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Oligopleuronectes germanicus gen. et sp. nov., an Oligocene Pleuronectid Flatfish from Frauenweiler, S-Germany

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Abstract One of the flatfish fossil specimens, which was found at the Frauenweiler fossil site (Oligocene, Rupelian), S-Germany, was determined to be a new genus and species in the family Pleuronectidae, order Pleuronectiformes, on the basis of the unique combination of characters, the dextral bilaterality, the lateral process on the frontal of the ocular side, the deep body, the origin of the dorsal fin at the middle of the postcranial region, and 10 abdominal+19 caudal vertebrae. This specimen was thus designated as the holotype for *Oligopleuronectes germanicus* gen. et sp. nov.
Key words: Oligocene, Rupelian, Germany, Frauenweiler, flatfish, Pleuronectiformes, Pleuronectidae, *Oligopleuronectes germanicus* gen. et sp. nov.

Introduction

The Frauenweiler fossil site (Rupelian stage of Oligocene), 13 km south of Heidelberg, Baden-Württemberg, S-Germany, is located in the upper part of the Rhine Valley Rift System (Sakamoto *et al.*, 2003). Together with the contemporary locality of Froidefontaine, Belfort Territory, France, it is famous for its rich, well-preserved marine fish fauna (Micklich and Parin, 1996; Micklich, 1998; Pharisat and Micklich, 1998). Some flatfish specimens have been unearthed at this site, including the first new genus and species, *Oligoscophthalmus weissi*, recently described (Sakamoto *et al.*, 2003). This second account describes another new flatfish fossil genus and species of the family Pleuronectidae from the same site, being distinct in the dextral bilaterality, the lateral process on the frontal of the ocular side, the depth of body, the position of the dorsal fin origin and the number of vertebrae.

Methods

Institutional code: HLMD-WT=Fossil vertebrate collection of Hessisches Landesmuseum, Darmstadt, Germany.

The specimen was prepared by the transfer method (e.g. Lippmann, 1987). Osteological terminology follows Hoshino (2001b).

Systematic Paleontology

Class Osteichthyes Huxley, 1880

Order Pleuronectiformes Bleeker, 1859

Family Pleuronectidae Rafinesque, 1810

Genus ***Oligopleuronectes*** nov.

Type species: *Oligopleuronectes germanicus* sp. nov., by monotypy.

Etymology: The genus name, *Oligopleuronectes*, is composed of two words: *Oligo* from Oligocene and *Pleuronectes*, type genus of the family.

Age and distribution: Known only from the Rupelian stage of the Lower Oligocene.

Diagnosis: The eyes are on the right side. The lateral process is present on the frontal of the ocular side. The body is deep and its depth is about 1.6 times in standard length. The origin of the dorsal fin is at the middle of the postcranial region. The number of vertebrae is 29 (10 abdominal+19 caudal).

Oligopleuronectes germanicus sp. nov.

(Figs. 1–2)

Holotype: HLMD-WT 257, complete transfer-prepared skeleton, 10.5 mm in standard length.

Etymology: The species name, *germanicus*, is derived from Germany.

Type locality: Bott-Eder clay pit close to Rauenberg village, about 13 km south of Heidelberg, Baden-Württemberg, S-Germany.

Type horizon: "Fischschiefer"(FS A/B), standard Nannoplankton Zone NP 23, Dinnoflagellate-Subzone D14 na (see Grimm *et al.*, 2002: 240–241).

Diagnosis: Same for genus.

Description: The specimen is well preserved. The body is rhomboid, the depth being greatest, about 1.6 times standard length, at about the middle of the body.

The head region is well-preserved and several bones are identifiable.

Head length is 4.2 mm. The mouth is small, the upper jaw length of the right (=ocular, see below) side (1.2 mm) being 3.5 times in head length. The premaxillary and maxillary of the upper jaw as well as the dentary, anguloarticular and retroarticular of the lower jaw are preserved, but teeth are not discernible.

Although the cranial elements are well preserved, the orbital region in particular, the exact shapes of most elements are difficult to identify, except for the frontal and lateral ethmoid of the ocular side, each having a lateral process (Fig. 2A). The process on the frontal is just under the middle of the upper eye.

