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A new species of the genus *Perleidus* (Actinopterygii: Perleidiformes) from the Middle Triassic of Southern China

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KEY WORDS - Actinopterygians, Perleidiformes, Perleidus sinensis *n. sp., Middle Triassic, Southern China, Tethys.*

ABSTRACT - Perleidus sinensis *n. sp., a new species of "Subholostean" fossil fish of the order Perleidiformes is described herein on the basis of a single, well-preserved specimen collected from the Upper Member of the Guanling Formation (Pelsonian, Middle Anisian, Middle Triassic) outcropping near Luoping (Yunnan Province) in South China. The vertebrate assemblage yielded by these levels is proving to be of importance with regard to the marine Triassic ichthyofaunas, not only due to the variety, richness and quality of preservation of the faunas, but also from a paleobiogeographic point of view. The new taxon here described belongs to the genus* Perleidus, *so far represented only in the upper Ladinian of Northern Italy and Switzerland; this find reconfirms a very close connection between the Eastern and Western Tethys during the Middle Triassic, when many fish genera may have migrated from the Southern China Block to the Western Tethys area, giving rise to a notable radiation during some intervals of the Triassic. Besides* Perleidus, *other actinopterygians are common to both margins of the Tethys, such as* Sangiorgioichthys, Habroichthys, Placopleurus, Peltopleurus, Peltoperleidus, Marcopoloichthys, Colobodus, Luopingichthys *as well as the cosmopolitan genera* Saurichthys *and* Birgeria.

RIASSUNTO - [Una nuova specie del genere *Perleidus* (Actinopterigi: Perleidiformi) nel Triassico Medio della Cina Meridionale] - *In questo lavoro viene descritta* Perleidus sinensis *n. sp., una nuova di specie di "Subolosteo" appartenente all'ordine dei Perleidiformi, sulla base di un unico esemplare ottimamente conservato, proveniente dal Membro Superiore della Guanling Formation (Pelsonico, Anisico Medio, Triassico Medio) dei dintorni di Luoping nella Provincia dello Yunnan in Cina Meridionale. Questo livello ha fornito una delle più importanti faune a vertebrati ritrovate nel corso degli ultimi decenni, in particolar modo per quanto riguarda le faune a vertebrati del Triassico marino, non solo per la diversità, ricchezza e qualità di conservazione, ma anche da un punto di vista più strettamente paleobiogeografico. Il nuovo taxon qui descritto, infatti, appartiene al genere* Perleidus, *segnalato finora esclusivamente nel Ladinico superiore dell'Italia settentrionale e della Svizzera. Questo ritrovamento conferma ulteriormente quanto emerso dai recenti studi, che hanno evidenziato l'esistenza di una connessione molto stretta tra la Tetide orientale ed occidentale nel corso dell'Anisico, quando molti generi di pesci hanno probabilmente migrato dal Blocco della Cina Meridionale verso l'area della Tetide occidentale, dove hanno dato luogo ad una straordinaria radiazione per gran parte del Triassico. Oltre a* Perleidus, *infatti, entrambe le terminazioni della Tetide condividono diversi generi di attinotterigi, come* Sangiorgioichthys, Habroichthys, Placopleurus, Peltopleurus, Peltoperleidus, Marcopoloichthys, Colobodus, Luopingichthys *e i generi cosmopoliti* Saurichthys *e* Birgeria.

INTRODUCTION

The recent discovery of a new vertebrate assemblage in the Upper Member of the Guanling Formation (Pelsonian, Middle Anisian, Middle Triassic), exposed around the Dawazi village (Luoping County, Yunnan Province, South China), proved to be one of the most important finds in the last decades for marine fishes of that age (Fig. 1A). A preliminary survey (Tintori et. al., 2008, 2010; Sun et al., 2009a, b; López-Arbarello et al., 2011) suggests that it could yield more than 25 taxa of Actinopterygians and coelacanths, most of them represented by several very well-preserved specimens. The fossil assemblages [the vertebrate level is about 12 m thick and the lithology is quite different throughout the 10 m thick Upper Vertebrate Horizon (UVH) and the much thinner Lower Vertebrate Horizon (LVH), which means that paleoenvironment varied during the depositional interval] consist also of marine reptiles (Li et al., 2011; Liu et al., 2011), different arthropod groups (isopods, decapods, horse-shoe crabs, mysidiaceans, etc.), molluscs (mainly gastropods, concentrated in a few beds) and terrestrial plants. A few beds in the LVH are also rich in quite large bioturbations. Although we know that many fish specimens are from the UVH, no detailed work has been done so far in this part. Following the traditional Chinese way of nominating the fossil fauna from the nearby major locality, this vertebrate fauna was considered as 'the Luoping Fauna' (Tintori et al., 2008; Sun et al., 2009) of Pelsonian age (Middle Anisian, Middle Triassic) owing to the presence of the conodont *Nicoraella kockeli* from the fossil-bearing layers (Fig. 1B).

