the chances of burial beneath wind-blown snow (e.g., Margerison et al., 2005).

3.4. Mineral separation and gas extraction

Whole-rock, cosmogenic samples were cut at the Lamont-Doherty Earth Observatory (LDEO) and then crushed at Boston University (BU) using a Spex Certiprep 8515 Shatterbox; fragments were then sieved to isolate the >150 μm and <300 μm fraction. Typical sample weights were about 30 mg. At LDEO, pyroxene grains were separated using magnetic and heavy liquid techniques, followed by handpicking. Separated pyroxenes were then analyzed for helium concentrations and isotopic composition at LDEO on a MAP 215-50 noble gas mass spectrometer calibrated with a known volume of a Yellowstone helium standard (MM) with a ^{3}He/^{4}He ratio of 16.45R_a, where $R_a = (^3\mathrm{He}/^4\mathrm{He})_{\mathrm{air}} = 1.384 \times 10^{-6}$ (following protocols outlined in Winckler et al., 2005; Schaefer et al., 2006). Hot procedural blanks contained less than 5000 atoms of ^{3}He with approximately atmospheric helium isotopic composition. Blank corrections for ^{3}He were smaller than 2% (for samples with low ^{3}He concentrations, K1), and in most cases smaller than 1%.

3.5. Exposure age calculations and erosion rates

We use the sea level, high latitude production rate from spallation reactions of 120 at $\mathrm{g}^{-1}\ \mathrm{yr}^{-1}$ for ^{3}He in pyroxene (Goehring et al., 2010). At each sample site we recorded local and regional shielding by measuring horizon geometry. Shielding factors were calculated for each sample after Balco et al. (2008) (Table 2a). Atmospheric pressures over Antarctica are anomalously low compared to typical pressure–elevation relationships. Therefore, we employed the Antarctic-specific equations in Stone (2000) to scale production rates to sample elevation. Choice of these production rates and scaling schemes relative to other reported production rates (i.e. Lal, 1991; Licciardi et al., 1999) does not impact our chronology or our main conclusions. Nuclide-measurement depths in all surface clasts were <5 cm. Minimum, no-erosion, exposure ages were calculated using the following equation:

$$N = Pt \tag{1}$$

where N is number of cosmogenic nuclides (at g^{-1}), P is the production rate (at $\mathrm{g}^{-1}\ \mathrm{yr}^{-1}$), and t is exposure time (yr).

By convention, exposure ages are typically reported assuming zero erosion. This assumption may be valid for some Holocene and younger-aged samples, but for older samples, surface erosion typically removes the outer crusts of rocks and reduces the total cosmogenic-nuclide inventory. As a consequence of this reduction, exposure ages not corrected for erosion are typically viewed as minimum constraints. If one assumes a constant erosion rate (see below), the relationship between exposure age and erosion rate is governed by the following equation:

$$N = \frac{PL}{E}\left(1 - e^{-\frac{E}{L}t}\right) \tag{2}$$

where N is number of cosmogenic nuclides (at g^{-1}), P is the production rate (at $\mathrm{g}^{-1}\ \mathrm{yr}^{-1}$), L is the attenuation length (g cm^{-2}), E is the erosion rate (g $\mathrm{cm}^{-2}\ \mathrm{yr}^{-1}$), and t is time (yr). Solving Eq. (2) assuming an infinite exposure age (t) yields the maximum possible erosion rate for a given sample (Table 2b). We used an attenuation length of 155 g cm^{-2} (after Sarda et al., 1993) and an average rock density of 2.7 g cm^{-3}.

Table 2a
Sample location, shielding and cosmogenic ^{3}He data from the Kennar Valley drifts.

