Supplementary Text: Analytical Methods

Uranium-Series Dating

Samples masses ranged from 22 to 111 milligrams and were totally digested to avoid laboratory fractionation of U and Th, using a combination of nitric acid followed by concentrated hydrofluoric acid on the residue. A mixed spike solution containing known amounts of isotopically enriched ^{236}U and ^{229}Th was added to the digested sample and allowed to equilibrate prior to separation and purification of U and Th using anion-exchange chromatographic resins (AG1×8) in hydrochloric and nitric acid media. The isotopic compositions of U and Th were determined on a Finnigan MAT 262™ thermal ionization mass spectrometer equipped with a secondary electron multiplier operating in ion-counting mode. Uranium was loaded as a nitrate onto the evaporation side of a double rhenium-filament assembly and measured as metal ions. Thorium was loaded onto single, center rhenium filaments along with a graphite suspension. Total procedural blanks were small (0.02 and 0.10 nanograms of ^{238}U and ^{232}Th) compared to abundances derived from the samples (9 to 1600 nanograms). Data were corrected for contributions from tracer solutions, procedural blank, and mass fractionation, and were normalized to a constant $^{234}U/^{238}U$ value for NIST SRM 4321B uranium standard (atomic ratio of 5.29×10^{-5} or activity ratio of 0.966) using values measured in parallel with unknown samples. Activity ratios (AR) were calculated using accepted decay constants (Cheng et al., 2000; Jaffey et al., 1971). Multiple analyses of a secular equilibrium standard analyzed using the same methods gave $^{234}U/^{238}U$ and $^{230}Th/^{238}U$ AR within analytical error of unity. All errors are given at 95% confidence level and include within-run errors plus uncertainties propagated from blank, spike, and mass fractionation corrections, as well as external error derived from multiple analyses of a U isotope standard (SRM 4321b). The method for subtracting isotopic constituents derived from non-authigenic (detrital) sources is discussed in the text.

Cosmogenic ^{36}Cl Geochronology

We employed cosmogenic ^{36}Cl ($t_{1/2}$ = 301 kyr) to directly date the timing of deposition of lacustrine beach barriers. Chlorine-36 is one of the family of terrestrial cosmogenic nuclides (TCN) that are commonly employed to determine the time that rocks on geomorphic surfaces have been exposed to atmospheric radiation (Cerling and Craig, 1994). TCNs are produced by nuclear reactions between secondary cosmic- ray particles and rock material at and near the surface of the earth. TCNs accumulate in rock or sediment at a rate proportional to the cosmic-ray flux intensity and the abundance of target nuclides in minerals within the geologic material (Gosse and Phillips, 2001). Measuring the concentration of TCN in rock allows calculation of the duration of exposure to cosmic radiation because TCNs accumulate in rock at known rates that depend on altitude, latitude, and topographic shielding (Gosse and Phillips, 2001). This technique has been most commonly applied to rocks at the ground surface (surface-exposure method), and can also be applied to depositional features if the TCN concentration with depth is determined (profile method).

If deeply-shielded rock becomes exposed at the surface of the earth, either by erosion or abrasive transport, the TCN inventory will be small to nil; whereas, after some period of time has elapsed, the TCN inventory will be nearly all a result of cosmogenic production *in situ*. The nuclide systematics, however, are more complicated when a landform is constructed from previously-eroded materials (e.g., a lacustrine bar composed of gravel that was eroded from older alluvial-fan deposits). The TCN concentration (N) within such depositional features consists of two parts: (1) the TCN concentration that accumulates *in situ* since deposition of the particular feature (N_{dep}) and (2) the TCN concentration from cosmic-ray exposure during surface weathering, exhumation, and transport prior to final deposition, or the "inherited" component (N_{in}). The inheritance builds up in clasts while they are being eroded from bedrock or transported, and (or) during residence in older sedimentary deposits that may have been re-eroded and redeposited to form the current feature. After final deposition in a feature, the N_{dep} is initially zero while the N_{in} concentration begins to decay. With time, N_{dep} increases and N_{in} decreases, and the TCN concentration within a sample becomes:

$$N = N_{dep} + N_{in} \qquad \text{(eq. 1)}$$

By substituting in the terms for cosmogenic production and decay (Lal, 1991), the concentration of ^{36}Cl (N_{36}) as a function of depth (z), time (t), and surface erosion rate (ε) can be obtained:

$$N_{36}(z,\varepsilon,t) = \frac{P_{36}(z)}{\lambda + \varepsilon\Lambda_e^{-1}}\left(1 - e^{-\lambda t}\right) + N_{in}e^{-\lambda t} ($$

In Equation (2), $P_{36}(z)$ is the production rate of ^{36}Cl (atoms g^{-1}) as a function of depth, λ is the ^{36}Cl decay constant ($\lambda = \ln 2/t_{1/2} = 2.303 \times 10^{-6}\ a^{-1}$), ε is the surface erosion rate (g cm^{-2} a^{-1}), Λ_e is the effective cosmic-ray attenuation length (g cm^{-2}), and t is the depositional age of the deposit. The first term represents the ^{36}Cl accumulation since deposition. The second term represents the decay of the inherited component. Therefore, if the inherited component of a sample can be uniquely determined, it is possible to calculate the ^{36}Cl accumulation since deposition and thus determine the age of the feature.

The deposit age was modeled by obtaining a best fit between a calculated ^{36}Cl inventory (as a function of depth) and the measured ^{36}Cl profile. The best-fit match was identified by minimization of the sum of the χ^2 values for all of the samples in the profile, computed from the differences between the calculated and measured values. Uncertainties in the ages were also calculated from the χ^2 variation. The modeled ^{36}Cl depth inventories were calculated using the spreadsheet model CHLOE (CHLOrine-36 Exposure age) (Phillips and Plummer, 1996), which is based on the cosmogenic-nuclide production equations given by Gosse and Phillips (2001). The high-energy cosmic-ray flux is calculated on the basis of standard exponential attenuation with mass and depth and the spallation production rate is proportional to that flux. The model then uses this flux distribution as the source term for the calculation of the epithermal and thermal neutron fluxes by means of the diffusion equations given in Phillips et al. (2001). The spatial distributions of low-energy neutron fluxes are then used to calculate the ^{36}Cl production by epithermal and thermal neutron absorption. Nuclide production parameters from Phillips et al. (2001) were employed. Use of alternative production parameters by Stone et al. (1996a, 1996b) would give ages that are younger by approximately 20 percent.

Modeling of profile age and uncertainties

Cosmogenic ^{36}Cl is produced in rocks and soils by three principal reactions: high-energy spallation of K and Ca and low-energy neutron absorption by Cl (Gosse and Phillips, 2001). The rate of production at any depth below the surface by the first two reactions depends on the concentrations of the target elements and the high-energy cosmic-ray flux at that depth. The high-energy cosmic-ray flux decreases exponentially with the cumulative mass traversed by the cosmic rays. Thus, production by these reactions can be calculated based on measurement of the bulk density, depth, and the concentrations of K and Ca in the sampled material.

Production by low-energy neutron absorption depends on the low-energy (thermal and epithermal) neutron fluxes and the Cl concentration. However, low-energy neutrons are produced by gradual deceleration of the high-energy flux and they can diffuse significant distances while in the thermal energy range. The characteristics of the low-energy flux thus depend on bulk properties of the sampled material (Phillips and others, 2001). CHLOE therefore uses the average bulk chemical composition of the sampled profile to compute the depth distribution of the low-energy neutron fluxes. The computed neutron fluxes and the Cl concentrations measured at each depth sampled are then used to calculate the ^{36}Cl production rate. In addition to production by the nucleonic component of the cosmic radiation, CHLOE also computes production rates due to primary and secondary effects of the cosmic-ray muon flux, using approaches analogous to those described above.

