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Diamonds in Almahatta Sitta 2008 TC3 ureilite

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Near Earth Object (NEO) 2008 TC3 impacted the Earth around northern Sudan on October 7, 2008. Its remnant was recovered immediately and called Almahatta Sitta as a meteorite. Almahatta Sitta is a first meteorite we could trace during a falling into the Earth after we found it in the space by astronomic observation. Almahatta Sitta TC3 consists mainly of coarse-grained and fine-grained ureilite. Both of them contain a carbon material. Here, we report the occurrence of the carbon material in the coarse-grained ureilite (MS-170-14).

Based on low-magnification BSE images, the carbon materials in the coarse-grained ureilite (MS-170-14) have two different textures; i.e., a) granular-like and b) booklet-like. The former is much dominant occurrence as a carbon material compare to the later. Most carbon materials filling cavities and fractures between the olivine grains show granular-like texture. The granular-like texture has concave and convex portions, which would be differences on resistance between them to polishing. Raman spectroscopy analyses indicate that the convex portions consist mainly of diamond. The main diamond Raman band stays within narrow range (1333.7 cm-1). High-magnification BSE image show that many diamonds (a dimension $>$ 2-3 micro m) have hexahedron- or octahedron-like shape, which would correspond to euhedral $\{001\}$ or $\{111\}$ diamond, respectively although their shaped are not perfect. The concave portions embedding the diamonds consist mainly of graphite. Interlayer C-C stretching vibration (E2g2) originating from graphite (G-band = ˜1586 cm-1) was confirmed by Raman analysis. In addition to G-band, strong and broad peak around 1358 cm-1 appears. This is a so-called D-band and is inherent in deformed graphite. TEM images show that most diamonds are single crystals. Some deformation textures are observed in the diamond. Some isolated graphite portions exist in the diamond. These features would be due to a dynamic event after diamond formation. These single diamonds having hexahedron- or octahedron-like shape are not found from ureilites up to now, and would not be formed from graphite through martensitic transformation mechanism by a dynamic event. It is likely that these diamonds were formed by chemical vapor deposition (CVD) process.