

## **Supplemental Online Material**

**Lifton et al. - Constraints on late Quaternary glacial history, E. Kyrgyz Tian Shan**

**Table S1 Recalculated  $^{10}\text{Be}$  ages from Koppes et al. (2008) and Zech (2012)**

Publication	Sample	Location °N/°E	Altitude m a.s.l.	Published $^{10}\text{Be}$ Age <sup>a</sup> ka	Recalculated $^{10}\text{Be}$ Age <sup>b</sup> ka
<b>Koppes et al. (2008)</b>	SCT-020901-2	42.03/77.19	3283	$40.5 \pm 3.1$	$42.8 \pm 2.4$
	SCT-020901-3	42.03/77.19	3283	$32.4 \pm 2.4$	$34.9 \pm 2.0$
	SCT-020901-4	42.04/77.21	3140	$30 \pm 2.3$	$32.4 \pm 1.8$
	SCT-020901-5	42.04/77.21	3140	$41.9 \pm 3.3$	$44.3 \pm 2.6$
	SCT-030901-6	42.04/77.12	2759	$98.1 \pm 7.9$	$99.4 \pm 5.6$
	KTS98-CS-61b	41.00/76.05	3804	$7.6 \pm 0.6$	$8.9 \pm 0.5$
	KTS98-CS-62a	41.00/76.05	3879	$4.6 \pm 0.3$	$5.5 \pm 0.3$
	KTS98-CS-62b	41.00/76.05	3879	$4.4 \pm 0.3$	$5.3 \pm 0.3$
	KTS98-CS-66	40.98/76.15	3576	$36.5 \pm 2.7$	$38.9 \pm 2.1$
	KTS98-CS-81	41.05/75.73	2598	$31.6 \pm 2.4$	$34.3 \pm 1.9$
	KTS98-CS-83	41.05/75.73	2598	$52.5 \pm 4.0$	$56.4 \pm 3.2$
	KTS98-CS-87	42.08/76.46	2496	$64.0 \pm 4.8$	$67.5 \pm 3.5$
	KTS98-CS-88	42.08/76.46	2496	$69.9 \pm 5.3$	$73.5 \pm 3.9$
	KTS98-CS-90	42.08/76.46	2403	$134.6 \pm 12.7$	$130.7 \pm 8.9$
	KTS98-CS-91	42.08/76.46	2403	$163.5 \pm 14.1$	$155.2 \pm 8.8$
	KTS98-CS-92	42.08/76.46	2403	$70.2 \pm 5.5$	$73.9 \pm 4.1$
	KTS98-CS-93	42.08/76.45	2229	$97.7 \pm 8.0$	$99.5 \pm 5.7$
	KTS98-CS-94	42.08/76.45	2229	$108.4 \pm 9.0$	$108.9 \pm 6.4$
	KTS98-CS-95	42.08/76.45	2229	$139.0 \pm 11.5$	$134.8 \pm 7.4$
	KTS98-CS-96	42.08/76.45	2229	$72.2 \pm 5.7$	$75.8 \pm 4.2$
	KTS98-CS-97	42.05/76.43	2850	$93.0 \pm 7.4$	$94.8 \pm 5.3$
	KTS98-CS-98	42.05/76.43	2850	$50.1 \pm 3.8$	$53.6 \pm 3.0$
	KTS98-CS-99	42.05/76.43	3750	$3.4 \pm 0.3$	$4.1 \pm 0.2$
	KTS98-CS-100	42.05/76.43	3750	$17.8 \pm 1.3$	$19.7 \pm 1.1$
	KTS98-CS-101	42.52/74.51	3246	$0.25 \pm 0.1$	$0.3 \pm 0.1$
	KTS98-CS-102	42.52/74.51	3180	$0.54 \pm 0.1$	$0.7 \pm 0.1$
	KTS98-CS-104	42.52/74.51	2040	$48.7 \pm 4.0$	$52.1 \pm 3.2$
<b>Zech (2012)</b>	KI11	40.7827/75.4876	3870	$9.3 \pm 0.9$	$10.6 \pm 0.7$
	KI12	40.7827/75.4876	3870	$14.7 \pm 1.4$	$16.5 \pm 1.0$
	KI13	40.7826/75.4869	3870	$15.7 \pm 1.4$	$17.6 \pm 1.0$
	KI14	40.7826/75.4869	3870	$14 \pm 1.4$	$15.7 \pm 1.1$
	KI21	40.7874/75.4728	3990	$18.8 \pm 1.7$	$21.0 \pm 1.3$
	KI22	40.7874/75.4728	3995	$21.4 \pm 2$	$23.8 \pm 1.4$
	KI23	40.7871/75.4734	3980	$16 \pm 1.4$	$17.9 \pm 1.1$
	KI24	40.7840/75.4763	3940	$15.8 \pm 1.4$	$17.7 \pm 1.1$
	KI25	40.7838/75.4763	3940	$17.9 \pm 1.6$	$20.0 \pm 1.2$
	KI31	40.7650/75.5025	3725	$52.8 \pm 4.8$	$61.8 \pm 3.6$
	KI32	40.7650/75.5025	3725	$56.1 \pm 5.3$	$65.0 \pm 4.2$
	KI33	40.7644/75.5024	3720	$16.6 \pm 1.5$	$18.6 \pm 1.2$
	KI34	40.7666/75.5084	3708	$27.6 \pm 2.5$	$30.8 \pm 1.8$

