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Crabs (Brachyura: Grapsoidea: Sesarmidae) as inclusions in Lower Miocene amber from Chiapas, Mexico

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Abstract

Nine crab remains preserved in Miocene amber from Chiapas are reported. Systematic affinities of the crab remains indicate that they belong to the Sesarmidae family. Semi-terrestrial sesarmid species are frequently found in mangroves and thus their presence in Lower Miocene (Aquitanian) amber from mines of Campo La Granja, Chiapas reinforce previous interpretations of a mangrove paleoenvironment near the ancient Gulf of Mexico coast.

Keywords: Crabs, amber, Miocene, Aquitanian, Chiapas, Mexico.

Resumen

Se reportan nueve restos de cangrejos, preservados en el ámbar del Mioceno de Chiapas. Las afinidades sistemáticas de los restos de cangrejo indican que pertenecen a la familia de los Sesarmidae. Las especies de sesármidos semi-terrestres se encuentran frecuentemente en manglares y por lo tanto, su presencia en el ámbar del Mioceno Inferior (Aquitaniano) de las minas de Campo La Granja, Chiapas, refuerza interpretaciones previas sobre un paleoambiente de manglar, cerca de la antigua costa del Golfo de México.

Palabras clave: Cangrejos, ámbar, Mioceno, Aquitaniano, Chiapas, México.

1. Introduction

Crustaceans are found as inclusions in several amber deposits of the world, but decapod crabs are so far know only for the Lower Miocene amber of Chiapas. Before the present contribution, only two specimens have been reported. The first specimen was illustrated by Grimaldi (1996) who indicated grapsoidean affinities for the specimen. In recent studies, Grapsoidea have been subdivided into eight families (Ng *et al.*, 2008): Gecarcinidae MacLeay, 1838; Glyptograpsidae Schubart, Cuesta and Felder, 2002; Grapsidae MacLeay, 1838; Percnidae Števčić, 2005; Plagusiidae Dana, 1851; Sesarmidae Dana, 1851; Varunidae H. Milne Edwards, 1853 and Xenograpsidae Ng, Davie, Schubart and Ng, 2007. Boucot and Poinar (2010) figured the same specimen and suggested a resemblance with the living species *Metopaulias depressus* Rathbun, 1896 (Sesarmidae). Both Grimaldi (1996) and Boucot and Poinar (2010) speculated on the possible association of this crab with bromeliads. A second specimen was reported by Vega *et al.* (2009), indicating affinity to the extant genus *Sesarma* Say, 1817 (Sesarmidae), whose species are frequently found associated to mangrove trees. Eight other crab remains are here reported, all found in amber from Campo La Granja

mines, north of Simojovel, Chiapas (Figure 1). The nine crab specimens here reported are represented by: thee small complete individuals, two incomplete, tree isolated pereiopods and one endophragmal fragment. It is possible that one of the corpses represents a specimen that was trapped right after the molting process. The carcasses could also be interpreted either as exuviae or decaying corpses in ponds where resin was deposited. Sesarmid crabs are ecologically diverse, living in terrestrial, semi-terrestrial, freshwater, and saltwater environments and include mangrove tree-climbers species (Fratini *et al.*, 2005). A coastal flood-plain with tidal influence in a mangrove system is suggested as the paleoenvironment of deposition for the Lower Miocene amber of Campo La Granja, Chiapas (Serrano-Sánchez *et al.*, 2015).

2. Stratigraphy and paleoenvironment

The Chiapas amber is found mainly in the north edge of Chiapas State, Southern Mexico. Three lithostratigraphic units that crop out in this region contain amber, known as (from base to top) La Quinta Formation, Mazantic Shale and Balumtum Sandstone (Allison, 1967; Frost and Langenheim, 1974; Perrilliat *et al.*, 2010; Solórzano-Kraemer, 2010; Riquelme et al., 2014) (Figure 2). Amber samples here reported were collected at Campo La Granja mines, which correspond to the upper portion of the La Quinta Formation (Finca Carmitto Member), dated as early Miocene in age (22.8 My, Aquitanian), based on the biostratigraphy of corals, mollusks, microfossils and strontium (Serrano-Sánchez *et al.*, 2015). The amber from Campo La Granja mines is peculiar because of its content of stratified sandstone layers, with unusual contents of mixed association of brackish water, freshwater and terrestrial organisms, mainly arthropods. Amorphous organic matter, decaying plant remains, pyritized ostracods, termites and hemipterans, as well as the presence of psychodid flies (Stebner and Solórzano-Kraemer, 2014), all suggest reducing conditions in the ponds were resin was deposited. Tube-like amber pieces are also found, possibly deposited into decapod galleries. The amber pieces show no evidence of significant transport. The suggested paleoenvironment for the Campo La Granja amber is that of small ponds near an estuary where tides transported sediment and organisms to ponds next to resin-producing trees (Leguminosae) that secreted an extremely fluid resin where aquatic organisms were trapped, but also terrestrial arthropod (arachnids, myriapods and insects) corpses were included (Serrano-Sánchez *et al.*, 2015).

