COSMOGENIC RADIONUCLIDES IN AGOUDAL IRON METEORITE AND ASSOCIATED BRECCIA.

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Introduction: The Agoudal IIAB iron meteorite was found in the Agoudal area, High Atlas Mountains, Morocco [1]. Many fragments of the Agoudal meteorite were recovered from ca. 2 x 6 km of strewn field; the total recovered mass of the meteorite is more than 500 kg. The strewn field closely overlaps an eroded impact structure [2]. It is debated whether the impact structure is genetically related to the Agoudal meteorite fall [3, 4]. A key issue is the origin of the breccia that was found at impact structure area and if it contains metallic iron similar to the iron comprising Agoudal. Another issue is whether the pre-atmospheric size of Agoudal matches the size of the impactor needed to produce the observed impact structure.

Samples and Experimental Method: Two pieces of the Agoudal iron meteorite were obtained from the NHM Vienna (Ago01) and the Vernadsky Inst., Moscow. After leaching with 5% HNO_3, each iron sample was dissolved in HNO_3 and Be, Al, and Cl were chemically separated and purified for cosmogenic radionuclide measurement by AMS at Purdue University [5]. A breccia sample that contains metallic fragments was also obtained from the Vernadsky Inst. About 17 g of breccia was crushed, yielding 8.2 g of non-magnetic and magnetic fractions each. The magnetic fraction was further purified with repeated treatments of 0.5 N HCl and HF, finally yielding 3.2 g of near clean metal. Cosmogenic radionuclides in both the non-magnetic and magnetic fractions were measured.

Results and Discussions: The chemical composition of Agoudal, measured by ICP-OES, is (93.0, 93.4%) Fe, (0.51, 0.52%) Co, and (5.45, 5.39%) Ni for two specimens (Ago01, Vernadsky) (% are wt%); these are consistent with previous LA-ICP-MS measurements [3]. The magnetic breccia fraction consists of 88.9% Fe, 0.49% Co, and 5.78% Ni, indicating that part of the iron is slightly oxidized. The non-magnetic breccia fraction consists of 0.21% Mg, 0.72% Al, 0.20% K, 3.9% Ca, 0.012% Mn, 46.0% Fe, 0.22% Co, and 2.89% Ni. The cosmogenic ^{10}Be concentrations in the Agoudal samples (Ago01 and Vernadsky Inst.), the magnetic fraction, and the non-magnetic fraction of the breccia are 0.79±0.01, 0.0126±0.0003, 0.00099±0.00006, and 0.0082±0.0003 dpm ^{10}Be/kg, respectively. The ^{26}Al concentrations are 0.63±0.01, 0.0105±0.0007, 0.00063±0.00014, and 0.0055±0.0009 dpm ^{26}Al/kg. The preliminary ^{36}Cl activity is 3.36±0.09 dpm ^{36}Cl/kg (Ago01). The ^{10}Be-^{36}Cl/^{10}Be terrestrial age is 187±23 kyr for Ago01. The cosmogenic nuclide results indicate that the magnetic and non-magnetic components of the breccia are both consistent with the Agoudal meteoritic, which is consistent with [3]. However, the non-magnetic phase has a factor of 10 more cosmogenic nuclides than the magnetic phase even though both phases coexist within a small breccia. These two cosmogenic components must have originated more than ~50 cm apart within the Agoudal meteoroid. It seems implausible that these two components could be brought together by the impact itself. An alternative explanation is that the breccia was consolidated from two or more Agoudal meteorite fragments that were more than 50 cm apart within the Agoudal meteoroid. A similar explanation was proposed by [4]. The lowest concentration of cosmogenic nuclides in magnetic phase of breccia indicates that the material originated from ~200 cm depth within the Agoudal meteoroid and the preatmospheric size of Agoudal meteorite was more than 4 m in diameter or over 300 t.

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