Aqueous histories in the Early Solar System: Microstructural and Microchemical constraints in CM Carbonaceous Chondrite

Shivani Baliyan and Dwijesh Ray

Physical Research Laboratory, Ahmedabad 38009, India

Asteroidal aqueous alteration processes which involves alteration of primary minerals into secondary can be understand by studying the carbonaceous chondrites. In this study, we discuss the mineralogy of different phyllosilicate clasts, with an aim to understand aqueous alteration history in Mukundpura CM2 meteorite.

Petrographic studies of Mukundpura indicate that amorphous Fe-(Mg)-silicate is located in matrix and that 70-80% of the meteorite is matrix. The matrix of Mukundpura consists of different clasts of phyllosilicates as confirmed by EPMA and XRD analysis. The EPMA elemental analysis shows varying concentration of FeO (13-25% & upto a range of 58%) in different clasts. For the varying degree of FeO, SiO_2 lies in the range 30-37%, while for the higher values of FeO the SiO_2 value is in the range 16-21%. The SO_2 varies from 0.01-18%, MgO 5-20%. Carbonate grains (10-200µm) are also found scattered in the matrix. Greater volumes of phyllosilicate formed in samples with greater initial H2O contents. Using XRD, modal mineral abundances are used to understand the nature and extent of hydration. Our preliminary XRD analysis shows the major identified phases in the matrix are found to be Fe cronstedtite and Mg serpentine and the minor identified phases are olivine, tochilinite, magnetite, troilite, calcite. Fe-rich phyllosilicates appear to be more crystalline in nature as compared to Mg-rich phyllosilicates. The accreted fraction of matrix can explain variations in the degree of aqueous alteration. Total abundance of phyllosilicate provides a measure of the degree of aqueous alteration that each meteorite has experienced.