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

BPT022-P01 Room:Convention Hall Time:May 25 10:30-13:00

Influence of shallow-water hydrothermal activity on the REE geochemistry of iron-rich surface sediment in the Nagahama B

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Satsuma-Iwojima Island is a part of mostly-submerged Kikai Caldera in southwest Japan. Active low-temperature, shallow-water hydrothermal activity in the semi-closed Nagahama Bay of the island supplies dissolved Fe in its baywater, which is then oxidized to ferric hydroxide to form as brownish precipitates. Because of this, seawater of the Nagahama Bay is colored in brown. Such environments may be regarded as a modern analogue for depositional site of ancient banded iron-formation (BIFs). BIFs are chemical sediments, and their trace element contents may reflect those of seawater from which BIFs precipitated. Here we report geochemical characteristics of rare earth element (REE) and yttrium (Y) compositions for various acid-leach from iron-rich modern sediments deposited in the Nagahama Bay. Major motivation of this study comes from questions regarding potential preservation of positive Eu anomaly and negative Ce anomaly, which are typical signatures of hydrothermal fluids and oxygenated seawater, in rapidly-precipitating iron-rich materials in shallow-water hydrothermal environments. Absence of negative Ce anomaly as well as presence of weak negative Eu anomaly and absence of elevated Y/Ho ratios, all observed from chondrite-nomalized REE patterns, consistently suggest that modern iron-rich sediments with high sedimentation rate do not necessarily record typical REE+Y (REY) signatures for hydrothermal fluids and oxygenated seawater. This study has important implications for interpretation of REY geochemistry of ancient BIFs to extract information on paleo-ocean chemistry and signature of submarine hydrothermal activity.

Keywords: Rare Earth Element, Eu Anomaly, Nagahama Bay

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Trace elements of stromatolitic, and microfossil-bearing massive and laminated cherts from the Strelley Pool Formation

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Black cherts (ca. 3.4Ga) from the Strelley Pool Formation in the Goldsworthy greenstone belt, Pilbara Craton, Western Australia exhibit various lithologies, including stromatolitic, laminatied, or massive structure. Massive cherts contain abundant microfossils. Rare-earth elements and selected trace elements were measured in 17 samples of the black cherts in order to reveal their origins and depositional environments. In shale-normalized REE patterns, stromatolitic cherts show negative Ce-anomalies(Ce/Ce$*_{SN}$ =0.651-0.85) and positive Eu-anomalies(Eu/Eu$*_{SN}$=1.285-1.748), with LREE-enrichment(Pr/Yb$_{SN}$=2.658-5.918). Half of massive and laminated cherts are characterized by positive Eu-anomalies(Eu/Eu$*_{SN}$=1.054-2.455) and the absence of negative Ce-anomalies, with MREE-enrichment(Sm/Yb$_{SN}$=1.298-3.537). All samples except one have super-chondritic to chondritic Y/Ho ratio(25.58-35.37). The variations of REE patterns and some heavy metal concentrations appear to correspond to their lithological variations, suggesting that REE and trace elements of the black cherts are clues for their origins and depositional environments. While many of empirical studies about REE+Y of Archean cherts and carbonates have indicated that Archean open water is characterized by HREEE-enrichment and weak positive Eu-anomalies, the studied 17samples do not. This suggests contributions of other components like hydrothermal water, or land water, to their origins. It is likely that massive cherts precipitated from low-T hydrothermal water because they show not only MREE-enrichment but also high levels of Zn or Pb, with not pronounced positive Eu-anomaly. Although it is, on the other hand, difficult to specify the origins of stromatoritic cherts, we imply the possibility of contribution of continental run-off.

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Keywords: Rare Earth Elements, Chert, Archean, Pilbara, Stromatorite, Microfossil

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Extraction methane from sedimentary carbonates and measurement stable carbon isotope

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To escape from snowball glaciations, a great amount of greenhouse gas was required. In particular, methane has been considered to contribute for escaping from entirely frozen earth because of its strong greenhouse effect (e.g. Kennedy et al., 2008). But amount and origin of methane in this period are still controversial.

We try to extract methane from sedimentary carbonates which deposited soon after snowball glaciations (cap carbonate). We then try to estimate of its CH4 flux into the atmosphere at that time.

We used the Doushantuo cap carbonate which formed after the Marinoan glaciation (ca. 635 Ma) for the analysis. Because evidences of methane were observed in the Doushantuo cap carbonate (Jiang et al., 2003; Wang et al., 2008), the sample is appropriate to test the utility of this method.

