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HED meteorites from Algeria: Evidences of impact cratering events on asteroid 4Vesta.

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Howardites, Eucrites and Diogenites (HED) group have presumed origin from the asteroid 4Vesta and are among the earliest magmatic rocks of the Solar System (McSween et al., 2011). Eucrites (basalts); cumulate eucrites (gabbros); and diogenites (orthopyroxenites, harzburgites) represent the main petrographic types on asteroid 4Vesta. Most HEDs are monomict (clasts from a single eucrite lithology), or polymict breccias (clasts from different lithologies) (Delaney et al., 1983). Brecciated eucrites and howardites represent samples of the asteroid 4 Vesta, formed by successive impacts at the surface of the planetary body (Warren, 1985). Polymict eucrites and howardites are a mixture of the main petrographic facies. Eighty-five per cent of the HED are brecciated by impact and their lithologic composition was modified by a thermal metamorphism (Yamaguchi et al., 1996). Generally, the brecciation by impact of eucrites causes a reheating superior to 800$^{°C}$ (Bogard and Garrison, 2003). Successive impacts on the asteroid have removed igneous rocks from various crustal levels. 4Vesta has, in the earliest history, been heavily cratered terrains in the north, but in the south part, at 1 billion years ago, an impact structure, about 500 km across was formed (Marchi et al., 2012). Several monomict, polymict eucrites and howardite were discovered in South-west Algeria. A polymict eucrite NWA2268 finely brecciated constituted by clasts of basaltic rocks and minerals (plagioclase, pyroxene, spinel, silica and iron metal). Fe-Ni metal in the matrix (Ni%>35) forms a sponge-like texture surrounding silicate grains. This metal is Ni-rich and it has derived from both impacting projectiles. Glass is present in this rock, and consists mainly of spherules (impact glass beads) and irregular brown objects. The glass is generated by impacts on the parent body. This regolite breccia is formed by minerals and rocks clasts of equilibrated or unequilibrated eucritic compositions. The variation in temperatures among clats of rocks suggests that metamorphism occurred prior to brecciation. A howardite NWA2251 constituted by eucritic and diogenitic clasts in a clastic matrix; diogenite clasts are composed by orthopyroxene (Fs_{32-26} Wo_{2-4}) and represents more than 40 vol%. This is a regolite that is formed by fragments of deep and surface rocks of the asteroid and is embedded in finely brecciated matrix. This howardite presents a pseudotachylite devitrified veins with milimetric size and intersect various lithologies. A monomict eucrite NWA4269 finely brecciated, with millimetrics metal grains, has heterogeneous granulitic matrix. Some clasts display residual coarse-grained lithology with ophitic texture. The granulitic association is the result of a recrystallization after a reheating by impact metamorphism. The removed material forms polymict breccias that are deposited either as ejecta blankets outside the crater or as fall-back breccias inside the crater cavity. The recrystallized monomict breccias can be found near the crater floor.

Key words: HED, 4Vesta, brecciation, monomict, polymict.

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