出雲層群産の中新世十脚甲殻類

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Decapod crustaceans from the Middle Miocene Izumo Group, Southwest Japan

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(Abstract)

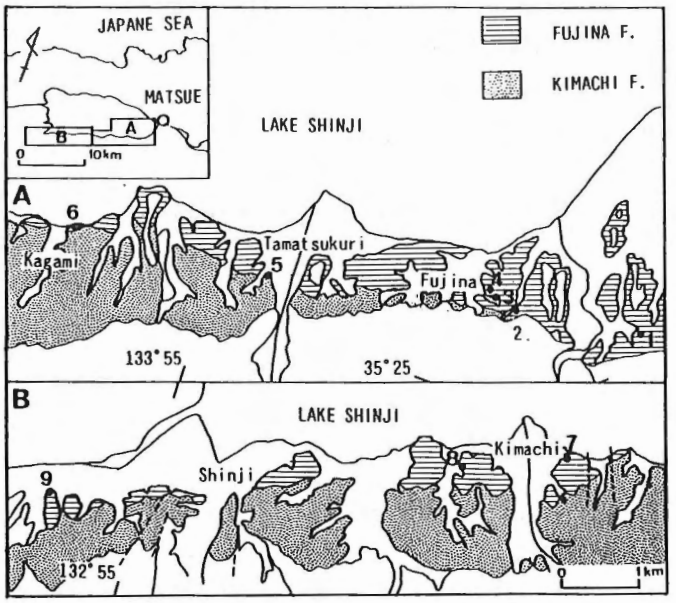
Eleven species in seven genera of decapod crustaceans are described and figured from the middle Middle Miocene Izumo Group exposed at the south coast of Lake Shinji, Shimane Prefecture, southwest Japan. *Cancer (Metacarcinus) izumoensis* and *C. (Cancer) fujinaensis* are newly described. The *Carcinoplax antiqua* assemblage from the lower and middle parts of the Fujina Formation and the *Mursia takahasii* assemblage from the uppermost part of the Kimachi Formation are recognized. Decapods from the Fujina Formation is similar to those from the Lower Miocene Yamanouchi Member, Akeyo Formation, Mizunami Group in specific composition.

はじめに

山陰中央部に分布する中部中新統出雲層群は下位より順に来待層，布志名層，松江層よりなり（高安ほか，1992），以前より貝化石等の古生物学的な研究が多く行われている（Yokoyama, 1913,1923；岡本，1981a; 末広，1979；Ogasawara and Nomura, 1980；Takayasu, 1982, 1986）．出雲層群からの化石十脚甲殻類の研究は，大久保（1975）が松江層より *Palaemon* sp., 柄沢（1990）が布志名層から *Carcinoplax antiqua* の産出を報じたにすぎない．

最近，筆者の一人，作本は出雲層群の地質調査を通じて，多数の化石十脚甲殻類を得た．それらは，2新種を含む6科7属11種に分類できる．本論ではこれらの十脚甲殻類について記載を行なう．また，出雲層群とは時代的にも地域的にも異なる瑞浪層群明世累層山野内層の群集の化石十脚甲殻類と出雲層群の組成が類似していることを指摘し，その意味について考察を

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第1図 産地図.（地質図は Takayasu, 1986より一部改訂）
Fig. 1. Locality map.

加える.

本論文をまとめるにあたり，名古屋大学地球惑星科学教室の糸魚川淳二教授には多くの便宜をはかっていただいた．また同教室大学院生諸氏，そして島根大学地質学教室の教官および大学院生諸氏には多くの御助言をいただいた．兵庫県高槻市在住の宮本淳一氏には、来待層の化石産地を教えていただいた．この場で厚くお礼を申し上げます.

産出地と周辺の地質

今回検討した標本の産地は，来待層最上部から布志名層の中，下部の層準に相当する9地点である．高安ほか（1992）は，それら産出層の地質時代を中期中新世中期（14～13Ma）とした.

以下に各産地の産出化石，地質について概略を述べる．なお Loc. 6,7の軟体動物化石の産出種は末広（1979）より引用した.

Loc. 1 田和付近（35°25′52″N, 133°5′44″E)

布志名層の細粒砂岩が分布する．島根大学理学部地質学教室所蔵の標本のひとつ（T. 3128,3129)が産出したとされるが，現在ではその露頭を特定することはできない.

化石十脚甲殻類；*Platepistoma kaedei.*

Loc. 2 乃白町工場跡地（35°25′

Species \ Formation	Izumo Group								
	Kimachi F.	Fujina Formation							
	5	1	2	3	4	6	7	8	9
Callianassa sp.					R				
Platepistoma kaedei (Karasawa) comb. nov.		R							
Cancer (Metacarcinus) izumoensis sp. nov.									R
C. (Cancer) fujinaensis sp. nov.						R			
C. (C.) tomowoi Karasawa									R
Mursia takahashii Imaizumi	R								
Itoigawaia minoensis (Karasawa)						R			
Scylla ozawai Glaessner						R			
S. sp.								R	
Carcinoplax antiqua (Ristori)			C	F	F	F	F		C
Tritodynamia globosa Karasawa									F

第1表 出雲層群産の中新世十脚甲殻類リスト
Tab. 1. List of Miocene decapod crustaceans from the Izumo Group
R, rare; F, frequent; c, common.

42″N, 133°2′38″E)

サンドパイプが多くやや淘汰の悪い布志名層下部の細粒砂岩に含まれるノジュールより，合弁の二枚貝化石とともに化石十脚甲殻類が産出した．また，砂岩中には3層の薄い石灰質砂岩層が認められ，この石灰質砂岩からは貝化石が多産し，頭足類の *Mizuhobaris izumoensis* も産出した．

化石十脚甲殻類； *Carcinoplax antiqua, Mursia takahasii.*

軟体動物化石； *Acila divalicata submirabilis, Mercenaria yokoyamai, Panope nomurae, Teredo* sp., *Fissidentalium yokoyamai.*

Loc. 3　玉湯町布志名 (35°25′44″N, 133°2′27″E)

Loc. 2とほぼ同層準で，同様の岩相である．

化石十脚甲殻類； *Carcinoplax antiqua, Callianassa* sp..