Due to the poor preservation of the crab specimens, it is difficult to offer an accurate identification, but the remains seem to belong to at least two different sesarmid species.

Specimens are deposited at Museo de Paleontología "Eliseo Palacios Aguilera" (Secretaría de Medio Ambiente e Historia Natural), Calzada de los Hombres Ilustres s/n, Tuxtla Gutiérrez, Chiapas, Mexico, and amber pieces with crab inclusions have the acronym IHNFG (Instituto de Historia Natural, Fósil Geográfico).

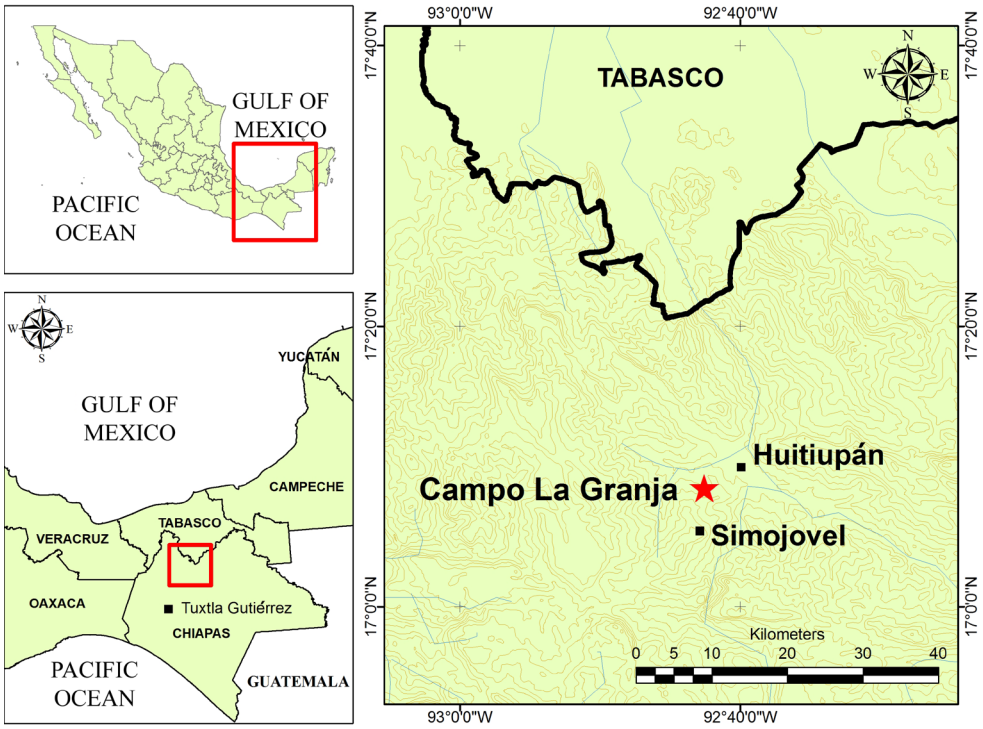

Figure 1. Location map of Campo La Granja mines near Simojovel, Chiapas, Mexico. Modified after Serrano-Sánchez *et al.*, 2015

