

Non-traditional stable isotope fractionation during impact-related evaporation, re-condensation and melting

RONNY SCHOENBERG¹, BÉATRICE LUAIS² AND ILKA C. KLEINHANNS¹

¹University of Tuebingen

²Université de Lorraine, CNRS, CRPG

Many experimental studies on elemental behavior during condensation under near vacuum conditions (10^{-4} bar) specific to the collapsing and condensing nebular disc were conducted in order to understand the formation and (isotope-) geochemical composition of solid matter - from dust particles to meteorites and planets - in our solar system [1]. However, studies on elemental and stable isotopic fractionation by evaporation from impact-related super-heated melts and gravitational escape from small planetesimals that then accreted to planets or during collision of planet-sized bodies, such as the Moon-forming event, are still relatively scarce [e.g. 2-4].

Similarly, only few studies so far investigated intra-planetary elemental and stable isotopic redistribution by evaporation from large-bolide impact-related melts on Earth under atmospheric pressures, such as the collaborative Zn stable isotope study of the 1849 Ma Sudbury impact melt sheet initiated by Balz Kamber [5]. In this respect, experimental determinations of stable isotopic fractionation during evaporation from silicate melts under atmospheric conditions [6] are of utmost importance, but these are understandably often limited to modern-day atmospheric pO_2 conditions, hampering interpretation of Precambrian impact melt sheets or lunar magma ocean scenarios.

Here we report Zn stable isotope variations determined in impact spherule layers of the ICDP Barberton Drilling Project BARB5 core that was drilled through the carbonaceous shales of the 3.26–3.32 Ga old middle Mapepe Formation of the Fig Tree Group, Barberton Greenstone Belt, South Africa, and discuss their potential as evaporation and re-condensation signals. We will further report on our first geochemical results of trinitites, the glassy re-condensed remnants of evaporated arkosic desert sand after the first test of a nuclear device on July 16, 1945, near Alamogordo (NM), USA, and discuss their potential as a proxy for impact-related evaporation processes under modern atmospheric conditions.

[1] Wood et al. (2019), *Am. Mineral.* 104, 844–856. [2] Day and Moynier (2014), *Phil. Trans. R. Soc. A.* 37220130259. [3] Sossi et al. (2018), *PNAS* 115 (43) 10920-10925. [4] Florin et al. (2021), *Meteorit. Planet. Sci.* 56, 1191. [5] Kamber and Schoenberg (2020), *Earth. Planet. Sci. Letters* 544, 116356. [6] Klemme et al. (2020), *Chemical Geology* 610, 121096.