Origin of the core, and species of light elements in the core

*Shigenori Maruyama[1]

1. Earth-Life Science Institute, Tokyo Institute of Technology

Since Abe and Matsui (1986; 1988) theoretically suggested that ocean and atmosphere was formed simultaneously with the birth of solid Earth, such model has been well-accepted, and giving strong impression that planetary formation proceeded with the presence of volatiles including hydrogen. As a result, some researchers think volatiles are included in mantle or core. However, it is clear that hydrogen is not included in the core at all. The reason is simply explained by the formation process of meteorite parental body.

An asteroid, grown larger than 200-300km across, has metallic core, mantle, and basaltic crust. Temperature at CMB reaches ca. 700-800ºC, which strongly indicates the ductile separation of metallic core from the granulite-facies temperature, and partial melting of mantle peridotite generates basaltic magma to form basaltic crust. At that time, if volatiles are present, such volatiles must be released to the outer space and blown by solar winds due to small gravity. Therefore, volatiles including water cannot be kept in asteroid. On the other hand, light elements, such as S, Cl, Si, O, and trace halogen elements must be in the core as iron meteorite’s inclusions. The origin of light elements in the core depends on parental body of fractionated meteorites.

Generally, it is assumed that the core was formed with the cooling of the solid earth. Therefore, initial formation of liquid core is basically considered. However, the observational facts do not support the presence of initial liquid ore, because the core is heterogeneous, particularly between east and west. If the core was liquid, it should be homogeneous. This observational fact indicates that the core formed as heterogeneous. Presumably, the Earth’s core was originally formed as solid without liquid. Through collision of asteroids, different types of metallic core from each asteroid accreted to solid earth, then it formed the solid central core with time, which resulted in patchy solid core.

With time, primordial continents enriched in KREEP basalts (FeO=25wt%, with high abundance of U, Th and K) on the Earth’s surface was transported to the CMB. Following to the accumulation of primordial continent on CMB, it heated solid core. As a result, outer core was partially melt to form liquid core and generated strong geodynamo at 4.2Ga. In other words, solid inner core is unmelted portion. If the resolution will be improved in future, heterogeneous patchy core will be clearly observed, and it will be possible to explain their origins corresponding to each of small asteroids. Asteroids which have been compositionally separated when the size increased ca. 200-300km across, therefore, metallic cores are compositionally different with each other, asteroid by asteroid.

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