

Table S1: Ne measurements.

| Sample name | Aliquot | Aliquot weight (g) | F/L ¹ | Heating temperature (deg C) | Heating time (hr) | Total ²⁰ Ne released ² (10 ⁶ atoms) | Total ²¹ Ne released ³ (10 ⁶ atoms) | ²¹ Ne / ²⁰ Ne ⁴ (10 ⁻³) | ²² Ne / ²⁰ Ne ⁴ (10 ⁻³) | Cosmogenic ²¹ Ne ⁵ This heating step (10 ⁶ atoms g ⁻¹) | Cosmogenic ²¹ Ne as % of ²¹ Ne released in this heating step | Percent of total cosmogenic ²¹ Ne released in this step | Total cosmogenic ²¹ Ne (10 ⁶ atoms g ⁻¹) |
|--|-----------|--------------------|------------------|-----------------------------|-------------------|--|--|--|--|---|--|--|--|
| Whippoorwill Paleosol, Pendleton Pit, Missouri | | | | | | | | | | | | | |
| PP-WH-0 | Fa | 0.9900 | F | 400 | 0.3 | 1.892 +/- 0.028 | 10.37 +/- 0.42 | 5.37 +/- 0.15 | 106.1 +/- 1.4 | 4.62 +/- 0.29 | 44.1 | 40.5 | 11.42 +/- 0.58 |
| | | 0.9900 | F | 1100 | 0.3 | 9.51 +/- 0.22 | 34.6 +/- 1.3 | 3.569 +/- 0.047 | 100.80 +/- 0.80 | 5.88 +/- 0.48 | 16.8 | 51.5 | |
| | | 0.9900 | F | 1500 | 0.2 | 0.184 +/- 0.016 | 1.46 +/- 0.14 | 7.77 +/- 0.97 | 124.9 +/- 12.7 | 0.92 +/- 0.15 | 62.6 | 8.1 | |
| | ab | 0.3137 | L | 700 | 0.3 | 3.298 +/- 0.030 | 12.81 +/- 0.39 | 3.808 +/- 0.074 | 104.4 +/- 0.90 | 8.95 +/- 0.79 | 21.9 | 81.3 | 11.01 +/- 0.97 |
| | | 0.3137 | L | 1200 | 0.3 | 1.028 +/- 0.013 | 3.76 +/- 0.20 | 3.59 +/- 0.17 | 104.0 +/- 2.4 | 2.06 +/- 0.57 | 17.2 | 18.7 | |
| | PP-WH-0.5 | Fa | 0.9710 | F | 400 | 0.3 | 0.889 +/- 0.026 | 4.94 +/- 0.23 | 5.50 +/- 0.24 | 105.5 +/- 3.5 | 2.33 +/- 0.23 | 45.8 | 22.7 |
| 0.9710 | | | F | 700 | 0.3 | 6.25 +/- 0.14 | 24.9 +/- 1.0 | 3.936 +/- 0.075 | 102.0 +/- 0.70 | 6.31 +/- 0.50 | 24.6 | 61.6 | |
| 0.9710 | | | F | 1500 | 0.2 | 3.681 +/- 0.082 | 12.58 +/- 0.54 | 3.381 +/- 0.080 | 103.1 +/- 1.0 | 1.61 +/- 0.31 | 12.4 | 15.7 | |
| PP-WH-1 | Fa | 0.9490 | F | 400 | 0.3 | 0.987 +/- 0.024 | 4.77 +/- 0.22 | 4.79 +/- 0.19 | 97.2 +/- 2.7 | 1.91 +/- 0.21 | 38.0 | 16.4 | 11.64 +/- 0.87 |
| | | 0.9490 | F | 700 | 0.3 | 6.398 +/- 0.080 | 26.1 +/- 1.0 | 4.05 +/- 0.11 | 101.9 +/- 0.90 | 7.39 +/- 0.73 | 26.8 | 63.5 | |
| | | 0.9490 | F | 1500 | 0.2 | 4.566 +/- 0.062 | 15.86 +/- 0.61 | 3.443 +/- 0.086 | 103.9 +/- 1.2 | 2.34 +/- 0.42 | 14.0 | 20.1 | |
| | a | 0.6153 | L | 1200 | 0.4 | 8.639 +/- 0.089 | 31.67 +/- 0.92 | 3.641 +/- 0.052 | 102.7 +/- 0.80 | 9.61 +/- 0.74 | 18.7 | 100.0 | 9.61 +/- 0.74 |
| | | | | | | | | | | | | | |
| PP-WH-1.75 | Fa | 0.9610 | F | 400 | 0.3 | 0.763 +/- 0.020 | 3.89 +/- 0.21 | 5.04 +/- 0.25 | 106.6 +/- 3.5 | 1.66 +/- 0.20 | 41.0 | 16.8 | 9.9 +/- 0.69 |
| | | 0.9610 | F | 700 | 0.3 | 4.91 +/- 0.10 | 20.08 +/- 0.77 | 4.049 +/- 0.059 | 101.7 +/- 0.80 | 5.59 +/- 0.33 | 26.8 | 56.5 | |
| | | 0.9610 | F | 1500 | 0.2 | 5.43 +/- 0.12 | 18.84 +/- 0.84 | 3.43 +/- 0.10 | 102.8 +/- 1.1 | 2.65 +/- 0.57 | 13.5 | 26.8 | |
| Riverbluff Cave, Springfield, Missouri | | | | | | | | | | | | | |
| RC-L5F ⁶ | a | 0.5810 | L | 1100 | 0.33 | 55.87 +/- 0.95 | 173.294 +/- 5.674 | 3.124 +/- 0.024 | 104.60 +/- 0.30 | 12.5 +/- 1.4 | 4.2 | 100 | 12.5 +/- 1.4 |

Notes:

¹ L, 75W diode laser; F, resistance furnace

² Computed by comparison to ²⁰Ne signal in air pipettes. 1-sigma uncertainty includes measurement uncertainty of ²¹Ne signal in this analysis and the reproducibility of the air pipette signal (0.8%)

³ Computed by comparison to ²¹Ne signal in air pipettes. 1-sigma uncertainty includes measurement uncertainty of ²¹Ne signal in this analysis and the reproducibility of the air pipette signal (2%)

⁴ Isotope ratio measured internally during each analysis: does not involve normalization to the Ne isotope signals in the air pipettes.

⁵ Analyses where cosmogenic ²¹Ne was not distinguishable from zero at 1 sigma are not shown. Cosmogenic ²¹Ne concentrations were calculated by normalization to either the ²⁰Ne or ²¹Ne signal in the air pipettes, depending on which method yielded better precision.

⁶ Cosmogenic ²¹Ne calculated as excess over mass-fractionated atmospheric Ne.