The skull is asymmetrical, and both eyes are on the right side (Figs. 1, 2A). A small protuber-

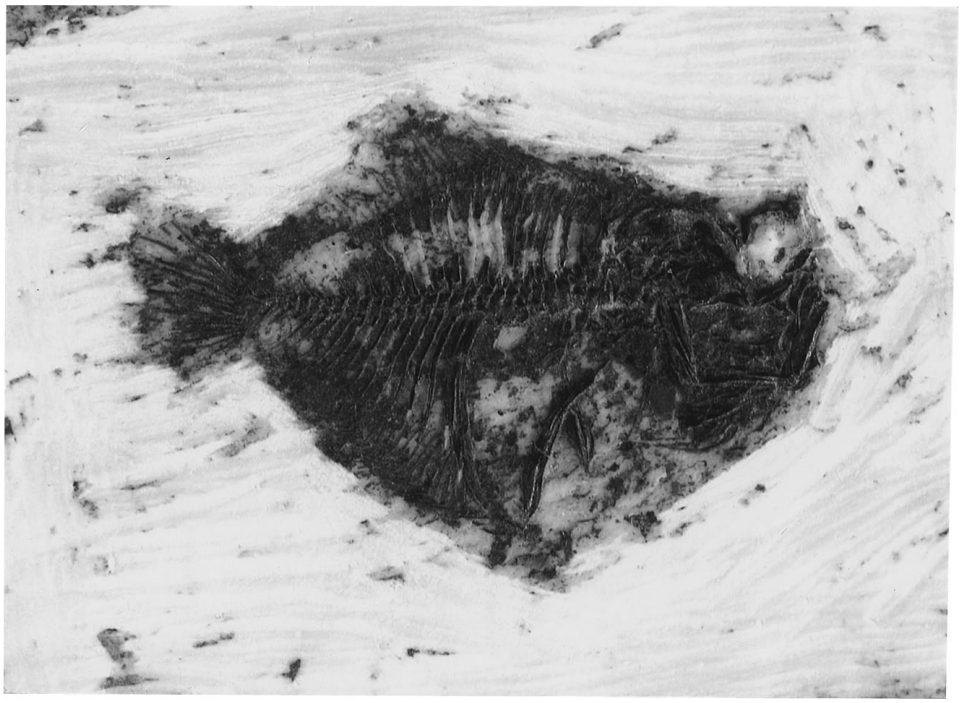

Fig. 1. Photograph of *Oligopleuronectes germanicus* gen. et sp. nov., holotype, HLMD-WT 257, Oligocene (Rupelian), Frauenweiler, Germany. 10.5 mm in standard length.

