Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

SEM37-01 Room:413 Time:April 30 09:00-09:15

Testing paleointensity determination using Wilson method

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The classical Thellier method still remains most reliable for paleointensity determination, but requires a quite demanding and rarely satisfied condition; a natural remanent magnetization (NRM) must be completely replaced by a laboratory thermoremanence (TRM) at every temperature interval. If a significant amount of multidomain grains is present, this condition is not satisfied and resulting in erroneous paleointensities as obtained from curvatures seen on the Arai diagrams.

A single-step heating method, which sounds quite primitive as adopted in early times (e.g., Folgheraiter [1899]) but is essentially still alive as in the Shaw method, escapes from the strict condition posed on the Thellier method. The Wilson method, being a sort of single-step heating methods, was developed a half century ago (Wilson, 1961 & 1962); comparison of high-temperature continuous thermal demagnetization curves, measured for a natural remanent magnetization (NRM) and then a thermal remanent magnetization (TRM) acquired in a known laboratory field, yield a paleointensity. The reason why the Wilson method was rarely used for paleointensity studies is that magnetization needs to be measured at elevated temperature. Yet this method has a great advantage of being extremely quicker than the other paleointensity methods. If using a modern automated high-temperature magnetometer, we can complete a Wilson measurement within one hour for a 1-cc cube.

We performed testing paleointensity measurements based on the Wilson method for 27 1-cc cubes of basalts and scorias of the 1983 eruption in Miyakejima (the expected field of 45.1 microT). A 1-cc cube was heated in air at the rate of ˜40 deg.C per minute along with measuring three-component NRM at elevated temperature using a Orion three-component vibrating sample magnetometer at the Borok Geophysical Observatory. When the magnetization is decreased less than 1 percent of the initial value, heating was stopped and then total TRM was imparted during cooling down in the magnetic field of 45 microT. The total TRM was also continuously demagnetized in the same way as NRM.

We did find nicely straight lines on the NRM-TRM diagrams for 85% of measured samples, indicating that the shapes of unblocking temperature spectrum are essentially unchanged for NRM and TRM. We obtained the expected field intensity of 45.1 microT for the about half of the samples. The Thellier method for the sister samples also gave the expected field, but some of the samples did not. For the another half, the gradients of NRM-TRM lines significantly deviated from unity to higher or lower values. This means that thermal alteration (NOT including domain alteration) increased or decreased TRM capacity but did not appreciably changed unblocking temperature spectrum. Such a kind of alteration is not detected on NRM-TRM diagrams, therefore it is possible to give erroneous paleointensities.

Although the Wilson method is quick and robust even for samples containing multidomain grains, we need to take caution that thermal alteration is not necessarily detected from the linearity on NRM-TRM diagrams. This caution should be exercised for other kinds of single-step heating methods.

Keywords: paleointensity, Wilson method, Thellier method, high-temperature magnetometer

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Microscopic observation of titanomagnetite grains during paleointensity experiments of volcanic rocks

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Titanomagnetite (Tmt) grains, some partially maghemitized, of various oxidation levels were microscopically observed under reflected light as a function of temperature step in a Kǒnigsberger Thellier Thellier experiment in air. The reflected light microscopy indicated that the brownish colour of homogeneous Tmt turned blue at ∼300 ℃. This false blue colour was caused by submicron scale rugged stripes on the surface, according to scanning electron microscope observations, which was made after the final heating step. The typical grey-to-bluish colour of maghemitized parts of Tmt grains turned to a brownish colour at ∼300 ℃, indicating inversion of titanomaghemite to a mixture of magnetite and ilmenite (Ilm) or haematite (Hem). Although these observations were from Tmt grains on the sample surface, oxidation must have proceeded similarly within samples because the surface changes in the Tmt grains were highly correlated with behaviour of data points on Arai plots. Alterations in Tmt after heating at 610 ℃ in air for increasing times from 10 to 500 min were evaluated by reflected light microscopy and scanning electron microscopy at the end of the experiment. Mottled patches gradually emerged in the Tmt grains during subsequent heatings. However, the formation of new Ilm lamellae was not observed, even after the final 500 min heating. In conclusion, the alteration of Tmt during laboratory heating in air at ∼600 ℃ is likely not due to the typical high-temperature oxidation that forms trellis-type Ilm lamellae. Below ∼400 ℃, the process should be closer to low-temperature oxidation. On the other hand, maghemitized parts of Tmt grains invert instantaneously at 300 ℃, and a trellis-type structure with Hem lamellae soon emerges when heated at 610 ℃.