軟体動物化石； *Acila divaricata submirabilis, Mercenaria yokoyamai, Cultellus izumoensis, Panope nomurae, Teredo* sp..

Loc. 4　玉湯町布志名 (35°25′48″N, 133°2′25″E)

Locs. 2，3よりもやや上位の層準に当たる布志名層．細円礫を含んだ細粒砂岩，ノジュール中より化石十脚甲殻類が産出する．そのほか板さい類の椎体なども産出する．

化石十脚甲殻類； *Carcinoplax antiqua, Callianassa* sp..

軟体動物化石； *Acila divaricata submirabilis, Mercenaria yokoyamai, Macoma optiva, Cultellus izumoensis, Panope nomurae, Neverita kiritaniana, Phos iwakianus fujinaensis.*

Loc. 5　玉湯町玉湯中学校前 (35°25′24″N, 133°0′27″E)

塊状凝灰質粗粒砂岩に泥および炭質物を薄く挟んだ露頭で来待層の最上部に相当する．化石十脚甲殻類は塊状凝灰質粗粒砂岩中のノジュールより産出する．貝化石はほとんど認められない．

化石十脚甲殻類； *Mursia takahasii.*

Loc. 6　宍道町鏡 (35°25′12″N, 132°55′35″E)

宮本淳一氏所蔵の標本と島根大学地質学教室所蔵の標本は，布志名層下部に相当する宍道町鏡の露頭より産出したとされるが，現在その露頭はコンクリートで覆われて観察することはできない．化石を含んでいるノジュールは細粒砂岩である．

化石十脚甲殻類； *Cancer (Metacarcinus) izumoensis, Cancer (Cancer) tomowoi, Itoigawaia minoensis, Scylla ozawai, Carcinoplax antiqua.*

軟体動物化石； *Ennucula praenipponica, Acila divaricata submirabilis, Portlandia (Megayoldia) gratiosa, P. (M.)* cfr. *thraciaeformis, Kotorapecten kagamianus, Cyclocardia onukii, Clinocardium shinjiense, Mercenaria yokoyamai, Kaneharaia kaneharai fujinaensis, Macoma optiva, Cultellus izumoensis, Panope nomurae, Thracia higashinodonoensis, Teredo* sp., *Turritella tanaguraensis, Neverita kiritaniana., Liracassis japonica, Siphonalia* sp., *Fissidentalium yokoyamai.*

Loc. 7　宍道町来待ＪＲ来待駅裏 (35°25′02″N, 132°57′13″E)

布志名層下部の細粒砂岩で，化石十脚甲殻類はまれに産出する．

化石十脚甲殻類； *Carcinoplax antiqua.*

軟体動物化石； *Ennucula praenipponica, Acila divaricata submirabilis, Mercenaria yokoyamai, Cultellus izumoensis, Liracassis japonica, Phos iwakianus fujinaensis, Fissidentalium yokoyamai.*

Loc. 8　宍道町西来待（35°24′45″N, 132°56′15″E）

島根大学理学部地質学教室所蔵の標本．離弁の二枚貝化石を多く含んでいる，布志名層下部の細粒砂岩．貝化石の産出はわずかである．

化石十脚甲殻類；*Scylla* sp..

軟体動物化石；*Laevicardium? shiobarense.*

Loc. 9　宍道町伊志見（35°23′41″N, 132°52′58″E）

布志名層中部に対比される明青灰色の極細粒砂岩で，わずかにサンドパイプが認められる．ノジュール中より化石十脚甲殻類が多産する．貝化石の産出は比較的少ない．この産地からも *Mizuhobaris izumoensis* が産出した．

化石十脚甲殻類；*Mursia takahasii, Cancer (Metacarcinus) izumoensis, Cancer (Cancer) fujinaensis, Carcinoplax antiqua, Tritodynamia globosa.*

軟体動物化石；*Acila divaricata submirabilis, Mercenaria yokoyamai, Macoma optiva, Cultellus izumoensis, Teredo* sp., *Mizuhobaris izumoensis.*

出雲層群の化石十脚甲殻類群集

柄沢（1990）は布志名層より *Carcinoplax antiqua* よりなる群集を認めた．今回，筆者らの検討により布志名層から *C. antiqua* 群集，来待層より *M. takahasii* 群集を認めることが出来た．

Carcinoplax antiqua 群集（Loc.2-4,6,7,9）

布志名層に特徴的な群集で *C.antiqua* が卓越する．*Carcinoplax* 属の現生種は水深約５０－１００ｍの砂，砂泥底に生息する表生生活者で，本州太平洋岸銚子以南に多く分布する（Sakai, 1976；酒井，1976）．来待層から引続いて産出する *Mursia takahashii* も，後述するように下浅海帯上部を支持する種である．そのほか Loc. 6または9から *Scylla ozawai* または *Cancer* 属等を産出し，布志名層の群集は多彩な種構成を示している．そのうちの *Scylla* 属の現生種は，熱帯・亜熱帯の内湾河口，潮間帯から上浅海帯に多く生息している（Sakai, 1976；酒井，1976）．しかしながら，これら生息域の異なる *S. ozawai* と *C. antiqua* が，同時に産出している産地がある．ただし産状は不明で，おそらく *S. ozawai* が死後，*C. antiqua* の生息域へと落ちこんできたものと思われる．

これらのことより，布志名層は下浅海帯上部を反映する *C. antiqua* 群集に，潮間帯から上浅海帯の要素がわずかに混入する暖流系要素の強い，砂底の表生生活者を主体とした群集と見なせる．また，わずかながら *Tritodynamia globosa* などの内生生活者を含んでいる．

Mursia takahasii 群集（Loc. 5）

Mursia takahasii のみからなる単調な群集で来待層に認められる．*Mursia* 属現生種は水深約６０－１５０ｍの砂，砂泥底，貝殻底に生息する，表生生活者である（Sakai, 1976；酒井，1976）．このことは岩層から推定される来待層の堆積環境と一致している．下浅海帯上部の粗粒な砂底に生息していた群集と見なせる．

