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A first recognition of the orithyiid crab (Decapoda: Brachyura) from the Miocene Mizunami Group, Japan

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Abstract

Orithyia eikii, new species discovered from the Lower Miocene Mizunami Group of Japan, constitutes the first reported occurrence of Orithyiidae Dana, 1852 in 1852–1853 in the fossil record. The new species superficially resembles *Orithyia sinica* (Linnaeus, 1771), the sole included extant species of the family and genus from East Asia, but it differs in having only one spine on the posterolateral margin of the carapace. The discovery of this species extends the geologic range for the family and genus back to the Early Miocene.

Key words: Eubrachyura, Orithyiidae, *Orithyia*, Miocene, taxonomy

Introduction

The monogeneric family Orithyiidae Dana, 1852 in 1852–1853 contains only one extant species, *Orithyia sinica* (Linnaeus, 1771) from the continental side of the South China Sea and East China Sea ranging from Hong Kong to Korea (Ng et al., 2008). Orithyiidae have not yet been known in the fossil record until this report.

The aim of this work is to describe a new species of the orithyiid crab, first recognized as a fossil. The specimen described herein was collected from the Lower Miocene Akeyo Formation of the Mizunami Group exposed at Toki-cho, Mizunami City, Gifu Prefecture, central Japan. The Sakuradō Facies of the Akeyo Formation is distributed in the decapod-bearing locality (Holman and Tanimoto, 2004). Itoigawa (1974) showed that the Sakuradō Facies, mainly composed of laminated siltstone alternating with sandstone, was shallow-marine deposits. Fossils are extremely rare in occurrence (Itoigawa, 1974). The studied specimen occurred in sandstone, associated with a pelecypod, "*Ostrea*" sp. and fragments of woods. Most recently, Hoshi et al. (2015) summarized the previously known chronostratigraphic works on the Mizunami Group and showed that the Akeyo Formation is Early Miocene (Chron C5Dr of the geomagnetic polarity time scale by Ogg (2012; 18.056–17.533 Ma).

The studied specimen is housed in the Mizunami Fossil Museum (MFM).

Systematics

Family Orithyiidae Dana, 1852 in 1852–1853

Genus *Orithyia* Fabricius, 1798

Type species: *Cancer mammaillaris* Fabricius, 1793 (=*Cancer sinica* Linnaeus, 1771), by monotypy.

Included species: *Orithyia eikii*, new species, Early Miocene, Japan; *O. sinica* (Linnaeus, 1771), China and Korea (extant).

Emended diagnosis: Carapace longitudinally ovate, longer than wide, widest at about mid-length, convex

