

## Supplementary Table S1

All radiocarbon ages used for the age-depth models at Plansee, Piburgersee and Achensee (Oswald et al., 2021a; b; and this study)

Core ID	Sample no.	Core depth (cm)	Radiocarbon age (a BP $\pm 1\sigma$ )	95% calibrated age range (cal a BP)	Material	Reference
<b>Plansee</b>						
Plan18-10	-	4.5	-	-36	137Cs peak	Oswald et al. (2021b)
Plan18-10	-	8.5	-	-13	137Cs peak	Oswald et al. (2021b)
PLAN18-L1A-0-1.5	ETH-101431	52	595 $\pm$ 35	654-538	leaf and fir needle remains	Oswald et al. (2021b)
PLAN18-L1A-0-1.5	ETH-101432	81.5	2154 $\pm$ 24	2181-2058	leaf and fir needles	Oswald et al. (2021b)
PLAN18-10	ETH-94774	89	2591 $\pm$ 22	2756-2720	needle and fir cone piece	Oswald et al. (2021b)
PLAN18-L1A-0-1.5	ETH-101433	116.5	3136 $\pm$ 43	3449-3241	fir needle remains	Oswald et al. (2021b)
PLAN18-L1A-0-1.5	ETH-103730	129	3581 $\pm$ 26	3972-3831	fir needle	Oswald et al. (2021b)
PLAN18-L1B-1-2.5	ETH-103731	183.5	3782 $\pm$ 24	4236-4089	fir cone scale, needle remains	Oswald et al. (2021b)
PLAN18-L1A-1.5-3	ETH-101434	208	3915 $\pm$ 25	4423-4285	leaf and fir needles	Oswald et al. (2021b)
PLAN18-L1B-2.5-4	ETH-101435	309	5718 $\pm$ 56	6855-6403	leaf and fir needles	Oswald et al. (2021b)
PLAN18-L1A-3-4.5	ETH-101436	322.5	5869 $\pm$ 57	6800-6529	fir needle remains	Oswald et al. (2021b)
PLAN18-L1A-3-4.5	ETH-101437	399	7084 $\pm$ 65	8021-7783	fir needle remains	Oswald et al. (2021b)
PLAN18-L1A-4.5-6	ETH-103732	473	7739 $\pm$ 29	8589-8443	leaf and fir needle remains	Oswald et al. (2021b)
PLAN18-L1B-4-5.5*	ETH-101438	436.5	2595 $\pm$ 24	2759-2720	fir needles	Oswald et al. (2021b)
PLAN18-L1B-4-5.5*	ETH-101439	473.5	3934 $\pm$ 25	4440-4288	pair of fir needles	Oswald et al. (2021b)
PLAN18-L1A-4.5-6	ETH-101440	524	8278 $\pm$ 75	9460-9077	fir needle remains	Oswald et al. (2021b)
PLAN18-L1A-6-7.5	ETH-101441	660	9800 $\pm$ 87	11412-11068	betula fruit, fir needle remains	Oswald et al. (2021b)
PLAN18-L1A-9-10.5	ETH-103733	85	11509 $\pm$ 36	13461 - 13311	Conifer needle fragments	this study
<b>Piburgersee</b>						
PIBU18-01	-	10	-	83-73	210Pb/137Cs extrapolated age <sup>t</sup>	Thies et al. (2012)
PIBU18-01	ETH-94775	54.5	882 $\pm$ 21	903-733	fir needles	Oswald et al. (2021b)
PIBU18-01	ETH-94776	82.5	2493 $\pm$ 22	2720-2489	leaf and fir needles	Oswald et al. (2021b)
PIBU18-01*	ETH-92029	81.5	6457 $\pm$ 23	7427-7323	fir needles	Oswald et al. (2021b)
PIBU18-L1A-3-4.5	ETH-94777	353.5	3241 $\pm$ 22	3557-3395	fir needles, fir cone remains, betula fruit	Oswald et al. (2021b)
PIBU18-L1A_3-4.5	ETH-92030	370.5	3515 $\pm$ 23	3860-3705	leaf and fir needles	Oswald et al. (2021b)
PIBU18-L1A-3-4.5	ETH-94778	383.5	3983 $\pm$ 22	4519-4416	needles and Carpinus Betulus fruit	Oswald et al. (2021b)
PIBU18-L1A-4.5-6	ETH-92031	450	4060 $\pm$ 22	4784-4440	fir needles	Oswald et al. (2021b)
PIBU18-L1B-4-5.5*	ETH-94779	456	4519 $\pm$ 23	5302-5053	fir needles, betula fruit, tree leaf stalk	Oswald et al. (2021b)
PIBU18-L1B-4-5.5	ETH-94780	493.5	4828 $\pm$ 23	5605-5482	fir needles, tree leaf stalk	Oswald et al. (2021b)
PIBU18-L1B-4-5.5	ETH-94781	511	5244 $\pm$ 23	6174-5926	fir needles	Oswald et al. (2021b)
PIBU18-L1A-4.5-6*	ETH-94782	528	6005 $\pm$ 23	6925-6757	leaf remains, needles, betula fruit	Oswald et al. (2021b)
PIBU18-L1A-4.5-6	ETH-94783	551.5	5933 $\pm$ 23	6830 – 6675	needles, twig remains	Oswald et al. (2021b)
PIBU18-L1B-5.5-7*	ETH-92032	571.5	2499 $\pm$ 21	2724-2490	birch fruits, leaves, fir needles	Oswald et al. (2021b)
PIBU18-L1B-5.5-7	ETH-96886	638	8310 $\pm$ 24	9429-9260	leaf fragments, fir needles	Oswald et al. (2021b)
PIBU18-L1A-6-7.5	ETH-94784	650	8762 $\pm$ 25	9899-9634	leaf, twig, betula fruit	Oswald et al. (2021b)

