

Table S1. Radiocarbon dating results for samples collected in the upper parts of trough valleys within the Russian Altai and published after (Agatova et al., 2012).

N	Lab code	Location				N° E°	Altitude m a.s.l.	Sample type	Tree specie	¹⁴ C Age	Calibrated age (2σ)	Interpretation	Reference
		Range	Range slope	Exposition	Loc.								
1	LU-6452	Mongun-Taiga	NE	NE	East Mugur valley		2350	Tree fragment		3370±70	3640±185	Warm and humid climate	Ganushkin et al., 2017
2	LU-6949	Mongun-Taiga	NE	NE	East Mugur valley		2640	Tree fragment		8140±80	9090±310	Warm and humid climate	Ganushkin et al., 2016
3	SOAN-8116	Mongun-Taiga	NE	E	East Mugur valley, floodplain in front of Aktru moraine of the East Mugur glacier	N49°17'24" E89°10'55"	2642	Base part of tree trunk with bark fragments <i>in situ</i>	Pinus Sibirica	8900±95	9960±270	Trees grow within modern glacial zone	Nazarov, Myglan 2012
4	SOAN-8117	Mongun-Taiga	NE	E	East Mugur valley, floodplain downstream the Aktru moraine of the East Mugur glacier	N49°17'54" E89°11'29"	2575	Base part of tree trunk with bark fragments <i>in situ</i>	Pinus Sibirica	5285±55	6065±140	Trees grow within modern glacial zone	Nazarov, Myglan 2012
5	IGAN 4089	Chikhachev	S	W	Upper Boguty valley	N49°45'40" E89°27'57"	2472	Fragment of charcoal	Larix Sibirica	7640±100	8415±210	Climate is favorable for growing tree vegetation	Nepop et al., 2020
6	SOAN 2122	Chikhachev	S	W	Upper Boguty valley		2480	Fragment of charcoal		8510±40	9505±35	Climate is favorable for growing tree vegetation	Rusanov and Orlova, 2013
7	SOAN 2288	Chikhachev	S	W	Upper Boguty valley		2480	Fragment of charcoal		8730±90	9840±305	Climate is favorable for growing tree vegetation	Rusanov and Orlova, 2013
8	SOAN 2289	Chikhachev	S	W	Upper Boguty valley		2480	Fragment of charcoal		8330±95	9280±240	Climate is favorable for growing tree vegetation	Rusanov and Orlova, 2013
9	SOAN 2290	Chikhachev	S	W	Upper Boguty valley		2480	Fragment of charcoal		8890±70	9970±235	Climate is favorable for growing tree vegetation	Rusanov and Orlova, 2013

10	SOAN 8674	Chikhachev	S	W	Upper Boguty valley	N49°45'40" E89°27'57"	2472	Fragment of charcoal	Larix Sibirica	7780±75	8630±225	Climate is favorable for growing tree vegetation	Nepop et al., 2020
11	SOAN 9366-2	Chikhachev	S	W	Upper Boguty valley	N49°45'40" E89°27'57"	2472	Fragment of charcoal	Larix Sibirica	7470±150	8265±280	Climate is favorable for growing tree vegetation	Nepop et al., 2020
12	IGAN 3694	South-Chuya	N	E	Akkol valley, forefield of Sofiisky glacier	N49°48'29" E87°49'20"	2476	Tree fragment washed out from the glacier	Pinus Sibirica	4050±80	4590±235	Trees grow within modern glacial zone	Nazarov, Myglan 2012
13	IGAN 3695	South-Chuya	N	E	Akkol valley, forefield of Sofiisky glacier	N49°48'29" E87°49'18"	2466	Tree fragment washed out from the glacier	Pinus Sibirica	3550±110	3860±290	Trees grow within modern glacial zone	Nazarov, Myglan 2012
14	IGAN 3882	South-Chuya	N	E	Akkol valley, forefield of Sofiisky glacier	N49°48'40" E7°50'13"	2458	Tree fragment washed out from the glacier	Pinus Sibirica	3040±70	3200±190	Trees grow within modern glacial zone	Nazarov, Myglan 2012
15	IGAN 3887	South-Chuya	N	E	Akkol valley, forefield of Sofiisky glacier	N49°48'29" E87°49'20"	2476	Tree fragment washed out from the glacier	Pinus Sibirica	3020±70	3190±185	Trees grow within modern glacial zone	Nazarov, Myglan 2012
16	SOAN 6915	South-Chuya	N	E	Akkol valley, forefield of Sofiisky glacier	N49°49'33" E87°49'20"	2451	Tree fragment washed out from the glacier	Pinus Sibirica	3525±70	3800±185	Trees grow within modern glacial zone	Nazarov, Myglan 2012
17	SOAN 6916	South-Chuya	N	E	Akkol valley, forefield of Sofiisky glacier	N49°48'28" E87°49'11"	2459	Tree fragment washed out from the glacier	Pinus Sibirica	3365±95	3615±220	Trees grow within modern glacial zone	Nazarov, Myglan 2012
18	SOAN 7383	South-Chuya	N	E	Akkol valley, forefield of Sofiisky glacier	N49°48'28" E87°49'13"	2480	Tree fragment washed out from the glacier	Pinus Sibirica	4270±110	4865±410	Trees grow within modern glacial zone	Nazarov, Myglan 2012

