

Resolving the Timing of Late Eratosthenian Volcanism at the Chang'e-5 Landing Site Through $^{40}\text{Ar}/^{39}\text{Ar}$ Chronology

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The Chang'e-5 landing site provides critical insights into the Moon's late-stage volcanic history, with its ~2 Ga basalts representing the youngest known lunar mare deposits. Precise radioisotopic dating of these materials is essential for constraining the thermal evolution and magmatic processes during the terminal phases of lunar volcanism. However, previous chronological investigations of Chang'e-5 basalts have reported age discrepancies spanning ~100 Myr, posing significant challenges for interpreting the duration and episodicity of regional volcanic activity. Here we present a multi-methodological study combining petrographic analysis and $^{40}\text{Ar}/^{39}\text{Ar}$ geochronology to resolve these temporal uncertainties. Nine representative basalt clasts were characterized using microcomputed tomography (μ -CT) and back-scattered electron (BSE) imaging to evaluate shock metamorphism and secondary alteration. Textural analysis reveals that several clasts exhibit no discernible shock features and limited thermal overprinting, preserving primary crystallization textures ideal for radiometric dating. Four subsamples from minimally shocked lithologies yielded high-precision $^{40}\text{Ar}/^{39}\text{Ar}$ plateau ages through incremental heating experiments, demonstrating remarkable internal consistency (2021 ± 17 Ma, 2σ). These results effectively resolve prior discrepancies in eruption timing. This work establishes a refined temporal framework for late lunar magmatism and provides key constraints for models of lunar interior dynamics during the Eratosthenian period.