

Genesis of chemical zoning of asteroid belt and origin of Earth

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Chemical composition of planets in the Solar system is determined by the chemical zoning of protoplanetary disk. There is a region called asteroid belt which is from 2AU to 5AU. In this region there are several tens of thousands of meteorites with various size, and also small planetary bodies with a diameter reaching 1000km. Chemical composition of asteroid belt has been recently investigated in details by telescopes and probes, and it revealed there is systematic distribution in chemical composition of asteroid belt. For example, most inner region of asteroid belt has enstatite chondrite, which is mainly composed of silicate minerals without ice, organic compounds, hydrous silicate minerals, in other words, they are extremely reductive meteorites. On the other hand, outer asteroid belt is dominated by carbonaceous chondrite, and outer side contains more volatiles, which reaches to 20%. This observation indicates there is chemical zoning in asteroid belt and this distribution pattern is same in whole solar system, not only in asteroid belt region. It is thought to be the function of distance from the Sun (= temperature) and reflected to the distribution of minerals and amount of minerals. Grown planetary bodies reflect the chemical composition of growing site of protoplanetary disk. In asteroid belt, small planetary bodies and debris of bodies are remaining as big planet was not formed. Therefore, detailed investigation of asteroid belt will give us original distribution pattern of chemical composition of protoplanetary disk.

The Earth was formed from enstatite chondrites existing at 1AU, and bombarded by carbonaceous chondrites to have atmospheric and oceanic components. Primordial atmosphere might have added gradually, so that the surface temperature was low to have glacier probably. Accumulated atmospheric CO₂ reacted with primordial continent to fix carbonate minerals, which was carried into deep mantle due to plate tectonics. The thickness of primordial atmosphere is determined by the balance between input by bombardment and fixation of CO₂. However, it is generally thought to spend some time to have suitable thickness of atmosphere. But finally, visible sun light became to reach to the surface of the Earth.

Keywords: asteroid belt, chemical zoning, origin of Earth