19	IGAN 3875	North- Chuya	NE	E	Maashey valley, forefield of Maashey glacier	N50°07'46" E87°35'32"	2157	Tree fragment washed out from the glacier	Pinus Sibirica	4870±70	5590±255	Trees grow within modern glacial zone	Nazarov, Myglan 2012
20	IGAN 3880	North- Chuya	NE	E	Maashey valley, forefield of Maashey glacier	N50°06'29" E87°36'46"	2174	Tree fragment washed out from the glacier	Pinus Sibirica	4540±80	5175±285	Trees grow within modern glacial zone	Nazarov, Myglan 2012
21	SOAN- 6467	North- Chuya	NE	E	Maashey valley, forefield of Maashey glacier	N50°06'32" E87°35'45"	2176	Tree fragment washed out from the glacier	Pinus Sibirica	5230±55	6045±140	Trees grow within modern glacial zone	Nazarov, Myglan 2012
22	SOAN- 6468	North- Chuya	NE	E	Maashey valley, forefield of Maashey glacier	N50°06'44" E87°35'37"	2158	Tree fragment washed out from the glacier	Pinus Sibirica	4890±50	5610±125	Trees grow within modern glacial zone	Nazarov, Myglan 2012
23	SOAN- 7376	North- Chuya	NE	E	Maashey valley, forefield of Maashey glacier	N50°07'46" E87°35'33"	2145	Tree fragment washed out from the glacier	Pinus Sibirica	4985±95	5705±215	Trees grow within modern glacial zone	Nazarov, Myglan 2012
24	SOAN- 7377	North- Chuya	NE	E	Maashey valley, forefield of Maashey glacier	N50°06'40" E87°35'42"	2158	Tree fragment washed out from the glacier	Pinus Sibirica	4680±90	5330±270	Trees grow within modern glacial zone	Nazarov, Myglan 2012
25	SOAN- 7378	North- Chuya	NE	E	Maashey valley, forefield of Maashey glacier	N50°06'34" E87°35'46"	2173	Tree fragment washed out from the glacier	Pinus Sibirica	4710±100	5360±295	Trees grow within modern glacial zone	Nazarov, Myglan 2012
26	IGAN 3876	Katun	N	E	Mensu valley, forefield of Mensu glacier	N49°51'58" E86°43'11"	1993	Tree fragment washed out from the glacier	Pinus Sibirica	2540±70	2570±190	Trees grow within modern glacial zone	Nazarov, Myglan 2012
27	IGAN 3877	Katun	N	E	Mensu valley, forefield of Mensu glacier	N49°51'22" E86°42'27"	2147	Tree fragment washed out	Pinus Sibirica	4520±60	5205±230	Trees grow within modern glacial zone	Nazarov, Myglan 2012

