

# ***CTENOCHELYYS STENOPORUS* (HAY, 1905) (TESTUDINES: TOXOCHELYIDAE) AND *CLIDASTES* SP. (SQUAMATA: MOSASAURIDAE) FROM THE UPPER CRETACEOUS OF NW-GERMANY**

*[Ctenochelys stenoporus (Hay, 1905) (Testudines: Toxochelyidae) y Clidastes sp. (Squamata: Mosasauridae) del Cretácico Superior del noroeste de Alemania]*

Hans-Volker KARL<sup>1,2</sup> & Christian J. NYHUIS<sup>3</sup>

<sup>1</sup> Thüringisches Landesamt für Denkmalpflege und Archäologie. Humboldtstraße 11. D-99423 Weimar, Germany. Email: hvkarl@web.de

<sup>2</sup> Geoscience Center of the University of Göttingen. Department of Geobiology. Goldschmidtstraße 3. D-37077 Göttingen, Germany

<sup>3</sup> Institut für Geologie und Paläontologie der Universität zu Köln. Zülpiches Strasse 49a. D-50674 Köln, Germany. Email: christiannyhuis@web.de

(FECHA DE RECEPCIÓN: 2011-08-22)

BIBLID [0211-8327 (2012) Vol. espec. 9; 129-142]

**ABSTRACT:** Fossil remains of a toxochelyid turtle and a mosasaur lizard from the Upper Cretaceous, NW Germany are described. The material includes shell fragments and several bones of *Ctenochelys stenoporus* (Hay, 1905) as well as a scapula of *Clidastes* sp. The material derived from the Alsen quarry in Lägerdorf near Itzehoe (Schleswig-Holstein) which is the type region for the Lägerdorf-Formation.

**Key words:** Upper Cretaceous, Campanian, Lägerdorf-Formation, *Ctenochelys stenoporus* (Hay, 1905), toxochelyid turtle, *Clidastes* sp., Mosasauridae.

**RESUMEN:** Se describen restos fósiles de una tortuga toxoquélida y de un Mosasaurídeo del Cretácico Superior del NO de Alemania. El material incluye fragmentos del caparazón de *Ctenochelys stenoporus* (Hay, 1905), así como una

escápula de *Clidastes* sp. El material procede de la cantera Alsen en Lägerdorf, cerca de Itzehoe (Schleswig-Holstein), que es la región-tipo de la Formación Lagerdorf.

**Palabras clave:** Cretácico Superior, Campaniense, Formación Lägerdorf, *Ctenochelys stenoporus* (Hay, 1905), tortuga toxoquelida, *Clidastes* sp., Mosasaurídeo.

## INTRODUCTION

The within this study described upper Cretaceous fossil turtle and mosasaur remains originally belong to the private Mosbach collection and were found in 1915 within the Alsen quarry in Lägerdorf near Itzehoe (Schleswig-Holstein) (see fig. 1). Later on the fossil material came to the Prussian Geological Survey in shelter of Dr. Karl Staesche.

In the 1950's he and the so far scientifically undescribed material moved to the Geological Survey Hanover. Recently his son Dr. Ulrich Staesche, who follows in his father's footsteps allocated the material to the author (HVK) for scientific research.

## GEOLOGICAL SETTING

The Alsen quarry in Lägerdorf (UTM 9°34'23.59"E, 53°53'10.33"N) near Itzehoe (Schleswig-Holstein, Germany) (see fig. 1) is located in the northern part of the North German Basin. Exposed layers belong to the white chalk ("Schreibkreide-Gruppe", Upper Cretaceous).

White chalk sediments in the North German Basin mostly are covered by a thick layer of Cenozoic sediments. In Lägerdorf these sediments are exposed due to uplifting caused by tertiary salt diapirism (HINSCH, 1977).

The area around Lägerdorf is the type region for the Lägerdorf-Formation, which is exploited by the cement industry (Alsen quarry and Heidestrasse quarry). The type profile is located on the southwestern outskirt of Lägerdorf.

Chronostratigraphically the Lägerdorf-Formation ranges from the upper Santonian to the lower Campanian (see fig. 2). It follows concordant with characteristically black cherts on top of the Krempe-Formation, which leads in contrast, light gray and white cherts.

Biostratigraphically important macrofossils of the Lägerdorf-Formation are belemnites, echinoids, crinoids and *Inoceramus* (SCHULZ *et al.*, 1984). Biostratigraphically important micro-and nanofossils are coccoliths calcisphaeres, foraminifera, ostracods and microfloral elements (NIEBUHR, 2007). A stratigraphy based on strontion isotopes has been developed by MCARTHUR *et al.* (1992, 1993).

