

PETROLOGY AND GEOCHEMISTRY OF LUNAR METEORITE ABAR AL'UJ 012.

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Introduction: Abar al'Uj 012 (AaU 012) is a feldspathic lunar meteorite, found in Saudi Arabia in 2012 with a total mass of 122.8 g. The meteorite is a vesicular crystalline impact-melt breccia, which lacks a fusion crust and has a ferroan anorthosite (FAN) affinity. Here we report mineralogy and geochemistry data of AaU 012.

Mineralogy: Two polished thin sections were examined with optical microscope, SEM and EMPA. AaU 012 is a clast-rich breccia, composed of lithic (up to 6.8 mm) and mineral clasts (up to 1 mm) set in a very fine-grained and well-crystallized matrix. The lithic clast population is dominated by clasts of anorthosite breccias, containing minor pyroxene and olivine. A basalt clast (1.5 mm), composed mainly of pyroxenes, contains minor SiO₂ and has a microcrystalline matrix. Most common mineral clasts in AaU 012 are plagioclase, with minor olivine and pyroxene. The matrix is composed mainly (~84%) of very fine, acicular plagioclase crystals. Vesicles, up to 3 mm in size, are visible on X-ray tomography images, but abundant vesicles are only a few μm in size. Trace minerals are troilite, Fe-Ni metal, spinel (pleonaste), SiO₂, zircon. Terrestrial weathering products include calcite and barite. The normative plagioclase content is ~84.5 vol%, slightly higher than in the average feldspathic upper crust (~83 vol% norm. plag.) [1]. Average plagioclase is An_{96.9}Ab_{3.0}Or_{0.1}. Olivine composition is Fa_{14.2-38.7}. Pyroxene compositions vary widely, En_{42.3-76.2}Fs_{13.4-36.2}Wo_{2.7-43.6} (excluding the basalt clast) and En_{19.3-71.8}Fs_{16.5-50.2}Wo_{5.9-36.6} in the basalt clast.

Bulk chemistry: Major element analysis was performed by ICP-OES by ActLabs (Ontario, Canada) using a 1.63g sample. Trace elements in eight ~30 mg samples were measured by INAA at Washington University. Major element composition is: 28.9±0.1wt% Al₂O₃, 5.04±0.05wt% FeO, and 3.86±0.04wt% MgO, which fits well within the range of the Apollo FAN-suite (Al₂O₃ 28.0-35.6 wt%, FeO 0.21-5.89 wt%, MgO 0.25-5.11 wt%) [2,3]. FeO content measured with ICP-MS is somewhat higher (~1 wt%), than that was measured by INAA (3.9±0.4 wt%). Trace element contents are: Sc 7.31±0.13 ppm, Sm 1.21±0.09 ppm, Eu 0.744±0.005 ppm, Ni 131±12 ppm, Ir 5.14±0.53 ppb and Th 0.39±0.04 ppm. These data agree well with the average "surface" values derived from the mean composition of feldspathic lunar meteorites [1], however bulk Mg# (58) is one of the lowest among them (Mg#₅₇₋₈₀). Oxygen isotopic composition (in ‰) is: δ¹⁷O +2.86, δ¹⁸O +5.46, Δ¹⁷O +0.02.

Discussion: All mineralogical and chemical data show that AaU 012 is a typical impact-melt breccia, most probably originating from FAN-suite highland rocks of the lunar farside, and containing a clast of mare volcanics.

References: [1] Korotev R. L. et al. 2003. *Geochimica et Cosmochimica Acta* 67:4895-4923. [2] Haskin L. A. et al. 1981. *12th Lunar & Planetary Science Conference*, 41-66. [3] Heiken G. et al. 1991. *Lunar Sourcebook*. Cambridge University Press.