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Genesis and timing of KREEP-free lunar Mg-suite magmatism indicated by the first norite meteorite Arguin 002

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There is ongoing debate about whether lunar magnesian suite (Mg-suite) magmatism was a global, nearly synchronous event with a genetic link to potassium, rare-earth element and phosphorus components (KREEP). Arguin 002 is the first unbrecciated, chemically pristine, fresh whole-rock meteorite definitively identified as an Mg-suite norite, offering a unique opportunity to explore the genesis and timing of Mg-suite rocks.

Here we investigated the detailed petrology, mineralogy, geochemistry, and chronology of Arguin 002, revealing it to be an evolved, KREEP-free Mg-suite rock with chemical similarities to atypical Apollo-15 Fe-norites. It likely formed through high-degree (>90 %) fractional crystallization of a primary magma generated by low-degree (<2 %) partial melting of the KREEP-free lower lunar mantle, and has a 207Pb/206Pb crystallization age of 4341.5 ± 9.3 Ma. The potential source of Arguin 002 is within the South Pole-Aitken basin, near the Chang'e-6 landing site. These findings indicate that lunar Mg-suite magmatism was not necessarily driven by or associated with KREEP components, and was a global and nearly synchronous event, potentially driven by rapid global mantle overturn.