*Ctenochelys stenoporus* (Hay, 1905) (Testudines: Toxochelyidae) and *Clidastes* sp. (Squamata: Mosasauridae) from the Upper Cretaceous of NW-Germany

Environmental reconstructions indicate pelagic conditions of an open epicontinental sea with approximately 100-150 m water depth.

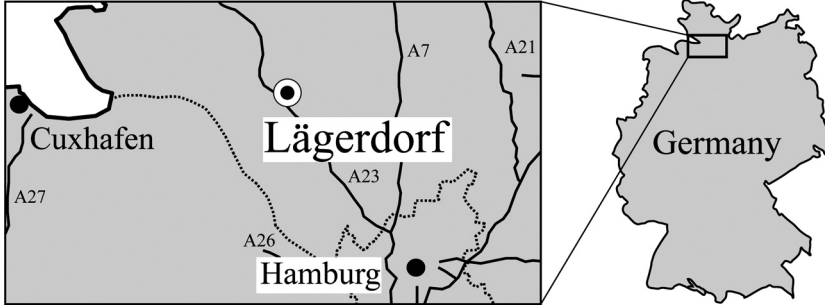


Figure 1. Geographical position of Lägerdorf (UTM 9°34'23.59"E, 53°53'10.33"N), district Steinburg, Schleswig-Holstein, Germany.

Upper Cretaceous		
Upper Santonian	Lower Campanian	Lower Uppercampanian
Krempe-Formation	Lägerdorf-Formation	Dägeling-Formation

Figure 2. Stratigraphy of the Lägerdorf-Formation (modified after NIEBUHR, 2007).

## SYSTEMATIC PALAEONTOLOGY

Order Testudines Linnaeus, 1758

Infraorder Cryptodira Cope, 1868

Superfamily Chelonioidea Agassiz, 1857

Family Toxochelyidae Baur, 1895

Subfamily Lophochelyinae Zangerl, 1953

Genus *Ctenochelys* Zangerl, 1953

*Ctenochelys stenoporus* (Hay, 1905)

SYNONYMS: See ZANGERL (1953) and HIRAYAMA (1997).

ADDITIONAL SPECIES: *C. tenuitesta* Zangerl, 1953 and *C. arcis* Zangerl, 1953.

REMARKS: Charles H. Sternberg discovered the type specimen of *Ctenochelys stenoporus* on December 14, 1904, near Monument Rocks in Gove

Co., KS. (Yale Peabody Museum collection; YPM-1786). It was originally named by George R. Wieland as *Toxochelys bauri* Wieland, 1905.

**MATERIAL:** BGR- Bundesanstalt für Geologie und Rohstoffe- LBEG Hannover, leg. and coll. Mosbach, 1915, old number Inv. Geol. S. Gr.A.24 n.º 8 (plate 1-2, 4).

**LOCALITY:** Alsen quarry (UTM 9°34'18.48"E, 53°52'36.30"N ) in Lägerdorf near Itzehoe (Schleswig-Holstein) (TK 25: 2123 Lägerdorf).

**STRATIGRAPHY:** Lägerdorf-Formation, UpperSantonian to lower Campanian, white chalk (Schreibkreide-Gruppe), Upper Cretaceous (Lithostratigraphic units of Germany ID: 2008074).

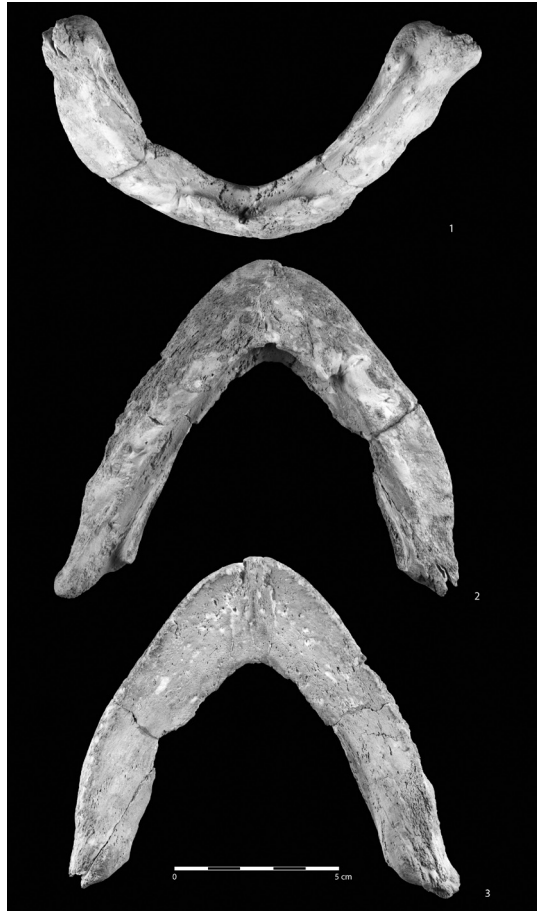


Plate 1. *Ctenochelys stenoporus* (Hay, 1905) from Lägerdorf near Itzehoe (Schleswig-Holstein), original: 1: mandible in posterior view shows the symphyseal cleft; 2: mandible in ventral view; 3: mandible in alveolar view. Scale bar = 5 cm. Photo Brigitte Stefan, TLDA.

