

A search for impact ejecta deposits in the Upper Triassic limestone of the Pizzo Mondello section, western Sicily, Italy.

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The 34-million-year (My) interval of the Late Triassic is marked by the formation of several large impact structures on Earth, including the 90-km-diameter Manicouagan impact crater in Quebec, Canada. This crater occurred in the middle-upper Norian (ca. 215.5 Mya). Late Triassic impact events have been considered a factor in biotic extinction events in the Late Triassic (e.g., end-Triassic extinction event), but this scenario remains controversial because of a lack of stratigraphic records of ejecta deposits. The Manicouagan impact ejecta deposits are known only from Mino terrane, Central Japan and southwestern Britain. To investigate the impact ejecta deposit derived from the Manicouagan impact crater, we examined the stratigraphic variations in major and trace element concentrations from the Upper Triassic Pizzo Mondello section in western Sicily, Italy. The Pizzo Mondello consists of a continuously exposed sequence (a 450m thick) of upper Carnian through late Norian (Upper Triassic) pelagic limestone. The trace element data from this study show a consistent trend of decreasing Cr and Ni values starting in the lower Norian. Concentration of these elements are observed in the upper part of the Pizzo Mondello section and is roughly located at the base of the *Epigondolella bidentata* conodont zone in the late Norian.

Keywords: Late Triassic, ejecta sediment, Pizzo Mondello, limestone, main trace element analysis

Study on analytical technique of carbon isotopes for samples with minute and lean organic carbon content.

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Stable organic carbon isotope ratio ($\delta^{13}\text{C}_{\text{org}}$) of oceanic sediments is useful to discuss paleoceanographic change (e.g. increasing productivity on ocean surface, the global carbon cycle). However, very low total organic carbon content (TOC) makes carbon isotope analysis of organic carbon with regular equipment quite difficult. A shortage of stratigraphic record of $\delta^{13}\text{C}$ from pelagic sediments including chert is partly owe to it.

This study tried carbon isotope measurement of minuscule quantity of carbon and low TOC samples with techniques of elementary analyzer introduction interface (EA/IRMS) and dual inlet. EA/IRMS is online method that uses continuous-flow system and dual inlet is off-line method that is an analysis with IRMS of dual inlet type after cryogenic purification with a glass vacuum line. L-alanine were mainly used for experiments of EA/IRMS method as a standard material. For dual inlet method, standards (ANU-Sucrose, L-alanine, eicosane, triphenylamine) were mostly used. A few chert samples were used for each experiment as a natural sample. Experimental contents of EA/IRMS method were: 1) to know how minute the sample is enough to analyze TOC with elemental analyzer (EA), 2) to know how much weight of powdered sample can be introduced for the measurement of $\delta^{13}\text{C}_{\text{org}}$ and 3) to test actual organic carbon isotope analysis with chert sample. They demonstrated that EA/IRMS method can deal with carbon as much as 10 μg , one-fifth of suitable carbon weight for the conventional analysis in our lab. In spite of it, we judged that EA/IRMS method did not suit for measurement of chert as the volume of chert powder was too much to introduce to the equipment, as an analysis effected on the next analysis (memory effect), and as it damaged the analytical device. For dual inlet method, 1) estimation how minute amount of CO_2 gas is able for the analysis, 2) evaluation the stability of $\delta^{13}\text{C}_{\text{org}}$ for minuscule samples, 3) evaluation of calibration line by multiple standard samples, 4) preliminary organic carbon isotope analysis of actual chert sample, were conducted in this study. The results showed that the values obtained with 50 μgC standards were similar to that with 500 μgC standards (the amount for regular analysis). Moreover, dual inlet method demonstrated that $\delta^{13}\text{C}_{\text{org}}$ value from chert (~700 mg) were not stabilized (showed >1% difference) in replicated sample. On the other hand, the difference of $\delta^{13}\text{C}_{\text{org}}$ between 760 mg of diluted L-alanine (with baked quartz sand) controlled as low TOC (0.007%) and non-diluted L-alanine 0.1mg was about 0.5% showing more stable result than chert samples. Although analysis of standard samples with 50 μgC and low TOC condition with dual inlet method is nearly achieved, problems related to specific character of chert may be remained unresolved for organic carbon isotope analysis of chert.