Among fishes, *Saurichthys* is known with at least 8 species (Wu et al., 2009, 2011) and it is found also on mass mortality surfaces, while *Sangiorgioichthys sui* López-Arbarello et al., 2011 seems to be by far the most common species, found in very crowded mass mortality surfaces too (Sun et al., 2009; López-Arbarello et al., 2011). These latter mass mortality surfaces are sometimes very close to each other. For instance, at least three subsequent laminae in the basal part of the LVH show an average of more than ten *Sangiorgioichthys* specimens each square meter, together with rare *Saurichthys, Placopleurus* and *Habroichthys*. Furthermore *Sangiorgioichthys sui*

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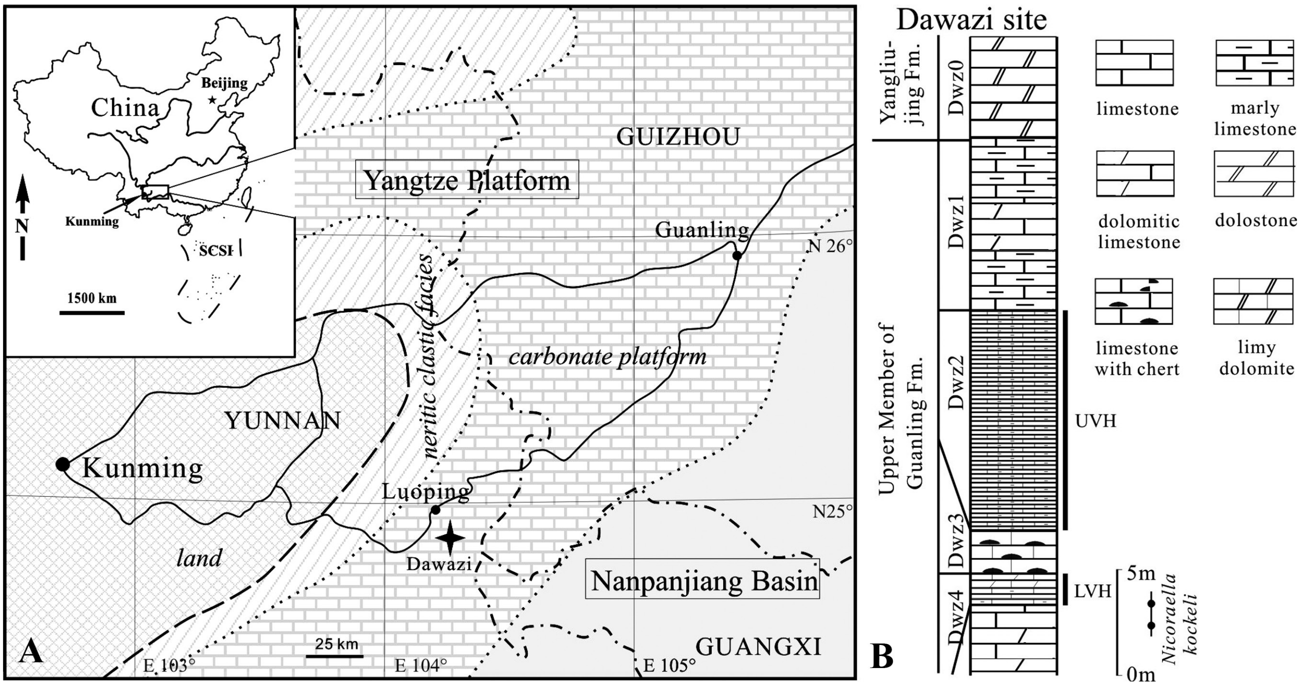

Fig. 1 - Simplified paleoenvironmental map (A) and section (B) with the stratigraphic position of the fossiliferous levels yielding the Luoping Fauna (UVH= Upper Vertebrate Horizon; LVH= Lower Vertebrate Horizon) (after Sun et al., 2009, modified).

specimens show a size grouping probably related to growth stages, from juveniles (4 cm in total length) with no complete scale covering, to adults up to more than 12 cm in total length (A.T. pers. obs.).

Generally, apart from the very common *Saurichthys* and *Sangiorgioichthys*, so far the other fish taxa can be considered from quite common to rare and in some cases, like the one described in this paper, very rare as only a single specimen is presently known.

A preliminary field investigation during the summer of 2008 pointed to a presence of *Sangiorgioichthys* and *Placopleurus* in all the beds of the LVH, while other taxa have been recorded only in one or few beds. This new fish-assemblage should be considered as more or less of the same age of the Panxian Fauna (Motani et al., 2008; Jiang et al., 2009). However, it is clear that there are some interesting differences regarding the fish taxa yielded by the two faunas, even if we must keep in mind the very different preservation quality from the two sites, with the Panxian Fauna being quite poor in both number of specimens and quality of preservation. The Luoping Fauna seems to be much richer in taxa, such as for *Saurichthys* species (Wu et al., 2009, 2011) and other new taxa under study, while, on the other hand, it seems to be deprived of *Colobodus*, quite common in Panxian (Sun et al., 2008). As for the general composition of these Pelsonian fish assemblages, even if there are not yet detailed data from scientific excavations, it seems that as for the number of taxa (at genus level) the basal neopterygians (Tintori et al., 2008, 2010) are somewhat more numerous than the "subholosteans" (Sun et al., 2009), while the basal actinopterygians and the coelacanths are not so common. However, if we consider the number of specimens, the most common are the neopterygians and the basal actinopterygians even if this is probably due to the presence of mass mortality layers for *Sangiorgioichthys* and *Saurichthys* spp.

The new taxon here described points again to a very close connection between Eastern and Western Tethys during the Anisian, when many fish genera might have migrated from the Southern China Block to the Western Tethys area (Monte San Giorgio and other sites in the Alps) where they flourished for most of the remaining Triassic time. *Perleidus* (this paper), as well as *Sangiorgioichthys* (López-Arbarello et al., 2011), *Habroichthys, Placopleurus, Peltopleurus, Peltoperleidus, Luopingichthys* (Sun et al., 2009), *Marcopoloichthys* (Tintori et al., 2008), *Colobodus* (Sun et al., 2008) and the ubiquitous *Saurichthys* (Wu et al., 2009, 2011) and *Birgeria* make the common base of the fish assemblage at both ends of the Tethys. It must also be pointed out that most of the fish taxa (both "subholosteans" and neopterygians) known from the whole Tethys are represented by quite small specimens, usually not more than five cm in length (excluding *Colobodus*, *Saurichthys* and *Birgeria*).

