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Supplement of

Regional beryllium-10 production rate for the mid-elevation mountainous regions in central Europe, deduced from a multi-method study of moraines and lake sediments in the Black Forest

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Detailed sample documentation

FS-01a

Table S1. Location and dimensions of the FS-01a boulder, characteristics of the sampling surface, sample thickness, and topographic shielding factors derived from field data and with the ArcGIS toolbox of Li (2018).

Coordinates (WGS 1984 coordinate system)		47.872193 °N 8.033919 °E
Elevation (m above sea-level)		1128
Context		Boulder on the distal side of the ice-marginal moraine at position FS-01 of the former Feldsee cirque glacier
Lithology		Gneiss
Dimensions: length, width, and height (m)		3.20 × 2.20 × 1.60
Strike/dip of the sampled surface (°)		210/10
Height above ground of the sampled surface (m)		1.50
Sample thickness (cm)		1.5
Topographic shielding factor	**Field-data-based (Balco, 2018)**	0.941791
	Digital-elevation-model-based (Li, 2018)	0.958616

Figure S1. Photo of the FS-01a boulder.

FS-02a

Table S2. Location and dimensions of the FS-02a boulder, characteristics of the sampling surface, sample thickness, and topographic shielding factors derived from field data and with the ArcGIS toolbox of Li (2018).

Coordinates (WGS 1984 coordinate system)		47.872164 °N 8.035611 °E
Elevation (m above sea-level)		1113
Context		Boulder on the crest of the ice-marginal moraine at position FS-02 of the former Feldsee cirque glacier
Lithology		Gneiss
Dimensions: length, width, and height (m)		2.80 × 2.60 × 1.10
Strike/dip of the sampled surface (°)		160/30
Height above ground of the sampled surface (m)		1.05
Sample thickness (cm)		2.4
Topographic shielding factor	**Field-data-based (Balco, 2018)**	0.932007
	Digital-elevation-model-based (Li, 2018)	0.947912

Figure S2. Photo of the FS-02a boulder.

FS-02b

Table S3. Location and dimensions of the FS-02b boulder, characteristics of the sampling surface, sample thickness, and topographic shielding factors derived from field data and with the ArcGIS toolbox of Li (2018).

Coordinates (WGS 1984 coordinate system)		47.871428 °N 8.037746 °E
Elevation (m above sea-level)		1103
Context		Boulder on the crest of the ice-marginal moraine at position FS-02 of the former Feldsee cirque glacier
Lithology		Gneiss
Dimensions: length, width, and height (m)		2.20 × 1.70 × 0.90
Strike/dip of the sampled surface (°)		190/10
Height above ground of the sampled surface (m)		0.85
Sample thickness (cm)		2.6
Topographic shielding factor	**Field-data-based (Balco, 2018)**	0.982220
	Digital-elevation-model-based (Li, 2018)	0.987496

Figure S3. Photo of the FS-02b boulder and the sampling surface.

FS-02c

Table S4. Location and dimensions of the FS-02c boulder, characteristics of the sampling surface, sample thickness, and topographic shielding factors derived from field data and with the ArcGIS toolbox of Li (2018).

Coordinates (WGS 1984 coordinate system)		47.869931 °N 8.036674 °E
Elevation (m above sea-level)		1108
Context		Boulder on the crest of the ice-marginal moraine at position FS-02 of the former Feldsee cirque glacier
Lithology		Gneiss
Dimensions: length, width, and height (m)		3.10 × 2.90 × 1.40
Strike/dip of the sampled surface (°)		100/5
Height above ground of the sampled surface (m)		1.40
Sample thickness (cm)		2.0
Topographic shielding factor	**Field-data-based (Balco, 2018)**	0.984843
	Digital-elevation-model-based (Li, 2018)	0.987583

Figure S4. Photo of the FS-02c boulder. The clipboard has a height of 0.3 m.

FS-02d

Table S5. Location and dimensions of the FS-02d boulder, characteristics of the sampling surface, sample thickness, and topographic shielding factors derived from field data and with the ArcGIS toolbox of Li (2018).

Coordinates (WGS 1984 coordinate system)		47.870075 °N 8.037022 °E
Elevation (m above sea-level)		1107
Context		Boulder on the crest of the ice-marginal moraine at position FS-02 of the former Feldsee cirque glacier
Lithology		Gneiss
Dimensions: length, width, and height (m)		2.50 × 2.30 × 1.80
Strike/dip of the sampled surface (°)		20/15
Height above ground of the sampled surface (m)		1.65
Sample thickness (cm)		1.9
Topographic shielding factor	**Field-data-based (Balco, 2018)**	0.986562
	Digital-elevation-model-based (Li, 2018)	0.988521

Figure S5. Photo of the FS-02c boulder. The clipboard has a height of 0.3 m.

