

Iron isotopic signature of red blood cell samples from shark and seal : new tracer for biological cycle of Fe in marine

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Among the essential metal elements, Fe is one of the most important essential elements for all organisms because its flexible redox activity contributes to a cell respiration, photosynthesis, nitrogen fixation, and hemoglobin enhances the efficiency of oxygen transport in blood. Recent Fe isotope studies have revealed that the $^{56}\text{Fe}/^{54}\text{Fe}$ and $^{57}\text{Fe}/^{54}\text{Fe}$ isotope ratios for the terrestrial plants or animals were systematically decreased with increasing the nominal trophic level (about 1‰/amu per trophic level). The systematical decrease in the $^{56}\text{Fe}/^{54}\text{Fe}$ isotope ratio can be attributed to the preferential absorption of lighter Fe isotopes from nutrients or dietary foods [1, 2]. However, the same is not true on the marine organisms. Despite the quite limited number of Fe isotope data, there were no significant difference in the reported $^{56}\text{Fe}/^{54}\text{Fe}$ ratio data between the marine organisms (phytoplankton, shrimp and tuna samples [3]) and the seawater samples [4], suggesting very small change in the $^{56}\text{Fe}/^{54}\text{Fe}$ ratio against the trophic level. This is contrasting to the $^{56}\text{Fe}/^{54}\text{Fe}$ ratio for the terrestrial plants or animals. To investigate the possible correlation in the $^{56}\text{Fe}/^{54}\text{Fe}$ isotope ratio and the trophic level for the marine organisms, the $^{56}\text{Fe}/^{54}\text{Fe}$ ratio for marine organism with high-trophic level is highly desired. In this study, we have measured the $^{56}\text{Fe}/^{54}\text{Fe}$ and $^{57}\text{Fe}/^{54}\text{Fe}$ ratios for red blood cell (RBC) samples from the high-trophic level animals of various ages (15 shark and 13 seal samples of various ages). After the series of chemical procedures, including sample decomposition, chemical purification, and the adjustments of the Fe valence, the $^{56}\text{Fe}/^{54}\text{Fe}$ and $^{57}\text{Fe}/^{54}\text{Fe}$ isotopic ratios were obtained by a multiple-collector ICP-mass spectrometry (MC-ICPMS). The resulting $^{56}\text{Fe}/^{54}\text{Fe}$ ratio for shark and seal samples were ranging from -1.11‰ to -2.56‰ and -0.70‰ to -1.26‰, respectively. For shark samples, there were no significant differences in the measured $^{56}\text{Fe}/^{54}\text{Fe}$ ratio between the male and female samples. This is contrasting with the $^{56}\text{Fe}/^{54}\text{Fe}$ ratio for the terrestrial animals, including human RBC samples. For the seal samples, no correlation in the resulting $^{56}\text{Fe}/^{54}\text{Fe}$ ratio and both the age and body length was found. More importantly, the resulting $^{56}\text{Fe}/^{54}\text{Fe}$ ratios for the shark and seal samples were significantly higher than those for the high-trophic level terrestrial animals. We will discuss the difference in the correlation of the $^{56}\text{Fe}/^{54}\text{Fe}$ ratio with trophic level between the terrestrial and marine organisms.

References

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