A Model for Generation of Isotope Anomalies in the Inner Solar System by Inhomogeneous Molecular Cloud Core

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Isotope Anomalies of ^{54}Cr in Various Meteorites: It was found that evaluated formation ages of various meteorite parent bodies and the degree of ^{54}Cr anomalies in those meteorites are in a good agreement [1], except for CAIs [2]. On the other hand, recent work shows that inside the molecular cloud cores that form stars and protoplanetary disks could be isotopically inhomogeneous [3]. This suggests that the isotope anomalies found in present day meteorites may be caused by the isotope heterogeneity in the original molecular cloud core.

Here, we examine a model that may reproduce the observed anomalies including the one by CAIs assuming the inhomogeneous molecular cloud cores.

Model: We assume that isotopically heterogeneous dust grains are inhomogeneously distributed in the initial molecular cloud core; especially, ^{54}Cr-rich grains are concentrated in the central part of the cloud core. We calculate the concentration of ^{54}Cr-rich grains as a function of the time and the place in the solar nebula. Principal model parameters include the initial angular velocity of the molecular cloud core ω, which determines the size of growing solar nebula, and the strength of the gas turbulence in the solar nebula α, which controls the radial flow of the gas and the diffusive motion of dust grains. The mass infall from the molecular cloud core to the solar nebula is supposed to last 0.4 Myr.

Results: The concentration of ^{54}Cr-rich grains as a function of time and the place in the solar nebula is obtained numerically. In the early phase (t < 0.4 Myr), the concentration decreases because of the addition of the ^{54}Cr-poor dust from the core. Later (t > 0.4 Myr), the concentration increases due to the diffusive motion in the nebula. In addition, the spatial distribution of concentration is generally an increasing function of the distance from the Sun all the time. These features are consistent with observations [1, 2].

References: [1] Sugiura and Fujiya (2014) *Meteorit. and Planet. Sci*. **49**, 772-787. [2] Trinquier *et al*. (2009) *Science* **324**, 374-376. [3] Kuffmeier, M. *et al.* (2016), *Astrophysical Journal* **826**, id. 22.