Drift	Sample	Longitude[a]	Latitude[a]	Altitude[a] (masl)	Shielding factor[b]	^{3}He[c] (10^8 at/g)
K1	DXP-04-03	160.142	−77.751	1405	0.912	0.088 ± 0.003
	DXP-06-20	160.141	−77.751	1405	0.912	0.089 ± 0.003
	KSX-06-39	160.434	−77.742	1395	0.883	0.094 ± 0.003
$\mathrm{K2_m}$[d]	DXP-04-01	160.425	−77.752	1415	0.992	0.692 ± 0.031
	KSX-06-35	160.416	−77.752	1415	0.993	0.522 ± 0.021
	KSX-06-41	160.432	−77.751	1410	0.996	0.624 ± 0.025
	KSX-06-42	160.433	−77.751	1410	0.996	0.917 ± 0.037
	KSX-04-43	160.438	−77.752	1410	0.996	0.487 ± 0.019
	KSX-06-47	160.422	−77.747	1450	0.995	1.220 ± 0.037
	KSX-06-49	160.423	−77.746	1460	0.995	0.669 ± 0.020
$\mathrm{K2_d}$[d]	DXP-04-02	160.419	−77.752	1395	0.992	0.786 ± 0.014
	KSX-06-36	160.421	−77.751	1400	0.993	1.388 ± 0.056
	KSX-06-37	160.423	−77.750	1400	0.987	1.533 ± 0.061
	KSX-06-38	160.428	−77.750	1400	0.991	0.429 ± 0.017
K3	KSX-06-45	160.418	−77.747	1470	0.994	1.070 ± 0.032
	KSX-06-46	160.417	−77.746	1475	0.995	1.770 ± 0.053
K4	DXP-04-06	160.402	−77.751	1500	0.995	2.810 ± 0.042
	DXP-04-07	160.403	−77.752	1490	0.995	3.290 ± 0.058
K5	KSX-06-50	160.395	−77.751	1487	0.994	5.390 ± 0.162
	KSX-06-63	160.395	−77.751	1482	0.995	2.410 ± 0.072
K6	DXP-04-04	160.387	−77.751	1500	0.995	3.135 ± 0.065
	DXP-04-05	160.387	−77.751	1503	0.995	2.370 ± 0.066
K7	DXP-04-08	160.384	−77.750	1492	0.995	9.160 ± 0.140
	KSX-06-62	160.384	−77.749	1494	0.995	8.890 ± 0.267
K8	KSX 06-55	160.341	−77.751	1610	0.985	15.12 ± 0.60
UD[e]	DXP-04-09	160.383	−77.750	1490	0.995	15.39 ± 0.25
	KSX-06-61	160.383	−77.749	1488	0.995	16.40 ± 0.49

[a] Longitude, latitude and altitude (masl = meters above sea level) were measured at each sample location using a Garmin 3000 (measurement error of ± 5 m horizontal and ± 10 m vertical). Due to this relatively high vertical error, we compared these data to topographic maps and measured moraine ridge elevations using a Trimble GeoExplorer 3000 (vertical error ± 1 m).

[b] Shielding factors were calculated after Balco et al. (2008) from horizon geometry measurements recorded for each sample in the field.

[c] 1σ errors of ^{3}He concentrations reflect propagated analytical uncertainties, based on statistical errors and variability in the sensitivity of the mass spectrometer.

[d] K2 ice-cored moraines ($\mathrm{K2_m}$) and K2 ice-cored drift ($\mathrm{K2_d}$) (Figs. 2 and 3).

[e] Undifferentiated drift distal to moraine K7 and stratigraphically below moraines K4–K7.

4. Results

4.1. The spatial distribution and weathering characteristics of Kennar Valley drifts

The mapped pattern of drifts in lower Kennar Valley indicates deposition from southward advance(s) of Taylor Glacier. In most cases, drifts are composed of scattered and isolated erratics whose concentration increases toward a single, major bounding moraine ridge (Figs. 2 and 3); a similar pattern was also noted for drifts deposited from the Ferrar outlet glacier in nearby Vernier Valley (Fig. 1) (Staiger et al., 2006). The Kennar Valley drifts are numbered sequentially from K1 (proximal to Taylor Glacier) to K8 (distal) (Fig. 2). As noted below, K2 is atypical in that it includes widespread, matrix-supported debris over stagnant, glacier ice. A second, matrix-supported drift of unknown origin (UD) underlies K4–K7 drifts and crops out extensively on an upper-level bench beyond K7 (Fig. 2).

Kennar Valley drifts show an overall reduction in maximum clast size with increasing distance from Taylor Glacier (Table 1). The a-axes of surface clasts decline from an average maximum of ~200 cm for K2, to ~100 cm for K5, and to ~50 cm for both K7 and K8 (Table 1). Some of the reduction in clast size likely reflects intermittent fracture (Fig. 4d–f) and pitting (Fig. 4a–c; Fig. 5). None of the clasts show evidence for transport beneath wet-based ice (e.g., striations, polish, molding, and/or faceting). For clarity we group Kennar drifts into two categories, ice cored (K1 and K2) and non-ice cored (K3–K8).