Water Storage in Martian Interior

Yuki Shibazaki[1]; Eiji Ohtani[2]

[1] Inst.Mineral. Petrol.& Econ. Geol., Faculty of Sci.,Tohoku Univ; [2] Depart. Earth and Planetary Materials Science, Tohoku Univ

Recent observation in Martian Rovers clarified existence of an ancient ocean in Mars. The geological studies of the Martian surface deposits indicated that the ocean existed at least until about 3.5 Ga ago. The fate of Martian ocean has been discussed previously, and some mechanisms such as escape from Mars due to a weak gravity field of Mars and a possible existence as subsurface water bearing layer in Martian crust.

Magnetic anomalies have been also observed on Martian crust by Mars Global Surveyor (Connerney et al., 2005). These observations strongly suggested that the ancient Mars had a magnetic field and the plate tectonics was operated in the early Martian history. It has been suggested that some amount of water has been returned into the mantle in Earth (e.g., Peacock, 1990), and the amount of water regassing into the Earth's interior was estimated to be about six times greater than that degassed by the arc volcanism. Thus, the ancient plate tectonics could have transported water into the Martian interior.

We have estimated the water transport into the Martian interior by the hypothetical Martian subduction. Assuming that the subduction process, such as subduction rates and water content of the slabs in the ancient Mars is similar to that of the present Earth, we estimated that the total amount of water transported into Martian interior was 1.3×10^{20} kg in 0.5 Ga assuming that the subduction processes similar to the present Earth were operated in ancient Mars. This is comparable with the amount of water in Martian ocean during Late Hesperian/Early Amazonian of 10^{19}~10^{20} kg estimated based on the surface morphology of Mars.

We propose two possibilities of the water reservoirs in Martian interior, i.e., wadsleyite or ringwoodite rich Martian mantle and hydrogen bearing Martian iron core. Since wadsleyite and ringwoodite can contain significant amount of water up to 3 wt.% (e.g., Inoue et al., 1996), water can be stored in Martian mantle. Our experimental works on reactions between metallic iron and hydrous ringwoodite indicated that water (or hydrogen) strongly preferred to metallic iron, and iron hydrite FeHx and anhydrous ringwoodite is formed as the reaction products (Shibazaki et al., the abstract in this meeting). Therefore, if hydrous mantle is contacted with Maritian core, the core can absorb hydrogen from the ringwoodite mantle, and generating hydrogen bearing Martian core. Therefore, there is a possibility that water in the Martian ancient ocean might exist in Martian mantle or core.