Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-01 Room:203 Time:May 25 10:45-11:00

Luminescence and ESR for dating and earth/planetary science

Shin Toyoda[1*], Masashi Takada[2]

[1]Okayama University of Science, [2]Nara Women's University

Electron spin resonance (ESR), thermoluminescence (TL), optically stimulated luminescence (OSL), and cathodoluminescence (CL) are methods based on solid state physics. They have quite long been used to study minearals, but not used to detect environmental change or large events quantitatively. ESR detects and quantify unpaired electrons, which are formed by radiation associated with lattice defects and with impurities. TL and OSL, based on the same principle, detects electrons formed by radiation and trapped at lattice defects and impurities, by observing the light which is emitted at the time of recombination. The major applications of these three methods have been dating. In particular, OSL dating method has become one of the most popular techniques in dating Quaternary sediments, like cabon-14 method. ESR dating method has succeeded in dating calcite, aragonite, and hydroxyapatite, however, still has many problems in dating quartz, which is one of the most popular minerals on the surface of the earth. CL is luminescence emitted when the mineral is irradiated by electrons, which is associated with lattice defects and impurities. CL has been used to check zoning which cannot be detected by SEM or by major element analysis when zircon is used for dating.

All these four methods detect small features in crystal such as lattice defects or impurities. New applications with these methods are now emerging such as identification of the source materials and detection and quantitative determination of shock events, in addition to conventional dating. In the presentation, the principle of the technique and the dating application, their current status, and these new application will be summarized.

Keywords: ESR, OSL, TL, CL, dating, luminescence

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-02 Room:203 Time:May 25 11:00-11:15

Use of ESR for study of geothermal activity

Keiko Mizugaki[1*]

[1]AIST, GSJ

ESR measurement is very useful in study of geothermal activity to date events, as well as to analyze thermal history. It can be applied other geological features, for example, to evaluate thermal influence at geological disposal sites.

1. Achievements

(1) ESR dating of quartz veins (Mizugaki, 2002)

ESR ages show that a younger hydrothermal event has been superimposed on older event products.

(2) ESR dating of quartz phenocrysts in hydrothermally altered rocks (Mizugaki, 2005)

In an active geothermal field, ESR ages of central silicified zone are younger, while those of peripheral zone are older. Both of them are much younger than original ages, then ESR ages show degrees of annealing by recent thermal activity. One sample shows younger age in peripheral zone, which located on a topographic lineament.It means that a fracture zone exists along the lineament, and hydrothermal fluid flow has been limited in it.

2. Future directions

Where very hot water springs out from a crack in quartz-rich rock, correlation between annealing and distance from the springing crack may be measured using ESR.

References: Mizugaki(2002) Advances in ESR Applications, 18, 181-186; Mizugaki(2005) Abst. 2005 Japan Earth and Planetary Sci. Joint Meeting, G018P-023

Keywords: ESR, electron spin resonance, geothermal activity, hydrothermal activity, thermal history

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-03 Room:203 Time:May 25 11:15-11:30

Relationship between OSL ages and water contents in the case of Japanese sediments

Masashi Takada[1*]

[1]Nara Women's University

There are a number of dating methods for Quaternary. Radiocarbon dating, for example, which can establish the time of formation of a wide range of organic materials, is predominant for late Quaternary ages, but for direct dating of the time of deposition of sediments the methods are relatively few (Aitken, 1998). The optically stimulated luminescence (OSL) dating (Huntley et al., 1985) is now used as an important tool for geoscientists concerned with sedimentary processes of the last million years or so, and also to some extent for archaeologists. It has been widely used for European, North American and Oceanian sedeiments. Though a number of OSL ages have been obtained from Indian and Chinese sediments in Asia also, OSL ages from Japanese sediments are not so many. In this study, the author report several OSL ages of Japanese Quaternary sediments and compare them with sedimentary sequence and other estimated ages, to discuss the relationship between water contents and OSL ages.

Aitken, M. J. (1998): An introduction to optical dating. Oxford University Press.
Huntley, D. J., Godfrey-Smith, D. I. and Thewalt, M. L. (1985): Optical dating of sediments. Nature, 313, 105-107.

Keywords: OSL dates, water content, Quaternary, sediments, the Japanese Archipelago

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-04 Room:203 Time:May 25 11:30-11:45

Radiation dosimetric survey logger with a NaI scintillator

Chihiro Yamanaka[1*], Akira Taniguchi[2]

[1]Graduate School of Science, Osaka Univ., [2]EMF-JAPAN Co.,Ltd.

NaI scintillators are widely used to investigate spatial dose rate in fields. Although, gamma-spectrometers are superior in spectral resolution, NaI scintillators have advantage in mobility in the field and should be meaningful devices for ESR/Luminescence dating. We have been successfully developed and tested as mobile dose survey loggers using NaI scintillators, including unfolding techniques of spectra, stabilization of environmental parameters for the device and calibration of spectra.

