Ne-E(L) ACCOMPANIED BY ^{40}K.

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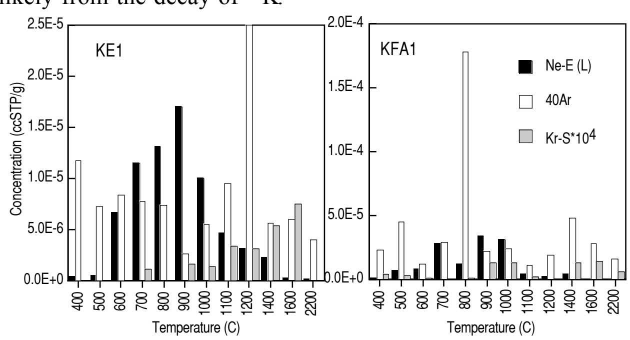
Introduction: Presolar graphite carries Ne-E(L) [1], the component highly enriched in ^{22}Ne. This huge excess prompted the idea that the ^{22}Ne is from the decay of radiogenic ^{22}Na ($T_{1/2}$ = 2.6 a) produced in novae [2]. Amari et al. [3] analyzed noble gases in the four graphite separates, KE1, KFA1, KFB1 and KFC1 with a range of density (1.6–2.2 g/cm^3) extracted from the Murchison meteorite [4], and concluded that the ^{22}Ne in KE1 and KFA1 (1.6–2.05 and 2.05-2.10 g/cm^3) is mostly ($\geq$ 90%) from the decay of ^{22}Na. Low-density graphite grains (1.65–1.72 g/cm^3) are characterized by ^{18}O excesses, Si isotopic anomalies (mainly in the form of ^{28}Si excesses) and high ^{26}Al/^{27}Al ratios (up to 0.1), indicating they formed in Type II supernovae [5]. From noble gas analyses of bulk samples [3] and of single grains [6] from the Murchison separates, Amari et al. [7] concluded that ^{22}Ne in low-density grains is from ^{22}Na produced in supernovae and is not from ^{22}Ne that was directly implanted onto the grains. Sodium-22 is synthesized during hydrostatic burning by ^{21}Ne(p,γ)^{22}Na, where ^{21}Ne is produced by ^{20}Ne(n,γ)^{21}Ne and protons are produced by ^{12}C(^{12}C,p)^{23}Na in the O/Ne zone [8].

Discussion: In the O/Ne zone, isotopes that have a similar first ionization potential as that of Na (5.203 eV) include K (4.34 eV). Potassium-40 ($T_{1/2}$ = 1.27 Ga) decays to ^{40}Ar (11.16%) and ^{40}Ca (88.84%). Predicted ^{22}Na/^{40}K ratios are 3.40 [9] and 9.77 [8] in the O/Ne zone of 25M_{sun} stars with the solar metallicity. If non-radiogenic ^{40}Ca and ^{40}Ar are not overwhelmingly abundant and ^{40}K was incorporated along with ^{22}Na, elevated ^{40}Ca and ^{40}Ar abundances are expected in ^{22}Ne-rich low-density grains. In graphite bulk analysis, the lighter noble gases were released in lower temperature steps than the heavier noble gases (Fig 2 in [3]), indicating noble gases were released by diffusion. In the figure below (data are from [3]), where ^{22}Ne, ^{40}Ar, and s-process Kr concentrations are plotted against temperatures for KE1 and KFA1, the ^{40}Ar release peaks are observed between the ^{22}Ne and the Kr-S release peaks. A similar release pattern is also observed in KFB1 (2.10–2.15 g/cm^3). Argon-40 must be from the graphite grains and is most likely from the decay of ^{40}K.



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