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Archeointensity trend between 8th and 11th century in Okayama

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This study presents three new archeointensity estimated from Sayama-area (Bizen city, Okayama prefecture), for the period of 8th to 11th century. The baked-earth samples (archaeological artifacts) we used in this study were collected from old kilns (part of floor and wall) of Sue wares. These kilns were found during the course of five excavations which were conducted under an archaeological project (see Archaeological lab, Okayama University of Science, 2012; 2013) aiming to trace development-history of ceramics production activity in Sayama-area between Nara and Heian-era. If we adopt the archeological chronology based on the Sue-mura type (e.g. Nakamura, 2006), the Sayama-Shin-ike kiln and the Sayama-Higashiyama kiln were estimated to be under operation during last half of 8th century (? 775±25 year), and the Sayama-Higashiyama-Oku kiln to be at around 10 century (? 900±50 year) (See Archaeological lab, Okayama University of Science, 2012; 2013).

Various rock magnetic and stepwise thermal demagnetization experiments revealed that (1) the samples are generally resistant to laboratory heating, (2) shape anisotropy is small, and (3) main magnetic carriers are Ti-poor titanomagnetite with high blocking temperature. Archeointensity measurements were done by using the IZZI Thellier method (double heating method; Yu & Tauxe, 2005). We applied this method to 19 specimens from 15 samples of the Shin-ike kiln, 10 specimens from 10 samples of the Higashiyama kiln, and 19 specimens from 9 samples of the Higashiyama-Oku kiln. After applying a set of very strict criteria, averaged archeointensity (with one standard deviation) is obtained as follows: 61.6±4.4 μT for the Shin-ike kiln (N=4), 51.8±6.5 μT for the Higashiyama kiln (N=8), and 49.8±9.8 μT for the Higashiyama-Oku kiln (N=9). These values are not contradicted from the ones obtained by the Tsunakawa-Shaw method (Tsunakawa and Shaw, 1994; Yamamoto et al., 2003) though they are preliminary. Our new data show general agreement with the most recent archeointensity compilation in Japan (Yoshihara et al., 2003) and confirm the rapid intensity decrease at ˜600 AD on average.

Keywords: Archeointensity, IZZI-Thellier method, Tsunakawa-Shaw method, Old kilns of Sue wares

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SEM37-04 Room:413 Time:April 30 09:45-10:00

Absolute paleointensity determinations of welded tuffs: Correlations between relative and absolute paleointensity data

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Absolute geomagnetic paleointensities (APIs) have been estimated from igneous rocks, while relative paleomagnetic intensities (RPIs) have been reported from sediment cores. These two datasets have been treated separately, as correlations between APIs and RPIs are difficult on account of age uncertainties. We present a procedure for directly correlating APIs with RPIs of a RPI stack. Correlations between APIs and RPIs were conducted with virtually no associated age errors using both tephrochronologic correlations and RPI minima. Using the stratigraphic positions of tephra layers in oxygen isotope stratigraphic records, we directly compared the RPIs and APIs reported from welded tuffs contemporaneously extruded with the tephra layers. In addition, RPI minima during geomagnetic reversals and excursions were compared with APIs corresponding to the reversals and excursions. The comparison of APIs and RPIs at these exact points allowed a reliable calibration of the RPI values. In this study, we applied the Tsunakawa-Shaw method to 21 welded tuffs to increase API dataset. We obtained mean paleointensities for 16 of the 21 welded tuffs. Since eight of the 16 welded tuff units were correlated with the oxygen isotope stratigraphy, they can be added to the API data used in the correlation procedure. Combining these API data with the reported data, we correlated API data with RPIs from the PISO-1500 stack and SINT-800 stack. For 13 correlation points, RPIs of the PISO-1500 stack showed a linear relationship with virtual axial dipole moments (VADMs) calculated from the APIs, indicating that the PISO-1500 stack has a linear relation to the axial dipole moment. On the other hand, PRIs from the SINT-800 stack has a tread with VADMs and the correlation coefficient is lower than that of the PISO-1500 stack. The correlation procedure with increased API data can contribute to constraining the relation between RPI of a RPI stack and API and calibrating a RPI stack to absolute values.