Keywords: NaI scintillator, Radiation, Dosimetry, logger

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-05 Room:203 Time:May 25 11:45-12:00

Thermoluminescence Study of Chondrites

kiyotaka ninagawa[1*], Hironori Matsui[1], Hirotoshi Kasane[1], Naoya Imae[2], Hideyasu Kojima[2]

[1]Okayama University of Science, [2]National Institute of Polar Research

Induced TL (thermoluminescence), the response of a luminescent phosphor to a laboratory dose of radiation, reflects the mineralogy and structure of the phosphor, and provides valuable information on the metamorphic and thermal history of meteorites. Especially the sensitivity of the induced TL is used to determine petrologic subtype of unequilibrated ordinary chondrites [1]. Natural TL, the luminescence of a sample that has received no irradiation in the laboratory, reflects the thermal history of the meteorite in space and on Earth. Natural TL data thus provide insights into such topics as the orbits of meteoroids, the effects of shock heating, and the terrestrial history of meteorites [2]. Natural TL properties are usually applied to find paired fragments [3-5].

This time we measured induced and natural TL properties of new twenty-four Yamato chondrites from Japanese Antarctic meteorite collection. Sampling positions of these chondrites were measured by GPS.

Most of the chondrites had TL sensitivities over 0.1 (Dhajala=1), corresponding to petrologic subtype 3.5-3.9. One chondrite, Y981221 (H3), was revealed to be a primitive ordinary chondrite, petrologic subtype 3.2-3.3. It is particularly significant in understanding the nature of primitive material in the solar system.

Natural and induced TL properties were also applied to find paired fragments. We found eight potential paired fragments, i) Y981275 - Y981285(L3), ii) Y981175 - Y981186(H3), iii) Y981278 - Y981283(L3), iv) Y981275 - Y980593(L3), v) Y981283 - Y980453(L3), vi) Y981301 - Y981285(L3), vii) Y981140 - Y980660(H3), viii) Y980593 ? Y981285(L3) by TL, satisfying the criteria of 1) the natural TL peak height ratios, LT/HT, should be within 20%; 2) that ratios of raw natural TL signal to induced TL signal should be within 50%; 3) the TL peak temperatures should be within 20oC and peak widths within 10oC.

References

[1] D. W. G. Sears et al. 1991. Proceedings of Lunar and Planetary Science 21:493-512.
[2] P. H. Benoit et al. 1991. Icarus 94: 311-325.
[3] K. Ninagawa et al. 1998. Antarctic Meteorite Re-search 11:1-17.
[4] K. Ninagawa et al. 2002. Ant-arctic Meteorite Re-search 15:114-121.
[5] K. Ninagawa et al. 2005. Antarctic Meteorite Re-search 18:1-16.

Keywords: Thermoluminescence, Chondrite, Subtype, Pairing

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-06 Room:203 Time:May 25 12:00-12:15

Detection of radiation-induced defect center in plagioclase using cathodoluminescence spectroscopy

Masahiro Kayama[1*], Hirotsugu Nishido[1], Shin Toyoda[2], Kosei Komuro[3], kiyotaka ninagawa[2]

[1]Res. Inst. Nat. Sci., Okayama Univ. Sci., [2]Dept. Appl. Phys., Okayama Univ. Sci., [3]Life Environment. Sci., Univ. Tsukuba

Cathodoluminescence (CL) techniques have been used as an effective method to visualize radiation halos in quartz. Recent scientific interests focus on the CL of quartz as a goedosimetry indicator to clarify the formation process of CL halos, whereas no method has yet been developed for a quantitative estimation of the radiation dose on quartz from disintegration of natural radionuclides. Feldspar is one of the most important rock-forming minerals in the Earth's crust, of which CL depends on the genetic conditions such as temperature, pressure, and radiation dose during various geologic processes. Geoscientific applications of the CL of feldspar minerals, therefore, have been extensively explored for the study of mineral genesis interpretation. No investigation of radiation effects on CL of feldspar has been performed to date, although the visible halos can be easily found in the feldspar directly attached to radioactive minerals. In this study, CL of plagioclase implanted by He^{+} ion has been conducted to quantitatively estimate the radiation dose from disintegration of natural radionuclides possibly to be applied to geodosimetry.

Single crystals of albite (Or_1Ab_{99}) from Minas Gerais, Brazil, oligoclase ($Or_2Ab_{82}An_{16}$) from Inabu, Japan, andesine ($Or_1Ab_{53}An_{46}$) from Bekily, Madagascar; and anorthite (Ab_5An_{95}) from Yoichi, Japan were selected for CL and Raman measurements. He^{+} ion implantation (dose density: 2.18 x 10^{-6} to 6.33 x 10^{-4} C/cm^2) on the samples was performed using a 3M-tandem ion accelerator at 4 MeV corresponding to the energy of alpha-particles from 238U. A scanning electron microscopy-cathodoluminescence (SEM-CL) was used to obtain CL spectra of these plagioclase. Operating conditions were set at 15 kV (accelerating voltage) and 1.0 nA (beam current).

