NWA 8114: ANALYSIS OF XENON IN THIS UNIQUE MARTIAN METEORITE

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Introduction: The Martian meteorite Northwest Africa (NWA) 8114 was discovered in 2013, and has been paired with a number of other samples including NWA 7034 ("Black Beauty"). These samples exhibit a number of differences from other SNC meteorites [1], and have been classified as a new group of basaltic breccias [2]. Recent analyses of NWA 8114 show it to be a polymict breccia, composed primarily of pyroxene and plagioclase mineral fragments. The presence of magnetite implies that it has experienced aqueous alteration [3].

Noble gases are key tracers of the history of solar system material, and xenon is of particular interest. Martian atmospheric xenon has an elevated ^{129}Xe/^{132}Xe ratio (=2.40(2) [4]), compared to values close to 1 for terrestrial atmosphere, solar wind xenon and Xe-Q. The isotopic compositions of Martian meteorites tend to contain contributions from the Martian atmosphere and interior, as well as fission and cosmogenic components, and sometimes terrestrial contamination [e.g. 5,6]. In this work we present the first xenon isotopic analysis of NWA 8114.

Experimental: 3 bulk rock samples of NWA 8114 were analysed using the RELAX mass spectrometer [7,8]. The masses of the samples ranged from 1.3 to 2.6 mg. Two of the samples were single chips of rock; the third comprised four smaller grains of matrix. Xenon was extracted from the samples by laser step-heating at sequentially increasing temperatures.

Results: The xenon isotopic composition of NWA 8114 is dominated by Martian atmospheric xenon, with contributions from (most likely) terrestrial atmospheric contamination at low temperature and fissiogenic xenon at high temperature. Cartwright et al. [9] recently reported a maximum ^{129}Xe/^{132}Xe ratio of 1.7205 ± 0.0142 for NWA 7034; with the exception of the lowest temperature steps, the ^{129}Xe/^{132}Xe ratios we measure in NWA 8114 are all in excess of this value. In contrast to the data of [9], several of our releases at intermediate temperatures are entirely consistent with Martian atmospheric xenon. Higher temperature releases reveal a contribution of xenon from spontaneous fission of ^{244}Pu and/or ^{238}U that correlates with spallation xenon.

The overall systematics are thus similar to those reported for Nakhla (also aqueously altered) by Gilmour et al. [10], who attributed the behavior to surface correlated Martian atmosphere mixing with volume correlated xenon produced in situ by spallation and fission of incompatible elements.

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