

The role of ^{26}Al in the thermal regime of KBO formation

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The role of short-living radionuclide ^{26}Al is studied in the process of Kuiper Belt objects (KBO) formation including the thermal regime and structural stability of the celestial bodies when they were created from the solar nebula material at the early stage of the solar system. The peculiarities of the nuclide radioactive decay and energy-release are taken into account. It has also been accounted that the KBO thermal evolution depends on the nuclide specific content in the body matter, the interaction patterns of radioactive products and the body matter and last but not least on the time interval between the nuclide formation during the nucleosynthesis and the beginning of the KBO formation (radionuclide “age”). Since the nuclide ^{26}Al lifetime is relatively small ($T_{1/2} \sim 0.72 \text{ MY}$), the impact of its decay energy on the KBO thermal evolution exists only at the early stage of the body formation. We have taken into consideration that the greater part of the nuclide ^{26}Al decay energy is taken by neutrino and, hence, it does not take part in the heating of the forming body material. The rest part of the energy is not enough to develop the process of the celestial body formation according to the global metamorphism scenario. Different scenarios of KBO formation of definite size and density are considered. Scenario modelling assumes the accretive material to contain amorphous water ice and a hard silica-alumina component in different ratios. The processes are studied by the example of a celestial body similar by its properties to KBO (20000) Varuna. It has been shown that if the accretion results in a body without water ice, the maximum temperature in its centre will not exceed

680 K. If voids are half-filled with ice, the temperature in the centre will reach a value of 520 K. If voids are completely filled with ice, the temperature in the body's centre will not exceed 280 K. For all that the body's crust depth, within which there are not any physical conditions for ice sublimation and melting, is equal, correspondingly, to 0.3, 0.4 and 0.99 of the formed body radius.