TAXONOMICAL REMARKS

"Subholosteans", which include mostly perleidiforms and peltopleuriforms (Tintori & Lombardo, 2005), flourished during Middle and Late Triassic with a number of genera and species characterized by a remarkable morphological plasticity, particularly well represented in the Anisian and Ladinan of Northern Italy, Switzerland, Spain, Africa and China (Bürgin, 1992, 1996; Lombardo, 1999; Murray, 2000; Lombardo, 2001; Lombardo &

Tintori, 2004; Lombardo et al., 2008; Sun et al., 2008) as well as the Carnian and Norian of Northern Italy (Tintori & Sassi, 1992; Tintori & Lombardo, 1996; Lombardo & Brambillasca, 2005). Perleidiformes and Peltopleuriformes are actually very well differentiated in diet, size, the way of swimming as well as in their environment (fresh vs. marine waters) even if most of them are clearly marine dwellers.

Perleidiforms, with the exception of the large *Colobodus* (Mutter, 2004; Sun et al., 2008), are represented by genera of small/middle size, characterized by different morphologies of the body, from the fusiform *Meridensia* (Brough, 1939; Bürgin, 1992) to the deep-bodied *Dipteronotus* (Tintori, 1990) or *Felberia* (Lombardo & Tintori, 2004). The dentition in these forms is generally referable to a hemi-durophagous diet, with marginal peg-like teeth and very small crushing ones on palatal and coronoid bones (Bürgin, 1996); nevertheless, some even more specialized forms are present (see *Ctenognathichthys*, Bürgin, 1996; Tintori, 1998; or *Stoppania*, Lombardo et al., 2008) as well as rare predators like *Gabanellia* (Tintori & Lombardo, 1996).

Peltopleuriformes are characterized by a preoperculum more verticalized and narrower than that of perleidiforms, very high flank scales and an axial body lobe much reduced, giving to the caudal fin an almost symmetrical structure. With the peltopleuriforms the morphological variability reaches its top, so that it's very difficult to put boundaries not only within species, but even within genera (Lombardo, 1999, 2001; Mutter & Herzog, 2004). With regards to squamation, flank scales are typically thin, narrow and high to very high all along the body in peltopleuriforms, while perleidiforms have thicker, subrectangular to rhombic scales and those on the flank can be somewhat higher than longer in the trunk region.

The Luoping Fauna points to a Triassic radiation of fishes quite earlier than previously supposed (Tintori, 1998; Tintori et al., 2008, 2010). On the other hand, we do not know very much about the late Ladinian/early Carnian fish assemblages in Southern China (Xingyi/Wusha *Keichousaurus* Fauna and Guanling Biota); it is therefore very difficult to understand what happened there after this very early blooming, especially if we compare these assemblages with those of the Western Tethys, coming from the Monte San Giorgio Kalkschieferzone (latest Ladinian), Raibl (early Carnian, N. Italy), the Zorzino Limestone and the Forni Dolomite (Norian, N. Italy) (Tintori, 1998).

The new species of *Perleidus* here described confirms that the Eastern Tethys in the Early/Middle Triassic (the Southern China block) was probably a radiating area for marine fishes: the type species of *Perleidus* (till now the only known one), *P. altolepis*, comes in fact from the late Ladinian of Western Tethys (Perledo and Monte San Giorgio areas).

Abbreviations used in figures - bf: basal fulcra; df: dorsal fin; dlls: scales bearing pores of dorsal lateral line; dpt: dermopterotic; dsph: dermosphenotic; exsc: extrascapular; fr: frontal; io: infraorbitals; lls: lateral line scales; mdrs: mid-dorsal ridge scales; mx: maxilla; na: nasal; op: operculum; pa: parietal; pcl: postcleithrum; pop: preoperculum; pt: posttemporal; ro: rostral; sbo: suborbital; scl: supracleithrum; so: supraorbital bone; sop: suboperculum.

SYSTEMATIC PALEONTOLOGY

Class Osteichthyes Huxley, 1880
Subclass Actinopterygii Cope, 1887
Order Perleidiformes Berg, 1937
Family Perleididae Brough, 1931

Genus *Perleidus* (De Alessandri, 1910)

Type species - *Perleidus altolepis* (Deecke, 1889).

Diagnosis (after Lombardo, 2001) - Small to medium-sized perleidiform fish with fusiform body; maxilla with narrow anterior and expanded posterior region; peg-like marginal teeth; preoperculum with wide dorsal region; wide opercular region with operculum slightly smaller than suboperculum; one suborbital; caudal fin with 6/7 epaxial rays; lepidotrichia of all fins with long proximal elements. Lateral flank scales moderately high and deeper than wide; all scales serrated.

Distribution - Middle Triassic: Middle Anisian of the Upper Member of the Guanling Formation (Luoping County, Yunnan Province, South China), upper Ladinian of Perledo Member (Perledo-Varenna Formation) from Perledo area (Lario Lake, Lecco) and of Kalkschieferzone (Meride Limestone) of Ca' del Frate (Viggiù-Varese) and Meride (Canton Ticino, Switzerland).

