HYDRATED MINERALS AND CARBONACEOUS CHONDRITE FRAGMENTS IN LOHAWAT HOWARDITE: ASTROBIOLOGICAL IMPLICATIONS: M. S. Sisodia, A. Basu Sarbadhikari and R. R. Mahajan. PLANEX, Physical Reasearch Laboratory, Ahmedabad, India (E-mail: sisodia.ms@gmail.com; amitbs@prl.res.in)

Introduction: Presence of hydrated minerals on asteroids, which are remnants of the blocks that formed the planets of the solar system has great importance for deducing the origin of Earth's water. Asteroid 4 Vesta is the parent body of the howardite-eucrite-diogenite (HED) family of the meteorites that have fallen on Earth [1]. Lohawat howardite that fell in India in the year 1994 is a heterogeneous breccia composed of variety of mineral and lithic fragments [2]. We report here optical study of hydrated minerals that we found in Lohawat howardite and then discuss their astrobiological implications.

Petrography of Lohawat howardite: Lohawat howardite is an assortment of different minerals and clasts. On simple crushing it yielded different types of hydrated minerals such as serpentine, phyllosilicate, zeolite minerals, carbonaceous chondrite fragments that show vugs and cavities as well as in situ hydrous minerals and oxidized regolithic material (Fig. 1). Most of the minerals including main constituent minerals, namely pyroxene, feldspar and olivine occur as coarse single mineral grains that may be indicative of probable weathering (Fig. 2).

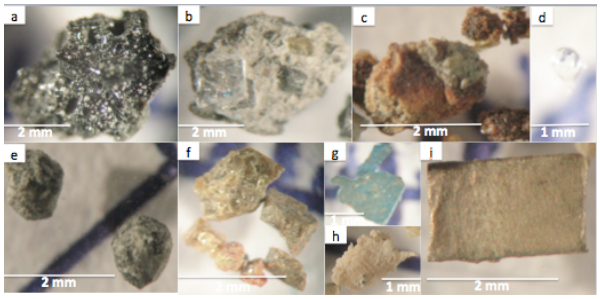

Fig. 1. Hydrated minerals in Lohawat howardite a. carbonaceous chondrite clast, note vugs and cavities; b. well crystallized hydrous mineral in carbonaceous chondrite fragment; c. oxidized regolithic material; d. transparent tear-shaped impact spherule (metallic spherules are also observed); e. weathered olivine grains; f. serpentine g. and h. hydrated minerals; i. phyllosilicate.

Discussion: NASA's Dawn mission that entered orbit of Vesta in 2011 was sent with one of the objectives as to find out whether Vesta is a surviving protoplanet. Vesta is supposed to have formed as a result of first condensation of the same nebular material that culminated into our solar system [3]. The trapped short lived radioactive nuclides such as ^{26}Al and ^{60}Fe in the nebula caused initial melting and subsequent gradual differentiation of these early accreting bodies into crust, mantle and core [4]. Dawn's results confirm that Vesta is a differentiated protoplanet and that it is a parent body of HED meteorites [5]. The presence of hydrated minerals on vesta as revealed by Lohawt howardite is very significant. Howardites originate from the surface of Vesta nad constitute representative samples from its crust, mantle and core. The low gravity of Vesta induce lower velocities to the impactors resulting into incomplete melting of impacting carbonaceous chondrites [6]. Whether these hydrated minerals were contributed on the surface of Vesta by carbonaceous chondrites will be revealed by isotope study under progress. Evidences for direct water activity on Vesta has already been documented [7] and Sarafian et al's [8] study based on eucrites confirms the model that carbonaceous chondritic planetesimals delivered water on Earth during its primary accretion.

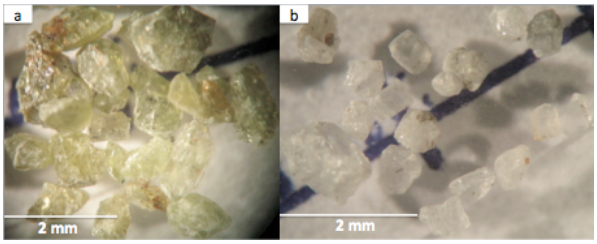

Fig. 2. Coarse single mineral grains of pyroxene (a) and feldspar (b).

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