OVERLOOKED CHONDRULES: A HIGH RESOLUTION CATHODOLUMINESCENCE SURVEY. G. Libourel[1,3] and M. Portail[2], [1]Université Côte d'Azur, Observatoire de la Côte d'Azur, Laboratoire Lagrange, Nice, libou@oca.eu, [2]CRHEA-CNRS, Sophia Antipolis, [3]Hawai'i Institute of Geophysics and Planetology, University of Hawai'i at Mānoa, Honolulu.

Chondrules, millimeter-sized igneous spherules making chondritic meteorites, formed during the Solar System's first few million years. They may provide powerful constraints on conditions in the solar protoplanetary disk only if the processes that led to their heating, melting and crystallization can be understood.

High-resolution cathodoluminescence survey of Type I porphyritic and barred chondrules of unequilibrated chondrites exhibiting magnesian-rich compositions (mg# = Mg/(Mg + Fe >> 0.95) belonging to several representative carbonaceous and ordinary chondrite samples (CV, CR, CO and OC) reveals changes of cathodoluminescence activator concentrations of magnesium-rich olivines and previously overlooked internal zoning structures. These stunning features observed in all the studied magnesian chondrules so far tell a complex, but similar, record of dissolution and epitaxial growth episodes of olivines during chondrule formation events. These observations provide evidence for gas-assisted near-equilibrium crystallization of olivines during chondrule formation, which is at odds with the classical cooling history models hitherto inferred for chondrules.

This finding implies that chondrules are direct thermochemical sensors of their high-temperature gaseous environment and that high partial pressures $Mg_{(g)}$ and $SiO_{(g)}$ are required in their protoplanetary disk forming region to maintain olivine saturation in chondrules. Although it has become clear over recent years that chondrules are affected by their surrounding gas rather than being dust balls heated in a closed system, this paper goes further in suggesting that this interaction defines their composition and texture. Furthermore, the inferred crystallization of olivines from stable melts approaching equilibrium with the surrounding gas provides an explanation for the notable absence of large and systematic isotopic fractionations in chondrules.