CL spectra of unimplanted plagioclase consist of emission bands at 350, 420, 580 and 700?740 nm which are assigned to Ce^{3+} impurity, Ti^{4+} impurity or Al-O^{-}-Al defect, Mn^{2+} impurity and Fe^{3+} impurity centers, respectively. Similar emission bands were recognized in CL spectra of the implanted plagioclase. The intensities of these CL emissions decrease with an increase in radiation dose of He^{+} implantation. Raman spectroscopy on the plagioclase reveals that Raman peak at 505 cm^{-1} shows a decrease in the intensity and an increase in the full width at half maximum (FWHM) with increasing radiation dose of He^{+} ion implantation. He^{+} implantation destroys a linkage of T-O-T bond in the framework structure of the plagioclase, resulting in a reduction of CL emissions caused by impurity centers. CL spectra of implanted samples of albite and oligoclase exhibit characteristic red emissions at 700 nm, of which intensities increase with an increase in the radiation dose. It suggests that CL emissions at 700 nm are assigned to radiation-induced defect center formed by He^{+} ion implantation. Deconvolution of CL spectra obtained from the implanted albite and oligoclase can successfully separate emission bands into six Gaussian components at 3.05, 2.82, 2.10, 1.86, 1.67, and 1.56 eV, where the component at 1.86 eV is undetectable in unimplanted samples. Integral intensity of the component at 1.86 eV linearly correlates with the radiation dose of He^{+} ion implantation. The deconvoluted CL spectra of andesine and anorthite, however, have no component at 1.86 eV. These results suggest that the component at 1.86 eV might be assigned to $O^{1-}/^{27}Al$ x $2^{23}Na$ center. The component intensity at 1.861 eV correlates with the radiation dose as a function of $O^{1-}/^{27}Al$ x $2^{23}Na$ center, but does not depend on the concentration and distribution of the emission center, degree of Si-Al order and on the presence of microstructures or texture. CL spectral deconvolution, therefore, should be applied to quantitatively evaluate radiation dose of alpha particles from natural radionuclides on Na-rich feldspar as a geodosimetry indicator.

Keywords: cathodoluminescence, plagioclase, radiation-induced defect center, radiation halo, deconvolution

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-07 Room:203 Time:May 25 12:15-12:30

Coastal transportation process of sands presumed from OSL intensity of alkali feldspar around the Sinano river mouth

Ryo Hayashizaki[1*], Masaaki Shirai[1]

[1]Tokyo Metropolitan University

In this research recent coastal sand grain transportation process around the Shinano river mouth is presumed using the bleaching percentage (BLP) estimated from OSL intensities of alkali feldspar grains contained in sand samples in addition to grain size distribution and the minerals ratio that had been used previous researches. The BLP distribution has the possibility of being useful for estimating recent coastal transportation process of sand grain which is not understood enough by the traditional method of grain size distribution and the mineral ratio. Generally, it is expected that bleached grain increase if transportation distance increase. Whereas sand grains eroded from beach probably obtained OSL intensity during its burial at beach.

As a result of research, it was presumed the sand grains which supplied from Ohkouzu Diversion Channel were transported to about 23 km northeasterly the Yotugouya-hama beach. The BLP distribution indicates the sand eroded from beach transportation process at the Nozumi beach, northern side of the Ohkouzu Diversion Channel mouth.

Keywords: transportation process of sands, OSL, alkali feldspar, grain size distribution, beach erosion, Ohkouzu Diversion Channel

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-08 Room:203 Time:May 25 12:30-12:45

Study of ESR signals and TLCIs from natural quartz for sediment provenance

Aiko Shimada[1*], Masashi Takada[2], Shin Toyoda[3]

[1]JEOL.Ltd, [2]Nara Women's University, [3]Okayama University of Science

Introduction

Quartz is one of the most abundant minerals on the surface of the earth. ESR dating of quartz, therefore, has been applied to a wide variety of samples, such as fault gouge, volcanic tephra, sediments, and flint artifacts [1]. Another direction of studies is to utilize the ESR signals as a marker of the samples like isotope analysis. The intensity of the E1' center in quartz is shown to be a useful parameter to investigate the provenance of Aeolian dust as well as of sediments [2]. As the intensity correlates with the age of the host granite in the range 10 Ma to 1 Ga, it is possible to distinguish quartz grains of Tertiary origin from those of Cretaceous. The Al, Ti-Li and E1' center signal intensity of natural quartz grains were irradiated with 2.5kGy gamma doses, as a means of estimating sediment provenance [3]. Samples were prepared various the host rocks and the sediments of Tertiary and Quaternary around Kizu River and Saho River. In this study, it will be discussed to estimate those sediments provenance. If this technique is established, it will be useful to elucidate the provenance of river basin and the encroachment of mountain.