FS-03a

Table S6. Location and dimensions of the FS-03a boulder, characteristics of the sampling surface, sample thickness, and topographic shielding factors derived from field data and with the ArcGIS toolbox of Li (2018).

Coordinates (WGS 1984 coordinate system)		47.869613 °N 8.037770 °E
Elevation (m above sea-level)		1108
Context		Boulder on the distal side of the ice-marginal moraine at position FS-03 of the former Feldsee cirque glacier
Lithology		Gneiss
Dimensions: length, width, and height (m)		3.20 × 2.00 × 2.20
Strike/dip of the sampled surface (°)		0/0
Height above ground of the sampled surface (m)		1.40
Sample thickness (cm)		2.1
Topographic shielding factor	**Field-data-based (Balco, 2018)**	Not determined, as the boulder was located in a dense mixed forest
	Digital-elevation-model-based (Li, 2018)	0.989194

Figure S6. Photo of the FS-03a boulder and the sampling surface.

FS-03b

Table S7. Location and dimensions of the FS-03b boulder, characteristics of the sampling surface, sample thickness, and topographic shielding factors derived from field data and with the ArcGIS toolbox of Li (2018).

Coordinates (WGS 1984 coordinate system)		47.869690 °N 8.037641 °E
Elevation (m above sea-level)		1112
Context		Boulder on the distal side of the ice-marginal moraine at position FS-03 of the former Feldsee cirque glacier
Lithology		Gneiss
Dimensions: length, width, and height (m)		2.20 × 2.20 × 2.50
Strike/dip of the sampled surface (°)		100/35
Height above ground of the sampled surface (m)		1.90
Sample thickness (cm)		2.1
Topographic shielding factor	**Field-data-based (Balco, 2018)**	Not determined, as the boulder was located in a dense mixed forest
	Digital-elevation-model-based (Li, 2018)	0.954505

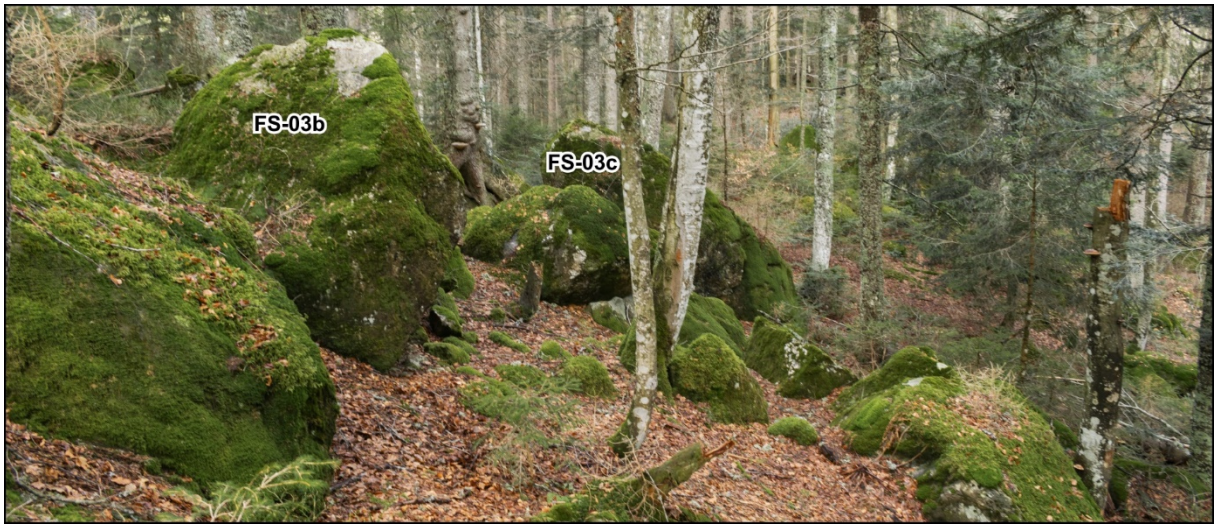

Figure S7. Photo of the FS-03b and FS-03c boulders.

FS-03c

Table S8. Location and dimensions of the FS-03c boulder, characteristics of the sampling surface, sample thickness, and topographic shielding factors derived from field data and with the ArcGIS toolbox of Li (2018).

