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An ichthyosaur (Reptilia: Ichthyosauria) specimen from the Lower Cretaceous (Berriasian) Spilsby Sandstone Formation of Nettleton, Lincolnshire, UK

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ABSTRACT

A fragmentary ichthyosaur specimen collected *in situ* at Castle Top Quarry in Nettleton, Lincolnshire, UK from exposures of the Lower Cretaceous (Berriasian) Spilsby Sandstone Formation (*Subcraspedites ?preplicomphalus* Zone) is reported. In general, Early Cretaceous ichthyosaurs from the Berriasian to Barremian are poorly understood. Despite the fragmentary nature of the described specimen, it is the first ichthyosaur reported from this specific zone and adds to the literature another rare ichthyosaur from the Berriasian.

1. Introduction

Berriasian-aged ichthyosaurs are exceedingly rare in the UK. One specimen was recorded from the Spilsby Sandstone Formation (Fischer et al., 2012) and another from the Berriasian exposures within the Purbeck Limestone Group (Ensom et al., 2009). Ichthyosaurs from the Berriasian documented outside the UK include *Caypullisaurus bonapartei* from Argentina (Spalletti et al., 1999; Fernández, 2007) and ichthyosaur fragments from Chilean Patagonia attributed to *Caypullisaurus* (Pardo Pérez et al., 2009, 2011). Ichthyosaurs reported from the 'Volgian' of Russia may also derive from the Tithonian/Berriasian interval (*e.g.* Arkhangelsky, 1998, 2001; Efimov, 2001), but require further assessment.

The ichthyosaur specimen described herein was collected – with permission – during field studies by JPG in 1995. The remains were found *in situ* within the Spilsby Sandstone Formation (*Subcraspedites ?preplicomphalus* Zone) at Castle Top Quarry, Nettleton, near Caistor, Lincolnshire, UK. The specimen (YORYM: 2014.212) comprises very fragmentary remains consisting of vertebral centra, a tooth, an isolated phalange, ribs and gastralia. It is of particular significance in that these are the first undoubted ichthyosaurian remains documented from this specific stratigraphic horizon in this formation and, therefore, provides further information on the occurrence and geographic distribution of these reptiles during the Lower Cretaceous, Berriasian Stage, an interval during which marine reptiles, and in particular ichthyosaurs, are poorly represented worldwide (Fischer et al., 2012). Another specimen (DONMG:2013.8.578), most probably from the same formation as the studied remains, comprises four dorsal vertebrae and is briefly mentioned.

Despite its fragmentary nature, YORYM: 2014.212 adds an important, but indeterminate, ichthyosaur specimen to the literature.

1.1. Institutional abbreviations

DONMG: Doncaster Museum and Art Gallery, Doncaster, South Yorkshire; **LEICT**: Leicester Arts and Museums Service, New Walk Museum and Art Gallery, Leicester, Leicestershire; **YORYM**: Yorkshire Museum and Gardens, York, North Yorkshire.

2. Geological setting

The Spilsby Sandstone Formation is a marginal marine quartzose sandstone, relatively homogenous, but varying in colour

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and in its content of phosphatic nodules, silt and clay (Gaunt et al., 1992). In Lincolnshire, deposition commenced within the latest Jurassic (Tithonian), with the northernmost proximity of the member resting on the southern edge of the nearby Market Weighton axis (Casey, 1973). Connections with the corresponding London platform were slowly severed, whilst a northern arm lay in continual contact with the arctic boreal ocean (Gaunt et al., 1992). The formation is divided into the Lower and Upper Spilsby Sandstone Members, both almost lithologically identical. The formation is best developed in the south of the county, where the succession was formerly considered to span the Jurassic/Cretaceous boundary at the horizon of the Mid Spilsby Nodule Bed, of *Peregrinoceras albidum* Zone age (Casey, 1973). Much of the formation is unconsolidated, but it encloses within it irregular calcareous concretions which are also the main source of fossils. Its uneven base is suggestive of infilled tidal channels, and the formation is believed to have accumulated originally as a coastal sand spread. Contrary to previous work suggesting that the formation was mainly Upper Jurassic (Tithonian) (Gaunt et al., 1992), Hopson et al. (2008) have placed the majority of the Spilsby Sandstone Formation within the Berriasian Stage of the Lower Cretaceous.

At the Castle Top Quarry, the Spilsby Sandstone Formation rests unconformably on the *Pectinatites pectinatus* Zone of the Late Jurassic Kimmeridgian Stage (Ancholme Clay Group) and is overlain unconformably by the Claxby Ironstone Formation of Valanginian age (Gaunt et al., 1992). Ammonites collected from scattered calcareous concretions, deriving from various horizons of the Spilsby Sandstone Formation at the studied locality, have indicated the presence of the zones of (in ascending order) *Titanites anguiformis* (Basal Spilsby Nodule Bed), *Subcraspedites primitivus*, *S. preplicomphalus* and *S. lamplughi*; this sequence thus corresponds to the succession at the nearby Top Barn Pit (Casey, 1973). The author (JPG) measured the thickness of the Spilsby Sandstone Formation as around 8.5 m thick which corresponds with the field observations of JPG (in 1995) at both Castle Top Quarry and Top Barn Pit.

