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

SGL041-01 Room:203 Time:May 25 08:30-08:45

Prediction of Palaeoenvironment and Geologic Stratigraphy after Pleistocene in the Western Seto Inland Sea

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Japanese only

Keywords: western seto inland sea, alaeoenvironment, fluctuation of sea level due to climate change, boring survey, geologic stratigraphy

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SGL041-02 Room:203 Time:May 25 08:45-09:00

Application of the finer-separated illite in fault gouge for K-Ar dating

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Direct dating of fault gouges can be critical for the age determination of brittle deformation when the timing is difficult to constrain from stratigraphical and geomorphological methods. We present the K-Ar age data for two fault gouge samples corrected from the Mizunami Underground Research Laboratory. The gouge samples were separated into four grain-size fractions of $<$0.1, $<$0.4, $<$2, 2-6 micrometer by using high speed centrifuge. The finer-size fractions yield younger K-Ar ages, suggesting that the finer-size fractions contain a high degree of authigenic illite. And, the K-Ar ages of the finer-size fractions were bracket by fission track ages of zircon and apatite separated from the wall rocks, indicating the illite grew at temperatures in the range about 100-250 degree Celsius, consistent with the stability of illite. These observations demonstrate the applicability of this method for direct dating of brittle deformation.

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SGL041-03 Room:203 Time:May 25 09:00-09:15

Zircon thermochronology of fault zones:A case study of the Okitsu region, Shikoku Island

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Quantitatively understanding of heat generation and transformation associated with faulting is a key to understand not only dynamics of faults but also heat budget, temperature structure and range records. To understand thermal history along faults, geologic thermometers such as thermochronometers, homogenization temperatures of fluid inclusions and vitrinite reflectances have been used. Zircon fission-track thermochronology has been one of the most powerful tools to reveal thermal history along faults (e.g., Murakami et al., 2004; Tagami and Murakami, 2007). Zircon fission-track thermochronology has advantages as below: (1) fission tracks are annealed only by heating, (2) zircon is physically robust and chemically stable and can occurs along fracture zones, and (3) short-term annealing kinetics of zircon fission tracks is well understood based on laboratory experiments.

In the Okitsu region, annealed ziercon fission tracks were observed for all samples collected across the fault. This observation is consistent with results of ZFT analysis reported by Sato (2004 MS) and Inoue (2010 BS). It implies that wide area along the fault was heated.

Keywords: Thermochronology, Fault, Shimanto belt, Zircon

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SGL041-04 Room:203 Time:May 25 09:15-09:30

Thermochronology of bentonite

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Bentonite consists mainly of montmorillonite and caused by diagenesis or hydrothermal alteration of tuff rock. In the geological disposal of high-level radioactive waste, compacted bentonite is planned to be used as the covering of carbon steel overpack. However, Fe(II)-bearing fluid originated from carbon steel may cause the alteration of bentonite. To predict what will happen in nature, natural analog study in the field where bentonite was altered by iron in nature is important. In Kawasaki and Shirosaki bentonite deposit, northeast Japan, one can find the greenish veins which may indicate the presence of interaction between iron bearing fluid and bentonite. To discuss the alteration temperature and period of bentonite, eruption event of parent rock of bentonite and formation event of bentonite, samples (greenish vein, altered bentonite, unaltered bentonite, original tuffaceous rock found in bentonite and so on) were collected, and fission track (FT) and 238U-206Pb dating were applied.

Apatite FT age could be calculated from samples both Kawasaki and Shirosaki deposit except for samples bearing no apatite grains. However, apatite FT age derived from most of the samples have large error because of small amount of apatite grains and low track density caused by relative low 238U content. Zircon FT and 238U-206Pb age was calculated for 6 samples (greenish vein, unaltered bentonite and original tuffaceous rock for each deposit). Samples from Kawasaki deposit were additionally FT dated by conventional method using neutron irradiation after FT dating using LA-ICP-MS. Apatite FT length data of all samples was not enough to discuss the thermal history of bentonite in detail, although 252Cf irradiation method was used. Because samples from Shirosaki deposit contained small amount of apatite grains and apatite FT length data, it is difficult to discuss in detail using analyzed data derived from Shirosaki samples.

Apatite from bentonite samples in Kawasaki deposit may indicate 238U diffusion or crystal dissolution and recrystallization process. Timing of these processes was probably consistent with formation of bentonite. Considering the results of this study and previous study, if 238U diffused, formation age, temperature and period of bentonite was estimated at about 15Ma, 46-48oC and more than 1m.y. If apatite dissolved and recrystallized, alteration temperature and period of bentonite was estimated at about less than 100oC and more than 1m.y. It may be considered from distribution of 238U-206Pb age that mixing of different rock into parent rock prevented parent rock from bentonite formation.

Two FT datings of same apatite grain from Kawasaki deposit using LA-ICP-MS and neutron irradiation indicated different FT age. Because this may suggest significant problem of FT dating using LA-ICP-MS, further discussion about this result is required.

