Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)


SEM34-P01 Room:Convention Hall Time:May 24 18:15-19:30

# Paleomagnetism of a lithological contact of granophyre dikes with bedrock granites at Vredefort dome, South Africa

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The Vredefort dome is known as the largest and oldest (2023 ± 4 Ma) terrestrial impact structures, which is the deeply-exhumed remanent of the central uplift zone (~10km) of an originally ca. 250-km diameter crater. The Vredefort impact structure contains a suite of granophyric dykes, referred to as the Vredefort Granophyre, occurring within and at the edge of the Archaean basement core. This unique melt rock occurs as vertical ring dikes along the contact between sedimentary collar and core of Archaean granites, and as vertical dikes extending northwest-southeast and northeast-southwest in the granitic core. Although there have been a lot of mineralogical and isotopic studies, the lithological contact has not been observed due to the lack of the outcrop. During our field survey, we found the lithological contact of the Vredefort granophyre with bedrock granites near the Kopjeskraal Country Lodge, Vredefort, South Africa. In this presentation, we report the presence of a distinct chilled margin from a cooperative study of petrology and rock magnetism of the contact and also a micro-paleomagnetic consideration across a transection of the chilled margin.

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)


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# Archeointensity study on baked clay from the reconstructed kiln: implication for validity of the Tsunakawa-Shaw method

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A reconstruction experiment of a kiln had been done to imitate completely that of an excavated kiln of the 7th century in Japan. Baked clay samples were taken from floor surface and -20 cm level, and they have been stored after determinations of the paleomagnetic directions by partial alternating field demagnetizations. A suite of the rock magnetic experiments and the scanning electron microprobe observations elucidate that dominant magnetic carriers of the floor surface samples are Ti-poor titanomagnetite grains in ˜10 nm size with single-domain and/or super-paramagnetic states, whereas contributions of multi-domain grains seem to be relatively large for the -20 cm level samples. We applied the Tsunakawa-Shaw method to the samples to assess how reliable archeointensity results are obtained from the samples. From the floor surface samples, six out of the eight successful results were discriminated and they give an average of 47.3 microT with a standard deviation of 2.2 microT. This is fairly consistent with the in-situ geomagnetic field of 46.4 microT at the timing of the reconstruction. They are obtained with a built-in anisotropy correction using anhysteretic remanent magnetization, and without any cooling rate corrections. In contrast, only one out of the four successful result was obtained from the -20 cm level samples. It yields an archeointensity of 31.6 microT, which is inconsistent with the in-situ geomagnetic field. Considering from the in-situ temperature record during the firing of the kiln, the floor surface samples acquired full thermoremanent magnetizations (TRMs) as their natural remanent magnetizations whereas the -20 cm level samples only acquired partial TRMs, and these differences probably cause the difference in the archeointensity results between the two sample groups. For archeointensity researches, baked clay samples from a kiln floor are considered to be ideal materials.

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)


SEM34-P03 Room:Convention Hall Time:May 24 18:15-19:30

# Archeointensity trend between 7th and 10th century in Japan

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Earth's magnetic field is known to show complicated, and irregular variations in time. It is important to investigate a paleomagnetic secular variation to deepen our understanding of the geodynamo. An approach based on the paleomagnetism is a powerful tool to obtain the information of geomagnetic variation before the 16th century when modern observations started. Especially, a technique based on the archeomagnetism is expected to provide high quality information. There has been much progress in archeomagnetism in Europe recently: for example, Donadini et al. (2009) complied the published direction and intensity data for the past 2,000 years, and Korte et al. (2009) proposed a global field model.

