Age and Sr isotopic composition of the Ishimaki limestones in the Northern Chichibu Belt, Toyohashi City, central Japan

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Introduction

The age of the limestones at Mt. Ishimaki in Toyohashi City, which belongs to the Northern Chichibu Belt, has not been known because the fossils have not been found out. To determine the age of marine limestone without index fossils, the idea of Sr isotopic stratigraphy is useful. This method is based on the secular variation of seawater Sr ratio determined by using marine fossils with known geologic ages. Tanaka et al. (2001) reported the low $^{87}Sr/^{86}Sr$ ratio 0.7067 at Mt. Ishimaki and they estimated the age around 250 Ma.

In the residues extracted from the Ishimaki limestones with an acetic acid, some black amorphous phosphate aggregations are observed. As the shape like the 'basal cavity' of conodont is found on their surface, they seem to be fused conodont elements. The Ca/P ratio and REE pattern were similar to apatite of marine species such as conodont. These results support that at least a part of them consists of fused conodonts. Therefore conodont fossils have to be left in the Ishimaki limestones.

Thus, in order to compare the Sr isotopic age with conodont fossil age, the measurement of Sr isotopc ratios and the detection of condont fossils have been carried out at Mt. Ishimaki.

Geologic setting

The limestones at Mt. Ishimaki are the exotic blocks juxtaposed in the Jurassic accretionary complex of the Northern Chichibu Belt in Toyohashi City, central Japan. They are supposed to be of the seamount-type limestones, since they have no terrigenous materials and are intimately associated with greenstones and cherts. Based on the fossils of fusulines and radiolarians extracted from sedimentary rocks at Mt. Ishimaki's neighborhood, their age was estimated that it was the middle Permian to the middle Jurassic. However, the Ishimaki limestones themselves do not yield index fossils such as fusulinids.

Conodont from Mt. Ishimaki

Grayish white limestone in the north side slope of Mt. Ishimaki crops out as a steep cliff of 50 m in height in the quarry. Samples were collected from several horizons in this outcrop to find out conodont and to measure the Sr ratio. The samples were crushed to about 1-2 cm pieces. They were immersed with a 10 % acetic acid solution for a few days. The residues were observed under a binocular microscope to detect conodonts. Some segminiplanate elements were obtained from the residue of sample collected from the bottom of the outcrop (Figure 1).

Each of these elements has a relatively narrow platform with straight lateral margin, low fused denticles and a small funnel-like basal cavity, although the anterior part has been broken and is not observable. According to these features, they can be identified as P1 element of *Norigondolella navicula* (Huckriede). It indicates early Norian (Late Traissic) for the age of the Ishimaki limestones. This is the first discovery of index fossils at Mt. Ishimaki.

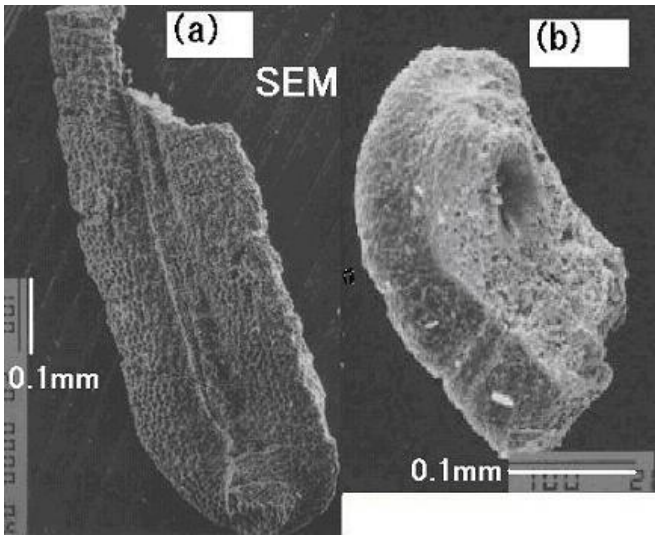
Variation of Sr isotopic ratios

The nine whole-rock Ishimaki limestone samples of this outcrop showed that the Sr isotopic ratios ($^{87}Sr/^{86}Sr$) varied from 0.7061 to 0.7076. These values satisfied on the Sr/Mn criteria of pure limestones from seawater (Denison et al, 1994). The Sr isotopic ratio 0.7061 is the lowest during the Phanerozoic age and it was gained at 20 m upper than the sampling point where conodont was detected. The Sr isotopic ratio of this point is so lower than previously reported value that the age cannot be estimated from this result.

Summary

Conodont fossils revealed the age of the Ishimaki limestones to be early Norian. According to the Sr isotopic stratigraphy, the age of it is not determined precisely. Environmental change which tha Sr isotopic ratio of seawater drastically reduced might have occurred during Triassic.

Figure 1 SEM image of conodonts. (a) and (b), *Norigondolella navicula* (Huckriede) P1 element


(a)
SEM
(b)
0.1mm
0.1mm