PIBU18-L1A-6-7.5	ETH-96887	671	9299 ± 26	10575-10419	leaf stalk	Oswald et al. (2021b)
PIBU18-L1A-6-7.5	ETH-92033	691	10019 ± 26	11701-11335	twig and leaf remains, fir needle, birch fruits	Oswald et al. (2021b)
PIBU18-L1B-7-8.5	ETH-92034	743	11025 ± 27	13004-12784	fir needles and birch fruit	Oswald et al. (2021b)

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**Achensee**

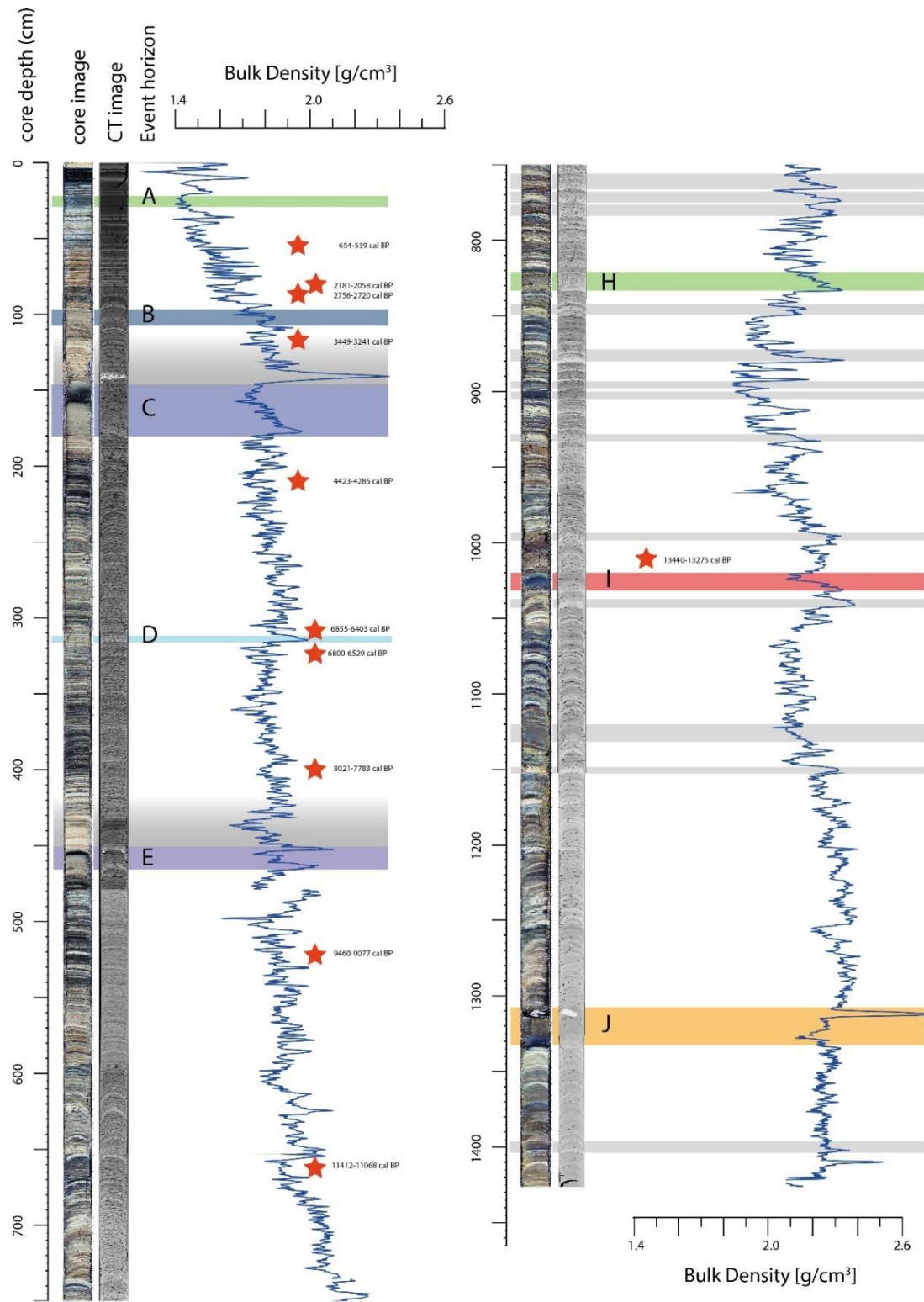
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ACH18-02	ACH18-02_10	7	-	CE 1986	<sup>137</sup> Cs peak	Oswald et al. (2021a)
ACH18-02	ACH18-02_18	15	-	CE 1963	<sup>137</sup> Cs peak	Oswald et al. (2021a)
ACH18-02	ETH-89637 *	40	831 ± 26	778 - 683	5x needle fragments, 1 leaf part	Oswald et al. (2021a)
ACH18-02	ETH-89638 *	45	380 ± 24	501 - 322	3x needles	Oswald et al. (2021a)
ACH18-02	ETH-89639	91	157 ± 25	284 - rec.	3x needles, 3 leaf parts	Oswald et al. (2021a)
ACH17-01	ETH-85081 *	40	3333 ± 24	3636 - 3482	needles, leaf fragments	Oswald et al. (2021a)
ACH17-01	ETH-85080 *	87	1107 ± 24	1060 - 956	needles, leaf fragments	Oswald et al. (2021a)
ACH17-01	ETH-85079	125	1382 ± 23	1344 - 1278	needles, leaf fragments	Oswald et al. (2021a)
ACH19-L3D	ETH-108238	244	7336 ± 29	8189-8030	coating of fruit and leaf, needle fragments	Oswald et al. (2021a)
ACH19-L3C	ETH-108239	418	8200 ± 28	9275-9026	needle fragments + coating of fruit	Oswald et al. (2021a)
ACH19-L3B	ETH-108240	585	8396 ± 30	9523-8305	many small needle fragments	Oswald et al. (2021a)

\* Samples excluded for age-depth modelling

## Supplementary Figure S2:

Longcore data of core PLAN18-L1 at Plansee including histogram-equalized core image, CT image, bulk density,  $^{14}\text{C}$  samples and interpreted event horizons.



### Supplementary Figure S3:

Evaluation of earthquake-related sedimentary imprints to represent a single event using the overlap of the 95% probability density functions of the individual event ages using the R software package 'overlapping' (Pastore & Calcagni, 2019). We defined a PDF event age overlap >40% to indicate a single earthquake event with impact in multiple lakes. PDF event age overlaps < 40% are rejected to represent potential single events. PDF event age overlaps of the events at circa 3.0 and 4.1 ka BP are derived from Oswald *et al.*, (2021b).