*Ctenochelys stenoporus* (Hay, 1905) (Testudines: Toxochelyidae) and *Clidastes* sp.  
(Squamata: Mosasauridae) from the Upper Cretaceous of NW-Germany

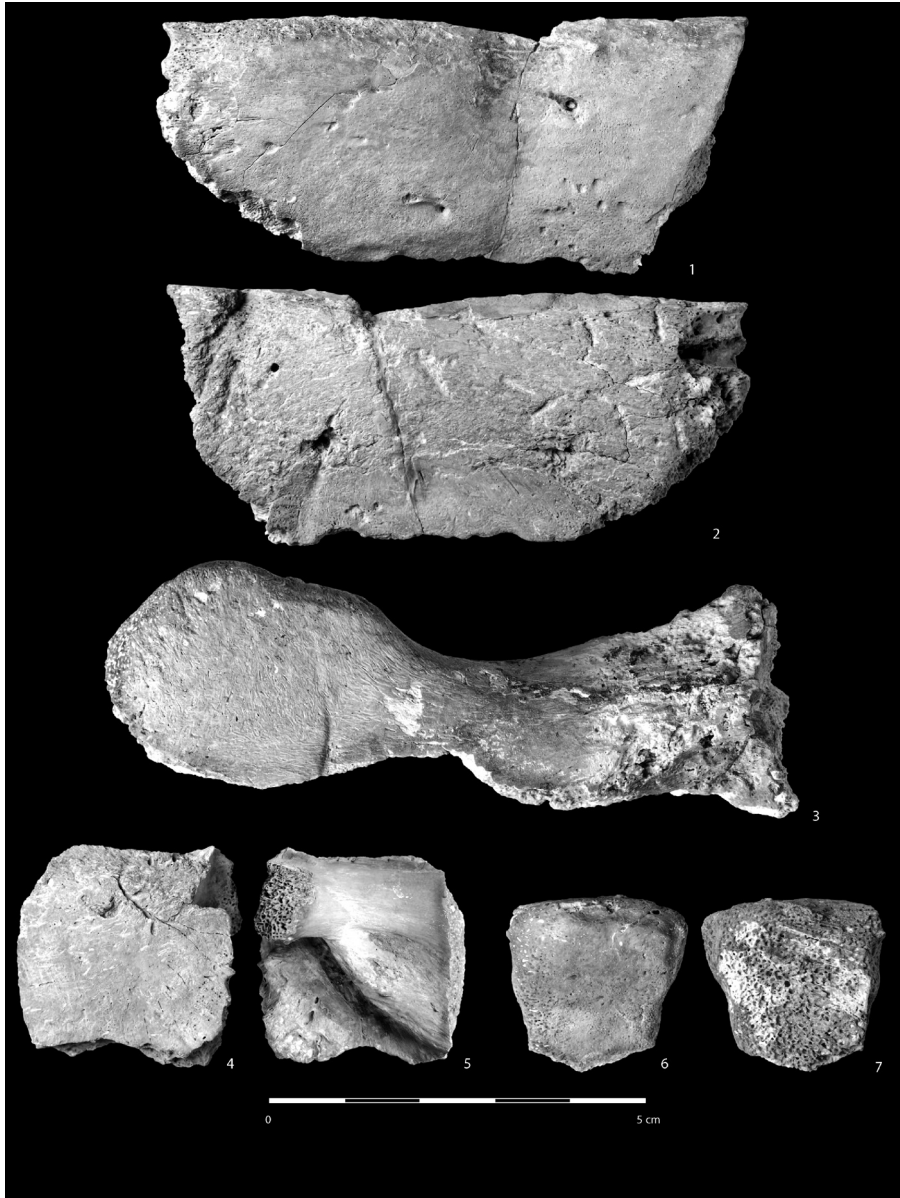


Plate 2. *Ctenochelys stenoporus* (Hay, 1905) from Lägerdorf near Itzehoe, original: 1: nuchal remain in visceral view; 2: nuchal remain in dorsal view; 3: pelvis remain; 4: skull remain in dorsal view; 5: skull remain in visceral view; 6-7: indeterminate bone fragment. Scale bar = 5 cm. Photo Brigitte Stefan, TLDA.