Coordinates (WGS 1984 coordinate system)		8.037687 °E 47.869732 °N
Elevation (m above sea-level)		1110
Context		Boulder on the distal side of the ice-marginal moraine at position FS-03 of the former Feldsee cirque glacier
Lithology		Gneiss
Dimensions: length, width, and height (m)		4.50 × 2.70 × 3.90
Strike/dip of the sampled surface (°)		80/20
Height above ground of the sampled surface (m)		1.60
Sample thickness (cm)		1.9
Topographic shielding factor	**Field-data-based (Balco, 2018)**	Not determined, as the boulder was located in a dense mixed forest
	Digital-elevation-model-based (Li, 2018)	0.985596

FS-03d

Table S9. Location and dimensions of the FS-03d boulder, characteristics of the sampling surface, sample thickness, and topographic shielding factors derived from field data and with the ArcGIS toolbox of Li (2018).

Coordinates (WGS 1984 coordinate system)		8.038474 °E 47.871280 °N
Elevation (m above sea-level)		1099
Context		Boulder at the end of the distal side of the ice-marginal moraine at position FS-03 of the former Feldsee cirque glacier
Lithology		Gneiss
Dimensions: length, width, and height (m)		2.70 × 2.20 × 0.90
Strike/dip of the sampled surface (°)		0/0
Height above ground of the sampled surface (m)		0.85
Sample thickness (cm)		2.0
Topographic shielding factor	**Field-data-based (Balco, 2018)**	0.985519
	Digital-elevation-model-based (Li, 2018)	0.989967

Figure S8. Photo of the FS-03d boulder and the sampling surface.

FS-03e

Table S10. Location and dimensions of the FS-03e boulder, characteristics of the sampling surface, sample thickness, and topographic shielding factors derived from field data and with the ArcGIS toolbox of Li (2018).

Coordinates (WGS 1984 coordinate system)		8.038263 °E 47.870467 °N
Elevation (m above sea-level)		1106
Context		Boulder on the distal side of the ice-marginal moraine at position FS-03 of the former Feldsee cirque glacier
Lithology		Gneiss
Dimensions: length, width, and height (m)		2.30 × 2.00 × 2.00
Strike/dip of the sampled surface (°)		320/35
Height above ground of the sampled surface (m)		1.15
Sample thickness (cm)		2.4
Topographic shielding factor	**Field-data-based (Balco, 2018)**	0.958662
	Digital-elevation-model-based (Li, 2018)	0.960224

Figure S9. Photo of the FS-03e boulder and the sampling surface.

FS-03f

Table S11. Location and dimensions of the FS-03f boulder, characteristics of the sampling surface, sample thickness, and topographic shielding factors derived from field data and with the ArcGIS toolbox of Li (2018).

Coordinates (WGS 1984 coordinate system)		8.038298 °E 47.870475 °N
Elevation (m above sea-level)		1106
Context		Boulder on the distal side of the ice-marginal moraine at position FS-03 of the former Feldsee cirque glacier
Lithology		Gneiss
Dimensions: length, width, and height (m)		3.20 × 2.30 × 2.20
Strike/dip of the sampled surface (°)		160/20
Height above ground of the sampled surface (m)		1.60
Sample thickness (cm)		2.8
Topographic shielding factor	**Field-data-based (Balco, 2018)**	0.982962
	Digital-elevation-model-based (Li, 2018)	0.985626

Figure S10. Photo of the FS-03f boulder and the sampling surface.

Photos of radiocarbon dated macrofossils

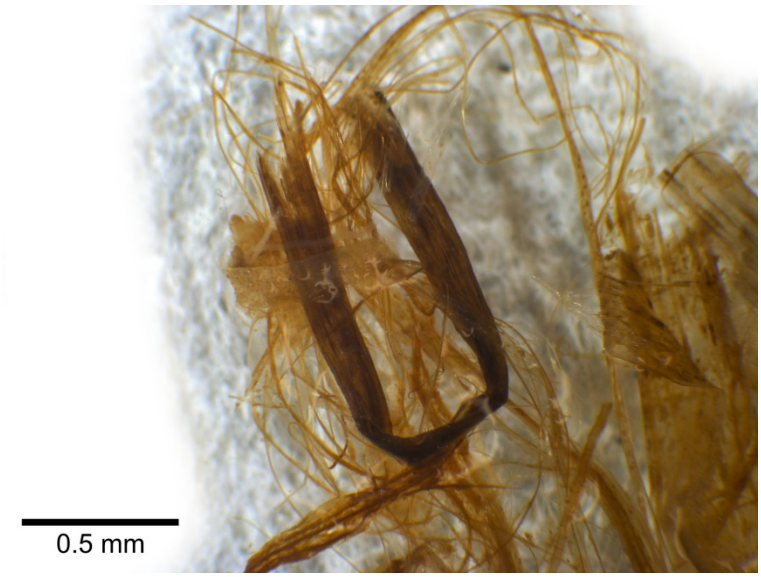

Figure S11. Photo of the FSM-536 sample.