Sample preparation and experiments

Quartz grains for ESR measurements and TLCIs were extracted from the host rocks and the sediments. The samples were irradiated 2.5kGy gamma dose, then heated at 270 degree Celsius for 15minutes to ensure that the intensity of E1' center signals approaches to the maximum. ESR spectra recorded on an ESR spectrometer (JEOL TE-100, FA200; X-band), operating amplitude of field modulation was 0.1mT at 100kHz modulation frequency. The ESR signals of E1' center signal were observed using a microwave power of 0.01mW at room temperature. The ESR intensities of the Al and Ti-Li centers were measured with a microwave power of 5mW at 77K.

Temperature range of TLCIs measurement were 200-400 degree Celsius to provide a heating rate 30 degree Celsius/s.

Result and discussion

The ESR signal intensities were found useful to distinguish the sediment provenance. The results in TLCIs were well correlated to the ESR results. The combination use of the ESR signal intensities and the characteristics of TLCIs were effective to investigate the fine-grained sediment provenance.

References

[1]Ikeya, M., Miki, T. and Tanaka K., Dating of a fault by electron spin resonance on intrafault materials. Science, 1983, 215, 1392-1293.

[2]Toyoda, S. and Naruse, T., Eolian Dust from Asia Deserts to Japanese Island since the last Glacial Maximum: the Basis for the ESR Method, Japan Geomorphological union, 2002, 23-5, 811-820.

[3]Shimada, A. and Takada, M., Characteristics of Electron Spin Resonance (ESR) signals in quartz from igneous rock samples: a clue to sediment provenance. Annual Reports of Graduate School of Humanities and Sciences, 2007, 23, 187-195.

Keywords: Electron Spin Resonance, Thermoluminescence, quartz grain, sediment, provenance

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-P01 Room:Convention Hall Time:May 25 14:00-16:30

Temperature quenching mechanism of cathodoluminescence in forsterite

Hirotsugu Nishido[1*], Taro Endo[1], kiyotaka ninagawa[2], Masahiro Kayama[1], Arnold Gucsik[3]

[1]Okayama University of Science, [2]Okayama University of Science, [3]Max Planck Institute

Cathodoluminescence (CL), the emission of visible light caused by electron irradiation, has been widely applied to geoscience by the reason of high detection sensitivity of emission center such as impurity elements and various structural defects. Recently, CL zoning of the forsterite in carbonaceous meteorites has been investigated to clarify the origin and thermal history of the chondrules. In this case, small amount of divalent Fe ions as quencher easily eliminate CL emissions caused by impurity and defect centers, so only near end forsterite can show CL emissions. Sample temperature is one of most important effects on CL in minerals, but has not been investigated to date for the forsterite. In this study, the effect on forsterite CL has been quantitatively analyzed by assuming the Mott-Seitz model for temperature quenching of luminescence.

Forsterite crystals (Fo: 99.1) in basalt from Mogok, Myanmar and micro-grains (Fo: 99.7?99.8) in chondrules from Allende and Kaba meteorites were prepared for CL spectral measurements. CL spectroscopy was made by a SEM-CL system, which is comprised of SEM (JEOL: JSM-5410) combined with a grating monochromator (OXFORD: Mono CL2) at accelerating voltage of 15 kV and beam current of 1.0 nA in a beam scan mode. The sample temperature was controlled by flowing liquid nitrogen and using an embedded heater in a cryostage. All spectra were corrected for total instrumental response, which was determined using a calibrated standard lamp.

At room temperature, the CL spectra show broad emission bands at around 400 nm in blue region and at around 650 nm in red region, and pronounced emissions increasing to IR region with small emissions at around 720 nm. These bands can be assigned to structural defect, divalent Mn and trivalent Cr impurities, respectively. Their emission intensities increase with a decrease in sample temperature. In general, luminescence efficiency decreases with rising temperature due to an increase in non-radiative transitions. This phenomenon is called temperature quenching.

CL spectral peaks in energy unit were deconvoluted by Gaussian curve fitting to determine the emission component for each emission center. The emission peak in blue region can be separated into two components centered at 3.15 and 2.99 eV, and the peaks caused by Mn and Cr impurity centers can be fixed at 1.91 and 1.74 eV, respectively. By assuming the Mott-Seitz model, activation energy in each temperature quenching process can be calculated by Arrhenius plots using integral intensity of each component. The straight-line relationships in the plots resulted in each activation energy as follows; blue emission at 3.15 eV: 0.08?0.04 eV, blue emission at 2.99 eV: 0.10?0.05 eV, red emission at 1.91 eV: 0.01?0.005 eV, red emission at 1.74 eV: 0.01?0.02 eV. The values of activation energies for blue emissions caused by structural defects correspond to the vibration energy of Si?O stretching mode in the lattice, and the values for red emissions caused by Mn and Cr impurity centers to Mg?O vibration energy. It suggests that the temperature quenching energy might be transferred as a phonon to the specific lattice vibration.