## DESCRIPTION OF Gr.A.24 n.º 8:

## 1. LOWER JAW

ZANGERL (1953) gave the following diagnosis for the lower jaw of his new genus *Ctenochelys*: "Mandible massive; triturating shelf widest at symphysis, gradually narrowing toward posterior end. Chin-shelf not protruding posteriorly beyond masticatory shelf". This feature can also be seen in the herein described material in plate 1, figure 1, for comparison see also MATZKE (2007: fig. 11). The mandible from Lägerdorf is wider than in *Toxochelys*. Available features are consistent with those of the genus *Ctenochelys* Zangerl, 1953, especially with *Ctenochelys stenoporus*.

## 2. SCAPULA REMAIN

According ZANGERL (1953) the scapula of Toxochelyidae has a characteristic neck area between the glenoidal and coracoidal facets and the base of the bifurcation. This feature can also be seen in the material in plate 2, figure 1. See also MATZKE (2007: fig. 14).

## 3. NUCHAL REMAIN

According ZANGERL (1953) the nuchal plate lacks lateral processes as described for the family Chelydridae. The ventral bulge of the cheloniid, dermochelyid and protostegid nuchal is small, insignificant or entirely lacking. This features is also visible in the herein described material, see plate 2, figure 1.

## 4. PERIPHERAL REMAIN

According ZANGERL (1953) the peripheral plates II in Toxochelyids are most commonly well developed. They may or may not be suturally attached to the costal plates. In the genus *Ctenochelys* they are not suturally attached. This feature is also visible in the herein described material, see plate 2, figure 1. For juvenile characteristics see MATZKE (2007: fig. 12).

## 5. ILIUM REMAIN

According ZANGERL (1953) the pelvis of Toxochelyidae is chelydrid in shape. The most obvious differences between the chelydrid and cheloniid pelves are the relative sizes of pubes and ischia. In the cheloniid turtles the

*Ctenochelys stenoporus* (Hay, 1905) (Testudines: Toxochelyidae) and *Clidastes* sp.  
(Squamata: Mosasauridae) from the Upper Cretaceous of NW-Germany

ischia are small compared to the pubes. The strong posterior processes of the chelydrid ischia are absent (ZANGERL, 1953). This feature is not developed within the herein described material. The ilium is imaged in plate 2, figure 1. See also MATZKE (2007: fig. 15).

#### 6. INDET. FRAGMENT AND INDET. SKULL REMAIN

An undetermineable plate fragment and skull fragment without diagnostic features. Both are imaged on plate 2, figure 1.

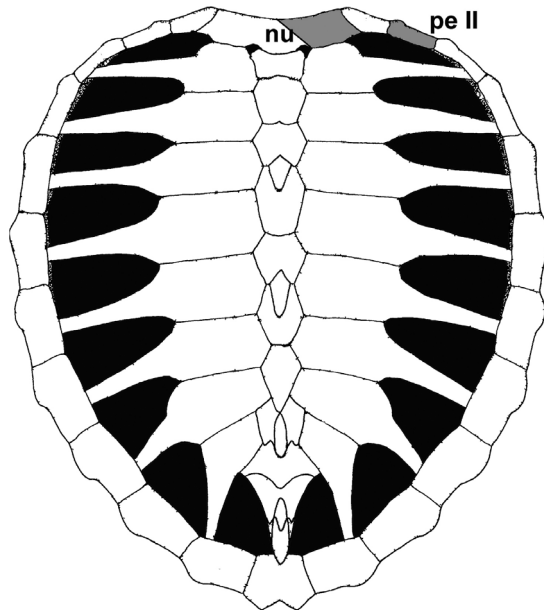


Figure 3. Schematic carapace reconstruction of *Ctenochelys stenoporus* (Hay, 1905). Preserved parts of the specimen Gr.A.24 n.° 8 from Lägerdorf are shaded in gray, based on the reconstruction by MATZKE (2007). White: bony elements (thin lines): nu = nuchal, pe II = second peripheral.

Order Squamata Oppel, 1811

Family Mosasauridae Gervais, 1853

Subfamily Mosasaurinae Gervais, 1853

Genus *Clidastes* Cope, 1868

TYPE SPECIES: *Clidastes propython* Cope, 1869, from the lower Campanian of the Mooreville Chalk Formation of the Selma Group in west-central Alabama, USA (see KIERNAN, 1992; LINDGREN & SIVERSON, 2004; ICZN Opinion 1750).

FOR SYNONYMS: See RUSSEL (1967).

ADDITIONAL SPECIES: *Clidastes liodontus* Merriam, 1894; according KIERNAN (2002) and LINDGREN & SIVERSON (2004). The frequently cited *C. "moorevillensis"* is still a nomen nudum.

*Clidastes* sp.

MATERIAL: BGR-Bundesanstalt für Geologie und Rohstoffe-LBEG Hannover, leg. and coll. Mosbach, 1915, old number "Inv. Geol. S. Gr.A.24 n.º 8" (plate 3).