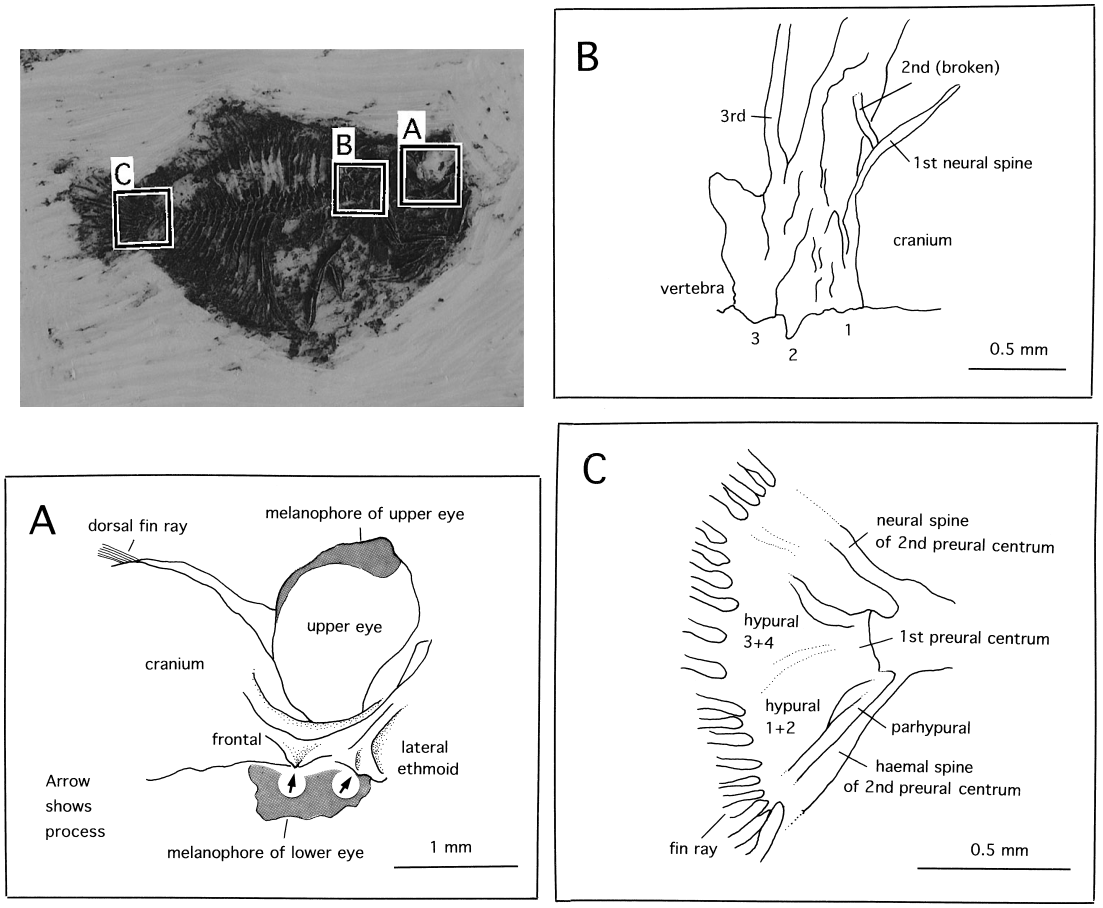

Fig. 2. Drawings of details of the holotype of *Oligopleuronectes germanicus* gen. et sp. nov. A, orbital region; B, anterior abdominal vertebrae; C, caudal skeleton and fin.

ance is recognizable as the upper eye, being located at the dorsolateral edge of the right side of the head. The lower one is recognized from the patch of melanophores remaining under the part of the frontal that forms the interorbital region.

In the suspensorial and opercular regions, almost all elements are preserved, however, their exact shapes cannot be distinguished. The observable margins of the following opercular bones of the ocular side are smooth: the ventral margin of the opercle, and the posterior and ventral margins of the subopercle and interopercle.

No elements of the branchial apparatus are preserved.

In the hyoid arch, only four branchiostegal rays can be identified. The urohyal is not preserved.

The dorsal fin, lacking the posterior part, originates behind the upper eye at the middle of the postcranial region (Figs. 1, 2A). Forty six rays and 38 proximal pterygiophores are countable, but each of their total cannot be estimated with certainity.

In the anal fin, 44 rays and 30 proximal pterygiophores can be counted, but each of their total cannot be estimated. The anteriormost proximal pterygiophore supporting the anteriormost rays is elongated, with its posterior maragin attached to the anterior surface of the first haemal spine, and with its anteroventral part curved forward.

In the shoulder girdle, cleithra of both sides remain, but are displaced to the middle of the body

cavity. Long postcleithra of both sides are preserved. Pectoral fin rays are not preserved.

No elements of the pelvic fin are preserved.

There are 10 abdominal vertebrae with neural spines. On the anteriormost abdominal vertebra, the first neural spine is well developed and slender, being observed along the posterior margin of the cranium. The second neural spine is broken, but it appears not to be attached to the cranium (Fig. 2B). Two incomplete feeble ribs are visible under the fifth to sixth abdominal vertebrae. There are 19 caudal vertebrae with neural and haemal spines. Accessory processes on caudal vertebrae (Cooper and Chapleau, 1998) are absent. Haemal spines are narrow at base on the anterior (anteriormost in Cooper and Chapleau, 1998) caudal vertebrae and attached medially to the centrum. The lateral foramen in all haemal arches cannot be observed.

Nineteen caudal fin rays are preserved, but their branched rays cannot be counted because the posterior portion of the fin rays are absent. In the caudal skeleton, the parhypural and hypurals remain incompletely, but the first and second, and third and fourth hypurals appear to be fused to each other respectively; the first preural centrum appears to be fused to the third+fourth hypurals, and articulated with the first+second hypurals (Fig. 2C). The parhypural and hypurals appear not to be subdivided.

No scales (or bony plates) and intermuscular bones (epipleurals, epicentrals, epineurals and myorhabdoi) can be observed.

