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Note: Numbers in brackets are exponents of ten.

Clayton (1) has suggested that the so-called X-He and X-Ne of carbonaceous chondrites are trapped in carbonaceous grains in the circumstellar coccoon of a massive star, and that X-Kr and X-Xe are trapped in these grains from the explosive exhalation of the central star at a later time when the exhalation barrels into the coccoon. This interesting idea does not work, because the X-gases in the carbonaceous chondrites should then be much richer in Ne-20, Ar, p-Kr, and poorer in r-Kr and r-Xe than they actually are. Inert-gas fractionations must therefore occur in the explosive exhalation prior to its encounter with the coccoon.

Lattimer et al. (2) have pointed out that grains may not form in the Fe-Si-rich zone of an explosive exhalation owing to the presence of Ni-56 and Co-56. These species generate from [+36] to [+35] watt of heat. The variant of Clayton's model presented here posits that there are generally three zones in an explosive exhalation. Radially outward: A = no condensation, B = partial condensation, i.e. formation of corundum and/or spinel SUNOCONS, and C = full condensation, i.e. primarily periclase SUNOCONS. The SUNOCONS from zone B are thermodynamically the most stable.

Inert-gas components occur at physically separate locations in the exhalation. I postulate that Ar, p-Kr, and a large fraction (>90%) of p-Xe occur in zone A, hence cannot be trapped in SUNOCONS, but remain in the gasphase. The remainder of p-Xe, all r-Xe and r-Kr, and some s-Xe and s-Kr occur in zone B by postulate; these are trapped by ion implantation. Partial ionization of the gasphase is maintained by Al-26. Grains in zone B are assumed order [+2] Å dimension with mass on the order [-17]g. Quantitative scavenging of the inert gases is assumed. Ne-20, and the bulk of s-Kr and s-Xe occur in zone C. Quantitative scavenging is assumed.

The explosive exhalation packs on the order [+50] erg, and individual SUNOCONS from zone B on the order [-1] erg kinetic energy. The coccoon cannot absorb more than [+47] erg by diatomic hydrogen → H+H without wholesale vaporization of grains. The coccoon must be swiftly ruptured and fragmented with the bulk of the explosive exhalation continuing its expansion into the interstellar medium beyond. The carbonaceous grains of Clayton's model, assumed spherical and "black bodies", can individually absorb heat at the rate of [+0] erg/s in steady state at 600 K and of 4[+1] erg/s at 1500 K. It is therefore possible that the abundant periclase SUNOCONS, which arrive first, are vaporized by grain-grain collisions, whereas the less abundant corundum and/or spinel SUNOCONS are caught in the "batter of carbonaceous" matter. The periclase SUNOCONS can also be eroded by reaction with a now SiO_2-rich gasphase. Atomic budgets show that the total mass of the corundum/spinel SUNOCONS in acid-resistant residues of carbonaceous chondrites can be less than 5[-3] g/g. The revised model accounts for the following features of the X-gases in carbonaceous chondrites: (a) excess p-Xe, but deficiency of p-Kr; (b) Xe-136/Xe-124 in the range 70-80; (c) Ne-20/Xe-136 ≈ 1.5[+3]; (d) Ar-36/Xe-136 ≈ 3[+2]; (d) inorganic SUNOCONS in acid-resistant residues not yet detected; (e) little, if any excess Xe-129 from I-129.

(1) Clayton D. D. (1981) Lunar and Planetary Science XII, p. 151.
(2) Lattimer J. M., Schramm D. N., and Grossman L. (1978) Astrophys. J. 219, 230.