Melting experiments on Fe-O-S alloys to core pressures

*Shunpei Yokoo[1], Kei Hirose[1,2], Ryosuke Sinmyo[1]

1. The University of Tokyo, 2. Earth-Life Science Institute, Tokyo Institute of Technology

High-pressure melting phase relations in Fe containing one or more light elements are important to constrain light elements in the core. A number of experiments have been performed on binary systems. For example, it has been reported that the eutectic liquid in Fe –Fe_3S system at the ICB pressure includes less sulfur than is required to account for the density deficit of the outer core and therefore sulfur cannot be a predominant light element in the outer core (Mori et al., 2017 EPSL). On the other hand, the liquidus phase relations in ternary systems could be very different from those of binary systems as found in Fe–Si–O (Hirose et al., 2017 Nature). More recently Tateno et al. (2018 AmMin) compared melting phase relations in Fe–Si–S with those of Fe–Si (Ozawa et al., 2016 EPSL) and Fe–S (Mori et al., 2017). In this study, we focused on oxygen and sulfur both of which are considered to be important light elements in the outer core, and examined the eutectic point in the Fe–O–S ternary system at high pressures.

A couple of homogeneous Fe–O–S samples with different O/S ratios were prepared by a sputtering method and used as starting materials. The samples were compressed to high pressure in a diamond-anvil cell and subsequently melted by heating with a laser. The cross sections of recovered samples were prepared by an FIB. Their textural and compositional characterizations were made with EDS and EPMA. The positions of cotectic lines and eutectic point were examined at each pressure from the compositions of liquid and coexisting solid. These results obtained in the Fe–O–S ternary are indeed consistent with the eutectic points previously found in the Fe–O and Fe–Fe_3S binary systems.

At the presentation, we will discuss the possible range of liquid outer core composition in the Fe–O–S ternary system.

Keywords: core, light element, oxygen, sulfur, high pressure, melting

