COMPARISON OF THE MINERALOGY OF FINE-GRAINED RIMS AND ADJACENT MATRIX IN THE CM PARIS CHONDRITE USING ADVANCED MICROSCOPY

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Fine-grained rims (FGRs) are an unequilibrated mineral assemblage that surrounds chondrules and refractory inclusions in chondritic meteorites. Although they certainly carry a diversity of information about processes which took place during accretion in the early solar system, their formation is still debated [1-3] and cannot be easily discriminated since investigations are limited by the spatial resolution of analyzes and by the material heterogeneity.

To differentiate matrices and chondrules rims and place constraints on the nature of the dust and the accretion conditions, we used a new analytical method on the Paris chondrite coupling phase cartography based on low-voltage energy dispersive spectroscopy (EDS) and conventional electron probe micro-analysis (EPMA). Those analyses are compared with Transmission electron microscopy (TEM) investigations. The Paris chondrite has been chosen for its primitiveness [4] and because it contains lithologies showing different alteration degree.

The phase cartography indicates that similar phases are present in both lithologies, but their modal abundances differ significantly. Tochilinite is well developed in the matrix (12% vol. %) but is less abundant in FGRs (2-5%). The same is true for carbonates and sulfates (1 and 2% respectively in the matrix), which are almost absent from the rims (<1%). The background modelisation of the hyperspectral data reveals that the external part of the rim is more porous (1.8 g/cm^3) compared to the matrix (2 g/cm^3), but also that the internal rim is more compacted. Finally, TEM investigations confirm the porosity values discuss above and show that FGRs are essentially composed of amorphous silicates while the matrix exhibit well crystallized phyllosilicates.

The methodology implemented has made possible to highlight significant differences between the matrix and FGRs. The volume of secondary phases higher in the matrix and the small amount of amorphous silicates suggests that the alteration is more advanced in the matrix. Consequently, we rule out parent-body aqueous alteration as an origin for significant FGR formation. To explain the observed features in Paris meteorite we propose that the chondrule-FGR entity has undergone a slight alteration before to be accreted with an ice-rich matrix. During the alteration on the parent body the matrix and a part of the external rim have been transformed. However, due to an insufficient amount of ice the alteration has stopped letting the rest of the chonrdule-FGR entity pristine.

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