The profile age and age uncertainty were calculated by means of χ^2 fitting (Bevington and Robinson, 1992) of the ^{36}Cl concentration data from the various depths to the ^{36}Cl distribution modeled by CHLOE. The sum of chi-squared function (χ^2) was calculated for each age-erosion pair as follows:

$$\chi^2 = \sum_{i=1}^{n} \frac{(O_i - M_i)^2}{S_i^2}$$

where O_i is the observed ^{36}Cl concentration at each depth interval (i) and M_i is the modeled value at the same depth. The number of concentration measurements is n. S_i is the standard deviation associated with the ith data point as follows:

$$S_i = S_{i,36} + S_{inheritance} + S_{other}$$

where $S_{i,36}$ is the standard deviation from the ^{36}Cl analytical measurement, $S_{inheritance}$ is the contribution to the total standard deviation from variability in the inherited ^{36}Cl concentration, and S_{other} is the contribution from other sources of variability, principally analytical uncertainties in the chemical analyses, bulk densities, and other parameters, combined with uncertainties in the ^{36}Cl production parameters. Values for $S_{i,36}$ were taken directly from the AMS analyses.

$S_{inheritance}$ was estimated based on the the standard deviation of ^{36}Cl of the deepest samples from the youngest of the barriers at Thorne Bar.

The ^{36}Cl age (TB02-00, see fig. 7 in text) for the late Pleistocene barrier is 17±8 ka. A number of radiocarbon dates place this Lake Lahontan highstand between 14,800 and 17,365 cal ka (Adams and Wesnousky, 1998; Benson et al., 1990). Due to the very young age of this feature, its calculated depth-profile age is largely insensitive to erosion or aggradation, and thus any misfit of the calculated ^{36}Cl concentration to the data can principally be attributed to variation in the inherited component. The average absolute error of the concentrations calculated for this depth profile based on the independent ages given above, relative to the measured concentrations, was 1.6%. S_{other} was estimated based on an empirical comparison of ^{36}Cl ages with independently constrained ages for 30 surficial rock samples from the ^{36}Cl calibration data set (Phillips and others, 2001) and was assigned a value of 8%. This value should incorporate systematic uncertainty due to errors in the assigned production rates, but the adequacy of this estimation is uncertain and difficult to assess inasmuch as the parameter calibration dataset was also used to estimate the systematic uncertainty. For each profile we also report the reduced sum of χ^2 (χ_v^2, table 2 in text), which is the sum of χ^2, as given above, divided by n, the number of samples in the profile. The magnitude of χ_v^2 is a measure of the goodness of fit of the data to the model. In general, for laboratory systems in which the model can be assured to provide a complete description, a χ_v^2 of less than one is considered a satisfactory fit (Bevington and Robinson, 1992). When dealing with environmental measurements for which the model may be incomplete, somewhat larger χ_v^2 are often considered acceptable. In the example given above (TB00-02), χ_v^2 was 0.04. Values of χ_v^2 this small in environmental data sets often indicate that the standard deviation in the denominator of the χ_v^2 equation have been overestimated, or at least given conservatively large values. The effect of such an overestimation is to increase the magnitude of the calculated uncertainty bounds (i.e., to indicate that the uncertainties may well be overestimated). The large number of small χ_ν^2 values for curve fits in this study probably indicates that the 1 σ uncertainty bounds we report are conservative.

CHLOE produces models of ^{36}Cl concentrations at the sampled profile depths, subject to variation of three adjustable parameters: the profile inheritance (t_p), the deposition age (t_d), and the rate of surface aggradation/erosion (ε). Given reasonable independent constraints on these variables, the model output was fairly sensitive to the first two parameters, but relatively insensitive to the last one (ε). The fitting of calculated ^{36}Cl concentrations to data was therefore restricted to aggradation/erosion rates limited between upper and lower bounds estimated for each site based on particle-size measurements and geological and pedological observations, as described above and in the Methods section in the text. The aggradation/erosion rate could potentially be used as a fitting parameter. However, in most cases, due to the weak sensitivity of the calculated ^{36}Cl concentration to aggradation/erosion, there was insignificant variation of the reduced sum of χ^2 across the prescribed range of ε. In this case, the midpoint of the range of ε was used to calculate the best-estimate deposition age (i.e., ε was used as a fixed, rather than fitting, parameter). In a few cases, there was a significant minimum in the reduced sum of χ^2 within the prescribed range for ε and in these cases this minimum was used to compute the best-estimate deposition age. However, use of the alternative criterion (midpoint of ε range) would have resulted in little difference in the best estimates of deposition age. The result of this pattern of insensitivity was that the variation in ε played a significant role in estimation of the uncertainty of the best-fit deposition age, but only a small role in estimating its actual value.

The array of reduced sum-of-χ^2 values generated as described above was contoured. The best age estimate corresponds to the minimum value (or, alternatively, the midpoint value) of the sum of χ^2 (in the t_d versus t_{inh} parameter space). One-standard-deviation uncertainty bounds were estimated from the maximum and minimum age limits of the $\chi^2_{\min} + \Delta\chi^2_\nu$ contour in the age-erosion parameter space. $\chi^2_{\min}$ is the minimum value of the calculated sum of χ^2 within the parameter space and $\Delta\chi^2_\nu$ is the critical value of the change in sum-of-χ^2 for a specified level of confidence and number of fitted parameters (e.g., Davis, 2002, Table A.4). For our problem, the appropriate level of confidence is 68.3% (corresponding to one standard deviation uncertainty) and two fitted parameters (t_d and t_{inh}), giving a $\Delta\chi^2_\nu$ of 2.30. The approach to uncertainty estimation described above is comprehensive (it includes potential systematic as well as random sources of uncertainty) and it includes an explicit evaluation of model accuracy, based on the fit of multiple samples within a single profile, as opposed to a single TCN age determination for which model error can only be estimated. We believe that the over-all uncertainty bounds calculated using this approach are conservative and are likely to overestimate, rather than underestimate, the actual uncertainties.

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Table DR1. Laboratory data for soil profiles, Thorne Bar (no samples analyzed for profile TB02-00) and Columbus Salt Marsh [N.D., not determined]

