N90-16629

IDENTIFICATION OF SOLAR NEBULA CONDENSATES IN INTERPLANETARY DUST PARTICLES AND UNEQUILIBRATED ORDINARY CHONDRITES.

W. Klöck[1], K.L. Thomas[2] and D.S. McKay[1], [1] SN14, NASA/JSC, Houston, TX, 77058; [2] Lockheed, 2400 Nasa Rd.1, Houston, TX, 77058

Orthopyroxene and olivine grains, low in FeO, but containing MnO contents up to 5 wt% were found in interplanetary dust particles (IDP) collected in the stratosphere (Fig.1). The majority of olivines and pyroxenes in meteorites contain less than 0.5 wt% MnO (Fig.2). Orthopyroxenes and olivines high in Mn and low in FeO have only been reported from a single coarse grained chondrule rim in the Allende meteorite (1) and from a Tieschitz matrix augite grain (2). The bulk MnO contents of the extraterrestrial dust particles with high MnO olivines and pyroxenes are close to CI chondrite abundances (3) except for 3 particles which are enriched in Manganese by factors of 2-6.

High MnO, low FeO olivines and orthopyroxenes were also found in the matrix of Semarkona, an unequilibrated ordinary chondrite (Fig.3). This may indicate a related origin for minerals in extraterrestrial dust particles and in the matrix of unequilibrated ordinary chondrites.

The origin of the observed Mg-silicates with high MnO contents, but having low iron contents, can be best understood by condensation processes from a gas of solar composition. Forsteritic (Fe-poor) olivine is the first major silicate phase to condense from a solar gas. Iron would condense as metal and react at rather low temperatures (500 K- 600 K) with forsteritic olivine to produce Fe-rich olivine. However, Mn, which is not stable as metal in the solar nebula would condense at around 1100 K as Mn_2SiO_4 in solid solution with forsterite (4,5). High MnO, low FeO olivines may have formed by condensation above 1000 K but failed to equilibrate with metallic iron at lower temperatures.

Low temperature metamorphic reactions may produce FeO- and MnO- rich olivines but are unable to explain the formation of FeO-poor MnO-rich olivines. The occurrence of solar nebula condensates in IDP's would be remarkable. Either the origin of IDP's is more closely related to chondritic meteorites than previously thought or comets, which are believed to be the parent bodies of chondritic porous IDP's (6,7,8,9), contain high temperature minerals, formed by condensation in the solar nebula.

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W. Klöck, K.L. Thomas, D.S. McKay

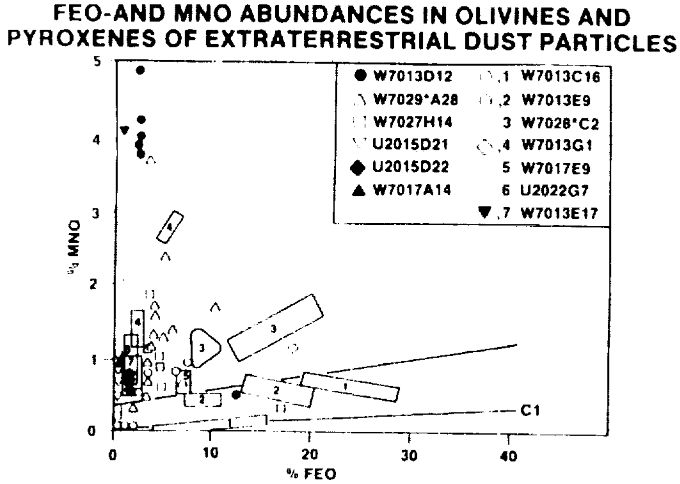

Fig. 1

FeO and MnO abundances in olivines and pyroxenes of extra terrestrial dust particles

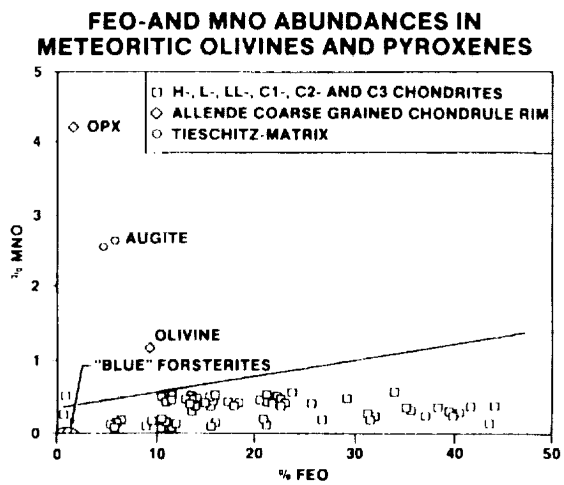

Fig. 2

FeO and MnO abundances in olivines and pyroxenes of various undifferentiated meteorites. MnO contents are always below 0.5 wt% and show no increase with increasing iron content.

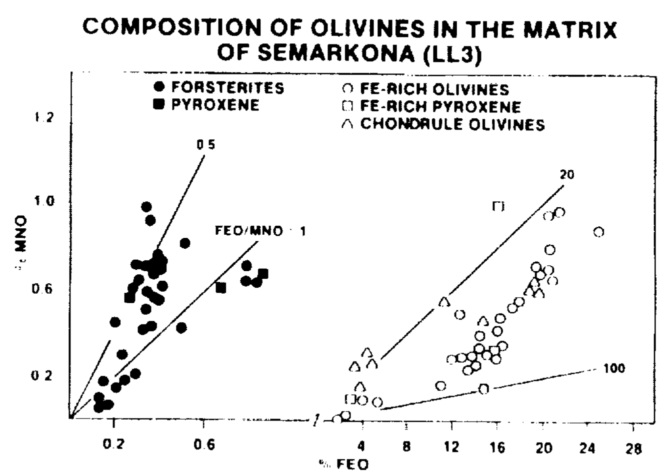

Fig. 3

Composition of olivine in the Semarkona matrix. Two olivine populations were found in the opaque matrix.

1. Fe-rich olivines compositionally similar to chondrule olivines.
2. Mg-rich olivines characterized by their Fe/Mn ratios of 0.5 - 1.0.