REWORKED ORDOVICIAN CONODONTS FROM YOKOKURA-YAMA, SHIKOKU, JAPAN

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Introduction

The Ordovician strata in Japan were first recognized in 1980 at Fukuji, Gifu Prefecture. The terrane of this Middle or Late Ordovician sequence belongs to the Hida Marginal Structural Belt of the Inner Zone of Southwest Japan. The Ordovician was named the Yoshiki Formation, being characterized by microfossils such as ostracodes, radiolarians and scolecodonts (IGO *et al.*, 1980).

During the detailed study of Silurian conodonts from the Outer Zone of Southwest

Japan, I reached the conclusion that reworked Ordovician conodonts are mingled in the Silurian strata of the Kurosegawa Tectonic Zone in Shikoku. This allows us to infer the earlier development of the Ordovician strata also in the Outer Zone of Southwest Japan. Below I intend to briefly describe the occurrence of reworked conodonts at Yokokura-yama. This paper is the first record of Ordovician conodonts in Japan.

Outline of geology

The Kurosegawa Tectonic Zone is a dis-

Fig. 1. Kurosegawa Tectonic Zone in Shikoku (lower left) and the localities of Ordovician conodonts in the eastern part of Yokokura-yama.

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continuous chain of lenticular rock bodies, with the N-S width ranging only 20 m to 2 km and the E-W length varying from 1 to 10 km, extending from western Central Kyushu through Shikoku then farther to the east coast of the Kii Peninsula for a distance of about 650 km. The lenticular bodies are characterized by the "trinity" of the Silurian-Devonian sedimentary rocks, the Mitaki Granites and the Terano Metamorphic Rocks (ICHIKAWA *et al.*, 1956; ICHIKAWA, 1976). These lenticular bodies have been interpreted as rootless older blocks thrust up along an uplift zone during the Late Permian. The Yokokura-yama Lenticular Body is one of the largest bodies with the length of about 8 km and the maximum width of about 1.5 km, forming the E-W trending mountain ridge of 600 to 1,000 m high (Fig. 1). The Silurian strata crop out along its crest and very steep southern slope of this narrow ridge, dipping nearly vertical to overturned to the north, with the strike of N70°W to EW in the west and N40 to 60°W in the east (NAKAI, 1980, 1981; YOSHIKURA, 1982). The Silurian sequence, namely the Yokokurayama Formation with the thickness of more than 1,150 m (NAKAI, *pers. comm.*) can be subdivided into three lithostratigraphic units: the lower, mainly clastic, the middle, predominantly carbonate and the upper, dominantly pyroclastic units.

Thin limestone lenses intercalated in the lower unit and thick, massive limestone layer of the middle unit both yield abundant megafossils. Conodonts are recovered from both of these two carbonate horizons (Fig. 2). Those from the lower unit clearly indicate the late Llandoveryan to early Wenlockian age, whereas those from the middle unit lack zonal markers so that the exact upper age limit of the middle unit is yet unknown (KUWANO, 1976, 1980).

Fig. 2. Stratigraphic column of the studied level of the Yokokurayama Formation. Squares attached to the left show the samples for conodont study. Solid-productive, hollow-barren samples. Numbered three samples yielded Ordovician forms.

Fig. 3. Ordovician conodonts from Yokokura-yama. A, B—*Belodina compressa* (BRANSON & MEHL, 1933). Grandiform element. MPC 2735. A, furrowed, B, unfurrowed sides. C, D—*Belodina* n. sp. BERGSTRÖM, 1978. Compressiform (?) element. MPC 2736. C, unfurrowed, D, furrowed sides. E–J—*Belodella* n. sp. Oistodiform elements. E–G, MPC 2737. E, outer, F, inner views, G, enlargement of E showing ornamentation on the main cusp. H, I, MPC 2738. H, inner, I, outer views. J, MPC 2739. A smaller element with less developed basal part, inner view. A–D: Loc. 1, the upper reach of Shiroishi-Ōsawa, sample 2906. The lower clastic unit (the so-called G_2), late Llandoveryan to early Wenlockian. E–J: Loc. 2, abandoned limestone quarry, samples 1208, 1210 (both from outcrop) and 2404 (debris). The middle carbonate unit (the so-called G_3), early Wenlockian and later age (upper age limit unknown). All figures are $\times 120$ ca. except for G, $\times 400$ ca. MPC denotes the Micropaleontology Collection reposed at the National Science Museum, Tokyo, Japan.

Reworked Ordovician conodonts and age assignment

Ordovician conodonts were found from both of the above-mentioned two carbonate horizons (Fig. 2). Four rock samples from two localities were proved to bear Ordovician conodonts. The recovered specimens are only few in number, being assigned to the genera *Belodina* and *Belodella*: *Belodina compressa* (BRANSON & MEHL), *Belodina* n. sp. BERGSTRÖM and *Belodella* n. sp. (Fig. 3).

Belodina compressa (BRANSON & MEHL) is a Middle Ordovician species, ranging from the early Blackriveran to middle Shermanian

(SWEET in ZIEGLER, ed., 1981). *Belodina* n. sp. was recorded from the Late Ordovician Maravillas Formation in Texas, which is correlatable to the Maysvillian (BERGSTRÖM, 1978). *Belodella* n. sp. most closely resembles the oistodiform element of *Belodella nevadensis* (ETHINGTON & SCHUMACHER, 1969) from the Middle Ordovician Woods Hollow Shale illustrated by BERGSTRÖM (1978). It also resembles *Oistodus* sp. B s.f. figured by SWEET et al. (1971) as one of the index forms of their Fauna 1 of the earliest Middle Ordovician.

Belodina is a genus restricted to the Middle

and Late Ordovician, namely from the Chazyian to Richmondian and questionably to the Gamachian (SWEET in ZIEGLER, ed., 1981), and there have been no informations about its occurrence from the Silurian (ALDRIDGE, 1972, 1975; COOPER, 1980; NOWLAN, 1981 *etc.*). McCracken & Barnes (1981) published the results of detailed study on the conodont succession in the interval from the Uppermost Ordovician to the Lowest Silurian of the Anticosti Island, Québec, Canada. They proved that this genus disappears at a level a little below the top of the Gamachian, not extending upwards into the Lowest Silurian. Just same as bedolinitiform elements, the occurrence of oistodiform elements has not been known from the Silurian. In consequence, the above-mentioned three species from the Silurian carbonates at Yokokura-yama are concluded to have been derived from the underlying Middle and Late Ordovician sequences.

Further refinement of age assignment needs future studies but it can be considered that the Ordovician strata had been widely distributed in Southwest Japan just like in the present-day Asian continent.

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