布志名層の貝化石群集と化石十脚甲殻類群集との比較

今回報告した布志名層の化石十脚甲殻類は，*Macoma-Cultellus* Ⅰ型の貝化石群集（Takayasu, 1986）を伴う場合が多い．

Macoma-Cultellus I型群集は，*Macoma optiva, Cultellus izumoensis, Panope nomurae* を主とした内生生活者が中心の種構成である．そして，これらの群集は上浅海帯－下浅海帯下部の生息深度を示し，特に上浅海帯の種が顕著である．さらにそれらは暖流系要素と寒流系要素が混在した特性を示すとされている（高安，1986）．

貝化石から推定される古環境を，今回検討した化石十脚甲殻類群集が示す環境特性と比較すると，貝化石群集の生息深度は，化石十脚甲殻類群集のものに似た特性を示すが，貝化石群集の方が上浅海帯要素が顕著であり，幅広い生息深度を有しているという相違点も見られる．

さらに貝化石群集は前述のように，暖流系と寒流系の要素が混在しているが，化石十脚甲殻類群集の方は，明らかに暖流系の要素が強く，この点が両者の大きな違いである．

また化石十脚甲殻類と共産した，頭足類の *Mizuhobaris izumoensis* の存在からも，他の層準よりも暖流の影響下にあり，比較的高い古水温であったことを示唆し，岡本（1981a, b）の布志名層の時期に暖流の流入があったとする見解を支持するものと思われる．

出雲層群布志名層と瑞浪層群明世累層山野内層との種構成の比較

化石十脚甲殻類に関する資料が比較的豊富な瑞浪層群と，今回報告した出雲層群布志名層とを比較してみる．瑞浪層群の化石十脚甲殻類に関しては Takeda and Tomida（1984），Karasawa（1989，1990，1991）の報告があり，２４属５１種が知られている．

この内，布志名層と瑞浪層群明世累層山野内層との間には *Platepistoma kaedei, Itoigawaia minoensis, Carcinoplax antiqua, Tritodynamia globosa* の４種が共通して産出する．これらの種は山野内層の全産出種の約29%，布志名層産の約36%の割合を示し，種レベルでは類似性に乏しい．

しかし，属レベルで比較した場合，*Callianassa* 属，*Cancer* 属，*Scylla* 属，*Itoigawaia* 属，*Carcinoplax* 属，*Tritodynamia* 属が両層に共通し，山野内層の全産出属の約50%，布志名層の約85%という高い類似性を示す．また，表生生活者の方に，より類似性が認められる．

柄沢（1990）の資料によれば，山野内層は表生生活者の *Carcinoplax antiqua* に，内生生活者の *Miosesarma japonica, Callianassa* sp.1.などを含んだ *Miosesarma*－*Carcinoplax* 群集を示し，（潮間帯）－上浅海帯－下浅海帯に分布する種によって構成される．そして，そのうち下浅海帯上部のものが優勢で，これに上浅海帯の要素が混入した群集とされている．

前述したように布志名層の場合も同様に，下浅海帯上部を反映する群集に，わずかながら上浅海帯の要素が混入した，表生生活者を主体とする群集構成を示す．

これら両群集の相違点は，山野内層の主要構成種である *Miosesarma japonica* が布志名層の構成種の中に認められない点のみである．*Miosesarma japonica* は前期中新世から中期中新世前期に西南日本に分布していた種であり（柄沢, 1990），中期中新世中期に相当する布志名層の時代には絶滅していたと思われる．

したがって *Miosesarma japonica* を除けば，山野内層の表生型の群集は布志名層の群集と非常に良く似た構成を示し，生態的に相同の時代的平行関係にある群集を形成していたものと考えられる．

ま　と　め

（1）出雲層群来待層および布志名層より６科７属１１種の化石十脚甲殻類を報告し，そのう

ち布志名層産の *Cancer* 属2種を新種として記載した.

(2)出雲層群布志名層より *Carcinoplax antiqua* 群集が, 来待層より *Mursia takahashii* のみからなる群集が認められた.

(3)布志名層産の化石十脚甲殻類は *Macoma-Cultellus* I型貝化石群集を伴う場合が多く, それらの群集特性を比較した場合, 貝化石群集の方が浅い要素が顕著であり, また化石十脚甲殻類群集の方が暖流系要素が強い.

(4) 瑞浪層群明世累層山野内層と出雲層群布志名との間に約3Maもの時間的間隙があるのにもかかわらず, 種構成に共通性が多く見られる. このことは中期中新世中期の布志名層の下部および中部の層準が, 前期中新世の山野内層の古環境に近かったことを暗示している.

Systematic Palaeontology

Infraorder Thalassinidea Latreille, 1831
Superfamily Callianassoidea Dana, 1852
Family Callianassidae Dana, 1852
Subfamily Callianassinae Dana, 1852
Genus *Callianassa* Leach, 1814

Type species: By monotypy *Cancer (Astacus) subterraneus* Montagu, 1808 (ICZN Opinion 434).

Callianassa sp.
(Pl. 60, Figs. 1, 2)

Material: T.3046, T.3047 (Shimane University).

Description: The fixed finger is slightly shorter than the dactylus and the lateral surface is ornamented with tubercles. The palm is about twice as long as the dactylus, slightly longer than broad and tapers distally. The carpus is as long as the palm; the dorsal margin is nearly straight and the ventral margin is strongly convex.

Remarks: This species resembles *Callianassa yagii* Imaizumi, 1957 from the Miocene Ronji Formation of Nagano Prefecture, but differs in having a longer palm.

Occurrence: Fujina (Locality 4), Tamayu-cho, Yatsuka-gun; Fujina Formation, Izumo Group (middle Middle Miocene).

Measurements (in mm): Dactylus length, 4.4; Palm length, 8.3; Palm width, 6.8; Carpus length, 8.5; Carpus width, 7.0 (T.3046).

Infraorder Brachyura Latreille, 1803
Section Heterotremata Guinot, 1977
Superfamily Cancroidea Latreille, 1803
Family Cancridae Latreille, 1803
Genus *Platepistoma* Rathbun, 1906

Type species: By monotypy *Platepistoma macrophthalmus* Rathbun, 1906.

