The 477th Geodynamics Seminar

Melting Temperature of Sahara 97072 (EH3) meteorite from 7 to 40 GPa

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Abstract

Magma ocean is an inevitable stage of terrestrial planets formation where silicate and metals are melted together during accretionary processes. Knowledge of the melting temperature and phase relations of chondrite-like materials at high pressure are, therefore, an important step to understand early planetary differentiation such as the core formation as well as bulk composition and redox state of the mantle of terrestrial planets. The bulk composition of the Earth has long been debated to result from the accretion of chondrites; to date, however, there is no firm conclusion about the origin and composition of the chondrites that served as the Earth's building blocks. Among other possible candidates (e.g. carbonaceous chondrites, ordinary chondrites, achondrites), enstatite chondrites (EC) have been of particular interest as they feature similar isotopic compositions to the Earth although their composition differ from that of the bulk silicate Earth (BSE) composition derived from upper mantle rocks. Natural ECs are, therefore, valid analogue starting materials to investigate the formation of Earth-like planets under reducing conditions and infer the composition of deeper parts of the mantle that are inaccessible to direct sampling.

We carried out experiments at 7, 15, 20, 25, 30 and 40 GPa, and temperatures between 1700 ° C and 2400 ° C using multi anvil apparatus. Sample consisted of a finely powdered natural EC from Sahara (ref. 97072) packed into a graphite capsule. After HP experiments, samples were recovered to atmospheric conditions and polished for textural and chemical characterization of the mineral phases using FE-SEM on accurately polished surfaces. The melting temperatures and phase relations of Sahara 97072 (EH3) are presented and discussed relative to that of synthetic enstatite chondrite, Allende (CV3) and Tagish Lake (CI2) meteorites and KLB1, respectively. Results on the phase equilibria are used to derive a model of accretion and core segregation that takes into consideration the possible stability of Si-rich phases along with a Fe-Ni sulfide melt.

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