

The sedimentology of the Paimogo dinosaur nest site (Portugal, Upper Jurassic)¹

P. P. CUNHA², O. MATEUS^{3,4} and M. T. ANTUNES^{4,5}

¹ Proj. PAL/36531/99-00, approved by the Fundação para a Ciência e a Tecn. and co-funded by FEDER

² Centro de Geociências Univ. Coimbra; Dept. Ciências da Terra, Coimbra, Portugal (E-mail: pcunha@dct.uc.pt) • ³ GEAL - Museu da Lourinhã, 2530-157 Lourinhã, Portugal (E-mail: omateus@dinocasts.com) • ⁴ Centro de Estudos Geológicos, FCTUNL, Qta Torre, 2829-516 Caparica, Portugal (E-mail: ip241333@ip.pt) • ⁵ Academia das Ciências de Lisboa, R. da Academia das Ciências 19, Lisboa, Portugal.

Sedimentological features of the Paimogo site, 6 km NNW of Lourinhã, western central Portugal are presented. More than one hundred theropod dinosaur eggs (some containing embryo bones) ascribed to *Lourinhanosaurus antunesi* Mateus 1998, three crocodylian eggs and some other fossils were found at the 32 m² excavated area of the egg-bearing horizon (Mateus *et al.*, 1998). The stratigraphic position of the site is the Praia Azul member (Lourinhã Formation), roughly corresponding to the Kimmeridgian-Tithonian boundary or, more likely lowermost Tithonian. The maximum flooding surface of the basinal transgressive event where the horizon is located corresponds to the base of the H depositional sequence defined by Pena dos Reis *et al.* (2000) and probably correlates to the base of sequence Ti1 identified within western European basins (Jacquin *et al.*, 1998), dated as 150 Ma.

Possibly during the normal river discharge, the theropods congregated in nesting colonies at the backswamp of an extensive flood plain with small meandering channels and freshwater ponds. There are no evidences that the nest was dug or the eggs buried. The eggs have probably been laid on a flat, shaded, muddy area near the bank of a large pond. It is probable that the eggs have not been actively incubated. The larger number of eggs suggest that they were laid near simultaneously by, at least, six females. The fossil record shows that crocodylians, mammals, gastropods and fish were also present.

A flood event occurred when theropod embryos had attained a late stage of ontogenetic development, probably just before hatching. The overflow from a nearby channel flooded the plain, including the area where the eggs had been laid. The sheet flood flowing over the nest resulted into the scattering and breaking up of some dinosaur eggs. Eggshell and embryos' skeletal parts fragments were displaced to an adjacent area where, due to hydrodynamic decline, the flow submerged other clutches and moderately dragged their eggs. The flooding

caused the drowning of the embryos and covered the eggs with fine-grained sediment, hiding them from predators and scavengers. Hydrodynamic interpretation of the arrangement of the theropod eggs and egg-fragments suggests that the flow came from the NW.

When the floodwaters receded, the fine-grained deposits became exposed to subaerial weathering. Although the sediment surface was often wet and small bodies of standing water may still have existed, the sediments were oxidized and plant remains have consequently been destroyed. Some carbonate cementation and redening resulted from pedogenesis under alternating dry and moist conditions, in a semi-arid/sub-tropical climate under seasonal changing, contrasting conditions. The thick, stratigraphically above and below the nesting horizon mudrocks indicate a long persistence of periodic flooding, alternating with pedogenesis.

During the early stages of diagenesis, vertical pressure crushed the eggs. Silt penetration into the inner part of each egg inhibited later flattening during the burial process.

References

- Jaquin, T., Dardeau, G., Durlet, C., Graciansky, P. and Hantzpergue, P.** (1998) The North Sea cycle: an overview of 2nd order transgressive/regressive facies cycles in Western Europe. Mesozoic and Cenozoic Sequence Stratigraphy of European Basins, *SEPM Special Publication*, **60**, 445-466.
- Mateus, I., Mateus, H., Antunes, M. T., Mateus, O., Taquet, P., Ribeiro, V. and Manuppella, G.** (1998) Upper Jurassic theropod dinosaur embryos from Lourinhã (Portugal). In: Upper Jurassic palaeoenvironments in Portugal (Ed. M. T. Antunes), *Memórias da Academia de Ciências de Lisboa*, **37**, 101-110.
- Pena dos Reis, R., Cunha, P. P., Dinis, J. L. and Trincão, P. R.** (2000) Geologic evolution of the Lusitanian Basin (Portugal) during the Late Jurassic. *GeoResearch Forum*, **6**, 345-356.