Keywords: Forsterite, Cathodoluminescence, Temperature quenching

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-P02 Room:Convention Hall Time:May 25 14:00-16:30

Cathodoluminescence characterization of forsterite in Kaba meteorite (CV3)

Taro Endo[1*], Arnold Gucsik[2], Hirotsugu Nishido[1], kiyotaka ninagawa[3], Masahiro Kayama[1]

[1]Okayama University of Science, [2]Max Planck Institute, [3]Okayama University of Science

The Kaba meteorite is the most primitive unshocked CV fall (in 1857) collected nearby Kaba village, East Hungary. This meteorite is subdivided into Bali-like CV3 chondrite by the reason of a similarity to the Allende meteorite. This meteorite contains porphyritic olivine-, granular and radial pyroxene-, and barred olivine chondrules, which are surrounded by magnetite and sulfide assemblages. The study of the refractory inclusions (CAI) indicates maghemite with inverse-spinel structure and higher FeO content in inner with lighter oxygen isotope ratio, whereas the outer part consist of MgO-spinel and scattered perovskite grains. The Kaba meteorite experienced aqueous alteration and contains hydrous phyllosilicates with altered features in constituent materials.

Cathodoluminescence (CL) emissions can occasionally be detected from olivine, especially forsterite, in meteorites, whereas terrestrial one mostly gives no luminescence. CL spectroscopy and microscopy provide useful information about the existence and distribution of lattice defects and trace elements in materials with high-spatial resolution of a few micron meters. In this study, therefore, CL of the forsterite in various types of chondrules has been characterized to clarify origin of the chondules in the Kaba meteorites.

Highly forsteric olivine (Fo: 99.2?99.7) in the Kaba meteorite emits bright cathodoluminescence (CL), whereas the olivine containing fayalitic composition, even if only slight, shows no luminescence due to quenching effect of divalent Fe ions. Red luminescent forsterite is predominant, but occasionally zoned forsterite shows blue in the core and red in the rim. CL spectra of red luminescent forsterite have two broad emission bands at approximately 630 nm in red region and over 700 nm in red?IR region. The former band can be assigned to impurity center of divalent Mn ion as an activator. The latter one shows a magnificent red emission in a wide range of wavelength responsible for trivalent Cr ions, which possess two components of Cr activator and structural defect caused by interstitial Cr ions. CL spectra from blue luminescent area in the core give a characteristic broad band emission at approximately 400 nm, also associated with minor red emissions related to Mn and Cr ions. EPM analysis reveals that the concentrations of Ca, Al and Ti increase toward the center of the grain. In this case, the quenching effect of divalent Fe ions on CL might be slight and homogeneous over a forsterite grain due to low and unvaried concentration of Fe. Therefore, CL color variation observed in Kaba forsterite should be attributed mostly to intrinsic structural defect, of which distribution cannot be detected by any other methods. It implies that aqueous alteration on the forsterite might eliminate intrinsic structural defects progressively from the rim of the grain to the core, accompanied by the migration of diffusible ions of Mn, Cr and Fe to the rim where Ca and Al ions might still lie in the core. This process could proceed at low temperatures (<300?C) over a short reaction time.

Keywords: Kaba meteorite, Forsterite, Cathodoluminescence

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-P03 Room:Convention Hall Time:May 25 14:00-16:30

ESR dating of barite in sulfide deposition formed by sea bottom hydrothermal activities

Fumihiro Sato[1*], Shin Toyoda[1], Debabrata Banerjee[1], Ai Uchida[1], Jun-ichiro Ishibashi[2], Shun'ichi Nakai[3], Asako Takamasa[3]

[1]Okayama University of Science, [2]Kyusyu University, [3]University of Tokyo

At the initial stage of studies on the seafloor hydrothermal activities, their temporal changes were not argued. However, their temporal changes, which are most probably controlled by geothermal conditions, is now an important issue in order to discuss its influence to the biosphere. For this purpose, new dating techniques are necessary, which are applied to hydrothermal minerals, in addition to conventional dating techniques.

Kasuya et al. (1991) pointed out the possibility of ESR (electron spin resonance) dating of barite ($BaSO_4$). *Okumura et al*. (2010) made the first practical application of this technique to the sea bottom hydrothermal barite where preliminary ages were obtained. However, in this paper, detailed discussion was not sufficient, such as the occurrence of barite included in sulfide chimney, contribution of each natural radiation from surrounding environment, optimum measurement conditions, and the stability of the signal.

In the present study, we investigated three basic issues on ESR dating of barite;(1)Optimum condition for ESR measurement (2)Thermal stability of the signal (3)Inhomogeneity of accumulated doses and dose rates.