longitudinally and transversely, with well-defined regions. Rostrum with three spines, median spine longest, well projected anteriorly. Orbits concave, directed forward, with shallow V-shaped notch medially; inner-orbital and intra-orbital spines short; outer-orbital spine long; infra-orbital spine long, well-developed, visible in dorsal view. Anterolateral margins sinuous, granular, rimmed, with two short spines laterally and with long spine at anterolateral corner. Posterolateral margins convex, granular, rimmed, with long spine. Posterior margin rounded, granular, rimmed. Dorsal surface densely granulated. Front-orbital and hepatic regions flattened; frontal region weakly concave medially. Protogastric regions elevated with large tubercle centrally. Mesogastric region inflated with large median tubercle. Cervical groove distinct, deeply separated from gastric regions from epibranchial regions. Metagastric region vaulted longitudinally with large, rounded central tubercle. Cardiac region inflated with central tubercle. Intestinal region long, separated from cardiac and branchial regions by weak grooves, with median tubercle anteriorly. Epibranchial regions with highly vaulted swellings developed along cervical grooves behind protogastric regions and extending to epibranchial spines; two large tubercles parallel to anterolateral margin, arranged on epibranchial swellings. Branchiocardiac grooves well marked. Mesobranchial and metabranchial regions undifferentiated, bearing large, eye-like spot with large tubercle centrally. Antennulae long, plicated obliquely. Antennae smaller than antennulae; basal antennal segment movable, standing loosely in orbital hiatus, with antero-external lobes entering orbit. Eyestalk long. Merus of maxilliped 3 subtriangular, elongate, pointed anteriorly, covering short, deep endostomial paired tubes formed by anterior portion of endostome; exopod short, lacking flagellum. Chelipeds subequal, relatively small. Pereiopods 2–4 with thick, sharp dactyli for digging; Pereiopods 5 paddle-like dactylus for swimming. Gonopod 1 of male short, finger-like, spinose subdistally; gonopod 2 relatively long with long flagellum. Thoracic sternum wide, subcircular, flattened, all sutures interrupted medially, median line present on sternites 7 and 8; sternite 8 narrow, with large part exposed. Sterno-pleonal cavity long but partly left uncovered by pleon. Male pleon very short, filling only part of cavity, pleonal somites 3–6 immovable in male; no press-button locking mechanism present, socket on pleon absent. Full condylar protection of penis; penis emerges directly from extremity of large coxo-sternal condyle of coxa of pereiopod 5 as a thick, short, cylindrical sclerotized tube enclosing ejaculatory duct; articulation of condyle with sternite concealed by penis. Penial papilla folded inside tube, supposedly devaginating for mating. Vulva on lateral part of sternite 6, completely exposed, not covered by pleon. [modified from Urita (1926, p. 437), Dai and Young (1991, p. 112), Števčić (2005, p. 102), Davie et al. (2015, p. 1094), Schweitzer and Feldmann (2019, p. 2)].

***Orithyia eikii*, new species**

(Figs. 1–3)

[New Japanese name: Eiki-gani]

Diagnosis: *Orithyia* with only one pair of spines on posterolateral margins of carapace.

Etymology: The specific name is dedicated from the late, Eiki Oguri, who has been my best colleague.

Material examined: Holotype, MFM9052; carapace with thoracic sternum, pleon, eye, and pereiopods 1–5; carapace width, 60.50 mm carapace length, 62.24 mm.

Type locality: River-bed of the Tokigawa River (35°22'16"N; 137°15'41"E), Toki-cho, Mizunami City, Gifu Prefecture; sandstone of the Sakuradō Facies, Akeyo Formation, Mizunami Group; Early Miocene (Chron C5Dr of the geomagnetic polarity time scale by Ogg (2012; 18.056–17.533 Ma) (Hoshi et al., 2015); collected by T. Kaede in 2020.

Description: Carapace longitudinally ovate, slightly longer than wide, widest at about mid-length, moderately convex longitudinally and transversely, with well-defined regions. Fronto-orbital margin about half of maximum carapace width. Rostrum narrow, projected forward, with three well-developed spines; median spine projected well beyond outer-orbital spines; lateral spines directed anterolaterally. Orbits concave; upper orbital margin with shallow V-shaped notch; inner-orbital and intra-orbital spine short, directed forward; outer-orbital spine well-developed, long, triangular, directed forward; infraorbital spine well-developed, visible in dorsal view, long, slender, directed anterolaterally, slightly projected beyond median frontal spine. Anterolateral margins sinuous, granular, rimmed; two short, anterolaterally directed spines present at lateral side of hepatic region; epibranchial spine positioned at lateral corner, long,

triangular, directed laterally. Posterolateral margins gently convex, granular, rimmed, with long, triangular, posterolaterally directed spine at about 65 percent the distance from front. Posterior margin gently convex, granular, rimmed, not confluent with posterolateral margin, about 40 percent maximum carapace width, with angular lateral corner. Dorsal surface densely granulated. Cuticles of frontal, gastric, cardiac, intestinal, and right branchial regions partly preserved; internal structures therefore visible in dorsal view. Front-orbital and hepatic regions flattened; frontal region weakly concave medially. Protogastric regions vaulted with trace of central tubercle. Mesogastric region inflated with trace of median tubercle; anterior mesogastric process broken. Cervical groove distinct, deeply separated from gastric regions from epibranchial regions. Metagastric region vaulted longitudinally with trace of central tubercle. Cardiac region inflated with trace of central tubercle. Intestinal region long, separated from cardiac and branchial regions by weak grooves, with trace of tubercle anteriorly. Epibranchial regions with highly vaulted swellings developed along cervical grooves behind protogastric regions and extending to epibranchial spine; two large tubercles parallel to anterolateral margin, arranged on epibranchial swellings. Branchiocardiac grooves deep, well-marked. Mesobranchial and metabranchial regions undifferentiated; broken large tubercle on mesobranchial area.

