A NEUTRON CAPTURE STUDY OF THE JILIN CHONDRITE

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Introduction: The Jilin chondrite (H5) is one of the largest stone meteorite to have fallen in the northern part of the district of Jilin in 1976. The total recovered mass is about 4 tons including the largest fragment (Jilin I) with a mass of 1770 kg. Previous consortium studies on this meteorite have found 2-stage cosmic ray exposure conditions and the thermal history in association with the excavation of the meteorite from its parent body [1, 2]. The study of cosmogenic nuclides produced in meteorites provides knowledge on the irradiation records of individual meteorites. Our major interest is the depth dependence of the neutron production rate in the 1st stage (2π geometry) of the Jilin chondrite. In this study, the isotopic compositions of Sm and Gd in a series of samples from the Jilin chondrite were determined to quantify the neutron capture records of the Jilin chondrite.

Experiments: Nine samples were collected from two cores, A and B, from the Jilin main mass. Core A, with a length of 64.8 cm, and core B, with a length of 105.0 cm, were drilled perpendicular and parallel with respect to the tentative 2π surface of the 1st stage irradiation that the main fragment experienced in space [3]. Samples A-1 and A-37, and samples B-1 and B-53 were the terminals of the cores A and B, respectively. Sample A-37 is considered to be closest to the surface of the 2π-geometry. All of the samples used in this study were aliquot samples for the measurement of cosmic ray-produced ^{36}Cl [4]. Powdered bulk samples weighing 69.1 to 213.3 mg were digested individually using a HF-$HClO_4$ mixture. The Sm and Gd fractions were chemically separated using a conventional ion exchange method [5]. The isotopic compositions of Sm and Gd were determined using a VG54-30 thermal ionization mass spectrometer equipped with seven Faraday cup collectors.

Results and Discussion: All the samples showed significant isotopic shifts of $^{150}Sm/^{149}Sm$ and/or $^{158}Gd/^{157}Gd$ corresponding to neutron fluences of $(1.3\text{-}1.7)\times10^{15}$ n cm^{-2}. Considering the short 4π irradiation age of ~0.4 Ma during the second stage, the 2π irradiation of ~10 Ma during the first stage is the main influence on the Sm and Gd isotopic shifts of the Jilin chondrite. Although a depth dependence of the neutron capture effects was expected from the isotopic variations of $^{150}Sm/^{149}Sm$ and $^{158}Gd/^{157}Gd$ in the Jilin chondrite core samples that were possibly drilled perpendicular to the surface of the large object with a radius of >10 m in the 2π-geometry, no clear evidence was observed in this study.

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