LOCALITY: Alsen quarry (UTM 9°34'18.48"E, 53°52'36.30"N) in Lägerdorf near Itzehoe (Schleswig-Holstein) (TK 25: 2123 Lägerdorf).

STRATIGRAPHY: Lägerdorf-Formation, Upper Santonian to lower Campanian, white chalk (Schreibkreide-Gruppe), Upper Cretaceous (Lithostratigraphic units of Germany ID: 2008074).



Plate 3. *Ctenochelys stenoporus* Hay, 1905. 1: scapula in ventral view; 2: scapula in dorsal view. *Clidastes* "scapula or coracoid" spec. from Lägerdorf near Itzehoe, original. Scale bar = 5 cm. Photo Brigitte Stefan, TLDA; 3: scapula ventral view; 4: scapula = dorsal view.



*Ctenochelys stenoporus* (Hay, 1905) (Testudines: Toxochelyidae) and *Clidastes* sp.  
(Squamata: Mosasauridae) from the Upper Cretaceous of NW-Germany

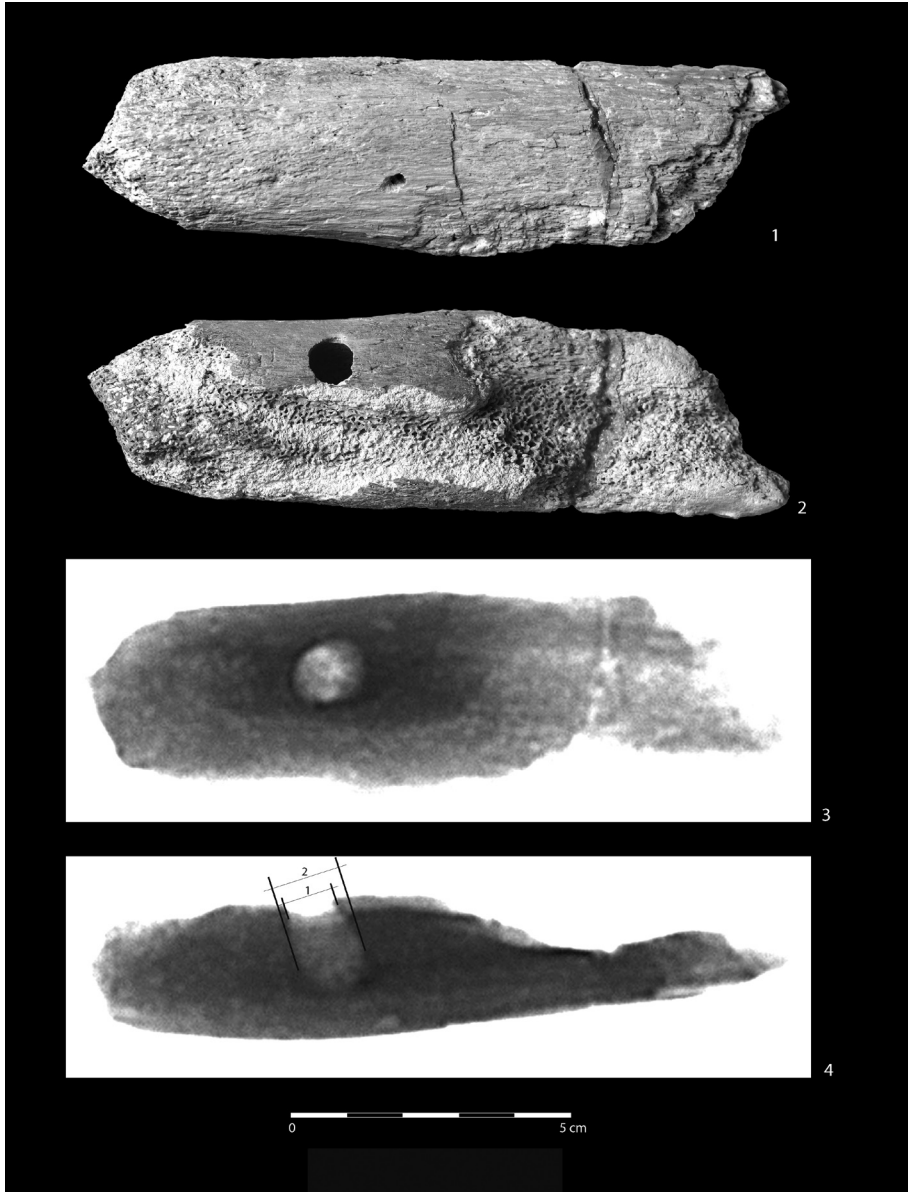


Plate 4. Holotype of cretaceous *n. ichnosp.* from Lägerdorf near Itzehoe, original. Scale bar = 5 cm. Photo Brigitte Stefan, X-ray photo Norbert Eichelmann, plate Heike Künzel, all TLDA. 1: pleural in ventral view; 2: pleural in dorsal view; 3: X-ray photo of pleural in ventral view; 4: X-ray photo of pleural in lateral view. Designations in figure 4: (1) average diameter of *Osedacoides cretaceus n. ichnosp.* opening; (2) average diameter of inner cavity.

