Supplement of

Magnitude and source area estimations of severe prehistoric earthquakes in the western Austrian Alps

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## 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 ± 1σ) | 95% calibrated age range (cal a BP) | Material                                      | Reference                  |
|-------------|-------------|-----------------|-------------------------------|-------------------------------------|-----------------------------------------------|-----------------------------|
| **Plansee** |             |                 |                               |                                     |                                               |                             |
| PLAN18-10   | -           | 4.5             | -13                           | 137Cs peak                          | Oswald et al. (2021b)                         |                             |
| PLAN18-10   | -           | 8.5             | -36                           | 137Cs peak                          | Oswald et al. (2021b)                         |                             |
| PLAN18-LIA-0.1-5 | ETH-101431 | 52               | 595 ± 35                      | leaf and fir needle remains         | Oswald et al. (2021b)                         |                             |
| PLAN18-LIA-0.1-5 | ETH-101432 | 81.5             | 2154 ± 24                     | leaf and fir needles                | Oswald et al. (2021b)                         |                             |
| PLAN18-10   | ETH-94774   | 89               | 2591 ± 22                     | needle and fir cone piece           | Oswald et al. (2021b)                         |                             |
| PLAN18-LIA-0.1-5 | ETH-101433 | 116.5            | 3136 ± 43                     | fir needle remains                  | Oswald et al. (2021b)                         |                             |
| PLAN18-LIB-1.2-5 | ETH-103730 | 129              | 3581 ± 26                     | fir needle                         | Oswald et al. (2021b)                         |                             |
| PLAN18-LIA-1.5-3 | ETH-101434 | 208              | 3915 ± 25                     | leaf and fir needles                | Oswald et al. (2021b)                         |                             |
| PLAN18-LIB-2.5-4 | ETH-101435 | 309              | 5718 ± 56                     | leaf and fir needles                | Oswald et al. (2021b)                         |                             |
| PLAN18-LIA-3.4-5 | ETH-101436 | 322.5            | 5899 ± 57                     | fir needle remains                  | Oswald et al. (2021b)                         |                             |
| PLAN18-LIA-3.4-5 | ETH-101437 | 399              | 7084 ± 65                     | fir needle remains                  | Oswald et al. (2021b)                         |                             |
| PLAN18-LIA-4.5-6 | ETH-103732 | 473              | 7739 ± 29                     | leaf and fir needle remains         | Oswald et al. (2021b)                         |                             |
| PLAN18-LIB-4.5-5 | ETH-101438* | 436.5            | 2595 ± 24                     | fir needles                         | Oswald et al. (2021b)                         |                             |
| PLAN18-LIB-4.4-5 | ETH-101439* | 473.5            | 3557 ± 22                     | pair of fir needles                 | Oswald et al. (2021b)                         |                             |
| PLAN18-LIB-5.6-5 | ETH-101440 | 524              | 8278 ± 73                     | fir needle remains                  | Oswald et al. (2021b)                         |                             |
| PLAN18-LIB-6.7-5 | ETH-101441 | 660              | 9800 ± 87                     | betula fruit, fir needle remains    | Oswald et al. (2021b)                         |                             |
| PLAN18-LIA-9-10.5 | ETH-103733 | 85               | 11509 ± 36                    | Conifer needle fragments            | this study                                   |                             |

