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Stretching out the Australasian microtektite strewn field in Victoria Land Transantarctic Mountains

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ABSTRACT

Petrographic and geochemical studies of microtektites collected in newly explored summit plateaus of the Transantarctic Mountains (i.e., Schroeder Spur, Killer Nunatak, Miller Butte in the inland catchment of the Rennick Glacier, and Allan Hills, in the inland catchment of the Mackay-David Glaciers) document a regional distribution of Australasian microtektites in Victoria Land. A geochemical comparison with Australasian microtektites from deep sea sediments at lower latitudes identifies a possible projectile geochemical signature for the first time, and confirms that Transantarctic Mountains microtektites experienced higher thermal regimes. Ballistic calculations reveal that the extraordinary distance of the Transantarctic Mountains microtektites from the hypothetical impact location in Indochina (~11,000 km) could be more efficiently attained at relatively low ejection angles (20°–40°). Finally, the occurrence of Australasian microtektites (~0.8 Ma old) on specific glacial surfaces of the Antarctic bedrock constrains the glacial history of the East Antarctic Ice Sheet in Victoria Land. In particular, data from Allan Hills supports a glaciological scenario envisaging an extremely stable East Antarctic Ice Sheet over at least the last ~1 Ma in the inland catchment of the Mackay/David glaciers. This is consistent with the large accumulation of meteorites in the adjacent blue ice fields.

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1. Introduction

Tektites are siliceous glass objects up to several tens of centimeters in size with splash, layered (or Muong Nong-type) or flanged forms (Glass, 1990; Glass and Simonson, 2013). Their microscopic counterparts are called microtektites and consist of siliceous glass spheroids less than 1 mm in diameter. Tektites and microtektites are produced by the melting and vaporization of the Earth's crust during oblique hypervelocity impacts of extraterrestrial bodies (Koeberl, 1994; Artemieva et al., 2002; Artemieva, 2008). They form distal ejecta found scattered over large areas of Earth's surface known as strewn fields (e.g., Montanari and Koeberl, 2000; Glass and Simonson, 2013).

The Australasian tektite/microtektite strewn field (Fig. 1) covers more than 10% of the Earth's surface, with a minimum lateral extent of 14,000 km (Glass and Simonson, 2013; Folco et al., 2008). Tektites were found on land from southeast Asia over much of Australia and Tasmania. Microtektites were found in the surroundings ocean basins in deep sea sediments, as well as on land in Victoria Land, Antarctica. The extent of the strewn field is one order of magnitude larger than that of the other known tektite/microtektite strewn fields (i.e., the Ivory Coast, the Central European and the North American fields; Glass and Simonson, 2013). The Australasian tektite/microtektite strewn field is also the youngest one, with an approximate age of 0.8 Ma (e.g., Izett and Obradovic, 1992). Although being the largest and the youngest strewn field, its source crater is not yet known. Most authors suggest however that it should be located somewhere in Indochina to explain abundance, petrographic and geochemical trends in microtektite distributions (e.g., Glass and Pizzuto, 1994; Lee and Wei, 2000; Ma et al., 2004; Glass and Koeberl, 2006; Prasad et al., 2007; Folco et al., 2010a, 2010b), and that its diameter should exceed 30 km (e.g., Glass and Koeberl, 2006). Due to the lack of a source crater, other authors proposed that the strewn field was generated by a low-altitude airburst of an impacting comet (e.g., Wasson, 2003).

After our first findings of Australasian microtektites in northern Victoria Land Transantarctic Mountains (TAM) during the 2003 and 2006 Programma Nazionale delle Ricerche in Antartide (PNRA) expeditions (Folco et al., 2008, 2009), in 2009 and 2012, we extended sampling along the mountain range in order to check the actual extension of the Australasian strewn field in the TAM. Search were conducted for up to 150 km due north and 350 km due south