## 1. SCAPULA REMAIN

The proximal and distal regions of the scapula are broken up. On the dorsal and the ventral side bite marks are visible. It is not clear whether these marks occurred pre- or postmortem. The present characters of “Gr.A.24 n.º 8” correspond with the scapula from the type sample of *Clidastes propyhton* (ANSP 10193, Academy of Natural Sciences of Philadelphia, Philadelphia, PA).

## DISCUSSION

According ZANGERL (1953: fig. 61) the lower jaws of the three subfamilies of Toxochehadae reflect the palatal condition of the skulls. In the Toxochelyinae, the mandible is essentially small as in the recent *Chelydra*. The masticatory surface is much narrower at the symphysis than the ventral symphyseal shelf. The masticatory surface is much wider in the Lophochelyinae, a sit can be seen in *Ctenochelys*. At the symphysis, it is as wide as the ventral shelf. In the Osteopyginae, the mandible looks like that of the recent genus *Caretta*. The symphysis is very long, probably more than a third of the length of the mandibular ramus.

For morphological descriptions of toxochelyids see ZANGERL (1953), HIRAYAMA (1995, 1997) and MATZKE (2007, 2008, 2009), for phylogenetic relationships GAFFNEY & MEYLAN (1988) and for earlier systematics see HAY (1905, 1908). The most important diagnostic features according ZANGERL (1953) of the Toxochelyidae are listed in table 1.

A close relationship between the herein studied specimen and the North American *Ctenochelys stenoporus* described by Wieland (1905) is strongly assumed.

The outer surfaces of all bones from the Alsen quarry show signs of bioerosion which are typical for necrophages animals, such as gastropods or lampreys. Furthermore the bone fragment of *Clidastes* sp. shows bite marks of an uncertain producer (see plate 3).

DIAGNOSIS: One peripheral of *Ctenochelys stenoporus* shows a single boring of *Osedacoides cretaceus* n. ichnosp. (pl. 4, figs. 1-4). Average diameter of opening (1) ranges from 10.5 to 10.1 mm, average of inner diameter (2) ranges from 15.5 to 19.5 mm.

REMARKS: As already mentioned, the pelagic sediments of the Lägerdorf-Formation indicate open epicontinental conditions with 100-150 m water depth (NIEBUHR, 2007). Recent *Osedax*- species fed on whale bones in a depth of about 120 m and thus perfectly fit very into the reconstructed water depth. Furthermore, ZANGERL (1953: fig. 122) figured a neural fragment of *Ctenochelys*

*tenuitesta* with “parasitic lesions” from the Mooreville chalk of the Selma group, which may be a part of an *Osedacoides* boring.

TAXON	LOWER JAW	NUCHAL NOTCH	CROSS-SECTION OF PERIPHERAL II
<i>Toxochelys latiremys</i>	small	moderate	without pleural alternation
<i>Toxochelys barberi</i>	unknown	moderate	oval to triangular with pleural alternation
<i>Thinochelys lapisossea</i>	unknown	flat	with complete pleural alternation
<i>Porthochelys laticeps</i>	strong	flat	with complete pleural alternation
<i>Lophochelys venatrix</i>	unknown	deep	with complete pleural alternation
<i>Lophochelys natatrix</i>	unknown	moderate	oval with knob, without pleural alternation
<i>Ctenochelys stenoporus</i> BGR old n.º Gr.A.24 n.º 8	wide	moderate	oval without pleural alternation
<i>Ctenochelys tenuitesta</i>	unknown	moderate	flat without pleural alternation
<i>Ctenochelys acris</i>	unknown	deep	oval
<i>Prionochelys nauta</i>	unknown	deep	triangular and with suture
<i>Prionochelys galeotergum</i>	unknown	deep	flat and with suture
<i>Osteopygis emarginatus</i>	very strong	moderate	with complete pleural alternation

Among marine Cretaceous (Campanian) deposits of NW Germany well-preserved and easily identifiable mosasaur remains are rare fossil elements. Since today only few reports have been published (CALDWELL & DIEDRICH, 2005; VON DER MARCK, 1892; SACHS, 2000; DIEDRICH & MULDER, 2004). Thus the herein described scapula remain of *Clidastes* sp. is a rare document of marine vertebrate occurrence in NW Germany.

