INERT GASES IN FIFTEEN IRON METEORITES

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We have measured all the inert gases mass-spectrometrically in the metal phases of 15 iron meteorites and in graphite and troilite separates of Odessa, but report only on Xe results here. Table 1 lists the meteorites of our study plus those iron meteorites in which Xe has been measured by other investigators. The meteorites of our study were selected primarily on the basis of short cosmic-ray exposure ages, i.e. less than about 200 x 10^6 y; however, a few such as Arispe and Butler have much longer ages. We find that Xe-124 and Xe-126 are always dominated by spallation Xe, and that Xe-128, particularly in the meteorites with long exposure ages, also shows clearly detectable spallation effects. The results for the remaining stable Xe isotopes are summarized in Figs. 1-4, which are three-isotope correlation plots. The specific isotope pairs on the axes have been chosen to bring out certain aspects of the isotopic variations of Xe. These variations are complex. Particularly Figs. 2 and 3 show that several samples have yielded Xe with (terrestrial) atmospheric composition, but it is not clear how much, if any of this is indigenous to the meteorites. We have tried hard to eliminate terrestrial contamination of the samples, but we suspect that these efforts cannot have been totally successful. This means that the indigenous gases are actually at locations in the Figures which are farther removed from the atmospheric point than they are now. Several of the meteorites are missing from Figures which contain Xe-128 as one variable; this is always due to spallation Xe-128. Braunau is anomalous in every respect. Xe-128 is deficient, but Xe-132 and Xe-130 show excesses. This is consistent with preterrestrial exposure of trapped Xe to thermal and/or epithermal neutrons, which is perhaps the strongest evidence that iron meteorites do, indeed, contain trapped Xe of their own. The composition of this indigenous trapped Xe is; however, not totally clear from our results. The data of Fig. 1 suggest the participation of "solar" Xe or of U-Xe(1), to which there is "admixed" either H-Xe or Pu-Xe, or both (1). Whether these are in the metal phase or in minor accessory phases is not clear from the results at hand. Sierra Gorda is also very anomalous, but in this case the anomalies are more consistent with the presence of an s-like component.

TABLE 1

List of meteorites. Letters in parantheses are symbols used in the figures. Arispe(A), Babb's Mill(BM), Bohumiltz(BO), Braunau(BR), Butler(B), Cape York (CY)(2), Carbo(C)(3), Cedar Town(CT), Costilla Peak(CP)(3), Dayton(D), Duchesne(DU), Edmonton(E), El Burro(EB), Hoba(H), Odessa(O), Odessa Graphite (OG), Odessa Troilite(OTR), Misteca(M)(3), Sierra Gorda(SG), Tawallah Valley (TV), Tombigbee River(TR),Xichipilco(X=Toluca)(2).

References:(1) R.O.Pepin and D. Phinney, submitted to Moon and Planets; (2) E.W. Hennecke, O.K. Manuel(1977) EPSL 36, 29; (3) M.N. Munk (1967) EPSL 2, 301; also EPSL 3, 133.

Notes for figures: These are three-isotope plots of data. Some data points fall outside the figure due to spallation Xe-128. The filled squares represent U-Xe(1); the filled circles represent trapped Xe in lunar soils; the filled triangles represent Xe in the earth's atmosphere. The arrows labeled H-Xe,Pu-Xe, Spall and S show the directionstowards the first two components, spallation Xe and s-Xe. The crosses in the lower right-hand corners indicate typical errors.

