Noble Gas Records in Martian Meteorites

KOIKE, M.[1]*, H. SUMINO[2], Y. SANO[1], AND M. OZIMA[3]

[1] Atmosphere and Ocean Research Institute, The University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa, Chiba 277-8564, Japan (*correspopndende: mizuho_k@aori.u-tokyo.ac.jp)

[2] Dpartment of Basic Science, The University of Tokyo, 3-8-1 Komaba, Meguro, Tokyo 153-8902, Japan

[3] Department of Earth and Planetary Science, The University of Tokyo, 7-3-1 Hongo, Bunkyo, Tokyo 113-0033, Japan

Mars is thought to have experienced drastic changes in its surface environments for the last 4 billion years. Abundances and isotopic compositions of the atmospheric components represent the past evolutional processes including volcanic outgas and atmospheric escape. Some Martian meteorites are known to contain Martian atmosphere, possibly trapped during their recent ejection from Mars [1]. Because most Martian meteorites are igneous rocks, they are also expected to record the primordial volatiles in Martian mantle, as well as the early atmosphere. The atmospheric records in the meteorites could complement the observation and exploration data and enormously improve our understanding concerning the evolution history of Mars.

Noble gases are helpful recorders, because they are chemically inert and simply record physical processes such as mass fractionation, radiogenic decay and mixing. However, meteoritic noble gases are complicated mixtures of several sources, which make it difficult to obtain the adequate interpretations. The possible sources, besides Martian atmosphere, are: Martian mantle gases, adsorbed terrestrial air, elementary fractionated terrestrial air, and radiogenic & cosmogenic products (e.g. [2]–[5]). Each component should be trapped in the certain site by its certain trapping mechanism.

In order to retrieve the exact atmospheric records of Mars from the meteorites, one needs to know their trapping mechanisms and sites. In this study, we try to determine noble gas compositions of Martian atmospheric and mantle components. We will present our latest results of combined stepped heating, vacuum crushing, and mineral separates analyses of the several Martian meteorites, and discuss the nature of the noble gas components derived from Mars.

Refs: [1] Becker and Pepin (1984) EPSL, 69, 225-242. [2] Ott (1988) GCA 52, 1937-1948. [3] Bogard and Johnson (1983) Science 221, 651-654. [4] Wiens (1988) EPSL 91, 55-65. [5] Mohapatra et al. (2009) GCA 73, 1505–1522.