#### NEW SPECIES OF OSEDACOIDES

##### *Osedacoides cretaceus* n. ichnosp.

HOLOTYPE: BGR-Gr.A.24 n.º 8, peripheral of *Ctenochelys stenoporus* described at page 174 (4) and illustrated at plate 4.

ETYMOLOGY: *cretaceous* = Cretaceous, the type stratum.

TYPE LOCALITY: Alsen quarry in Lägerdorf near Itzehoe (Schleswig-Holstein).

TYPE STRATUM: Lägerdorf-Formation, Upper Santonian to Lower Campanian, Schreibkreide-Gruppe, Upper Cretaceous.

DIAGNOSIS: X<sub>1</sub> from page 180.

REMARKS: X<sub>2</sub> from page 180. The newichnospecies differs to the type species. *Osedacoides jurassicus* Karl *et al.* (2012) with the larger dimensions and the single lifewise.

#### ACKNOWLEDGEMENT

We would like to thank Mike Everhart, Sternberg Museum of Natural History at Fort Hays State University (Hays, Kansas) for helpful comments to the *Ctenochelys* material under his care. We are also grateful to Ulrich Staesche (Isernhagen) and T. Wiese (Hanover) from the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) for loaning the material for scientific research.

#### BIBLIOGRAPHY

- CALDWELL, M. W. & DIEDRICH, C. G. (2005): Remains of *Clidastes* Cope, 1868, an unexpected mosasaur in the upper Campanian of NW Germany. *Netherlands Journal of Geosciences-Geologie en Mijnbouw*, **84** (3): 213-220.
- DIEDRICH, C. & HIRAYAMA, R. (2003): Turtle remains (Testudines, Chelonioida) from the Middle Turonian of northwest Germany. *Netherlands Journal of Geosciences / Geologie en Mijnbouw*, **82** (2): 161-167.
- DIEDRICH, C. & MULDER, E. W. A. (2004): A new record of *Clidastes* sp. (Squamata, Mosasauridae) in the Upper Campanian from the Münster Cretaceous Basin (NW Germany). *Netherlands Journal of Geosciences*, **83**: 367-372.
- ERNST, G.; SEIBERITZ, E. & WOOD, C. J. (1998): Cenomanian-Turonian of Wüllen near Ahaus. In: MUTTERLOSE, J.; BORNEMANN, A.; RAUER, S. & SPAETH, C. (Hrsg.): Key localities of the northwest European Cretaceous. *Bochumer geologische und geotechnischen Arbeiten*, **48**: 157-164.
- GAFFNEY, E. S. & MEYLAN, P. A. (1988): A phylogeny of turtles. 103-156. In: BENTON, M. J. (Ed.): *The phylogeny and classification of tetrapods*. Volume 1. *Amphibians, Reptiles, Birds*. Systematics Association. Special Volume **35 A**. Oxford University Press, Oxford, 377 pp.
- HAY, O. P. (1905): A revision of the species of the family of fossil turtles called Toxochelyidae, with descriptions of two new species of *Toxochelys* and a new species of *Porthochelys*. *Bulletin of the American Museum of Natural History*, **XXI**: 177-185.
- HAY, O. P. (1908): The fossil turtles of North America. *Carnegie Institution of Washington*, Publication N.º 75, 568 pp., 113 pls.
- HINSCH, W. (1977): *Karte des präquartären Untergrundes in Schleswig-Holstein*, **1**: 250 000. Geologisches Landesamt Kiel.

*Ctenochelys stenoporus* (Hay, 1905) (Testudines: Toxochelyidae) and *Clidastes* sp. (Squamata: Mosasauridae) from the Upper Cretaceous of NW-Germany