Remarks - The genus *Perleidus*, belonging to the order Perleidiformes, is characterized, among others, by the presence of epaxial rays in the caudal fin, as pointed out by Lombardo (1995, 2001); this character represents a synapomorphy for the "subholosteans" as stated originally by Gardiner (1988) and Gardiner & Schaeffer (1989). This feature has not been taken into consideration by previous authors, who ascribed to this genus several species coming from the Early Triassic of Spitzbergen (Stensiö, 1921), Greenland (Stensiö, 1932), Madagascar (Piveteau, 1934; Lehman, 1952), Angola (Teixeira, 1947), China (Su, 1981) and Canada (Schaeffer & Mangus, 1976; Neuman, 1986). The attribution of all these species to the genus has been made only on the skull pattern, of primitive kind, and often on very poorly preserved material. Nevertheless, the revision, at first mostly bibliographical, of each species, revealed a different structure of the caudal fin, without epaxial fin rays. For this reason, the attribution of these species to the genus *Perleidus* has been questioned, as well as the presence of the genus in the Early Triassic (for a detailed discussion see Lombardo, 2001).

Regarding the Early Triassic fish faunas from Southern China, Tong et al. (2006) ascribed all the Chinese species previously attributed to *Perleidus* to the genus *Plesioperleidus*, erected by Su & Li (1983). In particular, the species "*Perleidus" eurylepidotrichia* (Liu et al., 2002), "*Perleidus" yangtzensis* (Su, 1981) and *Zhangina yangtzensis* (Jin et al., 2003) are conclusively ascribed to the species *Plesioperleidus yangtzensis* (Su, 1981) in

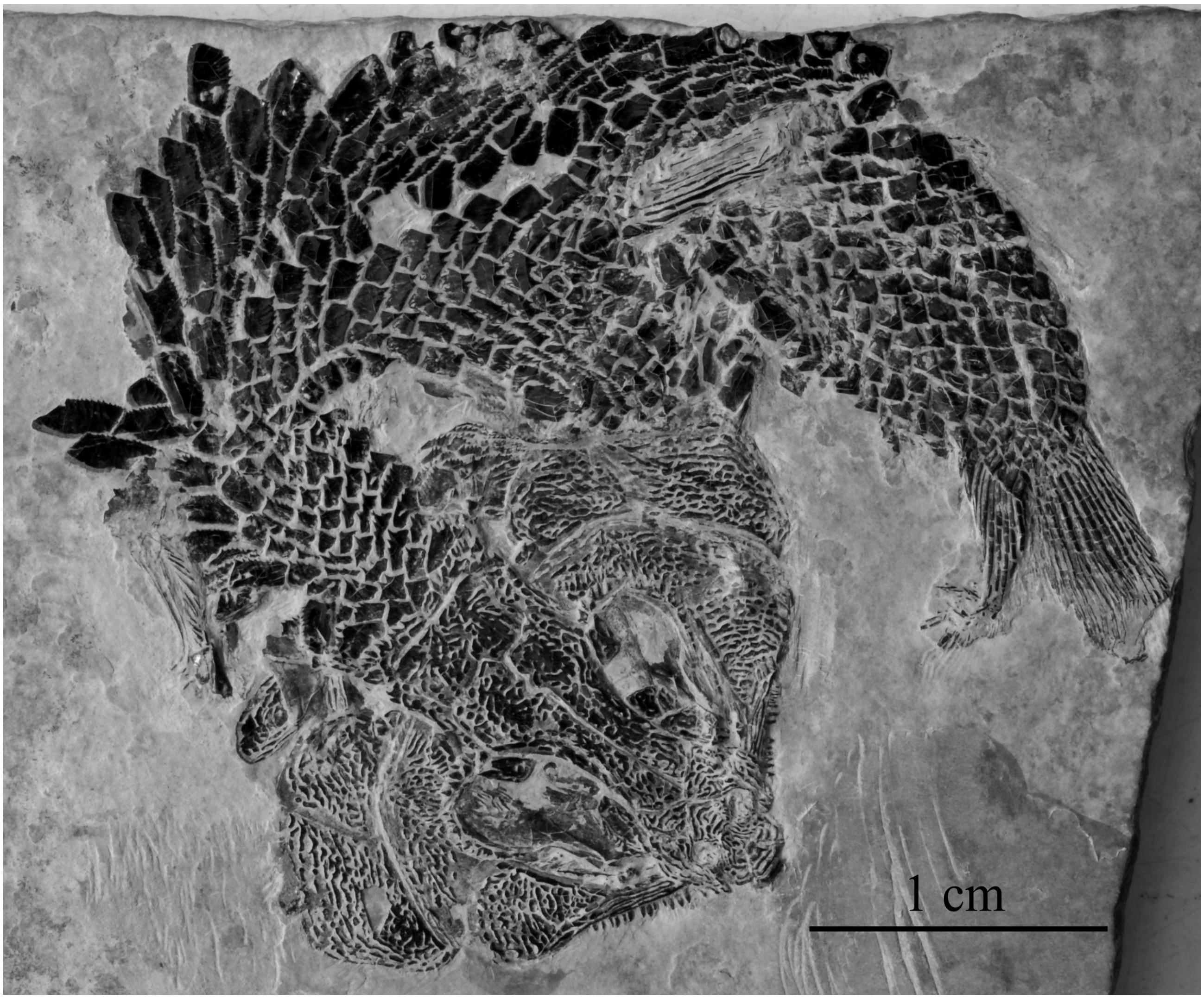

Fig. 2 - *Perleidus sinensis* n. sp., GMPKU-P-1350; the complete specimen.

