SEMI-QUANTITATIVE SHOCK CALIBRATIONS OF ASSAM CHONDRITE (L5, S6).

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Introduction: The Assam (L5) meteorite was found at Assam, north eastern part of India in 1846. Detailed petrographic studies, Electron Probe Micro Analysis (EPMA), Laser Raman Spectroscopy (LRS) aided by Scanning Electron Microscopy (SEM) and Cathodoluminescence (CL) studes have been carried out to decipher chondrules textures, mineral compositions and shock metamorphic stages.

Results and Interpretation: This chondritic meteorite consists of olivine + orthopyroxene (clinoenstatite) + clinopyroxene (Opx > Cpx) + plagioclase + Fe-Ni metals (kamacite and taenite) + magnetite + chromite + apatite + merrillite.The chondrules are dominantly composed of olivine and orthopyroxene, while feldspathic glass and clinopyroxene occur in mesostasis. The matrix is moderately to finely recrystallized and composed of fine aggregates of olivine + orthopyroxene + mafic (Opx) and feldspathic glasses + Fe-Ni metals (kamacite and taenite) ± clinopyroxene. Tiny specks of magnetite and Fe-Ni metals are concentrated along the shock melt veins.The length (L) and width (W) of shock veins also vary, though the (length: width) ratios are generally large enough (≥ 500 – 700). The length of opaque melt veins (shock veins; SV) goes upto ~ 1 – 2 cm (as measured under thin section) with varying width from 10 – 30 μm. Shock veins show sharp contact with the host meteorite. Development of anastomosing multiple opaque melt veins (shock veins) with relict and recrystallized olivine and pyroxene grains are also observed. The presence of microdiamonds (size ~ 1 – 3 μm) and different allotropic forms of carbon (C) are being reported for the first time from Assam chondrite (L5). Micro-diamonds (characteristic Raman peak values 1309 cm^{-1} and 1355 cm^{-1}) have bimodal occurrences, and are mainly present close to the shock/opaue melt veins and rarely as inclusions within shocked olivine and pyroxene.

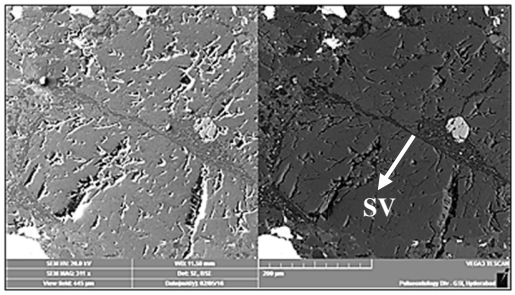

Fig. 1: Shock Vein (SV; length ~ 2 cm) with sharp contact to the host meteorite (in SEM-BSE; Assam)

Feldspathic mesostasis (mostly albite to andesine composition) ± tiny clinopyroxene blades form symplectite-like structure within BO chondrules, indicating rapid cooling from molten droplets. Presence of lithic fragments (olivine + orthopyroxene ± feldspathic glass) within matrix, having zoned olivine fragments are also observed. Zoned olivine crystals show significant compositional variation from core to rim ($Fa_{9\text{-}31}Fs_{69-91}$). The composition of feldspathic glass is $Ab_{46.4\text{-}85.5}An_{11–51.5}Or_{2–7}$, in which FeO^T content varies from 0.93 to 4%. Shock induced melting of plagioclase and pyroxene into glasses testify hypervelocity impacts in the asteroid belts [1]. The shocked mafic glass having pyroxene composition (SiO_2 = 54.73, TiO_2 = 0.18, Al_2O_3 = 0.17, FeO = 13.49, Cr_2O_3 = 0.17, MnO = 0.43, NiO = 0.09, MgO = 29.19, CaO = 0.73, Na_2O = 0.05, K_2O = 0.01 wt.%; Total = 99.23%), is associated with the porphyritic olivine (PO). Kamacite and taenite form intergrowth like texture surrounding a large euhedral magnetite crystal. Kamacite (α-Ni, Fe) contains Fe ~ 92% and Ni ~ 8% whereas Fe ~ 66% and Ni ~ 34% vary in taenite (γ-Ni, Fe). Different textural variants of olivine and orthopyroxene show near consistent range of mineral chemical compositions (X_{Mg}) suggesting Assam (L5) is an equilibrated ordinary chondrite. It shows temperatures of homogenization at ~ 845 – 1070ºC [2].

Conclusion: Extraterrestrial microdiamonds of diverse polytypes from ordinary chondrites along with other sensitive shock indicators can be used as an important marker for calibrating meteorites under different shock stages. Presence of opaque melt veins (shock veins) and microdiamond polytypes along with shocked apatite, planar fractures (PF's) in olivine, plagioclase melt glass and pyroxene (orthopyroxene) glass suggesting escalation of shock pressures at~ 50 Gpa (very strongly shocked;S6) [3,4,5].

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