First cyclid crustacean from East Asia

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Abstract: Based on a single specimen from Serpukhovian (Late Mississippian/late Early Carboniferous)
  limestone, Niigata Prefecture, central Japan, we describe a new species of cyclid crustacean, Cyclus tazawai,
  as the first record of the order from East Asia. Comparable Early Carboniferous species with C. tazawai
  are C. torosus Woodward, 1870, C. simulans Reed, 1908 and C. jonesianus Woodward, 1870, all of which
  were reported from Ireland. Previously, the Early Carboniferous cyclids have been regarded to be endemic
  in Euramerica. The new species may have had a parasitic relationship with cartilaginous fishes.

Keywords: Cyclida, Crustacea, Cyclus tazawai sp. nov., Serpukhovian (Late Mississippian/late Early Carboniferous),
  Hida–Gaien Belt, Itoigawa

Introduction

The Cyclida is an enigmatic order of crustaceans consisting of a flattened body with the oval to subcircular
shield-like carapace that occurs from the Lower Carboniferous to the Upper Cretaceous in marine to brackish,
or rarely from lacustrine, deposits. Since Phillips (1835), who placed cyclids to agnostid trilobites, many different
views have been proposed for their higher taxonomic placement. Although they are exclusively interpreted as
the class Maxillopoda in recent workers, three different subclasses for their assignment are advocated, namely
Branchiura (Dzik, 2008), Copepoda (Clark, 1989), and Halicyna (Gall and Grauvogel, 1967; Schram et al., 1997).
Herein, we document the occurrence of a new species of a cyclid from central Japan. This discovery extends to East Asia
in geographic range of cyclids, whose previous records were limited in Austria, Belgium, Bosnia, Central Asia, France, Germany, Ireland,
Italy, Madagascar, Netherlands Poland, Russia, the U. K. and the U. S. A. (Glaessner, 1969; Schram et al., 1997;
Fraaie et al., 2003; Dzik, 2008).

Geologic setting

The holotype (and only known specimen) of Cyclus tazawai sp. nov. was collected from a float of black
limestone (bioclastic wackestone) in the Tsuchikura-zawa Valley, Itoigawa, Niigata Prefecture. Latitude and
longitude coordinates of the fossil locality in Tokyo Datum are 36° 55’ 21” North and 137° 48’ 46” East (see fig.
1 in Niko and Yamagiwa, 1998, for detailed collecting site). The present float probably originates from exotic
blocks in the Middle to Upper Permian Kotaki Formation (Kawai and Takeuchi, 2001; Nagamori et al., 2010).
Judging from its faunal and lithologic analyses (i.e., Kamiya and Niko, 1996; Niko and Yamagiwa, 1998; Tazawa,
2004), the fossil-bearing limestone probably ascribes to a member of the Hida–Gaien Belt, that was deposited
in the eastern margin of the North China (Sino–Korea) Continent (Niko, 1998; Tazawa et al., 2010)
under a shallow marine environment. Associated foraminifers (Eostaffella postmosquensis, Pseudoendothyra
sp., Endothyra sp., Astroarchaeidiscus sp.) indicate a Serpukhovian (Late Mississippian/late Early Carboniferous)
age (Kamiya and Niko, 1996) of C. tazawai sp. nov.

Systematic paleontology

Order Cyclida Schram, Vonk and Hof, 1997
Family Cyclidae Packard, 1885
Genus Cyclus de Koninke, 1841
Type species.—Agnostus? radialis Phillips, 1835.

Cyclus tazawai sp. nov.
Figs. 1, 2

Diagnosis.—Carapace small, oval, depressed having 3.2 mm long (incomplete) and 4.2 mm wide, with flat
rim and smooth margin: two median bulges and four pairs of lateral bulges present: median bulges and first
and second pairs of lateral bulges without papillae; radial lateral ridge absent.

Description.—Carapace small for the genus, de-
pressed in an anterior-posterior direction (wider than
long), oval in outline with 3.2 mm long (incomplete)
and 4.2 mm wide; cross section strongly vaulted, dome-
Fig. 1. *Cyclus tazawai* sp. nov., holotype, FMM1998. A: dorsal view, B: left lateral view, C: posterior dorsal view, D: anterior dorsal view. Scale bar is 2 mm.