Tong et al. (2006). Jin et al. (2003) stated that also the two species from Madagascar *Perleidus* cf. *madagascariensis* (Piveteau, 1934) and *Perleidus piveteaui* (Lehman, 1952) could not be attributed to the genus *Perleidus* and referred them to *Plesioperleidus jiangsuensis* (Qian et al., 1997). Nevertheless, both Jin et al. (2003) before, and Tong et al. (2006) later, even emphasizing the differences between *Plesioperleidus* from Lower Triassic and *Perleidus* from Middle Triassic, yet they included *Plesioperleidus* within the family Perleididae, only on the basis of the primitive skull pattern, the covering of heavy ganoid scales, the quite deep lateral flank scales and fin rays only distally segmented, but ignoring the structure of the caudal fin, which is, when preserved, clearly heterocercal. As already stated, this attribution is inconsistent with the perleidiform structure of the tail and therefore we consider *Plesioperleidus* as a Paleopterygian incertae sedis. Ongoing studies (Lombardo et al., in prep.) aim to ascertain if also other Early Triassic "*Perleidus*" species (e.g. *Perleidus lutoensis* from Angola; Antunes & Schaeffer, 1990) can be considered as *Plesioperleidus* as well.

Therefore, *Perleidus altolepis*, the type species of the genus, has been so far considered to be the only valid species of the genus, to which the new Middle Anisian one is now added.

Perleidus sinensis n. sp.
(Figs 2-6)

Holotype - GMPKU-P-1350, the only known specimen, almost complete, preserved in dorso-ventral view.

Distribution - Middle Anisian of the Upper Member of the Guanling Formation (Luoping County, Yunnan Province, South China).

Etymology - From the Latin adjective *sinensis*: coming from China.

Diagnosis - Small species of *Perleidus*, with a very strong ornamentation on all the dermal bones made by flat short ridges, sometimes giving rise to larger patches; operculum noticeably smaller than suboperculum; preoperculum with an infraorbital process located in the lower part of the element; very large nasals; large supraorbitals; dentition made of slender teeth of similar size; 40 transverse scale rows, with marked serration, particularly in dorsal region; dorsal lateral line present.

Description -

Skull - Rostral large and subpentagonal; lateral borders showing a pronounced notch for the narial openings. The dorsal margins, meeting in an acute tip, fit perfectly in the space between the two nasals. The ventral area of the element bears the ethmoidal commissure, well detectable for the inverted V-shaped course of the sensory canal. The ornamentation is made of ganoine crests, parallel arranged to the borders of the element. The shape of the broad nasal bones is irregular, elongated dorso-ventrally with a dorsal squarish expansion and a narrower ventral region. The anterior margin shows a large notch for the narials while the posterior one is straight and bends anteriorly in its ventral region. The sensory canal ran throughout the length of the bone, from the antero-ventral to the postero-dorsal corner. Ornamentation is made of ganoine crests randomly arranged, and sometimes coalescent (Figs 2-3).

The long frontal bones are rectangular, with an expanded postorbital region occupying 1/3 of the length of the elements, and a much narrower anterior one. Laterally, the orbital margin is slightly convex; the interfrontal suture is straight, except for a marked indentation at the posterior end of the bone. The contact with parietals and nasals is slightly curved. Supraorbital sensory canal is hardly detectable, owing to the strong ornamentation of the bones: some pores and traces of the canal allow to pursue its course from the antero-lateral corner, and throughout the lateral margin, to the posterior border, where the sensory canal enters the parietal bones. The strong ornamentation is made of flat crests and patches of ganoine. The parietals are large and squarish; the interparietal suture is strongly wavy, while the contact with frontals anteriorly and dermopterotic laterally is only slightly irregular. The suture with extrascapular is almost straight. The sensory canal is visible as median and anterior pit-lines. The ornamentation is stronger in the median part of the bones and it is made of large, coalescent patches of ganoine. Dermopterotics are elongated antero-posteriorly, lining the lateral border of the parietals and the postero-lateral region of the frontals; the ganoine tubercles hide the course of the sensory canal (Figs 2-3).

The dorsal margin of the orbit is bordered by a series of large supraorbital bones. The anteriormost element is very large and triangular and it is followed by two smaller bones, respectively triangular and trapezoidal (visible only on the left side of the skull); on both sides of the skull, the fourth/fifth element is not preserved. The posteriormost element is drop-like and reaches the anterior margin of the dermosphenotic. The ornamentation is made of ganoine crests and patches and the ventral margin of the anteriormost elements is characterized by small spines. The rectangular dermosphenotic is elongated dorso-ventrally, lining the postero-dorsal margin of the orbit. The surface of the bone is ornamented by elongate ganoine tubercles, making a strongly serrated posterior margin and therefore an irregular posterior outline. The sensory canal is well detectable on its anterior margin, where the ornamentation and the ganoine are lacking. There is a single suborbital, placed posteriorly to the dermosphenotic: it is slightly larger than this latter element, rectangular in shape and dorso-ventrally elongated. It shows the same strong ornamentation than the dermosphenotic (Figs 2-3). Of the series of infraorbitals, only one large element, placed at the postero-dorsal margin of the orbit and ventral to dermosphenotic, is clearly detectable. It has a crescent shape, and it is ornamented only in its ventral region, below the infraorbital sensory canal, well detectable in the median region of the bone. The ventral margin is ornamented by well-developed spines of ganoine. Of the other elements, fragments are visible on both sides of the skull; moreover the anterior end of the snout is covered by the nasals, hiding also the antorbitals (Figs 2-3).