A vacuum crushing method has generally been adopted for extraction of gas from minerals, though we efficiently extracted gas to digest carbonate grains by phosphoric acid. Methane was concentrated by a purification line, and then its amount and carbon isotope ratio were measured using a GC-C-IRMS. In order to evaluate the blank methane production during experiment, we also analyzed powdered samples in which fluid inclusions and adsorbed gas were removed.

Amount of extracted methane from grain samples tend to be higher than those of powdered samples. The difference between powdered samples and grains is probably attributable to fluid inclusions and adsorbed gas. Amount of extracted methane from carbonate grain was up to 10257 nmol/g-rock. In terms of carbon isotope value, both grains and powder samples range from -38.7 permil to -43.1 permil (VPDB) and are consistent with thermogenic methane. Despite powderization, methane could be extracted from powder samples. This may indicate organic matters included in carbonates might react with hot acid to release methane.

Keywords: carbonate, methane, carbon isotope

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Detail stratigraphic description of Komati section at 3.2Ga in the Mapepe Formation in the Fig Tree Group of the Barbert

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The Mapepe Formation is the lowermost part of the Fig Tree Group in the Barberton Greenstone belt, and its sedimentary age of single zircon U-Pb datings is 3260 to 3230 Ma (Kroner et al. 1991). Our study area (Komati section) is located along the Komati River near the border to Swaziland. This section preserved more than 300m-long continuous outcrop and consists of well-stratified sedimentary sequence with bedded chert and shale. We performed 1/100 scale geologic mapping to identify stratigraphic continuity. The Komati section is divided into 6 blocks (B1-, B2-, C-, D1-, D2- and E-block) bounded by the deformed zones. Thickness of each blocks is 6.8m, 45m, 22.8m, 19m, 5.7m and 23m, respectively. Total thickness of the studied section reaches 128m.

Lithology: The studied section may be divided into the following four rock types. 1) white chert (massive); 2) red chert: It consists of laminated, red-colored bedded chert and white-red chert that changes its color from white to red with sharp boundary and partly with boudinage structure. 3) black shale (massive); 4) red-brown (Fe-rich) shale. In each block, the red-brown shale amounts to 60%, white chert 20%, and red chert and black shale 10%. Red chert is increasing and red-brown shale is decreasing to the top at each block.

Magnetic susceptibility (k) is measure of the degree of mineralization for a material in response to applied magnetic field. In this study, we measured magnetic susceptibility at two ways. 1) Vertical sections: To understand stratigraphic variation, we measured two times of the whole stratigraphic vertical section (total 128m thick) at 3cm intervals. 2) Horizontal sections: To understand horizontal variation in each bed, we measured 4m along in each bed, and totally 83 beds from all blocks. Magnetic susceptibility is increasing to the top in each block. Based on the horizontal variations of magnetic susceptibility, we divide the section into 4 groups; A-group: Low k value ($0.1*10^{text}$ SI˜$1.0*10^{text}$ SI). It consists of black shale, red-brown shale and white chert. B-group: Medium k value (1.0˜$5.0*10^{text}$˜$70*10^{text}$ SI). It consists of red chert and white-red chert. C-group: High k value (1.0˜$5.0*10^{text}$ SI˜70˜$420*10^{text}$ SI). It consists of boudinage red chert. Boudinage part has high k value. D-group: Very high k value (15˜$30*10^{text}$ SI˜70˜$420*10^{text}$ SI). It consists of red chert with iron bed. These groups represent different contents of Fe-bearing magnetic minerals.

Keywords: Archean, Barberton Greenstone Belt, Mapepe Formation, Magnetic susceptibility

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Carboniferous upper-slope succession of the Yangtze Carbonate Platform, South China

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During the Late Paleozoic, a large carbonate platform called the Yangtze Carbonate Platform had been developed on the South China Craton. In this platform, shallow-marine facies were dominated with a number of small, deeper basins in some places. In southern Guizhou Province, Carboniferous deposits of this platform are widely distributed with good exposure conditions. We recently studied a new, Carboniferous section showing upper-slope deposition.

The study section is located at Luokun of Luodian County, about 140km south of Guiyang, in Guizhou Province of China. The Luokun section, exposed along continuous road-cuts, is about 210 m thick and consists mainly of well-bedded, fine-grained limestone. Graded bedding is common in this limestone. Lime-mudstone and fine bioclastic wackestone, with some packstone, are the major microfacies. Siliceous (chert) bands and/or nodules are also commonly observed. This portion of the section is considered as representing limestone turbidites. Moreover, conglomeratic beds of more than 2 m in thickness in some cases, consisting of lithoclasts and bioclasts of shallow platform origin, are intercalated intermittently in this section. These beds are interpreted as being formed probably by debris flows, induced by platform shedding. The overall lithostratigraphic features of this section suggest upper-slope deposition within a carbonate platform-basin transect.

