Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.29211

Pb-Pb Isotope Systematics in Eucrites

HAYLEY LOWE[1], JOSHUA F. SNAPE[1], RHIAN H. JONES[1], HEEJIN JEON[2] AND MARTIN J. WHITEHOUSE[2]

[1]University of Manchester
[2]Swedish Museum of Natural History

Eucrites provide unique insights into early magmatic evolution of the asteroid Vesta. This study comprises 11 samples: eight basaltic, two cumulate, and one brecciated eucrite. All were analysed via Secondary Ion Mass Spectrometry (SIMS) to collect Pb-Pb isotope systematics, using a similar methodology to that outlined in previous studies [1-2]. While radiogenic Pb isotope compositions are indicative of sample age, initial Pb compositions provide a record of the isotopic composition of a rock's source at the time of crystallisation. By combining the age and initial Pb isotope composition of a sample it is possible to estimate the $^{238}U/^{204}Pb$ ratio (μ-value) of the source. Notably, given that Pb is a moderately volatile element and U is highly refractory, this μ-value provides an indication of volatile loss from a rock's mantle source or parent body, with higher μ-values indicative of high volatile loss.

The ages determined for five basaltic samples and one cumulate sample range from 4.51–4.54 Ga, consistent with previously reported ages for eucrite formation [e.g. 2]. However, the brecciated sample, NWA 11245, is significantly younger (4.14 Ga). This is consistent with the brecciated nature of the rock and with previously reported shock evidence relating to an impact event on Vesta at ~4.1 Ga [3]. One unbrecciated basaltic sample, NWA 12704, also dates to around this age (4.09 Ga). The remaining samples have intermediate ages between these groups, spanning 4.42–4.28 Ga. This suggests ongoing processes, likely impact-related, on Vesta during this period.

The initial $^{204}Pb/^{206}Pb$ values obtained for the samples indicate a range of source μ-values (38–791) significantly higher than terrestrial values (~8-10) and those previously reported for eucrite sources (~14–150; [5-6]). However, they are similar to those reported for lunar mare basalt sources (~350–700; [e.g. 2]) and support a .

References: [1] Snape J. F. et al. (2016) *EPSL* 451:149–158. [2] Kouvatsis I. et al. (2023) *GCA* 348:369-380. [3] Miyahara M. et al. (2014) *PNAS* 111(30):10939-10942. [5] Tera F. et al. (1997) *GCA* 61:1713-1731. [6] Lowe H. et al (2024) 86th Annual Meeting of the Meteoritical Society, *Abstract* 6303.