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Using basaltic Shergottites to understand the Martian Interior Environment with Experimental Petrology

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Knowing the composition of Mars is crucial to understanding the planet's thermal evolution and extent of volcanism over time. Erupted lavas, i.e., the Gusev basalts measured by the Spirit rover and the basaltic shergottites, can be compared with experimental partial melts to determine possible bulk compositions of Mars. Additionally, the age range between the shergottites (100–500 Ma) and the much older Gusev basalts (~4 Ga) point to continued volcanic activity on the planet. The most studied of these bulk compositions is that of Dreibus and Wanke [1]. However, the partial melts of this composition do not align with the CaO and Al_2O_3 of the shergottites [2] and are likely to be iron rich [3]. We constructed a new bulk silicate Mars composition to determine its partial melting behavior over a range of pressures suitable for the martian interior.We conducted piston cylinder experiments at 1 and 3 GPa from 1350 to 1700 °C, using our newly calculated bulk Mars composition. Run products were analyzed with the electron microprobe using WDS analysis and BSE imaging to determine mineralogy, composition of any partial melts, and overall texture.Our initial results constrain the martian solidus between 1375 and 1425 °C at 3 GPa, which indicates that martian volcanism with a lower melting temperature than the melting temperature identified as 1492°C at 3 GPa [4]. A lower melting temperature allows for more melt generation and thus can sustain martian volcanism in larger quantities for longer periods of time. Also, some of the lower melt fraction experimental partial melts provide a much closer compositional match to the shergottites than previous results.

[1] Dreibus and Wanke (1985) *Meteor. Planet. Sci*.
[2] Agee and Draper, (2004) *Earth Planet. Sci. Lett.*
[3] Yoshizaki and McDonough (2020) *Journal*.
[4] Duncan et al.(2018) *Geophys. Res. Lett*.