Noble Gases in Planetary Atmospheres

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The relative abundances of the noble gases and their isotopic ratios in the atmospheres of Mars, Earth and Venus provide clues to the origin and evolution of these atmospheres. The noble similarities between Mars and Earth stand in sharp contrast to the differences in the present masses and compositions of these two atmospheres. How closely linked are the noble gases to C, N, and H2O? What carrier(s) brought these volatiles to the planets? We can examine the possible roles of impacts by comets/icy planetesimals and meteorites/asteroids. Venus does not share the similarities in noble gases found on Earth and Mars but the abundances of C and N in her atmosphere are close to those in the Earth's reservoir. Jupiter reveals the existence of icy planetesimals in the early solar system that have not been identified in recent times.

K-Ar age determination on Honolulu Unit, Oahu, Hawaii

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There are four stages of activity in Hawaiian volcanoes, i.e., pre-shield, shield, post-shield and rejuvenated stages. Alkalic basalt and tholeiite are effused during pre-shield stage, tholeiite during shield stage, and alkalic basalt during both post-shield and rejuvenated stages. Among these stages, the rejuvenated stage is characterised by a volcanic hiatus of several million years prior to the stage and the eruption from isolated vents which are unrelated to rift zones. It is not yet known why the hiatus exists prior to rejuvenated stage, and even the duration of hiatus is not well constrained. Rejuvenated stage volcanics comprise less than 1% of total volume of each Hawaiian shield volcano, but ages of those volcanics are important to better understand the relation between plume and hotspot volcanism.

Honolulu Unit, which consists of 37 vents or groups of vents on Koolau shield volcano, is most extensively and carefully studied rejuvenated stage unit. However, neither precision nor number of age data are enough for constructing history of Honolulu Unit or determination of duration of the hiatus. Because subaerial part of Koolau shield is dated as 2.6-1.8 Ma, Honolulu Unit is considered to be younger than 1.8 Ma. However, many of Honolulu Unit lavas contain excess argon, and there are only a few ages that can be trusted.

We sampled about 30 lavas and other rocks from Honolulu Unit and the top of Koolau shield for K-Ar analyses. We used only groundmass for dating because phenocrysts and xenoliths often contain sufficient amount of excess argon. We also collected and analyzed historical lavas from Mauna Loa and Kilauea in order to better document the systematics of excess argon in phenocrysts and groundmass.

References

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