								from the glacier					
28	IGAN 3883	Katun	N	E	Mensu valley, forefield of Mensu glacier	N49°48'28" E86°49'13"	1993	Tree fragment washed out from the glacier	Pinus Sibirica	1440±70	1395±130	Trees grow within modern glacial zone	Nazarov, Myglan 2012
29	IGAN 3884	Katun	N	E	Mensu valley, forefield of Mensu glacier	N49°51'58" E86°43'11"	1993	Tree fragment washed out from the glacier	Pinus Sibirica	2310±70	2410±280	Trees grow within modern glacial zone	Nazarov, Myglan 2012
30	SOAN 6917	Katun	N	E	Akkem valley, forefield of Akkem glacier	N49°53'01" E86°32'55"	2106	Tree fragment on the valley slope near the modern glacier	Pinus Sibirica	400±40	420±100	Tree killed by climate deterioration	Galakhov et al., 2012
31	SOAN 6918	Katun	N	E	Akkem valley, forefield of Akkem glacier	N49°53'04" E86°32'55"	2114	Tree fragment on the glacier forefield	Larix Sibirica	1400±70	1350±170	Tree killed by climate deterioration	Galakhov et al., 2012
32	SOAN 6919	Katun	N	E	Akkem valley, forefield of Akkem glacier	N49°52'37" E86°33'05"	2113	Tree fragment on the glacier forefield	Larix Sibirica	3600±85	3900±250	Tree killed by climate deterioration	Galakhov et al., 2012
33	SOAN 6920	Katun	N	E	Akkem valley, forefield of Akkem glacier	N49°52'30" E86°33'04"	2109	Tree fragment on the glacier forefield	Larix Sibirica	2895±35	3045±115	Tree killed by climate deterioration	Galakhov et al., 2012
34	SOAN 6921	Katun	N	E	Akkem valley, forefield of Akkem glacier	N49°52'25" E86°33'04"	2124	Tree fragment on the glacier forefield	Larix Sibirica	3140±30	3350±95	Tree killed by climate deterioration	Galakhov et al., 2012
35	SOAN 6922	Katun	N	E	Akkem valley, forefield of Akkem glacier	N49°53'03" E86°33'05"	2114	Tree fragment on the glacier forefield	Larix Sibirica	2970±45	3160±165	Tree killed by climate deterioration	Galakhov et al., 2012
36	SOAN 6923	Katun	N	E	Akkem valley, forefield of Akkem glacier	N49°52'41" E86°33'09"	2100	Tree fragment on the glacier forefield	Larix Sibirica	3835±45	4255±155	Tree killed by climate deterioration	Galakhov et al., 2012

37	SOAN 6925	Katun	N	E	Mensu valley, forefield of Mensu glacier	N49°51'32" E86°42'30"	2149	Tree fragment washed out from glacier	Pinus Sibirica	5595±85	6420±205	Trees grow within modern glacial zone	Nazarov, Myglan 2012
38	SOAN 6926	Katun	N	E	Mensu valley, forefield of Mensu glacier	N49°51'32" E86°42'35"	2137	Tree fragment washed out from glacier	Pinus Sibirica	5545±85	6335±200	Trees grow within modern glacial zone	Nazarov, Myglan 2012
39	SOAN 6927	Katun	N	E	Mensu valley, forefield of Mensu glacier	N49°51'35" E86°42'31"	2137	Tree fragment washed out from glacier	Pinus Sibirica	5315±75	6105±170	Trees grow within modern glacial zone	Nazarov, Myglan 2012
40	SOAN 6930	Katun	N	E	Mensu valley, forefield of Mensu glacier	N49°51'35" E86°43'17"	1970	Tree fragment washed out from glacier	Pinus Sibirica	5395±75	6135±180	Trees grow within modern glacial zone	Nazarov, Myglan 2012
41	SOAN 6931	Katun	N	E	Mensu valley, forefield of Mensu glacier	N49°52'01" E86°43'12"	1970	Tree fragment washed out from glacier	Pinus Sibirica	2490±75	2550±185	Trees grow within modern glacial zone	Nazarov, Myglan 2012
42	SOAN 7386	Katun	N	E	Mensu valley, forefield of Mensu glacier	N49°52'05" E86°43'16"	1986	Tree fragment washed out from glacier	Pinus Sibirica	4610±80	5310±270	Trees grow within modern glacial zone	Nazarov, Myglan 2012
43	SOAN-9440	Katun	N	N	Jarlu valley	N49°55'06" E86°33'27"	2077	Fragment of paleotree in situ	Larix Sibirica	190±50	185±125	Warm and humid climate	Galakhov et al., 2018
44	SOAN-9590	Katun	N	watershed	watershed Jarlu-Tekelu	N49°55'17" E86°36'42"	2702	Fragment of paleotree trunk with a base part, buried by landslide	Larix Sibirica	8040±90	8925±315	Climate is favorable for growing tree vegetation	Galakhov et al., 2018
45	SOAN-9591	Katun	N	watershed	watershed Jarlu-Tekelu	N49° E86°	2702	Fragment of paleotree trunk with a base part, buried by landslide	Larix Sibirica	8285±85	9250±220	Climate is favorable for growing tree vegetation	Galakhov et al., 2018
46	SOAN-9592	Katun	N	watershed	watershed Jarlu-Tekelu	N49°55'13" E86°36'42"	2687	Fragment of paleotree trunk with a base part,	Larix Sibirica	6170±80	7035±225	Climate is favorable for growing tree vegetation	Galakhov et al., 2018

