PREPLANETARY-NEBULA'S SOLID MATTER FORMATION AND COMPOSITION OF CHONDRITES. M.N. Izakov, Space Research Institute, Profsojuznaja, 84/32, 117810, Moscow, GSP-7, USSR

Preplanetary nebula could be formed as an accretion disk during the formation of the Sun from the interstellar cloud (1). Using the version of model (1) with minimal angular momentum, 5.10^{51} $g.cm^2.s^{-1}$, we have substantiated the hypothesis, that the preplanetary-nebula's solid matter formed due to successive condensation of the components of the solar-composition gas (but with much lower hydrogen and helium abundances) during the gas' motion from a hot and dense region near the Protosun ($r<0.06AU$, $T>2000K$, $p>0.1$ bars) to the nebula's periphery with decreasing T and p (2). During the final stage of the nebula formation, for $t = 10^6$yr, at r=1AU, T was about 250K, $p \approx 10^{-4}$bars, and at r=4AU, $T \approx 80K$, $p \approx 3 \cdot 10^{-7}$bars. Comparing the p(T) curve for the portion of gas, moving from the center to periphery of the nebula, with condensation curves of some elements, $p_n(T_n)$, we have found that Os, W were condensed at T=2100-2000K and $P \cong 0.2$-0.1 bars; Al, Ca, Fe, Si, Mg at T = 1800-1450K and p = 0.1-0.05 bars; Zn, Bi at 700--500K and $p \approx 10^{-3}$ bars; and most volatile components at 200-100K and $p = 10^{-5}$-10^{-6} bars. This hypothesis settles the contradiction between the obvious records of high-temperature events in chondrites and the conclusion that at a distance from the Protosun of $r = 2 \div 4AU$ (from where meteorites are coming now to the Earth) temperatures have never been so high. The hypothesis explains the thermal history of chondritic matter: from the condensation temperatures of refractory metals and minerals, through the temperatures recorded by cosmothermometers, down to low temperatures corresponding to noble-gases adsorption. The fact that the pressures in the nebula were considerably greater than those in stationary models makes the explanation of chondrule formation easier. The long time of chondritic matter formation (10^4-10^5 yr) agrees with some indirect data. In our model iron was condensed before silicates, so that the matter of some iron meteorites can be a primordial nebular condensate. The temperature dependence of chondritic abundances of refractory and moderately volatile elements normalized to their solar abundances shows the decisive role of condensation. In the context of our hypothesis the following interpretation of this dependence is possible. During the initial stage of the nebula and its solid matter formation all components (except most volatile ones) were condensed; it was so even during the formation of the matter of carbonaceous chondrites Cl; but during the formation of the matter of C2, part of the nebular substance was already lost, probably under the influence of the enhanced solar wind of T-Tauri type; later, during the formation of the matter of ordinary chondrites and of terrestrial planetesimals, the loss of nebular substance became greater and greater. Some fraction of the interstellar cloud's substance fell directly on the nebular disk, was vaporized and then condensed entering the nebula. Composition of Ca-Al rich inclusions implies that they could be formed from this substance. Then this exogenous component could form from several to 20 percent of the nebular solid matter. Small part of interstellar grains could be preserved during the entrance, retaining their isotopic composition. Great isotopic homogeneity of the most of the Solar system matter confirms that it has passed the hot and turbulent stage near the Protosun. Nucleogeneous isotopic anomalies are contained only in about 1 percent of the chondritic matter. On the other hand, isotopic variations of oxygen could form due to fractionation under the influence of the Protosun's ultraviolet radiation, as follows from the experiments (3). Few data on the composition of the cometary nuclei matter show its difference from the solar and from the interstellar matter, which confirms the possibility of cometary matter formation on the periphery of the nebula.

References. (1) Cassen, P., Summers, A. (1983) Icarus 53, 26. (2) Izakov, M.N. (1985) Geochimija (in press). (3) Heindenreich, J.E., Thiemans, M.H. (1983) J. Chem. Phys.78, 892.