

EXPERIMENTAL CONSTRAINTS ON DUSTY OLIVINE FORMATION.

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Introduction: Dusty olivines are typically described as forsteritic olivines that contain abundant micron size blebs of metallic Fe, located in the core of the crystals, whereas the rims of these olivines are free of blebs. These dusty olivines are interpreted as relict grains produced by reduction of more fayalitic olivines, these reactions proceeding before or during chondrule formation. In this scenario, clear rims may represent overgrowths that grew during the last cooling episode of chondrule formation. Studying these dusty olivines may therefore clearly provide constraints on chondrule history (e.g.: thermal chondrule history, reprocessing events, ...). We thus have performed reduction experiments in order to study Fe-metal distribution in dusty olivines and significance of the clear rims that surrounded dusty olivine cores.

Experiments: Experiments were conducted in a vertical gas mixing furnace at 1610°C, with time scales ranging from 7 minutes up to 4h. Powder of San Carlos olivines (from 100 µm to 2 mm in size) was used as starting material. This powder was placed in a graphite crucible

and suspended in the hot zone of the furnace. Moreover, pure CO gas was flown in the furnace at 300 cm³ min⁻¹, buffering the oxygen fugacity at the C/CO level. Experiments were terminated by drop quenching the samples at room temperature in the furnace atmosphere.

Results and discussion: Experimentally reduced olivines display numerous submicrometer-sized metal blebs mimicking natural dusty olivines. These metal blebs are not distributed randomly in the olivines. The average size of the blebs increases toward the center of the grains. This size distribution is not consistent with a simple propagation of reduction front inside the crystal. Therefore a complex mechanism that combines reduction and dissolution is proposed. Reduction process produced metal blebs and dissolution process induced disappearance of blebs previously formed and located on the rim of olivine grains. In addition, volatilization process occurred during reduction step.