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SOLAR NEBULA CONDENSATION: IMPLICATIONS
FROM ALLENDE INCLUSION MINERALOGY

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Mineralogical study of a coarse-grained, hibonite-rich Type A inclusion
from the Allende meteorite provides information on its mode of formation
and, by inference, conditions in the solar nebula (Allen et al., 1978). Primary
phases are melilité, hibonite, Ti-Al-pyroxene, perovskite, spinel and rhönite.
Although some evidence exists that Type B inclusions were once molten, the
possibility that this was the case for Type A inclusions has never been
specifically addressed. Because the inclusion studied here is composed almost
entirely of CaO, Al₂O₃ and SiO₂, the melting relations in this system can be
used as a tool for determining whether the primary phases crystallized from a
liquid. For this bulk chemical composition, the phase diagram predicts the
presence of melilité enclosed by hibonite, the phase CaAl₂O₇ and an
interstitial assemblage of gehlenite, hibonite and anorthite if the inclusion
crystallized from a melt. None of these features are found in the inclusion,
indicating that the primary phases could be direct solid condensates from the
solar nebular gas. These were intensely altered during a later condensation
event which deposited grossular, anorthite, nepheline and wollastonite in
veins and cavities. Five condensate rims were then deposited as layers on the
outside of the inclusion, from inside to outside consisting of perovskite + 
spinel, nepheline + anorthite, Ti-Al-pyroxene + diopside, hedenbergite ± 
andradite ± wollastonite, and Mg-Fe clinopyroxene + wollastonite + andrad-
ite.

Primary melilitite grains are reversely zoned from cores of Ak₂₀ to rims 
of Ak₀ and spinel inclusions have halos of Ak-poor melilitite, both features 
indicative of increase in T, decrease in P or change in composition of the gas. 
At fixed temperature and gas composition, the observed zoning could be 
produced by condensation of melilitite from a gas whose total pressure 
dropped by 40 percent during crystallization. Spinel and perovskite show 
irregular, grain-to-grain variations in minor element contents. Spinels vary in 
Cr, V, Fe and Ti, with interior ones richer in Cr and V and poorer in Fe than 
those in the rim. Differences in composition between different interior spinels 
are often greater than differences between interiors and rim spinels. 
Perovskites vary in Sc, Y, Zr and Fe, with interior one poorer in Fe than 
those in the rim. These element differences and the mineralogical 
composition differences between primary, alteration and rim assemblages are 
evidence that different phases in the inclusion condensed from gases under 
different physico-chemical conditions.


“PLANETARY” NOBLE GASES IN CHONDRITES: A REVIEW
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A variety of ancient noble-gas components are hidden in chondrites. 
They can be disentangled by unconventional mineral separation techniques 
(peptization, selective etching), combined with stepwise heating. 

The following topics will be reviewed, in the light of recent work by 
B. Srinivasan, R.S. Lewis, and L. Alaerts.

1. The “normal” planetary component; its host mineral Q, and its 
variation in chondrites of different petrologic types.

2. The “fission” Xe component, its possible origin from a volatile 
superheavy element, and its albatross: the “light” Xe component.

3. A new, apparently presolar component, showing the signature of 
nuclear reactions in red giants: enhancement of Xe¹²⁸, Xe¹³⁰, Xe¹³², Kr⁸², 
Ne¹², and He³.