Keywords: absolute paleointensity, relative paleointensity, tephra, oxygen isotope stratigraphy, welded tuff

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SEM37-05 Room:413 Time:April 30 10:00-10:15

Rock magnetic study of the North Atlantic sediment during late Pliocene and early Pleistocene

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As the ocean is a major component in the climatic system, it is crucial for palaeoclimatic study to understand the past evolution of the thermohaline circulation. The North Atlantic Ocean is one of the most important sea areas because newly formed deep water mass is redistributed to the global ocean from there (Broecker et al., 1991). In order to recover the past change in deep ocean circulation at the North Atlantic Ocean, a variety of proxies have been studied. However, the change during Pleistocene and Pliocene is still poorly understood.

In this study we conducted rock magnetic measurement of deep-sea sediments recovered from IODP Site U1314 on the Gardar Drift, to investigate the past change in bottom current flows at the North Atlantic Ocean. Since a coercivity of magnetic mineral varies sensitively with its state such as chemical composition, grain size, grain shape, stress, and so on, coercivity spectra can be used as a proxy for the constituent spectra of the sediment.

The samples were collected at 16 - 50 cm resolution from 199.3 to 262.5 mcd of the core, which corresponds to the age between 2.22 and 2.75 Ma according to the age model by Hayashi et al. (2010). Rock magnetic properties were measured for these samples using a MicroMag 2900 Alternating Gradient Magnetometer. The isothermal remanent magnetization (IRM) acquisition curve was obtained by the application of stepwise-increasing uniaxial fields to the sample at 30 steps from 1 mT to 1 T. The ratio of IRM acquired in a back-field of 0.1 T to that in a forward-field of 1 T (S-ratio) was also measured for all samples.

In order to reveal constituents of the sediment, decomposition of coercivity spectra were conducted. The IRM acquisition curve was normalized by the IRM intensity at 1 T and then the first derivative of the curve was calculated with respect to log10 field (hereafter referred to as IRM gradient curve). The least square fit was performed so as to decompose the IRM gradient curve into linear combination of two end-members. Two end-member components were calculated by averaging the IRM gradient curves of selected samples. Samples with low S-ratio ($<$0.57) and younger than 2.4 Ma were chosen for component 1. Samples with high S-ratio ($>$0.88) and during MIS100, which were associated with the ice rafted debris, were chosen for component 2. These components were distinctly different from each other; coercivity distribution of component 1 was magnetically harder than that of component 2.

In consequence of the decomposition, the fitting error was significantly small for all samples, indicating that North Atlantic sediments in the Garder Drift during late Pliocene and early Pleistocene are explained by mixing of two end-member components. The fraction of two components periodically changes with time and agrees well with the LR04 $\delta^{18}O_{benthic}$ stack (Lisiecki and Raymo, 2005): the high-coercivity component dominated during interglacial periods, and the low-coercivity component dominated during glacial periods.

On the basis of the elemental ratio of potassium to titanium (K/Ti), Grutzner and Higgins (2010) reported change in proportion of sources of sediment at Site U1314 during the last 1.1 Ma. They demonstrated that Ti-rich basaltic material transported by the Iceland-Scotland Overflow Water and K-rich particle (continental rock like) derived from the other source dominated during interglacial periods and glacial periods, respectively. Our result is consistent with their result because high-coercivity and low-coercivity components are interpreted as the fine-grain titanomagnetite of Icelandic sources and the coarse-grain magnetic mineral of continental sources, respectively. Therefore the change in fraction of two end-member components represents change in fraction of bottom currents, and the bottom current flow patterns similar to those during the last 1.1 Ma might prevail at the North Atlantic Ocean during late Pliocene and early Pleistocene.

