# TEKTITES AS CHRONOSTRATIGRAPHIC MARKERS IN AUSTRALIAN REGOLITH

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About 790 ka (Schneider *et al*. 1992), an asteroid or comet impacted in southeast Asia, producing tektites, microtektites and impact debris which are found over more than 10% of the Earth's surface (Schnetzler & McHone 1996), including much of Australia and surrounding oceans (Figure 1). The distribution, size and concentration of tektites and microtektites indicate a likely impact site somewhere in southern Laos or Thailand, but the location of the impact site has not yet been discovered.

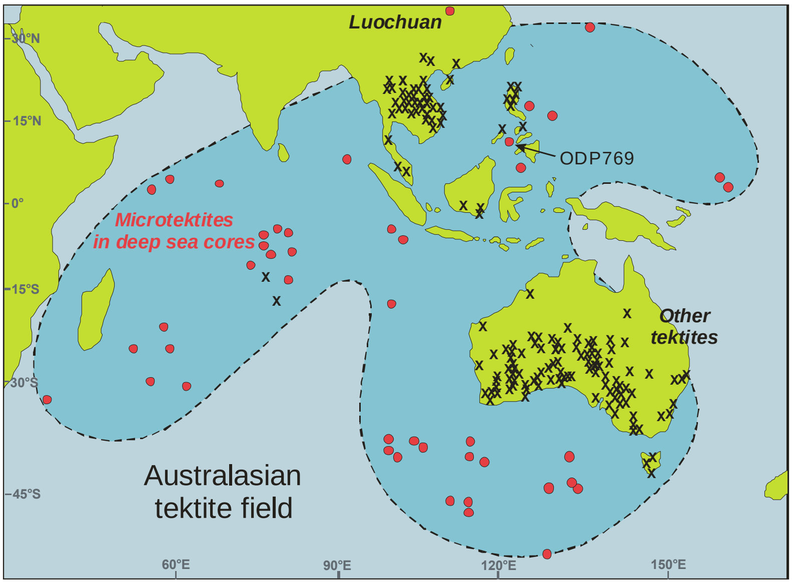


**Figure 1:** Distribution of Australasian tektites and microtektites (after Prasad *et al.* 2003).

Although there has been considerable debate concerning the age of the Australasian tektites, their age is now firmly established through magneto-stratigraphy of deep sea cores in which microtektites occur just prior to the Matuyama/Brunhes polarity transition (Schneider *et al*. 1992), as well as direct laser fusion $^{40}Ar/^{39}Ar$ dating of tektite glass (Izett & Obradovich 1992). Previously, a number of field studies supported a Late Pleistocene age in the range 5 to 25 ka (e.g., Gill 1970, Lovering *et al*. 1972), but these occur-rences are now considered to represent reworking into younger sediments (e.g., Fudali 1993, Shoemaker & Uhlherr 1999). There has long been speculation that the impact may have triggered the Matuyama/Brunhes reversal (e.g., Glass & Heezen 1967). However, the estimated time (12-15 ka) between the impact and the reversal appears to be too long for a causal link between the two events (Schneider *et al*. 1992).

Tektites have been found in abundance at numerous sites across Australia, particularly southern Australia (Figure 1), where Fudali *et al*. (1991) estimated that finds must number in the tens of thousands. The reason(s) why very few finds have been reported from north of 25°S is (are) unclear. Indeed, it might be expected that there should be a general tendency for increasing size and number of tektites in northwestern Australia as the impact source in southeast Asia is approached. Most tektites in southern Australia have been found on bare, usually wind-deflated surfaces, so their apparent rarity in northern Australia may be a function of a general lack of exposure at the surface.

