THERMAL ALTERATION OF METEORITE PARENT BODY AS RECORDED BY INSOLUBLE ORGANIC MATTER: XANES AND RAMAN STUDY

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Introduction: Meteorites, especially chondrites accreted 0.1-5wt% of carbon in both organic and inorganic forms. A large amount of this organic carbon (>60-70%) is the acid Insoluble organic material (IOM) and the remaining is the Soluble organic material (SOM). These organic constituents within the meteorites are tell tales of their journey through the interstellar space and into the formation of the solar system in a molecular cloud in which low temperature radiation-driven chemistry and isotopic fractionation could occur in both the gas phase and on ice and mineral grain surfaces[1-2]. Additional changes in organics could have taken place after incorporation into planetesimals, including asteroids and comets. Furthermore the radiogenic decay of short-lived radionuclides (e.g., 60Fe and 26Al), impact shocks and other processes could heat the planetesimals[3-4] thereby forming a long and diverse range of thermal metamorphism and aqueous alteration conditions affecting the formation , destruction and transformation of the organic content within.

A correlation between petrographic type and molecular structure of IOM have been shown in various studies. In the present study, we analyzed the IOM extracted from recently fallen Carbonaceous Chondrite, Mukundpura, along with 34 other meteorite samples with varying groups and petrological types (1-6). The IOM extraction was carried out using CsF method [5]. The insoluble organic contents were then subjected to various analytical techniques starting with Field Emission Scanning Electron Microscopy (FE-SEM) , Carbon X-ray Absorption Near Edge Structure (C-XANES) spectroscopy and laser RAMAN to obtain the temperatures of thermal metamorphism of different samples using the exciton intensity (1s-σ*) and Raman band parameters , Γ_D and Γ_G [6-7] and to understand the effects of petrologic grade on them.

Results and Discussions: The effective alteration temperatures derived from XANES analysis and the Raman parameters of meteoritic IOM are as shown in the figure. The calculated temperatures for our samples is within range predicted form various mineralogical studies [8-9].The peak width Γ_D and Γ_G generally decrease with increasing metamorphism[7]. Sharp and wide D and G band for Mukundpura indicates very low thermal alterations which compliments the least effective temperatures calculate using exciton intensity. Low temperatures of Mukundpura is also consistent with the mineral based petrological study of the meteorite [10]. This study also favours the thermometric calculations from XANES and Raman as described in[6-7].

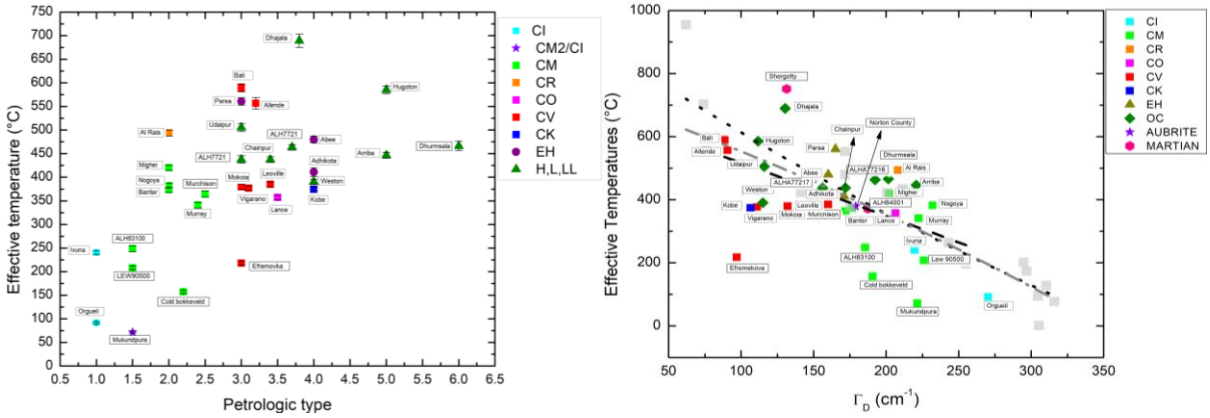

Figure : a)Correlation between T_{EFF} obtained from XANES analysis of IOM and their petrological type. b) The correlation between Raman width parameters and the exciton derived T_{EFF} estimates. The bold dashed line shows the best linear fit through the data ; the dotted line represents the fit through literature data [6] and the gray line represents the fit for all data combined

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