I-Xe ages of chondrites and its relevance for solar-wind derived noble gas concentrations

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The lifetime of protoplanetary disk gas ranges 1-10 million years, which depends on viscous dissipation and photo-evaporation of the disk gas. It is not clear how long the Sun’ s protoplanetary disk held its gas component, during which gas giants formed. Ca-, Al-rich inclusions and chondrules are considered to have formed in the presence of disk gas, but the timing of clearing of disk gas has not yet been tightly constrained [1]. Bajo [2] found a correlation between Solar-wind derived noble gas concentrations and I-Xe ages of brecciated chondrites. Bajo [2] hypothesized that the I-Xe ages, which could represent impact ages [3], of solar-wind-rich meteorites indicated the timing of disk-gas clearing because the solar wind reaches to the surface of small bodies only after the complete dissipation of disk gas. In this study, to test this hypothesis, I-Xe ages and solar-wind noble gas concentrations of Zag (H36), Northwest Africa 801 (CR2) (NWA 801), Ochansk (H4), Nuevo Mercurio (H5) meteorites were determined.

About 30 mg fragments of these meteorites, irradiated with neutrons at the Kyoto University research reactor, were heated in vacuum stepwisely in the temperatures range of 400-1800˚C to extract xenon. After purifying the noble gases extracted at each heating step, xenon isotope ratios were measured using a magnetic-sector-type mass spectrometer VG3600. The obtained $^{129}Xe/^{128}Xe$ ratios of the samples after corrections for low temperature alteration and trapped component were converted to relative I-Xe ages by comparing with $^{129}Xe/^{128}Xe$ ratio of the Shallowater meteorite with the absolute age of 4.5633±0.0004 billion years [4]. About 5 mg fragments of these meteorites were heated in vacuum at 800 and 1700℃ for noble gas analysis. We found that the solar-wind-poor portion of Zag was systematically older (4.551±0.008 and 4.558±0.013 billion years) than the solar-wind-rich portion (4.541±0.010 and 4.551±0.006 billion years) as shown in [2]. NWA 801 is also a solar wind rich meteorite Its I-Xe age is obtained as 4.529±0.016 billion years. The present dataset is broadly consistent with the hypothesis [2], but further data with lesser analytical uncertainties is surely required.

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