Barite ($BaSO_4$) was extracted from hydrothermal chimney samples (220-E, 1354-R1, 903R7-2) taken from two sites at Okinawa Trough and at the Southern Mariana Trough. The radioactivity distribution of the chimney sample was observed in one sliced piece of chimney piece (903R7-2) to find that radioactivity is concentrated in barite with imaging plate after cutting into 13 blocks. About 2.0g of each block was crushed and was soaked in 12M hydrochloric acid. The beaker was covered with a watch glass and left for approximately 24 hours. Then, 13M nitric acid was added. Finally, after rinsing in distilled water, the sample was filtered and dried. Impurities were removed by handpicking. The extracted sample was examined by X-ray diffraction to confirm that the grains are pure barite. The dose rate was calculated assuming alpha and beta particles in an infinite system. We ignored the contribution of cosmic rays and considered the shape of the chimney about the gamma ray.

As a result, it was found that the signal of SO_3^- in barite starts to saturate at 0.01mW. Annealing experiments revealed that the signal is stable enough for age range of 10^2-10^3, which are the values we obtained for present samples. The inhomogeneity of accumulated doses and of dose rates will be discussed in the presentation.

Keywords: barite, electron spin resonance, dating, hydrothermal activities

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-P04 Room:Convention Hall Time:May 25 14:00-16:30

Thermoluminescence dating of Hakusan volcanic

yasuyuki nakano[1*], Noriko Hasebe[1], Kazumi Ito[1], Shoji Arai[1]

[1]Kanazawa University Graduate school

Geochronological study on various events related to the magma process is important to lead to the prediction of volcanic eruptions. The Hakusan volcano, central Japan, consists of Kagamuro, Kohakusan, Shinhakusan and Uguisudaira volcanoes, and the existence of the magma chamber and related seismicity was reported to raise the alarm on the future possible eruption (Hiramatsu, 2006).The eruption age of each volcano was measured by K-Ar dating method (Higasino et al, 1984,Sakayori et al, 1999,Kitahara et al, 2006). However, some of eruptions, except for Kagamuro volcano, are relatively young within applicable age range of K-Ar dating method, so that additional dating by other dating method should be useful to reconstruct eruption history of the Hakusan volcano. This study applies thermoluminescence (TL) dating to know the eruption age of Hakusan volcano. Five samples from the Kohakusan volcano were successfully dated by the TL method. However, TL signal for andesite from Shinhakusan volcano was so small that it was difficult to be detected. The TL age for dacite from Kohakusan volcano is about 60 ka and ages from andesite are about 100 ka, concordant with the K-Ar ages reported in previous studies. The eruption activity of the Kohakusan volcano spanned more than 40 kyrs. These ages are compared to crystallization ages of zircons within magma chamber (Miyamoto et al, unpublished data) estimated by U-Th method for the samples collected from the same localities. U-Th ages are different grain by grain, though peak crystallization occurred about 30kyr earlier than the eruption age. Based on these age data, the history of Kohakusan volcano is proposed. Crystallization occurred in andesite magma and then erupted at about 95 ka. At that time, next stage of crystallization within magma chamber was going on. Somehow magma chemistry had changed from andesitic to dacitic, and then erupted at around 60 ka to bring crystals formed at the time of previous eruption.

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-P05 Room:Convention Hall Time:May 25 14:00-16:30

TL dating of marker tephras for 100 ka relevant to archeological chronology

Yorinao Shitaoka[1*], Tsuneto Nagatomo[2]

[1]IGS, Kyoto University, [2]Nara University of Education

To determine the age of an archeological site accurately, tephra as key bed is one of the most important markers. It is effective to determine the age of tephra layer samples collected from the area close to the source vent of the tephra. The tephra sample near by the source vent, which is collected from a thick and less-altered layer, give us the most provable age of the tephra.

In this work, we try to determine the age of marker tephras using Thermoluminescence (TL) dating. We make a comparison between TL age and calibrated radiocarbon chronologies.

We think that the data set of numerical ages of marker tephras will constitute valuable contribution to the framework of the archeological chronology.

Keywords: marker tephra, TL dating, Archeological chronology, key bed

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-P06 Room:Convention Hall Time:May 25 14:00-16:30

Application of OSL dating to Tottori coastal dunes

Toru Tamura[1], Yu Saitoh[2*], Mark D. Bateman[3], Yoshinori Kodama[4], Dan Matsumoto[1], Naofumi Yamaguchi[1], Kazuaki Watanabe[1]

[1]Geological Survey of Japan, AIST, [2]Doshisha University, [3]SCIDR, University of Sheffield, [4]Tottori University

We examine a simplified method to obtain robust OSL age results from quartz sand samples with high recuperation based on young dune samples in the Tottori coast. Past topographic maps compiled 36 yrs and 77 yrs ago constrains depositional ages of 10 samples. A standard quartz single aliquot regenerative dose (SAR) OSL protocol was applied to these samples, but results showed age underestimation for most of them, including two that showed negative values of equivalent dose estimate. The underestimation was caused by a high recuperation due to a large contribution of the slow OSL component. To suppress the slow component contribution, we applied the early background (EBG) subtraction for estimating OSL intensity with a time window 7?19 s to a dose recovery test of 1.1 Gy for one of these samples, which successfully replicated the given dose. Thus, the EBG subtraction was applied to all of the young samples, appropriately estimating their ages except for one with a slight overestimation. Although it is uncertain what actually causes the large slow component, the method used here may be useful to analyze OSL dating results from sand samples in the Japanese archipelago that typically show high recuperation.