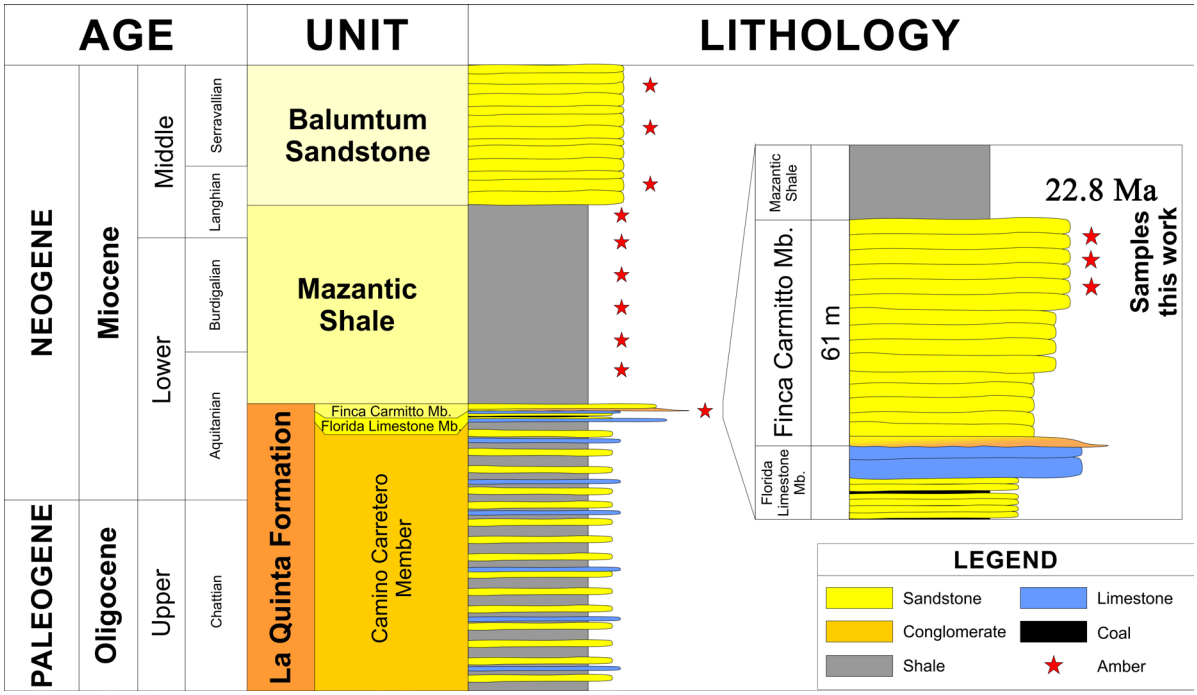

Figure 2. Stratigraphy from the Simojovel area, indicating relative position of Campo La Granja mines. Modified from Allison (1967, figs. 5, 6) and Frost and Langenheim (1974, text-figure 9).

3. Systematic Paleontology

Order: Decapoda Latreille, 1793
Infraorder Brachyura Latreille, 1802
Superfamily Grapsoidea MacLeay, 1838
Family: Sesarmidae Dana, 1851
Figs. 3,4

Description of specimens. Cephalothorax small (width of cephalothorax between 1 to 6 mm), wider than long, with prominent, large eyes; dorsal cephalothorax regions rugose, poorly defined, covered by sediment and/or fragments of molted cuticle; front of cephalothorax straight, wide, being about ¾ of the maximum cephalothorax width; eyes prominent, globose, projected beyond orbits; orbits wide; anterolateral margin smooth, curved; posterolateral margin short, about 1/3 the maximum cephalothorax length, curved; posterior margin straight, nearly 2/3 the maximum cephalothorax width; pterygostomial region of specimen IHNFG-4992 with a network-like reticulated pattern (distinguishing feature of Sesarmidae, Fig. 3.11, 4.1, 4.2); thoracic sternum subquadrate; third maxillipeds elongate, suboval; left cheliped slightly larger than right cheliped, carpus robust, palm subrectangular; fixed finger short, acute, nearly straight; movable finger curved, acute; pereiopods 2-5 long, slender, merus long, tubular; carpus similar to merus but 1/3 its length; propodus slender, half the length of merus; dactylus long, acute, 2/3 length of propodus; pleon triangular; pleonite 5 subrectangular, 1/6 the maximum cephalothorax width, 1/8 length; telson triangular, slightly narrower than somite 5 but subequal length.

