COMPOSITION OF THE LOWER MANTLE AND ORIGIN OF THE MOON FROM INTERSTELLAR DUST O.L. Kuskov, Yu.I. Sidorov, A.I. Shapkin Vernadsky Institute, Academy of Sciences of Russia, 117975, Kosygin street 19, Moscow, Russia

It is quite possible that the differences in mean density and chemical composition between the Earth and the Moon are explainable by physicochemical mechanisms of Fe/Si and Fe/FeO fractionation. High temperatures in the inner solar nebula imply that sequential condensation of solids as the nebula cooled may well have occurred (Grossman, 1972). However, the Moon is depleted in the most volatile elements and iron, and is enriched in the refractory elements. None of the analyzed models of lunar formation satisfies these geochemical constraints. The composition of he Moon remains unusual in comparison with the inner planets (Taylor, 1987).

We decided to test a new hypothesis of lunar formation - formation of the Moon from a material that has the lowest known Fe/Si ratio of any object in the solar system during heating in H_2-He atmosphere (nonsolar gas) so that to satisfy the mean (uncompressed) density of the Moon. The initial composition of such a material was assumed to be the abundance of elements from Comet Halley data (Anders and Grevesse,1989).

A new numerical code has been developed for studying condensation-evaporation processes in the nebula (Shapkin and Sidorov, 1994 a,b). The trends of the density change in the solid residuum (fig. 1) and changes in the Fe/Si, Mg/Si and O/Si ratios (fig. 2) show the possibility of the formation of the terrestrial planet matter and lower mantle matter of the Moon from the initial composition.

The composition of the silicate phase recalculated to the CFMAS system is (wt.%): 49 - SiO_2, 9 - FeO, 29 - MgO, 6 - CaO, 7 - Al_2O_3; MG# 85 (molar).

This composition enriched in Ca and Al relative to the Earth's mantle was used for calculation of phase relation and physical properties (density, P- and S-velocities) at high pressures and temperatures using thermodynamic approach described by Kuskov and Fabrichnaya (1994) and Kuskov (1995). Along a chosen selenotherm (at depths of 700 and 1000 km temperatures of 1450 K and 1520 K were adopted), we have calculated the physical properties of such a composition in the CFMAS system and obtained the following: ρ =3.362 g/cm^3, V_p=8.03 and V_s=4.50 km/s at 700 km depth; ρ =3.381 g/cm^3, V_p=8.12 and V_s=4.53 km/s at 1000 km depth (fig. 3).

Within the limits of uncertainty of thermodynamic calculations and resolution of the seismic data, these values are in close agreement with Nakamura

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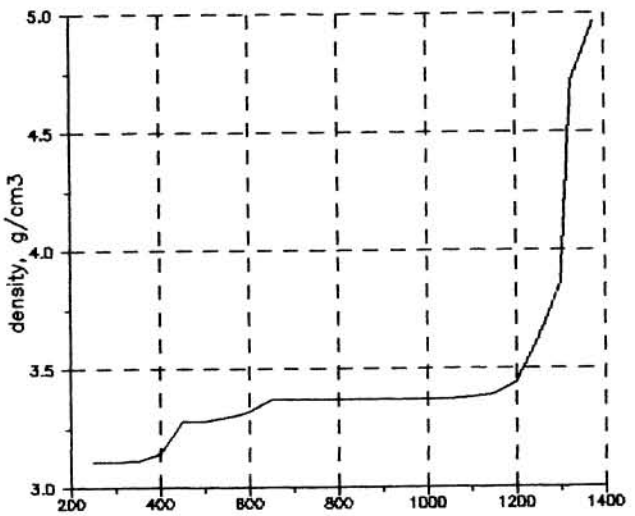

fig.1

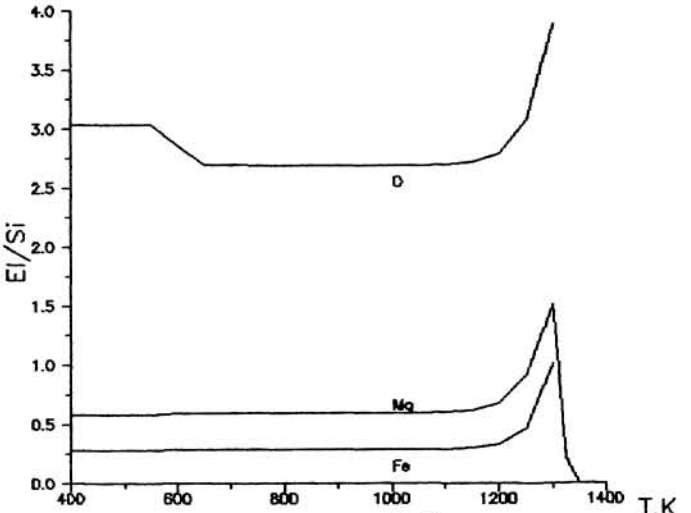

fig.2

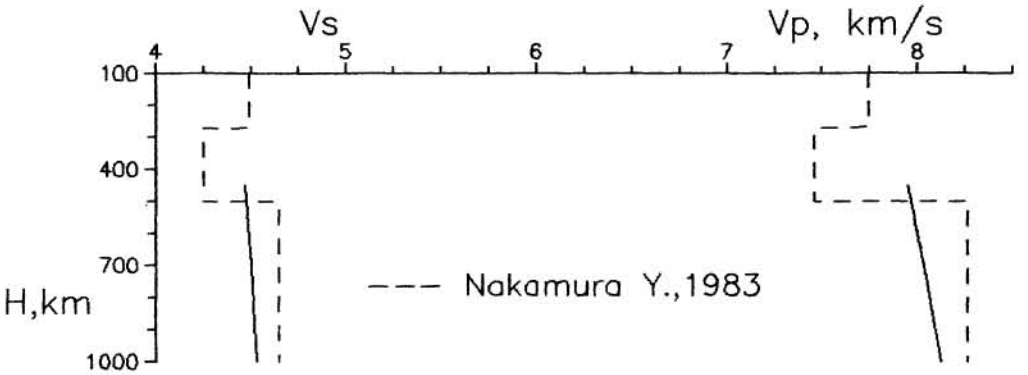

fig.3

(1983) seismic model (V_p=8.26 (0.4) km/s and V_s=4.65 (0.16) km/s at 500-1000 km depth).

If this scenario is correct, then the low mantle of the Moon may be composed of differentiated (heated) material of bulk lunar composition. This material might originate from interstellar dust.

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