Keywords: North Atlantic Ocean, Deep-sea Sediment, IRM acquisition curve, Bottom current flow

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SEM37-06 Room:413 Time:April 30 10:15-10:30

Magnetic properties of REY rich red clay near Minami-Torishima in the Pacific Ocea

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Red clay accumulates slowly on the seafloor deeper than CCD in mid-latitudes. Paleoceanographic and paleomagnetic studies were limited so far because red clay does not yield microfossils that can be used for precise age estimation and sedimentation rates were extremely low, less than a few meters per million years. However, red clay has attracted interest since Kato et al. (2011) reported that red clay rich in REY (rare-earth elements and yttrium) distributes widely in the Pacific Ocean. In this paper, we present magnetic properties of red clay cores obtained from the seafloor near Minami-Torishima during the R/V Kairei KR13-02 cruise. From these cores, extremely high REY contents were reported (Fujimoto et al., 2013, JpGU; Suzuki et al., 2013, JpGU). We will discuss a possible relationship between REY content and magnetic properties.

It is known in red clay that magnetostratigraphy can be established back to only ˜3 Ma, and this also holds for the KR13-02 cores. However, noisy but rather coherent inclinations were obtained throughout the cores even where polarity reversal patterns were obscure. Although a possibility that these directions are of magnetic overprint cannot be excluded, the observed inclinations are not much lower than that expected from the GAD model at the present latitude. This may suggest that the sediments including the intervals of high REY content are not very old, possibly Eocene to Oligocene or younger in age, and that they deposited in the northern latitudes not very far from the present sites. This result is not consistent with the idea that the high REY content is influence of hydrothermal activity along the East Pacific Rise. The cores showed a common magnetic susceptibility variation pattern, and a peak of REY content occurs just below an interval of high magnetic susceptibility. The REY peak coincides with a sharp upward decrease in the ratio of ARM to SIRM, which indicates an increase of the mean magnetic grain size and/or an increase in the proportion of detrital to biogenic magnetic mineral component. These results suggest that the increased REY concentration may have occurred in association with a paleoceanographic event.

Keywords: red clay, REY, rock magnetism, environmental magnetism, Pacific, Minami-Torishima

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SEM37-07 Room:413 Time:April 30 11:00-11:15

A method for measuring rapid magnetization change in high field using a pulse magnetizer: A new rock magnetic approach

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Pulse magnetizers have frequently been used in rock magnetic studies for the convenience of the production of high magnetic field without the need for a large electromagnet, enabling the rapid acquisition of isothermal remanent magnetization (IRM) for short (*c*. 10^{-2} sec) period of time. Because the demand for high field is limited as much as 10 T for rock magnetism, the pulse magnetizer can be compact and low-cost, and several commercial systems are available for the purpose of imparting IRM. We propose in this study a new method for measuring the dynamical behavior of magnetization in pulsed high-field, a new cost-effective system comprised of a fast broad-bandwidth digital oscilloscope and a newly designed coil system. We show examples of such dynamical behaviors from a set of natural samples, and discuss these results in comparison with conventional rock magnetic analyses.

Keywords: rock magnetism, pulse magnetic field, magnetic hysteresis

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SEM37-08 Room:413 Time:April 30 11:15-11:30

Paleomagnetic study of the Holocene volcanic rocks and tephras from post-caldera central cones of Aso Volcano

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We have conducted a paleomagnetic study on Holocene volcanic rocks and tephras from post-caldera central cones of Aso Volcano. Paleomagnetic sampling was made at 25 sites of seven units. Nineteen out of 25 sites gave reliable mean paleomagnetic directions that had a 95% confidence circle of lower than 5 degree. Different sites from a few lavas, which had been treated as a single unit in the geological map of Aso Volcano (Ono and Watanabe, 1985), gave distinct mean directions at 95% confidence level. For Kishimadake lava, Ojodake lava, Nakadake young volcanic edifice, two different mean directions were obtained from multiples sites. These differences in mean directions indicate that multiple flows were extruded with a temporal gap of more than 10 or 100 years. We also found that Kamikomezuka scoria, two sites of Kishimadake lava, two sites of Ojodake lava gave identical mean directions at 95% confidence level. The concordance of the mean directions suggests that the multiple vents erupted simultaneously, in a time interval of the order of 10 years, and these lavas were extruded over a wide area of the post-caldera central cones. In this study, we also made paleomagnetic measurements on tephra layers in a section. Oriented samples were collected from 22 layers of a tephra section, 4km NNE of Nakadake vocano (Miyabuchi and Watanabe, 1997). Seventeen of the 22 layers gave mean paleomagnetic directions that had a 95% confidence circle of lower than 5 degree. Most of the N6 layer, and N5 and N4 layers give an identical direction, which suggests these layers were formed in a short period of several tens of years. A tephra layer record a same direction of a lava flow, which suggests a simultaneous formation of the tephra layer and lava flow.

