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Geochemical and isotopic characterization of shergottite Asuka 12325

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The shergottites represent the most abundant subgroup of martian meteorites. They can be classified according to their mineralogy but also according to their content in rare earth elements (REE), based on which three categories of shergottites can be highlighted [1]. The shergottites can be depleted in the most incompatible light-REE, enriched in those same elements or with compositions intermediate between these two endmember compositions. The crystallization age of each group is distinct: the enriched shergottites are the youngest (~170 Myr), the intermediate are slightly older (~195 Myr) and the depleted are the oldest (~450 Myr). In addition, it has been evidenced that the geochemical and mineralogical classification do not correlate, as the geochemical range encompasses all mineralogical categories [2].

In this study, we report the major and trace element composition, as well as the Lu-Hf and Sm-Nd isotope data for the shergottite Asuka (A) 12325. The major element composition of A 12325 shows that it is similar to those of intermediate shergottites. Concerning trace elements, A 12325 is clearly depleted in the light-REE but presents a signature more comparable to intermediate shergottites in terms of its heavy-REE composition. The Lu-Hf and Sm-Nd isochrons yield respective crystallization ages of 231 ± 31 Myr and 286 ± 120 Myr, which is slightly older than the average age of intermediate shergottites but significantly younger than the depleted shergottites. The ^{142}Nd was also investigated and we determined a μ^{142}Nd of -9.4 ± 4.0 for A 12325. This value falls outside the range of any other known subgroups of shergottites. Based on the similarities between Asuka 12325 and both the intermediate and depleted shergottites, this meteorite could represent the first member of a new subtype of shergottites that has not yet been sampled, hence unravelling a new insight on Mars' evolution.

[1] Debaille et al. (2008), *Earth and planetary science letters* 269**,** 186-199.

[2] Lapen et al. (2017), *Science advances* 3, 1-6.