Discussion

Because the skull is asymmetrical and the dorsal fin origin is at the cranial region, representing two of the three synapomorphies for the Pleuronectiformes (Chapleau, 1993), the present species can be assigned to this flatfish order. Also, because it has the following three characters: hypurals 1+2 (the first and second hypurals fused to each other), hypurals 3+4, hypurals 3+4+first preural centrum, and hypurals 1+2 articulated with first preural centrum (see *Description*), it can be included in Hoshino's (2001b: see p. 401, fig. 7) Clade F comprising the Scophthalmidae, Paralichthyidae, Pleuronectidae and Bothidae. Although these three characters in the caudal skeleton which are shared by members of Clade F are also found in the citharid genus *Brachypleura* [see Hoshino (2001b)], the present species appears not to be related to *Brachypleura*, because in this fossil specimen the anteriormost anal proximal radial (pterygiophore in the present study) is elongated, vs. short in *Brachypleura* (See Amaoka, 1972), a character considered as a reversal by Hoshino (2001b). Two other characters, both reversals, which could support placement in Clade F, the second neural spine is detached from the cranium and 17 "principal" [sensu Hoshino (2001a)] caudal fin rays, cannot be observed in the present fossil specimen, but the second neural spine, although broken, appears to be detached from the cranium. Furthermore, this species is not a member of the Bothidae because the first neural spine is present (Hoshino, 2001b).

No characters defining each family in Clade F (Paralichthyidae, Scophthalmidae and Pleuronectidae) are fully presented or can be observed in this fossil (Chapleau, 1993; Cooper and Chapleau, 1998; Hoshino, 2001b; Chanet, 2003). However, we concluded that it is reasonable to classify the present species in the Pleuronectidae on the basis of the dextral bilaterality and the presence of the lateral process on the frontal of the ocular side which is found only in some pleuronectid genera within Clade F (dicussed below).

In their phylogenetic study on Recent pleuronectid fishes, Cooper and Chapleau (1998) examined many morphological characters, most of which were studied by Norman (1934) and Sakamoto (1984a, b), however the condition of the present fossil allows determining only 13 of the 106 characters adopted by Cooper and Chapleau (1998). Even so, it is possible to demonstrate that the present species does not belong to any Recent pleuronectid genera.

Although several genera have been described in the family Pleuronectidae on the basis of

skeletal records, they all were considered by Chanet (1997) as the suborder Pleuronectoidei *incertae sedis*. In the present study, however, we made a comparison between characters of the present species and three genera recently described, *Psettoraptor* from Middle Miocene in Sakhalin Island, Russia (Nazarkin, 2002), *Chibapsetta* from Late Pleistocene in central Japan (Sakamoto and Uyeno, 1988), and *Saitamapsetta* from Middle Miocene in central Japan (Sakamoto and Uyeno, 1992). The present species differed from *Chibapsetta* in deep body, from *Saitamapsetta* in small mouth, and from *Psettoraptor* in postcranial dorsal fin origin and in having (probably) no bony tubercles in the skin. Thus, the present species could not be assigned to any known pleuronectid genera.

The present species is similar to several species of *Microstomus* and *Pleuronichthys* (both sensu Cooper and Chapleau, 1998) in having the lateral process on the frontal of the ocular side (81st character in Cooper and Chapleau, 1998), and further to those of *Pleuronichthys* in its deep body. However it can be distinguished from these genera in the origin of the dorsal fin [at the middle of the postcranial region in the present species vs. above the upper eye in *Microstomus* and reaching onto the blind side in *Pleuronichthys* (but above the upper eye in *P. guttulata*)], and also in the number of vertebrae (10 abdominal+19 caudal vertebrae vs. 11–14+34–51 in *Microstomus* and 12–14+21–27 in *Pleuronichthys*) (Sakamoto, 1984a and unpublished data; Cooper and Chapleau, 1998).

As discussed above, the present species could not be assigned to any known pleuronectid genera, both Recent and fossil, and it is distinct in the several characters as discussed above. Therefore, we have decided to erect a new genus to accommodate this new species.

The oldest fossil record of the Pleuronectidae was from the early Late Oligocene in western Japan (Sakamoto and Uyeno, 1997), but the present study extends the rise of the pleuronectid fishes back to at least early Oligocene.

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References

Amaoka, K., 1972. Osteology and relationships of the citharid flatfish *Brachypleura novaezeelandiae*. *Japan. J. Ichthyol.*, **19**(4): 263–273.

