

Iron Speciation of Cored Sediments from Erhai Lake, SW China

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Various geochemical indicators can be used to identify past depositional environments, for which modern sediments in lakes are usually ideal candidates. Six sub samples were obtained from one core collected using a gravity corer from the Erhai Lake, one of fresh water lakes along the Yuanjiang fault zone in Yunnan Province SW China and analyzed for iron species using Mossbauer Spectroscopy. The 120 cm core has a distinct lithological boundary at a depth of about 70 cm. Four iron species were identified as paramagnetic Fe³⁺, superparamagnetic Fe³⁺, hematite Fe³⁺, and paramagnetic Fe²⁺. With increasing burial depth, hematite (Fe₂O₃) decreased, especially below depth great than 25 cm, and finally disappeared at depth around 95 cm. The summed paramagnetic Fe³⁺ (superparamagnetic Fe³⁺ and paramagnetic Fe³⁺) did not change as much, only exhibiting a slightly decrease at depths greater than 75 cm, about 5 cm beneath the lithological boundary within the core. The intensity of paramagnetic high-spine Fe²⁺ increased with depth. These vertical variations were in harmony with organic geochemical parameters such as total organic matter (TOC) content, H-index and O-index, indicating that reducing conditions are strongly intensified in the sediments below 70 cm. The geological background, organic geochemistry and ¹⁴C data combined with the present Mossbauer spectroscopic study give a strong indication that the redox environment of the Erhai Lake probably shifted rather rapidly shifted from a deep reducing to a shallow oxic state about 2 ka ago, which could be caused by either strong earthquake events or anthropogenic activities.

In addition, a proposed method to quantitatively identify sedimentary pyrite was developed by using ⁵⁷Fe Mossbauer spectroscopy and X-ray absorption near-edge structure (XANES) with a series of acidic pre-treatments. This method can be used to measure pyrite in aquatic sediments, especially when the pyrite contents are very low and the particles of pyrite are small or the crystallinity is low, even in amorphous status.

References

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