Thoracic sternum poorly preserved, wide, circular in outline. Surfaces of sternites 7 and 8 granular Telson, and pleonal somites 5 and 6 poorly preserved. Outer cast of telson roundly triangular. Outer cast of pleonal somite 6 trapezoidal, much wider than long, with lateral margin converged anteriorly. Pleonal somite 5 with longitudinally vaulted lateral elements.

Eye elongate, oblique, with long eyestalk.

Chelipeds incompletely preserved, subequal. Merus short, stout. Carpus short. Palm longer than high; dorsal margin shorter than ventral margin; lateral surface densely granulated, deeply hollowed along dorsal margin. Both fingers with dentate occlusal margin.

Pereiopods 2–5 flattened laterally. Pereiopods 2–4 showing mesial surface; detailed characters of coxae, bases, and ischiums not observed; meri long, finely granulated on mesial surface. Carpus of pereiopod 4 short; propodus subrectangular in lateral view, about twice times longer than high; dactylus elongate, much longer than propodus, medially grooved on lateral surface, with sharply pointed tip. Ischium of pereiopod 5 short with ventro-distal spine on ventral margin; merus long, about twice times longer than high; carpus and propodus much shorter than merus; propodus lanceolate, about as long as merus, height about half of length.

Remarks: The characters of the carapace and preserved appendages of the new species well agree with the diagnostic characters of *Orithyia*. The hitherto known species within the genus is only one species, *Orithyia sinica* (Linnaeus, 1771), from the extant continental side of East China Sea and northwestern South China Sea (Ng et al., 2008). The new species possesses carapace characters most like of those of *O. sinica*, but only one pair of spines on posterolateral margins readily distinguishes *O. eikii* from the extant species having two pairs of posterolateral spines.

Orithyia eikii represents the first fossil record and the second species of the genus. A discovery of this species extends the geologic range for the genus back to the Early Miocene (about 18.0–17.5 Ma).

