.3±1.1 and 14.7±1.4 ka. Snails present in reworked loess deposits that overlie the landslide deposit have uncalibrated ^{14}C ages of 11055±60 years and 12690±90 years (errors 1 sigma). We infer from the ^{10}Be and ^{14}C ages a landslide detachment age of 11-15 ka, although multiple failures are possible at this site. In the Ukok river (42°6'N 75°54'E), a younger rock avalanche with a volume of 30-70 x 10^6 m^3 yields more scattered ^{10}Be exposure ages. The oldest apparent age of 35.3±3.2 ka likely results from a significant inherited nuclide component and overestimates the age of landslide detachment. Two ^{10}Be ages of 8.21±0.84 ka and 5.89±0.59 ka suggest that the landslide occurred in the early to mid-Holocene. In the Aksu valley (Kyrgyz Range at 42°32.5'N 73°0'E), we sampled four boulders of the largest rock avalanche in this study (1.5 x 10^9 m^3). Three of four ^{10}Be ages cluster tightly between 63 and 67 ka (63.1±5.8 ka, 66.5±6.1 ka, and 67.1±6.8 ka) and are interpreted to date the landslide (a younger age of 35 ka may result from tilting of the sampled block during the long period of exposure).

The ^{10}Be ages from the Aksu valley are among the oldest dated landslide deposits from humid and tectonically active mountain belts. The ages indicate that since 65 ka no glaciers have advanced beyond the landslide site (1900 m a.s.l.), and hence nowhere near the northern fringe of the Kyrgyz Range. Although the Aksu landslide seems to be of lateglacial or early interglacial age according to the preliminary regional chronology proposed by Koppes et al. (2008), the location of the glacially undisturbed landslide deposit requires much higher palaeo-equilibrium line altitudes (ELA) and commensurately shorter glacier lengths, indicating that some of the most humid parts of the Tien Shan have not seen any significant glaciation comparable to extensive ice-stream networks in the European Alps during the last 70 ka.

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