Fig. 2. Camera lucida drawing of the carapace of *Cyclus tazawai* sp. nov., dorsal view. The drawing shows the names and location of bulges, ridge, grooves, and rim. Scale bar is 2 mm.

like: its greatest height 1.5 mm, somewhat behind middle; anterior margin incompletely preserved, possibly inflated; lateral to posterior margin smooth, rounded; flat rim developed; width of rim in lateral margin nearly three times than that in posterior margin. Ten bulges in anterior part of carapace present (Fig. 2), consisting of unpaired two (anterior and posterior) bulges on median line and four pairs of bulges that are symmetrically arranged on both sides of median line; anterior median bulge incompletely preserved, relatively large and probably subtriangular; posterior median bulge indistinct small lozenge-shaped; the first pair consists of large indistinct quadrate bulges; the second pair incompletely preserved, relatively large, and probably consisting of drop-shaped bulges; the third pair consists of small elliptic bulges; the fourth pair consists of well-prominent and large kidney-shaped bulges. In posterior part of carapace, a median ridge and lateral grooves developed; lateral grooves roughly run concentrically with carapace margin; radial lateral ridge absent. Except for anterior and posterior median bulges and first and second pairs of lateral bulges and rim, the surface is covered with papillae. Appendages not preserved.

**Etymology.**—The specific name honors Dr. Jun-ichi Tazawa, in recognition of his contributions for geology of the Omi-Kotaki area including the type stratum.

**Material.**—A single specimen (holotype) FMM1998 is reposited in Fossa Magna Museum, Itoigawa.

**Discussion**

*Cyclus tazawai* sp. nov. is principally distinguishable from other species of the genus based on morphologic combination of its depressed (wider than long) carapace with a flat rim and the absence of the radial lateral ridge. Distinctive characters of somewhat similar Early Carboniferous species with the new species are as follows: *C. torosus* Woodward (1870, p. 555, pl. 23, figs. 4, 4a; 1878, p. 250, 251, text-figs. 80a, b) has a subcircular outline of the carapace with larger size of approximately 8 mm in diameter, the much larger posterior median bulge, and the three pairs of the lateral bulges; *C. simulans* Reed (1908, p. 551, 552, text-figs. 1, 2) has a compressed (longer than wide) carapace, the three median bulges and the five pairs of the lateral bulges; and *C. jonesianus* Woodward (1870, p. 557, 558, text-figs. 1, 2) has a compressed carapace with larger size of approximately 7 mm long and 5 mm wide and papillate ornaments on the first lateral bulges. The comparable three species with *C. tazawai* are reported from Ireland. A Missourian (Upper Pennsylvanian/Upper Carboniferous) species, *C. limbatus* Rogers (1902, p. 273, pl. 14,
fig. 4), from Kansas, central North America also has a depressed outline of the carapace, but the younger species is characterized by the slender spines on its carapace margin, whereas C. tazawai has a flat rim with smooth margins.

Cyclids appear in fossil record from the Visean (middle Early Carboniferous). Previously it has been thought that the earliest known representatives of the group were endemic in Euramerica, and they exhibit distinct provincialism consisting of the eastern fauna typified by Schramine in Montana, North America and the western one typified by Cyclus in England, Ireland and Belgium (Goldring, 1967; Schram et al., 2005; Dzik, 2008) (see Fig. 3). The present discovery of C. tazawai from Far East Asia revealed wide distribution of Cyclus. The migration of the genus likely occurred along the northern shelves of the Paleo-Tethys from its probable origin in Euramerica to the western shelves of the Panthalassa and has already completed before Serpukhovian time.

As summarized by Schweigert (2007), various interpretations concerning the mode of life of cyclids have been advocated due to the absence of crucial information to solve this problem. These hypotheses include: 1) a parasitic lifestyle, lived on the surface of fishes (Müller, 1955), 2) a benthic, predatory lifestyle (Gall and Grauvogel, 1967), and 3) an herbivorous or scavenging lifestyle (Schram et al., 1997). Among them, we agree with Müller's (1955) hypothesis based on the following circumstantial evidence. The flat rim of the carapace of Cyclus tazawai probably has a function of a sucker. Ibaraki et al. (2006) documented co-occurrence of a tooth of a cartilaginous fish, Petalodus sp., from limestone at the Tsuchikura-zawa Valley with the species. The wide distribution with a rapid rate of Cyclus can be explained by migration of the hosts. Cyclus tazawai may have had a parasitic relationship with cartilaginous fishes, like as certain copepods, including modern Nemesis and Pandarus.

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References


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" in Japanese
"" in Japanese with English abstract

用語対比
Tsuchikura-zawa 土倉沢