

5 Fig. S1: Transect of short cores at proximal (Plan19-04) to distal (Plan18-10) locations with respect to the juvenile fan. a) Bathymetric slope gradient map showing the coring sites of the transect and the spur of profile b). b) Vertically exaggerated topographic profile from the proximal fan delta in the South across the short core transect towards the depocentre. Note that although the cores are relatively closely spaced (50–75 m) there is almost 2 m height difference between the most proximal to the most distal core. Onshore DEM derived from Land Tirol (data.tirol.gv.at).

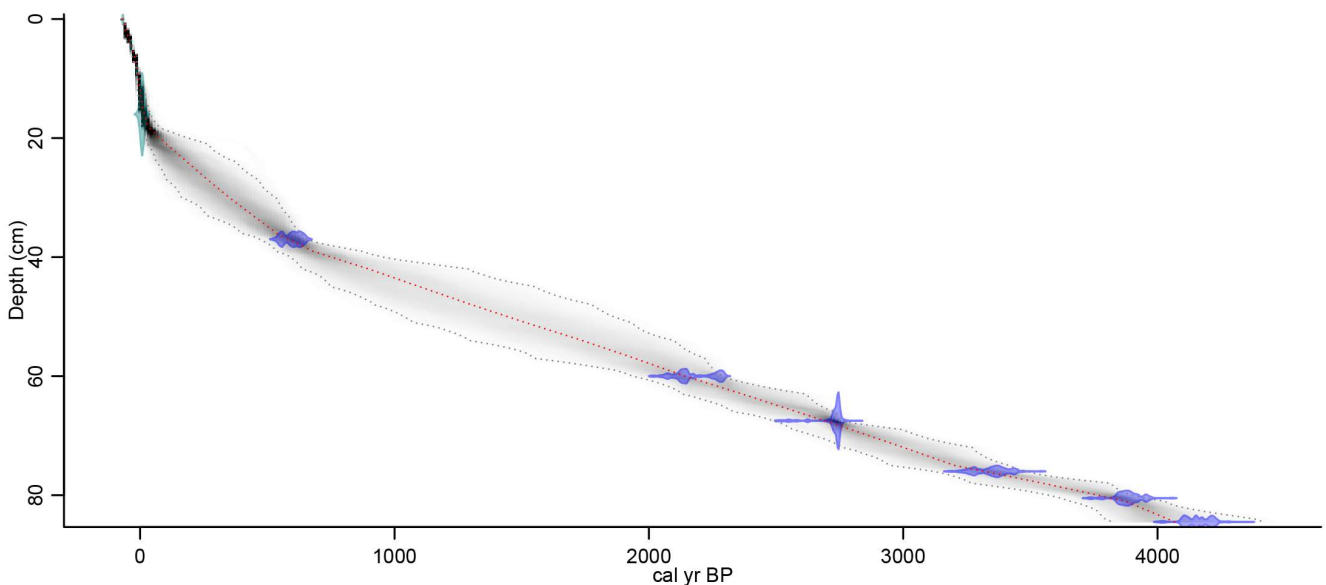


Fig. S2: Age-depth model of the most distal core Plan18-10 (Oswald et al., 2021), established by Bayesian age–depth modelling of radiocarbon ages using the R-software Bacon v 2.4.3

10 **Table S1: Coring locations**

Core ID	X UTM	Y UTM	Water depth (m)
Plan18-10	635618	5258915	77
Plan19-01	635595	5259023	77
Plan19-02	635593	5258841	76
Plan19-03	635582	5258791	75

Table S2: Radiocarbon and short-lived radionuclide samples of Plansee

Core ID	Sample no.	Core depth in core Plan18-10 (cm)	Radiocarbon age (CE/BCE $\pm 1\sigma$)	95 % calibrated age range (cal CE/cal BCE)	Material
Plan18-10	-	4.5	-	1986 cal CE	¹³⁷ Cs peak
Plan18-10	-	8.5	-	1963 cal CE	¹³⁷ Cs peak
Plan18-L1A-0-1.5	ETH-101431	55.5	1355 \pm 35 CE	1296 cal CE to 1412 cal CE	leaf and conifer needle remains
Plan18-L1A-0-1.5	ETH-101432	85	204 \pm 24 BCE	231 cal BCE to 108 cal BCE	leaf and conifer needles
Plan18-10	ETH-94774	92.5	641 \pm 22 BCE	806 cal BCE to 770 cal BCE	needle and conifer cone piece
Plan18-L1A-0-1.5	ETH-101433	106.5	1186 \pm 43 BCE	1499 cal BCE to 1291 cal BCE	conifer needle remains
Plan18-L1A-0-1.5	ETH-103730	112	1631 \pm 26 BCE	2022 cal BCE to 1881 cal BCE	conifer needle

