PRIMORDIAL NOBLE GAS-RICH COMPONENT IN THE CM CHONDRITES: IMPLICATIONS FOR THE SITE OF PHASE Q; T. Nakamura¹, K. Nagao², and N. Takaoka¹ (1) Department of Earth and Planetary Sciences, Faculty of Science, Kyushu University, Hakozaki, Fukuoka 812-81, Japan, (2) Institute for the Earth's Interior, Okayama University, Misasa, Tottori 682-01, Japan.

Laser-spot analysis of noble gases [1] in chondrules, rims around chondrules and PCP-rich portions in the Yamato-791198 and Murchison CM chondrites was performed in order to seek the most primordial noble gas-rich component in the CM chondrites. Large amounts of primordial noble gases were extracted from the rims around chondrules, i.e., $^{132}$Xe concentration of the rims is enriched up to two orders of magnitude compared to that of chondrules. Gas-balance calculation provides the conclusion that most of the primordial noble gases in the CM chondrites reside in the rim material. Rims on different chondrules and in different meteorites show relatively uniform concentration of primordial noble gases, suggesting that the carrier phase of primordial noble gases, "phase Q" [2], may be evenly distributed in the rims of chondrules of CM chondrites.

It is known that CM chondrites are rich in primordial noble gases and these gases are mainly sited in "phase Q", that is probably a set of adsorption sites of a HF/HCl-resistant carbonaceous residue [e.g., 3, 4]. But, a conventional technique for identifying noble-gas career phase dissolves almost entire meteorites [e.g., 2-4], thus it remains uncertain where phase Q is located in bulk meteorites and how phase Q is incorporated into meteorites. So as to verify the presence of phase Q in situ within bulk meteorites, we applied Nd-YAG laser to extract noble gases from very small portions (~2µg) in meteorites. Thin slices of ~300µm thick with both sides polished are prepared from meteorite chips of Y-791198 and Murchison. The laser could make a through hole with diameter from 50 to 100 µm by a single pulse with energy of approximately 30 mJ.

CM chondrites were usually affected by secondary processes on the meteorite-parent bodies, thus most CM chondrites lose their primary records regarding accretion sequence of their constituent components. But some CM chondrites retain their primitive nature, free of impact-induced brecciation and minimized aqueous alteration [5]. The two CM chondrites, Y-791198 and Murchison are selected for this study, since they exhibit almost brecciation-free texture; entire portions of their slices are composed of chondrules and PCP objects coated by fine-grained rim material and are absent of "matrix" material as reported by [5-7]. Thus, three components, chondrules, rim of chondrules and PCP-rich portions (PCP plus rims of PCP), are the main constituents of Y-791198 and Murchison.

We analyzed He-Xe in 7 chondrules (5 from Murchison and 2 from Y-791198), 14 rims of chondrules (9 and 5, respectively) and 8 PCP-rich portions (4 and 4, respectively). Primordial noble gases are apparently rich in rims of chondrules. $^{132}$Xe, $^{84}$Kr and $^{36}$Ar in rims are enriched up to two orders of magnitude compared to those in chondrules. Mean concentrations of $^{36}$Ar, $^{84}$Kr and $^{132}$Xe in the rims are $1.8 \times 10^{-6}$ cc STP/g, $1.7 \times 10^{-8}$ cc STP/g and $2.1 \times 10^{-8}$ cc STP/g, respectively. Concentrations of primordial noble gases in PCP-rich portions are

variable, but are not greater than those in rims of chondrules. This may be explained by that rims of PCP are rich in noble gases, probably comparable to rims of chondrules, but PCP themselves are not rich in noble gases. Compared with bulk concentration of Murchison [8], $^{36}$Ar, $^{84}$Kr and $^{132}$Xe in rim material are enriched by a factor of three. The rim material consists approximately 1/3 of bulk CM chondrites in weight, thus it is convincing that nearly all heavy primordial noble gases in bulk meteorites are contained in the rim material.

Since almost all $^{132}$Xe, $^{84}$Kr and $^{36}$Ar in the CM chondrites are resided in phase Q [2], remarkable high concentrations of these gases in rim material indicate that the phase Q concentrates in the rim material. Furthermore, these gases from small laser pits within 14 different rims show a rather uniform concentration within a factor of two, suggesting that the phase Q may be homogeneously distributed in the rim material at least within micro-gram level. Rims of chondrules and PCP objects are aggregates of mainly small Fe-Mg serpentine grains ranging in diameter from 1 to 1000 nm [9, 10] and are thought to have formed in the nebula by accretion onto chondrules and PCP [5]. Carbonaceous matters in carbonaceous chondrites are approximately in the same size range as the serpentine grains in the rims [11, 12]. Thus, it seems likely that phase Q-bearing carbonaceous matter and the serpentine grains might have simultaneously accreted on the chondrules and PCP. Enrichment of carbon in the rims in CM chondrites (>5 wt% in C) is consistent with our interpretation [13].

$^{20}$Ne and $^4$He are also enriched in the rims. Cosmogenic contribution to He and Ne in Murchison is very small [cf., 14]. Solar implantation is negligible in the Murchison sample used in this study, because the Murchison sample show brecciation-free texture and has never been exposed to solar wind after consolidation. Average $^3$He/$^4$He isotopic ratio in the rims in Murchison is $2 \times 10^{-4}$, indicating radiogenic $^4$He is minor fraction. From these reasons, we regard $^4$He and $^{20}$Ne in the rims in Murchison as predominantly primordial. $^4$He/$^{132}$Xe and $^{20}$Ne/$^{132}$Xe ratios in the rims in Murchison are 15 and 7 times larger than those of Q-gases in Murchison [2]. This implies that phase Q actually trapped much more primordial He and Ne than Wieler et al. observed [2], but it lost these gases during acid-etching treatment. Alternatively, these gases are trapped in portions other than phase Q in the rims in Murchison.