Notes:

- a As published in Koppes et al. (2008) and Zech (2012). The Koppes et al. (2008) data were calculated using CRONUS-Earth online calculator v. 1.2, time-independent Lal (1991)/Stone(2000) scaling scheme (St),  $P_{\text{SLHL}} = 5.15$  at  $\text{g}_{\text{qtz}}^{-1} \text{ yr}^{-1}$ , assuming 1 mm  $\text{ka}^{-1}$  erosion rate. The Zech (2012) data were calculated using CRONUS-Earth online calculator v. 2.2, time-dependent Lal (1991)/Stone (2000) scaling scheme (Lm),  $P_{\text{SLHL}} = 4.39$  at  $\text{g}_{\text{qtz}}^{-1} \text{ yr}^{-1}$ , assuming no erosion.
- b Recalculated using Balco et al. (2009) northeastern North America SLHL production rate, time-dependent Lal (1991)/Stone (2000) scaling scheme (Lm),  $P_{\text{SLHL}} = 3.85 \pm 0.19$  at  $\text{g}_{\text{qtz}}^{-1} \text{ yr}^{-1}$ , assuming no erosion.

## Sample Descriptions

Below we include detailed descriptions of the boulder samples. Locations are given in Table 1 in the main text.

### INK-01, INK-01B

Blocky granitic boulder on crest of large terminal moraine at west end of Inylchek Valley. Dimensions: 9 m x 13 m x ca. 4 m high. Dip/Dip direction: 12°/300°. Sample collected from center of upper surface, sample B collected from edge of top surface.



## INK-02

Large granitic boulder, darkly varnished, from crest of terminal moraine ridge at west end of Inylchek Valley – likely the same ridge as INK-01. Dimensions: 20 m x 15 m x ca. 5 m high. Horizontal upper surface.



**TS12-IN-01**

Medium to coarse-grained granitic boulder on crest of lateral moraine ridge adjacent to the Inylchek River. Ridge crest approximately 10-15 m above sandur. Lowest moraine ridge of a set of “staircase” ridges along the north bank of the Inylchek River. Lightly varnished on sampled surface and moderate lichen cover. Dimensions: 2.4 m x 1.6 m x 0.5 m high. Dip/dip direction: 14°/220°.



### TS12-IN-02

Medium to coarse-grained granitic boulder on crest of moraine ridge adjacent to the Inylchek River. Same ridge as TS12-IN-01. Lightly to moderately varnished on sampled surface and moderate lichen cover. Dimensions: 3.1 m x 1.6 m x 1.3 m high. Dip/dip direction: 10°/223°.



### TS12-IN-03

Medium to coarse-grained granitic boulder on crest of moraine ridge adjacent to the Inylchek River. Same ridge as TS12-IN-01. Moderately varnished on sampled surface and moderate lichen cover. Dimensions: 2 m x 1 m x 0.6 m high. Dip/dip direction: 03°/010°.



### TS12-IN-04

Medium to coarse-grained granitic boulder on crest of moraine ridge adjacent to the Inylchek River. Same ridge as TS12-IN-01. Moderately to heavily varnished on sampled surface with patchy lichen cover. Dimensions: 4 m x 3.1 m x 1.1 m high. Dip/dip direction: 13°/310°.



**TS12-IN-05**

Large, medium to coarse-grained granitic boulder on crest of moraine ridge adjacent to the Inylchek River. Same ridge as TS12-IN-01. Lightly to moderately varnished on sampled surface. Dimensions: 9.2 m x 7.1 m x 2.4 m high. Dip/dip direction: 04°/104°.



**TS12-IN-06**

Medium to coarse-grained granitic boulder on crest of the outermost (closest to the mountain front) lateral moraine ridge from the set of “staircase” ridges along the north bank of the Inylchek River. This moraine level is actually composed of set of three small moraines, forming a broader terrace. Small granitic and limestone boulders along the moraine ridges. Approximately 200 m above ridge with TS12-IN-01 to -05. Heavily varnished on sampled surface with extensive lichen cover. Largest boulder observed on this moraine level. Marmot burrow beneath boulder but no outward evidence of boulder instability. Dimensions: 1.5 m x 1.6 m x 0.7 m high. Dip/dip direction: 09°/110°.