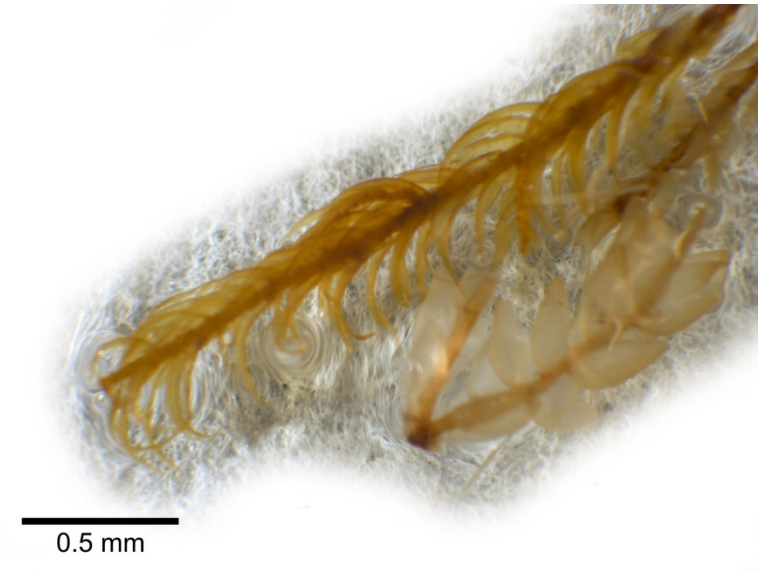

Figure S12. Photo of the FSM-538 sample.

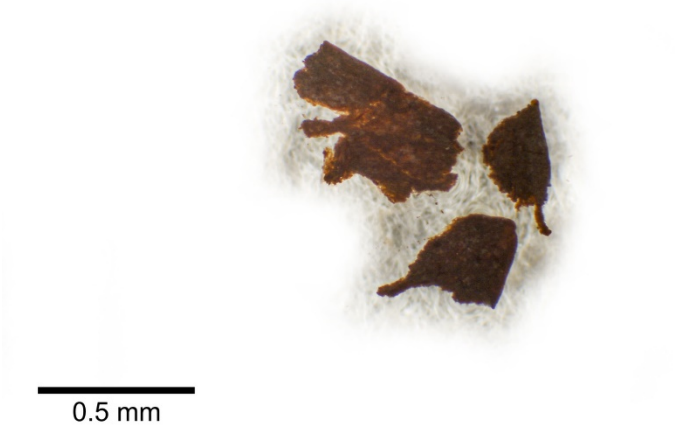

Figure S13. Photo of the FSM-550 sample.

Figure S14. Photo of the FSM-553 sample.

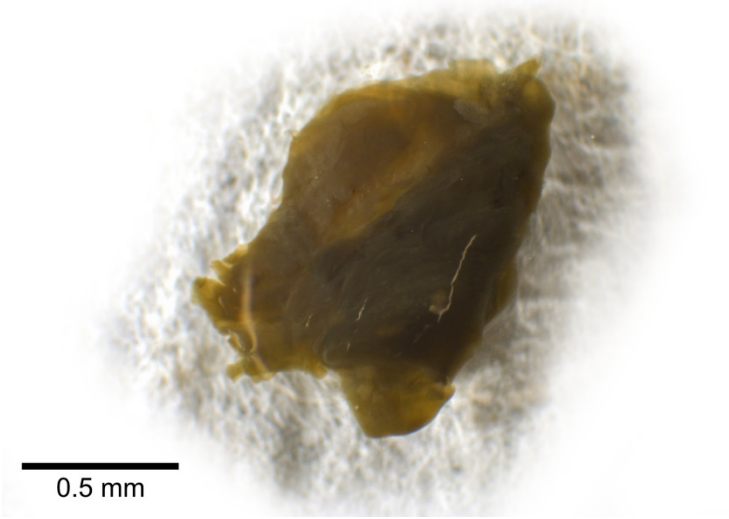

Figure S15. Photo of the FSM-558 sample.

Figure S16. Photo of the FSM-560 sample.