In Japan, archeomagnetic directions have been studied activery since 1960's, and the resultant 'master curve' has been utilized in scientific studies in cultural properties (e.g. Hirooka et al., 2006). In contrast, archeointensity data have been published only in the four papers (Nagata et al., 1963; Sasajima and Maenaka, 1966; Sakai and Hirooka, 1986; Yoshihara et al., 2003). Considering a set of statistical selection criteria, they provide only 43 high quality data which were also obtained by the Thellier method without a pTRM check. It is thus necessary to obtain new data by modern experimental techniques with modern selection criteria. This study presents new archeointensity data between 7th and 10th century which are obtained from backed-clay samples taken from the Oku kilns in Okayama prefecture and the Sue-Mura kilns in Osaka prefecture. The experimental techniques used in this study are the IZZI-Thellier method (Tauxe and Staudigel, 2004) and the Tsunakawa-Shaw method (Tsunakawa and Shaw, 1994; Yamamoto et al., 2003).

Various rock magnetic experiments revealed that (1) the samples are generally resistant to laboratory heating, (2) main magnetic carriers are non-interactiving SD-like Ti-poor titanomagnetite, and (3) blocking temperatures distributed widely between 100 and 600 $^{o}$C. It is considered that the IZZI-Thellier method and the Tsunakawa-Shaw method are applicable to the samples. We obtained 41 successful results by the IZZI-Thellier method and 23 successful ones by the Tsunakawa-Shaw method. We screened these data by selection criteria as follows: (1) at least three successful results are obtained from a site, (2) a standerd deviation of these results is less than 20 %. The screening resulted in seven reliable site-mean archeointensities: (1) 48.0 +/- 9.6 uT for KM-11 kiln (A.D. 630 +/- 10), (2) 45.4 +/- 2.0 uT for TG-38-III kiln (A.D. 720 +/- 10), (3) 55.3 +/- 8.4 uT for KM-102 kiln (A.D. 750 +/- 10), (4) 50.0 +/- 4.3 uT for KM-38-II kiln (A.D. 770 +/- 10), (5) 55.9 +/- 8.4 uT for Sayama Shin-Ike 1st kiln (A.D. 775 +/- 25), (6) 48.9 +/- 7.4 uT for Sayama Higashiyama kiln (A.D. 775 +/- 25), (7) 49.4 +/- 4.5 uT for Sayama Higashiyama-Oku kiln (A.D. 900 +/- 50).

The former published high-quality archeointensity data in Japan indicated a decreasing trend approximatery from 70 uT at A.D. 600 to 50 uT at A.D. 900. In contrast, the presently obtained data rather suggested a constant trend about 50 uT for the same period. This constant trend appeared to be consistent with the recently reported archeointensity data from Korea and China by the IZZI-Thellier method (Hong et al., 2013; Cai et al., 2014). New data also appeared to be consistent with the world VADM data extracted from the GEOMAGIA50 database (Donadini et al., 2006; Korhonen et al., 2008), showing a decreasing trend approximately from $11*10^{22}$ Am$^2$ at A.D. 0 to $8*10^{22}$ Am$^2$ at present.

Keywords: archeointensity, secular variation, climbing kiln of Sue ware, high-quality data, IZZI-Thellier method, Tsunakawa-Shaw method

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)


SEM34-P04 Room:Convention Hall Time:May 24 18:15-19:30

# Archeomagnetic study of Takabatake ruins and Wada-taishido ruins in Matsumoto city

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This study presents some archaeomagnetic directions from burnt sediments at Takabatake ruins (site TK2˜4) and Wada-taishido ruins (site W1) in Matsumoto city, Japan. Compared with the secular variation curve in Japan (Hatakeyama et al., in prep.), archaeomagnetic dating and local magnetic anomaly will be discussed.

As a result of our study, reliable archaeomagnetic directions were obtained. The abandonment of TK2, TK3, TK4 and W1 has been dated to 1025±25 AD, 1015±15 AD, 1075±50 AD and 850±50 AD, respectively. Declination values of our data were almost one or two degrees smaller than those of the secular variation curve in Japan. The present field around the studied area show smaller declination (GSI, 2010.0). Local magnetic anomaly resulted from non-dipole component around the studied area possibly continue in the past several thousand years.