Keywords: organic carbon isotope ratio, low total organic carbon content (TOC), dual inlet, Elemental Analyzer/ Isotope Ratio Mass Spectrometer (EA/IRMS)

Reconstruction of seamounts by stratigraphy and geochemistry of greenstones in an accretionary complex in the Mitsuishi area, Hokkaido, Japan

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Seamounts and oceanic islands are ones of the common volcanoes on the earth. Their structures and growth processes have been modeled mainly by observation of deep sea drill cores and uplifted submarine volcanic complex (ex. Schmincke, 2010). However, modern volcanoes can provide limited information on their internal structure.

A large amount of greenstones occurs in the Kamuikotan zone of Hokkaido, Japan. Nakano&Komatsu (1979) interpreted that they originated from oceanic island alkali basalts based on the common occurrences of aegirine and kaersutite. While Kimura et al. (1994) assumed an oceanic plateau for their origin based on geochemistry of greenstones, plate tectonic reconstruction, and occurrences of chert xenoliths. Sakakibara et al. (1999) considered its age as Late Jurassic based on radiolarian fossils from chert xenoliths. Although their origins are still controversial, eruptive structures and stratigraphy preserved in the southern Kamuikotan zone will provide further knowledge on internal structure of intra-plate submarine volcanoes.

Therefore, this presentation tries to reconstruct volcanic structures from stratigraphy, eruptive and sedimentary features, and geochemistry of greenstones in the Kamuikotan zone of the Mitsuishi area.

The Futagawa unit along the Futagawa River, a tributary of the Mitsuishi River, is characterized by non-deformed greenstones associated with sedimentary rocks, and shear zones consisting mainly of pelitic mixed rock.

Greenstones in the Futagawa unit can be classified into slightly enriched mid-ocean ridge basalt (T-MORB), ocean island alkali basalt (OIA), and ocean island basalts showing a transitional composition of tholeiitic and alkaline series (OITB). The Futagawa unit is subdivided into sheets A, B, and C, bounded by the shear zones.

Sheet A consists of pillow lava of T-MORB and OITB, dolerite sills of OIA, and sedimentary rocks such as chert and clastic limestone at the bottom of the sequence. Therefore, it is speculated to have formed at a foothill of a volcano in the deep sea during the initial undersea volcano stage of ocean island formation. Sheet B consists of chert at the bottom, overlying pillow lava of relatively homogenous OITB, and large amounts of dolerite sill. It was considered to have formed at a deep sea foothill of the volcano in the shield volcano stage. Sheet C consists of vesicular lavas and pyroclastic rocks of OITB, with a dike crosscutting them. It suggests a central part of the undersea volcano at a relatively shallow level, although it is difficult to assign exact evolutionally stage.

Keywords: seamount, accretionary complex, greenstone

Detrital clinopyroxene and zircon in the Tokoro Belt, Hokkaido: Insight to Cretaceous magmatic arc in the Sea of Okhotsk

