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Thermal history of CO chondrites determined from zoning of chondrule and matrix minerals

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We analyzed the Fe-Mg zoning in olivine and spinel in different chondrule types and in the matrix of 6 CO3.0-3.6 chondrites using EMPA and STEM. Thermodynamic modeling with MELTS [1] and diffusion modeling were used to identify and characterize the thermal processes that shaped the observed mineral zoning. The Fe-Mg zoning in type II chondrule olivine was found to be consistent with formation during chondrule crystallization at cooling rates of 3-750°C/h and only minor modification by thermal metamorphism. Fe-Mg zoning in type II chondrule spinel, type IB chondrule olivine and matrix olivine is not consistent with crystallization from the chondrule melt, but formed during later re-equilibration. The extent of this secondary zoning correlates with the petrologic sub-type of the studied meteorites and yields internally consistent estimates of metamorphic peak temperatures of 350-420°C.

[1] Ghiorso & Sack (1995), *Contrib Mineral Petrol* 119, 197-212.

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