Platepistoma kaedei (Karasawa, 1990) comb. nov.

(Pl. 60, Figs. 3-4)

1990 *Cancer (Glebocarcinus) kaedei* Karasawa, p. 9, pl. 1, figs. 4a-c, 7a, b, 13, 14.

Material: T.3128, T.3129 (Shimane University).

Remarks: Karasawa (1990) originally described this species from the Miocene Mizunami Group of Gifu Prefecture. At that time, he included this species in the *Cancer (Glebocarcinus)*, following Nation (1975)'s definition. Takeda (1977) considered that the *Glebocarcinus* Nations, 1975 was a junior subjective synonym of the genus *Platepistoma* Rathbun, 1906 and settled the *Platepistoma* in the *Cancer*. Davie (1991) recognized the generic rank between the *Cancer* and *Platepistoma*. According to his definition, this species can be transferred from the *Cancer (Glebocarcinus)* to the *Platepistoma* by having sparsely granulated dorsal regions of the carapace, a granulated posterolateral margin with 5 spines, and the median frontal tooth which is projected forward and placed ventral to the lateral teeth.

The carapace and chelipeds of our specimen are twice larger than those of the type specimen. The type specimen appears to be a juvenile. The juvenile type is distinguished from the adult type (our material) by having dorsal deep sculptures of the carapace and well separated slender anterolateral teeth.

Occurrence: Tawa (Locality 1), Matsue City; Fujina Formation, Isumo Group (middle Middle Miocene).

Measurements (in mm):

	T.3128	T.3129
Carapace length	40.4	-
Carapace width		-
	right	left
Palm length	24.9	23.8
Palm width	21.3	19.0

Genus *Cancer* Linnaeus, 1758

Type species: By subsequent designation of Latreille, 1810 ; *Cancer pagurus* Linnaeus, 1758 (ICZN Opinion 104).

Subgenus *Metacarcinus* A. Milne Edwards, 1862

Type species: By original designation *Cancer magister* Dana, 1852.

Cancer (Metacarcinus) izumoensis sp. nov.

(Pl. 60, Figs. 5a-c ; Pl. 61, Figs.1)

Material: T.3130, T.3131 (Shimane University).

Holotype: T.3130.

Paratype: T.3131.

Type Locality: Ijimi (Locality 9), Sinji-cho, Yatsuka-gun, Simane Prefecture.

Formation and Geologic age: Fujina Formation, Izumo Group, (middle Middle Miocene).

Etymology: Named in reference to an ancient county name, "Izumo no kuni".

Diagnosis: Mesogastric lobe having median ridge with two nodes; anterolateral margin with forwardly directed broadly triangular teeth.

Description: The large carapace is transversely oval in outline and the length is about three-fourths of the width. The gently convex dorsal surface is covered with fine granules. The regions are poorly defined by board, shallow grooves. The mesogastric lobe has a median ridge with two nodes. The inflated cardiac region with two nodes transversely arranged, is hexagonal in outline. The hepatic regions are depressed. The branchial regions are tumid. The orbitofrontal margin is narrow and about one-fifth of the carapace width. The frontal margin bears three teeth and a median tooth is small. The finely granulated orbital margin is pierced by two shallow fissures laterally. Gently convex anterolateral margins appear to be nine forwardly directed broadly triangular teeth which are fringed with fine granules. Gently concave posterolateral margins are slightly shorter than the anterolateral margins.

Remarks: The present new species resembles the Pliocene species, *C. (M.) minutoserratus* Nagao, 1940 from the Tatsunokuchi and Yushima Formations of northeast Japan (Takeda *et al.*, 1984), but differs in having the finely granulated anterolateral teeth without irregular serrations and spines. *C. (M.) izumoensis* sp. nov. is closely related to *C. (M.) danai* Nations, 1975 from the Middle Miocene of California, but can be differentiated by a mesogastric ridge with two nodes of the carapace in *C. (M.) izumoensis* sp. nov.

Occurrence: Ijimi (Locality 9), Sinji-cho, Yatsuka-gun; Kagami (Locality 6) Sinji-cho,Yatsuka-gun; Fujina Formation, Izumo Group (middle Middle Miocene).

Measurements (in mm): Carapace length, 60.4 ; Carapace width, 90.9+ (T.3130).

Associated forms: Decapod crustaceans:- *Mursia takahashii, Cancer (Cancer) tomowoi, C. (C.) fujinaensis, Scylla ozawai, Carcinoplax antiqua, Tritodynamia globosa.* Pelecypoda:- *Acila divaricata submirabilis, Mercenaria yokoyamai, Macoma optiva, Cultellus izumoensis.*

Subgenus *Cancer sensu stricto*

Cancer (Cancer) tomowoi Karasawa, 1990

(Pl. 61, Figs. 2a-c)

1990 *Cancer (Cancer) tomowoi* Karasawa, p. 11, pl. 1, figs. 2a-d, 3a-d, 8, 16a, b.

Material: T.3301 (Shimane University).

Occurrence: Kagami (Locality 6), Shinji-cho, Yatsuka-gun; Fujina Formation, Izumo Group (middle Middle Miocene).

Measurements (in mm): Palm length, 50.0 ; Palm width, 31.8 (T,3301).

Cancer (Cancer) fujinaensis sp. nov.

(Pl. 61, Figs. 3a-c)

Material: T.3132 (Shimane University).

Holotype: T.3132.

Type Locality: Ijimi (Locality 9), Shinji-cho, Yatsuka-gun, Shimane Prefecture.

Formation and Geologic age: Fujina Formation, Izumo Group (middle Middle Miocene).

Etymology: From "Fujina", a place name.

Diagnosis: Cancer with dorsal surface decorated with tubercles and granules of carapace and rounded anterolateral teeth.