Sample Number*	Depth (cm)	Thick (cm)	Excav. bulk density (g/cm^3)[1]	Ped bulk density (g/cm^3)[2]	Calc. <2mm bulk density (g/cm^3)[3]	$CaCO_3$ %	Soluble salt %	Gypsum %	Estimated field gravel (vol. %)	Laboratory gravel (wt. %)	Sand %	Silt %	Clay %
TB00-01													
Av	0-7	7	N.D.	1.29	1.23	5.7	0.051	0.002	<10	19	74.5	19.0	6.4
Bw	7-20	13	N.D.	1.56	1.49	5.4	0.060	0.002	25	64	56.7	31.3	11.9
2Bwk1	20-32	12	N.D.	2.20	1.26	6.1	0.079	0.002	60	73	80.7	13.4	5.9
2Bwk2	32-51	19	N.D.	2.20 e [4]	1.26	6.7	0.213	0.002	60	72	81.9	14.2	3.9
2Bk1	51-78	27	1.63	1.74	1.23	8.9	1.311	0.008	50	78	81.3	13.9	4.8
2Bk2	78-114	36	2.07	2.05	1.23	4.2	0.917	0.009	75	87	51.3	39.8	8.9
2C	114-200+	86+	N.D.	2.01	1.23	9.3	0.315	0.003	90	81	47.2	45.3	7.5
TB00-02													
Av	0-11	11	N.D.	1.60	1.59	2.7	0.057	0.002	15	15	71.0	20.9	8.2
Btk	11-30	19	N.D.	1.43	1.33	3.2	0.083	0.002	20	34	79.6	14.4	6.0
2Bk	30-85	55	N.D.	1.69	1.52	6.7	0.304	0.002	50	47	58.8	37.0	4.3
2/3Bk	85-125	40	N.D.	1.89	1.71	3.9	0.400	0.003	50	57	60.6	31.9	7.5
3Btjk [5]	125-156	31	N.D.	2.07	1.61	3.7	0.341	0.002	75	71	64.4	28.5	7.1
3Btj [5]	156-200+	44+	N.D.	2.25	1.54	4.4	0.674	0.007	75	76	72.3	19.1	8.6
TB00-03													
Av	0-8	8	N.D.	1.59	1.59	3.0	0.145	0.003	15	12	83.0	13.1	3.9
Av/Bw	8-19	11	N.D.	1.42	1.35	3.6	0.108	0.002	15	9	51.3	31.9	16.8
Btk	19-30	11	N.D.	1.43	1.19	4.4	0.400	0.003	50	45	61.6	28.9	9.5
2Btky	30-48	18	2.06	1.43 e	1.23	4.4	0.547	0.004	60	65	64.6	29.4	6.0
2Bkm	48-60	12	N.D.	1.63	1.36	5.9	0.457	0.003	60	79	40.9	41.3	17.8
3Bk	60-162	102	2.14	1.79	1.30	6.1	0.411	0.003	90	81	45.6	46.7	7.8
4C	162-210+	48+	N.D.	2.15	1.77	2.9	0.193	0.003	90	83	60.5	33.4	6.1
TB00-04													
Av	0-7	7	N.D.	1.68	1.52	2.7	0.264	0.007	10	27	23.1	51.0	26.0
Btk1	7-15	8	N.D.	1.74	1.47	4.1	1.153	0.008	20	67	10.8	62.2	27.0
Btky2	15-31	16	N.D.	1.74 e	1.20	3.0	1.831	0.217	60	72	7.0	76.6	16.4
Btky3	31-49	18	2.18	1.74 e	1.20	8.8	0.685	0.008	60	62	44.8	46.6	8.6
2Bk	49-67	18	1.09	1.74 e	1.10	4.4	1.363	0.004	0	1	48.6	45.9	5.4
3Btk	67-108	41	2.33	1.53	1.50	4.2	0.951	0.003	80	76	33.0	51.5	15.5
4Bk	108-151	43	N.D.	1.70	1.62	5.3	0.764	0.002	15	23	56.9	38.2	4.9
5Bk	151-230+	79+	N.D.	2.19	1.31	3.1	0.669	0.002	90	93	76.6	19.2	4.2

Table DR1. Laboratory data for soil profiles, Thorne Bar (no samples analyzed for profile TB02-00) and Columbus Salt Marsh [N.D., not determined]

Sample Number*	Depth (cm)	Thick (cm)	Excav. bulk density (g/cm^3)[1]	Ped bulk density (g/cm^3)[2]	Calc. <2mm bulk density (g/cm^3)[3]	$CaCO_3$ %	Soluble salt %	Gypsum %	Estimated field gravel (vol. %)	Laboratory gravel (wt. %)	Sand %	Silt %	Clay %
CM01-01													
Av	0-12	12	N.D.	1.63	1.54	16.7	0.69	0.008	20	21	49.2	35.7	15.1
Bwkz	12-25	13	1.94	1.79	1.39	10.0	1.60	0.239	70	78	97.7	2.0	0.3
2Bk1	25-40	15	2.00	1.57	1.13	8.6	1.14	0.246	70	75	98.7	1.2	0.1
2Bk2	40-75	35	2.20	1.57 e	1.13	9.7	0.72	0.016	90	70	98.3	1.5	0.2
2Bk3	75-122	47	N.D.	1.57 e	1.13	11.1	0.33	0.006	60	71	99.4	0.5	0.1
3C	122-150	28	N.D.	1.36	1.40	7.0	0.41	0.004	25	36	99.0	0.7	0.3
4C	150-218	68	1.86	1.86	1.40	8.8	0.02	0.003	55	80	98.5	1.1	0.3
5Btkb	218-233	15	N.D.	1.57	N.D.	12.5	0.54	0.007	50	60	97.4	2.2	0.5
5Bwkb	233-280+	47+	N.D.	1.57 e	N.D.	17.5	0.41	0.008	80	90	95.6	3.9	0.5
CM01-02													
Av	0-9	9	N.D.	1.60	1.49	6.1	4.27	0.042	20	15	58.0	32.8	9.2
Btk1	9-16	7	N.D.	1.39	1.17	4.0	1.57	0.017	40	45	61.3	29.4	9.3
Btk2	16-43	27	2.32	1.74	1.14	3.4	1.37	0.009	50	55	63.8	32.1	4.1
Bwk	43-60	17	N.D.	1.88	1.41	4.1	0.90	0.017	60	53	94.2	5.1	0.8
Bk1	60-89	29	N.D.	1.88 e	1.44	2.0	0.55	0.010	70	71	98.6	0.8	0.6
Bk2	89-125	36	2.25	2.16	1.44	4.2	0.03	0.008	70	63	99.1	0.6	0.3
2C	125-220+	95+	2.03	2.15	1.44	1.7	0.05	0.002	75	76	99.6	0.2	0.2
CM01-03													
Av	0-10	10	N.D.	1.37	1.35	6.1	1.30	0.042	15	24	63.1	27.5	9.4
Bwkz	10-26	16	N.D.	1.50 e	1.20	6.3	3.01	0.607	75	66	83.5	14.9	1.6
Bkz1	26-43	17	N.D.	1.80 e	1.10	3.7	1.46	0.014	60	59	95.9	3.4	0.7
Bk2	43-85	42	2.03	2.03	1.40	2.5	1.59	0.015	70	55	95.6	3.2	1.3
Bk3	85-123	38	N.D.	2.03 e	1.40	1.8	1.45	0.020	70	54	95.2	4.0	0.8
2Bk4	123-210	87	N.D.	2.03 e	1.40	1.8	0.32	0.004	85	60	97.7	2.3	0.1
3C -R-	210-230+	20+	N.D.	1.36	1.36	N.D.	N.D.	N.D.	0	N.D.	N.D.	N.D.	N.D.

* See Redwine (2003) for Newark Valley soil data.

[1] Bulk density measured by excavating and weighing a measured volume of sediment; measured sample intervals do not necessarily match horizon boundaries.

[2] Bulk density measured in the laboratory by the paraffin-clod method (described in Singer and Janitzky, 1986).

[3] Bulk density of <2mm fraction was calculated by subtracting the mass of gravel (weight percent of total sample times bulk density of rock, assumed to be 2.65 g/cm^3) from total mass.

[4] Bulk density was estimated by comparison to measurements on similar horizons (similar gravel percent, clast size, lithology, sorting, soil development, etc).

[5] In horizon name, "t" at depths below ~50 cm denotes clay coats on clasts in strata consisting of open-work gravels with little matrix

Table DR2. Soil profile bulk density measurements used in ^{36}Cl modeling (table DR3). Depth increments correspond to soil horizons. Where both ped and excavation methods were used to obtain bulk density data for the same horizon (see table DR1), generally the ped data are shown here unless peds were considered unrepresentative of the entire horizon. Horizons with no bulk density measurement were considered homogeneous with measured horizon above, or were estimated by comparison with horizons having similar gravel content (denoted by "e"). All bulk density values for profile TB02-00 were estimated (table DR3).

