Stratigraphy and lithofacies of the Middle-Upper Permian in Far East: correlation between the South Kitakami belt and the Sergeevk ablet in Primorye

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Before the Miocene opening of the back-arc basin named Japan Sea, the pre-Cenozoic geotectonic units in Japan and Primorye were connected to each other. The Jurassic and Cretaceous accretionary complexes have good mutual correlation; nonetheless, good information is still lacking for correlating Pelaozoic units. Our preliminary U-Pb dating of detrital zircon from the Paleozoic sandstones documented that a similar depositional setting with common provenance has existed in Japan and Primorye. As to the Permian, overall lithostratigraphy is common between the South Kitakami belt in NE Japan and the Sergeevka belt in Primorye; the Capitanian (Middle Permian) shallow marine limestone covered by the Wuchiapingian/Changhsingian black shale. Judging from the detrital zircon spectra, these Middle-Upper Permian sequences were deposited on a shallow-marine shelf of the continental margin of South China. This stratigraphic interval is noteworthy because it records extinction-related paleo-environmental changes across the Guadalupian-Lopingian boundary in relatively higher latitude.

Keywords: Permian, Far East Asia, South China, extinction, Primorye, South Kitakami belt

Middle Ordovician in Estonia: litho- and chemo-stratigraphy of the Velise F97 drill-core

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During the Great Ordovician Bio-diversification Event (GOBE), the diversity of marine animals increased all in species, genus and family levels, together with individual size increase, particularly in the Middle Ordovician. Various unique geologic episodes occurred during the Middle Ordovician besides biological changes, e.g., sea-level, Sr-isotope ratio and carbon isotope ratios of seawater, large-scale volcanism, meteorite shower, geomagnetic polarity reversal etc; nonetheless, their mutual cause-effect relationships were not well explained. This study analyzed litho-and chemo-stratigraphy (bulk composition and isotope ratio of inorganic carbon) of a continuous drilled core of the Middle Ordovician (Velise-F97 core recovered from central Estonia by the Geol. Surv. Estonia). The Middle Ordovician of the core comprises the Volkhov unit, Kunda unit, Aseri unit, Lasnamagi unit, and Uhaku unit, in ascending order. The occurrence of glauconite, once abundant in the Volkhov unit, becomes rare upsection and absent in the upper Kunda unit and above. In contrast, the occurrence of oolite first started in the Kunda unit and continued into the overlying units. These recorded the overall sea-level changes in the shallow marine shelf setting from shelf edge to intertidal zone in central Baltica. The bulk geochemical composition (major and trace elements) of the fine-grained limestone clarified the occurrence of a unique interval of high silica content in the lowermost Kunda unit. This reflects a short-term, large flux of terrigenous clastics into the basin but does not necessarily synchronized with the above-mentioned sea-level drop. On the other hand, the isotope ratio of inorganic carbon increase for ca. 2 permil from the middle Kunda unit to Uhaku unit with the peak in the Aseri unit, which corresponds to the MDICE episode reported elsewhere. These records indicate that the major change in the shallow marine environment in central Baltica occurred mostly during the deposition of the Kunda unit. This study clarified for the first time in a single section that the Middle Ordovician change started from the onset of overall shallowing (episode 1), and followed by the increase of primary production (episode 2) in the shallow shelf domain. These may have linked to the GOBE, and further correlation with biostratigraphy of the core under analysis is necessary. The short-term influx of terrigenous clastics was likely a remnant of meteorite impact in the neighborhood.

Keywords: Ordovician, Baltica, core

Radiogenic Sr isotope excursions in the Ediacaran seawater

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The Ediacaran to Cambrian period records one of the most dramatic biological episodes in Earth's history; for example, the emergence of multicellular animals, Ediacara-type fauna (*Vendobionta*), and possible bilaterians. To understand perturbations occurring at this period, several kinds of geochemical proxies have been measured by many researchers. Especially in south China, strata deposited in various kind of sedimentary environments, from shallow to slope facies, well crop out. Recent geochemical studies demonstrated that carbon isotopes of coeval carbonate rocks in south China show different patterns according to the sedimentary environments. For example, large negative carbon isotope anomaly called Shuram excursion was not observed in slope facies sediments. The weathering influx from continents is thought to be a major influence on the change in composition of ancient seawater and on biological evolution. Its flux can be estimated from the $^{87}Sr/^{86}Sr$ ratio of carbonate rocks. Due to the large isotopic difference between these two main sources of strontium, the $^{87}Sr/^{86}Sr$ composition of seawater tracks the long-term changes in the weathering of the continental surface relative to the hydrothermal flux. For further understandings of regional variation of the $^{87}Sr/^{86}Sr$ ratio in the Ediacaran, we carried out on-land drilling of the Ediacaran Doushantuo Formation at Three Gorges, Weng'an, Siduping, and Tianping areas. We prepared rock powders from the carbonate rocks, and dissolved them in 2 M acetic acid at 70 Celsius degrees for 24 hours. After removing coexisting matrix elements using a chromatographic technique, Sr isotope compositions were measured with a MC-ICP-MS. Along with the data from previous studies, we review the radiogenic Sr isotope excursions in the Ediacaran carbonate rocks and discuss the cause of regional variations.

Keywords: South China, Radiogenic Sr isotope ratio