Keywords: Archeomagnetism, Geomagnetic secular variations, non-dipole component, thermal remanent magnetization, depositional remanent magnetization, ruins

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)


SEM34-P05 Room:Convention Hall Time:May 24 18:15-19:30

# Anallyzing the early 19th century's Geomagnetic declination in Japan from Tadataka Inoh's Santou-Houi-Ki The 9th report

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The Santou-Houi-Ki is a national treasure of Japan recorded by cartographer Tadataka Inoh in 1800-1816, is 67 volumes survey ledger consist of approximately 200,000 magnetic compass land survey azimuth data accuracy of 5 min, from the coast of eastern Hokkaido to Yakushima Island in western Japan.

We continue the work of analysis that stopped after only one analysis in 1917, which done about the magnetic compass survey azimuth data at known position of the retirement home of Tadataka Inoh at Fukagawa in Edo (Tokyo) in 1802-1803.

From this interdisciplinary simultaneous analysis across geomagnetism, survey science, historical cartography and local history and human sciences, we can increase precise evidence to verify the real azimuth, geomagnetic declination and short description of the reference point where magnetic compass survey was executed or the historical place name of survey target points recorded in The Santou-Houi-Ki, than the traditional way of study separated in each field.

(1) The short description of survey reference point where Tadataka Inoh executed magnetic compass survey, the place name of each survey target points, and magnetic compass survey azimuth in accuracy 5min were recorded inThe Santou-Houi-Ki.

(2)Procedure of analysis.

Use the recreation software of scenery and digital map of GSI Japan Denshi Kokudo to know the latitude and the longitude of particular survey target points in accuracy 1 second, and the latitude and longitude at the outline position of survey reference point, to grasp the outline of each real azimuth from the survey reference point to survey target points.

Geomagnetic declination= Real azimuth - Magnetic compass survey azimuth recoded in The Santou-Houi-Ki

Calculate backward the precise position of the survey reference point should be adjusted to the position in accuracy 1 second in latitude and longitude, where all of geomagnetic declination values unit of 1 second,calculate from the magnetic compass survey azimuth to each different targets at the reference point are approximately equal to each other.

Calculate the average value of each geomagnetic declination unit of 1 second, and express it as the geomagnetic declination unit of 1 second on the day Tadataka Inoh's magnetic compass survey was executed. To use the consecutive formula of Excel for speed up and keep accuracy. If it possible to go to the field of the survey reference point, confirm the real scenery at the reference point and use GPS transmitter to confirm the longitude and the latitude, and recalculate the value of geomagnetic declination.

(3)It is able to change Japan as one of the most concentrated area of accurate geomagnetic declination data in the world, in early 19th century, from insufficient area of data, and supply new data to northeast Asia by analysis of The Santou-Houi-Ki. The total number of analyzed points exceeded 183 and the outline of isogonic line in Japan archipelago and the distribution of the declination in every 15 minutes in western Japan coast in those days, began to appear. The analysis is developed from the coast area of Japanese archipelago to the inland area of Honnshuu Island.

(4)Compare the isogonic line of declination in those year's Japanese Archipelago by analysis of The Santou Houi Ki, with the Historical Magnetic Declination -Map-by NOAA (1800,1805,1810,1815) is almost similar. The difference is the NOAA's pace of variation west is almost 5 years later than the analysis of The Santou-Houi-Ki.

(5)However, from the analysis of Santou-Houi-Ki, we can recognise the magnetic declination supposed as the local geomagnetic anomaly in southern coast of eastern Hokkaido, some part of Noto Peninsula, Mt.Asama in Ise, Nobeoka city in Kyuushuu Island etc, can not drow in Historical Magnetic Declination -Map-by NOAA. . Therefore the analysis of THe Santou-Houi-Ki becomes more important.

Keywords: geomagnetic declination, Tadataka Inoh, Santou-Houi-Ki, Survey reference point, Survey Target point, interdisciplinary

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)


SEM34-P06 Room:Convention Hall Time:May 24 18:15-19:30

# Remanent magnetization observed in core sediments from the Ichinomegata Maar, Akita Prefecture

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The Ichi-no-megata is a maar lake with a maximum water depth about 45 m, located in the Oga Peninsula on the Japan Sea coast. A piston-core sample (IMG13P) obtained in 2013 provided a Holocene paleomagnetic secular variation (PSV) record through measurements of natural remanent magnetization (NRM) of 7cm$^3$ cubic samples. Also, we collected Mackereth core samples (IMG13M-1 and IMG13M-2) at the center of the lake, and measured magnetic susceptibility, anisotropy of magnetic susceptibility (AMS) and NRM of 7cm$^3$ cubic samples.

