Mineralogically zoned chondrules in chondrites: implications for chondrule formation conditions

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Mineralogically zoned chondrules have been recognised since long, but only systematically studied a few years ago ([1], [2]). They typically consist of an olivine core, surrounded by a low-Ca pyroxene rim of variable thickness that formed when molten chondrules exchanged material with the ambient gas ([3]). The number of chondrules with mineralogical zonation is characteristic of their host chondrite group, with in ~80% in CC, ~40% in OC, and ~60% in R chondrites. We recently completed this count in enstatite chondrites. Zoned chondrules with olivine cores and low-Ca pyroxene rims are abundant (OC, EC, R) or even dominant (CC) in all chondrite groups, except for K chondrites. Gas-melt exchange in an open system can reasonably explain all observed characteristics of all chondrite, including enstatite chondrite chondrules. We suggest that this process indeed formed mineralogically zoned chondrules in all chondrites, and, thus, is an important constraint for chondrule formation conditions.

[1] Barosch et al. (2019) GCA 249, 1–16. [2] Friend et al. (2016) GGCA173, 198–209. [3] Ebel et al. (2018) In: Chondrules: Records of Protoplanetary Disk Processes, Cambridge UK. pp. 457.