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BITE TRACES IN A TURTLE SHELL FRAGMENT FROM THE KIMMERIDGIAN (UPPER JURASSIC) OF NORTHERN GERMANY

[Huellas de mordeduras en un caparazón de quelonio del Kimmeridgiense (Jurásico Superior) del norte de Alemania]

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ABSTRACT: From the original sample Upper Jurassic turtles described by OERTEL (1914), one delivered specimen from the Langenberg near Oker (Goslar), Lower Saxony, Northwestern Germany is described, which are still today in the collection of the Geomuseum Göttingen. That is reproduced photographically for the first time. That shell fragment of *Plesiochelys etalloni* shows clear bite marks by two predatory vertebrates. In contrast to the round bite marks of the crocodile (A-B) in the center of present scars, and the irregular sharp scratches of sharks, the present irregular and narrower. These correspond to machimosaurid and a velociraptorine dromaeosaurid (C-H) rather than the polluters.

Key words: Kimmeridgian, Upper Jurassic, Langenberg near Oker (Goslar), Lower Saxony, Northwestern Germany, *Plesiochelys etalloni* Rüthimeyer, 1873, machimosaurid and velociraptorine dromaeosaurid bite traces, description, interpretation.

RESUMEN: De entre los ejemplares del Jurásico Superior descritos por OERTEL en 1914, se describe uno, recolectado en Langenberg, cerca de Oker (Goslar) (Baja Sajonia, noroeste de Alemania), que hoy se encuentra en las colecciones del Göttingen Geomuseum. Se reproduce fotográficamente por primera vez.

Ese fragmento de caparazón de *Plesiochelys etalloni* muestra señales claras de mordeduras de dos vertebrados depredadores. En contraste con las marcas de mordeduras redondeadas de cocodrilo (AB), en el centro de las cicatrices de este ejemplar, y de las líneas irregulares afiladas de los tiburones, en este ejemplar son irregulares y estrechas. Estos corresponden a machimosáuridos y dromeosáuridos velocirraptorínidos (CH).

Palabras clave: Kimmeridgiense, Jurásico Superior, Langenberg cerca de Oker (Goslar), Baja Sajonia, noroeste de Alemania, *Plesiochelys etalloni* Rüthimeyer, 1873, machimosáurido y dromaeosáurido velocirraptorínido, huellas de mordedura, descripción, interpretación.

INTRODUCTION

The invertebrate fauna of the Langenberg Quarry near Oker (Goslar) including bivalves, brachiopods, gastropods, echinoderms and nautiloids, the vertebrate fauna sharks, bony fishes, crocodiles, turtles, sauropod dinosaurs, pterosaurs, and velociraptorine dromaeosaurid (MUDROCH & THIES, 1996; DUFFIN & THIES, 1997; THIES *et al*., 1997; MUDROCH *et al*., 1999; THIES & BROSCHINSKI, 2001; DELECAT *et al*., 2001; FASTNACHT, 2005; KARL, 2006; KARL *et al*., 2006, 2007, 2008; LAVEN, 2001; SANDER *et al*., 2006; THIES *et al*., 2007; DIEDRICH, 2011). Some layers show a greater terrestrial influence and thus bones and teeth of land vertebrates, especially of sauropods and theropods are accumulated. The deposits at this locality have yielded a rich diversity of invertebrate and vertebrate fossils, derived from palaeoenvironments comprising shallow marine lagoons and small islands (VAN DER LUPPE, 2009). THIES *et al*. (2007) postulated an archipelago with islands of changing expansions depending on sea level. The investigations of PAPE (1970) and FISCHER (1991) suggest that the calcareous sedimentary rocks exposed in Langenberg Quarry were deposited in a shallow marine inlet or in a small marginal basin of the German Late Jurassic Basin, but the nature of the palaeoenvironment in which the Kimmeridgian rocks of northwest Germany were deposited is still under dispute (VAN DER LUPPE, 2009). Among the turtle remains of the North German Upper Jurassic described by OERTEL (1914) some original specimens are still in the collection of the Geomuseum of Göttingen, also two from the Langenberg near Oker. During the inventory obvious a specimen with unpublished strong scars and should be presented here.

SYSTEMATIC POSITION OF THE TURTLE SPECIMEN

Order Testudines Linnaeus, 1758

Infraorder Cryptodira Cope, 1868

Capaxorder Eucryptodira Gaffney, 1975a sensu Gaffney, 1984

Family Plesiochelyidae Baur, 1888

***Plesiochelys solodurensis* Rütimeyer, 1873**

– *Plesiochelys solodurensis* var. *Langenbergensis*, Oertel, 1924, p. 60, figs. 6-7.

– *Plesiochelys solodurensis* var. *Langenbergensis* nov. var. Oertel, 1924, KUHN, 1964, p. 23.

– *Plesiochelys solodurensis*, Rütimeyer, 1873, KARL *et al*., 2007, p. 23.