TB00-01		TB00-02		TB00-03		TB00-04	
Depth (cm)	Bulk Density (g cm^{-3})	Depth (cm)	Bulk Density (g cm^{-3})	Depth (cm)	Bulk Density (g cm^{-3})	Depth (cm)	Bulk Density (g cm^{-3})
0-7	1.29	0-11	1.60	0-8	1.59	0-7	1.68
7-20	1.56	11-30	1.43	8-19	1.42	7-15	1.74
20-32	2.20	30-85	1.69	19-30	1.43	15-31	1.74e
32-51	2.20	85-125	1.89	30-48	1.43e	31-49	1.74e
51-78	1.74	125-156	2.07	48-60	1.63	49-67	1.74e
78-114	2.05	156-200+	2.25	60-162	1.79	67-108	1.53
114-200+	2.01			162-210+	2.15	108-151	1.70
						151-230+	2.19

CM01-01		CM01-02		CM01-03		NV00-02	
Depth (cm)	Bulk Density (g cm^{-3})	Depth (cm)	Bulk Density (g cm^{-3})	Depth (cm)	Bulk Density (g cm^{-3})	Depth (cm)	Bulk Density (g cm^{-3})
0-12	1.63	0-9	1.60	0-10	1.37	0-8	1.92
12-25	1.79	9-16	1.39	10-26	1.50e	8-25	1.64
25-40	1.57	16-43	1.74	26-43	1.80e	25-33	1.64e
40-75	1.57e	43-60	1.88	43-85	2.03e	33-50	2.08
75-122	1.57e	60-89	1.88e	85-123	2.03e	50-150+	2.00e
122-150	1.36	89-125	2.16	123-210	2.03e		
150-218	1.86	125-220	2.15	210-230	1.36		
218-233	1.57						
233-280+	1.57e						

NV00-01		P00-01		P00-02		P00-03	
Depth (cm)	Bulk Density (g cm^{-3})	Depth (cm)	Bulk Density (g cm^{-3})	Depth (cm)	Bulk Density (g cm^{-3})	Depth (cm)	Bulk Density (g cm^{-3})
0-9	1.54	0-15	1.54	0-12	1.49	0-13	1.44
9-19	1.97	15-48	1.42	12-29	1.55	13-30	1.34
19-26	1.71	48-94	1.91	29-59	1.71	30-51	1.48
26-43	1.71	94-117	1.86	59-88	1.85	51-67	1.77
43-92	1.91	117-230+	1.86	88-192	1.80e	67-95	1.51
92-155	1.90			192-238	1.37	95-156	1.45, 1.71*
155-158	1.85			238-263+	1.80e	156-185	1.46e
158-162	1.50e					185-230+	1.46
162-163	1.50e						
163-190+	1.45e						

Table DR3. Calculations of eolian additions and surface inflation for trench soil profiles [N.D., not determined; N.A., not available]

Profile no.	Trench altitude (m)	Eolian additions to profiles (g/cm^2/soil column) Sand	Silt	Clay	$CaCO_3$	Salts	Total	Eolian adds. to solum (g/cm^2/soil column)[1]	Inflation (mm)[2]	Independent age control (ka)[3]	Inflation (mm/kyr)
Thorne Bar, Walker Lake subbasin of Lake Lahontan[4]											
TB02-00	1325	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
TB00-01	1333	6.3	11.1	2.2	1.3	0.3	21.2	9.6	64	15.2 (cal ^{14}C)[5]	4.23
TB00-02	1351	8.6	20.0	3.3	3.8	0.4	36.0	12.0	80	128 (U-series)	0.62
TB00-03	1357	18.0	19.6	4.8	2.5	0.2	45.1	26.5	177	190 (U-series)	0.93
TB00-04	1399	2.7	18.1	6.0	3.6	1.1	31.5	12.0	80	<760 (tephra)	0.10
Columbus Salt Marsh, Lake Columbus[4]											
CM01-01	1392	6.0	4.4	2.0	3.3	0.5	16.2	14.7	98	17.8 (cal ^{14}C)	5.51
CM01-02	1413	18.9	9.4	2.1	2.3	0.9	33.7	29.5	197	N.A.	N.D.
CM01-03	1423	11.0	6.1	1.5	2.1	1.3	22.0	16.7	111	148 (U-series)	0.75
Newark Valley, Lake Newark[6]											
NV00-02 (N5)	1846	18.1	16.5	6.6	10.8	N.P.	51.9	38.6	258	16.2 (cal ^{14}C)	15.90
NV00-01 (N1)	1856	20.4	38.0	15.3	53.1	N.P.	126.9	116.5	777	130 (AAR)[7]	5.98
P00-01 (P1)	1849	55.7	15.7	16.8	17.9	N.P.	106.2	93.3	622	130	4.79
P00-02 (P2)	1854	41.0	14.3	11.0	41.8	N.P.	108.1	90.3	602	130	4.63
P00-03 (P3)	1863	14.1	27.8	17.3	34.5	N.P.	93.6	55.6	370	N.A.	N.D.

1 Solum generally consists of Av, Bw, Bwk, and (or) Bt and Btk horizons; see table DR1 for Thorne and Columbus soils, Redwine (2003) for Newark soils

2 Calculation assumes that bulk density = 1.5 g/cm^3 for the <2mm fraction that composes eolian additions

3 Independent age control derived from data in tables 3 and 4 in text, except as noted in footnotes 5 and 7

4 Soil laboratory data are in Table DR1

5 Calibrated fadiocarbon age for Thorne bar is that of Lake Lahontan highstand (using ^{14}C age of Adams and Wesnousky, 1998)

6 Soil profile descriptions and laboratory data in Redwine (2003)

7 AAR is amino-acid racemization age estimate reported in Redwine (2003)

Table DR4. Field and analytical data for ^{36}Cl samples.