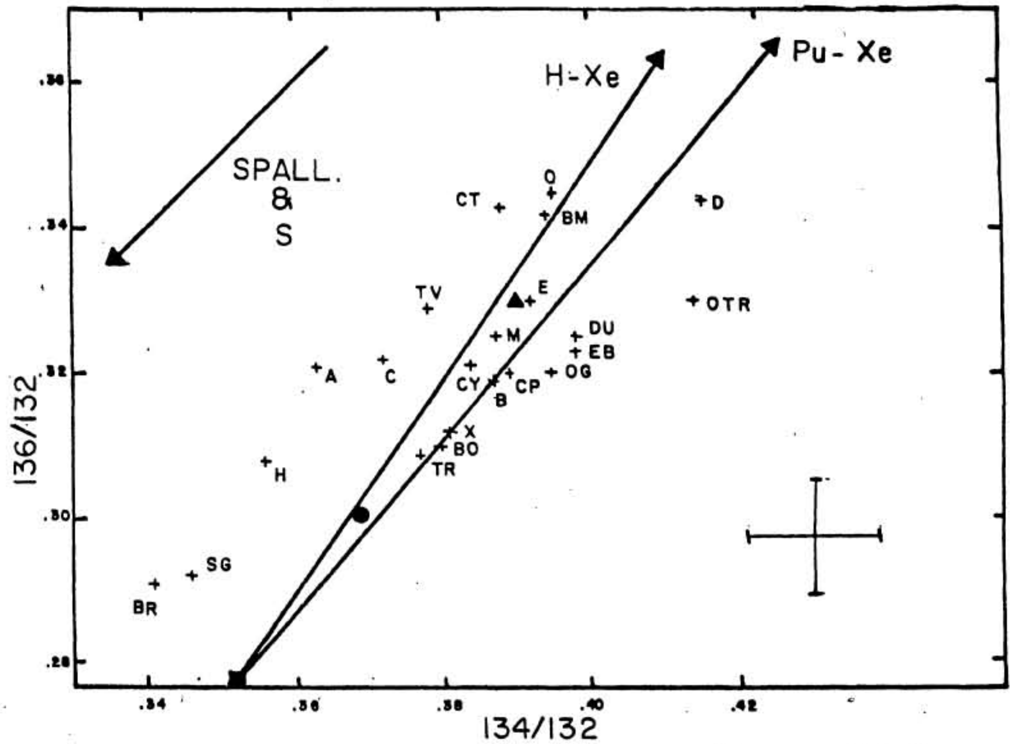

Figure 1

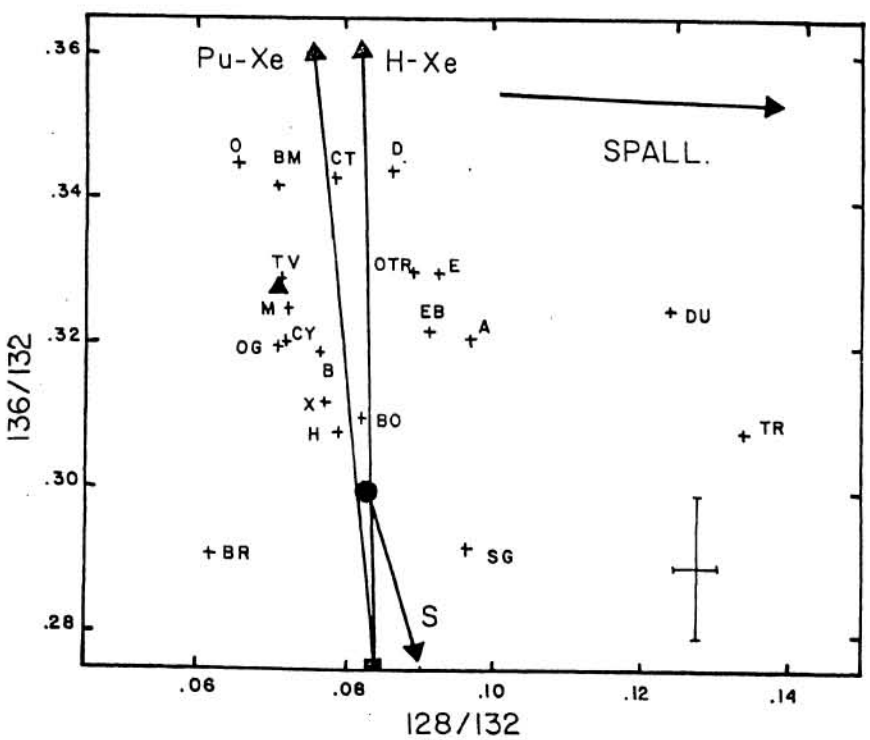

Figure 2

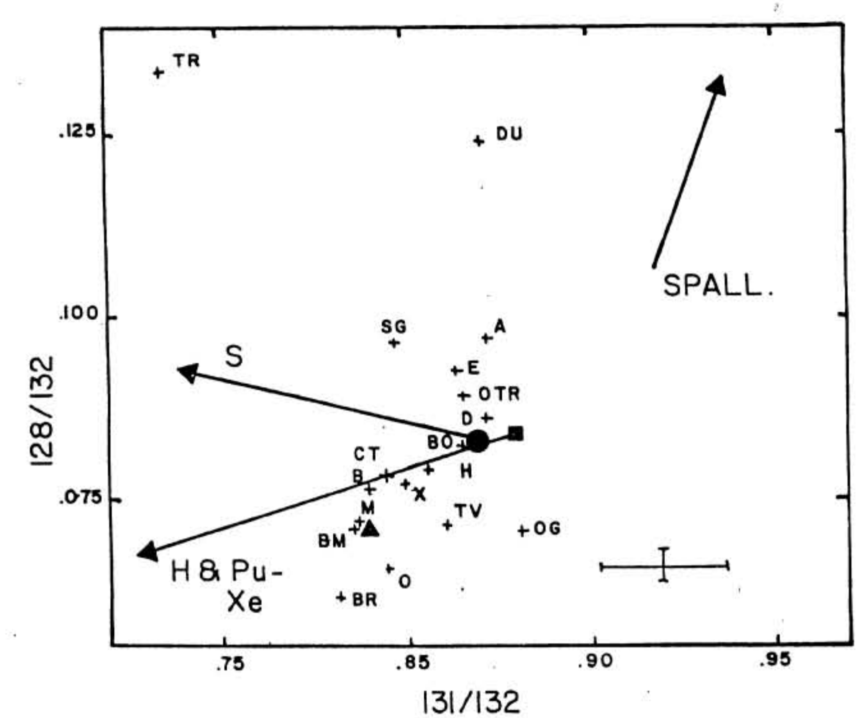

Figure 3

Figure 4