Keywords: optically-stimulated luminescence, chronology, Quaternary, coast, dune, sand

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-P07 Room:Convention Hall Time:May 25 14:00-16:30

OSL dating using fine quartz grains of Atotsugawa Fault

Yoshihiro Ganzawa[1*]

[1]Hakodate Campus Hokkaido Univ. of Edu.

An age evaluation of an active fault has been carried out tentatively using OSL signals emitted from crushed fine quartz grains. The tested sample was collected from Atotugawa Fault located in southern part of Toyama prefecture, which was the origin of the Hietsu earthquake in 1858.

The OSL equipment, designed by MEDC Co., Ltd and our lab, is composed of IR leaser stimulation unit (wave length:852nm) and detection unit cooperating DUG 11 filter (detection wave length:320-380nm). Different quartz grain samples in size, 63-125, 125-250, 250-355, 355-500 micron meter, were prepared for SAR dating method. Ten quartz grains were prepared for one aliquot to obtain sufficient OSL signal.

The expected equivalent dose (De) is calculated about 0.26Gy using the dose rate (1.68Gy/ka), which was estimated by U, Th, K and water content of the sample. The OSL De values lead by SAR method shows the centered value between 0.1 and 0.2Gy or value less than 0.1Gy.

Keywords: OSL dating, active fault, quartz grain, SAR method

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-P08 Room:Convention Hall Time:May 25 14:00-16:30

Luminescence dating of fine grained sediments from Lake Hovsgol, Mongolia

Kazumi Ito[1*], Noriko Hasebe[1], Kenji Kashiwaya[1], Yoshihiro Ganzawa[2]

[1]Kanazawa University, [2]Hokkaido University of Education

Sediment core samples are recovered from the lake bottom, and meaningful proxy records to represent surrounding environment are obtained along its depth. To convert the depth profiles to the age profiles, the age model determination plays an important role. This study aims to develop the new luminescence dating technique for small amount of samples of lake sediments and the technique must supply ages easily and quickly to provide many dated horizons in a core sample. For indirect annual dose calculation, new pellet making procedures is examined, and then laser ablation - inductively coupled plasma - mass spectrometry (LA-ICP-MS) is applied to measure the concentrations of radioactive isotopes (^{87}Rb, ^{232}Th, ^{234}U and ^{238}U). To investigate that the red thermoluminescence (RTL) from inorganic carbonate is capable of giving a reliable estimate of accumulated (or equivalent) dose since its deposition on the lake floor, the present work compare the result from RTL considering the residual dose of calcium carbonate from Lake Hovsgol to that estimated from conventional fine-grained quartz optical stimulated luminescence (OSL). Both equivalent doses are concordant considering the error range in most samples except for some samples which have particular reason, such as low equivalent doses and existence of authigenic carbonate. The depth profiles given based on luminescence ages are concordant with the age model of the other core sample from Lake Hovsgol and analyzed core has the environmental information from late MIS 5 or early MIS 4 to LGM.

Keywords: OSL, RTL, Lake sediments

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-P09 Room:Convention Hall Time:May 25 14:00-16:30

Thermoluminescence color image and paleoenvironment change in sediments of Lake Hovsgol, Mongolia

Ayako Inagaki[1], Noriko Hasebe[2*]

[1]NaturalSci.&Tech., KanazawaU., [2]Nature&EnvironmentalTech., KanazawaU.

The seasonal climate differences in continental interior are very intense due to the heat balance. Lake Hovsgol in Bikal Rift Zone is located on high plateau of Mongolia and has a small water catchment, which make the lake sensitive to insolation. The sediments of Lake Hovsgol record paleoclimate change in good condition because it has only one outlet at its south end, Egiin river, without influence of human activity. East Eurasia continent including this area have unique geological formation, mainly which controls the climate and environment of here, so specific information of local climate change is needed for understanding the mechanism of climate change in the entirely supracrustal.

A lot of proxies in core samples (e.g. diatoms, mineral particle size, biogenic SiO2, pollens, trace elements) have been used for reconstructing paleoclimate. In this study, thermoluminescence color image (TLCI) analysis is applied to continuous lake sediments core (HDP-04) and the validity as a new proxy is investigated.

TLCIs are recorded by digital camera and the images are converted into numerical information by using developed application. The color pixels are plotted on CIE (Commission Internationale de lEclairoge) chromaticity diagram and counted within a color zone for statistical color analyses. The diagram makes us understand the characteristic of TLCI visually.