Sample Number			TB02-00-25	TB02-00-40	TB02-00-60	TB02-00-100	TB02-00-152	TB00-01-40	TB00-01-50	TB00-01-75	TB00-01-110	TB00-01-140	TB00-01-160	TB00-01-220
Depth	sample depth interval	(cm)	20-30	35-45	55-65	95-105	147-157	30-40	50-60	75-85	110-120	140-150	160-170	220-240
Depth	mass depth	(g cm^{-2})	33.8	54.0	81.0	135.0	205.2	62.3	104.5	148.6	220.3	280.6	320.8	451.4
R_{36}	sample $^{36}Cl/Cl$ ratio	($^{36}Cl/10^{15}$ Cl)	1226	1241	1253	1150	1150	1608	1498	1300	1024	1167	959	949
$\pm R_{36}$	sample $^{36}Cl/Cl$ 1σ uncertainty	($^{36}Cl/10^{15}$ Cl)	22	23	51	27	38	63	154	66	54	40	23	44
ρ_b	bulk density	(g cm^{-3})	1.87	1.87	1.87	1.87	1.87	2.20	1.74	2.05	2.05	2.01	2.01	2.01
l_s	sample thickness	(cm)	10	10	10	10	10	10	10	10	10	10	10	20
θ_{avg}	water content	(cm^3/cm^3)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Elev		(m)	1325	1325	1325	1325	1325	1333	1333	1333	1333	1333	1333	1333
lat	degrees		38.66	38.66	38.66	38.66	38.66	38l.670	38l.671	38l.672	38l.673	38l.674	38l.675	38l.676
long	degrees		-118.65	-118.65	-118.65	-118.65	-118.65	-118.642	-118.642	-118.642	-118.642	-118.642	-118.642	-118.642
S_{snow}	snow shielding	(unitless)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
S_T	total shielding	(unitless)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Λ_f	effective atten. length	(g cm^{-2})	170	170	170	170	170	170	170	170	170	170	170	170
LOI	loss on ignition	(wt %)	0	0	0	0	0	0	0	0	0	0	0	0
Na_2O		(wt %)	4.35	4.52	4.44	4.37	4.5	4.53	4.59	4.46	4.49	4.43	4.54	4.46
MgO		(wt %)	0.86	0.87	0.86	0.82	0.85	0.92	0.81	0.97	1.04	0.88	0.94	0.89
Al_2O_3		(wt %)	15.32	15.47	15.35	15.31	15.46	15.42	15.28	15.59	15.63	15.32	15.45	15.43
SiO_2		(wt %)	69.42	69.77	69.83	69.975	69.75	70.02	70.65	68.96	69.18	70.63	69.58	69.52
P_2O_5		(wt %)	0.05	0.05	0.04	0.04	0.05	0.05	0.04	0.05	0.06	0.04	0.04	0.04
K_2O		(wt %)	3.24	3.32	3.32	3.45	3.38	3.54	3.75	3.27	3.11	3.62	3.51	3.36
CaO		(wt %)	1.99	1.91	1.99	1.75	1.88	1.81	1.57	2.14	2.22	1.75	1.89	1.96
TiO_2		(wt %)	0.36	0.37	0.35	0.36	0.38	0.36	0.33	0.4	0.4	0.35	0.36	0.36
MnO		(wt %)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.6	0.06	0.06	0.06	0.06
Fe_2O_3		(wt %)	3.03	3	2.91	2.79	3.01	2.94	2.72	3.12	3.24	2.79	3	3
Cl		(ppm)	107.35	110.75	104.19	99.98	105.87	124.46	153.7	121.67	126.24	114.01	131.29	113.89
B	(may be estimated)	(ppm)	10	10	9	8	5	8	6	8	8	8	6	9
Sm	(estimated)	(ppm)	12	12	12	12	12	12	12	12	12	12	12	12
Gd	(may be estimated)	(ppm)	2	2	2	3	2	3	3	3	4	2	3	2
U	(may be estimated)	(ppm)	4	3	3	3	3	4	3	3	3	4	2	4
Th	(may be estimated)	(ppm)	12	11	11	10	10	13	6	4	4	12	6	13
M_{sample}	sample mass	(g)	50.3835	50.1566	60.6902	50.6777	50.4016	60.0095	50.044	60.009	61.9977	50.2808	70.1738	60.0039
M_{spike}	mass ^{35}Cl spike solution	(g)	3.0101	3.0228	4.004	3.0203	3.0092	4.0091	4.027	4.044	4.023	4.0256	4.0593	4.018
C_{spike}	conc. spike solution	(g g^{-1})	0.998	0.998	0.998	0.998	0.998	0.998	0.995	0.998	0.998	0.995	0.998	0.998
S/S	analytical stable isotope ratio	($^{35}Cl/(^{35}Cl+^{37}Cl)$)	5.39	5.34	5.7	5.55	5.42	5.31	5.25	5.298	5.296	5.97	4.92	5.517
±S/S	anal. st. isotope ratio unc.	($^{35}Cl/(^{35}Cl+^{37}Cl)$)	0.05	0.05	0.05	0.05	0.05	0.043	0.16	0.037	0.045	0.2	0.057	0.06
R/S	analytical $^{36}Cl/Cl$ ratio	$^{36}Cl/10^{15}$ Cl	785	800	763	748	732	1042	980	844	665	683	663	595
±R/S	analytical $^{36}Cl/Cl$ ratio unc.	$^{36}Cl/10^{15}$ Cl	14	14	31	17	23	40	100	42	35	22	16	27

Table DR4. Field and analytical data for ^{36}Cl samples.

Sample Number			TB00-02-30	TB00-02-50	TB00-02-75	TB00-02-100	TB00-02-135	TB00-02-165	TB00-02-240	TB00-03-30	TB00-03-60	TB00-03-95	TB00-03-120	TB00-03-190
Depth	sample depth interval	(cm)	30-45	50-65	75-90	100-120	135-150	165-180	235-245	30-40	60-70	95-105	120-130	190-205
Depth	mass depth	(g cm^{-2})	56.6	90.4	136.0	186.9	246.3	317.6	468.4	51.2	98.3	161.0	205.7	347.2
R_{36}	sample $^{36}Cl/Cl$ ratio	($^{36}Cl/10^{15}$ Cl)	3500	2349	1892	1288	1004	1351	720	3247	2581	2087	1430	1201
$\pm R_{36}$	sample $^{36}Cl/Cl$ 1σ uncertainty	($^{36}Cl/10^{15}$ Cl)	81	117	62	95	41	50	15	169	90	83	66	37
ρ_b	bulk density	(g cm^{-3})	1.69	1.69	1.89	1.89	2.07	2.25	2.25	1.43	1.79	1.79	1.79	2.15
l_s	sample thickness	(cm)	15	15	15	20	15	15	10	10	10	10	10	15
θ_{avg}	water content	(cm^3/cm^3)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Elev		(m)	1351	1351	1351	1351	1351	1351	1351	1357	1357	1357	1357	1357
lat	degrees		38.669	38.669	38.669	38.669	38.669	38.669	38.669	38.668	38.668	38.668	38.668	38.668
long	degrees		-118.642	-118.642	-118.642	-118.642	-118.642	-118.642	-118.642	-118.639	-118.639	-118.639	-118.639	-118.639
S_{snow}	snow shielding	(unitless)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
S_T	total shielding	(unitless)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Λ_f	effective atten. length	(g cm^{-2})	170	170	170	170	170	170	170	170	170	170	170	170
LOI	loss on ignition	(wt %)	0	0	0	0	0	0	0	0	0	0	0	0
Na_2O		(wt %)	4.09	4.05	4.18	4.19	3.42	4.4	4.2	5.49	6.00	4.07	5.28	5.27
MgO		(wt %)	1.39	1.47	1.27	1.29	0.96	1.15	1.16	1.66	1.40	1.21	1.84	1.57
Al_2O_3		(wt %)	16.29	16.55	16.1	16.17	15.52	16.18	16.14	17.64	17.46	16.97	17.31	16.37
SiO_2		(wt %)	65.91	65.29	67.29	66.94	67.73	67.35	66.36	54.47	58.92	58.90	56.68	60.38
P_2O_5		(wt %)	0.06	0.07	0.06	0.08	0.05	0.05	0.05	0.14	0.03	0.42	0.18	0.10
K_2O		(wt %)	3.03	3.1	3.12	3.18	4.97	3.17	3.12	6.01	6.89	5.63	6.24	6.71
CaO		(wt %)	3.36	3.58	3.1	3.36	2.79	3.14	3.1	4.82	2.43	5.61	4.50	2.72
TiO_2		(wt %)	0.54	0.61	0.54	0.52	0.69	0.49	0.5	1.44	0.68	1.03	0.78	0.75
MnO		(wt %)	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.19	0.08	0.12	0.17	0.13
Fe_2O_3		(wt %)	4.44	4.64	4.07	3.98	3.79	3.76	3.86	7.53	5.94	6.01	7.02	6.01
Cl		(ppm)	87.23	90.7	109.67	112.26	91.71	86.03	92.58	109.24	114.46	114.73	133.42	115.03
B	(may be estimated)	(ppm)	11	13	12	11	9	9	11	7	8	53	10	8
Sm	(estimated)	(ppm)	12	12	12	12	12	12	12	12	12	12	12	12
Gd	(may be estimated)	(ppm)	3	5	3	2	3	3	3	3	4	1	3	3
U	(may be estimated)	(ppm)	3	4	3	2	2	2.5	2	3	3	3	3	3
Th	(may be estimated)	(ppm)	11	12	6	12	6	4	6	12	4	12	12	4
M_{sample}	sample mass	(g)	50.6167	50.2506	50.1877	50.9189	71.6889	71.2182	60.2429	70.863	60.1991	60.008	60.008	71.185
M_{spike}	mass ^{35}Cl spike solution	(g)	3.9934	3.008	3.0315	4.0143	4.0199	3.9982	4.0001	4.0082	4.0173	4.019	4.0209	5.018
C_{spike}	conc. spike solution	(g g^{-1})	0.995	0.995	0.995	0.995	0.998	0.995	0.995	0.998	0.995	0.998	0.998	0.995
S/S	analytical stable isotope ratio	($^{35}Cl/(^{35}Cl+^{37}Cl)$)	6.78	5.8	5.36	5.97	5.612	5.77	6.03	5.233	5.49	5.5	5.17	5.61
±S/S	anal. st. isotope ratio unc.	($^{35}Cl/(^{35}Cl+^{37}Cl)$)	0.15	0.32	0.55	0.1	0.021	0.24	0.06	0.027	0.08	0.08	0.09	0.07
R/S	analytical $^{36}Cl/Cl$ ratio	$^{36}Cl/10^{15}$ Cl	1830	1410	1216	754	620	554	418	2130	1625	1312	948	742
±R/S	analytical $^{36}Cl/Cl$ ratio unc.	$^{36}Cl/10^{15}$ Cl	42	70	40	54	25	20	12	110	57	53	44	23

Table DR4. Field and analytical data for ^{36}Cl samples.