The core sediments are mostly composed of laminated clay or silt intercalating sandy turbidite layers. According to correlation between the Mackereth cores and the piston cores based on lithological and magnetic susceptibility data, it is revealed that uppermost parts of the piston cores were missed. Inclinations of minimum axis and shape parameters q of AMS ellipsoids indicate that turbidite layers of upper parts have not preserved primary sedimentary fabric. Stepwise AF demagnetization of the NRM showed that remanence of the laminated layer is more stable than turbidite layers. Therefore, we argue that the turbidite sediment is not suitable for preservation of NRM.

Keywords: Remanent magnetization, magnetic susceptibility, Ichi-no-megata Maar

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)


SEM34-P07 Room:Convention Hall Time:May 24 18:15-19:30

# Remanent magnetization of a sediment core from Haneji-naikai, Okinawa : Diagenetic modification of magnetic mineral

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We have studied magnetic properties of sediment core samples from the Haneji Inner Bay and the Shioya Bay on the northwest coast of Okinawa Island in order to investigate runoff of red soils associated with environmental changes in the watershed. Here we present results of measurements of natural remanent magnetization (NRM) of the core sample from Haneji-naikai Bay.

Pass-through measurement of the u-channel samples revealed that NRM above 120 cmbsf (cm below sea floor) has a stable component, which shows linear decay toward the origin (MAD $<$10 degree). By contrast, NRM intensity below 130 cmbsf is only 2% of the upper interval and no characteristic magnetic component was isolated (MAD $\geq$ 10 degree). While low-field magnetic susceptibility shows gradual down-core decrease of at 100-150 cmbsf, anhysteretic remanent magnetization (ARM) decreases sharply at 140-160 cmbsf. Isothermal remanent magnetization (IRM), which was measured for discrete cubic specimens of 1 $cm^3$ subsampled from the u-channels, showed consistent variation with the ARM. It was also found that proportion of low-coercivity ($<$0.3 T) magnetic minerals (S-ratio) decreases at 140-160 cmbsf. Thermal demagnetizations of three-component IRM made for selected specimens suggest abundance of titanomagnetite and magnetite at the upper interval, but such medium to low coercivity minerals were not observed in the lower part. It is suggested that a loss of fine-grained magnetite have occurred due to reductive diagenesis, resulting destruction of stable NRM signals below 130 cmbsf.

Keywords: paleomagnetism, natural remanent magnetization, diagenesis, sediment, red soil, Okinawa

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)


SEM34-P08 Room:Convention Hall Time:May 24 18:15-19:30

# Rock magnetic property of the marine sediment cores recovered from IODP Site U1403 in the Northwest Atlantic

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Marine sediment is an important recorder of the past environmental changes. It can provide important information to investigate the environmental change continuously back in time, once a high-resolution age model is constructed by multiple techniques. Integrated Ocean Drilling Program (IODP) Expedition 342 recovered marine sediment cores from the Northwest Atlantic, off Newfoundland, to investigate the environmental change from the Paleocene to the Eocene. Our objective is to estimate relative paleointnsity variation for that period. In order to achieve this, we need to find out relatively homogeneous intervals in rock magnetic properties. In this study, we conduct preliminary rock magnetic measurements on the 88 discrete samples taken from Hole A in Site U1403 at every ˜1.5 m interval (25-160 mcd: meter composite depth).

Low temperature magnetometry failed to detect, the Verwey transition except some horizons. We therefore, think that Ti-poor titanomagnetite is not much included in the present samples. Below about 117 mcd, the samples showed a distinct phase transition at about 25 K. It is probably due to an existence of rhodochrosite.

