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The Taung Child (*Australopithecus africanus*), the Plio-Pleistocene boundary and a supernova hypothesis

Significance:

The Taung Child is a fossilised hominin skull and jaw from the North West Province in South Africa. One hundred years ago it was described by Raymond Dart as the type specimen of *Australopithecus africanus*, a distant human relative. On the basis of biochronology, it has recently been estimated to be 2.58 million years old. This date coincides with the Plio-Pleistocene boundary. In terms of a supernova hypothesis, it is proposed that global cooling between about 3 and 2.6 million years ago is related to factors associated with a supernova less than 100 parsecs from the solar system.

The Taung Child (Figure 1) is the nickname of the holotype of *Australopithecus africanus*, a Plio-Pleistocene hominin described by Raymond Dart in the pages of *Nature* 100 years ago.¹ It has been dated at 2.58 Ma on the basis of ratios of dental dimensions, using lower first molars.²⁻⁴ Coincidentally, this is the date for the Plio-Pleistocene boundary⁵ at the time of a change in the earth's magnetic field from normal (Gauss Chron) to reversed (Matuyama Chron). The date of 2.58 Ma for the Taung Child²⁻⁴ is consistent with the lower age estimate of 2.6 Ma given by McKee⁶ based on a biochronological study of non-hominin fauna from the site of Taung.

Biologically, the magnetic reversal coincided with the extinction of certain species of *Discoaster*, star-shaped marine algae (nanoplankton) with calcareous exoskeletons, in particular the extinction of *D. pentaradiatus* and *D. surculus*. On the basis of such biological signals, the Plio-Pleistocene boundary is defined as the base of the Gelasian as represented in Sicily, corresponding to Marine Isotope Stage 103, astronomically tuned to an age of 2.58 Ma.⁷

The boundary between the Pliocene and Pleistocene is shown in Figure 2 in relation to $\delta^{18}\text{O}$ oxygen isotope ratios determined from marine calcareous foraminifera within a period of 3 Ma, showing dominant elements of astronomical Milankovitch cycles (eccentricity, obliquity and precession) in three intervals within the Pleistocene, associated with periodicities of 100 ka, 42 ka and 23 ka, respectively.⁸

Knie et al.⁹, Compagnucci et al.¹⁰, Deschamps and Mottez¹¹ as well as Melott and Thomas¹² explored a scenario of palaeoclimatic change and other events in the context of an isotope of iron (⁶⁰Fe) in marine core deposits¹³ linked to a supernova^{14,15} less than 100 parsecs (pc) from the solar system. This scenario is related to an increase in high-energy galactic cosmic rays and a weakening of the shielding effect of the earth's magnetic field, associated with an increase in ionisation of the earth's atmosphere at least 1000 years in duration. ⁶⁰Fe is a radioisotope (unlike $\delta^{18}\text{O}$) with a half-life of 2.6 Ma and therefore does not normally occur on earth. It is extraterrestrial in origin.

Excluding samples with ⁶⁰Fe detector events of only 1 or 2, I have calculated a three-sample running mean for ⁶⁰Fe/Fe ratios from east Indian Ocean cores published by Wallner et al.¹³ (their Table S4). There is a regular increase in the ⁶⁰Fe/Fe ratio from about 3 to 2.6 Ma, followed by a decline (Figure 2).



Photo: Bernhard Zipfel, Evolutionary Studies Institute, University of the Witwatersrand (reproduced with permission)

Figure 1: The Taung Child, holotype of *Australopithecus africanus*.