- HIRAYAMA, R. (1995): Phylogenetic systematics of chelonoid sea turtles. *The Island Arc* 1994, 3 (4): 270-284.
- ICZN OPINION 1750 (1993): *Clidastes* Cope, 1868 (Reptilia, Sauria): *C. propyhton* Cope, 1869 designated as the type species. *Bulletin of Zoological Nomenclature*, 50: 297.
- KAPLAN, U.; TRÖGER, K.-A.; VOIGT, S.; VOIGT, T.; WIESE, F. & WILMSEN, M. (2007): *Lithostratigraphie der norddeutschen Oberkreide*, 55: 43-44.
- KARL, H.-V. (1991): Die toxochelyiden Seeschildkröten (Chelonioidea, Toxochelyidae) von Sachsen. *Mauritiana (Altenburg)*, 13 (1/2): 233-145.
- KARL, H.-V. (2002): Übersicht über die fossilen marinen Schildkrötenfamilien Zentraleuropas (Reptilia, Testudines). *Mauritiana (Altenburg)*, 18 (2): 171- 202.
- KARL, H.-V.; GRÖNING, E. & BRAUCKMANN, C. (2012): Revision of *Tropidemys seebachi* Portis, 1878 (Testudines: Eucryptodira) from the Kimmeridgian (Late Jurassic) of Hanover (Northwestern Germany). *Studia Palaeocheloniologica*, IV: 11-24.
- KIERNAN, C. R. (1992): *Clidastes* Cope, 1868 (Reptilia, Sauria): proposed designation of *Clidastes propyhton* Cope, 1869 as the type species. *Bulletin of Zoological Nomenclature*, 49: 137-139.
- KIERNAN, C. R. (2002): Stratigraphic distribution and habitat segregation of mosasaurs in the Upper Cretaceous of western and central Alabama, with an [sic] historical review of Alabama mosasaur discoveries. *Journal of Vertebrate Paleontology*, 22: 91-103.
- KUHN, O. (1964): Testudines. In: WESTPHAL, F. (Ed.): *Fossilium Catalogus, I: Animalia*, Pars, 107; 299 S. Gravenhage.
- LAPPARENT DE BROIN, F. de (2001): The European turtle fauna from the Triassic to the Present. *Dumerilia*, 4 (3): 155-217.
- LINDGREN, J. & SIVERSON, M. (2004): The first record of the mosasaur *Clidastes* from Europe and its palaeogeographical implications. *Acta Palaeontologica Polonica*, 49 (2): 219-234.
- LYDEKKER, R. (1889): *Catalogue of the fossil Reptilia and Amphibia in the British Museum (Natural History)*: Part III. *The Order Chelonia*, 239 pp.
- MCARTHUR, J. M.; KENNEDY, W. J.; GALE, A. S.; THIRLWALL, M. F.; CHEN, M.; BURNETT, J. & HANCOCK, J. M. (1992): Strontium isotope stratigraphy in the Late Cretaceous: intercontinental correlation of the Campanian/Maastrichtian boundary. *Terra Nova*, 4: 385-393.
- MCARTHUR, J. M.; THIRLWALL, M. F.; CHEN, M.; GALE, A. S. & KENNEDY, W. J. (1993): Strontiumisotope stratigraphy in the Late Cretaceous: numerical calibrations of the Sr isotope curve and intercontinental correlation for the Campanian. *Paleoceanography*, 8, 859-873.
- MĘYNARSKI, M. (1976): Testudines. In: KUHN, O. (Ed.): *Encyclopedia of Paleoherp-  
petology*, Part 7: 130 pp.
- MATZKE, A. T. (2007): An almost complete juvenile specimen of the cheloniid turtle *Ctenochelys stenoporus* (Hay, 1905) from the Upper Cretaceous Niobrara formation of Kansas, USA. *Palaeontology*, 50 (3): 669-691.
- MATZKE, A. T. (2008): A juvenile *Toxochelys latiremis* (Testudines, Cheloniidae) from the Upper Cretaceous Niobrara Formation of Kansas, USA. *N. Jb. Geol. Paläont. Abb.*, 249 (3): 371-380.

- MOODY, D. (1993): Cretaceous-Tertiary marine turtles of North West Europe. *Revue de Paléobiologie. Volume Spécial*, 7: 151-160.
- NIEBUHR, B. (2007): Lägerdorf-Formation. In: NIEBUHR, B.; HISS, M.; KAPLAN, U.; TRÖGER, K.-A.; VOIGT, S.; VOIGT, T.; WIESE, F. & WILMSEN, M. (Eds.): Lithostratigraphie der norddeutschen Oberkreide. *Schriftenr. dt. Ges. Geowiss.*, 55: 70-71.
- RUSSELL, D. A. (1967): Systematics and morphology of American mosasaurs (Reptilia, Sauria). *Peabody Museum of Natural History, Yale University, Bulletin*, 23: 1-241.
- SACHS, S. (2000): Mosasaurier-Reste aus der Ober-Kreide von Nordrhein-Westfalen. *Geologie und Paläontologie in Westfalen*, 56: 35-44.
- SCHULZ, M.-G.; ERNST, G.; ERNST, H. & SCHMID, F. (1984): Coniacian to Maastrichtian stage boundaries in the standard section for the Upper Cretaceous white chalk of NW Germany (Lägerdorf-Kronsmoor-Hemmoor): Definitions and proposals. *Bull. geol. Soc. Denmark*, 33: 203-215.
- VON DER MARCK, W. (1858): Über einige Wirbeltiere, Cruster und Cephalopoden der Westfälischen Kreide. *Zeitschrift der deutschen geologischen Gesellschaft*, 10: 231-271.
- WIELAND, G. R. (1905): A new Niobrara *Toxochelys*. *American Journal of Science*, XX: 324-343.
- ZANGERL, R. (1953): The vertebrate fauna of the Selma Formation of Alabama. Part III. The turtles of the family Protostegidae. *Fieldiana: Geology Memoirs*, 3 (3): 63-133.