**Experimental methods:** Noble gases. Six samples with masses between 24 and 36 mg were preheated at 150 °C for 24 h and then degassed stepwise at temperatures of 500, 800, 1000, 1300 and 1800 °C for 30 minutes. He, Ne, Kr, and Xe were measured with a mass spectrometer, VG-5400, originally modified at the University of Tokyo and now transferred to Korea Polar Research Institute (KOPRI) [4]. Sensitivities and mass discrimination correction factors were determined by measuring aliquots of atmospheric Ne, Ar, Kr, and Xe and separately standardized mixtures of 3He and 4He.

**Results and discussion:**

\(^3\)He/\(^4\)He ratios. We examined the \(^3\)He/\(^4\)He ratios for evidence of the presence of He acquired at an early stage of Solar System history, before the completion of deuterium burning in the Sun. Such He is expected to have a \(^3\)He/\(^4\)He < 3.62 \(\times 10^{-4}\), the value deduced for the Outer Convective Zone (OCZ) of the Sun from the Genesis measurements [5]. However, the data indicate that \(^3\)He is mostly cosmogenic.

**Ne isotopes.** A neon 3-isotope plot [Fig. 1] shows mostly cosmogenic components with terrestrial contamination restricted to the low-T releases from Quinzen and Ilafegh 009.

\(^{40}\)Ar/\(^{39}\)Ar ages. \(^{40}\)Ar/\(^{39}\)Ar measurements are in progress. Our interest for the \(^{40}\)Ar/\(^{39}\)Ar study is that it would provide valuable information for understanding the chronological history and heating events. The reported \(^{40}\)Ar/\(^{39}\)Ar ages [Fig. 2] for Abee, Khairpur, Quinzen, Ilafegh, Happy Canyon, etc. are generally
4.2-4.5 Ga, but with a few young ages ~2 Ga. Bogard et al [6] reported that most enstatite chondrites show evidence for substantial recoil redistribution of $^{39}$Ar, but nevertheless determined ages in the range between 4.50–4.54 Ga. Hopp et al. [7] also reported $^{40}$Ar/$^{39}$Ar ages of 4.49 ± 0.01 Ga for 6 samples of EL5 and EL6, 4.45 ± 0.01 Ga for EL3 and 4.53 ± 0.01 Ga for EH impact melt LAP 02225. Two samples of Sahara 97096 (EH3) and EET 96135 (EH4/5) show obvious $^{40}$Ar loss with a young age of ~2 Ga, possibly due to a late thermal event. Noble gas data for the Norton County enstatite achondrite, aubrite [8] indicate from the CRE age of ~115 Ma the possible pre-irradiation of the aubrite parent body.

Xe isotopes (Fig. 3) The data cluster near the composition expected for the Q-component [9] and show mixing of Q and atmospheric gases with only minor contributions of solar Xe. Some excess $^{136}$Xe is due to the addition of Xe-HL, carried by presolar diamonds [10] or of $^{244}$Pu-fission Xe to a mixture of Q and atmospheric gases.

Heavy trapped noble gases. Elemental ratios of trapped $^{36}$Ar, $^{84}$Kr, and $^{132}$Xe in subsolar-gas-carrying enstatite chondrites [11] are shown in Fig. 4. Enstatite chondrites seem to be divided into two groups, subsolar-gas-carrying and subsolar-gas-free based on Ar, Kr and Xe studies [11]. Okazaki et al [12] found very high concentrations of $^{36}$Ar in chondrules of enstatite chondrite Y-791790, and suggested that certain chondrules were carriers for this component, which may have been derived from solar gas implanted into chondrule precursors during the T-Tauri phase of the Sun [11]. The noble gas implantation would have occurred in fine grains of the precursor materials of the chondrules rather than in the chondrules themselves. Further investigations of chondrules containing gases of solar-origin will help to determine whether they trapped noble gases during the T-Tauri stage of the sun. Extreme enrichments, if any, might suggest implantation close to the early sun as well as an enhanced flux of solar gases.

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Fig. 2. Summary of $^{40}$Ar/$^{39}$Ar ages of enstatites and aubrites in the literatures.

Fig. 3. $^{136}$Xe/$^{132}$Xe vs. $^{130}$Xe/$^{132}$Xe for Aubrites and Enstatites.

Fig. 4. $^{84}$Kr/$^{132}$Xe vs. $^{36}$Ar/$^{132}$Xe for Aubrites and Enstatites.