Investigating lunar crustal melting: Implications for genesis of silicic volcanism on the Moon

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Silicic domes are increasingly being recognized on the lunar surface. Two main models have been proposed as a possible explanation for this volcanism, silicate liquid immiscibility and crustal melting [1]. We are investigating whether crustal melting can produce a melt similar to lunar granite compositions via a series of partial melting experiments. Likely protoliths and melting conditions have been identified using the thermodynamic modeling software MELTS and Rhyolite-MELTS [2,3,4].

Experimental results have been obtained for a synthetic composition equivalent to a lunar monzodiorite (14161,7069), containing 54% SiO_2 and 14% FeO. The experimental run was performed in a 1-bar gas-mixing furnace, with fO_2 set at IW. It was first heated to 1300°C for 30 mins before temperature was lowered to 1000°C and held for 5 days, then rapidly quenched. The result is a ferroan glass (~85%)(56 wt.% SiO_2; 14 wt.% FeO), coexisting with plagioclase, pyroxene, quartz, and a minor amount of oxides. The ferroan glass composition is similar to liquids predicted at 1100°C and FMQ-5 by MELTS. However, immiscibility occurs locally around crystal clusters, comprising SiO_2-rich blebs located within FeO-rich glass. The SiO_2-rich glass composition (<3% of the sample) appears to match those of lunar granites within a few percent error for the majority of oxides (excluding Al_2O_3 and MgO).

Additional experiments are being run at 1-bar to explore the immiscibility of melts of monzodiorite and at upper crustal pressures (0.5-2 kbar) for more realistic melting conditions and to potentially inhibit immiscibility. These results will be presented at the conference.

[1] Hagerty *et al* (2006) *JGR*, **111**, E06002. [2] Ghiorso and Sack (1995) *CMP*, **119**, 197-212. [3] Asimow and Ghiorso (1998) *Am. Min.*, **83**, 1127-1131. [4] Gualda *et al* (2012) J. *Petrol*. **53**, 875-890.