This supplemental material accompanies

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SAMPLES AND METHODS

Lacking detailed geochemical data on sands from the drill cores in the Alashan Desert, we suggest that Chinese loess offers a fair approximation of source materials for Australasian tektites (AAT), and is more realistic than unproven mixtures of sources in Indochina proposed by other authors. We have compared internally consistent geochemical data (mostly measured in one lab using the same method) for a representative suites of AAT (all major types and strewn field parts) and Lingtai loess (a long loess/paleosol sequence covering several glacial and interglacial transitions), and completed them with literature data for materials not available for our analyses.

Analyzed samples and literature data selection

In Mizera et al. (2016), hypothetical origin of AAT in the Alashan Desert (preferentially the Badain Jaran part, BJD) has been supported by geochemical similarity of a representative AAT suite analyzed by neutron and photon activation analyses with Chinese loess data from literature. The analyzed AAT suite covered all main morphological types – splash-form (SF-AAT), layered (Muong Nong, MN-AAT), and ablated (flanged button australites) – and major parts of the AAT strewn field (Indochina, South China, Philippines, Indonesia, Australia). In the present work, comparison of geochemical compositions of AAT and their potential source materials has been significantly extended. Missing average values for several elements (Y, Zr, Nb, Gd, Ho, Tm) in the previously published in-house MN-AAT data (Mizera et al., 2016) have been completed from Žák et al. (2019). Compositions of Australasian microtektites (AAMT), separately for the normal group and the high-Mg group, have been obtained by averaging the values for AAMT from deep sea sediments (Glass et al.,

2004; Glass and Koeberl, 2006) and values for Transantarctic Mountains microtektites (Folco et al., 2009, 2016), all compiled in Folco et al. (2016). Data for the unmelted ejecta recovered from the Australasian microtektite layer in the South China Sea were taken from Glass and Koeberl (2006). Literature data for Chinese loess presented in Mizera et al. (2016) have been replaced by in-house data acquired recently for a loess suite from the Lingtai section (35.2°N, 107.7°E; see Fig. 1) sampled and described by Zhu et al. (2000). The suite of about eighty loess and paleosol samples from the last glacial covered the uppermost 15 meters (Holocene soil layer S_0 to loess layer L_2) of the section. Their analysis employed procedures used for AAT in Mizera et al. (2016). Data ranges shown in Fig. 2 represents selection of ten specimens covering the whole sampled profile whose compositions was recalculated to volatile-free basis. Data ranges for modern sands in BJD were taken from Hu and Yang (2016) and Zhao et al. (2019) for major oxides (volatile-free basis, both data sets averaged), and from Zhang et al. (2018) for trace elements (silicate fraction), except for As values taken from Gao et al. (2006). All data have been normalized to the average upper continental crust (UCC) composition adopted from Rudnick and Gao (2003).

Analytical methods

The AAT and loess samples were analyzed by different modes of instrumental neutron and photon activation analyses (INAA and IPAA, respectively) at the Nuclear Physics Institute, Czech Academy of Sciences (NPI). AAT samples for analysis were cut from individual tektite bodies as pieces with a total weight of 3-5 g. They were crushed in a mortar made of surface hardened, non-alloyed steel to a grain size less than 1 mm. Possible contamination by steel chips was removed by a magnet. Loess samples were crushed and powdered in an agate mortar. Typical sample masses were 50-200 mg in INAA and 0.5-2 g in IPAA. Irradiations for INAA were carried out in the experimental nuclear reactor LVR-15 of the Research Centre Řež within the CANAM infrastructure (project No. LM2011019 of the

Ministry of Education, Youth and Sports of the Czech Republic). Irradiations for IPAA employed bremsstrahlung photons produced in the microtron MT-25 of NPI. For quality control purposes, reference materials granodiorite GSP-1 (USGS) and granite GS-N (CRPG) were analyzed simultaneously with samples. The precision of the analysis (relative combined uncertainty) was better than 5% for most analyzed elements, except for Mg, K, Zn, As, Sr, Y, Zr, Nb, Sb, Gd, Dy, Ho and Ta with 5-10% precision. A detailed description and discussion of the analytical procedures can be found in our previous papers (Řanda et al., 2007; Mizera and Řanda, 2010; Mizera et al., 2012).

The values for Y, Zr, Nb, Gd, Ho, Tm in MN-AAT adopted from Žák et al. (2019) were determined at the Institute of Geology, Czech Academy of Sciences by ICP-MS with precision better than 3% (for analytical details see Žák et al., 2016, 2019). Good concordance of the ICP-MS results with our INAA/IPAA data for most elements was confirmed previously in joint analyses of moldavites (see Mizera and Řanda, this volume).

Recalculation of loess compositions to volatile-free basis used loss on ignition values determined from thermogravimetric analysis at the Faculty of Science, Masaryk University. Thermogravimetric analysis and differential scanning calorimetry (TG/DSC) was performed on a Netzsch Jupiter STA 449 instrument with a heating rate 10 K min^{-1} and the maximum temperature 1000 °C in nitrogen atmosphere.

Spreadsheet data

The spreadsheet data (553-25-Figs_2-3-data.xlsx) included in the Supplemental Material contains in the sheet "geochem-Fig.2" geochemical data (both measured in our laboratories and from literature) used in construction of the graph in Fig. 2. Both averaged/min-max, UCC-normalized values presented in Fig. 2 and available original, untreated data are included. List of AAT samples with their description and provenance, and complete results for individual samples, are included as images copied from Mizera et al.

(2016). For Lingtai loess, data before recalculation to volatile-free basis are also included, and a graph showing position of analyzed samples within the sampled profile, together with the major oxide compositions and lithology-pedology. A photograph of the profile is included. The sheet “Sr-Nd-Fig.3” provides Sr-Nd isotopic data in AAT from literature, used in construction of the graph in Fig. 3, with brief description of individual samples, where available.

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