DESCRIPTION OF BITE TRACES

Close examination of the specimen reveals several sets of bite marks which fall into two categories. The first type on the dorsal side, two rounded indentions in the shell center are present (plate 1, figure 1A-B); the holes are nearly circular, measures 28 and 40 mm in diameter and has penetrated complete through the bone (plate 1, figure 1A-B). A second type, also on the dorsal side, positioned around A and B, comprises a series of six irregular holes measures 13 mm (plate 1, figure 1C) to 25 mm (plate 1, figure 1H) in diameter and has penetrated complete through the bone in parts (plate 1, figure 1H). Some bite marks has caused the bone to fracture (plate 1, figure 1A,B,H). The distance between the single holes C-H is circa 50 mm.

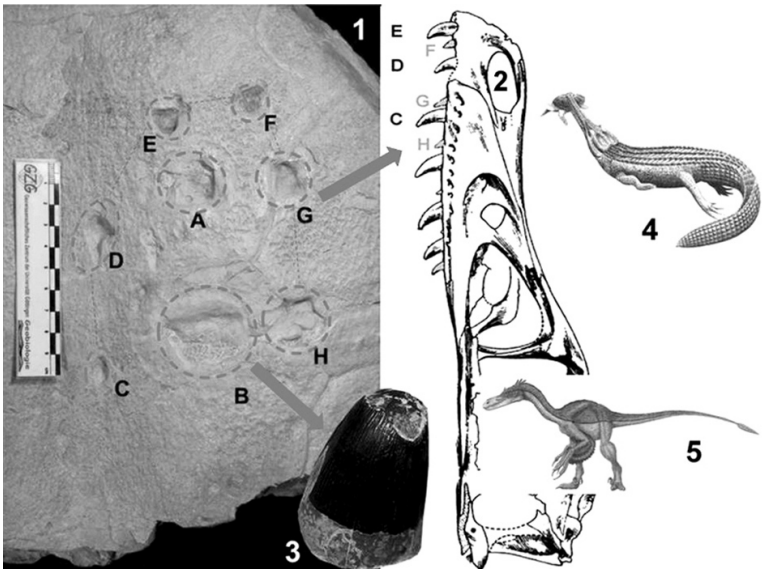

Plate 1. Plesiochelys solodurensis *var*. Langenbergensis*, Oertel, 1924, holotype, GZG. BA. partially shell from Langenberg near Oker, Lower Saxony, NW-Germany. Oertel-collection. Photo Thomas Daniel, Geomuseum Göttingen. Scale bar = 10 cm. 3:* Machimosaurus hugii*, teeth from Langenberg near Oker, photo Nils Knötschke, Dinosaur Museum Münchehagen. Scale bar = 3 cm; 2:* Velociraptor mongolensis*, skull of type specimen in left side view adapted from OSBORN (1924); 4:* Machimosaurus hugii*, reconstruction according MEYER, 1994; 5:* Velociraptor*, reconstruction by Bob Strauss, New York, NY.*

INTERPRETATION

In northern Germany, the fossil remains of theropods consist mainly of isolated teeth. Discoveries of articulated skeletons, bones or skulls are very rare. The isolated teeth of Langenberg Quarry show features hitherto only known from the Dromaeosauridae like *Velociraptor* (plate 1, figure 5), which are strongly labiolingually compressed, strongly distally recurved and apically sharply pointed (plate 1, figure 2) and the carinae are serrated mesially and distally, with a distinct size difference between mesial and distal denticles (OSTROM, 1990; VAN DER LUPPE, 2009). This corresponds exactly to the character of the present bite traces C to H on turtle shell. Another type represents the bite holes A-B. These are nearly rounded, which corresponds to the character of crocodile bites. From The Langenberg the mesosuchids *Theriosuchus pusillus* Owen, 1878, *Goniopholis simus* Owen, 1878, *Steneosaurus brevirostris* Owen, 1842 and *Machimosaurus hugii* (H. v. Meyer, 1837) described (KARL *et al.*, 2006, 2008). *Machimosaurus* is mainly known by teeth (KARL & TICHY, 2004; KREBS, 1967) and most likely to bite marks as a producer of A-B into consideration (plate 1, figure 4). The teeth of *Theriosuchus*, *Goniopholis* and *Steneosaurus* are either too small or too thin. Only the short and robust "crack teeth" of *Machimosaurus* (plate 1, figure 3) could cause the two large bite holes (plate 1, figure 1 and 4 according MEYER, 1994). The bites attacks of the crocodile and dinosaur were taught to at different times to the turtle. All wounds were healed, so the animal has survived both attacks (compare with MEYER, 1994: 51). See more about crocodile and shark bite marks in JIMÉNEZ FUENTES (2003), KARL & TICHY (2004), MCCOY *et al.* (2011) and MILAN *et al.* (2011).

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