NOBLE GAS SUTIDES ON NORTHWEST AFRICA (NWA) 8785 EL3 AND NWA 8789 EH3 CHONDRITES.

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Introduction: We present noble gas analyses of the recent finds Northwest Africa (NWA) 8785 (EL3) and 8789 (EH3). Both were found in 2014 in Rissani, Morocco. NWA 8785 is an unusual EL3 in having a high abundance of matrix which is FeO-rich and contains secondary minerals [1]. Additionally, a refractory inclusion in NWA 8785 contains sodalite [1], a common alteration mineral in refractory inclusions in some CV chondrites (e.g., [2]). Our main interest in NWA 8785 is to see if there is a signature of aqueous processes in the noble gas abundances. While most enstatite chondrites are dry, lacking any evidence of alteration minerals, the presence of FeO-rich matrix and sodalite in NWA 8785 is an important clue of secondary alteration.

In laboratory experiments, disaggregated samples of Allende (CV) chondrite showed losses of noble gases after hydrothermal treatment (T=200ºC; P(H_2O)=15 atm; t=1 week) [3]. Similarly, powdered samples of the Ningqiang (C3) kept in deionized water at 200ºC for periods of 10 and 20 days, also lost noble gases. The latter authors [4] interpreted the losses as due to the removal of noble gas components from amorphous coatings of fine grained olivine and pyroxene. Nebular water might have been present during accretion of enstatite chondrites, thereby accounting for the presence of sodalite in NWA 8785, and providing the potential for loss of noble gas components. Earlier noble gas studies on some carbonaceous chondrites [4-8] suggested losses of primordial Ar, Kr, and Xe and some loss of He and Ne under a light HF-HCl etching conditions. The authors commented that the majority of the noble gases other than Q in this inclusion were located in very acid-sensitive material.

Methods: Six bulk samples with masses between 24 and 36 mg were preheated at 150 °C for 24 h and then degassed stepwise at temperatures of 500, 800, 1000, 1300 and 1800 °C for 30 minutes in order to search for signatures of aqueous alteration in the noble gas data. Noble gas concentrations and isotopic compositions of He, Ne, Ar, Kr, and Xe were measured with a mass spectrometer, modified-VG5400 at Korea Polar Research Institute (KOPRI) [9]. Sensitivities and mass discrimination correction factors were determined by measuring aliquots of atmospheric He, Ne, Ar, Kr, and Xe, and separately standardized mixtures of ^{3}He and ^{4}He to determine mass discrimination correction factor for ^{3}He/^{4}He.

Results and discussion: Generally most of the ^{3}He, radiogenic ^{4}He and ^{40}Ar (largely radiogenic) are released at low temperatures (500–1000 °C) during stepped-heating analyses. Cosmogenic Ne typically is released between the temperatures of 1000 and 1800 °C, while much of the trapped ^{20}Ne compoents are released below 1000 °C. For NWA 8785, 54 % of the trapped ^{20}Ne content was released in the 800 °C step, possibly from trapped components of P3 [10]. Possibly it is because of the matrix rich in NWA 8785 [1]. Judging from their neon isotope ratios, and like most other E3 chondrites, NWA 8785 (EL3) and NWA 8789 (EH3) contain little or no solar wind (^{20}Ne/^{22}Ne of ~12 for some enstatite chondrites with trapped solar wind [11]). ^{40}Ar (radiogenic)/^{36}Ar(trapped) in NWA 8785 is higher than in NWA 8789. ^{36}Ar, ^{84}Kr and ^{132}Xe enrichments in NWA 8785 are observed compared to those in NWA 8789 by a factor of 2. ^{36}Ar/^{132}Xe ratios are rather constant near the Q-value throughout the stepped heating; ^{84}Kr/^{132}Xe ratios trend from Q towards higher values for both meteorites. So far we are unable to identify alteration signatures from the bulk noble gas data. More analyses of specific mineral phases will be necessary.

For further work, we plan (1) isotope analyses of the matrix materials in NWA 8785 and (2) ^{40}Ar/^{39}Ar dating to define the timing of any alteration, either on the E chondrite parent body, or on a secondary body after breakup and ejection. (3) TEM and XRD to identify the matrix mineralogy and determine effects of alteration.

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