Discussion of specimens. Grimaldi (1996), Vega *et al.* (2009) and Boucot and Poinar (2010) agree on the grapsoidean affinity of the crabs preserved in Mexican amber. Boucot and Poinar (2010) suggested affinity of the first figured crab with *Metopaulias depressus*. Comparing the illustrations of that specimen by Grimaldi (1996, p. 66) and Boucot and Poinar (2010, p. 351, fig. A23), it seems that at least one corpse here reported is similar (Fig. 3.1). However, although *M. depressus* is a small crab too (less than 20 mm in cephalothorax width), it is found nowadays inland, usually above 300 m, associated exclusively to the water-storing leaf axils of bromeliad plants in Jamaica. The bromeliads provide a supporting microclimate, safety, food, and are expandable and defendable resources (Hartnoll, 1964; 1988; Diesel and Schubart, 2007). The paleoenvironment interpreted for the Campo La Granja amber is that of small temporary ponds, controlled by tidal and fluvial influence. The association of crab remains with brackish water copepods and ostracods makes it improbable that the crabs were living in bromeliads. The cephalothorax of *M. depressus* is different from the Mexican amber specimens in having more defined cephalothorax regions, more robust, nearly equal chelipeds and proportionally longer merus of pereiopods 2-5.

Vega *et al.* (2009) suggested affinities of the second specimen (Fig. 3.1-3.5) to *Sesarma* Say, 1817. There are two fossil species of Sesarma known so far: *S. paraensis* Beurlen, 1958, from the Lower Miocene of Pará, Brazil (de Araújo-

