Primary and Impactor Components in Lohawat Howardite

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Lohawat is a polymict breccia howardite with amalgamated clasts of eucrite, diogenite and loosely bound regolith materials. Small spherules were reported to be present in the regolith clasts. In this study, detailed mineral and bulk chemistry, nitrogen and noble gas composition of separated minerals from lithic and monomineralic clasts, and fine matrix of Lohawat are carried out to better understand the primary and impactor components.

Pyroxene shows a wide range of compositions in all the different type of clasts. Green color diogenitic pyroxenes generally forms coarse (a few mm) monomineralic clasts with high Mg content (Mg# 75-83). In the eucritic clasts, pyroxenes are finer and show exsolution lamellae. Pyroxene are of two types in eucrite clasts: Mg-rich (Mg# 55-58) and Mg-poor (Mg# 38-43). In Ca-Mg-Fe compositional space eucritic pyroxenes are plotted as main-group (Mg-poor) and Mg-rich cumulate eucrite-like distributions. Equilibration temperatures are 940 ± 30^{o} C for Mg-rich eucrites and 830 ± 30^{o} C for Mg-poor eucrites. Plagioclase composition is restricted to typical anorthite in different type of clasts. Partially or fully melted impact spherules (Mg# 43-68) are present in the matrix.

REE abundance in separated diogenitic and regolith clasts, melt spherules and bulk sample indicates highly depleted nature of the diogenitic clasts. REE trend in the regolith is almost parallel and similar with the diogenitic clasts except the LREEs, indicating that regolithic clasts have mostly been contributed from the diogenites. The glassy spherules are the most enriched in REEs and show a relatively large negative Eu-anomaly. High REE abundance of the melt spherules is similar to that of the eucrites, indicating low-T eucrite clasts were transformed to the melt spherules.

Study of the noble gases and nitrogen isotopes indicates that planetary type (Ne-HL) and solar wind (Ne-SW) trapped gases are present in several separated grains. Presence of solar wind indicates their residence on the surface of Vesta. The solar cosmic ray effects in some of the grains support their residence within the upper most layers of regolith. Nitrogen is a mixture of more than one component, such as solar wind and indigenous trapped, either interior or impactor derived. Carbonaceous chondrite type of impactor is inferred from simultaneous nitrogen and noble gas study. Perhaps the chondrite components were mixed in the pulverized matrix regolith or in the melt spherules.