Inter-specific variations in trace element concentrations of modern brachiopod shells collected from Otsuchi Bay, Japan

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Carbon- ($\delta^{13}C$) and oxygen-($\delta^{18}O$) isotope composition and trace element to calcium ratios (Me/Ca; e.g., Mg/Ca and Sr/Ca) in biogenic carbonates have been used as a powerful tool for reconstructing paleoceanographic and paleoenvironmental conditions throughout the Phanerozoic. Rhynchonelliformea brachiopods, hereafter called “brachiopod”, are regarded as one of the excellent archives for the conditions because of (1) their extensive fossil records from the early Cambrian onwards, (2) their dense, low-magnesium calcite shells less susceptible to diagenetic alteration than aragonitic precipitates of marine calicifiers, and (3) the occurrence of modern analoguesin the oceans.For these reasons, $\delta^{13}C$ and $\delta^{18}O$ values of fossil brachiopod shells have been served as a major data source in many studies on paleoenvironments, especially those in the Paleozoic and Mesozoic. In contrast, Me/Ca in brachiopod shells has not been used as paleoenvironmental indicators because the relationship between shell chemistry and seawater composition and physical properties (e.g., temperature, salinity) are not well understood. This is at least partly due to difficulties in obtaining time-series of Me/Ca from modern brachiopod shells to compare directly with those in seawater chemistry (pH and carbonate system as well as Me/Ca) and the oceanographic properties at their growth sites.
We investigated inter-specific variations in Mg/Ca, Sr/Ca, Mn/Ca, and Fe/Ca in the shells of four modern brachiopod species collected from two different water depths in Otsuchi Bay, Japan, and established a new technique for converting distance domain Me/Ca profiles of the ontogenetic-series samples to the Me/Ca time-series. Mg/Ca of *Terebratulina crossei*is higher than that of the other species (*Laqueus blanfordi*,*Laqueus rubellus*, and *Terebratalia coreanica*). Significant correlations are found between Mg/Ca and $\delta^{18}O$ values of some samples. If the correlations are statiscally significant, regression equations established for Mg/Ca and seawater temperatures for brachiopod shells have steeper slopes and higher intercepts than those for foraminiferal tests. Sr/Ca profiles are likely different in their patterns among species even though they live at the same water depth. Mn/Ca and Fe/Ca of the all species are verylow or below detection limits.

Keywords: Modern brachiopod, Trace element concentration, Paleoenvironmental proxy, Otsuchi Bay