Keywords: Aso Volcano, paleomagnetic direction, volcanic rock, tephra

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SEM37-09 Room:413 Time:April 30 11:30-11:45

Paleomagnetic secular variation record for the last 7000 years observed in piston cores from the Ichinomegata Maar

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The Ichinomegata is a maar lake located in Oga peninsula, Akita Prefecture. Thin-wall core samples (IMG06) obtained in 2006 provided a Holocene paleomagnetic secular variation (PSV) record through measurements of natural remanent magnetization (NRM) of u-channel samples. In this study, we collected the piston-core samples (IMG13P-1 and IMG13P-2) from the center of the lake, and measured magnetic susceptibility, anisotropy of magnetic susceptibility (AMS) and natural remanent magnetization (NRM) of 7cc cubic samples. According to correlation between IMG06 and the piston cores based on lithological and magnetic susceptibility data, both IMG13P-1 and IMG13P-2 cover the last 7000 years. Stepwise AF demagnetization of the NRM showed that high intensity NRM decayed toward the origin linearly in most samples, so we determined the directions by applying the principal component analysis. We excluded some by evaluating inclinations of minimum axis and shape parameters q of AMS ellipsoids. Excepting some intervals that probably disturbed in coring, inclination and relative declination are showed consistent variations between IMG13P-1, IMG13P-2 and IMG06 cores. Therefore, we argue that the sediments of the Ichinomegata Maar are suitable for PSV studies. The paleomagnetic record from the Ichinomegata Maar shows a good similarity with the archeomagnetic secular variation from southwest Japan (Shibuya, 1980) and the PSV record from Lake Biwa (Ali et al., 1999), implying a great importance in regional reconstruction of the PSV record in Japan.

Keywords: Paleomagnetic secular variation, remanent magnetization, magnetic susceptibility, Ichinomegata Maar

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Thermomagnetic characteristics in the Hikageyama lava: searching a paleomagnetic record of the Laschamp excursion

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In the JpGU 2013 Meeting, we reported a paleomagnetic record from the Hikageyama lave. Among the 9 sites, 4 sites in the eastern part of the Hikageyama yielded consistent site mean directions characterized by shallow inclinations and easterly deflection. These site mean directions provide virtual geomagnetic poles (VGP) at around 50 N and 100 W. It can be assumed therefore that the Hikageyama dacite recorded anomalous geomagnetic field at the time of the Laschamp excursion. In addition to the above record, stepwise thermal (TH) demagnetization revealed that the above 4 sites yielded consistent site mean directions.

Thermomagnetic analysis revealed that most samples are composed of a single phase Curie temperature, suggesting magnetite as a remanence carrying mineral. And, the above 4 sites are classified into two groups. One (HKG-9, 10) shows a single phase, similar to the above. The other (HKG-11, 12) shows two phases, suggesting titanohematite and hematite. According to TH demagnetization results, one has two or three NRM components remanence. The other has a single component, which showed highly stable remanence which cannot be demagnetized at peak alternating field of 100 mT as previously reported. We will report these components discussion together with the thermomagnetic results.

Keywords: Rock magnetism, Hikageyama lava, Geomagnetic excursion, Laschamp excursion

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SEM37-11 Room:413 Time:April 30 12:00-12:15

Electromagnetic core-mantle coupling and length-of-day variation in numerical dynamo models