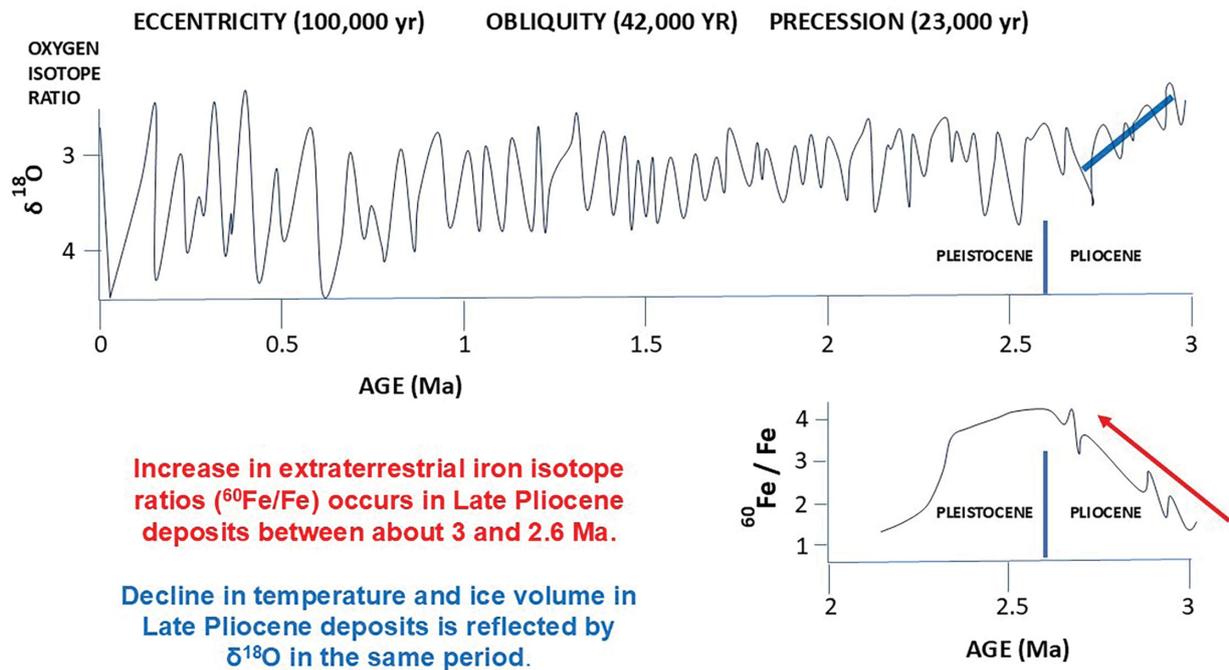


Figure 2: Oxygen isotope ratios ($\delta^{18}\text{O}$, related to global temperature) associated with dominant elements of astronomical Milankovitch cycles in three periods within the Pleistocene. An increase in extraterrestrial iron isotope ratios ($^{60}\text{Fe}/\text{Fe}$) occurs in Late Pliocene deposits between 3 and 2.6 million years ago, in contrast to a decline in temperature (and ice volume) reflected by $\delta^{18}\text{O}$ in the same period.

It is evident from Figure 2 that an inverse relationship exists between $^{60}\text{Fe}/\text{Fe}$ from Late Pliocene deep-sea sediments and $\delta^{18}\text{O}$ from marine foraminifera. A decline in global temperature spanning at least 300 ka is reflected by oxygen isotope ratios preceding the Plio-Pleistocene boundary at 2.58 Ma. In terms of a supernova hypothesis, I attribute this decline in temperature, between about 3 and 2.6 Ma, to factors associated with a supernova in the same period.

It cannot be concluded that the death of the Taung Child circa 2.58 Ma was directly caused by the effects of a supernova remnant. This would be far-fetched. There is in fact evidence from talon marks on the skull that this individual, about 3 years old, was killed by an eagle.¹⁶ In my opinion, it is also too far-fetched to consider that the origin of bipedalism in Plio-Pleistocene hominins relates to the effects of a supernova event, including increased lightning and a subsequent increase of terrestrial fire associated with a change in African habitats from forest to woodland savanna.¹¹ However, it is plausible at least to hypothesise that populations of *A. africanus* (at around the time of the Plio-Pleistocene boundary) were indirectly affected by factors associated with a supernova, including increased cloud cover (caused by an increase in cosmic-ray induced atmospheric radiation)¹⁷ contributing to global changes in temperature before and after 2.58 million years ago. Korschinek and Faestermann¹⁸ recognise that palaeoclimatic change may have contributed to the appearance of the genus *Homo*.

This note serves as a contribution to the celebration of the centenary of Raymond Dart's description of the Taung Child.¹

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Declarations

I have no competing interests to declare. I have no AI or LLM use to declare.

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