Chanet, B., 1997. A cladistic reappraisal of the fossil flatfishes record consequences on the phylogeny of the Pleuronectiformes (Osteichthys: Teleostei). *Annales des Sciences naturalles*, *Zoologie*, *Paris*, 13 Ser., **18**(3): 105–117.

Chanet, B., 2003. Interrelationships of scophthalmid fishes (Pleuronectiformes: Scophthalmidae). *Cybium*, **27**(4): 275–286.

Chapleau, F., 1993. Pleuronectiform relationships: a cladistic reassessment. *Bull. Mar. Sci.*, **52**(1): 516–540.

Cooper, J. A. & F. Chapleau, 1998. Monophyly and intrarelationships of the family Pleuronectidae (Pleuronetiformes), with a revised classification. *Fish. Bull.*, **96**(4): 686–726.

Grimm, K. I., M. C. Grimm, A. Köthe & Th. Schindler, 2002. Der "Rupelton" (Rupelium, Oligozän) der Tongrube Bott-Eder bei Rauenberg (Oberrheingraben, Deutschland). *Cour. Forsch.-Inst. Senckenberg*, **237**: 229–253.

Hoshino, K., 2001a. Homologies of the caudal fin rays of Pleuronectiformes (Teleostei). *Ichthyol. Res.*, **48**: 231–246.

Hoshino, K., 2001b. Monophyly of the Citharidae (Pleuronectoidei: Pleuronectiformes: Teleostei) with considerations of pleuronectoid phylogeny. *Ichthyol. Res.*, **48**: 391–404.

Lippmann, H. G., 1987. Präparation von Fossilien aus der Grube Messel. *In* R. W. Heil *et al.* (eds), Fossilien der Messel-Formation, pp. 37–58. Hessisches Landesmuseum, Darmstadt.

Micklich, N., 1998. New information on the fishfauna of the Frauenweiler fossil site. *Ital. J. Zool.*, **65**, *Suppl.*: 169–184.

Micklich, N. & N. Parin, 1996. The fishfauna of Frauenweiler (Middle Oligocene, Rupelian; Germany): first results of a review. *Publ. Espec. Inst. Esp. Oceanogr.*, **21**: 129–148.

Nazarkin, M. V., 2002. Large flatfishes from the Miocene of the Agnev Formation of the Sakhalin Island. *J. Ichthyol.*, **42**(1): 7–18. Translated from *Voprosy Ikhti-*

ologii, **42**(1): 11–22.

Norman, J. R., 1934. A systematic monograph of the flatfishes (Heterosomata). 1. Psettodidae, Bothidae, Pleuronectidae. i–viii + 1–459 pp. British Museum, London.

Pharisat, A. & N. Micklich, 1998. Oligocene fishes in the western Paratethys of the Rhine Valley Rift System. *Ital. J. Zool.*, **65**, *Suppl.*: 163–168.

Sakamoto, K., 1984a. Interrelationships of the family Pleuronectidae (Pisces: Pleuronectiformes). *Mem. Fac. Fish.*, *Hokkaido Univ.*, **31**(1/2): 95–215.

Sakamoto, K., 1984b. Pleuronectidae. *In* H. Masuda *et al.* (eds), The fishes of the Japanese Archipelago, pp. 351–354, pls. 314–318. Tokai Univ. Press, Tokyo.

Sakamoto, K. & T. Uyeno, 1988. A new righteye flounder from the Late Pleistocene Togane Formation, Chiba Prefecture, Japan. *Bull. Natn. Sci. Mus.*, *Tokyo*, Ser. C, **14**(3): 135–142.

Sakamoto, K. & T. Uyeno, 1992. *Saitamapsetta nomurai* gen. et sp. nov., a righteye flounder from a Middle Miocene bed in Saitama Prefecture, Japan. *Bull. Natn. Sci. Mus.*, *Tokyo*, Ser. C, **18**(3): 101–112.

Sakamoto, K. & T. Uyeno, 1997. An Oligocene record of a flatfish from the Kiwado Formation, Yamaguchi Prefecture, Japan. *Bull. Natn. Sci. Mus.*, *Tokyo*, Ser. C, **23**(1, 2): 51–59.

Sakamoto, K., T. Uyeno & N. Micklich, 2003. *Oligoscophthalmus weissi* gen. et sp. nov., an Oligocene scophthalmid flatfish from Frauenweiler, S-Germany. *Bull. Natn. Sci. Mus.*, *Tokyo*, Ser. C, **29**: 25–32.