We made a provisional study of foraminifers in samples collected mainly from coarse-grained sediments. The following genera were identified from them. They are *Tetrataxis*, *Palaeotextularia*, *Climacammina*, *Archaediscus*, *Endothyranopsis*, *Nevillea*, *Pohlia*?, *Paraarchaediscus*?, *Omphalotis*, *Endothyra*, *Bradyina*, *Pseudostaffella*, *Neostaffella*, *Eostaffella*, *Ozawainella*, *Profusulinella*, *Fusulinella*, *Eofusulina* and *Beedeina*. These foraminifers suggest that the base of the section is broadly Visean (Middle Mississippian) and the top is probably Moscovian (Middle Pennsylvanian). Moreover, there is no evidence of large sedimentary gap in this section based on the foraminiferal contents.

In southern Guizhou Province, detailed Carboniferous stratigraphy and biostratigraphy has been studied since the 1970's. Most previous studies, however, dealt with shallow platform facies sections (e.g. the Yashui and Zongdi sections) or deeper-slope sections (e.g. the Nashui section). In the shallow platform sections, foraminifers, particularly fusulines, are abundant but conodonts are very scarce. In contrast, deeper-slope sections generally contain rich conodonts but less foraminifers. In the Luokun section, fine-grained limestone yields abundant conodonts and coarse-grained beds, such as debris-flow conglomerates contain foraminifers derived from shallow platform areas. Thus, this section is considered to be important because it has potentials to connect fusuline biostratigraphy mainly developed in the shallow platform sections with conodont biostratigraphy established in the deeper-slope sections within the Yangtze Carbonate Platform.

Keywords: Carboniferous, upper slope facies, Yangtze Carbonate Platform, South China, foraminifer, conodont

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Chemostratigraphic consideration of the Ediacaran sedimentary rock in northwestern Hunan province, South China

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In the Ediacaran period (635 Ma ~ 542 Ma), two glacial events, the Marinoan and the Gaskiers glaciations have been widely recognized. On the Yangtze block of South China, no glacial diamictite corresponding to the Gaskiers glaciation has been known, although those of the Marinoan glaciation called the Nantuo Formation are exposed in many places. Recognition of the Gaskiers glaciation has been mainly based on chemostratigraphy. Zhu et al. (2007) suspected the possible horizon for the Gaskiers glaciation from a negative shift of inorganic carbon isotope ratio and the increased fossil occurrence in the Doushantuo Formation. Recently, Sawaki et al. (2010) attempted the identification of Gaskiers glaciation in the Yangtze block with high-resolution strontium isotopic ratio. In this study, we tried the chemostratigraphic correlation in relation to the Gaskiers glaciation with strontium isotopic ratio and inorganic carbon ratio at Fengtan section and Yangjiaping section, northwestern Hunan province.

Fengtan section was in a basinal environment of the Yangtze block (Jiang et al., 2007) and sedimentary rocks deposited after the Marinoan glaciation is continuously exposed. This section is about 100 m thick and divided into the Marinoan diamictite of the Nantuo Formation, carbonate-shale sequence of the Doushatnuo Formation, and the black chert of the Liuchapo Formation in ascending order. On the other hand, Yangjiaping section was in a shallow environment (Dobrzinski and Bahlburg, 2007) and exposes the Ediacaran sedimets of 470 m thick , which consist of the Nantuo diamictite, carbonate-shale-phosphate sequence of the Doushantuo Formation, and the carbonate of Dengying Formation in ascending order.

In the upper part of the lower Doushantuo Formation at Fengtan section, there was distinct co-variation among the strontium isotopic ratio, inorganic carbon isotopic ratio and oxygen isotopic ratio. Here, high strontium isotopic ratio (0.711) was accompanied with the negative shifts of oxygen and inorganic carbon isotopic values. High strontium isotopic ratio (0.709) was also obtained from the upper Doushantuo Formation of Yangjiaping section. Co-variation of strontium isotopic ratio and inorganic carbon isotopic values of this part appear similar relationship with that was observed in Fengtan section.

From these results, it is possible that signature from the Gaskiers glaciation was recorded in the lower Doushantuo Formation in Fengtan section, and in the upper Doushantuo Formation in Yangjiaping section. The sedimentary rates on the Yangtze block greatly vary with depositional environments.

Keywords: Ediacaran, chemostratigraphy, glaciation, China