Description: The gently convex dorsal surface of the carapace is covered with tubercles and granules which vary in size. The regions are well defined by board, shallow grooves. The inflated protogastric lobes are decorated with tubercles on the anterior half. The anterior mesogastric process, and mesogastric and urogastric lobes are densely decorated with fine granules. The flattened cardiac region with a shallow median depression, is hexagonal in outline and finely granulate. The hepatic regions are gently vaulted and ornamented with irregular tubercles. The more convex epibranchial regions are decorated with tubercles which vary in size. The mesobranchial regions are sparsely covered with tubercles. The details of the orbitofrontal, anterolateral and posterolateral margins are obscured by poor preservation. The orbital margin is pierced by two deep fissures laterally. The first three anterolateral teeth are present, rounded in outline and the first tooth is broadest of all the teeth. The posterolateral margins are gently concave.

Remarks: The present new species is quite unlike the Miocene species, *Cancer (Cancer) tomowoi* Karasawa, 1990 from the Mizunami and Izumo Groups. A carapace of *C. (C.) tomowoi* has not found yet. *C. fujinaensis* sp. nov. is near to the American Pliocene species, *C. fissus* Rathbun, 1908, but differs in having the carapace of which the protogastric, hepatic, epibranchial and mesobranchial regions covered with irregular tubercles.

Occurrence: Ijimi (Locality 9), Shinji-cho, Yatsuka-gun; Fujina Formation, Izumo Group (middle Miocene).

Measurements (in mm): Carapace length, 35.5 + ; Carapace width, 44.5 + (T.3132).

Associated forms: Decapod crustaceans:- *Mursia takahashii, Cancer (Cancer) tomowoi, C.(M.) izumoensis, Scylla ozawai, Carcinoplax antiqua, Tritodynamia globosa.* Pelecypoda:- *Acila divaricata submirabilis, Mercenaria yokoyamai, Macoma optiva, Cultellus izumoensis,*

Superfamily Calappoidea de Haan, 1833
Family Calappidae de Haan, 1833
Subfamily Calappinae de Haan, 1833
Genus *Mursia* Desmarest, 1823

Type species: By subsequent designation of H. Milne Edwards, 1837 ; *Mursia cristata* H. Milne Edwards, 1837.

Mursia takahashii Imaizumi, 1952
(Pl. 61, Figs. 4,5)

1952 *Mursia takahashii* Imaizumi, p. 90, figs. 1-4.

Material: T.3124, T.3125, T.3302, T.3304 (Shimane University).

Remarks: In our collection, carapaces and a left chela remain. *Mursia takahasii* Imaizumi, 1952 was originally described from the Miocene Hatate Formation. A perfect cheliped is first found in our collection. The fingers are short and densely covered with microscopical granules on the lateral surface. The palm is about 1.5 times as long as the

dactylus, and the lateral surface with two conical tubercles, is covered with small granules. The dorsal margin of the palm has seven forwardly directed acutely triangular teeth diminishing in size forward. The anterolateral margin in our specimen has 11 granules, but that in the type specimen has 7 granules.

Occurrence: Tamayu-cho (Locality 5), Yatsuka-gun; Kimachi Formation, Izumo Group (middle Middle Miocene). Noshira-cho (Locality 2), Matsue City. Ijimi (Locality 9), Shinji-cho, Yatsuka-gun; Fujina Formation, Izumo Group (middle Middle Miocene).

Measurements (in mm):

	T.3124	T.3302
Carapace length	-	19.1
Carapace width	-	24.6
	left cheliped	
Dactylus length	6.6	-
Palm length	10.9	-
Palm width	8.3	-

Superfamily Portunoidea Rafinesque, 1815

Family Portunidae Rafinesque, 1815

Subfamily Polybiinae Ortmann, 1893

Genus *Itoigawaia* Karasawa, Sakumoto and Takayasu, 1992

Type species: By monotypy *Portunites minoensis* Karasawa, 1990.

Itoigawaia minoensis (Karasawa, 1990)

(Pl. 61, Figs. 6a,b)

1990 *Portunites minoensis* Karasawa, p. 14, pl. 2, figs. 1a, b, 3-5.

1992 *Itoigawaia minoensis* (Karasawa); Karasawa *et al.*, p., pl. 69, figs. 1-7.

Material: Miyamoto coll.

Occurrence: Kagami (Locality 6), Shinji-cho, Yatsuka-gun; Fujina Formation, Izumo Group (middle Middle Miocene).

Subfamily Portuninae Rafinesque, 1815

Genus *Scylla* de Haan, 1833

Type species: By subsequent designation of Rathbun, 1922 ; *Cancer serratus* Forskal, 1775 (ICZN Opinion 73).

Scylla ozawai Glaessner, 1933

(Pl. 62, Figs. 1a,b)

1933 *Scylla ozawai* Glaessner, p. 20, pl. 67, fig. 2.

1938 *Scylla miocenica* Inagaki, p. 1, pl. 3, figs. 1, 2.

1990 *Scylla ozawai* Glaessner; Karasawa, p. 18, pl. 2, figs. 6, 7 ; pl. 3, figs. 1a, b (including further synonymy).

Material: T.3136, T.3137 (Shimane University).

Occurrence: Kagami (Locality 6), Shinji-cho, Yatsuka-gun. Fujina Formation; Fujina

Formation, Izumo Group (middle Middle Miocene).

Measurements (in mm): Carapace length, 51.3 ; Carapace width, 78.9 + (T.3137).

Scylla sp.

(Pl. 62, Figs. 2a-c)

Material: T.3305 (Shimane University).

Remarks: The specimen is a fragment of the right dactylus. The occuldent margin bears two large, conical teeth.

Occurrence: Nisi-Kimachi (Locality 8), Shinji-cho, Yatsuka-gun; Fujina Formation, Izumo Group (middle Middle Miocene).

Superfamily Xanthoidea MacLeay, 1838

Family Goneplacidae MacLeay, 1838

Subfamily Carcinoplacinae H. Milne Edwards, 1852

Genus *Carcinoplax* H. Milne Edwards, 1852

Type species: By subsequent designation of Glaessner, 1929 ; *Cancer (Crutonotus) longimanus* de Haan, 1833.

Carcinoplax antiqua (Ristori, 1889)

(Pl. 62, Figs. 3a, b; Pl. 63, Figs. 1a,b)

1889 *Crutonotus antiqus* Ristori, p. 4.