Table S3: Geochemical data

Core	Sediment depth [cm]	d ¹³ C _{TOC}	wt% TN	wt% TOC	TOC/TN _{molar}	Interpretation
Plan 18-10	23	-29.2	0.22	2.2	12	eq
Plan 18-10	24	-28.8	0.22	2.3	12	eq
Plan 18-10	25	-28.7	0.21	2.2	12	eq
Plan 18-10	26	-28.8	0.22	2.2	12	eq
Plan 18-10	96	-27.7	0.13	1.7	15	eq
Plan 18-10	97	-27.7	0.12	1.4	14	eq
Plan 18-10	114	-27.3	0.09	1.0	14	df
Plan 18-10	117	-27.5	0.10	1.3	14	df
Plan 18-10	120	-27.7	0.12	1.4	14	eq
Plan 18-10	121	-27.2	0.11	1.3	14	eq
Plan 18-10	122	-27.3	0.12	1.5	14	eq
Plan 18-10	123	-27.6	0.10	1.6	18	eq
Plan 19-02	1	-28.3	0.11	1.5	15	background
Plan 19-02	4	-29.9	0.22	2.1	11	df
Plan 19-02	7	-28.0	0.12	1.8	16	df
Plan 19-02	10	-29.2	0.14	2.0	15	df
Plan 19-02	13	-28.7	0.15	2.0	16	background
Plan 19-02	16	-27.9	0.15	2.2	17	df
Plan 19-02	19	-28.7	0.19	2.2	13	df
Plan 19-02	24	-29.2	0.19	2.3	14	df
Plan 19-02	29	-28.5	0.15	1.9	14	background
Plan 19-02	39	-30.4	0.20	2.3	13	background
Plan 19-02	44	-29.6	0.19	2.2	14	background
Plan 19-02	49	-28.5	0.18	2.3	15	background
Plan 19-02	54	-28.4	0.17	1.8	12	df
Plan 19-02	56	-28.6	0.19	2.2	13	df
Plan 19-02	59	-27.9	0.12	1.7	17	df
Plan 19-02	64	-29.7	0.20	2.6	15	df
Plan 19-02	69	-27.4	0.11	1.9	20	df
Plan 19-02	79	-29.5	0.17	2.3	15	df
Plan 19-02	84	-27.7	0.09	1.5	21	df
Plan 19-02	85	-28.6	0.15	2.0	16	df
Plan 19-02	89	-28.5	0.11	1.9	21	df
Plan 19-02	94	-28.9	0.15	1.9	15	df
Plan 19-02	99	-29.2	0.16	2.2	17	background
Plan 19-02	104	-28.3	0.15	2.3	18	background
Plan 19-02	114	-27.8	0.12	1.2	12	eq
Plan 19-02	115	-27.8	0.11	1.7	17	eq
Plan 19-02	116	-28.1	0.11	1.7	17	eq
Plan 19-02	117	-27.7	0.10	1.5	16	eq
Plan 19-02	118	-28.6	0.10	1.4	16	eq
Plan 19-02	119	-28.5	0.10	1.3	15	eq
Plan 19-02	120	-28.0	0.10	1.7	19	eq
Plan 19-02	124	-28.0	0.08	1.5	22	df
Plan 19-02	129	-27.8	0.13	1.6	14	df
Plan 19-03	4	-28.5	0.11	1.2	13	df
Plan 19-03	7	-29.2	0.16	1.9	14	df
Plan 19-03	10	-27.9	0.15	2.1	16	df
Plan 19-03	13	-28.9	0.18	2.1	14	df

Core	Sediment depth [cm]	d ¹³ C _{TOC}	wt% TN	wt% TOC	TOC/TN _{molar}	Interpretation
Plan 19-03	16	-29.5	0.20	2.2	13	df
Plan 19-03	19	-27.8	0.18	2.0	13	df
Plan 19-04	4	-25.5	0.11	1.8	18	df
Plan 19-04	7	-28.7	0.17	2.1	15	df
Plan 19-04	13	-29.5	0.19	2.1	13	df
Plan 19-04	16	-27.6	0.17	2.2	15	df
Plan 19-04	24	-28.8	0.17	2.3	15	df
Plan 19-04	34	-28.3	0.12	2.2	21	df
Plan 19-04	37	-28.8	0.18	2.8	18	df
Plan 19-04	39	-28.0	0.14	2.3	19	background
Plan 19-04	49	-28.2	0.17	2.8	19	df
Plan 19-04	54	-28.2	0.10	1.9	17	df
Plan 19-04	59	-29.2	0.15	2.3	18	df
Plan 19-04	61	-27.7	0.13	1.8	16	df
Plan 19-04	69	-27.2	0.11	1.7	16	df
Plan 19-04	79	-26.9	0.06	1.3	17	df
Plan 19-04	84	-27.9	0.10	1.7	14	df
Plan 19-04	94	-27.2	0.05	1.1	24	df
Plan 19-04	104	-27.5	0.06	1.4	21	eq
Plan 19-04	109	-27.3	0.05	0.7	13	eq
Plan 19-04	114	-27.1	0.07	0.9	13	eq
Plan 19-04	119	-26.9	0.07	0.9	13	eq
Plan 19-04	124	-28.0	0.06	0.8	10	eq
Plan 19-04	129	-27.1	0.07	1.0	12	eq
Plan 19-04	134	-26.9	0.05	0.7	18	eq