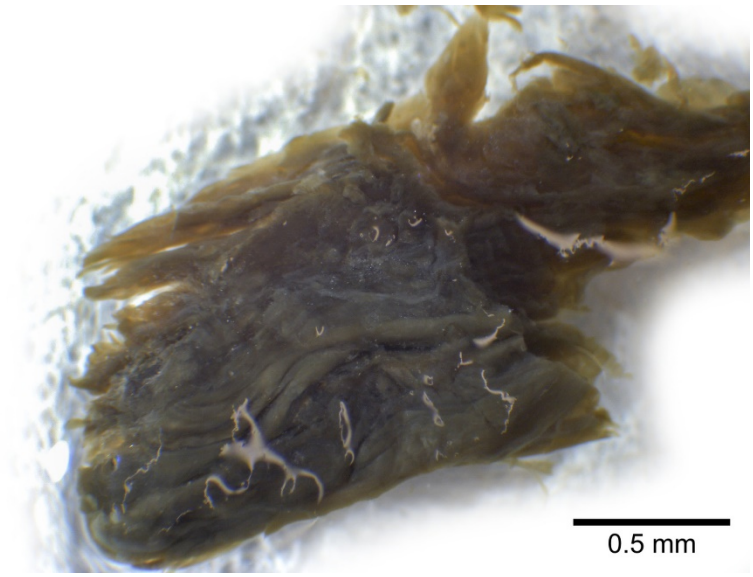

Figure S17. Photo of the FSM-563 sample.

Input code for the *P_Sequence*

```
Options()
 {
  BCAD=FALSE;
 };
 Plot()
 {
  P_Sequence("Feldseemoor",1,2,U(-2,2))
  {
   Boundary("Diamict/lake sediments boundary")
   {
    z=568;
   };
   R_Date("FSM-563", 12880, 60)
   {
    z=561;
   };
   R_Date("FSM-559", 12770, 60)
   {
    z=556;
   };
   Date("FSM5", N(calBP(14526),980))
   {
    z=555.5;
   };
   R_Date("FSM-558", 12930, 70)
   {
    z=554;
   };
   R_Date("FSM-550", 11540, 120)
   {
    z=543;
```

```
 };
 Date("Laacher See Tephra", N(calBP(13006),9))
 {
  z=491;
 };
 Date("FSM1-FG", N(calBP(12127),1000))
 {
  z=485.5;
 };
 R_Combine("FSM-450a / FSM-450b")
 {
  R_Date("FSM-450a", 8620, 60);
  R_Date("FSM-450b", 8650, 50);
  z=428;
 };
 Boundary("Upper boundary of lake sediments")
 {
  z=400;
 };
};
};
```

Input-sheet for the online calculators formerly known as the CRONUS-Earth online calculators

Name for calibration data set: Feldsee Cirque

FS-02a 47.87216 8.03561 1113 std 2.4 2.65 0.947912 0 2020;

FS-02a Be-10 quartz 135802 5343 STD11;

FS-02a true_t FSM 15640 420;

FS-02b 47.87143 8.03775 1103 std 2.6 2.65 0.987496 0 2020;

FS-02b Be-10 quartz 140611 5307 STD11;

FS-02b true_t FSM 15640 420;

FS-02c 47.86993 8.03667 1108 std 2.0 2.65 0.987583 0 2020;

FS-02c Be-10 quartz 142114 4623 STD11;

FS-02c true_t FSM 15640 420;

FS-03a 47.86961 8.03777 1108 std 2.1 2.65 0.989194 0 2020;

FS-03a Be-10 quartz 160738 13164 STD11;

FS-03a true_t FSM 15640 420;

FS-03c 47.86973 8.03769 1110 std 1.9 2.65 0.985596 0 2020;

FS-03c Be-10 quartz 141544 4610 STD11;

FS-03c true_t FSM 15640 420;

FS-03d 47.87128 8.03847 1099 std 2.0 2.65 0.989967 0 2020;

FS-03d Be-10 quartz 133327 4670 STD11;

FS-03d true_t FSM 15640 420;

FS-03e 47.87047 8.03847 1106 std 2.4 2.65 0.960224 0 2020;

FS-03e Be-10 quartz 144143 5434 STD11;

FS-03e true_t FSM 15640 420;

FS-03f 47.87047 8.03830 1106 std 2.8 2.65 0.985626 0 2020;

FS-03f Be-10 quartz 147407 5026 STD11;

FS-03f true_t FSM 15640 420;

References

Balco, G.: Topographic shielding calculator, http://stoneage.ice-d.org/math/skyline/skyline_in.html, last access: 17 October 2023, 2018.

Li, Y.-K.: Determining topographic shielding from digital elevation models for cosmogenic nuclide analysis: a GIS model for discrete sample sites, J. Mt. Sci., 15, 939–947, https://doi.org/10.1007/s11629-018-4895-4, 2018.