A New Discovery of *Colobodus* Agassiz, 1844 (Colobodontidae) from the Carnian (Upper Triassic) of Guizhou, South China

LI Ji[1,*], LUO Yongming[2], WANG Yue[1], XU Guangfu[1], MA Zhiheng[1,3]

1 *College of Resource and Environmental Engineering, Guizhou University, Guiyang 550025, China*

2 *Geological Survey of Guizhou, Guiyang 550004, China*

3.Chongqing Institute of Geology and Mineral Resources, Chongqing 400042, China

Corresponding author E-mail: liji_gzu@163.com

Objective

Palaeoichthyology has been identified a research hotspot since abundant Triassic ichthyolite was discovered in Monte San Giorgio and South China. Critical review of the Colobodontidae reveals that this family has important research value. Furthermore, the family Perleididae Brough, 1931 and the probably paraphyletic '*Perleidus* group' Gardiner & Schaeffer, 1989 have been implicitly regarded a synonym of the unsatisfactorily defined family Colobodontidae. Until 2002, Colobodontidae had been universally accepted as a significant taxon among all Triassic ichthyolite. However, the most colobodontids are probably confined to the Anisian and Ladinian in the Western Tethys. A well-preserved colobodontid discovered in Guizhou, South China, throws new light on its distribution and stratigraphic range.

Methods

A specimen was collected at the Wusha village of Xingyi City, Guizhou Province, South China and is preserved in the Geological Museum of Guizhou Province. The repair work was completed in a physical way in the laboratory of the Department of Geology, Guizhou University. Photographing the specimen was done by a 3D Microscope VHX-100k and drawings were made with reference to the digital photographs.

Results

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Systematic Paleontology

Class **Osteichthyes** Huxley, 1880

Subclass **Actinopterygii** Cope, 1902

Order **Perleidiformes** Berg,1940

Family **Colobodontidae** Andersson, 1916

Genus ***Colobodus*** Agassiz, 1844

Diagnosis: Large sized fusiform in body shape with slender infraorbitals; posterior region of maxilla expands dorsally well and slightly downwards, robust mandible with broad symphysis; operculum and subopercular covered by fine exquisite rugae; preoperculum inclines slightly forward; well-developed crushing dentition; scales richly ornamented with longitudinal ridges; lepidotrichia branch asymmetrically at least in dorsal and anal fins; caudal fin almost externally symmetrical.

***Colobodus wushicus* sp. nov. (Fig.1)**

Etymology: Wusha (Named after the locality of the holotype-Wusha, Xingyi, Guizhou, South China).

Holotype: A fairly complete and articulated specimen. (The Geological Museum of Guizhou Province. No.GZ12203845)

Stratotype: The Zhuganpo Member of the Falang Formation, Carnian, Upper Triassic, within the conodont *Neogondolella polygnathiformis* zone.

Diagnosis: Relatively large, moderately fusiform body, with 68 vertical scale rows along the lateral line; jaw borders hemmed by slender-conical teeth, often reduced posteriad along upper jaw border; supracleithrum absent; preoperculum lacks any ornament; scales in anterior flank deeper than broad; the ganoin ornament on all scales shows a typical pattern consisting of straight and parallel ridges; scales near the caudal pedicle have the ornament of moderate ganoin sculpture.

Description: The holotype is an almost complete, fusiform fish, except for the extremities of the fins. Its total length is 438mm and the maximum body depth is 113mm (Fig.1b). The ratio of body length/body depth is approximately 4. Length of skull almost equals to depth of body, nearly a quarter of total length, the depth of skull is 95mm. The skull is not possible to accurately determine the relationships of all bones, and some bones of the restored skull must be regarded as tentative in certain details (Fig.1c). The snout is typically round and blunt, it is composed of the unpaired rostral and postrostral, and the paired nasals. The postrostral is a large squarish bone, capping the most of the snout and separating the nasals. The paired nasals are irregularly rhomboidal, wider dorsally than ventrally. The frontal bone is narrow in lateral view and the middle of it is the widest. The margins of frontal are covered by more tubercles, whereas the remaining parts are ornamented by elongate ganoin ridges. The parietal is roughly square and meets the dermopterotic in a vague suture. There are four infraorbital bones, the highest of which is usually considered as the dermosphenotic. Dermosphenotic is ornamented by longitudinally-waved ganoin ridges. The maxilla has a slight dislocation with narrow anterior region and significantly enlarged posterior plate. Moreover, it has a partial overlap with the antero-ventral margin of the preoperculum. Short ganoin tubercles and ridges cover most of the maxilla The mandible is wedge-shaped, which is largely covered by thick ganoin ridges and ganoin tubercles are present near the oral margin (Fig.1a). Anterior edge of the jaw is inlaid by slender-conical teeth and the teeth become small and dull at the back of the jaw, which shows a tendency towards crushing adaptation. The preoperculum is a large wedge-shaped and it inclines slightly forward. Its postero-dorsal edge meets the dermohyal, a small triangular bone. This specimen preserves a hyomandibular bone which has overlap with most region of the preoperculum, it plays a role in suspending the jaws and operculum, the hyomandibular bone is a triradiate element comprising a triangularly dorsal head, a robustly ventral shaft and a unconspicuous opercular process. The operculum is a rectangle with round posterior border and the subopercular is trapezoidal in outline. Both surfaces of them are decorated with ganoin rugae. The shoulder girdle is poor developed, it

