GEOCHEMICAL CHARACTERIZATION OF MUKUNDPURA CARBONACEOUS CHONDRITE (CM2): INSIGHTS INTO PLANETARY PROCESSES.

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Introduction: Mukundpura meteorite was analyzed by LA-ICPMS (Quadrapole) to decipher in-situ trace elements (TEs) and REEs distribution among different types of chondrules and clasts mostly composed of olivine. EPMA data shows olivine in PO and POP chondrules and clasts compositionally ranges from Fa_{20-45} Fo_{55-80}, whereas a few relict end member forsteritic olivine (Fa_{0-2} Fo_{98-100}) fragments are also present in the matrix. Zoned olivine phenocrysts / clasts (size ~ 200µm) occur as isolated grains within matrix having forsteritic core (Fo_{98-99}) and relatively fayalitic (Fa_{26-28} Fo_{72-74}) rim [1]. Selective fractionation of TEs and REEs among these chondrules/clasts and matrix may involve stellar cosmo chemical process(es). Partitioning of different trace elements and REEs among the various silicate phases, in particular olivine and its mesostasis component, may be very sensitive to its nebular conditions [2].

Analytical Setup: Trace elements were analyzed using the 213 nm, Teledyne Cetac Technologies, LSX G2 laser ablation unit installed at GSI, Faridabad and coupled with a Agilent Technologies 7700x mass spectrometer. The ICP-MS was operated at 1350 W plasma power. Ablations were performed in pure He-atmosphere (550 ml min^{-1}) mixed before entering the Plasma torch with a flow of Ar (830 ml min^{-1}). Laser ablation conditions are: Laser power ~ 55% (2.5mJ) with pulse frequencies varying between 5 and 10 Hz and spot sizes of 50 - 30 µm, carrier gas flow (He + Ar) is 1.38 L min^{-1} in ICP unit. With such pulse frequencies, depth speed for silicates analysis is about 1 µm s^{-1}. Each analysis consists of 60 s of background analyses and 30 s of ablation or sample run time. Data reduction was carried out using the GeoPro software. In the present study in-situ trace elements and REE analysis was carried out from matrix and olivine clasts / chondrules (both line and point scan) using NIST 614 and NIST 612 glasses as external standards [3].

Results and Interpretation: The line scan from matrix shows slightly (-ve) anomaly for Ce and Sm with (+ve) Eu/Eu* anomaly. The REE fractionation is minimum with almost flat LREE and HREE pattern. The REE pattern of matrix components are comparable. Matrix components show a prominent clustering, almost comparable to chondrite composition with negligible fractionation trend (HREE > LREE) (Fig. 1a). The chondrite normalized REE and trace elements distribution pattern obtained from olivine clasts / chondrules show positive U, Sm and negative Zr and Sr anomaly, though a few point analysis show positive Ti anomaly (Fig. 1b). Relatively higher concentrations of Co and Ni are observed from olivine chondrules and matrix, probably contributed from the sulphides. Opaque (Ni-metals) within olivine may also display the Ni variability / enrichment profile. Differential distribution and fractionation pattern of REE and trace elements obtained from olivine clasts / chondrules shows positive U, Sm, Ti and strong negative Zr and Sr anomaly, suggesting exogenic stellar / nebular process (es) at relatively higher temperatures ($T_{min} \geq 600°C$). Moreover, compositional heterogeneity obtained from EPMA data in particular for olivine and matrices may also be linked with such process (es) that controls elemental concentration and partitioning.

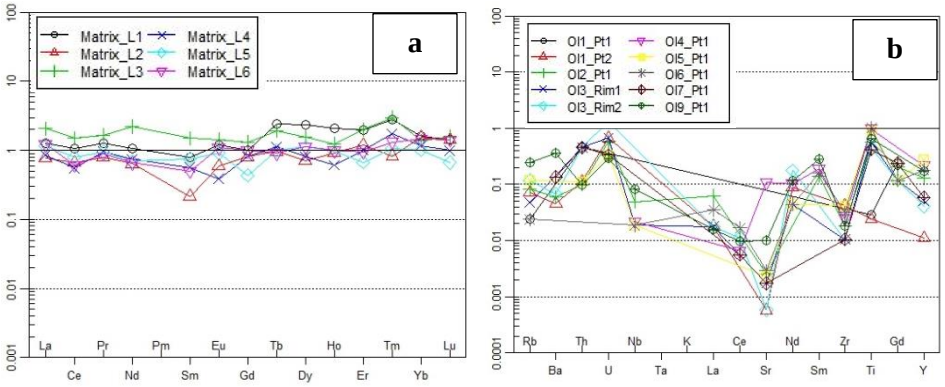

Fig. 1a: Chondrite normalised REEs spidergram of Mukundpura chondrite obtained from matrix line (L) scan [4].
Fig. 1b: Chondrite normalised REEs and TEs spidergram of Mukundpura obtained from olivine clasts / chondrules point (P) analysis [5].

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