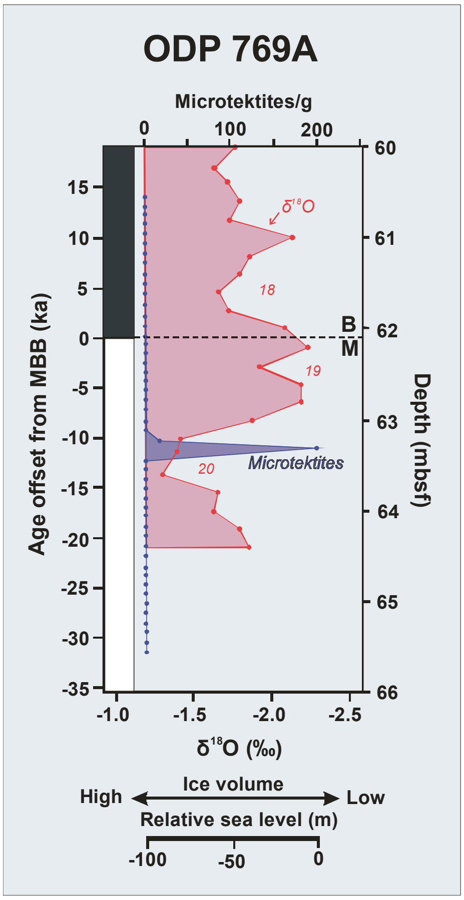


**Figure 2 (right):** Occurrence of microtektites in ODP core 769A after Schneider *et al.* (1992).

Regolith deposits of Lower and Middle Pleistocene age (0.1 to 1.8 Ma) are notoriously difficult to date in Australia. The Matuyama/Brunhes polarity transition (0.78 Ma) is the most valuable magnetostratigraphic marker in this time range. It has been identified in sediment cores from Lake George, Lake Tyrrell, Lake Lefroy, Lake Amadeus, Lake Buchanan and Lake Lewis, as well as sedimentary sequences near Naracoorte and Adelaide (Pillans & Bourman 1996, 2001, Pillans 2003). However, primary magnetization may be masked by secondary weathering-induced overprints. As in deep-sea cores, the temporal association of tektites with the Matuyama/Brunhes polarity transition provides a potential way of verifying its position in continental sequences. For example, Australasian microtektites occur in Chinese loess sequences, where their presence as a discrete layer has been used to correct the misleading position of the Brunhes/Matuyama polarity transition (Zhou & Shackleton 1999). The two have yet to be located in the same section in Australia.

It is unfortunate that while most museums and many private mineral collectors in Australia have tektites in their collections, the provenance of the overwhelming majority of specimens is poorly documented. Most commonly, location will be stated as "Adelaide region", or something similarly broad, with no details of stratigraphic setting. Possibly the best documented specimens are from the Port Campbell area of Victoria, where Shoemaker & Uhlherr (1999) carefully described the stratigraphic setting of nearly 4000 tektites and tektite fragments. According to Shoemaker & Uhlherr (1999), the majority of the tektites in the Port Campbell area occur as a lag deposit at the basal contact of the Late Pleistocene to Holocene Sturgess Sand, where they have been reworked from the underlying Hanson Plain Sand (Plio-Pleistocene). In regolith deposits where reworking is suspected, the presence of tektites provides a maximum age of 790 ka for the enclosing sediment. For example, waterworn tektites have been found in diamond-bearing alluvial gravel terraces some 25 km downstream of the Argyle diamond mine in northwestern Western Australia (Fudali *et al.* 1991, Fudali 1993), indicating a maximum age of 790 ka for the terraces.

As part of the CRC LEME geochronology project I would like to hear from anyone who has found tektites. I also encourage all of you to be alert to tektites in your field work. Usually, they are dark-coloured, smooth glassy objects, not unlike iron nodules at first glance, but readily distinguishable from bottle tops and other surface litter (Figure 3).


**Figure 3:** Three tektites from the Alice Springs area are readily distinguishable from bottle tops and other surface litter.


**REFERENCES**

FUDALI R.F. 1993. The stratigraphic age of australites revisited. *Meteoritics* **28**, 114-119.

FUDALI R.F., MILLER A. & BEVAN A.W.R. 1991. Australites from northern Australia. *Meteoritics* **26**, 153-155.

GILL E.D. 1970. Age of australite fall. *Journal of Geophysical Research* **75**, 996-1002.

GLASS B.P. & HEEZEN B.C. 1967. Tektites and geomagnetic reversals. *Scientific American* **217**, 32-38.

IZETT G.A. & OBRADOVICH J.D. 1992. Laser-fusion $^{40}$Ar/$^{39}$Ar ages of Australasian tektites (Abstract). *Lunar and Planetary Science* **23**, 593-594.

LOVERING J.F., MASON B., WILLIAMS G.E. & MCCOLL D.H. 1972. Stratigraphical evidence for the terrestrial age of australites. *Journal of the Geological Society of Australia* **18**, 409-418.

PILLANS B. 2003. Subdividing the Pleistocene using the Matuyama-Brunhes boundary (MBB): an Australasian perspective. *Quaternary Science Reviews* **22**, 1569-1577.

PILLANS B. & BOURMAN R. 1996. The Brunhes/Matuyama polarity transition (0.78 Ma) as a chronostratigraphic marker in Australian regolith studies. *AGSO Journal of Australian Geology and Geophysics* **16**, 289-294.

PILLANS B. & BOURMAN R. 2001. Mid Pleistocene arid shift in southern Australia, dated by magnetostratigraphy. *Australian Journal of Soil Research* **39**, 89-98.

PRASAD M.S., GUPTA S.M. & KODAGALI V.N. 2003. Two layers of Australasian impact ejecta in the Indian Ocean? *Meteoritics and Planetary Science* **38**, 1373-1381.

SCHNEIDER D.A., KENT D.V. & MELLO G.A. 1992. A detailed chronology of the Australasian impact event, the Brunhes-Matuyama geomagnetic polarity reversal, and global climatic change. *Earth and Planetary Science Letters* **111**, 395-405.

SCHNETZLER C.C. & MCHONE J.F. 1996. Source of Australasian tektites: Investigating possible impact sites in Laos. *Meteoritics and Planetary Science* **31**, 73-76.

SHOEMAKER E.M. & UHLHERR H.R. 1999. Stratigraphic significance of australites in the Port Campbell Embayment, Victoria. *Meteoritics and Planetary Science* **34**, 369-384.

ZHOU L.P. & SHACKELTON N.J. 1999. Misleading positions of geomagnetic reversal boundaries in Eurasian loess and implications for correlation between continental and marine sedimentary sequences. *Earth and Planetary Science Letters* **168**, 117-130.