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An evolutionary system of mineralogy, Part IV: Planetesimal differentiation and impact mineralization (4566 to 4560 Ma)

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Abstract

The fourth installment of the evolutionary system of mineralogy considers two stages of planetesimal mineralogy that occurred early in the history of the solar nebula, commencing by 4.566 Ga and lasting for at least 5 million years: (1) primary igneous minerals derived from planetesimal melting and differentiation into core, mantle, and basaltic components and (2) impact mineralization resulting in shock-induced deformation, brecciation, melting, and high-pressure phase transformations.

We tabulate 90 igneous differentiated asteroidal minerals, including the earliest known occurrences of minerals with Ba, Cl, Cu, F, and V as essential elements, as well as the first appearances of numerous phosphates, quartz, zircon, and amphibole group minerals. We also record 40 minerals formed through high-pressure impact alteration, commencing with the period of asteroid accretion and differentiation. These stages of mineral evolution thus mark the first time that high pressures, both static and dynamic, played a significant role in mineral paragenesis.

Keywords: Classification, mineral evolution, planetesimals, non-chondrite meteorites, iron meteorites, stony-iron meteorites, achondrites, differentiation, shock minerals