Geochemical evolution of lunar anorthositic crust as told by meteorite

Dwijesh Ray

Physical Research Laboratory, Ahmedabad 380009, India

E-mail: dwijesh@prl.res.in

The geochemical constraint of primordial crust on Moon is important to understand the early evolution of terrestrial planets in the inner Solar system. Current understanding on the formation of anorthositic crust is largely dependent on the lunar magma ocean hypothesis. However, alternative explanations also exist. The early foundation of knowledge on lunar anorthositic crust is based on the Apollo samples. However, lunar feldspathic meteorites offer a global representation of lunar crust (randomly sampled) as compared to limited sampling from near side during Apollo and Luna missions. Geochemical investigations of lunar meteorites invoke that ferroan anorthosite crust may not necessarily produce from global magma ocean alone, rather complex, localised magmatic processes are equally important to explain the geochemical diversity in the lunar crust.

Preliminary study of lunar anorthositic breccia, Dhofar 081 includes relict igneous clast – a true representative of lunar ferroan anorthosite. Petrography of Dhofar 081 showed intergrown texture of plagioclase and pyroxene suggesting cotectic crystallisation of anorthostic magma. Based on experimental phase diagram (Fo-An-SiO_2), the parent melt of anorthostic magma is also envisaged to be a low silica (SiO_2 ~40-47 wt%) H-chondrite melt. The temperature of crystallisation and pressure for anorthositic parent melt has been estimated ~1050°C and 8 kbar, respectively. This finding is not consistent with the most popular global magma ocean hypothesis, rather favours involvement of serial magmatism. To constrain the diverse lithology of lunar anorthositic crust, studies for additional lunar meteorite samples are warranted. This study is also appropriate as ISRO's future Chandrayaan mission was planned to probe on the feldspathic-rich, hybrid, highland region of southerly Moon with an aim to provide new results on the early evolution and origin of the lunar crust.