SIT03-P01 Room:Convention Hall Time:May 21 18:15-19:30

Comparison between the temporal spectrums of geomagnetic paleointensity and paleomagnetic direction: A case study

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Continuous estimates of relative geomagnetic field intensity from sediments have been the essential data for determining the geomagnetic temporal spectrum. The geomagnetic spectrum is believed to reflect the dynamics in the outer core, and it may change through geological time in accordance with the deep earth evolution. However, it would be difficult to obtain high quality continuous paleointensity data for geological past. Paleomagnetic direction can be obtained with higher accuracy. Directional data were used for spectral analysis in early days (e.g., Barton and Lowes, 1982). Apparently, the spectrums obtained from the directional data are similar to that from relative paleointensity. To check the practical resolution of directional spectrum, we examine the relationship between paleointensity and directional (inclination) spectrums using existing data from marine sediments. Records from low sedimentation rate sites revealed remarkable similarity between the directional and intensity spectrums at frequencies from 10^{-3} to 10^{-1} [1/kyr]. Both spectrums resolve a corner frequency at ca. 200 [1/kyr] observed in the SINT-2000 global paleointensity stack. Records from some high sedimentation rate sites (e.g., ODP Leg 162) also revealed the similarity at frequencies below 10^{-1} [1/kyr]; however, at higher frequencies, the power of directional variation becomes increasingly lower compared to the paleointensity variation. This disagreement may reflect different behavior between dipole and non-dipole components at high frequencies, lower accuracy of inclination data due to the lack of stacking, or site-specific systematic inclination error. In any case, our results indicate that paleomagnetic directional data may be used to reconstruct ancient geomagnetic spectrum at least below 10^{-1} [1/kyr], given high resolution stratigraphy and rapid demagnetization techniques are available. In the presentation, we will also introduce the preliminary development of continuous thermal demagnetizer for this purpose.

Keywords: paleomagnetism, spectral analysis, core, paleointensity

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SIT03-P02 Room:Convention Hall Time:May 21 18:15-19:30

Sound velocity and density measurement of alloy liquid under pressure

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Sound velocity and density of liquid alloys under high pressure are important physical properties for understanding the light element(s) in the terrestrial molten outer core by comparing with the seismological data. We have developed the system for sound velocity (V_P) and density (*rho*) measurements combined with X-ray computed micro-tomography (CT) at high pressure and high temperature. V_P of Fe-S liquid has been recently reported up to 5.4 GPa (Nishida et al., 2013). The terrestrial core is likely to contain 5-10 wt% of Ni. In order to clarify the Ni alloying effect on the V_P and *rho*, we have measured the V_P and *rho* of Ni-S liquid at high pressure and temperature. V_P was measured using ultrasonic pulse-echo overlap method and *rho* was measured using X-ray absorption method.

High pressure experiment was performed using 80-ton uni-axial press (Urakawa et al. 2010) installed at X-ray CT beamline (BL20B2), SPring-8. High pressure was generated using opposed cupped anvils. The Ni-S with an eutectic composition was enclosed in hBN capsule and single crystal sapphire rods were placed at top and bottom of the sample for ultrasonic measurement. P-wave signals with frequencies of 37 MHz were generated by $LiNbO_3$ transducer. The echo signals from the sample were detected using high-resolution digital oscilloscope. CT measurement was carried out by rotating the press from 0 to 180 degree with 0.2-0.3 degree steps. Monochromatized X-ray of 51 keV was used. X-ray absorption profile was obtained from the X-ray radiograph and the sample thickness in X-ray direction was directly measured from the CT slice image.

Sound velocity and density measurements at room temperature was performed up to 1.4 GPa and those at high temperature was carried out up to 0.4 GPa and 1673 K. P-wave signal was clearly observed at the present conditions. V_P of Ni-S suddenly dropped after melting of the sample. The V_P of liquid Ni-S decreases slightly with increasing temperature in the range of 1273-1673 K. Density of Ni-S decreased slightly after melting. The present measurement can provide the relationship between V_P and *rho* for alloys under pressure.

Keywords: Sound velocity, Density, Liquid, Core

SIT03-P03 Room:Convention Hall Time:May 21 18:15-19:30

Phase relationships of the Fe-Ni-S system at 15GPa

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The melting relations of the iron and light elements system are fundamental information to understand the formation and evolution of the planetary liquid core. Here we report the results of high-pressure experiments on the phase relationships of the Fe-Ni-S system. We have studied the entire filed of the Fe-Ni-S system at 15 GPa based on the textural observation and chemical analysis of the quenched samples. The melting relation of the Fe-Ni-S system is a pseudo-binary eutectic system between the Fe-Ni alloy and (Fe, Ni)S monosulfide. The eutectic trough divides the liquidus surface into the metallic field and the sulfide field. Eutectic temperature shows a minimum point at Ni/Ni+Fe=0.75, and sulfur content of the eutectic point is about 30 at%. We revealed the stability fields of $(Fe,Ni)_3S_2$ and $(Fe,Ni)_3S$ phases, intermediate phases which affect the melting relations of the Fe-Ni-S system. $(Fe,Ni)_3S_2$ makes a complete solid solution between Fe_3S_2 and Ni_3S_2, which melts incongruently into (Fe, Ni)S and liquid. On the other hand, $(Fe,Ni)_3S$ is stable at Ni-rich side and melts incongruently into Fe-Ni alloy and liquid. We also study the subsolidus stability of $(Fe,Ni)_3S_2$ by synchrotron-based in situ X-ray observation, and those results will be discussed.

Keywords: core, melting, high pressure, iron sulfide