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Palaeomagnetism of Ferricrete From Vale of Belvoir, Western Tasmania: Implications For Tasmanian Cenozoic Glacial History

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The preliminary results of paleomagnetic studies of ferricretes associated with glacigenic sediments from the Vale of Belvoir, western Tasmania, have important implications for Tasmanian Cenozoic glacial history. The geology of the Vale of Belvoir (Fig. 1) is dominated by glacigenic drift and Tertiary basalt which overlie karstified Ordovician Gordon Group limestones. Ferricrete, up to 2 m in thickness, is developed within and adjacent to the weathered glacigenic sediments and is exposed in road cuttings, as well as in scattered blocky outcrops across the area (Fig. 1). Widely spaced joints in the ferricrete outcrops sometimes give the appearance of crude bedding. The ferricrete blocks appear to have developed *in situ*, rather than being deposited as erratics. The ferricrete is mainly developed adjacent to basalt in the valley. This suggests derivation of the iron from chemical weathering of the basalt, and its lateral migration and accumulation to produce massive and concretionary horizons controlled by local water-tables.

U/Th dating of the ferricrete gave ages of $227+\infty/-107$ ka and $83.8+30.8/-25.7$ ka. The first date indicates that the ferricrete has remained a closed system for uranium during the last two glacial/interglacial cycles, although some reworking of the ferricrete may have occurred during the last interglaciation. The massive ferricrete outcrops thus indicate a minimum mid-Pleistocene age for the initial Fe/Mn oxide accumulation, and hence for the deposition of the associated glacigenic sediments.

Thirty-four oriented core samples were collected at the Vale of Belvoir for palaeomagnetic analysis (e.g., Schmidt and Embleton, 1976; Idnurm and Senior, 1978). The ferricrete outcrops as discrete areas of typically 2000 m^2 which are spread over ~10 km^2. The ferricrete appears to be *in situ*, as confirmed by the grouping of remanence directions, shown in figure 2. However, block tilting is possible, and may have contributed to the directional scatter. Tilting could be due to overriding by younger glacial advances, and/or solution of underlying Ordovician limestones causing destabilisation of the ferricrete cap. However, the clustering of remanence directions from samples taken from several discrete ferricrete blocks and from *in situ* massive ferricrete exposed in track cuttings, suggests that tilting is not a serious problem. Further work is being undertaken on adjacent ferricrete blocks to obtain a better estimate of the remanence direction.

Both normal and reversed polarities were recorded, sometimes within the same specimen, indicating that the magnetisation occurred over a sufficiently long period to span reversals of the geomagnetic field. This suggests that much of the secular variation of the geomagnetic field has been averaged out so that the pole represents the period of magnetisation. The pole, calculated by assigning unit weight to each specimen direction, is 98.7°E, 71.9°S, A_{95} = 8.7°.

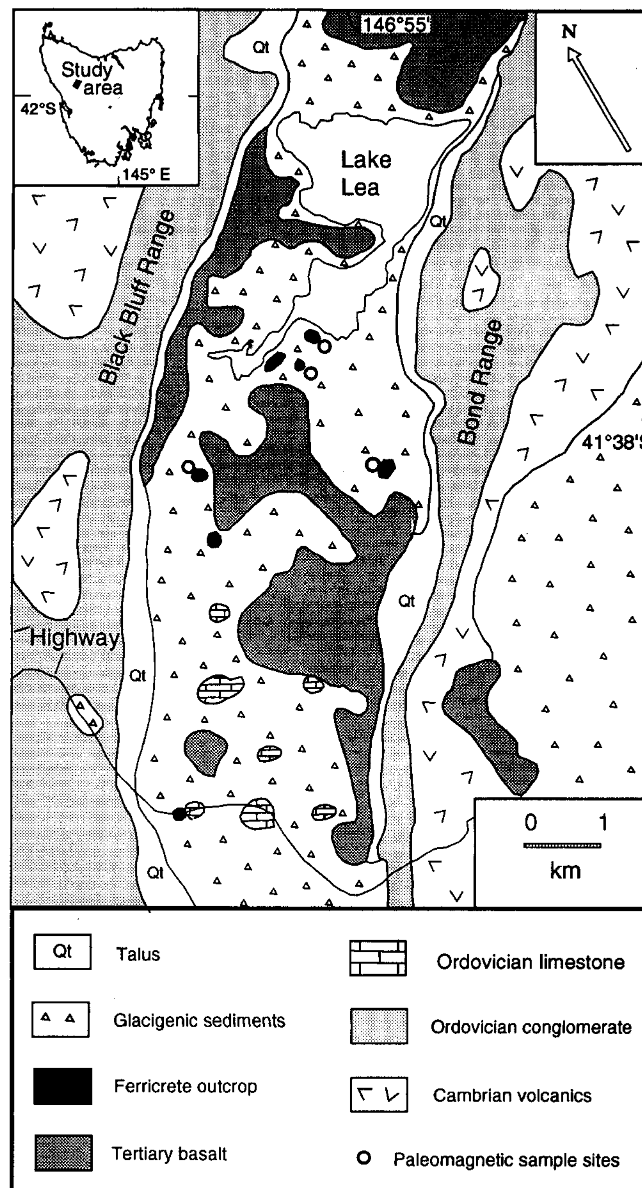

FIGURE 1
Simplified geological map of Vale of Belvoir showing location of ferricrete sample sites.

