

## **Silicate liquid immiscibility in the Chang'e 5 lunar mare magmas: Constraints on the petrogenesis of lunar granitic rocks**

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### **ABSTRACT**

Silicate liquid immiscibility was a common mechanism during the late-stage evolution of lunar basaltic magmas, which produced coexisting and immiscible Si- and Fe-rich melts. However, the relationship between silicate liquid immiscibility and lunar granitic rocks is debated. In this study, we investigated Si-rich melt inclusions hosted in fayalite fragments from lunar soil returned by the Chang'e 5 mission. These melt inclusions have high SiO<sub>2</sub> (76.4 wt%), Al<sub>2</sub>O<sub>3</sub> (11.1 wt%), and K<sub>2</sub>O (5.8 wt%), and low FeO (2.8 wt%), TiO<sub>2</sub> (0.42 wt%), and MgO (0.02 wt%) contents. The texture and chemical composition indicate that these Si-rich melt inclusions formed through late-stage silicate liquid immiscibility of the Chang'e 5 mare basaltic magma. Mass balance considerations show that the unfractionated rare earth element patterns and Eu anomalies of these melt inclusions are similar to those of lunar granitic rocks. Dynamic calculations indicate that the accumulation of Si-rich melt was hindered by the high cooling rate of the Chang'e 5 basaltic magma after eruption. However, in deep-crustal magma chambers, basaltic magma would have cooled slowly, and the Si-rich melt generated by late-stage silicate liquid immiscibility would possibly have had enough time to migrate upward and accumulate to form a granitic melt body of significant size. The results of this study support the possibility that lunar granitic rocks are products of silicate liquid immiscibility.

**Keywords:** Chang'e 5, silicate liquid immiscibility, lunar granite, Si-rich melt, melt inclusion, olivine, fayalite, Fe-rich melt