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The Moon is hypothesized to have formed approximately four billion years ago during a giant-impact between a Mars sized object and Earth. Material ejected from both objects accreted to form the Moon, producing enough heat to form a widespread lunar magma ocean. One consequence of the magma ocean is that the Moon's heterogeneity was preserved. Lunar mare basalts, which are partial melts of the Moon's mantle, have a non-uniform composition that is differentiated by both the abundance of titanium and iron isotope composition. High-calcium pyroxene is an important phase that crystallized during the magma ocean period on the Moon. It is therefore possible that high-calcium pyroxene crystallization imprinted a distinct Fe-isotope signature on magma ocean cumulates, and subsequently, the mare basalts.

We conducted experiments that produce two phases: pyroxene and glass (quenched melt) at lunar mantle conditions. The experiments can be grouped into two broad groups: low pressure and high pressure. Low pressure experiments mimic clinopyroxene (cpx) crystallizing at shallow depths in the lunar magma ocean, whereas high pressure experiments replicate clinopyroxene crystallizing at greater depths in the lunar magma ocean. In both cases, not all of the melt crystallizes into clinopyroxene and the residual magma quenches to a glass. By analyzing both the cpx and glass from these experiments in a multi collector inductively-coupled mass spectrometer, we are able to determine the difference in Fe-isotope composition between cpx and glass. This isotopic fractionation allows us to test whether cpx crystallization from a melt is responsible for the varied Fe-isotope compositions in lunar mare basalts. The results of this research will provide data necessary for determining and modeling the evolution of the iron isotope composition of the lunar mantle.