consists of a crescent posttemporal ornamented by elongate ganion ridges, and of a prominently sickle-shaped cleithrum which is associated with the pectoral fin. The posterior part contacts vertically with suboperculum, and the anterior part extends forward to ventral. There are 4 definite branchiostegal rays.

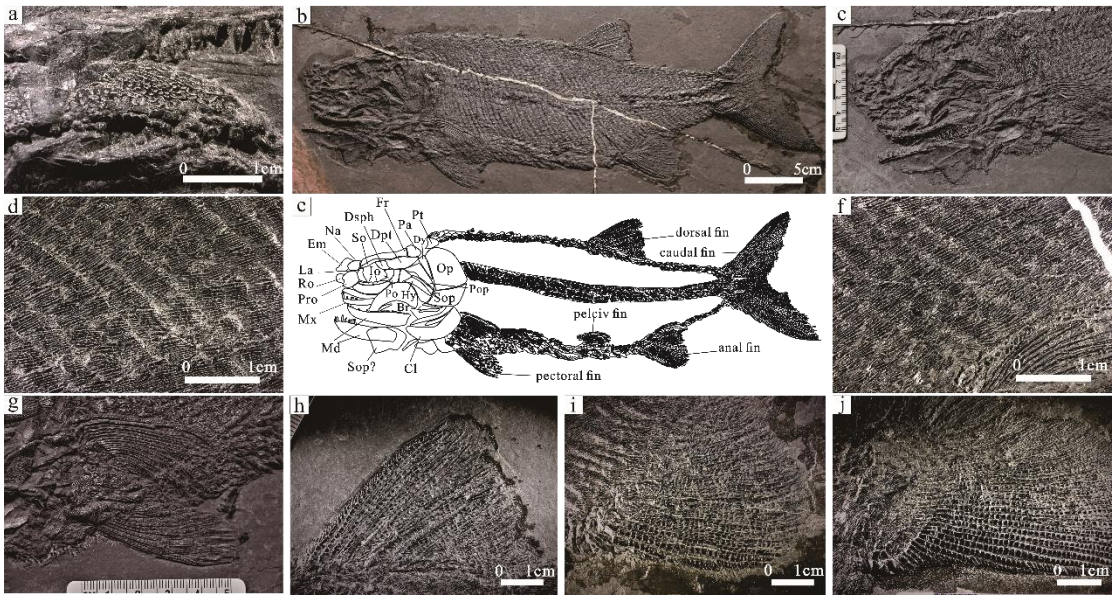

Fig.1 a: The mandible of the holotype; b: The photograph of the holotype in lateral view; c: The skull of the holotype; d: The anterior flank scales of the holotype; e: The drawing of the holotype; f: The medial flank scales of the holotype; g: The pectoral fins of the holotype; h: The dorsal fin of the holotype; i: The anal fin of the holotype; j: The partial lower lobe of caudal fin of the holotype. Abbreviations: Br, branchiostegal rays; Cl, cleithrum; Dy, dermohyal; Dpt, dermopterotic; Dsph, dermosphenotic; Em, ethmoid; Fr, frontal; Hy, hyomandibular; Io, infraorbital; La, lachrymal; Mx, maxilla; Md, mandible; Na, nasal; Op, operculum; Pa, parietal; Pt, posttemporal; Pro, postrostral; Po, postorbital; Pop, preoperculum; Ro, rostral; So, supraorbital; Sop, suboperculum.