1933 *Carcinoplax antiqua* (Ristori); Glaessner, p. 17, pl. 4, fig. 3.

1961 *Carcinoplax antiqua* (Ristori); Imaizumi, p. 164, pl. 12-17.

1990 *Carcinoplax antiqua* (Ristori); Karasawa, p. 23, pl. 7, figs. 1-8 (including further synonymy).

Material: T.3138-T.3257 (Shimane University).

Occurrence: Noshira-cho (Locality 2), Matsue City. Fujina (Locality 3,4), Tamayu-cho, Yatsuka-gun. Kagami (Locality 6), Shinji-cho, Yatsuka-gun. Kimachi (Locality 7), Shinji-cho, Yatsuka-gun. Ijimi (Locality 9), Shinji-cho, Yatsuka-gun; Fujina Formation, Izumo Group (middle Middle Miocene).

Measurements (in mm):

	T.3138		T.3139	
Carapace length	28.2+		29.1	
Carapace width	39.7		41.9	
Cheliped.	right	left	right	left
Dactylus length	-	-	16.2	-
Palm length	22.2	21.4	24.0	-
Palm width	12.8	12.0	12.0	-
Carpus length	11.6	11.0	12.1	12.0
Carpus width	13.3	13.2	13.0	12.9
Merus length	15.2	15.5	19.3	19.8
Merus width	9.4	8.5	8.7	8.3

Section Thoracotremata Guinot, 1977
Superfamily Pinnotheroidea de Haan, 1833
Family Pinnotheridae de Haan, 1833
Subfamily Asthengnacthinae Stimpson, 1858
Genus *Tritodynamia* Ortmann, 1894

Type species: By monotypy *Tritodynamia japonica* Ortmann, 1894.

Tritodynamia globosa Karasawa, 1990
(Pl. 63, Figs. 2a, b, 3a-c, 4)

1990 *Tritodynamia globosa* Karasawa, p. 30, pl. 8, figs. 12a-c, 15.

Material: T.3283 T.3294 (Shimane University).

Remarks: Karasawa (1990) originally described this species from the Miocene Mizunami Group. Our specimens are slightly different from the type specimen in having a longer carapace and slightly convex branchial lobes.

Occurrence: Ijimi (Locality 9), Shinji-cho, Yatsuka-gun Fujina Formation; Fujina Formation, Izumo Group (middle Middle Miocene).

Measurements (in mm):

	T.3283	T.3284	T.3285
Carapace length	9.9	7.6	11.9
Carapace width	12.3	10.6	14.6+

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Plate 60

Figs.1, 2. *Callianassa* sp. Locality 4. Palm and carpus of left cheliped, × 2.0.

Figs. 3a-c, 4a-c. *Platepistoma kaedei* (Karasawa). Locality 1.

Figs.3a-c. Carapace. a, dorsal view. × 1.4.b, ventral; c, frontal view. × 1.0.

Figs.4a-c. Palm of right cheliped. a, dorsal; b, lateral; c, mesial view. × 1.2.

Figs. 5a-c. *Cancer (Metacarcinus) izumoensis* sp. nov.

Figs.5a-c. *Holotype* (T.3130). Carapace. Locality 9. a, dorsal view. × 1.4. b, ventral; c, frontal view. × 0.8.