Although this pole plots to the west of the Australian late Mesozoic-Cenozoic polar wander path (Idnurm, 1985), its confidence circle intersects the path (Fig. 3). The position on the path suggests a pre-Pliocene, possibly mid-Cenozoic age for the magnetisation.

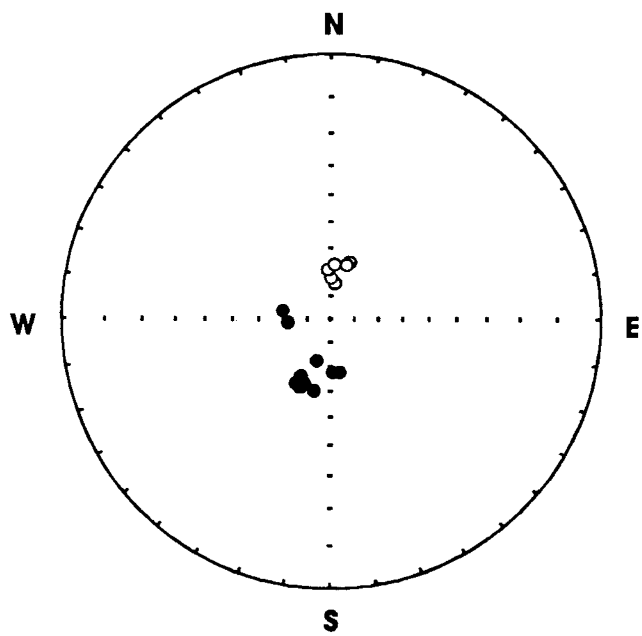

FIGURE 2
Equal-angle projection of directions obtained from principal components analysis of thermally demagnetised specimens.

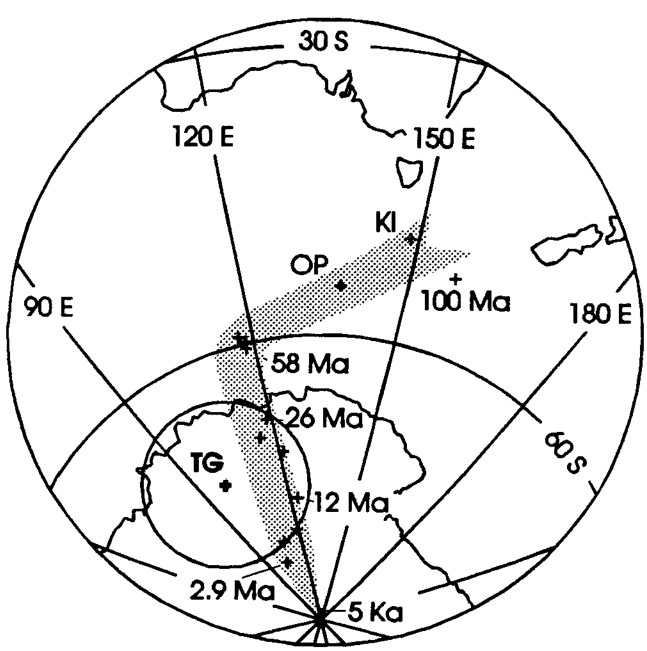

FIGURE 3
Tertiary and Cretaceous poles for Australia (after Idnurm, 1985). TG denotes the pole derived from the Vale of Belvoir ferricrete. Circle denotes 95% confidence limit.

Geomorphological Implications

The pre-Pliocene magnetic age is a minimum age for the glacigenic sediments. U/Th dating of the ferricrete indicates that it has been a closed system since at least the mid-Pleistocene, which is consistent with the palaeomagnetic evidence. Both are minimum ages for the host glacigenic sediments and the latter suggests that the Vale of Belvoir was initially glaciated prior to the mid-Cenozoic.

The palaeomagnetic analysis provides the first surficial evidence for extensive pre-late Cenozoic glaciation of the western Tasmanian Highlands. Recent re-appraisal of the glacial history of the Forth Valley, western Tasmania, suggests that a diamicton in a drill core from the Forth Valley which is interpreted as glacial till, is at least early Oligocene in age (Macphail *et al.,* 1993). It is not possible to correlate the Vale of Belvoir glacigenic sediments with those from the Forth Valley, but the minimum pre-Pliocene age for the timing of ferricrete magnetisation indicates that the expansion of glaciers in the western Central Highlands of Tasmania during the mid-Cenozoic was not an isolated event.

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