

## What is the Noble gas composition and inventory in Venus interior?

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**Introduction:** Terrestrial planetary objects (Mercury, Venus, Earth, Mars and asteroid Vesta) are differentiated and have three layer structure: a metallic core, a silicate shell (mantle and crust), in general. Chondrites of various types are the basic building blocks of these terrestrial objects [1]. The geological history of Venus is the most unknown among the terrestrial planets, preventing a full understanding of the processes that led to its current state.

Venus is Earth's near twin in radius and mass, and our nearest planetary neighbour, yet conditions there are very different in many respects. Its atmosphere, mostly composed of carbon dioxide, has a surface temperature and pressure far higher than those of Earth. Only traces of water are found in the Venusian atmosphere, although it is likely that there was much more present in the past, possibly forming Earth-like oceans [2]. For Venus, only little is known, evidencing the critical need for dedicated missions.

Terrestrial planets in our solar system are differentiated but we don't have direct samples from the interior. If we have samples of Venus it gives opportunity to understand the geological and volatile evolution of the early solar system processes. Noble gases can be seen as a key to a planet's past because their abundances and isotope ratios represent the records of terrestrial planets evolutionary history. Their evolved isotope ratios contain records of outgassing from the planetary interior that the evolving parent body experienced. Here, in this present work we utilize the data set of basaltic rocks from differentiated objects to understand interior of Venus.

**Methodology:** In the present study, we utilize the noble gas abundances in Earth, Mars and Vesta (Eucrites and diogenites). Noble gas abundances in bulk samples of eucrites and diogenites are used and concentrations of trapped noble gases were estimated [4]. We also estimated the average concentrations of noble gases in interior of Vesta.

**Discussion:** The average abundances of trapped gases  $^{36}\text{Ar}$ ,  $^{84}\text{Kr}$  and  $^{132}\text{Xe}$  in eucrites and diogenites are compared with different reservoir of the solar system. The concentrations of  $^{36}\text{Ar}$ ,  $^{84}\text{Kr}$  and  $^{132}\text{Xe}$  in the eucrites and diogenites are different from the carbonaceous, ordinary and enstatite chondrites.

The concentrations of trapped noble gases in eucrites and diogenites are dissimilar to that in Chassigny (mantle of Mars) [6] and Mid Ocean Ridge Basalt (mantle of Earth) [5]. These results suggest that the concentration in MORB, Chassigny and eucrites and diogenites are depleted as compared to starting material of carbonaceous chondrites. A major link in understanding the elemental and isotopic concentration of noble gases in interior of Venus with atmosphere is still poorly known. The isotopic ratios of neon and argon in Venus atmosphere are unique. Neon isotopes in Venusian atmosphere are similar to the solar wind, however the  $^{40}\text{Ar}/^{36}\text{Ar}$  is of primordial nature [7]. From the abundances of trapped noble gases, the interior of three differentiated objects, Earth, Mars and Vesta is highly degassed when compared to the primitive chondrites. Using the noble gases, there are two possible scenarios proposed for the Venusian interior. Case I: Venusian interior is highly degassed: This complies with the differentiated objects, Earth, Mars and Vesta. However, the  $^{40}\text{Ar}/^{36}\text{Ar}$  ratios in Venusian atmosphere is contrast to this, compared with Earth and Mars. Asteroid Vesta has no atmosphere. Case II: Venusian interior is less degassed. This is in contrast with the mantle of Earth and Mars. However, the range of trapped noble gases in Venusian interior could be of similar ranges as that of Earth, Mars and Vesta. Elemental ratios,  $^{36}\text{Ar}/^{84}\text{Kr}/^{132}\text{Xe}$  in mantle of Earth, Mars and Vesta are distinct with each other. They also differ from the primitive chondrites.

**Conclusions:** The differences between the Earth, Mars and Vesta in the abundance pattern, three of them are depleted in heavy isotopes with respect to carbonaceous chondrites. The measurement of the heavy isotopes in Venus will allow to understand the volatile evolution of the respective parent body. Future exploration of Venus will help us to improve understanding of Venusian volatile evolution.

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