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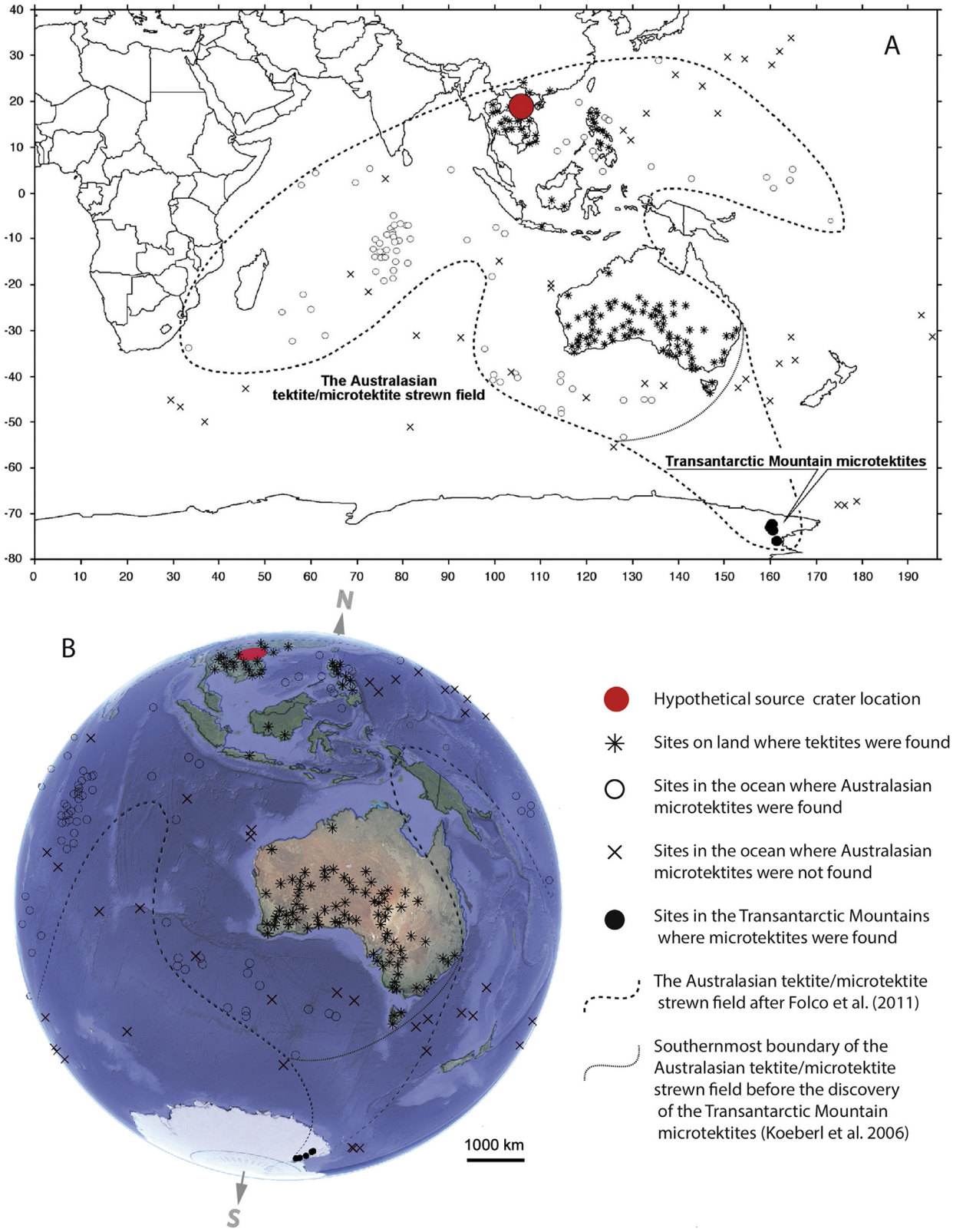

Fig. 1. The geographic extension of the Australasian tektite-microtektite strewn field extended by the finding of AUS/TAM (dashed line; after Folco et al., 2011). The southernmost boundary of the strewn field defined by AUS/DSS (dotted line) is after Glass and Koeberl (2006). Additional find locations of the AUS/DSS are from Lee and Wei (2000), Carcaillet et al. (2003), Suganuma et al. (2011) and Valet et al. (2014). A) Mercator projection of the Pacific, Indian and Southern oceans areas. B) A projection of the AUS strewn field over a general perspective of the Earth's globe centered on southern Western Australia. The red area in Indochina is the possible source impact location of the Australasian tektite-microtektite strewn field (See Chapter 1. for details).

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