which silicates have been described, consisting of albitic plagioclase, enstatite,
and SiO$_2$ in a phosphate matrix (Scott and Bild, 1974).

The absence of clinopyroxene and chromite from the silicate inclusions
is reflected in their bulk composition (determined by broad-beam microprobe
technique) by a depletion of Cr, Mn, and Ca relative to ordinary chondrites
(metal-free basis). Similar trends on a much smaller scale are found in IAB
silicate inclusions. A comparison of trace element data (Scott and Wasson,
1975) also suggests that trends in group III-C-D are very similar to but more
pronounced than in group IAB. Thus the two groups may either be derived
from the same parent body, or from very similar parent bodies which
presumably formed in the same region of the solar system.


A NEW TYPE OF Ca-Al-Na-RICH INCLUSIONS WITH AN IGNEOUS
TEXTURE IN THE LANCE CARBONACEOUS CHONDRITE

G. Kurat and A. Kracher, Museum of Natural History, Division of Mineralogy,
P.O. Box 417, A-1014 Vienna, Austria

Three inclusions of an apparently new type have been found in the
Lance carbonaceous chondrite (no. 2L1N, 3A1, and 5B). They are well-
delineated aggregates with a groundmass that is granular in some places, but
resembling an ophitic igneous texture in others. Parts of metal and sulfides
are present along the rim and occasionally within the inclusions. The granular
groundmass consists in all three cases of very pure enstatite (en > 97%). In
addition, inclusion 2LN contains ophitic feldspar (an 73), occasionally
together with nepheline, and a very intimate intergrowth of Ca-rich
pyroxenes, with skeletal hedenbergite or ferrosilite (en 10-25, fs 30-40, wo
45-50) embedded in augite (en 53, fs 3, wo 44). The augite is remarkable for
its high Mn content (Mn/Fe - ratio about 1), and analyses give low eation
sums unless most Ti and Cr are converted to Ti (3+) and Cr (2+). Hercynitic
spinel (Fe/(Fe + Mg) = 0.6 and Cr$_2$O$_3$ around 1.3 wt %) surrounded by
nepheline, and minor olivine of variable composition (fa 9-33) are also
present. The bulk composition is alkali olivine basaltic (8% normative
nepheline). Inclusion 3A1 does not contain nepheline or hedenbergite, but
the other phases are generally similar to inclusion 2LN, except that olivine is
more fayalitic (fa 40-60). Inclusion 5A is different in some respects from the two
others: The ophitic feldspar component is variable in composition (an 47-70),
and there is only one Ca-rich pyroxene with very high Al$_2$O$_3$ (10 wt %).
Olivine is more abundant and is strongly zoned (fa 8-32).

This type of inclusion is unique in bearing evidence for the presence of
a basaltic melt during or perhaps even prior to the formation of the Lance
rock, i.e. very early in the history of the solar system.

The fragments encountered apparently had a complex history, of which
at least three stages are still distinguishable: (a) formation of a highly reduced
mineral assemblage, (b) fragmentation of this first generation rock and
incorporation of fragments as xenoliths into a basaltic melt, and (c) emplacement
of xenolith-rich basalt fragments into the Lance parent rock, where they
were subject to an alkali and Fe(2+)/Fe(3+) metasomatism similar to what we
have previously observed on a Ca-Al-rich inclusion in Lancel (Kurat and
Kracher, in preparation).

ANGRA DOS REIS REVISITED:
PARTICLE TRACKS AND THEIR IMPLICATIONS

D. Lal*, D. Macdougal and J. Carlson, Scripps Institution of Oceanography,
La Jolla, CA

There has been continued controversy about the interpretation of the
particle track record in Angra Dos Reis (1-3). Measurements of track densities
in various phases of ADOR by different groups are in agreement, but
assignment of fractions of the total track density among cosmic ray, Pu + U
fission, and possible superheavy element fission sources is in dispute. Recent
evidence that particle tracks in ADOR are completely unaffected by post-
crystallization heating (3) lends credibility to the method of track length
measurements, first used for ADOR by Bhandari et al. (1), for distinguishing
among these sources in pyroxenes. Cosmic rays, $^{238}$Pu and $^{239}$U fission,
and superheavy element fission each produce distinguishable tracks. We have
therefore re-examined track lengths in ADOR in an attempt to check the
work of (1) and to improve statistics. We have also measured additional
phases.

Our track density measurements in pyroxene and olivine fall in the
range reported by others (1-3). At this writing, 634 track lengths have been
measured in ADOR pyroxenes; they have a mean of 14.6 $\mu$m and a standard
development of 1.1 $\mu$m, which compares well with the mean length of 14.4 $\mu$m,
measured by (1). More than 98% of the measured tracks fall within the
expected Gaussian range of lengths, even for $\sigma = 0.9 $\mu$m, a firm lower limit
for this type of measurement based on published data for neutron-induced
track length distributions. These data reaffirm the conclusion of Bhandari et al. (1)
that fossil tracks in ADOR pyroxenes result almost exclusively from $^{238}$Pu
fission.

The cosmic ray track density may be estimated from our data in several
ways. A maximum value is obtained by assuming all tracks $< 2 \mu$m in length
to be due to nuclei lighter than iron, which results in a calculated CR track

---

283

---

284