SEARCH FOR EXTINCT CHLORINE-36: A HALITE GRAIN FROM THE ZAG METEORITE

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Introduction: It was suggested that halite (NaCl) in the Zag and Monahans (1998) ordinary chondrites is a product of aqueous alteration, given the presence of fluid inclusions [1-2]. Halite grains from the two meteorites contain abundant radiogenic ^{129}Xe [3-4]. It was suggested that the halite grains formed ~5Ma after Shallowater [4], which is in agreement with the timing of parent body processes such as aqueous alteration and metamorphism.

One can expect that the halite grains in the ordinary chondrites acquired the short-lived radionuclide ^{36}Cl ($T_{1/2}$=0.3Myr). Although only 1.9% of ^{36}Cl decays lead to ^{36}S, a search for radiogenic ^{36}S may be advantageous because of its much lower volatility as compared to Ar [5]. Lin et al. [5] found ^{36}S excesses correlating with Cl/S in sodalite from a CAI in Ningqiang, corresponding to ^{36}Cl/^{35}Cl ~5×10^{-6} at the time of sodalite formation. Thereafter, it was revealed by numerous Cl-S isotope analyses of sodalite and wadalite in CAIs and chondrules that ^{36}Cl/^{35}Cl ratios are variable (~10^{-8} to 1.7×10^{-5}; [6-13]), suggestive of temporal differences in the sodalite and wadalite formation.

NanoSIMS analysis: A blue halite grain (~40µm), which was picked up from finely dispersed bulk sample of Zag, was embedded in epoxy and polished. The polished surface was then studied by FE-SEM. The isotope analysis of Cl and S was done with the Mainz NanoSIMS in the image mode, as opposed to the spot mode in our previous analyses [10]. Beyond this, the analytical settings were the same as those in [10].

Results and Discussion: The δ^{36}S values of the halite grain showed no anomalies of more than 2σ, although ^{35}Cl/^{34}S ratios were up to 1.5×10^{6}. By considering the 2σ uncertainty on the slope of a weighted fit regression an upper limit for the ^{36}Cl/^{35}Cl ratio of 3.2×10^{-7} is calculated. This is clearly lower than the ratios of ~ (4-5)$\times10^{-6}$ inferred by [5-6].

The low level of radiogenic ^{36}S in the Zag halite grain can be explained by heterogeneous distribution of ^{36}Cl in the early solar system, temporal difference of secondary alteration that formed halite, sodalite, and wadalite, and/or later disturbance of the ^{36}Cl-^{36}S system. In the second case, the Zag halite grain must have formed ≥1.2Ma after the Ningqiang CAI sodalite [5]. Because the half-life of ^{129}I ($T_{1/2}$=15.7Myr) is considerably longer than that of ^{36}Cl the observed low level of radiogenic ^{36}S and the presence of comparatively large amounts of radiogenic ^{129}Xe in halite grains [3-4] are not surprising.

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