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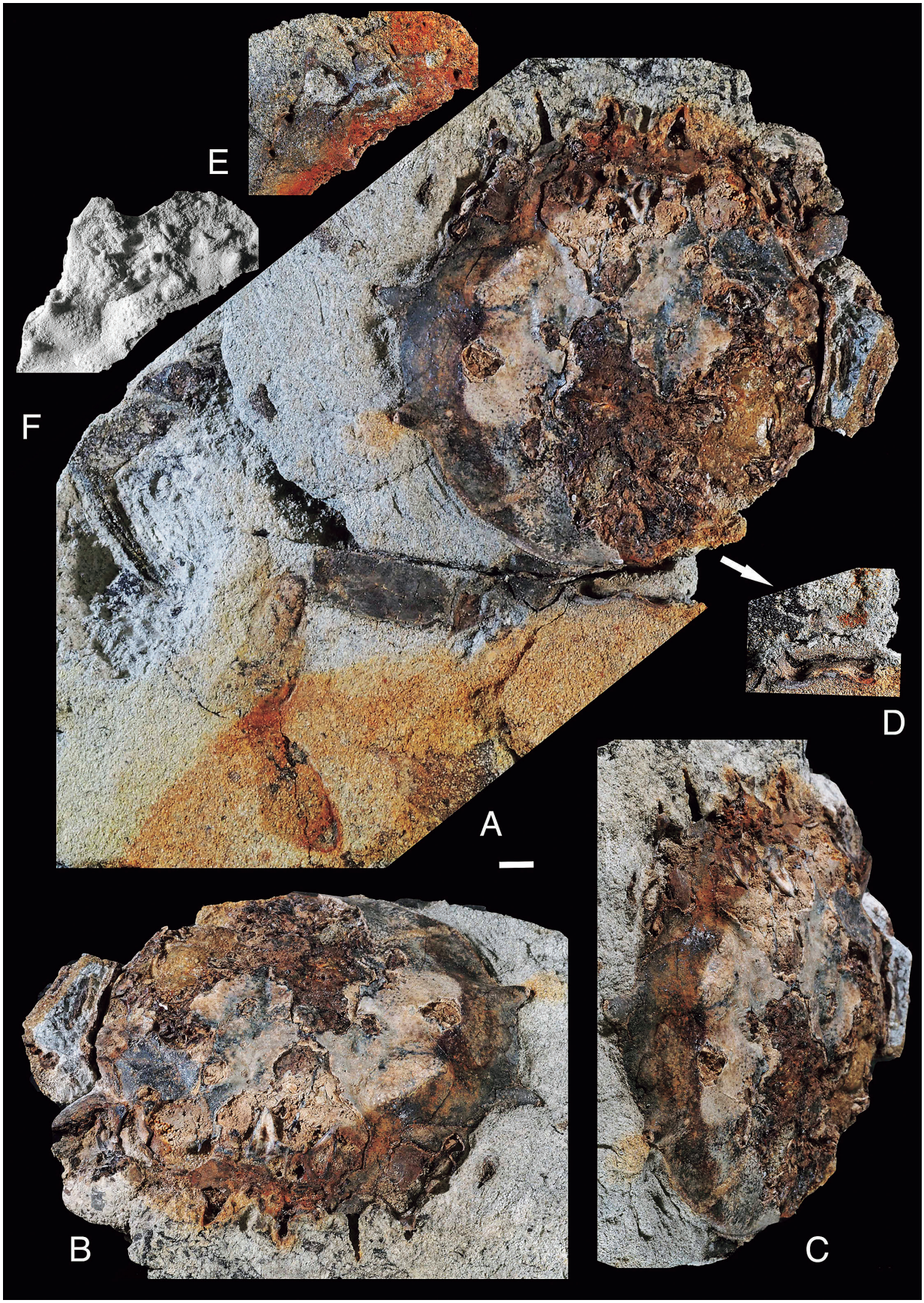

Fig. 1. *Orithyia eikii,* new species. Holotype, MFM9052, Akeyo Formation, Early Miocene. ***A,*** dorsal view of carapace and pereiopods; ***B,*** frontal view of carapace; ***C,*** lateral view of carapace; ***D,*** outer mold of telson and pleonal somite 6, and pleonal somite 5; ***E,*** reversal image of outer mold of anterior region of carapace; ***F,*** whitening image coated with ammonium chloride sublimate of latex cast derived from outer mold (Fig. 1E). Scale bar = 5 mm.

