SEARCH FOR N AND Xe CARRIERS IN THE ACAPULCO METEORITE; Y. Kim, J. S. Kim, and K. Marti, Department of Chemistry, University of California, San Diego, La Jolla, CA 92093-0317.

The Acapulco meteorite has a chondritic composition and an achondritic texture. Its major element composition is intermediate between those of H- and E-chondrites (1). This unique meteorite reveals abundances of the volatile elements close to the levels observed in carbonaceous chondrites. Concentrations of the heavy noble gases are comparable to those observed in type 4 ordinary chondrites, not expected for a presumed highly equilibrated object (1). It is not known where the volatile elements and noble gases are sited in this meteorite, except for nitrogen for which metal was shown to be the carrier of one component (2, 3). We now study N and Xe in separated mineral phases.

Noble gas carriers: In order to understand the origin of the noble gases, the carriers need to be identified. The heavy noble gases were first measured in a bulk sample ($^{132}\text{Xe}=0.62\times10^{-9}$ cm$^3$ STP g$^{-1}$), and in magnetic ($0.84\times10^{-9}$ cm$^3$ STP g$^{-1}$), and nonmagnetic ($0.16\times10^{-9}$ cm$^3$ STP g$^{-1}$) separates. The enrichment in the magnetic fraction was unexpected, since magnetic fractions of ordinary chondrites are strongly depleted. This must represent a distinct feature of the Acapulco parent environment. The metal and troilite are very minor carriers, hinting that orthopyroxene with its abundant swarms of Fe-Ni blebs and other inclusions may hide the carrier. The first results are clear-cut, since the "magnetic" orthopyroxene separate reveals four times the Xe concentration of bulk ($2.4\times10^{-9}$ cm$^3$ STP g$^{-1}$), but the specific carrier among the inclusions in orthopyroxene needs to be identified. However, the trapped noble gas carrier is distinct from the major N carrier. The inferred noble gas concentrations in this carrier may be very large, since its mass may be a small fraction of the "magnetic" orthopyroxene separate. It is important to study this potential sample of the solar system reservoir.

Nitrogen carriers: Nitrogen isotopic abundances in a bulk sample of Acapulco showed the presence of two distinct nitrogen isotopic signatures ($\delta^{15}\text{N}=+10$ and $\leq-110\%$ ) (2). A study of a magnetic separate yielded higher nitrogen concentrations but a similar isotopic pattern (3), supporting the conclusion that the carriers of nitrogen were not equilibrated, in apparent conflict with other evidence for a high degree of recrystallization (1). We measured nitrogen isotopic abundances observed in silicate and metal separates of Acapulco. After magnetic separation, silicate grains were further purified by etching with 0.2N HCl, and metal grains were hand-picked under binocular magnification. Figure I shows the nitrogen release of the metal fraction which was studied by pyrolysis (p-steps) and oxidation (c-steps) at stepwise increasing temperature. Nitrogen is enriched in the metal portion revealing two distinct isotopic signatures ($\delta^{15}\text{N}=+20$ and $-130\%$ ). Light nitrogen ($-130\%$ ) has been found only in metal, while heavy nitrogen ($+20\%$ ) has been observed in both silicate and metal separates. Oxygen consumption during oxidation steps does not correlate with nitrogen release. This evidence and the release pattern suggest a heterogeneous distribution of nitrogen carrier(s) (possibly enriched in the taenite phase). The possibility that nitrogen is carried in nitrogen-bearing inclusions cannot be excluded.
$^{129}$Xe carrier: Radiogenic $^{129}$Xe excesses were found in the magnetic and nonmagnetic separates. However, the $^{129}$Xe release patterns are different in the magnetic and nonmagnetic separates, the Xe isotopic composition of the nonmagnetic separate revealed the signature of Pu fission along with $^{129}$Xe excess (Fig. 2). We have measured $^{129}$Xe abundances in the following mineral separates: hand-picked metal (metal-o), NaOH-etched metal (metal-p), "magnetic" orthopyroxene (containing metal blebs), phosphate, acid-etched silicate, troilite, and nonmagnetic fines (<40μm). Major $^{129}$Xe excesses were observed only in the phosphate (412x10^{-12} cm³ STP g⁻¹) and in metal-o (46x10^{-12} cm³ STP g⁻¹). It appears that the $^{129}$Xe carrier, a minor flaky phase associated with metal contains ~80% of $^{129}$Xe, but is lost during chemical treatment. Figure 2 shows the Xe isotopic compositions (normalized to $^{130}$Xe) for several temperature steps. Two characteristic patterns and isotopic ratios identify two main carriers, supporting results obtained from magnetic and nonmagnetic separates and from nonmagnetic fines. The low temperature ($\leq 600^\circ$C) release characteristics of $^{129}$Xe in the (uncharacterized) flaky phase has important implication regarding the thermal history of Acapulco. The fission Xe concentration observed in the phosphates, coupled with the Nd concentration (4), imply a $^{244}$Pu/Nd ratio (>10^{-3}) which is considerably larger than ratios observed in chondritic phosphates (see also 5).


Fig. 1. Isotopic data from a stepwise release of N in Acapulco metal (>100μm).

Fig. 2. Three-isotope correlation plot of Xe isotopic compositions in Acapulco separates.