THE FIRST CHARACTERIZATION OF A NEWLY FOUND IRANIAN METEORITE GANDOM BERYAN 008.

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Introduction: Meteorite Gandom Beryan 008 was found by the Meteoritical Expedition of the Ural Federal University on January 5, 2017 in the northern part of the Lut Desert, Iran. This meteorite was classified as ordinary chondrite H5, shock stage 2, weathering grade 3–4 (Meteoritical Bulletin, 106, 2017). In the present work we discuss preliminary results of a Gandom Beryan 008 fragment characterisation by the means of optical microscopy, scanning electron microscopy (SEM) with energy dispersive spectroscopy (EDS), X-ray diffraction (XRD) and Mössbauer spectroscopy.

Materials and methods: Polished section of the Gandom Beryan 008 fragment was prepared for characterization by optical microscopy with Axiovert 40 MAT (Carl Zeiss) and scanning electron microscopy using ΣIGMA VP (Carl Zeiss) with EDS X-max 80 (Oxford Instruments). Then surface material was mechanically removed and powdered sample was prepared for XRD and Mössbauer measurements. XRD pattern was measured by means of XRD-700 diffractometer (Shimadzu) operated at 40 kV and 30 mA with CuK_α radiation. Mössbauer spectrum was recorded using SM-2201 spectrometer with a high velocity resolution at room temperature.

Results and Discussion: Optical and SEM with EDS analysis showed the presence of the following phases: olivine $(Fe, Mg)_2SiO_4$, orthopyroxene $(Fe, Mg)SiO_3$, chlorapatite $Ca_5[PO_4]_3Cl$, plagioclase $(Na, Ca)AlSi_3O_8$, clinopyroxene $(Fe, Mg, Ca)SiO_3$, troilite FeS, chromite $FeCr_2O_4$ with some content of Al as the third metal in addition to Cr and Fe, metallic grains of Fe-Ni-Co alloy consisted of α-Fe(Ni, Co) and γ-Fe(Ni, Co) phases. SEM with EDS demonstrated also a large content of ferric compounds as a result of meteorite weathering. XRD showed the following phase composition in the Gandom Beryan 008 fragment: olivine 37.2 wt.%, orthopyroxene 32.1 wt.%, anorthite $(CaAl_2Si_2O_8)$ 7.6 wt.%, Ca-poor clinopyroxene 6.9 wt.%, chromite 4.6 wt.%, troilite 3.6 wt.%, hercynite $(FeAl_2O_4)$ 0.5 wt.%, γ-Fe(Ni, Co) 0.3 wt.%, α-Fe(Ni, Co) 0.1 wt.% as well as ferric oxides and oxyhydroxides such as goethite (α-FeOOH) 5.9 wt.% and hematite $(\alpha\text{-}Fe_2O_3)$ 1.2 wt.%. Using the Rietveld full profile analysis the unit cell parameters for silicate crystals were evaluated: a=10.2480(9) Å, b=6.0032(7) Å, c=4.7665(5) Å for olivine, a=18.263(6) Å, b=8.853(5) Å, c=5.203(4) Å for orthopyroxene and a=9.63(5) Å, b=8.88(4) Å, c=5.19(4) Å, β=108.5° for Ca-poor clinopyroxene. The first Mössbauer spectrum of the Gandom Beryan 008 fragment matter demonstrates complex spectrum which is similar to the other ordinary chondrites Mössbauer spectra with a large weathering grade. The main spectral components are olivine (two quadrupole doublets related to the ^{57}Fe in the M1 and M2 sites), orthopyroxene (two quadrupole doublets related to the ^{57}Fe in the M1 and M2 sites), troilite magnetic sextet, magnetic sextet related to residual α-Fe(Ni, Co) phase, paramagnetic singlet associated with chromite as well as components related to ferric oxides and oxyhydroxides. The latter products of meteorite weathering were determined as follows: two magnetic sextets which can be related to octahedral and tetrahedral sites in magnetite (Fe_3O_4), magnetic sextet associated with hematite, two magnetic sextets which hyperfine parameters were not associated with known ferric compounds yet, two paramagnetic quadrupole doublets which hyperfine parameters may be related to nanosized goethite, akaganéite (β-FeOOH) or ferrihydrite $(5Fe_2O_3 \times 9H_2O)$ with the total relative area of ferric components of ~48 %. In spite of the poor signal-to-noise ratio for small spectral components we were able to reveal two pairs of doublets related to the M1 and M2 sites in olivine and orthopyroxene while clinopyroxene components were not found yet. Therefore, we can compare estimations of Fe^{2+} occupations of two sites in olivine and orthopyroxene using two independent techniques: XRD and Mössbauer spectroscopy, similar to [1, 2]. XRD data showed the Fe^{2+} occupation ratios X_{Fe}^{M1}/X_{Fe}^{M2} for olivine and orthopyroxene were 1.43 and 0.14, respectively. Estimations of these ratios using the relative areas of corresponding components in the Mössbauer spectrum A^{M1}/A^{M2} showed the values 1.12 and 0.21 for olivine and orthopyroxene, respectively. These results demonstrated that values of Fe^{2+} occupations of the M1 and M2 sites in both olivine and orthopyroxene in Gandom Beryan 008 obtained using XRD and Mössbauer spectroscopy appeared to be in agreement.

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