Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.15901

Néma 001 – a fragment of the crust of the acapulcoite-lodranite parent body?

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Partial melting in the interior of planetesimals and planets typically generate basaltic melts. These are, therefore, of high scientific value as they allow us to investigate the formation, interior composition, and differentiation history of asteroids and planetary bodies [1-2]. In our collections, planetary basalts include lunar basalts (both returned samples and meteorites), most martian meteorites, eucrites, and a handful of ungrouped achondrites such as Northwest Africa (NWA) 011, NWA 13188, and NWA 15201.

The meteorite Néma 001 [3] is one of the latest addition to the planetary basalt collection. Néma 001 was found in 2021 in the Mauritanian Sahara desert; it is a coarse-grained igneous rock composed primarily of mm to cm-sized crystals of pyroxene, plagioclase, and olivine, with accessory ilmenite, chromite, kamacite, and troilite. The bulk oxygen isotope composition of Néma 001, measured by laser fluorination coupled with IRMS, is undistinguishable from that of the acapulcoites and lodranites primitive achondrites, suggesting that they may originate from the same asteroidal parent body. This is also supported by their similar olivine Fe/Mn ratios. Partial melting modelling of the rare earth element abundance measured in Néma 001 using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) suggests that it could have formed by ~10-15% partial melting of a chondritic precursor. The trace element composition of acapulcoites and lodranites is consistent with these meteorites representing residues of ~2-15% partial melting of the same chondritic precursor [4-5].

Néma 001 and the acapulcoites-lodranites meteorites may thus comprise the full range of partial melting products and residues from their parent body, providing us with crucial samples to better characterise the formation and evolution of early-formed planetesimals.

References: [1] Papike and Bence (1979) Review Geophys. 17, p. 1612 [2] Karner et al. (2004) Am. Mineral. 89, p. 1101 [3] Meteoritical Bulletin (2022), no. 111, in prep. [4] McCoy et al. (1997) GCA 61, p. 639 [5] Dhaliwal et al. (2017) GCA 216, p. 115.