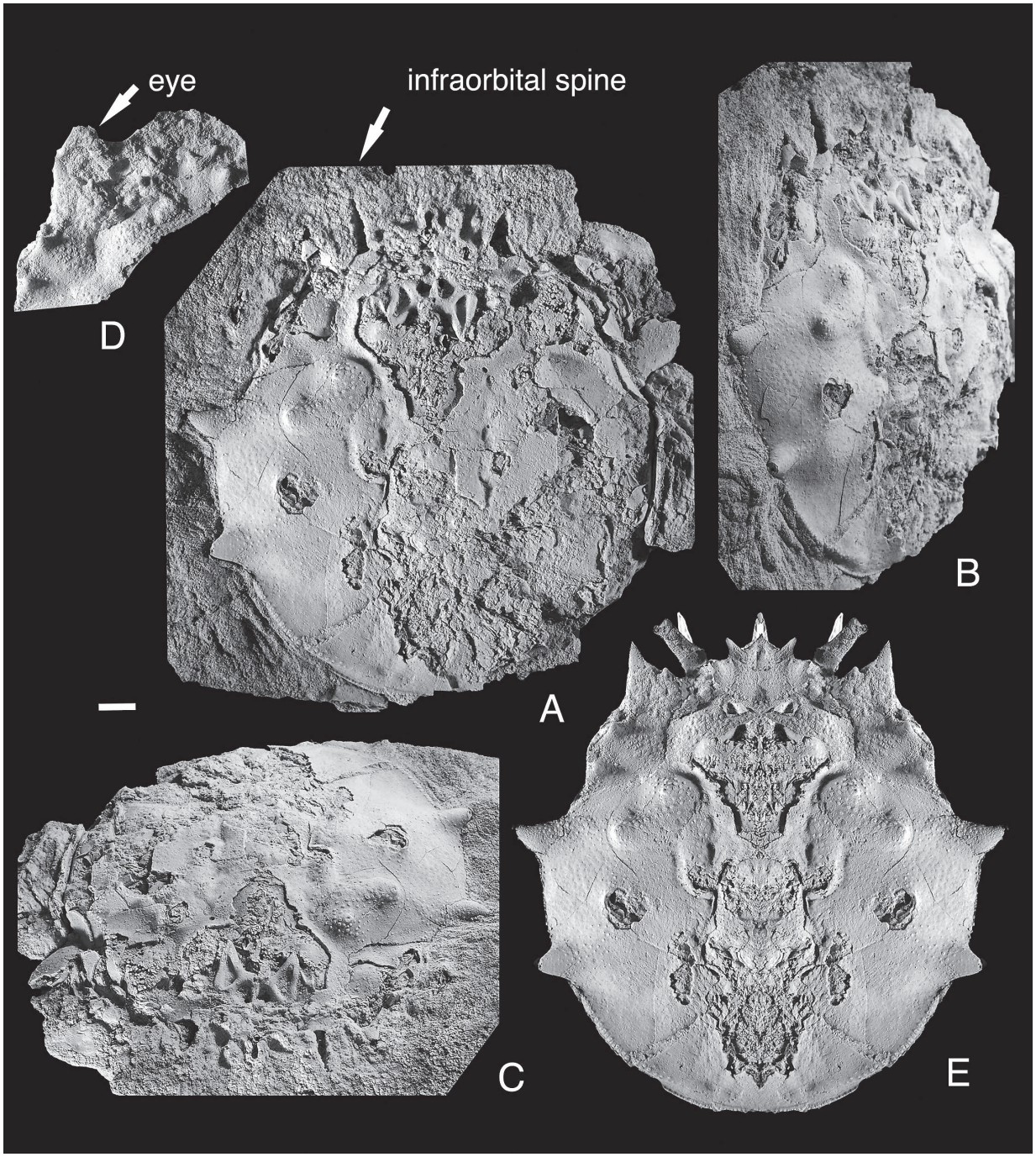

Fig. 2. *Orithyia eikii*, new species. Holotype, MFM9052, Akeyo Formation, Early Miocene. ***A,*** dorsal view of carapace; ***B,*** lateral view of carapace; ***C,*** frontal view of carapace; ***D,*** latex cast derived from outer mold (Fig. 1E); ***E,*** reconstructed image combined Fig. 2A with Fig. 2D. All are whitening images coated with ammonium chloride sublimate. Scale bar = 5 mm.