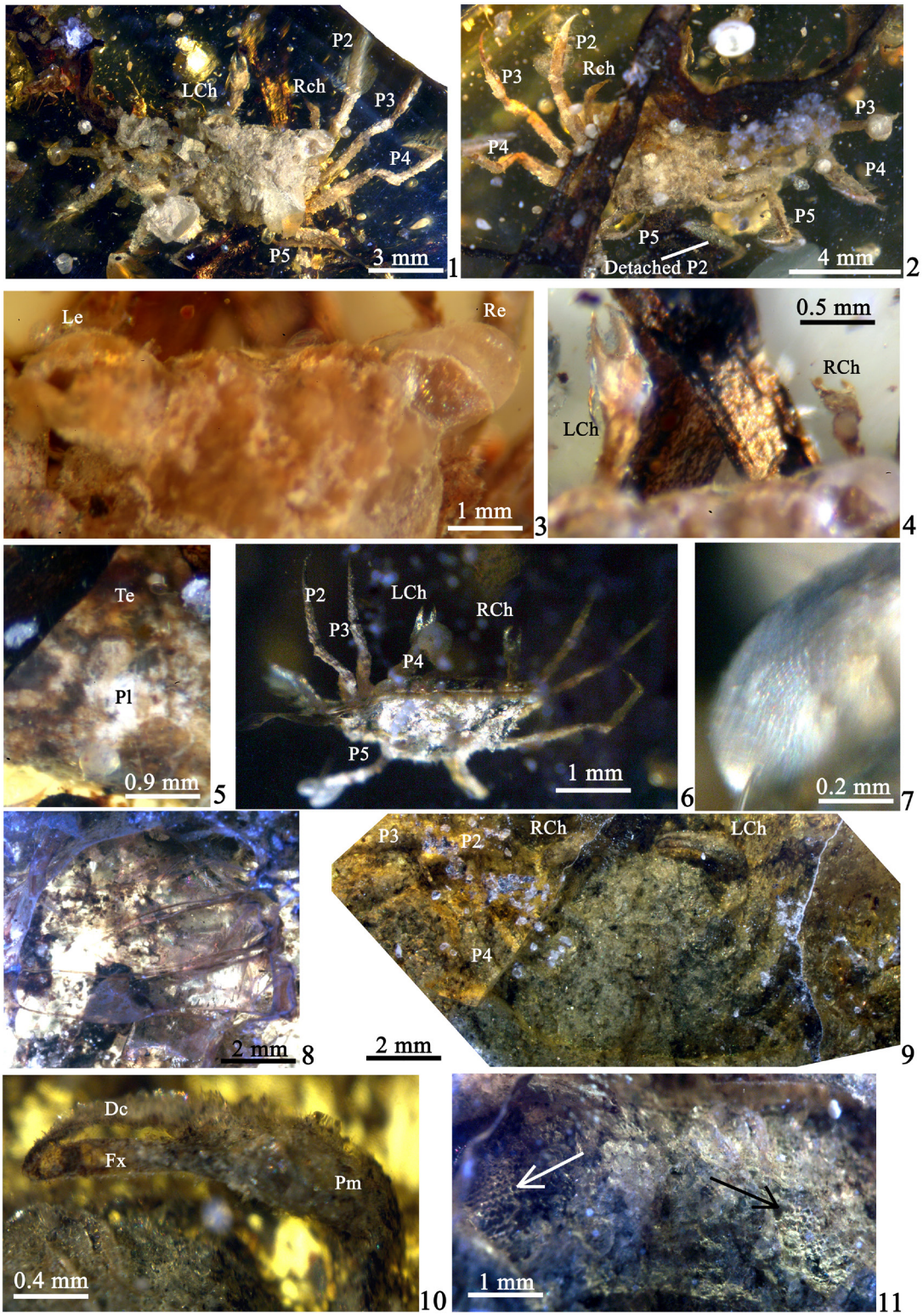

Figure 3. Sesarmidae. 1, Dorsal view of cephalothorax, specimen IHNFG-4991. 2, Ventral view of cephalothorax, same specimen. 3, Detail of front, same specimen. 4, Detail of chelipeds, same specimen. 5, Detail of sternum, same specimen. 6, Frontal view of cephalothorax, specimen IHNFG-5555. 7, Detail of left eye, same specimen. 8, Endophragmal fragment, specimen IHNFG-5316. 9, Ventral view of cephalothorax, specimen IHNFG-4992. 10, Detail of left chela, same specimen. 11, Detail of the network-like reticulated pattern (arrows) on pterygostomial region, same specimen. Abbreviations: Dc = dactylus, Fx = fixed finger, LCh = left cheliped, Le = left eye, P2-P5 = pereiopods, Pl = pleon, RCh = right cheliped, Re = right eye, Te = telson.

