Iron Isotope Signatures of Gastropods at the Hydrothermal Vent

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Variation in iron isotope ratio ($\delta^{56}Fe/^{54}Fe$) of biological samples can reflect principally the differences in the Fe absorption efficiency from food sources. In the marine environment, several pioneering studies have revealed that $\delta^{56}Fe$ of marine organisms did not vary significantly among different organs of an organism, or among different trophic levels, due to the availability of Fe being very limited in seawater. In contrast, Fe abundance in hydrothermal vent fields (~10%) is many fold higher than most of seawater (~10^{-7}%). This evoked us to consider that the Fe bio-cycle at hydrothermal vents is likely to be different from most other marine environment. However, the detailed understanding concerning the Fe absorption and metabolism in organisms inhabiting hydrothermal vents remained obscure.
To investigate the Fe bio-cycle at the Fe-enriched hydrothermal vent environment, the Fe isotope ratio of two vent endemic snails with thioautotrophic endosymbionts were measured. This included the 'scaly-foot gastropod' (*Chrysomallon squamiferum*) (n=5) and *Gigantopelta aegis* (n=5), which are members of the same family Peltospiridae and live side-by-side in the Longqi vent field, Southwest Indian Ridge. The $\delta^{56}Fe$ of various tissues (muscle, gill, blood, heart, endosymbiont-containing oesophageal gland), shell, and scales on the foot were measured using a multiple collector ICP-mass spectrometer (MC-ICP-MS), after the decomposition of organic component and the purification of Fe through an anion-exchange chromatography.
The resulting of $\delta^{56}Fe$ for muscle, gill, blood, and heart from the 'scaly-foot' was approximately the same as the $\delta^{56}Fe$ value of the environment, indicating high absorption efficiencies of Fe. On the other hand, the $\delta^{56}Fe$ of such tissues in *Gigantopelta aegis* was about 1‰ lower than the 'scaly-foot' and the environment, indicative of lower Fe absorption efficiencies. No differences in $\delta^{56}Fe$ was detected in the endosymbiotic bacteria hosting oesophageal gland between the 'scaly-foot' and *Gigantopelta aegis*; but only in the 'scaly-foot' the isotopic ratio was different from other tissues. These results suggest that the 'scaly-foot' has high Fe absorption efficiency from the environment but low Fe supply efficiency to its endosynbionts, whereas *Gigantopelta aegis* has low Fe absorption efficiency but high Fe supply efficiency to its endosymbionts. The Fe isotope signatures obtained here revealed clear differences in the absorption efficiency of dietary Fe, between two closely related snails in the same environment with similar lifestyle. These signatures will also be discussed in relation to two key adaptations of these snails, namely hosting endosymbiotic bacteria in an internalized organ and having an iron-compound layer on the shell and scales.

Keywords: Fe stable isotope, Fe bio-cycle, hydrothermal vent, scaly-foot gastropod, Gigantopelta aegis, multiple collector ICP-mass spectrometer (MC-ICP-MS)