								buried by landslide					
47	SOAN-9593	Katun	N	watershed	watershed Jarlu-Tekelu	N49°55'13" E86°36'41"	2671	Fragment of paleotree trunk with a base part, buried by landslide	Larix Sibirica	8310±90	9065±335	Climate is favorable for growing tree vegetation	Galakhov et al., 2018
48	SOAN-9615	Katun	N	watershed	watershed Jarlu-Tekelu	N49°55'25" E86°36'37"	2720	Fragment of tree roots	Larix Sibirica	4480±80	5095±220	Climate is favorable for growing tree vegetation	Galakhov et al., 2018
49	SOAN-9617	Katun	N	watershed	watershed Jarlu-Tekelu	N49°55'25" E86°36'37"	2720	Fragment of tree roots	Larix Sibirica	4835±70	5525±195	Climate is favorable for growing tree vegetation	Galakhov et al., 2018
50	SOAN-9618	Katun	N	watershed	watershed Jarlu-Tekelu	N49°55'13" E86°36'42"	2687	Fragment of paleotree trunk with a base part, buried by landslide	Larix Sibirica	5780±60	6585±140	Climate is favorable for growing tree vegetation	Galakhov et al., 2018
51	SOAN-9637	Katun	N	watershed	watershed Jarlu-Tekelu	N49°55'13" E86°36'42"	2687	Fragment of tree roots in situ	Larix Sibirica	3870±100	4275±295	Climate is favorable for growing tree vegetation	Galakhov et al., 2018
52	SOAN-9638	Katun	N	watershed	watershed Jarlu-Tekelu	N49°55'27" E86°36'44"	2700	Fragment of paleotree trunk	Larix Sibirica	7880±125	8720±295	Climate is favorable for growing tree vegetation	Galakhov et al., 2018
53	SOAN-9639	Katun	N	watershed	watershed Jarlu-Tekelu	N49°55'27" E86°36'44"	2700	Fragment of paleotree trunk in moraine	Larix Sibirica	9905±125	11425±525	Climate is favorable for growing tree vegetation	Galakhov et al., 2018
54	SOAN-9640	Katun	N	watershed	watershed Jarlu-Tekelu	N49°55'25" E86°36'37"	2720	Fragment of tree roots	Larix Sibirica	4250±120	4860±420	Climate is favorable for growing tree vegetation	Galakhov et al., 2018
55	SOAN-9641	Katun	N	watershed	watershed Jarlu-Tekelu	N49°55'13" E86°36'42"	2687	Fragment of tree roots in situ	Larix Sibirica	5930±100	6750±255	Climate is favorable for growing tree vegetation	Galakhov et al., 2018