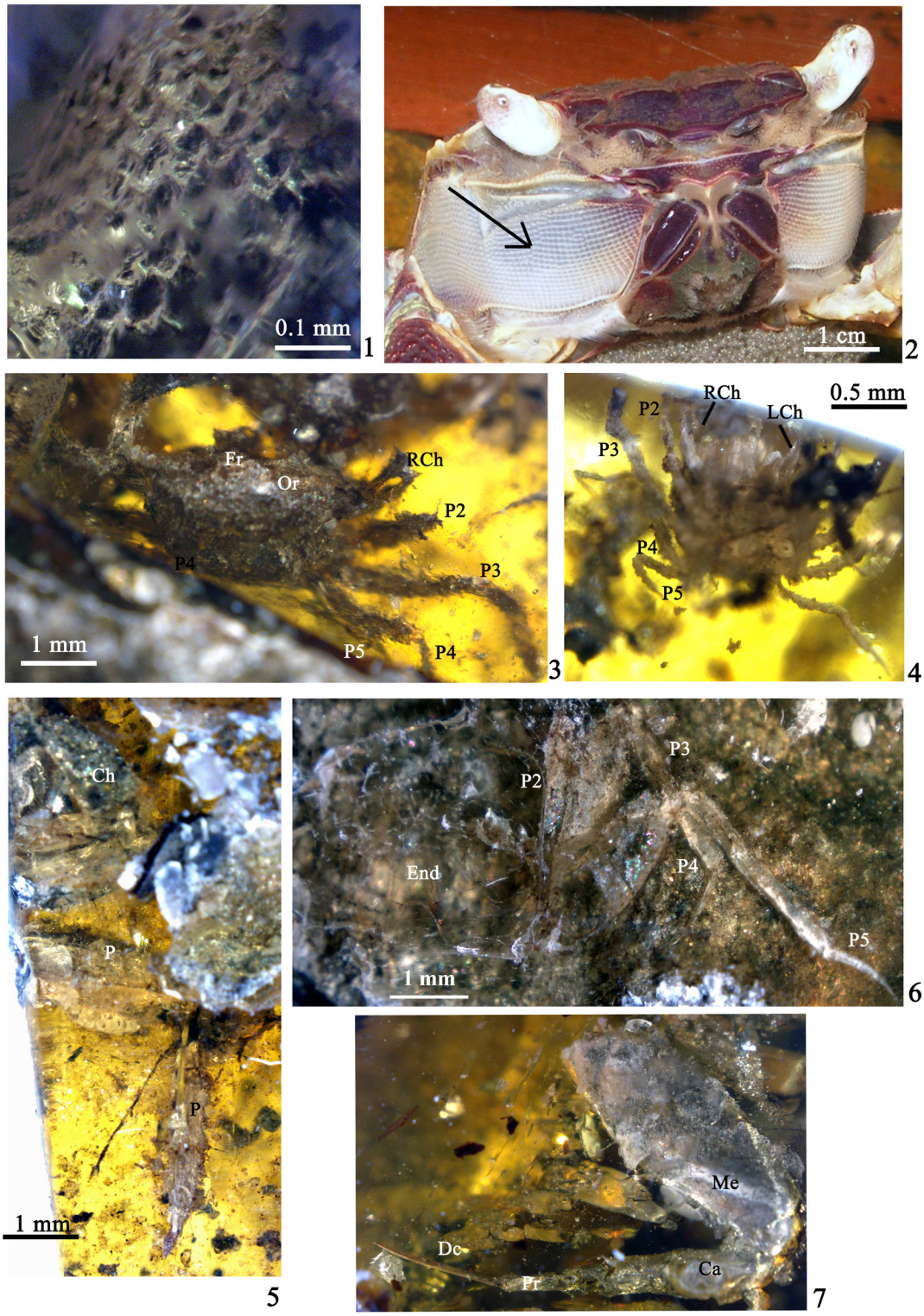

Figure 4. Sesarmidae. 1, Detail of the network-like reticulated pattern on right side of pterygostomial region, specimen IHNFG-4992. 2, Detail of the network-like reticulated pattern (arrow) on right side of pterygostomial region of a living specimen of *Pseudosesarma bocourti* (A. Milne-Edwards, 1869). 3, Frontal view of cephalothorax, specimen IHNFG-4969. 4, Ventral view of cephalothorax, specimen IHNFG-4970. 5, Isolated cheliped and pereiopods, specimen IHNFG-4912. 6, Isolated pereiopods, specimen IHNFG-4929. 7, Isolated pereiopod, specimen IHNFG-4993. Abbreviations: Ca = carpus, Ch = cheliped, Dc = dactylus, End = endophragma, Fr = frontal margin of cephalothorax, Fx = fixed finger, LCh = left cheliped, Le = left eye, Me = merus, Or = eye orbit, P = pereiopod, P2-P5 = pereiopods, Pr = propodus, RCh = right cheliped.

Távora *et al.*, 2010) and *S. primigenium* Collins, Mitchell and Donovan, 2009, from the Pleistocene of Jamaica. The first was described based on a single cephalothorax (25 mm), while the second was described based on small chelae fragments. There are also similarities between the crabs in Mexican amber and the genus *Armases* Abele, 1992. Species of *Armases* tend to be wider than long, have more slender pereiopods than *Sesarma* spp., but no diagnostic features were preserved in order to offer a more precise identification for the specimens, beyond the family level.

Based on size (0.5 to 2 mm cephalothorax width) of the three corpses here reported (Figs. 3.1-3.5, 3.6-3.8, 4.4), it seem that the specimens got trapped into the resin as juveniles (Anger *et al.*, 1995; Guerao *et al.*, 2007).

Since the crab remains are found in pieces containing also brackish water crustaceans, it is possible that the crabs were carried to the ponds of the flood-plain by tides, where they either died or were already dead when transported.

4. Conclusions

The nine remains here reported belong to sesarmid crabs, representing corpses and detached appendages. Two specimens were probably alive when they were trapped into the resin; one of them preserves a detached pereiopod, possibly as autotomy resulting of the trapping in the sticky resin. The other remains represent corpses and detached appendages. Based on shape of amber pieces, sedimentological evidences and nature of inclusions, ponds in tidal flat mangrove environment is suggested as the resin deposit scenario for Campo La Granja amber, 22.8 Ma ago. Although crabs are relatively scarce when compared with other crustaceans (ostracods, copepods, tanidaceans, amphipods, isopods), they are an important addition to the knowledge of semi-terrestrial crustaceans and the paleoenvironment of deposition of Mexican amber.

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