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The ferruginous ocean in the Ediacaran; evidence from iron isotope ratios in pyrite.

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The Latest Proterozoic records some important events through the Earth history. Large multi-cellular animal first appeared and some severe glaciation (Snowball Earth) occurred during this period. Recent geological studies (e. g. Hoffman and Schrag, 2002) focus on re-appearances of BIF in the strata during the Latest Proterozoic. Iron is one of the essential elements for the life and sensitive to redox condition in seawater. Therefore, decoding iron cycle provide important information when discussing biological evolutions and ocean environments. The paleo-oceanic iron cycle is revealed by iron isotope ratios of iron-bearing minerals (e.g. Rouxel et al., 2005; Nishizawa et al., 2010).

South China is one of the best places for decoding surface environments during the Ediacaran, the last period of the Latest Proterozoic. The Ediacaran to Cambrian successions are widely distributed and contain many fossils. We carried out on-land drilling of the Ediacaran to Cambrian sedimentary succession in Three Gorges, South China. The drill-sampling allows us to minimize the effect of secondary alteration and oxidation on the surface and to make a very continuous chemostratigraphy at intervals of centimeters. We analyzed iron isotope ratios (56Fe/54Fe) of sulfide minerals (pyrite) in the drill cores, using fs-LA-MC-ICP-MS at Kyoto University.

The results show large variations in iron isotope ratios, from -1.3 to +1.0 permil, through the Ediacaran. These high values, over +0.5 permil, require a partial oxidation of ferrous iron in the seawater, which indicates that the Ediacaran seawater had been ferruginous (ferrous iron-rich). Previously, most researchers have thought that iron was depleted in the seawater after 1.8 Ga. However, our results show opposite consideration to traditional recognition. Iron concentration locally changes according to water depth and tectonic setting. Therefore, it is future task to demonstrate that the ferruginous condition acquired in Three Gorges reflect global ocean environment.

Keywords: Ediacaran, Iron isotope ratios