Sample Number			TB00-03-240	TB00-04-10	TB00-04-40	TB00-04-70	TB00-04-140	TB00-04-165	TB00-04-190	TB00-04-240	CM01-01-15	CM01-01-45	CM01-01-90	CM01-01-150
Depth	sample depth interval	(cm)	240-260	10-15	40-50	70-80	140-150	165-175	190-200	240-260	15-25	45-55	90-100	150-160
Depth	mass depth	(g cm^{-2})	461.1	21.3	77.9	130.1	241.8	293.6	348.4	468.8	33.9	82.1	152.7	240.0
R_{36}	sample $^{36}Cl/Cl$ ratio	($^{36}Cl/10^{15}$ Cl)	791	1608	1081	899	526	558	528	415	1020	830	936	1293
$\pm R_{36}$	sample $^{36}Cl/Cl$ 1σ uncertainty	($^{36}Cl/10^{15}$ Cl)	28	85	28	35	41	84	20	11	38	27	23	31
ρ_b	bulk density	(g cm^{-3})	2.15	1.74	1.74	1.53	1.70	2.19	2.19	2.19	1.79	1.57	1.57	1.36
l_s	sample thickness	(cm)	20	10	10	10	10	10	10	20	10	10	10	10
θ_{avg}	water content	(cm^3/cm^3)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Elev		(m)	1357	1399	1399	1399	1399	1399	1399	1399	1392	1392	1392	1392
lat	degrees		38.668	38.676	38.676	38.676	38.676	38.676	38.676	38.676	38.139	38.139	38.139	38.139
long	degrees		-118.639	-118.629	-118.629	-118.629	-118.629	-118.629	-118.629	-118.629	-117.961	-117.961	-117.961	-117.961
S_{snow}	snow shielding	(unitless)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
S_T	total shielding	(unitless)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Λ_f	effective atten. length	(g cm^{-2})	170	170	170	170	170	170	170	170	170	170	170	170
LOI	loss on ignition	(wt %)	0	0	0	0	0	0	0	0	0	0	0	0
Na_2O		(wt %)	5.29	5.50	4.43	4.06	4.31	4.20	4.17	4.44	0.69	0.81	0.93	0.66
MgO		(wt %)	1.66	1.68	1.07	1.13	1.23	1.31	1.26	1.08	0.73	0.97	1.12	0.72
Al_2O_3		(wt %)	16.00	16.71	15.79	15.67	15.89	16.08	15.95	15.69	6.31	7.33	8.41	6.01
SiO_2		(wt %)	60.47	58.70	68.63	68.52	67.59	66.77	67.66	68.81	85.05	82.35	79.75	84.73
P_2O_5		(wt %)	0.12	0.13	0.07	0.09	0.08	0.07	0.09	0.07	0.05	0.08	0.08	0.06
K_2O		(wt %)	6.45	6.78	3.36	3.45	3.26	3.21	3.29	3.34	1.47	1.63	1.80	1.38
CaO		(wt %)	3.00	3.67	2.30	2.42	2.56	2.92	2.64	2.13	0.16	0.24	0.24	0.14
TiO_2		(wt %)	0.50	0.71	0.47	0.49	0.50	0.55	0.51	0.46	0.61	0.69	0.92	0.68
MnO		(wt %)	0.12	0.12	0.07	0.07	0.07	0.07	0.07	0.07	0.02	0.02	0.02	0.02
Fe_2O_3		(wt %)	6.34	5.96	3.65	3.64	3.91	4.20	3.95	3.59	3.10	3.67	4.39	3.39
Cl		(ppm)	115.07	105.47	136.40	131.35	116.68	136.45	110.49	117.19	29.10	45.14	41.58	24.05
B	(may be estimated)	(ppm)	10	10	12	14	12	11	10	10	37	41	52	39
Sm	(estimated)	(ppm)	12	12	12	12	12	12	12	12	12	12	12	12
Gd	(may be estimated)	(ppm)	3	4	4	3	3	3	3	3	2	2	2	2
U	(may be estimated)	(ppm)	3	3.5	3.5	4	3	3	4	3	2	2	2	2
Th	(may be estimated)	(ppm)	12	6	6	14	6	5	13	6	4	4	5	4
M_{sample}	sample mass	(g)	70.153	61.0218	49.8123	50.8227	70.0947	59.9932	59.9051	59.9642	79.9423	60.0136	60.3085	126.188
M_{spike}	mass ^{35}Cl spike solution	(g)	4.0142	4.0212	3.9983	4.0246	4.0128	3.99	3.9904	2.0037	3.0203	1.9977	2.0172	2.012
C_{spike}	conc. spike solution	(g g^{-1})	0.998	0.998	0.995	0.995	0.995	0.995	0.995	0.995	0.998	0.998	0.998	0.998
S/S	analytical stable isotope ratio	($^{35}Cl/(^{35}Cl+^{37}Cl)$)	5.15	5.666	5.512	5.57	5.117	5.104	5.57	4.284	8.36	6.12	6.39	5.82
±S/S	anal. st. isotope ratio unc.	($^{35}Cl/(^{35}Cl+^{37}Cl)$)	0.07	0.014	0.048	0.01	0.039	0.59	0.17	0.056	0.08	0.06	0.06	0.06
R/S	analytical $^{36}Cl/Cl$ ratio	$^{36}Cl/10^{15}$ Cl	526	985	678	559	352	374	328	322	441	475	516	774
±R/S	analytical $^{36}Cl/Cl$ ratio unc.	$^{36}Cl/10^{15}$ Cl	19	51	18	21	26	38	12	9	16	15	12	18

Table DR4. Field and analytical data for ^{36}Cl samples.