YORYM: 2014.212 was collected in August 1995 at Castle Top Quarry (TF1198), Nettleton, near Caistor, Lincolnshire, UK (Fig. 1). It was collected *in situ* from the Spilsby Sandstone Formation, in a vertical quarry face, some 3.5 m above the Basal Spilsby Nodule Bed. The remains were preserved within an unconsolidated sandstone which therefore greatly facilitated recovery of the specimen. Bone material was previously observed at the same level and working face, indicating further remains (Andrew Vincent, pers. comm. 1995). Unfortunately, JPG was informed too late and the remains were not collected or photographed. The sandstone at the horizon of the specimen lacked primary sedimentary structures or bedding; this phenomenon is particularly apparent in the Spilsby Sandstone Formation due to intense bioturbation (Gaunt et al., 1992). The stratigraphical horizon of the specimen, 3.5 m above the Basal Spilsby Nodule Bed, places it within the presumed zone of *Subcraspedites preplicomphalus*, following Casey (1973) and Gaunt et al. (1992). The former author assigned over 4 m of the Nettleton Top section to this zone, noting it consisted of "unfossiliferous sands" that commenced 2 m above the Basal Spilsby Nodule Bed. However, in the absence of *in situ* macrofossil evidence, this conclusion must remain provisional, although a specimen of the ammonite *Subcraspedites sowerbyi* Spath (indicative of the *preplicomphalus* Zone) was collected loose by JPG. This specimen came from scree that originated from the same working face as the studied specimen.

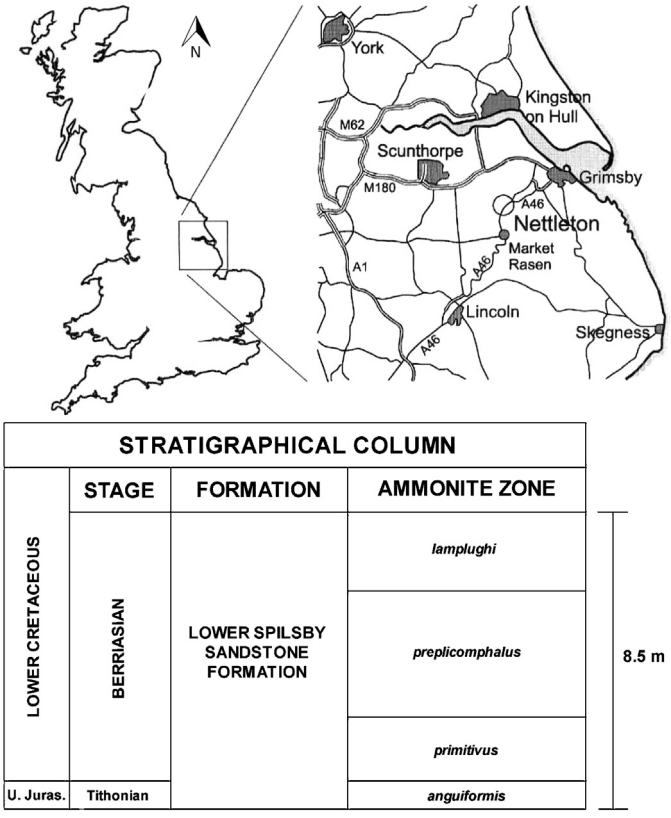

Fig. 1. Site of the Castle Top Quarry in Nettleton, Lincolnshire, UK.
Source: Reproduced from Forrest and Oliver (2003, Fig. 1) by permission of the council of the Yorkshire Geological Society. Additionally, the stratigraphical column (not reproduced from the aforementioned publication) is based upon the interpretation of Hopson et al. (2008).

3. Ichthyosaur remains from the Spilsby Sandstone Formation

The previous record of marine reptile remains from the Spilsby Sandstone Formation in Lincolnshire comprised predominantly of plesiosaur remains, but some ichthyosaur fragments also. The remains were observed during field observations at Top Barn Quarry, Nettleton, (TF106990) in 1999 (Forrest and Oliver, 2003). Accompanying macrofossil evidence suggested they derived from the horizon of the Basal Spilsby Nodule Bed; *i.e.* from the base of the Spilsby Sandstone Formation. This nodule bed is a condensed remanié horizon, less than 0.15 m thick, rich in phosphatic nodules, containing abundant reworked and indigenous faunas that represent several Kimmeridgian and Tithonian zones (Gaunt et al., 1992).

The only ichthyosaur remains reported by Forrest and Oliver (2003) includes an isolated propodial (LEICT G1. 2001.016) and a single basioccipital (LEICT G3. 2001.001). Both specimens have recently been re-examined by Fischer et al. (2012), who confirmed that the propodial (left humerus) probably did derive from the Basal Spilsby Nodule Bed and is therefore late Tithonian in age. The basioccipital, however, was determined to have been deposited in the *primitivus* Zone and is thus earliest Berriasian in age. Fischer et al. (2012) provisionally assigned these fragments to *cf. Ophthalmosaurus*.

Aside from the primary specimen of this study (YORYM: 2014.212), a second specimen (DONMG:2013.8.578) comprising four anterior dorsal vertebrae was recently rediscovered at DONMG. The specimen consists of four associated centra, three of which are articulated (one of which is only half a centrum). The preservation is very good, with the rib articulations and neural canal well-preserved. Unfortunately, DONMG:2013.8.578 has no stratigraphic information, but based upon the preservation and apparently identical lithology, the specimen most probably also derived from the Spilsby Sandstone Formation (JPG, pers. obs.).

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