INTERSTELLAR NOBLE GAS COMPONENTS IN INMAN AND TIESCHITZ; *C. M. Hohenberg, R. H. Nichols, Jr., C. M. O'D. Alexander, and C. T. Olinger*, McDonnell Center for the Space Sciences, Physics Department, Washington University, St. Louis, MO 63130 USA, *J. W. Arden*, Dept. of Earth Sciences, Oxford University, Oxford OX1 3PR, U.K.

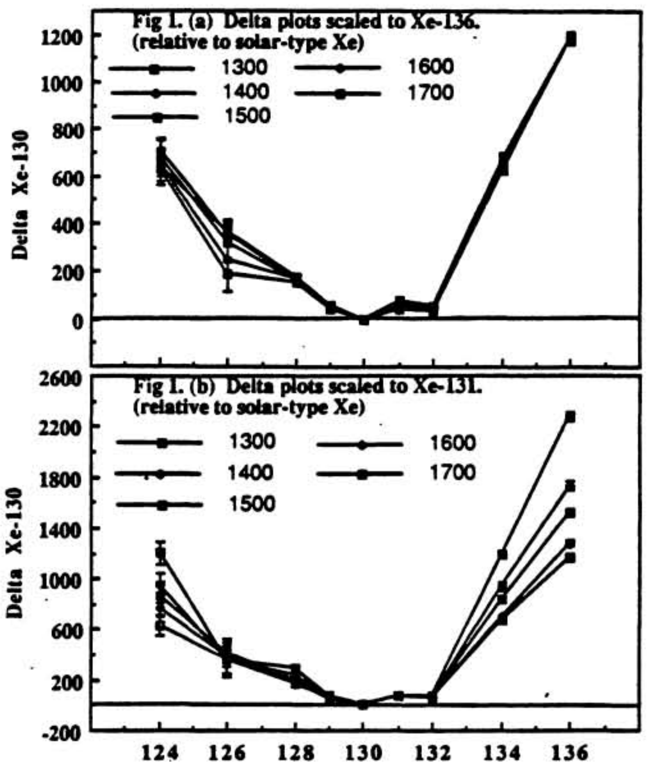
Of the numerous noble gas components present in carbonaceous chondrites four are so isotopically unusual as to be almost certainly interstellar in origin. Ne-E(H) and S-Xe are thought to be carried in SiC, Xe-HL in diamond (Cδ) and Ne-E(L) in poorly crystalline graphite (Cα) [cf.1]. Recent results by a number of groups [2-5] have demonstrated the presence of such components in acid-resistant residues from unequilibrated ordinary chondrites. We report here the results of step-wise pyrolysis experiments on Inman and Tieschitz demineralized residues (11,000 times enriched by successive treatment in HF, HCl, $HClO_4$ and $H_2Cr_2O_7$). This work differs from that of Schelhaas *et al.* [5] in that the HF/HCl treatment is followed by highly oxidizing acids to effectively remove the planetary noble gas carrier.

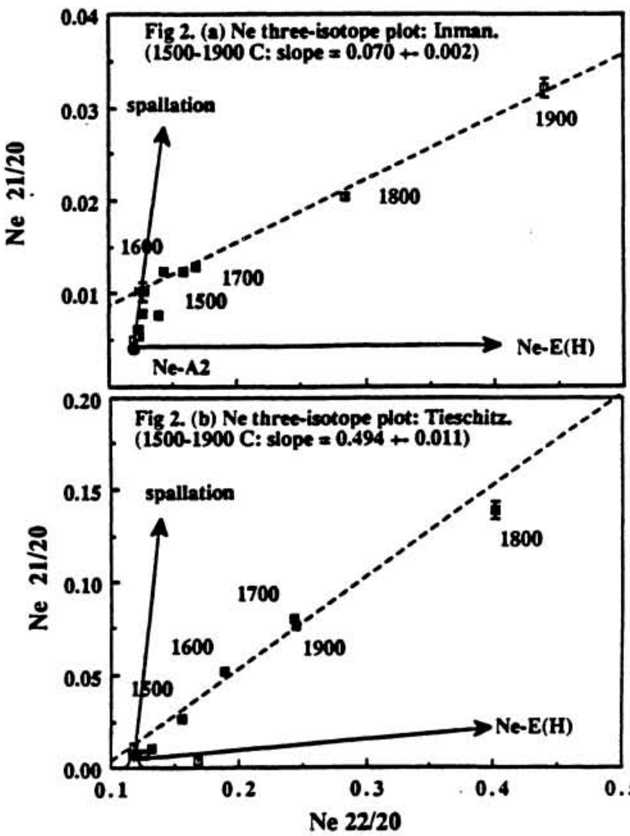
The dominant xenon and neon components in these residues are Xe-HL and Ne-A2, both of which are apparently carried by Cδ, the dominant phase. In addition, Ne-E(H) and Xe-S were observed, but no Ne-E(L) was detected, even in the residues subject to only the HF/HCl treatment. There is very little trapped xenon in the conventional sense (solar, planetary, atmospheric) in the oxidized residues. Xenon in the higher temperature fractions is dominated by Xe-HL, but significant other xenon components are also evident in this material: Xe-S in the highest temperature fractions (reflecting the refractory nature of its SiC carrier) and an iodine-derived xenon component in the lower temperature fractions [6].