Sample Number			CM01-01-265	CM01-02-15	CM01-02-45	CM01-02-70	CM01-02-140	CM01-02-245	CM01-03-15	CM01-03-45	CM01-03-65	CM01-03-100	CM01-03-195	NV00-02-35
Depth	sample depth interval	(cm)	265-275	15-25	45-55	70-80	140-150	245-255	15-20	45-55	65-75	100-110	195-205	25-35
Depth	mass depth	(g cm^{-2})	407.3	31.1	84.3	131.3	278.6	505.3	23.3	68.5	95.9	143.9	274.0	31.8
R_{36}	sample $^{36}Cl/Cl$ ratio	($^{36}Cl/10^{15}$ Cl)	1139	1588	1535	1184	423	648	1147	743	794	582	603	2620
$\pm R_{36}$	sample $^{36}Cl/Cl$ 1σ uncertainty	($^{36}Cl/10^{15}$ Cl)	27	61	43	30	48	18	32	36	30	20	22	105
ρ_b	bulk density	(g cm^{-3})	1.57	1.74	1.88	1.88	2.16	2.16	1.37	1.37	1.37	1.37	1.37	1.51
l_s	sample thickness	(cm)	10	10	10	10	10	10	5	10	10	10	10	10
θ_{avg}	water content	(cm^3/cm^3)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Elev		(m)	1392	1413	1413	1413	1413	1413	1423	1423	1423	1423	1423	1846
lat	degrees		38.139	38.134	38.134	38.134	38.134	38.134	38.025	38.025	38.025	38.025	38.025	39.462
long	degrees		-117.961	-117.975	-117.975	-117.975	-117.975	-117.975	-117.881	-117.881	-117.881	-117.881	-117.881	-115.685
S_{snow}	snow shielding	(unitless)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
S_T	total shielding	(unitless)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Λ_f	effective atten. length	(g cm^{-2})	170	170	170	170	170	170	170	170	170	170	170	170
LOI	loss on ignition	(wt %)	0	0	0	0	0	0	0	0	0	0	0	0
Na_2O		(wt %)	0.95	0.18	0.12	0.17	0.14	0.14	0.17	1.05	1.01	1.19	1.02	0.53
MgO		(wt %)	1.07	0.40	0.44	0.46	0.41	0.58	0.46	0.86	0.81	0.96	0.67	2.70
Al_2O_3		(wt %)	7.08	3.05	3.31	3.27	3.22	4.13	3.27	6.71	6.86	7.23	6.67	9.30
SiO_2		(wt %)	82.04	92.46	92.38	91.68	92.02	89.86	91.68	84.08	84.28	82.03	84.97	76.16
P_2O_5		(wt %)	0.09	0.04	0.04	0.04	0.04	0.05	0.04	0.07	0.06	0.08	0.05	0.06
K_2O		(wt %)	1.40	0.84	0.93	0.90	0.89	1.18	0.90	1.48	1.56	1.63	1.57	2.06
CaO		(wt %)	0.22	0.02	0.02	0.03	0.03	0.03	0.03	1.21	1.11	1.31	1.04	1.81
TiO_2		(wt %)	0.90	0.14	0.16	0.15	0.15	0.17	0.15	0.42	0.39	0.40	0.33	0.46
MnO		(wt %)	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.04	0.02	0.03	0.02	0.03
Fe_2O_3		(wt %)	3.82	1.50	1.44	1.34	1.39	1.91	1.34	2.65	2.44	2.86	2.06	3.67
Cl		(ppm)	28.31	8.99	7.49	7.74	10.59	7.10	58.63	74.90	53.67	66.96	34.19	42.40
B	(may be estimated)	(ppm)	39	26	23	22	24	30	28	32	32	36	30	6
Sm	(estimated)	(ppm)	12	12	12	12	12	12	12	12	12	12	12	12
Gd	(may be estimated)	(ppm)	2	0	2	2	0	2	1	2	0	3	2	12
U	(may be estimated)	(ppm)	2	1	2	1	2	2	1	2	2	2	1	4
Th	(may be estimated)	(ppm)	4	1	3	1	0	2	1	4	4	4	4	5
M_{sample}	sample mass	(g)	175.5133	70.1758	80.2569	81.2095	70.9439	125.4415	60.8197	60.7255	60.6282	60.0712	99.8804	70.1131
M_{spike}	mass ^{35}Cl spike solution	(g)	1.0183	2.9984	3.0232	3.0018	2.9942	1.004	2.9844	3.0041	3.0152	3.0062	2.0018	3.0239
C_{spike}	conc. spike solution	(g g^{-1})	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.995
S/S	analytical stable isotope ratio	($^{35}Cl/(^{35}Cl+^{37}Cl)$)	3.96	21.42	22.42	21.5	18.63	7.68	6.52	5.81	6.88	6.16	5.51	7.23
±S/S	anal. st. isotope ratio unc.	($^{35}Cl/(^{35}Cl+^{37}Cl)$)	0.04	0.2	0.2	0.2	0.2	0.08	0.06	0.06	0.07	0.06	0.05	0.21
R/S	analytical $^{36}Cl/Cl$ ratio	$^{36}Cl/10^{15}$ Cl	944	273	252	203	84	303	621	445	410	332	378	1293
±R/S	analytical $^{36}Cl/Cl$ ratio unc.	$^{36}Cl/10^{15}$ Cl	22	11	7	5	10	8	17	21	15	11	14	50

Table DR4. Field and analytical data for ^{36}Cl samples.

Sample Number			NV00-02-50	NV00-02-75	NV00-02-95	NV00-02-130	NV00-02-160	NV00-02-205	NV00-01-55	NV00-01-75	NV00-01-90	NV00-01-115	NV00-01-140	NV00-01-170
Depth	sample depth interval	(cm)	40-50	65-75	85-95	120-130	145-160	195-205	50-60	75-85	90-100	110-120	135-145	165-175
Depth	mass depth	(g cm^{-2})	90.7	127.2	156.4	207.5	251.3	317.0	96.2	143.9	172.6	210.8	258.5	337.4
R_{36}	sample ^{36}Cl/Cl ratio	(^{36}Cl/10^{15} Cl)	2251	1651	2056	1521	1768	1320	5119	4042	4107	4123	3006	2491
$\pm R_{36}$	sample ^{36}Cl/Cl 1σ uncertainty	(^{36}Cl/10^{15} Cl)	115	66	99	128	78	71	108	150	58	124	132	127
ρ_b	bulk density	(g cm^{-3})	2.08	1.46	1.46	1.46	1.46	1.46	1.91	1.91	1.90	1.90	1.90	1.24
l_s	sample thickness	(cm)	10	10	10	10	15	10	10	10	10	10	10	10
θ_{avg}	water content	(cm^3/cm^3)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Elev		(m)	1846	1846	1846	1846	1846	1846	1856	1856	1856	1856	1856	1856
lat	degrees		39.462	39.462	39.462	39.462	39.462	39.462	39.462	39.462	39.462	39.462	39.462	39.462
long	degrees		-115.685	-115.685	-115.685	-115.685	-115.685	-115.685	-115.687	-115.687	-115.687	-115.687	-115.687	-115.687
S_{snow}	snow shielding	(unitless)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
S_T	total shielding	(unitless)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Λ_f	effective atten. length	(g cm^{-2})	170	170	170	170	170	170	170	170	170	170	170	170
LOI	loss on ignition	(wt %)	0	0	0	0	0	0	0	0	0	0	0	0
Na_2O		(wt %)	0.77	0.76	0.72	0.61	0.60	0.64	0.59	0.55	0.55	0.40	0.47	0.48
MgO		(wt %)	3.58	3.00	2.54	2.86	2.49	2.64	1.11	2.19	1.58	1.70	1.79	2.07
Al_2O_3		(wt %)	11.27	9.82	8.94	9.84	9.26	9.79	7.55	8.67	6.76	7.37	7.66	8.13
SiO_2		(wt %)	71.59	75.69	77.60	74.57	77.36	74.70	81.50	75.62	82.88	80.58	81.86	80.20
P_2O_5		(wt %)	0.05	0.04	0.05	0.06	0.05	0.05	0.04	0.05	0.05	0.05	0.04	0.04
K_2O		(wt %)	2.38	2.10	1.93	1.95	1.90	2.09	1.60	1.65	1.42	1.52	1.45	1.68
CaO		(wt %)	1.61	1.16	1.12	1.86	1.28	1.21	0.41	0.94	0.66	1.28	0.72	0.69
TiO_2		(wt %)	0.58	0.54	0.51	0.49	0.48	0.53	0.41	0.41	0.39	0.38	0.40	0.41
MnO		(wt %)	0.04	0.03	0.03	0.03	0.03	0.03	0.01	0.02	0.02	0.02	0.02	0.02
Fe_2O_3		(wt %)	4.79	3.92	3.39	3.68	3.65	4.72	3.62	6.07	3.03	3.36	3.15	3.50
Cl		(ppm)	47.00	49.02	47.03	45.75	38.19	48.69	24.67	33.33	24.08	28.17	29.22	39.37
B	(may be estimated)	(ppm)	6	6	6	6	6	6	6	52	46	45	47	53
Sm	(estimated)	(ppm)	12	12	12	12	12	12	12	12	12	12	12	12
Gd	(may be estimated)	(ppm)	12	12	12	12	12	12	12	3	1	1	0	2
U	(may be estimated)	(ppm)	4	4	4	4	4	4	2	5	3	5	4	4
Th	(may be estimated)	(ppm)	5	5	5	5	5	5	6	6	3	4	3	3
M_{sample}	sample mass	(g)	60.0967	60.3523	59.443	59.4668	60.3592	80.2359	40.604	60.9986	90.2411	71.0279	50.023	50.8498
M_{spike}	mass ^{35}Cl spike solution	(g)	4.0142	3.017	3.0125	3.0012	2.9955	2.0104	4.0059	3.9921	2.9894	3.0115	5.0034	3.0181
C_{spike}	conc. spike solution	(g g^{-1})	0.995	0.995	0.995	0.995	0.995	0.995	0.998	0.995	0.995	0.995	0.995	0.995
S/S	analytical stable isotope ratio	(^{35}Cl/(^{35}Cl+^{37}Cl))	8.83	7.24	7.47	7.572	8.35	5.214	18.68	10.95	8.65	9.16	16.5	9.17
±S/S	anal. st. isotope ratio unc.	(^{35}Cl/(^{35}Cl+^{37}Cl))	0.08	0.08	0.2	0.044	0.12	0.05	0.19	0.4	0.5	0.3	0.1	0.26
R/S	analytical ^{36}Cl/Cl ratio	^{36}Cl/10^{15} Cl	925	814	985	720	765	1320	1014	1356	1720	1637	675	988
±R/S	analytical ^{36}Cl/Cl ratio unc.	^{36}Cl/10^{15} Cl	47	32	50	60	34	70	22	50	70	50	30	50

