Application of *in situ* X-ray observations to melting and melt properties at high pressure

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In situ X-ray observation is useful for studying melting and the melt properties at high pressure. Here, I will present our recent developments for the *in situ* X-ray absorption, imaging, and diffraction methods. We use both large volume press and the diamond anvil cell to conduct the above *in situ* X-ray observations. The density and viscosity of silicate and metallic melts are measured by the X-ray absorption and imaging using a large volume press at SPring-8 and Photon Factory. The X-ray absorption method is based on the Lambert-Beer's law. We developed the cell assembly using diamond or corundum capsules for measuring the density of the silicate melt or metallic melt. The X-ray intensity was measured by the two ion chambers placed in front and rear of the press. We measured the density of the dry and wet peridotite and basaltic magmas up to 4 GPa by this method.

X-ray imaging is also applied for the measuring the melt density and viscosity. A composite density marker, composed of metal and corundum, was developed for the density standards for metallic melts. The movement of the density marker can be monitored by the CCD camera with a YAG fluorescence screen. Viscosity of basaltic and peridotite magmas and the Fe-Si melts are measured by this method.

X-ray diffraction is used to detect melting at high pressure. We determined the solidus temperatures of Fe (Ni)-S and Fe (Ni)-Si alloys to the core pressures by the diamond anvil cell, whereas we applied a multianvil press (SPEED-Mk II) to determine the melting temperature of Fe (Ni)-H and FeS-H systems. I will show the procedure and some results on determination of the melting temperature using the X-ray diffraction method at high pressure.

In situ analyses of Sr isotopes and REE of phosphate minerals in the Ediacaran phosphorite of Weng'an region, South China

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The Ediacaran is one of the most important ages through the history of the life because of the multicellular animal appeared for the first time. Especially, the Ediacaran sections in Weng'an region, are relatively continuous, and contain various fossils like the oldest animal embryo fossil and multicellular algae fossil [1]. The Sr in the ocean is derived from the hydrothermal and continental sources, and the former has a low Sr isotope ratio and the latter has the high ratio [2]. So the elucidation of Sr isotope variation of seawater through the time allows us to estimate variation in the continental influx. Sawaki and colleagues showed the change in Sr isotope ratios from the Ediacaran to early Cambrian [3]. However, the whole rock composition of carbonate rocks is susceptible to secondary alteration and involvement of detrital materials. This study presents the *in situ* Sr isotope analyses of phosphate and carbonate minerals in the phosphorite with nano-SIMS to evaluate the Sr isotope signatures in the Ediacaran, and *in situ* REE analyses of those with LA-ICP-MS to estimate the redox condition during the precipitation of the phosphate minerals

The Sr isotope ratios of phosphate minerals are consistent with those of the whole rock within the errors. The REE patterns of the phosphate minerals in the Upper Phosphorite Member, where the animal and multicellular algal fossils occur, have different REE patterns from those in the Lower Phosphorite Member. The former has a faint negative Ce anomaly whereas the anomaly lacks in the latter. The appearance of its in the upper indicates that the phosphate deposition occurred under the oxic condition. In addition, the change from lack of Ce anomaly in the lower to its appearance in the upper, concomitant with the first occurrence of multicellular algae and metazoans, implies oxygenation of seawater due to more active photosynthetic activity by algae, and foundation of a new niche for the multicellular animals.

[1] Xiao *et al*. (1998) *Nature* **391**, 553. [2] Richter *et al*. (1992) *EPSL* **109**, 11. [3] Sawaki *et al*. (2008) *Gondwana Res,* **14**, 134. [4] Sawaki *et al*. (2010) *Precambrian Res,* **176**, 46.