In the thermomagnet experiments, slight increase in magnetization at about 400 ℃ and Curie temperatures at about 580 ℃ and/or about 670 ℃ were recognized throughout the studied interval. Because the Verwey transition was not detected except some horizons ,the Curie temperature at about 580 ℃ is probably originated from a breakdown of titano-maghemite upon heating. These results indicate that the present samples contain titano-maghemite and titano-hematite.

Anhysteretic remanent magnetization (ARM) was imparted by a DC field of 100

$\mu$T and AF of 80 mT. The samples from the 50-90 mcd interval showed a relatively constant high ARM intensity of 3-5X$10^{-4}$ (A/m). Except this interval, the ARM intensity varied a lot, as low as 1X$10^{-6}$ (A/m). Isothermal remanent magnetization (IRM) imparted by a DC field of 2.5 T exhibited a similar tendency. The samples from the 50-90 mcd interval showed a relatively constant high IRM intensity of 1-3X$10^{-3}$ (A/m). Except this interval, the IRM intensity varied a lot, as low as 1X$10^{-5}$ (A/m).

Ratios of ARM to IRM (ARM/IRM), which are often used as parameters of magnetic grain size and/or degree of magnetostatic interaction, resulted in either about 0.15 or 0.05 for the studied interval. The interval of 50-90 mcd showed a constant ratio of 0.15. S-ratio (-0.1T and, -0.3T) which stands for a remanence fraction according to a coercivity resulted in constant values of 0.97 (-0.1T) and, 0.98 (-0.3T) for the 50-90 mcd interval.

In summary, the 50-90 mcd interval is considered to be little affected by a diagenesis and have relatively homogeneous rock magnetic property, because of the relatively strong ARM and IRM intensities and constant values of several rock magnetic parameters. We think that, this interval is suitable for an estimate of relatively paleointensity variation.

Keywords: geomagnetic field, paleointensity, marine sediments

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)


SEM34-P09 Room:Convention Hall Time:May 24 18:15-19:30

# Relative paleointensity during the last 3 m.y. from sediments in the western equatorial Pacific

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It is important to determine the strength of the past geomagnetic field for better understanding of the geodynamo. This study aims to estimate relative paleointensity of the geomagnetic field (RPI) back to about 3 Ma. Marine sediments can preserve temporally continuous paleomagnetic records. Piston core samples obtained from the West Caroline Basin (R/V MIRAI MR14-02 cruise, core PC01) were used. This area is empirically known for yielding good paleomagnetic records. Alternating field demagnetization of the natural remanent magnetization (NRM) enabled to estimate directions of the past geomagnetic field. Ages of the sediments were estimated from the magnetic polarity reversal sequence. We are also trying age estimations based on the oxygen isotope stratigraphy. The anhysteretic remanent magnetization (ARM) and the saturation isothermal remanent magnetization (sIRM) were imparted to normalize the NRM intensity for obtaining RPI. Here, the ARM was chosen for the normalizer. The result generally agrees with the previous RPI stacked curves of the last 2 m.y.. However, the RPI record seems to correlate with the ARM/sIRM ratio, which may reflect the variation in the sedimentary environment. Thus the RPI record may be influenced by environmental changes. We need to evaluate this influence for more reliable RPI estimation.

Keywords: paleomagnetic intensity, marine sediments

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)