Table DR4. Field and analytical data for ^{36}Cl samples.

Sample Number			P00-01-40	P00-01-65	P00-01-110	P00-01-150	P00-01-240	P00-02-40	P00-02-65	P00-02-85	P00-02-140	P00-02-190	P00-02-280	P00-03-45
Depth	sample depth interval	(cm)	25-40	55-65	95-110	130-150	210-240	30-40	50-65	75-85	135-140	170-190	270-280	35-45
Depth	mass depth	(g cm^{-2})	58.6	94.1	188.4	262.0	429.4	61.3	105.8	143.6	226.8	299.3	426.1	56.3
R_{36}	sample $^{36}Cl/Cl$ ratio	($^{36}Cl/10^{15}$ Cl)	2045	2073	1399	1555	1050	3144	3219	2795	2156	1885	1704	3265
$\pm R_{36}$	sample $^{36}Cl/Cl$ 1σ uncertainty	($^{36}Cl/10^{15}$ Cl)	49	43	33	59	44	72	67	131	127	72	68	127
ρ_b	bulk density	(g cm^{-3})	1.42	1.91	1.86	1.86	1.86	1.71	1.71	1.85	1.51	1.51	1.45	1.48
l_s	sample thickness	(cm)	15	10	15	20	30	10	15	10	5	20	10	10
θ_{avg}	water content	(cm^3/cm^3)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Elev		(m)	1849	1849	1849	1849	1849	1854	1854	1854	1854	1854	1854	1863
lat	degrees		39.452	39.452	39.452	39.452	39.452	39.456	39.456	39.456	39.456	39.456	39.456	39.453
long	degrees		-115.673	-115.673	-115.673	-115.673	-115.673	-115.674	-115.674	-115.674	-115.674	-115.674	-115.674	-115.666
S_{snow}	snow shielding	(unitless)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
S_T	total shielding	(unitless)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Λ_f	effective atten. length	(g cm^{-2})	170	170	170	170	170	170	170	170	170	170	170	170
LOI	loss on ignition	(wt %)	0	0	0	0	0	0	0	0	0	0	0	0
Na_2O		(wt %)	0.32	0.31	0.35	0.27	0.50	0.59	0.85	0.61	0.69	0.59	0.60	0.60
MgO		(wt %)	0.32	0.30	0.37	0.22	0.27	0.37	0.82	0.52	0.62	0.37	0.56	0.57
Al_2O_3		(wt %)	2.47	2.79	2.91	2.62	3.04	3.21	5.50	3.71	4.29	3.21	4.03	3.56
SiO_2		(wt %)	93.42	93.04	91.69	93.65	92.55	91.03	83.85	88.95	87.20	91.03	88.32	88.24
P_2O_5		(wt %)	0.03	0.03	0.04	0.03	0.03	0.04	0.06	0.05	0.05	0.04	0.04	0.06
K_2O		(wt %)	0.59	0.63	0.70	0.83	0.84	0.89	1.41	0.96	1.09	0.89	1.02	0.91
CaO		(wt %)	0.16	0.09	0.35	0.08	0.15	0.58	1.15	0.93	1.01	0.58	0.68	1.21
TiO_2		(wt %)	0.12	0.14	0.13	0.11	0.11	0.16	0.34	0.23	0.27	0.16	0.24	0.23
MnO		(wt %)	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.02	0.02	0.01	0.02	0.02
Fe_2O_3		(wt %)	1.51	1.39	1.51	1.07	1.05	1.52	3.65	2.03	2.46	1.52	2.86	2.17
Cl		(ppm)	60.43	55.97	66.06	91.61	97.59	56.75	72.80	93.53	77.52	106.35	104.42	97.58
B	(may be estimated)	(ppm)	22	21	20	19	21	31	36	40	32	30	29	6
Sm	(estimated)	(ppm)	12	12	12	12	12	12	12	12	12	12	12	12
Gd	(may be estimated)	(ppm)	0	0	0	0	0	0	1	2	1	0	0	12
U	(may be estimated)	(ppm)	3	3	1	3	3	3	4	3	3	3	4	4
Th	(may be estimated)	(ppm)	0.01	0.01	2	2	2	1	0.01	1	1	1	2	3
M_{sample}	sample mass	(g)	71.5391	71.0004	61.7488	69.8833	101.3802	70.3326	58.9319	50.2395	61.9452	70.3326	99.9381	50.2629
M_{spike}	mass ^{35}Cl spike solution	(g)	3.0056	2.9898	2.9977	2.9733	3.0133	2.9917	3.0129	2.9996	2.99	2.9917	2.0092	4.0068
C_{spike}	conc. spike solution	(g g^{-1})	0.998	0.998	0.998	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995
S/S	analytical stable isotope ratio	($^{35}Cl/(^{35}Cl+^{37}Cl)$)	5.95	6.18	6.11	5.011	4.363	6.16	5.97	5.713	5.64	4.75	3.907	6.43
±S/S	anal. st. isotope ratio unc.	($^{35}Cl/(^{35}Cl+^{37}Cl)$)	0.06	0.06	0.06	0.04	0.06	0.06	0.06	0.05	0.06	0.08	0.05	0.09
R/S	analytical $^{36}Cl/Cl$ ratio	$^{36}Cl/10^{15}$ Cl	1200	1177	931	1059	803	1790	1884	1700	1326	1343	1427	1790
±R/S	analytical $^{36}Cl/Cl$ ratio unc.	$^{36}Cl/10^{15}$ Cl	28	25	22	40	30	42	40	80	56	50	60	70