



Contribution ID: 123

Type: **not specified**

Layered high-pressure, high-temperature experiments with lunar Fe-Ti cumulate and Mg-rich mantle compositions to understand the origin of varied Ti-contents of lunar basalts

Thursday, 16 November 2023 12:00 (15 minutes)

1. Introduction

Lunar magma ocean (LMO) crystallization experiments and simulations performed by earlier workers have revealed that at the last stage, Fe-Ti-rich cumulates are formed [1,2,3], which have been linked to the varied TiO₂ contents of the lunar basalts [4]. These last stage cumulates are postulated to be dense enough to sink down through the underlying Mg-rich mantle [5], possibly till depths of the lunar core-mantle boundary [6]. To understand this interaction between the Fe-Ti cumulates and the underlying mantle, new high-pressure, high-temperature, layered experiments have been performed between an iron-titanium-rich silicate composition signifying the Fe-Ti cumulates (6.22 wt.% TiO₂ and 40.54 wt.% FeO) and forsteritic olivine (Mg# ~ 92) signifying the lunar mantle composition, taken in nearly 1:4 weight ratio (Fig. 1). These experiments were performed between 1-3 GPa and 1100-1525 °C pressure and temperature ranges, respectively.

Fig. 1: Run product showing the two layers of starting material and the reaction zone

2. Results

The results show that it is not necessary that the cumulates would sink through the underlying mantle. Even if they do, the Fe-Ti cumulates may undergo melting at the pressures and temperatures that were prevalent in the early lunar mantle. These would produce partial melts of various TiO₂ contents, depending on the dissolution of different phases, degree of melting and extent of interaction with the lunar mantle. These different melts have different densities, which may or may not be negatively buoyant with respect to the ambient lunar mantle. Thus, these melts may be stranded inhomogeneously at various depths in the lunar interior. The assimilation of these melts with lunar basaltic melts may perhaps explain the TiO₂ variation in lunar basalts.

3. References

- [1] J. F. Rapp and D. S. Draper. *Meteorit. Planet. Sci.* 53 (2018) 1432.
- [2] G. A. Snyder, L. A. Taylor and C. R. Neal. *Geochim. Cosmochim. Acta* 56 (1992) 3809.
- [3] B. Charlier, T. L. Grove, O. Namur and F. Holtz. *Geochim. Cosmochim. Acta* 234 (2018) 50.
- [4] S. M. Brown and T. L. Grove. *Geochim. Cosmochim. Acta* 171 (2015) 201.
- [5] P. C. Hess and E. M. Parmentier. *Earth Planet. Sci. Lett.* 134 (1995) 501.
- [6] S. Zhong, E. M. Parmentier and M. T. Zuber. *Earth Planet. Sci. Lett.* 177 (2000) 131.

Primary author: MOITRA, HIMELA (INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR)

Co-authors: Dr GHOSH, SUJOY (INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR); Mr MUKHERJEE, TAMALKANTI (INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR); Prof. GUPTA, SAIBAL (INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR)

Presenter: MOITRA, HIMELA (INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR)

Session Classification: Partner

Track Classification: Partner