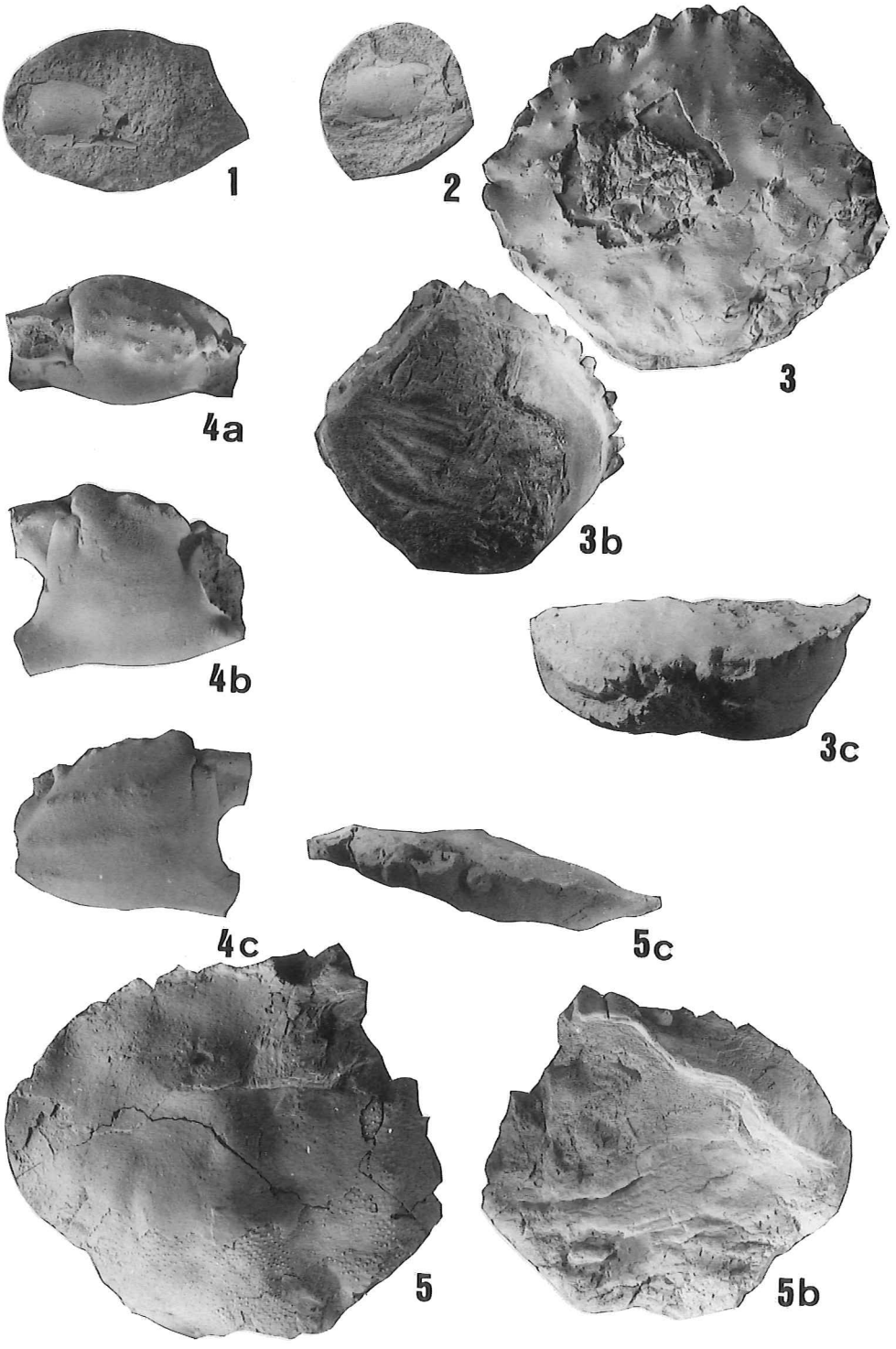

1
2
3
4a
3b
4b
3c
4c
5c
5
5b

Plate 61

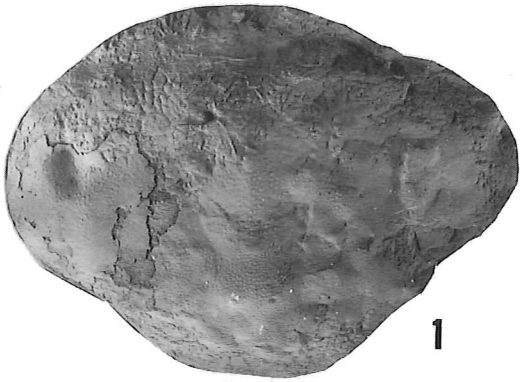
Figs. 1. *Cancer (Metacarcinus) izumoensis* sp. nov.
Paratype (T.3131). Carapace. Locality 6. dorsal view. × 1.3.

Figs. 2a-c. *Cancer (Cancer) tomowoi* Karasawa. Palm of left cheliped. Locality 6. a, dorsal; b, lateral; c, mesial view. × 0.9.

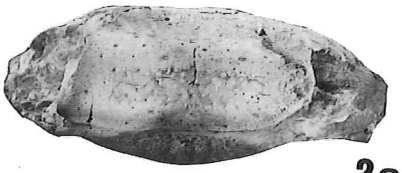
Figs. 3a-c. *Cancer (Cancer) fujinaensis* sp. nov. Holotype (T.3132). Carapace. Locality 9. a, dorsal view. × 1.4. b, ventral; c, frontal view. × 1.0.

Figs. 4, 5. *Mursia takahashii* Imaizumi.
Fig. 4. Carapace. Locality 5. dorsal view. × 1.4.
Fig. 5. Palm of left cheliped. Locality 9. lateral view. × 1.6.

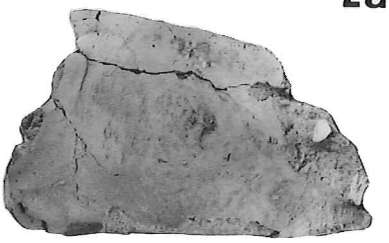
Figs. 6a, b. *Itoigawaia minoensis* (Karasawa). Locality 6.
Fig. 6a. Carapace. dorsal view. × 1.5.
Fig. 6b. Palm of right cheliped. lateral view. × 2.0.



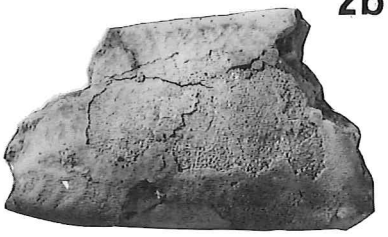
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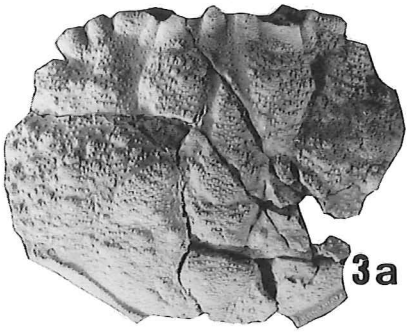
2a



2b



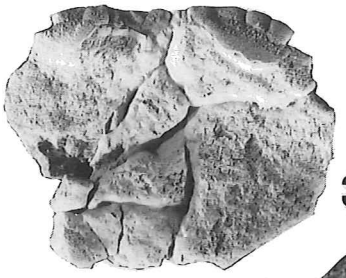
2c



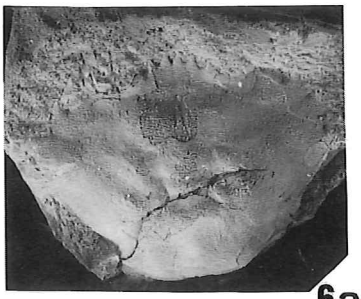
3a



3c



3b



6a



4



6b



5

Plate 62

Figs. 1a, b. *Scylla ozawai* Glaessner. Carapace. Locality 6. a, dorsal; b, ventral view. × 1.0.

Figs. 2a-c. *Scylla* sp. Dactylus of left cheliped. Locality 8.
a, dorsal; b, lateral; c, mesial view. × 1.2.

Figs. 3a, b. *Carcinoplax antiqua* (Ristori). Carapace. Locality 9.
a, dorsal; b, ventral view. × 1.0.