Table S4: 138 cross-correlated debris-flow (df) deposits in Plan18-10

Df No.	Mean age [cal CE/cal BCE]		Deposit thickness [cm]	Df No.	Mean age [cal CE/cal BCE]		Deposit thickness [cm]
1	2017	CE	0.2	70	647	CE	1.2
2	2015	CE	0.4	71	591	CE	0.2
3	2011	CE	0.7	72	570	CE	0.2
4	2010	CE	0.5	73	548	CE	0.4
5	2005	CE	0.6	74	520	CE	0.2
6	1999	CE	0.7	75	499	CE	0.9
7	1993	CE	0.4	76	470	CE	0.2
8	1991	CE	0.3	77	361	CE	0.2
9	1988	CE	0.2	78	287	CE	0.5
10	1984	CE	1.3	79	213	CE	0.9
11	1973	CE	0.2	80	179	CE	0.2
12	1972	CE	0.4	81	144	CE	1.1
13	1969	CE	0.3	82	27	CE	0.5
14	1966	CE	0.7	83	19	BCE	0.4
15	1965	CE	0.2	84	53	BCE	0.2
16	1965	CE	0.2	85	60	BCE	0.4
17	1964	CE	1.4	86	67	BCE	1.3
18	1959	CE	1.3	87	106	BCE	0.3
19	1955	CE	1.1	88	200	BCE	0.2
20	1950	CE	0.2	89	222	BCE	0.4
21	1950	CE	0.3	90	290	BCE	0.2
22	1946	CE	0.3	91	357	BCE	0.4
23	1945	CE	0.4	92	409	BCE	0.2
24	1942	CE	0.3	93	439	BCE	0.3
25	1937	CE	0.5	94	532	BCE	0.4
26	1934	CE	0.3	95	568	BCE	0.3
27	1933	CE	0.3	96	626	BCE	0.6
28	1932	CE	0.3	97	661	BCE	0.3
29	1932	CE	1.3	98	754	BCE	0.2
30	1931	CE	0.2	99	775	BCE	0.2
31	1930	CE	1	100	782	BCE	0.2
32	1923	CE	0.6	101	818	BCE	0.4
33	1918	CE	0.3	102	874	BCE	0.4
34	1908	CE	0.8	103	881	BCE	1.3
35	1881	CE	0.7	104	935	BCE	0.2
36	1844	CE	0.5	105	969	BCE	0.4
37	1828	CE	0.5	106	1025	BCE	0.2
38	1806	CE	0.3	107	1032	BCE	0.2
39	1793	CE	0.8	108	1085	BCE	0.2
40	1779	CE	0.5	109	1092	BCE	0.5
41	1739	CE	0.5	110	1185	BCE	0.9
42	1706	CE	0.4	111	1225	BCE	0.4
43	1701	CE	0.4	112	1238	BCE	0.2
44	1671	CE	0.5	113	1287	BCE	0.4
45	1650	CE	0.5	114	1345	BCE	0.1
46	1611	CE	0.3	115	1368	BCE	0.1
47	1596	CE	0.2	116	1507	BCE	0.2
48	1584	CE	0.2	117	1541	BCE	0.2
49	1547	CE	0.3	118	1576	BCE	0.2

Df No.	Mean age [cal CE/cal BCE]		Deposit thickness [cm]	Df No.	Mean age [cal CE/cal BCE]		Deposit thickness [cm]
50	1454	CE	0.4	119	1631	BCE	0.3
51	1435	CE	0.5	120	1664	BCE	0.2
52	1416	CE	0.3	121	1707	BCE	0.3
53	1404	CE	0.3	122	1718	BCE	0.3
54	1329	CE	0.3	123	1761	BCE	0.8
55	1265	CE	0.3	124	1847	BCE	0.2
56	1213	CE	0.2	125	1900	BCE	0.2
57	1110	CE	0.9	126	1944	BCE	0.4
58	1095	CE	0.4	127	1950	BCE	0.3
59	1066	CE	0.3	128	1961	BCE	1.3
60	1044	CE	0.4	129	1978	BCE	5.4
61	984	CE	0.4	130	1984	BCE	0.2
62	950	CE	0.2	131	1989	BCE	0.2
63	930	CE	0.3	132	1995	BCE	0.4
64	910	CE	0.3	133	2000	BCE	0.5
65	863	CE	0.4	134	2006	BCE	0.7
66	836	CE	0.6	135	2012	BCE	0.5
67	782	CE	0.2	136	2017	BCE	0.3
68	769	CE	0.4	137	2023	BCE	0.4
69	695	CE	0.2	138	2034	BCE	0.9