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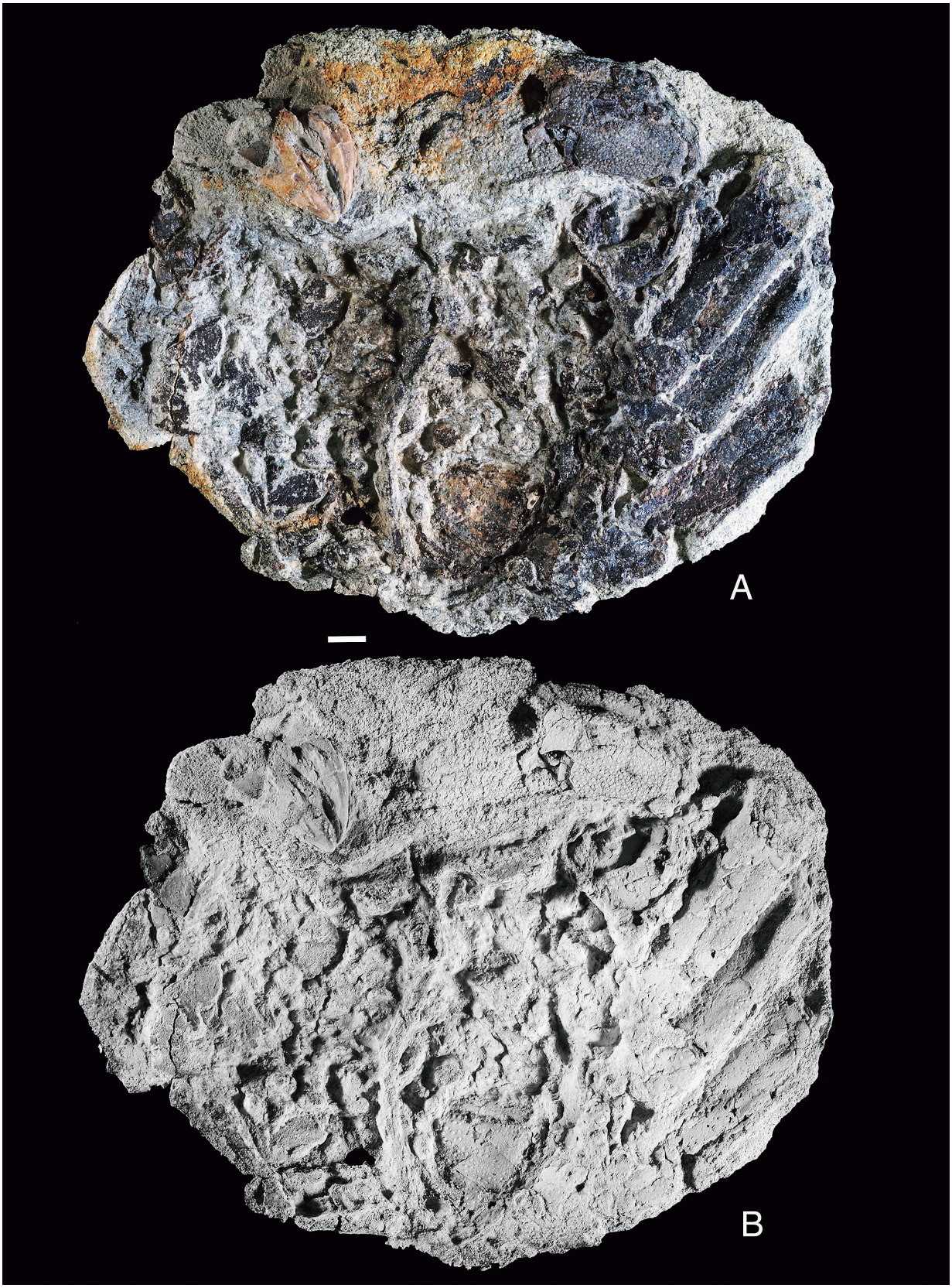

Fig. 3. *Orithyia eikii*, new species. Holotype, MFM9052, Akeyo Formation, Early Miocene. ***A, B,*** lateral view of chelipeds and ventral view of thoracic sternum and pereiopods 2–5. B is whitening image coated with ammonium chloride sublimate. Scale bar = 5 mm.

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Appendix

Orithyia eikii Karasawa, new species LSID: urn:lsid:zoobank.org:act:E25E5560-0305-42AD-A59F-45E460BD0A80

新称:エイキガニ