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Exchange of angular momentum between the core and the mantle is likely to be responsible for the decadal variations in the length-of-day (LOD). If the changes in the angular momentum of the mantle are balanced by the opposite changes of the core, some coupling mechanisms between the core and the mantle should be invoked. Here we examine the electromagnetic (EM) coupling as a possible mechanism of angular momentum exchange. We use numerical dynamo simulations to investigate the mechanism to explain the LOD variations with respect to time including the decadal time scale. In numerical dynamo models, we impose a uniformly electrically conducting layer of about 200 km-thick on the mantle side of the core-mantle boundary corresponding to the D" layer. The electric current associated with the dynamo-generated magnetic field can flow in the conducting layer and the Lorentz force can yield a net EM torque with respect to the rotation axis. The electrical conductivity of the layer is varied from 200 - 500 S/m in dynamo models. The LOD variations can put some feedback effects on flows in the core through the changes in the angular velocity, which emerge as a change in the effective Ekman number and the Poincare force. Influences of such a feedback are also included in numerical models. The Ekman number adopted as a nominal value is 10^{-4}. We have obtained the EM torque resulting in typical angular velocity variation of the order of 10^{-6} relative to the nominal angular velocity in a time scale of the magnetic diffusion time. Much smaller changes in shorter time scale are also observed. Based on the findings in the present study, it is suggested that the EM core-mantle coupling in a likely range of the conductance within the D" layer is a promising mechanism to yield LOD variations in decadal to longer time scale.

Keywords: dynamo, electromagnetic core-mantle coupling, LOD variation, D" layer

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SEM37-12 Room:413 Time:April 30 12:15-12:30

Infulence of surface displacement on fluid motions induced by Joule heating in the inner core of the Earth

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The elastic anisotropy of the earth's inner core as revealed by recent seismic observations is considered to originate from the alignment of texture formed along the solidification of the core or alignment of the preferred orientation of crystals by plastic deformation of fluid motions. The depth dependency of the anisotropy is difficult to explain by the solidification mechanism, whereas the various factors driving fluid flows in the inner core considered thus far do not appear to yield sufficiently strong stresses for generation of the elastic anisotropy. Takehiro (2011) proposed Joule heating of the magnetic field penetrating diffusively from the inner core boundary (ICB) as a possible source of inner core flows. His specific calculation in the case of toroidal magnetic field with the horizontal structure of spherical harmonics $Y_2{}^0$ showed that downward flow in the equatorial region and upward flows in the polar region are induced by the Joule heating. This flow field has non-zero radial velocity component at the ICB, causing mass exchange between the inner and the outer core. This feature is a result of the constant normal stress boundary condition at the ICB, and it is implicitly assumed that the phase change occurs instantaneously at the ICB. However, the actual speed of the phase change is finite. If the speed of the phase change is slow enough, the ICB would be deformed and the surface displacement is induced by the non-zero radial velocity at the ICB. This surface displacement may prevent inner core flows due to the buoyancy force originated from the density contrast between the inner and the outer cores. Therefore, in this study, we investigate influence of surface displacement on fluid motions induced by horizontally heterogeneous Joule heating in the inner core. We examine the extent of development of the surface displacement and modification of flow field of the inner core.

The difference of the governing equations from those of Takehiro (2011) is the boundary conditions at the ICB. Temperature disturbance at the ICB coincides with the melting temperature which varies depending on the surface displacement. The normal component of stress equates with buoyancy induced by the surface displacement. The toroidal magnetic field and surface displacement with the horizontal structure of $Y_2{}^0$ is given. The flow fields are calculated numerically for various amplitudes of the surface displacement with the expected values of the parameters of the cores.

The results show that, when the surface displacement is the order of 0.01–0.001m or less, the flow and stress fields are similar to those of Takehiro (2011), where the surface displacement vanishes. As the amplitude of the surface displacement is increased, counter flows from the polar to the equatorial regions come to emerge around the ICB, while the flow in the inner regions is directed from the equatorial to the polar regions in the inner region and non-zero radial component of velocity at the ICB still exists. When the surface displacement is about 0.14–14m, radial component of velocity at the ICB vanishes, the surface counter flows becomes stronger than the flow in the inner region, and the amplitude of the stress field near the ICB dominates that of the inner region, which might be inconsistent for the elastic anisotropy in the inner core.

Reference: Takehiro, S., 2011: Phys. Earth Planet. Inter., 184, 134–142.

