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^{10}Be in Australasian microtektites compared to tektites: Size and geographic controls

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In discussion of ^{10}Be in Australasian tektites and microtektites (AAT and MTK, respectively), Rochette et al. (2018) rejected loess from their potential source materials. An argument of inconsistency with a target sedimentary sequence in which ^{10}Be content decreases with depth fails if the target was a loess/paleosol (LP) sequence constrained by proper stratigraphic position and column height. Considering ^{10}Be contents in paleosol 200–300 Mat/g higher than in loess (Gu et al., 1996), an ideal target would consist of a thick loess column topped with a thin paleosol layer. The AAT impact occurred ~12 k.y. prior to the Matuyama-Brunhes reversal, at a transition from glacial MIS20 to the interglacial MIS19, in Chinese LP sequences recorded by a change from a thick loess layer L9 to a thin paleosol layer S8 (Liu et al., 2015). Rochette et al. do not take into account participation of the S8 layer in the target. Excavation of a thicker column including lower paleosol layers may result in inconsistent ^{10}Be variation in AAT/MTK with launch distance, but with limited ^{10}Be data for AAT, their uncertainty, and questionable launch distances of MTK, a "non-monotonous" model cannot be excluded.

LP is not suitable as AAT source materials for other reasons. The decay-corrected ^{10}Be range of 60–280 Mat/g in AAT/MTK (Ma et al., 2004; Rochette et al., 2018) is less than half of ^{10}Be in Chinese LP sequences (Gu et al., 1996). Dilution by a low-^{10}Be material such as bedrock during impact seems problematic due to mixing issues (Ma et al., 2004), but a more serious hindrance may be the relation between ^{10}Be and Ca contents. In AAT/MTK, ^{10}Be increases with Ca (Blum et al., 1992), whereas an opposite trend is observed for ^{10}Be and carbonate contents in LP sequences (Gu et al., 1996). This problem may not be encountered in LP precursors—sedimentary deposits in the Alxa deserts, located northwest of the Chinese Loess Plateau—suggested as a suitable AAT source by Mizera et al. (2016a). Paleoenvironmental proxies in the WEDP02 drill core in the Badain Jaran Desert (BJD) (sand/dust proportions, grain size, carbonate content) show that dust and carbonate fractions were higher in the humid conditions of interglacials (Wang et al., 2015) associated with higher ^{10}Be uptakes in sediments than during glacials (Gu et al., 1996). The range of ^{10}Be values in Alxa sediments agrees with with AAT: 11–51 Mat/g in sand, 120–280 Mat/g in falling dust originated from the deserts, and 73–311 Mat/g in mud crust formed on the desert surface after rainwater evaporation (Shen et al., 2010). Carbonate variation in WEDP02 between MIS19 and MIS25 allows constraining a target thickness to ~35 m; a "monotonous" carbonate/^{10}Be model would require a thinner target (~10 m). On the other hand, oscillations in the carbonate content (the presence of calcareous cementation layers) could explain extremely high Ca or Mg contents in some AAT/MTK.

Other arguments of Rochette et al. (2018) disqualifying LP due to a high chemical homogeneity and very fine grain size, adopted from Blum et al. (1992), were questioned by Ma et al. (2004). The chemical match between LP and AAT is exceptional for most elements except those volatilized during impact, as well as their matching Nd-Sr isotopic compositions (Mizera et al., 2016a). Composition of Alxa sediments, similar to LP, suits AAT even better thanks to higher chemical and grain-size heterogeneities. The Nd-Sr isotopic pattern in LP/Alxa sediments represents mixing materials from two sources: the Qilian Mountains and the Gobi Altay Mountains (Zhang et al., 2015). AAT outliers with very low ^{87}Sr/^{86}Sr (H-Ca philippinites, australites) may have sampled a higher fraction of marine carbonates. On the contrary, a model of a variable weathered/fresh bedrock mixture of Jurassic sediments, adopted from Blum et al. (1992), has not been supported by field data and mixing calculations. The universally accepted location of the AAT impact in Indochina, having been searched for in vain for decades, suffers from serious flaws, including the absence of a suitable target and analogy with other tektite-strewn fields (Mizera et al., 2016a). The alternate hypothesis of an impact into BJD meets conditions of sufficient supply of suitable source materials and crater burial (under sand megadunes), while complying with current interpretations of the distribution of various morphological and constitutional AAT types, MTK, and unmelted ejecta. Subsurface elevation trends and sand thickness derived from ground gravity survey (Yang et al., 2011), along with global gravity data (Mizera et al., 2016b) reveal a suitably large circular structure centered around ~40°N, 102°E, the area of BJD lakes. Finally, the AAT impact location more distant from Indochina agrees better with all three other known tektite-strewn fields.

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