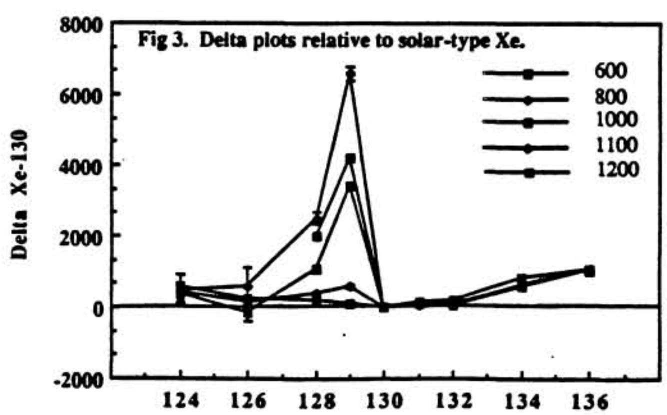
Delta ^{130}Xe values, calculated relative to solar-type xenon and scaled to a second isotope should be identical if the gas is a simple mixture of of Xe-HL and solar. When scaled to ^{136}Xe (Fig. 1a) the ^{124}Xe, ^{128}Xe, ^{129}Xe and ^{134}Xe in Inman do behave as perfect mixtures, but scatter is introduced at ^{126}Xe, ^{131}Xe and ^{132}Xe; when scaled to ^{131}Xe, the converse is true (Fig. 1b). Similar results were obtained for any other reasonable trapped component. This behavior is indicative of at least two distinct components, presumably of different nucleosynthetic origins, being released as Xe-HL, and may be similar to that reported for Allende Xe-HL [1]. Such a clean separation of these two components was not observed in the Tieschitz residue.

The carrier of Ne-E(H) is also thought to be SiC [1]. At high temperatures a ^{22}Ne-enriched component was released (Ne-E(H)) from the Inman residue, but in apparent correlation with spallation-produced ^{21}Ne (Fig. 2a). This component has a ^{21}Ne/^{22}Ne ratio of 0.07, much higher than that reported by Tang and Anders [1]. Based upon the correlation observed in Murray residues, Tang and Anders [7] have calculated a 40 Ma cosmic ray exposure age for the Ne-E(H) carrier of that meteorite. The age we would obtain for the ^{22}Ne-enriched carried in Inman using the model of Tang and Anders [7] is approximately 1200 Ma. It should, however, be pointed out that our Inman residue is not pure SiC and Cδ, but contains other refractory minerals such as spinel, zircon and TiO_2. The possibility, therefore, exists that such a correlation between Ne-E(H) and spallation ^{21}Ne is fortuitious, caused by reactions at high temperatures between the spinel and the SiC, which conspires to release spallation neon from the spinel in proportion with Ne-E(H) from the SiC carrier. If one assumes that all of the spallogenic ^{21}Ne came from the spinel, and that the correlation is strictly fortuitous, there is still too much spallation neon (but only by about a factor of 2) than could be produced during the 20 Ma exposure age of the bulk meteorite. This interpretation receives more support in the case of Tieschitz, whose correlation between spallation-produced ^{21}Ne and Ne-E(H) is even more extreme, suggesting a ^{21}Ne/^{22}Ne ratio of 0.5 (Fig. 2b). This ratio is too low to be spinel spallation, but far too large, for any reasonable exposure time, to be due to the SiC carrier of Ne-E(H). However, evidence of unusual irradiation conditions does appear in the xenon.

In the lower temperature steps, sizable and correlated excesses of ^{128}Xe and ^{129}Xe are observed. As is clear from Fig. 3, these are the only anomalies at these temperatures that cannot be explained as mixtures of solar-type Xe and Xe-HL. The ^{129}Xe probably results from decay of now-extinct ^{129}I. Considering the absence of spallation-produced xenon and correlation with iodine-derived ^{129}Xe, the excess ^{128}Xe is almost certainly a product of neutron-irradiation of stable ^{127}I. The neutron fluence required to produce the observed ^{128}Xe/^{129}Xe ratio was found by two independent methods: In the first, if one assumes an initial ^{129}I/^{127}I ratio of about 1×10^{-4} (as found in any other primitive meteorite), a thermal equivalent neutron dose of 3×10^{17} n/cm^2 is required. As we were skeptical about the magnitude of this dose in a naturally irradiated sample, an aliquot of the Inman residue was irradiated at the University of Missouri Research Reactor, also with 3×10^{17} n/cm^2, enhancing the excess ^{128}Xe from additional (reactor-produced) neutron capture reactions. The results confirm the large natural neutron fluence, although it is difficult to imagine the setting under which cosmic ray produced neutrons can provide the necessary dose. Using the highest neutron fluxes estimated from lunar regolith samples [8] a regolith exposure age of roughly 1500 Ma would be required, and it is also difficult to imagine a non-regolith setting in which a thermal neutron fluence of this magnitude could have occurred. At the present time the interpretation of this apparent anomaly remains a mystery.







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