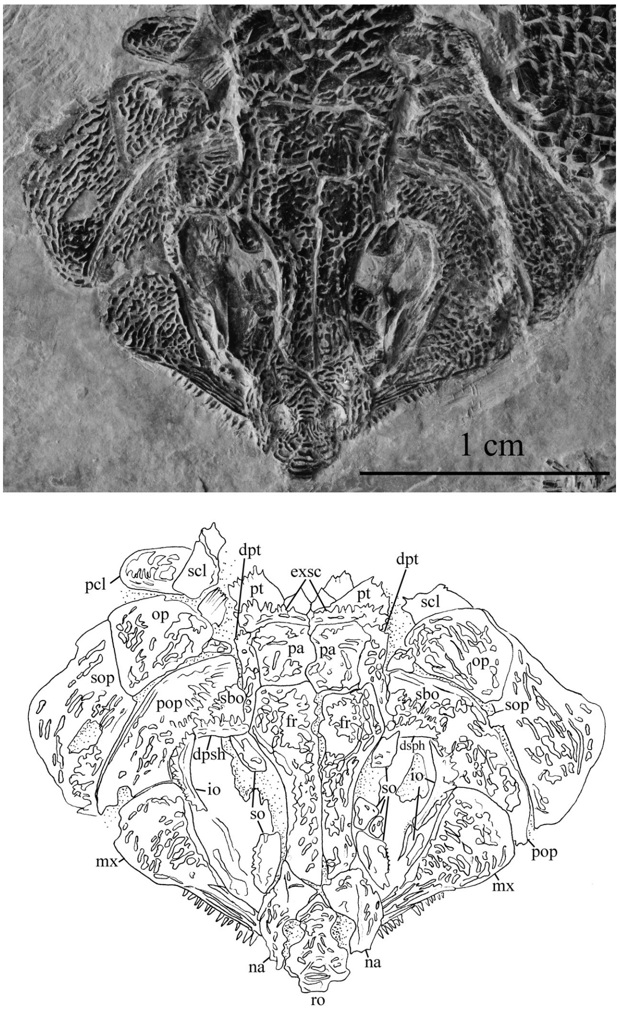

Fig. 3 - *Perleidus sinensis* n. sp., GMPKU-P-1350; the skull.

The preopercular is large and expanded both dorsally and ventrally, with the infraorbital process placed at 1/3 of the height of the bone. Being covered by infraorbitals, dermosphenotic and suborbital, the anterior margin is not visible, and consequently, the precise shape of the element. Posteriorly, the border is straight for almost its length, bending slightly forward in the dorsal region. The preopercular sensory canal ran very close to the

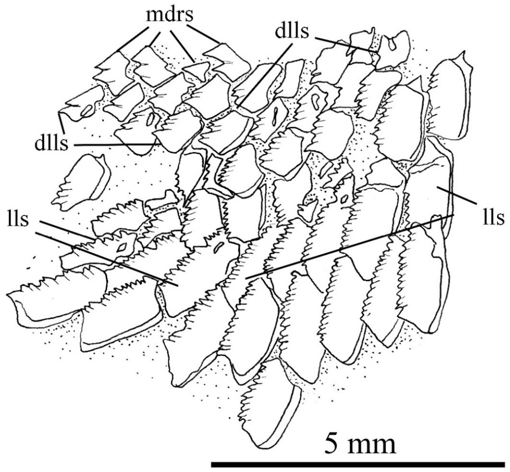

Fig. 4 - *Perleidus sinensis* n. sp., GMPKU-P-1350; detail of the scales of the flank, showing the pores of sensory canal, both of lateral and dorsal lines.

posterior margin of the bone, following its profile. The ornamentation is stronger in the median region of the element and the surface of the bone near to the borders lacks ornamentation and ganoine. The flat elongated tubercles making the ornamentation of preoperculum are differently arranged in dorsal and ventral region of this element: they are longitudinally oriented in the lower part and horizontally in the upper one (Figs 2-3).

The opercular region is deep, more developed ventrally than dorsally. The operculum, remarkably smaller than suboperculum, is sub-triangular with a rounded posterior border; the dorsal corner contacts a small triangular dermohyal, inserted between operculum and preoperculum. Suboperculum is one time and a half higher than operculum and it is slightly expanded in its ventral region. The postero-ventral border is semicircular, while the anterior one is straight. Suture with operculum is oblique and a small antero-dorsal process is present. Ornamentation is made by short crests of ganoine, which tend to be arranged and coalesce in longitudinal rows. The surface of the bone near the borders of the elements lacks ganoine (Figs 2-3).

Of the upper jaw only the maxilla is visible, the anterior end of the mouth being covered by the nasals and rostral. The maxilla has a narrow anterior region and an expanded posterior one. The oral margin is straight and bears a row of slender, peg-like teeth that decrease in size proceeding posteriorly. Each tooth bears a small cap of enamel. The ornamentation of the maxilla is made of flat tubercles, arranged in concentric rows in the posterior region of the bone; proceeding anteriorly, tubercles become short crests arranged perpendicularly to the oral margin. On the narrow anterior part of the maxilla, ornamentation changes to long ridges, arranged parallel to its oral and dorsal margin. Dorsally, a long and wider ganoine ridge lines the upper margin of maxilla. As for the other bones, the surface near the borders lacks ganoine. The lower jaw is not visible (Figs 2-3).

Extrascapulars are triangular in shape, contacting throughout their mid-line; the posterior margin is denticulate, owing to the strong ornamentation, made of elongated ganoine tubercles. The course of the supratemporal commissure is well detectable along the medial part of the bones; the sensory canal branches in the ventral region, entering the dermopterotic anteriorly