SEM34-P10 Room:Convention Hall Time:May 24 18:15-19:30

# Origin of magnetic remanence in coral skeletons in Ishigaki Island, Japan

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Coral skeletons have an attractive potential as high-resolution recorders of the Earth's ancient geomagnetic field for the last several hundreds of years due to their long-lived and annual growth rate, but they have a general problem: 1) the magnetization of corals is very weak and 2) its origin has not been understood. Some of the corals appear to carry an excellent record of the field. Sato et al. (2014) succeeded, even using a conventional spinner magnetometer, to measure enough magnetizations of deceased coral tsunami boulders along the shorelines of Ishigaki Island where the coral reefs are grown on bedrock of Ryukyu limestone and Jurassic schist. Therefore, the in-situ coral skeleton of this Island would provide us a high-resolution paleomagnetic record if we could determine what magnetic minerals and their domain structures. However, our understanding of the magnetic mineral assemblages within coral frameworks is not well developed, because of rare abundance of magnetic particle. Previous rock-magnetic studies have reported two different results of both biogenic magnetite and abiogenic detrital titanomagnetite in late Cenozoic shallow-water carbonate platforms as the main remanence carriers at Bahamas (McNeil et al., 1988) and Tahiti (Ménabréaz et al., 2010), respectively. To determine the remanence carriers for our corals, we conducted petrologic observations of acid-treated residuals of corals by a field-emission type scanning electron microscope (FE-SEM) and revealed the presence of c.a. 80˜100 nanometer rectangular-shaped individual iron oxide grains with a very short chain of them, implying the origin of biogenic magnetite. We also found some titanium iron oxides from detrital deposits transported from bedrock schist. A first order reversal curves (FORC) measurements are also conducted to confirm the magnetic mineralogy. FORC diagrams have a narrow ridge along the $H_c$ axis with little vertical spread. The FMR spectra represent a similar form with those of magnetosome-bearing carbonates. Our results indicate that the main magnetic carriers of coral frameworks are from both bacterial and detrital fine-grained magnetite.

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)


SEM34-P11 Room:Convention Hall Time:May 24 18:15-19:30

# A new magnetic relaxation dating reveals tsunami ages from individual tsunamigenic coral boulders on Ishigaki Island

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Information about past tsunami hazards, such as their recurrence interval and magnitude, is needed for future disaster prevention and mitigation. Tsunamigenic boulders could estimate a magnitude of tsunami waves to transport them to coastlines, but no information for recurrence intervals has been obtained. In the Ishigaki Island, Japan, there are tsunamigenic boulders consisted of the hermatypic corals. The distributions of large numbers of radiocarbon dating for these boulders determined the timing of past tsunamis. Although the radiocarbon dating is a powerful tool for estimating tsunami age for corals including radiocarbon, information for subsequent transportations of individual coral boulders and for ages of tsunamigenic igneous boulders without any trace of radiocarbon. Paleomagnetic viscous dating could overcome this problem because time-dependent viscous remanent magnetization is acquired parallel to the Earth's magnetic field after the transportation. Furthermore, Neel's thermal relaxation theory on single domain magnetite particles predicts the time-temperature relation for the viscous relaxation. Following Pullaiah et al. (1975), we can derive a time-temperature nomogram for single domain nanoparticle ensembles describing that a remanence acquired during a time at a room temperature in nature can unblock during shorter heating step at higher temperature in a laboratory. We have been applying this relation to the coral boulders in Ishigaki Island, but their emplacement ages determined from this time-temperature relation showed an older age than radiocarbon dating for the same boulders. Here, we revisited the Neel's exponential relaxation model of magnetic relaxation in order to determine the same age as radiocarbon dating by extending the previous time-temperature relation. It is considered that magnetic viscous relaxation of fine-grained magnetite is following an exponential or logarithmic function of time, but the reexamination of previously published viscous relaxation data suggested that magnetic viscous data is fit by a stretched exponential function of time. Using this stretched exponential function, we obtained a new time-temperature relation for estimating accurate tsunami ages. Combined this new relation and statistical data measured by the repeated thermal demagnetizations with a varied duration time, we succeeded to determine the same ages as radiocarbon dating for our coral boulders.

Keywords: tsunamigenic boulder, viscous remanence, time-temperature relation, stretched exponential

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)


SEM34-P12 Room:Convention Hall Time:May 24 18:15-19:30

# Precise determination of Fe species in plagioclase crystals: a preliminary study

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Silicate minerals such as plagioclase and pyroxene sometimes contain fine-grained magnetite crystals; such silicates are called magnetic silicates. Magnetic silicates are ubiquitous in mafic and intermediate plutonic rocks [Dunlop and Ozdemir, 1997; Gee and Kent, 2007]. As the middle and lower crust have greater mafic composition than the upper crust [Rudnick and Gao, 2004], magnetic silicates should play an important role in controlling the magnetic properties of deep crustal rocks. For understanding the sources of magnetic anomalies, which are often originated from thick magnetized layers within the crust [Shive et al., 1992 and reference therein], it is crucial to investigate the condition of exsolution of magnetite in silicate minerals.

