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^{57}FE MÖSSBAUER ANALYSIS OF THE UPPER TRIASSIC-LOWER JURASSIC DEEP-SEA CHERT: PALEO-REDOX HISTORY ACROSS THE TRIASSIC-JURASSIC BOUNDARY AND THE TOARCIAN OCEANIC ANOXIC EVENT

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For checking oceanic paleo-environments, pelagic deep-sea cherts in ancient accretionary complexes are inevitable because pre-Jurassic deep-sea floors were lost from the Earth's surface by the oceanic subduction. Accessory iron-bearing minerals in deep-sea cherts, such as hematite and pyrite, have been used as redox indicators for ancient deep-sea environment, as performed for the Permian-Triassic boundary Superanoxia [1, 2]. In order to analyze paleo-redox history across the Triassic-Jurassic (T-J) boundary (~200 Ma) and the Early Toarcian Oceanic Anoxic Event (T-OAE, ~183 Ma), this study examined the Mössbauer spectroscopy of the Upper Triassic to Lower Jurassic deep-sea cherts in the Inuyama area, central Japan.

We collected 45 samples from 20 m-thick deep-sea chert sequence of the Late Triassic-Early Jurassic age, including the T-J boundary and the T-OAE intervals, in the Katsuyama section, Inuyama [3, 4, 5]. The T-J boundary lies in the red cherts, whereas the T-OAE interval lies in organic-rich black cherts above the grayish cherts. Chert samples were prepared in the same procedure as the previous studies [2, 6]. Mössbauer spectra were measured with an Austin Science S-600 Mössbauer spectrometer using a 1.11 GBq ^{57}Co/Rh source at room temperature (293 K).

The Mössbauer analysis identified five iron species from the chert samples; hematite (α-Fe_2O_3), pyrite (FeS_2), paramagnetic Fe^{3+}(h.s.), and two types of paramagnetic Fe^{2+}(h.s.), i.e., Fe^{2+}(outer) with larger quadrupole splitting and paramagnetic Fe^{2+}(inner) with smaller one (Fig. 1). Red cherts contain hematite, Fe^{3+}(h.s.), Fe^{2+}(outer), and occasionally Fe^{2+}(inner), suggesting their primary deposition in oxidizing conditions. In contrast, grayish colored cherts are classified into two groups; i.e. ones with pyrite, Fe^{2+}(outer), and occasionally Fe^{3+}(h.s.), and the others mainly with Fe^{2+}(outer) and some Fe^{3+}(h.s.) without pyrite. The former group with framboidal pyrites was likely deposited primarily under reducing conditions, whereas the latter group without pyrite was likely altered from primary hematite-bearing red cherts [6]. Fe^{3+}(h.s.) and Fe^{2+}(outer) are likely included in clay minerals such as illite or chlorite. Fe^{2+}(inner) may be contained in siderite ($FeCO_3$)-like amorphous mineral that is derived from hematite by the post-depositional alteration.

The results confirmed that an oxidizing condition persisted in deep-sea throughout the Late Triassic to the earliest Jurassic across the T-J boundary. In contrast, across the T-OAE, the deep ocean shifted into a less-oxygenated condition. The first appearance of the gray pyrite-bearing chert marked the onset of a deep-sea oxygen-depletion in the middle Pliensbachian; i.e., clearly before the shallow marine T-OAE. After all, the reducing condition in deep-ocean likely persisted much longer than in shallow-ocean.

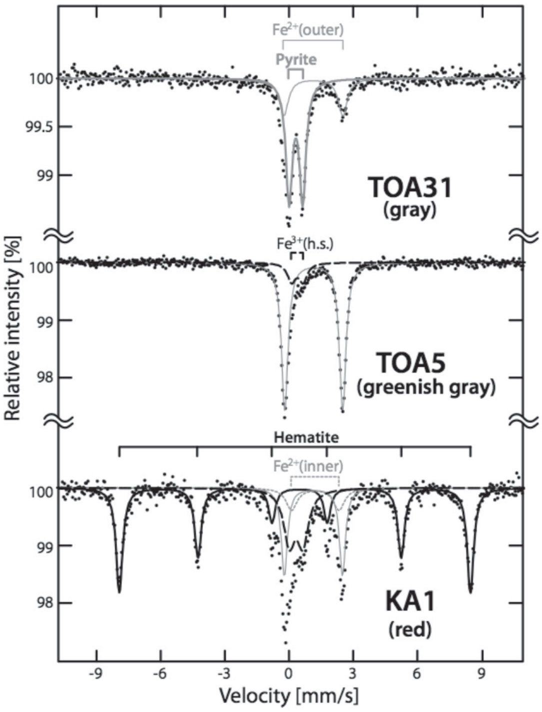

Fig. 1 Mössbauer spectra of the analyzed cherts from Inuyama, Japan. KA1, TOA5, and TOA31 are representative of red, greenish gray, and gray cherts, respectively.

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