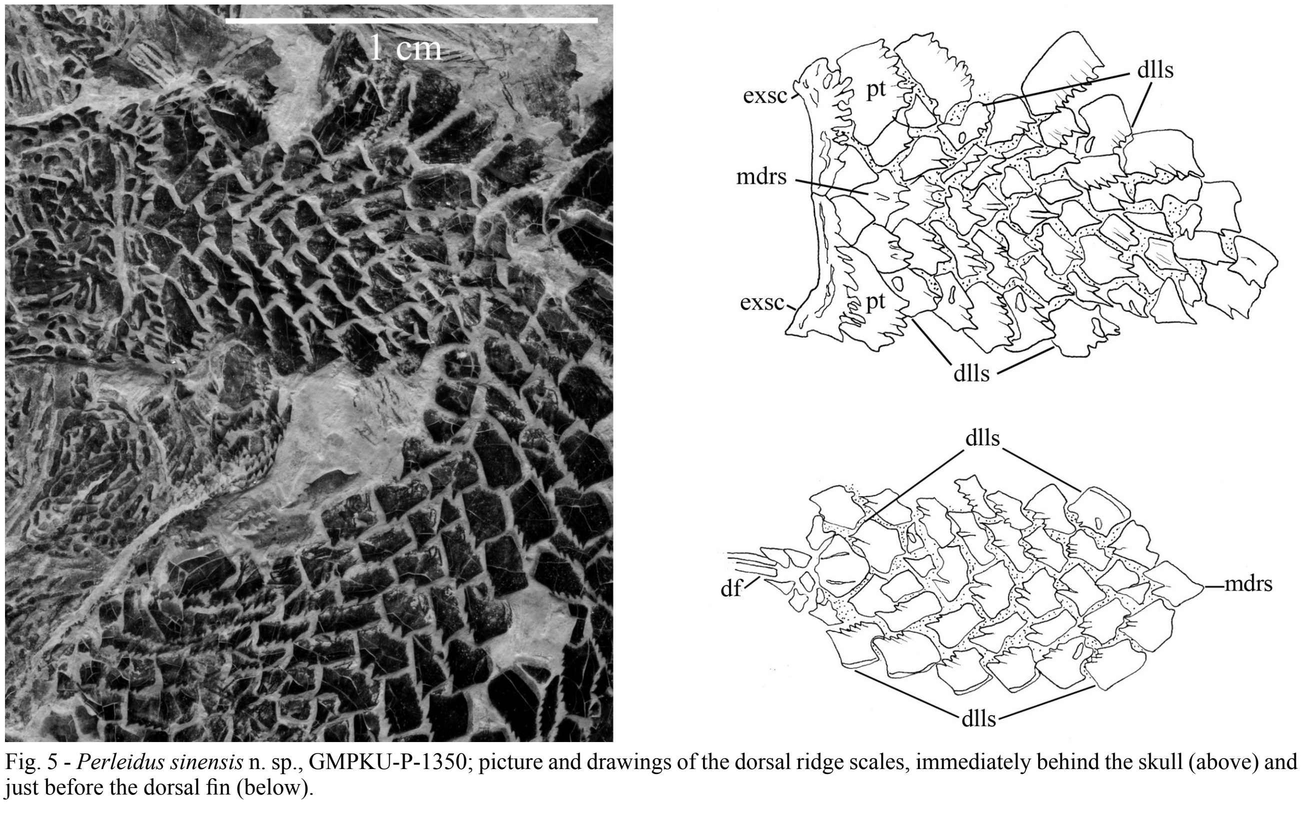

Fig. 5 - *Perleidus sinensis* n. sp., GMPKU-P-1350; picture and drawings of the dorsal ridge scales, immediately behind the skull (above) and just before the dorsal fin (below).

and the post-temporal posteriorly. The post-temporals are large and trapezoidal elements, separated by a couple of scales; their posterior margin is denticulate. The sensory canal ran along their ventral border.

Only the right supracleithrum is visible from its inner side; its dorsal margin is obliquely crossed by the trace of the sensory canal. An ovoid element, ornamented with concentric ganoine crests, is interpreted as postcleithrum, moved from its original position, owing to the disarticulation of the skull bones behind the opercular region (Figs 2-3).

The surface of the bones not covered by ornamentation is devoid of ganoine, mainly in correspondence to the external margin of each element.

Appendicular skeleton - Owing to the kind of preservation, it is possible to give a description only of the general pattern of the fins, which is typical for perleidiforms: lepidotrichia are made of long proximal and short distal elements, but it is not possible to detect the number of branches (Fig. 2).

The right pectoral fin, the only preserved, shows a large basal fulcrum and strong fringing fulcra along the anterior margin of the fin. The dorsal fin, inserted at the level of 21st/22nd scale row, is preceded by a large scute and two basal fulcra and is made of two long unsegmented and unbranched rays, followed by at least six ones with long proximal and short distal segments. It is not possible to state the ratio between the unsegmented and segmented part of each ray, being the distal end of the fin not visible (Fig. 2).

The caudal fin is slightly twisted, so that presumably not all the rays are visible. The axial body lobe is short and bears 5-6 epaxial fin rays; the first of them is segmented but not branched and it is preceded by 5 basal fulcra. It is possible to count up to 14-15 lepidotrichia that branch at least twice. The distal end of the fin is not preserved, so that it is not possible to determine the number of rudimentary and principal rays. Both dorsal and ventral lobes bear strong fringing fulcra (Figs 2, 6).

Squamation - The scale covering consists of about 40 vertical scale rows. The scales of the anterior region of the trunk are higher than long; they become gradually smaller towards the posterior and dorsal part of the body. The scales of the antero-lateral flank region are rectangular, with the scales of the lateral line higher than the others. The highest scales have an H/L (Height/Length) ratio of 3.5/1; their height decreases gradually towards the dorsal region, where they become rhomboidal, but the belly region is hidden so it is not possible to say anything about ventral scales (Figs 2, 4).

In the posterior region of the body, scales tend to become rhombic, as high as long. A mid-dorsal ridge scale row is present: the scales show a single or a double spine on their posterior margin (Figs 2, 5). Scales on caudal peduncle are leaf-like (Figs 2, 6). All scales are serrated, also in the posterior region of the body, where the number of denticles decreases with the depth of the elements. Although the scale row of the lateral line is not completely preserved, the course of the sensory canal is visible through small vertical slits and/or notches on dorsal-posterior margin of most of the visible scales. Besides the median lateral line, there is also a dorsal lateral line detectable on both sides of the body. It is visible on the scales of the second horizontal row counting from the mid-dorsal ridge scales (Figs 2, 5).

