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Melting relation of Fe-O-S alloy at the outer core condition

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The Earth's core consists of the liquid outer core and the solid inner core, which suggests that the temperature at a boundary of the inner/outer core (ICB) corresponds to the melting temperature of the core material. Thus, the melting temperature of the Fe-alloy under high pressure is important in order to clarify the thermal structure of the Earth's core. However, solidus and liquidus temperatures of Fe-alloys have never yet been measured simultaneously in the megabar pressure range.

In this study, the solidus and liquidus temperatures of the Fe₇₅O₅S₂₀ alloy are determined up to 157 GPa using a laser-heated diamond anvil cell combined with in situ X-ray diffraction technique.

The liquidus temperature is 260-670 K lower than the melting temperature of pure Fe because of the alloying effect of S and O on the melting temperature of Fe. Based on our results, we estimated the temperatures at the core/mantle boundary and at the boundary of the inner/outer core.

Keywords: Liquidus, Solidus, Earth's core, high pressure