PETROLOGICAL FEATURES OF A NEW UREILITE (NWA 6235) FROM FEZZOU, MOROCCO

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A ureilite-like meteorite (NWA 6235), about 6cm x 5cm x 5cm and 216g, with a dark brown to black fusion crust, was collected at Fezzou, Morocco (30°55.68'N, 4°51.50'W).

This study of petrographical analyses of NWA 6235 is based on microscopy, areal compositional mapping and mineral chemistry by EPMA (X-ray microanalyzer) and cathodoluminescence (CL). In addition, carbonaceous matter was analyzed using pyrolysis gas chromatography (py-GC) and mass spectrometry (py-GC/MS), and Raman microspectorometric analysis. C-N-S elemental analysis and stable carbon and oxygen isotope analyses of powdered samples were also performed.

NWA 6235 consists mainly of olivine and pigeonite with minor amounts of enstatite, augite, graphite, diamond, metallic iron, iron oxide, limonite and Fe-Cr-Ni sulfide as a mesostasis. The meteorite shows ureilite texture with triple junctions between olivine grains.

Olivine grains of about 0.5mm in diameter show compositionally reverse zoning between core (Fo_{85-78}) and rim (Fo_{96-85}), and high Cr_2O_3 contents (about 0.7wt%), moderate CaO contents (ca. 0.3wt%) and low NiO contents (<0.05wt%). Some olivine grains include fine-grained metallic iron, iron oxide and sulfide in the rim zone. Pigeonite grains are less than 0.3mm in diameter and compositionally homogeneous, En_{75} and $Wo_{7.5}$. Grain boundaries between olivines and /or pigeonites are occupied by iron oxide, limonite, metallic iron, carbonaceous matter, silicate minerals and sulfide.

Bulk composition of non-carbonate carbon, hydrogen and sulfur are 3.34wt%, 0.12wt% and 0.17wt%, respectively. Nitrogen and carbonate carbon contents were under detection limit (<0.01wt%). Organic matter was not detected by py-GC and py-GC/MS. Carbon and oxygen stable isotope ratios are as follows; $d^{13}C = -2.35 \pm 0.07$ ‰. (vs. PDB), $d^{17}O = 3.98 \pm 0.57$ ‰ and $d^{18}O = 8.08 \pm 0.47$‰ (vs. SMOW). Oxygen isotope values are similar to those of ureilites and plot close to the CCAM line (carbonaceous chondrite anhydrous minerals).

Based on the data reported above-mentioned we conclude that NWA 6235 should be classified as a ureilite.

The Raman peaks for diamond in NWA 6235 range from $1334cm^{-1}$ to $1336cm^{-1}$. Fine-grained olivine grains in the mesostasis show broad CL spectra around 640nm, 720nm and 800nm, probably due to Mn^{2+}, Cr^{3+} and lattice defects from Cr, respectively. Diamond grains have CL spectral peaks at 420nm, 520nm and 620nm, which are similar to those of ureilites previously reported. The CL peaks of these diamonds are completely different from those of terrestrial ones, and consistent with those of diamonds from impact craters. It suggests that the diamonds in NWA 6235 were generated from graphite precursors by the impact of celestial bodies in the solar system.