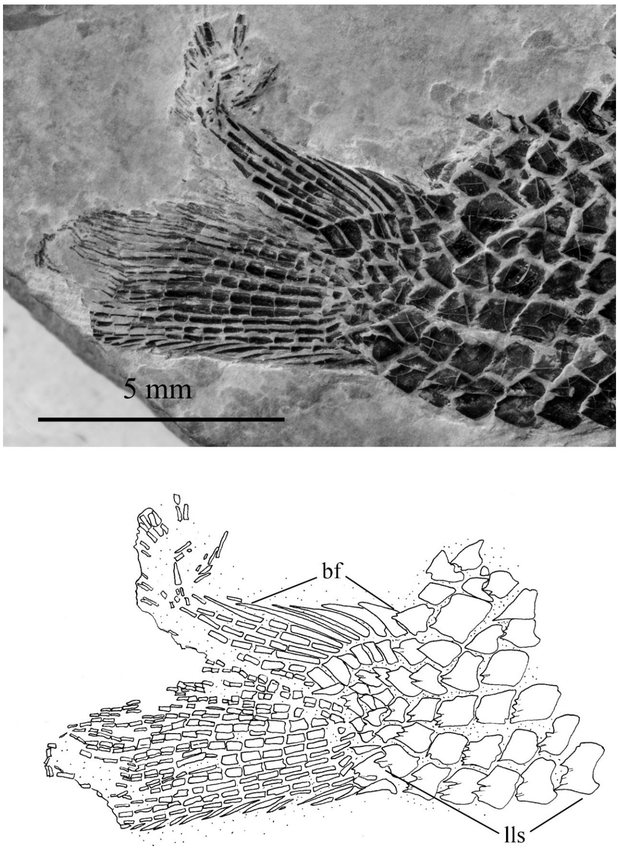

Fig. 6 - *Perleidus sinensis* n. sp., GMPKU-P-1350; the caudal fin.

Discussion - The new taxon is clearly related to the Perleidiformes owing to the presence of epaxial rays of the caudal fin, the preopercular shape and the subrectangular, thick scales on the flanks, somewhat higher than long in the trunk region.

The families currently recognized in this order are Cleithrolepididae, Polzbergiidae, Gabanellidae, Luganoidae, Pseudobeaconiidae, Colobodontidae, Perleididae and a possible new one under description still on material from the Anisian of Luoping (Sun et al., in prep).

Cleithrolepidae and Polzbergiidae (Lombardo et al., 2008) are characterized by a very deep body and other derived characters especially in the mouth region, while Gabanellidae show very thin scales arranged in very numerous rows and a predatory dentition (Tintori & Lombardo, 1996). Luganoidae have as a major synapomorphy a unique pattern of the cheek region, where the preopercular just touches the posterior region of the maxilla (Bürgin, 1992). Pseudobeaconiidae (López-Arbarello & Zavattieri, 2008) have a gently rounded posterior edge of most scales and spinous mid-dorsal ones. The family Colobodontidae is represented by large fishes, even more than 50 cm in length, with peculiar scale ornamentation (Sun et al., 2008). Although it should be considered that a detailed phylogenetic analysis has never been carried out, Perleididae is so far the largest family, which yields several genera, other than the type one, *Perleidus*, distributed throughout the Middle Triassic up to the Norian: *Meridensia*, *Aethodontus*, *Peltoperleidus, Altisolepis, Dipteronotus, Ctenognathichthys, Daninia, Endennia* (Bürgin, 1992; Lombardo, 2001; Mutter & Herzog, 2004; Lombardo & Brambillasca, 2005; Tintori, 1990, 1998).

The new taxon is clearly different from any of the cited taxa: the genus *Meridensia* differs remarkably in the shape of both preoperculum and maxillary, and the morphology of scales; a particular squamation, made of minute scales, is characteristic also for *Aetheodontus*, which moreover shows a peculiar dentition made of very small teeth both on the oral margin of the jaws and the palatal bones; on the contrary, the genus *Altisolepis* is different from the new Chinese taxon in the very high flank scales and the shape of preoperculum, while *Peltoperleidus* is different for the skull roof, made of a single fused bone plate, the pattern of cheek bones and the dentition (Bürgin, 1992; Mutter & Herzog, 2004). Even more evident is the difference with *Dipteronotus*, this latter having quite a deep body, while both *Ctenognathichtys* and *Endennia* show highly specialized dentition, besides remarkable differences in the skull pattern (Tintori, 1990, 1998; Lombardo & Brambillasca, 2005). Also the small and fusiform *Daninia* looks different for the general body morphology and squamation and for kind of dentition (Lombardo, 2001).

On the contrary, the new taxon is very similar to *Perleidus altolepis*: the two taxa share the pattern of the dermal skull bones, the body morphology and pattern of squamation, as well as the non-specialized kind of dentition and few epaxial rays. Nevertheless, we can observe some differences in ornamentation of dermal bones, both in density and kind of the elements (mainly rounded tubercles, well separate from each other, in *Perleidus altolepis* and flat short ridges, sometimes giving rise to larger patches, in the new Chinese species) and in the stronger denticulation of the posterior margin of the scales, even if the holotype, and unique specimen so far known, is smaller than the adults of *P. altolepis*. For this reason, we consider the new taxon belonging to *Perleidus* as a new species; furthermore, we must take into account the different age, Middle Anisian vs. late Ladinian, and the geographical distance between the living areas of the two taxa, though we can confidently consider the whole Tethys as a single bioprovince at least during the Middle Triassic.

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