Keywords: anisotropy of the Earth's inner core, magnetic fields in the Earth's outer core, flows in the Earth's outer core, inner core boundary of the Earth, dynamo action in the Earth's outer core

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SEM37-13 Room:413 Time:April 30 14:15-14:30

Paleomagnetism of the Znp-Ohta tephra in eastern Honshu: relative tectonic rotations at local and regional scales?

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We present paleomagnetic data suggesting relative tectonic rotations in eastern Honshu since 3.9 Ma. Samples were collected from a widespread ash bed, called the Znp-Ohta tephra, at three localities. One is the Tomioka locality located to the east of the Abukuma Mountains, where the ash bed (local name = SF4.5 tephra) was samples at three sites. The other two are the Miyobara and Kohsaka localities on the Boso Peninsula, where the ash bed (local name = An85 tephra) was sampled at three sites at each locality. Stepwise demagnetization was performed on all specimens, and the principal component analysis was applied to the demagnetization data to extract characteristic remanent magnetization (ChRM) components. At Tomioka, site-mean ChRM directions were determined at all sites. They are tightly clustered after tilt correction and have a southerly direction of reverse polarity. Interestingly, the direction is deflected significantly counterclockwise with respect to the direction of the correlative tephra at Chita in central Honshu (Hoshi & Deguchi, 2013). At Miyobara and Kohsaka, the locality-mean ChRM directions are significantly different to each other. The paleodeclination of Miyobara is similar to that of Tomioka, and the paleodeclination of Kohsaka is almost identical to that of Chita. The difference in paleodeclination between Miyobara and Kohsaka seems to be related to the difference in the general geological trend of Neogene strata on the Boso Peninsula, suggesting relative rotation on the peninsula. Our results imply that in eastern Honshu, relative rotations have taken place at local and regional scales since the Pliocene.

Keywords: eastern Honshu, paleomagnetism, Pliocene, relative rotation, tectonics, Znp-Ohta tephra

Japan Geoscience Union Meeting 2014
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SEM37-14 Room:413 Time:April 30 14:30-14:45

Past continental shape inferred from GPS data

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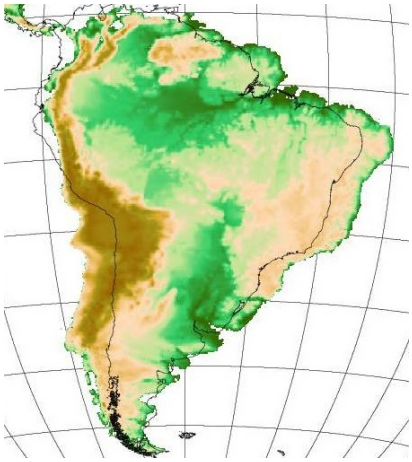
Kono et al.,1985 analyzed paleomagnetic data around Andes and showed past shape of the south American continent about 50Ma and figured the Andes mountain range were more linear shape than at present. We tried to reconstruct the 50Ma shape of the south American continent from the current crustal motion of GPS data. Plate motion vectors observed from space geodesy including GPS, can comparable with plate motions of geological time scale. Gordon, 1993 showed VLBI plate motion (time scale of years) and NUVEL-1 plate motion (3 million years mean motion) are in great harmony with each other.

We applied a method of Harada and Kato(AGU Fall Meeting 2012), and calculated about 50Ma shape of the south American continent (figure below). The shape of the Andes mountain range were linear and in good harmony with the result of Kono et al.,1985. We conclude, thus, decades scale GPS data can compare with plate deformation of ten thousands years.

Keywords: GPS, Past continental shape, Deformation of plates



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Problems related to the past motion of the Philippine Sea Plate

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Plate motion through geological time is reconstructed based on the correlation of marine magnetic anomaly patterns and/or hot-spot track analysis. But the past motion of the Philippine Sea Plate cannot be clarified because the plate is surrounded by convergent plate boundary (trench) and it has no hot-spot track. Therefore the paleomagnetic approach is the only method to reconstruct the past location and motion of the plate. However this method contains unacceptable problems that the paleomagnetic declination does not indicates the total rotation of the plate around its Euler pole in most cases. The paleomagnetism has been thought as an effective tool to reconstruct the Philippine Sea Plate motion, but actually it is impossible to clarify the past motion of the plate by paleomagnetic method.

Keywords: tectonics, paleomagnetism, Philippine Sea Plate