**TS12-IN-07**

Medium to coarse-grained granitic boulder on crest of innermost terminal moraine ridge at west end of Inylchek Valley, near ice-contact margin. Part of a complex of several moraine ridges and remnants. Darkly varnished boulder surface. Dimensions: 8 m x 5.7 m x 1.1 m high. Dip/dip direction: 07°/225°.



**TS12-IN-08**

Medium-grained granitic boulder on crest of discontinuous terminal moraine ridge outside of ridge sampled for TS12-IN-07 at west end of Inylchek Valley. Darkly varnished boulder surface. Evidence of exfoliation and grusification on boulder – appears significantly more weathered than TS12-IN-07. Sample collected from area of darkest varnish near top of boulder with least evidence of exfoliation. Dimensions: 6.8 m x 4.2 m x 2.1 m high. Dip/dip direction: 20°/215°.



**TS12-IN-09**

Medium to coarse-grained large granitic boulder on crest of high moraine ridge south of and approximately 170 m higher than the inner terminal moraine complex at the west end of Inylchek Valley. Patchy varnish on boulder surface suggesting spalling of surface. Sampled raised area with very dark varnish. Dimensions: 12.4 m x 7.1 m x 0.7 m high. Dip/dip direction: 09°/030°.



### TS12-IN-10

Medium to very-coarse-grained large granitic boulder on crest of same moraine ridge as TS12-IN-09. Patchy varnish on boulder surface suggesting spalling of surface. Sampled raised area with darker varnish. Dimensions: 10.1 m x 8.9 m x 1.6 m high. Dip/dip direction: 10°/034°.



**TS12-IN-11**

Medium to coarse-grained granitic boulder on crest of innermost terminal moraine ridge at west end of Inylchek Valley. Part of a complex of several moraine ridges and remnants. Moderately varnished boulder surface, with local very dark patches. Sampled darkly varnished raised area approximately 5 cm above surrounding rock. Dimensions: 7.5 m x 3.5 m x 1.3 m high. Dip/dip direction: 31°/144°.



### TS12-IN-12

Medium to coarse-grained granitic boulder on crest of older, lower moraine ridge south of the main terminal moraine (INK-01, -02, TS12-IN-07) at west end of Inylchek Valley.

Part of a complex of several moraine ridges and remnants. Moderately varnished boulder surface, with local very dark patches. Sampled darkly varnished raised area approximately 2 cm above surrounding rock. Dimensions: 16 m x 10 m x 5.5 m high.

Dip/dip direction: 31°/144°.



**TS12-SD-01**

Medium to coarse-grained granitic boulder in shallow closed depression on the second highest hummocky moraine observed to the south of the Sary-Dzaz River. Sampled pegmatite vein along boulder crest. Moderate to sparse lichen cover on sampled surface. Dimensions: 8.0 m x 3.8 m x 1.1 m high. Dip/dip direction: 24°/188°.



### TS12-SD-02

Medium to coarse-grained, flat-lying, granitic boulder on crest of hummock along the second highest hummocky moraine observed to the south of the Sary-Dzaz River. Sampled pegmatite vein along boulder crest. Moderate to sparse lichen cover on sampled surface. Dimensions: 2.0 m x 1.0 m x 0.4 m high. Dip/dip direction: 02°/092°.



### TS12-SD-03

Medium to coarse-grained granitic boulder perched just off the crest of a roche moutonnée north of the Sary-Dzaz River. Moderate lichen cover on sampled surface.

Dimensions: 2.2 m x 2.0 m x 1.2 m high. Dip/dip direction: 08°/170°.



### SJ-Q1-1

Rounded granitic boulder found in association with a moraine ridge remnant high up on the valley slope along E side of Sary-Dzaz River, south of western end of Inylchek Valley and north of the junction with Kaindy Valley. Approximately 4 m from the crest of the ridge. Dimensions: ca. 1 m equant. Sub-horizontal upper surface sampled.



**SJ-Q1-4**

Coarse-grained granitic boulder on same ridge remnant as SJ-Q1-1. Dimensions: 5 m x 5 m x 1 m high. Horizontal upper surface sampled.



### SJ-Q1-5

Very large medium-to coarse-grained granitic boulder from same moraine remnant as SJ-Q1-1. Dimensions: 2 m x 6 m x 4 m high. Sampled upper surface dip/dip direction: 27°/010°.

