would be a reasonable guide to the variability from 8.56 to 10.00 Myr. The linear relationship between sediment thickness and absolute time from 6.34 to 10.00 Myr supported this assumption, and nothing in the data contradicted it. We stand by our estimate of ±90,000 yr.

Ehrlich and Lerche are mistaken about three other points. (1) Our re-sampling involves no palaeomagnetic intervals of shorter duration than those originally measured. (2) No re-sampling 'filter' is involved. (3) Our statement that error due to all forms of uncertainty should not be systematic simply means that interpolated age estimates should be too high about as frequently as they are too low.

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Are enigmatic markings in Adelaidean of Flinders Ranges fossil ice-tracks?

SEVERAL questions may be raised concerning the provenance of markings recently described by Dyson[1] as "unequivocal metazoan remains" from the "base" of the "Wilpena Group" in the southern Flinders Ranges, South Australia. Dyson[2] indicated that the markings occurred in sandstones ~25 m stratigraphically below a dolomite bed representing the Nuccaleena Formation. This dolomite is the regional marker for the base of the Wilpena Group in the western Flinders Ranges[3]; it is discontinuous in the vicinity of the markings (near Wilmington) but locally reaches a thickness of ~7 m. Directly below it is 11–20 m of maroon-coloured, silty diamictite containing sub-angular to sub-rounded clasts up to 1 cm in diameter. Interlayered sandstones and siltstones at the indicated level of the markings are underlain by pink sandstones which also contain trains of exotic granules and pass laterally into sandy diamictites containing pebbles up to 3 cm. The sandstones variously show flat internal lamination and cross-bedding; stacked sets of ripple bedding outlined by heavy minerals are common and are related to linguoid current ripples and wave oscillation ripples. These diamictites and sandstones are diagnostic facies of the Elatina Formation[4], the glaciogenic interval of the Marinoan and upper division of the Umberatana Group.

Refrigeration during deposition of the Elatina Formation is attested by widespread varvites and common ice-rafted clasts. Pebbly arenites within the unit have been assigned a glaciofluvial or deltaic origin[5]. In a coeval terrestrial setting, laminated sandstone wedges formed in harsh periglacial conditions[5].

Dyson[1] suggested a similarity between the markings and known Precambrian frond-like fossils such as *Pteridinium* and *Charniodiscus*, but *Pteridinium* was evidently rather resilient or 'rubbery' and despite common folding and distortion, the transverse 'ribs' are generally quite regular in width, respectively 2–3 mm and 3–5 mm wide in several described forms. The transverse elements in *Charniodiscus* vary in width (~2–28 mm) with the size of the organism, but show a progressive gradation in dimensions along the frond. Parts of the markings show rapid changes in the width of the ribs, from 2 to 6 mm and from 1 to 10 mm wide in limited areas. Moreover, different numbers of ribs occur on either side of given intervals of the 'axis' of the 'bilateral' marking.

In size and in showing numerous nearly parallel longitudinal striae, the markings may be compared to a group of broadly intergrading inorganic sedimentary structures variously described as grooves and transverse shear wrinkles[6], or interrupted chevron marks and striae with 'jigger' marks[7]. Linear grooves result from current-transported objects touching bottom, and chevrons may develop due to hydrodynamic conditions generated if such objects move just above the substrate[7]. Transverse shear wrinkles have been formed experimentally by passing dense suspension currents over plastic substrates[6]. 'Jigger' marks associated with parallel grooves are evidently made by floating objects touching bottom, and examples are commonly attributed to floating ice[7]. Oscillatory motions imparted to the ice by waves may lead to sets of transverse marks showing cyclical changes in width[7]. The Marinoan markings show just such changes in the width of the 'ribs' (Fig. 1) and their proximity to ice-rafted materials lends circumstantial evidence to their formation by a similar process. Comparable markings formed by ice on the modern-day tidal flats of the St Lawrence, Quebec are illustrated by Dionne[9] (his Fig. 19).

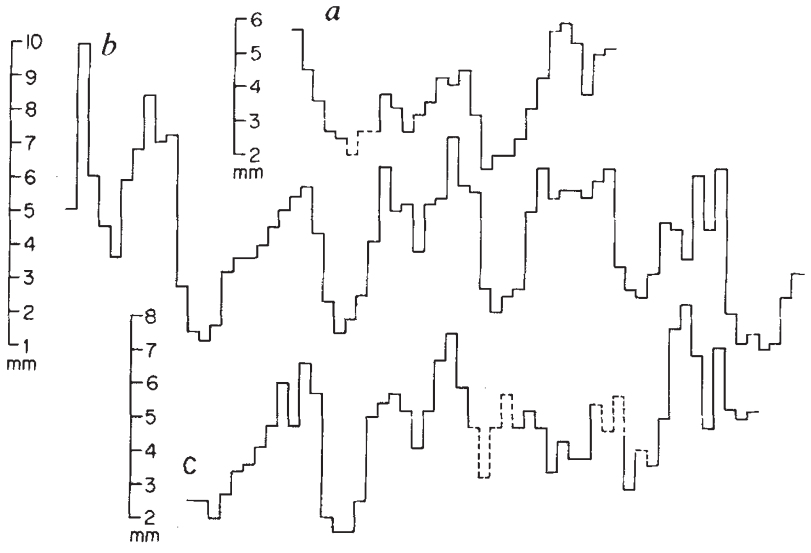

Fig. 1 Cyclical changes in width of ribs in structures described by Dyson[1] from the Flinders Ranges: *a*, series of ribs from left to right in marking 'a' in Dyson's Fig. 3; *b*, upper row of ribs in 'b'; *c*, lower row in 'b' shifted laterally (right) to show maximum correspondence with row above. The mean cyclicity indicated by groups of fine ribs is ~12 ribs and grooves.

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