| **Piburgersee** |             |                 |                               |                                     |                                               |                             |
| PIBU18-01      | -           | 10              | 83-73                         | 210Pb/137Cs extrapolated age^1        | Thies et al. (2012)                           |                             |
| PIBU18-01      | ETH-94775   | 54.5            | 882 ± 21                      | leaf and fir needles                 | Oswald et al. (2021b)                         |                             |
| PIBU18-01      | ETH-94776   | 82.5            | 2493 ± 22                     | leaf and fir needles                 | Oswald et al. (2021b)                         |                             |
| PIBU18-01*     | ETH-92029   | 81.5            | 6457 ± 23                     | leaf and fir needles                 | Oswald et al. (2021b)                         |                             |
| PIBU18-LIA-3.4-5 | ETH-94777 | 353.5            | 3241 ± 22                     | leaf and fir needles                 | Oswald et al. (2021b)                         |                             |
| PIBU18-LIA-3.4-5 | ETH-92030 | 370.5            | 3515 ± 23                     | leaf and fir needles                 | Oswald et al. (2021b)                         |                             |
| PIBU18-LIA-3.4-5 | ETH-94778 | 383.5            | 3983 ± 22                     | leaf and fir needles                 | Oswald et al. (2021b)                         |                             |
| PIBU18-LIA-4.5-6 | ETH-92031 | 450              | 4060 ± 22                     | leaf and fir needles                 | Oswald et al. (2021b)                         |                             |
| PIBU18-LIB-4.5-5 | ETH-94779* | 456              | 4519 ± 23                     | leaf and fir needles                 | Oswald et al. (2021b)                         |                             |
| PIBU18-LIB-4.5-5 | ETH-94780 | 493.5            | 4828 ± 23                     | leaf and fir needles                 | Oswald et al. (2021b)                         |                             |
| PIBU18-LIB-4.5-5 | ETH-94781 | 511              | 5244 ± 23                     | leaf and fir needles                 | Oswald et al. (2021b)                         |                             |
| PIBU18-LIB-4.5-6 | ETH-94782* | 528              | 6005 ± 23                     | leaf and fir needles                 | Oswald et al. (2021b)                         |                             |
| PIBU18-LIB-4.5-6 | ETH-94783 | 551.5            | 5933 ± 23                     | leaf and birch fruits               | Oswald et al. (2021b)                         |                             |
| PIBU18-LIB-5.5-7 | ETH-92032* | 571.5            | 2499 ± 21                     | leaf and birch fruits               | Oswald et al. (2021b)                         |                             |
| PIBU18-LIB-5.5-7 | ETH-96867 | 638              | 8310 ± 24                     | leaf and birch fruits               | Oswald et al. (2021b)                         |                             |
| PIBU18-LIB-6.7-5 | ETH-94784 | 650              | 8762 ± 25                     | leaf and birch fruits               | Oswald et al. (2021b)                         |                             |
| PIBU18-LIB-6.7-5 | ETH-96887 | 671              | 9299 ± 26                     | leaf and birch fruits               | Oswald et al. (2021b)                         |                             |
| PIBU18-LIB-6.7-5 | ETH-92033 | 691              | 10019 ± 27                    | leaf and birch fruits               | Oswald et al. (2021b)                         |                             |
| PIBU18-LIB-7.8-5 | ETH-92034 | 743              | 11025 ± 27                    | leaf and birch fruits               | Oswald et al. (2021b)                         |                             |

| **Achensee** |
|--------------|
| ACH18-02     | ACH18-02_10 | 7               | -                            | CE 1986                             | Oswald et al. (2021a)                         |                             |
| ACH18-02     | ACH18-02_18 | 15              | -                            | CE 1963                             | Oswald et al. (2021a)                         |                             |
| Location | Sample Code | Age (Years ± Uncertainty) | Depth (m ± Uncertainty) | Description | Reference |
|----------|-------------|---------------------------|--------------------------|-------------|-----------|
| ACH18-02 | ETH-89637 * | 40 ± 26 | 778 - 683 | 5x needle fragments, 1 leaf part | Oswald et al. (2021a) |
| ACH18-02 | ETH-89638 * | 45 ± 24 | 501 - 322 | 3x needles | Oswald et al. (2021a) |
| ACH18-02 | ETH-89639 | 91 ± 25 | 284 - rec. | 3x needles, 3 leaf parts | Oswald et al. (2021a) |
| ACH17-01 | ETH-85081 * | 40 ± 24 | 3636 - 3482 | needles, leaf fragments | Oswald et al. (2021a) |
| ACH17-01 | ETH-85080 * | 87 ± 24 | 1060 - 956 | needles, leaf fragments | Oswald et al. (2021a) |
| ACH17-01 | ETH-85079 | 125 ± 23 | 1344 - 1278 | needles, leaf fragments | Oswald et al. (2021a) |
| ACH19-L3D | ETH-108238 | 244 ± 29 | 8189-8030 | coating of fruit and leaf, needle fragments | Oswald et al. (2021a) |
| ACH19-L3C | ETH-108239 | 418 ± 28 | 9275-9026 | needle fragments + coating of fruit | Oswald et al. (2021a) |
| ACH19-L3B | ETH-108240 | 585 ± 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, $^{14}$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 and 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).
**Supplementary Table S4:**

Available geophysical and core data sets of the investigated lakes.

| Lake     | Geophysical data | Core data | Measurements |
|----------|------------------|-----------|--------------|
|          | Multibeam bathymetry | Seisms (km) | Long core | Short core | MSCL | CT | XRF |
|          | Pinger source | Sparker source | Number | Number |       |     |     |
| Achensee | yes            | 133      | 99       | 2       | 3     | yes | yes | no  |
| Plansee  | yes            | 45       | -        | 1       | 4     | yes | yes | no  |
| Piburgersee | yes       | no penetration | -   | 1       | 1     | yes | yes | yes |
References

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