TLCI analytical results for Lake Hovsgol sediments are ;

1) The emission intensities of TLCIs were different from sample to sample, though TLCIs showed poor reproducibility based on the large standard deviations of emission intensities on the same samples.

2) The emission intensity of TLCI and the amount of HCl-soluble-material showed similar fluctuation and the color pixel points on CIE chromaticity diagram fell in the same region with those for calcium carbonate from Darkhad basin.

3) The emission intensities of coarse samples were higher than that of fine samples.

4) A small number of color pixel points were found on blue-purple region apart from main cluster of pixels in the CIE diagrams of fine samples, however, we couldn't find the concrete evidence of presence of eolian dust fractions due to few samples analyzed.

5) The emission intensity seemed to have no relation with glaciation or insolation cycles except for several events, in which the emission intensity and the rate of red emission were decreased.

6) By spectrum analysis, the emission intensity shows cycles in connection with insolation as was found in HCl-soluble-material and grain size fluctuation.

The emission intensity does not fluctuate irregularly and must reflect amount of HCl- soluble-material and something else. More investigations of the factor having an influence on the emission intensities of TLCIs are needed. In addition, we must consider the most suitable color threshold on CIE chromaticity diagram for sample characterization. It is suggested that TLCI analysis will be valuable as a proxy of climate change in the future.

Keywords: thermoluminescence, Lake Hovsgol, paleoenvironment, HCl-soluble-material

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-P10 Room:Convention Hall Time:May 25 14:00-16:30

Temporal change of the sources of aeolian dust delivered to East Asia revealed by ESR signals in quartz

Yuya Yamamoto[1*], Shin Toyoda[1], Kana Nagashima[2], Isozaki Yuko[3], Ryuji Tada[3], Yasuhito Igarashi[4]

[1]Okayama University of Science, [2]JAMSTEC, [3]The Univeristy of Tokyo, [4]Meteorological Research Institute

Change of atmospheric circulation system in the past is an important issue for studies of paleoclimate. Aeolian dust, fine particle suspended in air and brought by wind, is a clue to know the wind direction and the strength in the past. Historical record of aeolian dust accumulation in Japan will give important information on this issue as well as on the climate change in the arid source regions in China. Various features, such as grain size distribution, mineral compositions, and isotope compositions, have been investigated for loess sequence for this purpose. In the present study, we would like to propose that ESR signals in quartz are other good proxies as well.

Electron spin resonance (ESR) detects unpaired electrons in minerals, trapped at lattice defects and impurities. In quartz, we observe the signals due to the E_1' center, an unpaired electron trapped at an oxygen vacancy, the Al hole center, an electronic hole at aluminum impurity atom replacing a silicon, the Ti centers, and the Ge center. It was shown previously that, by measuring the number of oxygen vacancies, the precursor of the E_1' center, in loess sequence, the aeolian dust source in Holocene was different from that in LGM (Toyoda and Naruse, 2002). Later, the crystallinity index was found to be another proxy for such studies. Temporal change of the origins of the eolian dust accumulated in the Sea of Japan was found to be correlated with the climate change by using these proxies (Nagashima et al., 2007).

The dust samples taken at meteorological observatories in Japan since 1960's were examined by the same method. It was found that finer grain fractions contain more dust component of Chinese origin than coarser fractions and that the ratio of the Chinese component varies year to year.

The number tends to decrease with time (1964-1990) with some variation from 9 to 1.5 (1.3×10^{15} spins/g) in June and from 3 to 1.8 in March. The number in June is higher than the one in March in the 1960s while it is opposite in the 1970s. The decrease of the number of oxygen vacancies can be due to change in sources of dust in China.

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS028-P11 Room:Convention Hall Time:May 25 14:00-16:30

Standard procedures for evaluing the oxygen vacancies and the crystallinity index in quartz: applications to provenance

Shin Toyoda[1*], Yuya Yamamoto[1], Tomohiro Yoshida[2], Ryuji Tada[2], Kana Nagashima[3]

[1]Okayama University of Science, [2]University of Tokyo, [3]JAMSTEC

The number of oxygen vacancies, obtained by ESR (electron spin resonance) measurements, and the crystallinity index, obtained by X ray diffraction studies, have been found to be good proxies in estimating the origin of aeolian dust. The variations of origins of aeolian dust were investigated using these techniques to discuss the changes related to temporal changes in climate and monsoon by examining the loess sequence in Japan and the sediments in Japan Sea.

However, the methodology of these techniques has not yet been established. For example, gamma ray dose which is thought to be necessary to evaluate the number of oxgen vacancies by ESR, and scan speed and scan range vary depending on the researchers. In case of fine atomospheric deposition, it is very difficult to obtain pure quartz by chemical treatment. Therefore, the value is obtained by dividing the observed value by the quartz content, which is measured by X ray diffraction. It may be an issue to examine to test if the value varies depending on the quartz content. In the present study, we study the best measurement parameters for these techniques.

Keywords: ESR, crystallinity index, quartz, provenance