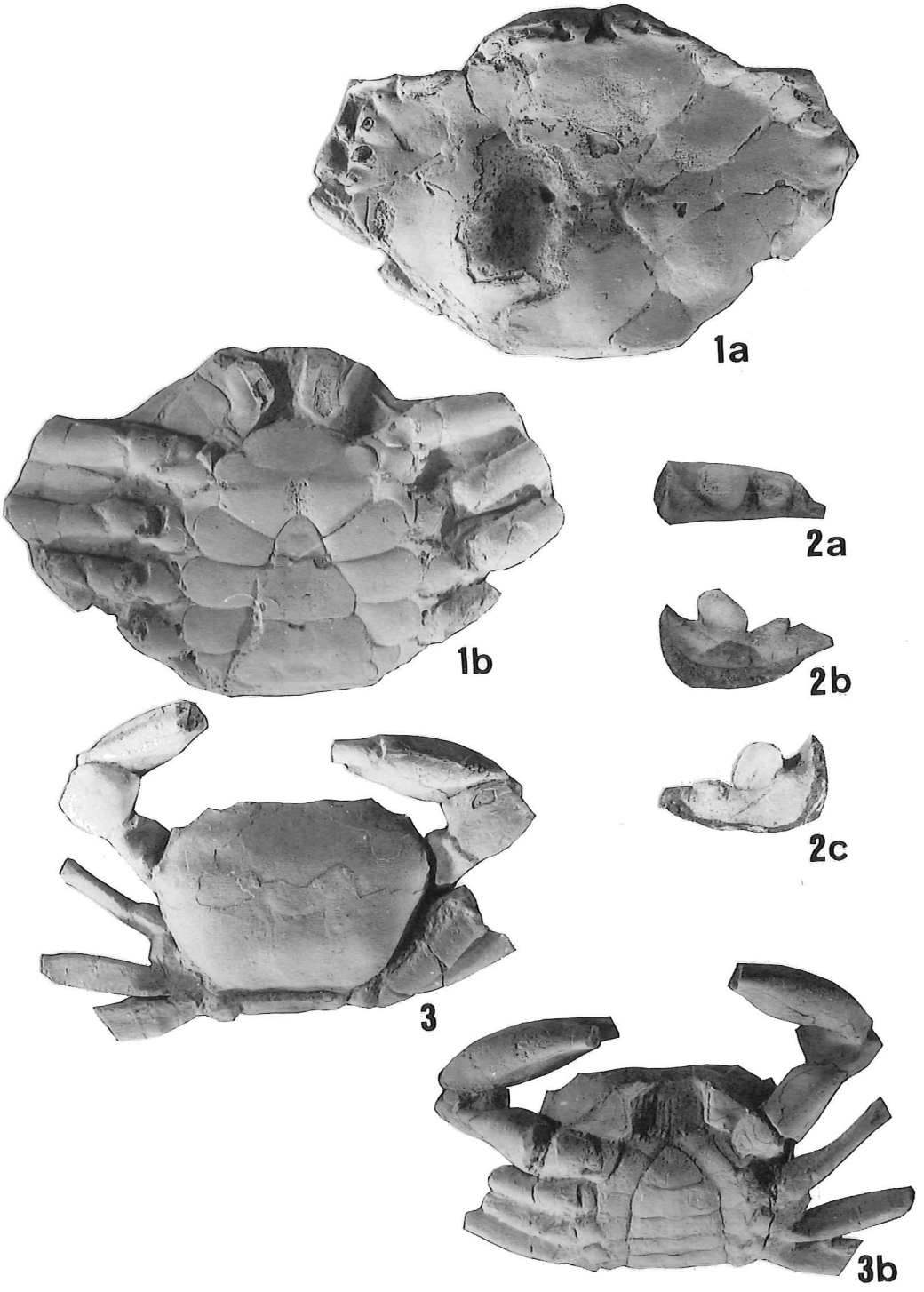
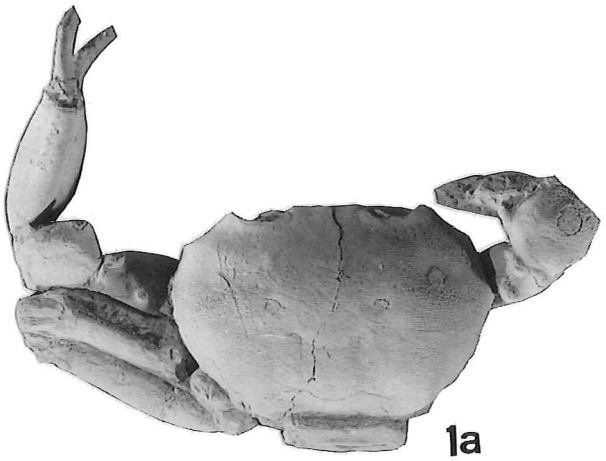

1a
1b
2a
2b
2c
3
3b

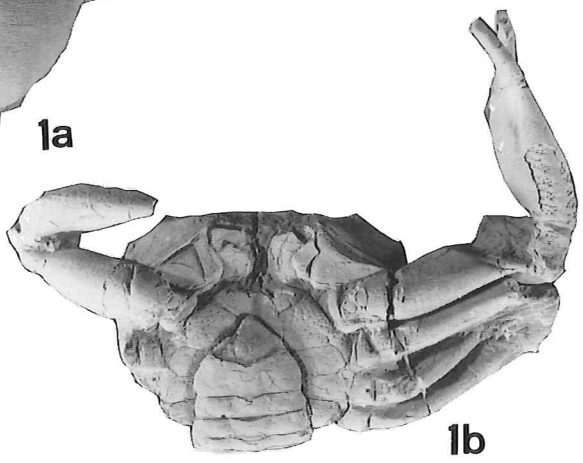
Plate 63

Figs. 1a, b. *Carcinoplax antiqua* (Ristori). Carapace. Locality 9.
a, dorsal; b, ventral view. × 1.0.

Figs. 2a, b-4. *Tritodynamia globosa* Karasawa. Carapace. Locality 9.
Figs. 2a, b. a, dorsal; b, ventral view. ×. 2.0.
Fig.3a-b. Carapace. a, dorsal; b, ventral; c, frontal view. × 1.3.
Fig. 4. Right and left cheliped. × 2.0.



1a



1b



2a



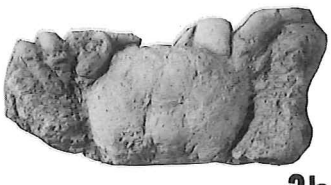
2b



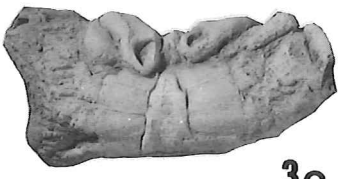
4



3a



3b



3c