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SGL041-05 Room:203 Time:May 25 09:30-09:45

Pb-Pb dating of Middle Permian carbonate rocks from an accretionary complex in Kyushu, Japan

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Pb isotope data and a resulting age are obtained on Guadalupian (Middle Permian) carbonate rocks from Kamura, N-Chichibu belt, in Kyushu. The study section is composed of the Guadalupian Iwato Formation and Lopingian Mitai Formation, spanning across the Guadalupian and Lopingian (G-L) boundary characterized by a major biotic crisis. Because the limestone in Kamura area primarily deposited on ancient mid-oceanic seamount, it does not contain any zircons or appropriate minerals for isotopic dating. Direct Pb-Pb dating of carbonate rocks provides a useful tool to constrain the age of the Middle-Upper Permian sedimentary sequence where no volcanic beds are available for isotopic dating. We analyzed 11 samples of fine-grained limestones in bulk from the Upper Iwato Formation that is constrained to the Capitanian interval (265.8-260.4 Ma), Guadalupian, by fusulines. The limestones yielded Pb-Pb isochron ages of 252 +- 24 Ma that is interpreted to date the time of early diagenesis as it correspond to the published biostratigraphic age. The data points form a reasonably good linear array, and the geologically meaningful age could be obtained for the Permian limestones as an application to the youngest limestones of the previous works, despite relatively high age uncertainties.

Keywords: Permian, Pb-Pb dating, limestone

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SGL041-06 Room:203 Time:May 25 09:45-10:00

Merits of LA-ICP-MS U-Pb zircon dating method: From two case studies

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LA-ICP-MS has an advantage of inexpensive, simple and quick technique to obtain U-Pb ages over conventional TIMS and SIMS (SHRIMP) techniques. It also has a merit to obtain fission-track ages using the same zircons prepared for U-Pb dating and vice versa. Here, two case studies are presented using LA-ICP-MS equipped with 193 nm excimer laser in Kanazawa Univ.

As zircon U-Pb method has a closure temperature of as high as ~1000 degree C, it is useful to estimate the crystallization age of granitic magmas. As for the Ryoke granite in Awaji Island, a K-Ar hornblende age of 87.7 Ma had been the age of the highest closure temperature (~500 degree C). A newly obtained LA-ICP-MS U-Pb zircon age of 87.6 Ma could further constrain the crystallization age of the granite and also helped to reveal the entire cooling history of the granite from crystallization age to the present. As for granitic xenoliths from clastic dykes in Matsukawa geothermal area, Iwate Prefecture, a LA-ICP-MS U-Pb zircon age of 1.30 Ma was obtained. Because the zircons were previously dated as 1.0 Ma by the fission-track method (closure temperature: ~240 degree C), the crystallization age of the granite was constrained ranging from 1.3 to 1.0 Ma. The U-Pb age was better in quality than the fission-track age in that individual grain U-Pb ages were more uniform than individual fission-track ages. This demonstrates that LA-ICP-MS can easily yield reliable U-Pb zircon ages as young as 1 Ma and promises a bright future for this method.

Keywords: LA-ICP-MS, U-Pb dating, zircon, granite, Quaternary

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SGL041-07 Room:203 Time:May 25 10:00-10:15

3D subtraction imaging and U, Th concentration measurement of single grain of zircon

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(U-Th)/He age is calculated from helium content in a crystal generated by alpha decay. Alpha particles, nuclei of helium, are emitted with high kinetic energies and typically require about 20 micrometers to stop within zircon. These long stopping distances partly cause helium loss from near surface zone in the crystal and underestimation of (U-Th)/He age. This effect is corrected from the size and shape of crystals at present, called ”alpha correction”. Although this correction assumes a homogeneous distribution of decay precursor, it is not always appropriate, especially in zircon.

Therefore we need to measure 3D distribution of U and Th in the crystal for more accurate alpha correction before (U-Th)/He dating, and the measurement have to be performed without destruction of the crystal for following (U-Th)/He method. 3D subtraction imaging of micro X-ray computed tomography is one of such methods. However, a high-flux source is required for this application because a bulk zircon crystal absorbs/scatters X-rays. In this study, we tried to take the images of ten grains using a micro X-ray computed tomography facility in the large synchrotron radiation facility ”SPring-8”. At the result, we succeeded to detect a 3D varied distribution without destruction of the crystal. We also measured concentrations of U and Th using laser ablation ICP-MS in some of the crystals to investigate the sensitivity or detection limit of subtraction imaging of U and Th in zircon, and the effect for (U-Th)/He age.

Keywords: zircon, micro CT, subtraction imaging, (U-Th)/He dating

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SGL041-08 Room:203 Time:May 25 10:15-10:30

Development of un-irradiated and un-spiked laser fusion K-Ar dating: a trial applied to pyrite single grains

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Laser fusion measurements for a single grain of phenocryst or of in-situ measurement of less-abundant minerals found on thin sections are established for K-Ar dating method. For such kind of samples, Ar-Ar dating is applied widely to obtain radiometric ages because the Ar-Ar method is insensitive to the site difference between K and Ar in the specimen. However, Ar-Ar dating at least raises a difficulty that nuclides produced by irradiation mask some of the original isotope ratios in rock and mineral samples. In the cases of small amount of radiogenic 40Ar, large uncertainty is brought to ages useless by the masking. This motivates us to develop an un-irradiated and un-spiked laser fusion K-Ar dating method, with which we can analyze both Ar and K for the individual grains. This has been tested in following two protocols, which is K measurement following/after laser fusion Ar measurement applied to the retrieved single melted mineral grain itself. Especially, in this protocol, the model of the Hitachi Z-5010, which employs double-beam polarized Zeeman method for background correction, is used. The deuterium lamp and the polarized Zeeman method realize less background in atomic absorption photometry and the new optical system and the improved graphite furnace ensure high sensitivities. This method is expected to enable acquisition of precise radiometric ages of single grain K-Ar dating. Here we report a trial of single pyrite grain analyses from Nobeoka area coupled with multigrain analyses.

Keywords: K-Ar dating, laser fusion, in situ, single grain, un-spiked, un-irradiated