Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.35814

Prolonged Lunar Magmatism Driven by KREEP: Evidence from a 3.9 Ga Mg-suite in Chang'e-5 Samples

XING WANG[1], KANG-JUN HUANG[2], HENG-CI TIAN[3], ZHUANG GUO[1], QIU-LI LI[3], LIHUI CHEN[2], GUOCHUN ZHAO[4], YUDONG CHENG[1] AND JINGRU MA[1]

[1]Northwest University-China
[2]Northwest University
[3]Institute of Geology and Geophysics, Chinese Academy of Sciences
[4]The University of Hong Kong

KREEP, enriched in potassium (K), rare earth elements (REE), phosphorus (P), uranium (U), and thorium (Th), represent the final residual component of lunar magma ocean (LMO) crystallization and plays a fundamental role in sustaining prolonged lunar magmatism. However, the origin, crystallization history, and petrogenetic mechanism of KREEP-related magmatism remain highly debated. Here we report the geochemical signatures and petrogenesis of a KREEP-rich Mg-suite identified in Chang'e-5 regolith, providing new constraints on the origin and evolution of KREEP-related magmatism. The Mg-suite exhibits extremely enriched REE abundances (~1000× CI) with unfractionated REE patterns, indicating limited magmatic differentiation. Sr–Nd isotopic systematics suggest that its parental magma was derived from the deep lunar mantle rather than generated through shallow crustal assimilation as widely proposed. Notably, this Mg-suite yields an age of ~3.9 Ga. After excluding the possibility of age resetting, we interpret this age as primary magmatic crystallization, significantly revising the previously proposed 4.1–4.4 Ga range for KREEP-rich Mg-suite magmatism. Besides, thermal evolution modeling indicates that its parental magma was derived from lunar mantle cumulates incorporating at least ~1 wt% KREEP. Combined with the sample age and the Chang'e-5 landing location, the material is inferred to originate from Mare Imbrium, a major KREEP-enriched region. These observations support a deep mantle cumulate origin for KREEP-rich Mg-suite and challenge conventional shallow crustal assimilation models. Radiogenic heating associated with KREEP likely sustained prolonged mantle melting after lunar magma ocean solidification, generating Mg-suite magmatism 0.2-0.5 billion years later than previously recognized. In conclusion, these results provide new constraints on KREEP formation and suggest a more complex and long-lived thermal evolution of the Moon.