The pectoral fins were held in a nearly horizontal position (Fig.1g), They are the largest of all fins and have approximately 18 lepidotrichia. The fin rays have long proximal bases and a row of fringing fulcra lies on the anteriormost ray. The pelvic fins consisting of 10 lepidotrichia are the smallest. They are between the 21st to 24th rows of scales with the proximal long bases of lepidotrichia. The dorsal and the anal fins are nearly equal in size, they are triangular-shaped with rather wide base and composed of about 25-28 lepidotrichia (Fig.1h, Fig.1i). Moreover, they are between the 34th to 42nd and 31st to 40th rows of scales, respectively. The fin rays are completely segmented and the main rays have at least two branches. The segments of the dorsal fin rays have greater length than width, which is different from anal fins. The caudal fin is deeply cleft and it is homoceral. The total number of lepidotrichia of caudal fin is approximately 66 and they are completely segmented (Fig.1j). The borders of all unpaired fins are fringed by delicate fulcra. The squamation is a conspicuous feature of the new specimen. The scales on anterior trunk are rectangle (Fig.1d), the scales on the middle of body are squarish (Fig.1f), and the rest are rhombic. All scales are ornamented with dense, straight and nearly parallel ganoin ridges.

Conclusions

Taxonomic studies of *Colobodus* were in a state of chaos before 21st century. The genus *Colobodus* has been used as a hospice, and become universally applied to fish remains, such as molariform teeth associated with richly ornamented scales, but many species were reported only by the fragments of dentition and squamation without other details. The earliest, well-known species of *Colobodus* is *Colobodus hogardi* L.Agassiz, 1844. However, *C.hogardi* was ignored as holotype for the damage of type specimen. Afterwards, *Colobodus bassanii* Alessandri, 1910 became widely accepted as holotype of this genus. Besides, there are at least three valid species of Colobodus. They are *Colobodus maximus*

Quensted, 1867, *Colobodus koenigi* Stolley, 1920 and *Colobodus baii* Sun, 2008. The former two species have not been found in Tethyan sediments. The fragments assigned to *C. maximus* bear no resemblance with crushing teeth of *Colobodus* and *C. koenigi* has actually only slight differences in the scale ornamentation from *C.bassanii*. Thus, the new material of this study was only compared with *C. bassanii* and *C. baii*.

Although the skull of *C. wushicus* sp. nov. is similar to *C. bassanii* and *C. baii* in general pattern, there are still some bones that are morphologically different. In *C.wushicus* sp. nov., supracleithrum is absent, while in *C. bassanii* and *C. baii*, supracleithrum are present. Further, at least four branchiostegal rays of *C. wushicus* sp. nov. are definite, while the same elements are not mentioned in *C. bassanii* and *C. baii*. The hyomandibular of *C. wushicus* sp. nov. has a stronger ventral shaft, respect to that of *C. bassanii* and *C. baii*, moreover, the angle between the dorsal head and the ventral shaft is more obtuse in the new species.

The dorsal and the anal fins of the new specimen are nearly equal in size. However, the dorsal fin is longer than anal fin in *C. bassanii* and *C. baii*. Additionally, the median fin rays of *C. wushicus* sp. nov. have shorter proximal bases than those of *C. bassanii* and *C. baii*. Concerning the ornamentation on the rays of the median fins, *C. baii* shows a single ganion patch for each segment. Moreover, contrary to what happens in *C. baii*, in our specimens the ganion patch for each segment is much more irregular.

In *C. bassanii* and *C. baii*, the ganoin ornament on the scales is strongly variable, which is related to their positions. But in *C. wushicus* sp. nov., the ornament of ganoin ridges on all scales is almost uniform. In *C. wushicus* sp. nov., each scale has about 8-12 straight and nearly parallel ridges, while in *C. bassanii* and *C. baii*, each scale has 18-20 ridges. The ridges of the new species are much finer, however, the ridges of scales in *C. bassanii* are much stronger and thicker. Actually, the variable ornament on scales in different specimens has been an enigma. According to statistical studies on colobodontids squamation, the variation of ganoin ornament may depend on age and size of the fish and on the palaeoenvironment in which it lived.

It must be pointed out that *C. bassanii* is produced at the boundary between the Anisian Age and the Ladinian Age, *C. baii* is produced in Middle Pelsonian (Anisian) and *C. wushicus* sp. nov. is produced in the Carnian Age (Late Triassic). Although the evidence of age is not enough to establish new species, it is feasible to establish new taxon in the genus *Colobodus* according to observed morphological differences.

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