In this study, to precisely determine the chemical species of Fe in the plagioclase crystals, magnetic measurements combined with microscopic observation and synchrotron radiation study were conducted for single grain plagioclase crystals. We prepared the two types of plagioclase crystals from (1) the basalt (Ofunato scoria) from the Miyakejima volcano [Ushioda et al., 2014] and (2) the gabbro from the Oman ophiolite [Sato et al., submitted]. The plagioclase crystals were collected under a stereoscopic microscope and used for the measurements after a hydrochloric acid (HCl) leaching for several days.

The main series of measurements for the single grain plagioclase crystals were as follows. (1) To estimate a content of magnetic mineral in the plagioclase crystals, magnetic hysteresis loop was measured using an Alternating Gradient Magnetometer (Micro-Mag 2900, Princeton Measurements Corporation) and magnetic hysteresis parameters (saturation magnetization $M_s$, saturation remanence $M_{rs}$, coercivity $B_c$, and coercivity of remanence $B_{cr}$) were calculated. (2) To investigate chemical compositions of the plagioclase crystals, microscopic observation was conducted using a field emission electron microprobe (JXA-8530, JEOL). (3) To investigate valence state of Fe, K-edge X-ray absorption near edge structure (XANES) spectra were measured at BL-4A of Photon Factory (PF).

The $M_s$ value for the plagioclase crystals of the basalt and gabbro samples were $<5 \times 10^{-4}$ $Am^2$/kg and ca. $1 \times 10^{-2}$ $Am^2$/kg, respectively. Therefore, the plagioclase crystal of the gabbro contained substantial amount of magnetic minerals, while that of the basalt contained no or little magnetic mineral. Taking into account the Curie temperature of 548 $^oC$ [Sato et al., submitted], the ulvospinel content for the plagioclase crystal of the gabbro was estimated to be x = 0.047 [Hunt et al., 1995] and the magnetite content was estimated to be 0.011wt%.

The microscopic observation showed that the FeO contents for the plagioclase crystals of the basalt and gabbro samples were 0.45wt% and 0.18wt%, respectively. The XANES analysis showed that the valence state of Fe for the plagioclase crystals of the basalt and gabbro samples were ca. 2.54 ($Fe^{3+}/Fe^{2+}$ = 1.17) and ca. 2.59 ($Fe^{3+}/Fe^{2+}$ = 1.44), respectively. In the case of the basalt sample, all Fe was contained in the plagioclase crystal, which is consistent with the thermal history of the Miyakejima basalt [Ushioda et al., 2014]. In the case of the gabbro sample, about 95% of Fe was contained in the plagioclase crystal and the remaining 5% of Fe was exsolved as magnetite crystals. The presence of magnetite was also suggested by the linear combination fitting of XANES spectra.

Now, our plan is to conduct high temperature heating experiment for the plagioclase crystals with varying the oxygen fugacity. On the basis of the measurements results for the samples before and after heating, we will discuss the high temperature heating effect on the Fe chemical species in the plagioclase crystals.

Keywords: Plagioclase, Magnetic silicate, Rock-magnetism, XANES

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# The magnetic structure in Taiwan

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In this study, the main focus is to construct a magnetic structure model for Taiwan. The well covered total-field geomagnetic anomaly map in Taiwan was calculated by the observed data during a series of survey at 2003-2004. A new 3D forward modeling of total-field magnetic anomaly method was applied to our calculation. We assign the susceptibility to the particular rectangular prism from the reference studies, which had defined the susceptibility from the result of Geological survey. Two profiles in West-East direction and one in North-South direction has been studied. The modeling total-field magnetic anomaly along these profiles are used to compare with the observed data and further discuss the magnetic structure along with it.

Keywords: geomagnetic, Taiwan, magnetic structure