News feature

The ‘Polish Solnhofen’: a long-awaited alternative?

Here we briefly report on the discovery of a new Fossil-Lagerstätte locality, Owadów-Brzezinki quarry (central Poland), which exposes Late Jurassic (Late Tithonian) carbonate sediments with an extremely fossiliferous horizon of lithographic-type limestones. Numerous specimens of horseshoe crabs were found in association with an enormously rich assemblage of the soft-shelled bivalves *Corbulomima obscura* and *Mesosaccella* sp., the remains of various fishes and marine reptiles, rare ammonites, crustaceans, land insects and pterosaurs. The uniqueness of this new locality lies in its very close stratigraphical relationship to one of the most famous Fossil-Lagerstätte localities in the world—Solnhofen, in southern Germany, with approximately 2 Ma separating them. Marine and terrestrial creatures lived and died during the Late Jurassic both at Solnhofen (Hybonotum Zone) and in another area (Owadów-Brzezinki quarry, Zarajskensis Subzone), under closely related environmental conditions. The small palaeogeographical distance separating these two locations enables, for the first time, an effective palaeobiological test of the pace of evolutionary speciation amongst different groups of organisms.

Our discovery was in the Tithonian limestones of the Owadów-Brzezinki quarry, located about 18 km south-east of Tomaszów Mazowiecki (Central Poland, Figs 1, 2). Here Late Tithonian (= middle Volgian) carbonate sediments are exposed in a small working quarry belonging to the Nordkalk Company (Sławn). The main results of our work will appear in the journal *Lethaia*; this article reports on the findings for a wider audience.

Fig. 1. Locality map of ‘Polish Solnhofen’ = Owadów-Brzezinki quarry (central Poland). Key: 1, Marine sediments, not studied in detail. 2, Shallow water limestone. 3, Siliclastic, fine-grained sediments.
The uppermost unit (III) is highly fossiliferous, with a horizon of finely bedded fine-grained limestones at its base (also called the ‘Corbulomima horizon’), dominated by small opportunistic bivalve Corbulomima obscura and somewhat less numerous Mesosaccella sp. (Fig. 3). Other fossils are much rarer (i.e. in comparison with corbulid bivalves) and represented by well-preserved moulds of ammonites ?Zaraiskites ex gr. zarajskensis (Fig. 4), horseshoe crabs Limulus sp. n. and Crenatolimulus sp. n. (Fig. 5) plus other marine and land arthropods (including decapods, beetles and dragonflies). Moreover, quite rich and well-preserved teeth and bones (much rarer articulated skeletons) of different vertebrates also occur in the ‘Corbulomima horizon’ (Figs 7–9). One of the most interesting recent finds is the remains of an aquatic sphenodontian (Fig. 9, and see the Supporting Information). Taphonomic evidence from the macrofossil assemblage of the fossiliferous ‘Corbulomima horizon’ shows that the unit is a Konzentrat-Lagerstätte. However, a rare find of an almost completely preserved organism (e.g. limulids and fish) within the fossiliferous ‘Corbulomima horizon’ suggests, that locally, this horizon could also represent a transitional facies between a Konzentrat- and Konservat-Lagerstätte. The ‘Corbulomima horizon’

**Fig. 2.** Panoramic view of the highest level of exploitation in Owadów-Brzezinki quarry (i.e. unit III and most fossiliferous ‘Corbulomima horizon’ occurring in the middle of the quarry wall).

**Fig. 3.** Soft-shelled bivalves: 
(a) Lithographic limestone slab with Corbulomima obscura and Mesosaccella sp. (scale bar = 10 mm); 
(b) Mesosaccella sp. (scale bar = 60 mm).

**Fig. 4.** Ammonite ?Zaraiskites ex gr. zarajskensis (scale bar = 10 mm).

**Fig. 5.** Horseshoe crab Crenatolimulus sp. n. (scale bar = 10 mm).
passes upwards into thin- to medium-bedded limestones with very rare corbulid bivalves, and almost no other macrofossils. In general, the sedimentary and palaeontological evidence from units I, II and III documents the change from an offshore to nearshore, perhaps lagoonal, setting.

There are some obvious similarities between Solnhofen and the Owadów-Brzezinki quarry. First, a similar range of macrofauna has been identified in both localities. Interestingly, these similarities are confirmed among both marine and terrestrial organisms and allows us to begin comparative palaeontological studies at a previously unattainable level of taxonomic resolution. An example showing the great importance of these comparative studies may be the identification of a new species of dragonfly, belonging to the family Eumorbaeschnidae, a family previously known only from the Solnhofen area. Preliminary studies already conducted on other organisms from the ‘Corbulomima’ horizon present similarly encouraging results. This fact allows us to conclude that the Owadów-Brzezinki quarry will carry the status of a new outstanding ‘open window’ into the evolution of living organisms, especially as it represents the first closely-aged palaeontological ‘alternative’ to Solnhofen, one of the most famous Fossil-Lagerstätte in the world.

In both localities, whole exceptionally well-preserved fossils occur in micritic limestones of lithographic-type (i.e. very pure, well-bedded limestones also known as platy limestones or plattenkalk), formed in a similar—lagoonal—depositional environment. In the case of Solnhofen, which during the Late Jurassic was located at the northern margin of the Tethys, the carbonates were deposited in a relatively deep lagoon with only slightly restricted access to the open ocean (i.e. a natural barrier constituted of algal-sponge reefs and small, isolated coral reefs). In contrast, the eastern part of the epicontinental sea in the Owadów-Brzezinki area was extremely shallow and the lagoon was probably almost completely isolated from open marine conditions (a periodic connection with the open sea indicated by a very rare occurrence of ammonites).

An innovative part of our research into the ‘Polish Solnhofen’ and its exceptionally well-preserved fossils is the application of X-ray microcomputed tomography (XMT) as a non-invasive tool for detailed research on marine and terrestrial fossil faunas. This method provides excellent results for the high-resolution quantitative volumetric investigation of diverse samples (Figs 8b, 9b, see also Supporting information). One of the most effective methods for digital processing and analysis of tomographic data is the construction of isosurface-based ‘virtual fossils’, which can be manipulated and dissected interactively. To generate 3-D models the XMT technique was applied, which is based on differences in attenuation of the X-ray beam propagating through a solid object. The background was removed from the images by thresholding (compare Figs 8 and 9). Further information will be published in our forthcoming paper in *Lethaia*.
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Suggestions for further reading


Kin, A., Gruszczyński M., Martill D., Marshall J.D. & Błazejowski B. 2012. The paleoenvironment and taphonomy of a Late Jurassic (Late Tithonian) Lagerstätte from central Poland. Lethaia, in press.


Supporting Information

Additional Supporting Information may be found in the online version of this article: http://www.phacops.pl/pl/news/273.pleuro

The video shows Visualization (3-D model) of the *Pleurosaurus* sp. mandible from ‘Corbulomima horizon’ at Owadów-Brzezinki quarry, central Poland.

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Fig. 9. Mandible of aquatic sphenodontian Pleurosaurus sp.: a. specimen in piece of lithographic limestone; b. 3-D model of ‘virtual fossils’—a different view of the same specimen (visible from the inside) after digital processing and analysis of tomographic data (both scale bars = 10 mm).