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Iron isotopic composition of seawater recorded in ferromanganese deposits

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Iron isotopic composition of marine ferromanganese deposits could be a useful tool to understand the biogeochemical cycle of iron in the ocean. In this study, we measured the iron isotopic compositions (δ^{56}Fe relative to IRMM-14) of hydrogenetic and diagenetic ferromanganese deposits from the Pacific Ocean (1400-6000 m water depth). The hydrogenetic ferromanganese crusts and nodules had a consistent average Fe isotopic composition of -0.32±0.12 ‰ (2SD). The consistent δ^{56}Fe values imply homogenous Fe isotopic composition of modern deep seawater in the central to northwestern Pacific. Despite differences in mineralogy and chemistry, the δ^{56}Fe values of diagenetic nodules (-0.34 to -0.20 ‰) were indistinguishable from those of hydrogenetic origin. These observations suggest that dissolution and re-precipitation of Fe in sediments resulted in no significant Fe isotope fractionation. These values are apparently lower than the δ^{56}Fe values of seawater from <900 m in the central Pacific ranging from +0.01 to +0.58 ‰ (Radic et al., 2011), implying that deep water is enriched in isotopically light iron. We also reconstructed the temporal variations of iron isotopic compositions in three hydrogenetic ferromanganese crusts from different water depths (1440, 2239, 2987 m) in the northwest Pacific. Regardless of water depth, the δ^{56}Fe values of these crusts showed essentially constant (-0.31±0.13 ‰, 2SD) throughout the past ~ 20 Ma. This is remarkably consistent with the constant iron isotopic compositions of ferromanganese crust (-0.31±0.10 ‰, 2SD) in the central Pacific over the last 10 Ma (Chu et al., 2006). Thus, it is suggested that the Pacific deep water has remained constant in iron isotopic composition for long time scale.

Keywords: iron isotope, ferromanganese crust