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Basement of the Sea of Okhotsk consist of ~20 km thick continent-like crust. Jurassic and younger granites and volcanic rocks have been dredged from its sea floor. It is thus regarded as a continental block (Okhotsk Sea Block: OSB). However, rocks suggestive of Precambrian basement and Paleozoic strata common in continental blocks in NE Asia derived from the super-continent have not been found from the sea. Therefore, the origin of OSB is left unknown and could be different from the common continental blocks. It is however difficult to directly explore the OSB basement in detail because it is mostly submerged in the sea. Cretaceous and Paleogene in the Nemuro and Tokoro belts of eastern Hokkaido belong to the paleo-Kuril arc of the OSB margin. They are characterized by volcanogenic sandstones, whose clastic sources are assumed to be a volcanic arc in OSB. They can thus be a key to understand age and composition of OSB. This paper tests chemical composition of clinopyroxene and ages of zircons in sandstones of the Tokoro Belt. Detrital clinopyroxenes are common in sandstones of the Nikoro Group (middle? Cretaceous accretionary complex), Saroma Group (Late Cretaceous forearc basin), and the Yubetsu Group (early Paleogene accretionary complex). All of analyzed clinopyroxene grains are poor in titanium and resemble to those of island arc volcanics. The Nikoro and Saroma sandstones contain scarce and tiny zircon crystals. Among them, grains with enough sizes for LA-ICPMS measurement yielded approx. 90-100 Ma. On the contrary, the Yubetsu sandstone yielded abundant zircon grains, whose U-Pb ages cluster in the Late Cretaceous (65-80 Ma), Jurassic, Permian, and Paleoproterozoic to Neoproterozoic. A large age gap exists between 430 and 1600 Ma in the sample. Occurrences of detrital zircons suggest that a distinct change in clastic supply occurred in the end of Cretaceous. Detrital zircons in the Yubetsu sandstone share the common age distribution with those in the NE Japan arc, whereas the Yubetsu Group still has characteristics of paleo-Kuril arc with abundant intermediate to mafic volcanic clasts and clinopyroxene composition common with the Nikoro and Saroma groups. Such coexistence of both NE Japan (Eurasia) and Kuril (Okhotsk) natures in the Yubetsu Group is consistent with the dual provenance model by Nanayama (1992), in which the group deposited at the junction between the two arc-trench systems. It is reasonable to consider that the two arcs joined in late Late Cretaceous, so far as no sign of clastic supply from the Eurasia is found in the Saroma and Nikoro groups. These groups formed before the coupling might be more important to examine the origin of OSB using clastic composition.

Keywords: Tokoro Belt, Okhotsk Sea, Paleo-Kuril arc

Sandstone dikes within pelagic cherts of the Permian Yoshii Group in Southwest Japan and its deformation structure

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Deformation structure of consolidated cherts would record its diagenetic process. The Akiyoshi terrane, which is a Permian accretionary complex of the Inner Zone of Southwest Japan, contains Permian cherts. However, there are a few studies that have described the deformation structure of the Permian cherts of the Akiyoshi terrane. The Yoshii Group, distributed over west Okayama Prefecture, belongs to the Akiyoshi terrane.

We discovered ductilely- and brittlely-deformed chert blocks within sandstone dikes of the Yoshii Group in the Mihara area. The ductilely-deformed chert blocks and the clay minerals within the sandstone dikes are elongated and have slightly preferred orientation.

Pseudoalbaillella sp. cf. *P. longtanensis* Sheng et Wang was obtained from a chert bed just below the sandstone dike. *Pseudoalbaillella longtanensis* is characteristic species of the *P. longtanensis* Assemblage-Zone corresponding tentatively to the Kungurian (Cisuralian: Lower Permian).

The presence of the ductilely-deformed cherts suggests that the siliceous deposits had yet been unconsolidated when the sandstone dikes intruded. The sandstone dikes might be originated in terrigenous clastic, which is a component of chert-clastic sequences of the Yoshii Group in the Mihara area. The Permian chert had kept unconsolidated more than 10 My in this case.

Keywords: ductile deformation, Permian, radiolaria, pelagic chert, sandstone dike, Akiyoshi terrane

InterRad 15 in Japan (October, 2017) and outreach activities for radiolarians

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InterRad is the international association of radiolarists. The 15th InterRad meeting will be held in Japan during 23-27 October in 2017. In relation to this international meeting, we are planning to do something in enhancing a degree of recognition of radiolarians. Our projects include not only research and education but also outreach activities. It is essential for any academic associations to introduce relevant topics into society. The organizing committee of the InterRad 15 will carry out outreach activities continuously and systematically by using available tools.

Keywords: Radiolaria, InterRad, outreach