

Retracing the history of a stegosaurian dinosaur discovery in Portugal and the importance of record-keeping in Palaeontology

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Abbreviations: **LNEG**, Laboratório Nacional de Energia e Geologia, Portugal; **MG**, Museu Geológico, Lisboa, Portugal; **SGP**, Serviços Geológico de Portugal, Portugal

INTRODUCTION

An undescribed stegosaur specimen (MG 4863, a partially complete fossilized skeleton missing most of the forelimbs, cranium and osteoderms) herein referred to the Upper Jurassic species *Miragaia longicollum* Mateus *et al.*, 2009 (for their analogous and unique cervical vertebrae) was stored in LNEG (Alfragide campus, Lisbon) and prepared under the ongoing work for the master dissertation in Palaeontology of one of the authors (F.C.). However: a) all information accompanying the specimen since collection was the label “Atouguia da Baleia” in some of the boxes it was stored in; b) the specimen was mixed in some cases with unprepared and unpublished material from the holotype of the ankylosaurian dinosaur *Dracopelta zbyzowskii* Galton, 1980. Although effective methods to retrieve the missing information in this case were conceived, the required effort urges on the importance of publicly available and detailed record-keeping of fossil finding, collecting and storing.



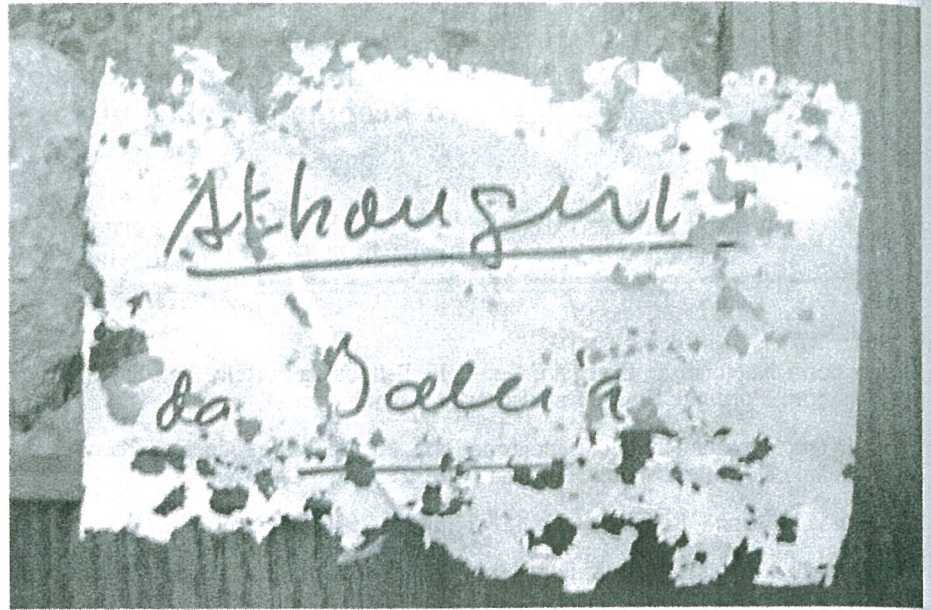


Figure 1. Note handwritten by Georges Zbyszewski evidencing “Atouguia” misspelled as “Athouguia”.

DETERMINING THE AUTHOR, EXACT LOCATION AND YEAR OF DISCOVERY

Georges Zbyszewski led the collection of dinosaur fossils by Serviços Geológicos de Portugal (current LNEG) from 1942, while conducting his extensive work of geologic cartography in central-west Portugal (Lapparent & Zbyszewski, 1957). As a result, almost all the dinosaurs stored in the LNEG, including undescribed material such as MG 4863, are credited to him as collector. The authorship of G. Zbyszewski is supported by a label accompanying the specimen “gallicized” as “Athouguia da Baleia” (Fig. 1), understandable misspelling considering his French mother tongue. Zbyszewski and Lapparent published in 1957 a detailed report of all dinosaurs from Portugal, which included many stegosaurs but not the Atouguia da Baleia specimen, so the discovery must have followed the publication. The method of storage was used by the institution during the 1950s and 1960s.

The geologic survey of Atouguia da Baleia (for the program of nationwide geocartography by SGP) was carried out in 1959 (Da Mota, 2007) and the Geologic Map at 1:50 000 scale of Peniche (sheet 26-C, where Atouguia da Baleia is included) was published in 1960. From it, the

Kimmeridgian layer “J³⁻⁴” is the only one credited with dinosaur remains. This is the current Lourinhã Formation, where the holotype of *M. longicollum* and many other dinosaurs were found. In these beds, there are three coordinates marked as “Main deposits of fossil vertebrates”: two in Pedras Muitas, Baleal, and one about one kilometer NE of the center of Atouguia da Baleia (Fig. 1). The explanatory text for 26-C (França *et al.*, 1960) mentions from Pedras Muitas the stegosaur described by Zbyszewski in 1946, but not the findings signaled from Atouguia da Baleia. The LNEG records of dinosaur fossils include no material from Atouguia da Baleia besides MG 4863, so the coordinate presumably refers to this specimen. If so, since MG 4863 was not prepared or described until recently, the lack of further detail in the explanatory text is comprehensible. Considering all these largely co-supportive evidences, it is plausible that MG 4863 was collected in 1959 by Georges Zbyszewski about 1 km NE of the center of Atouguia da Baleia (39°20'45"N, 9°18'58"W). The locality was visited by some of the authors (OM and FC) in 2015 and the geology matches the sediment matrix from the specimen (see below). The description of J³⁻⁴ as muddy sandstones with intercalations of mudstones also matches the matrix of MG 4863.

SEPARATION FROM THE *DRACOPELTA* MATERIAL

Blocks with fossils of two thyreophoran dinosaur specimens (the stegosaur *Miragaia* and the ankylosaur *Dracopelta*), with similar anatomy and rock matrix, were mixed together, sometime after the discovery of *Dracopelta zbyszewskii* around 1963, i.e. in cases stored in the same boxes and label. As such, some material from Atouguia da Baleia was stored in boxes labeled “*Dracopelta*” and/or “Ribamar”, and vice-versa (“Ribamar” refers to the provenance of *Dracopelta*, but it has since been corrected to Praia do Sul, Assenta; see Pereda-Suberbiola *et al.*, 2005). Both locations are from the Lourinhã Formation, part of the Upper Jurassic Lusitanian Basin, in the west coast of central Portugal and distanced about 100 km from each other. Most bones were almost completely encased in sediment, but some were visible enough to classify through anatomy to either dinosaur. With this an initial separation of some blocks was possible, and to observe as a result that the matrix of the ankylosaur is a quartz rich sandstone, while the matrix of the stego-

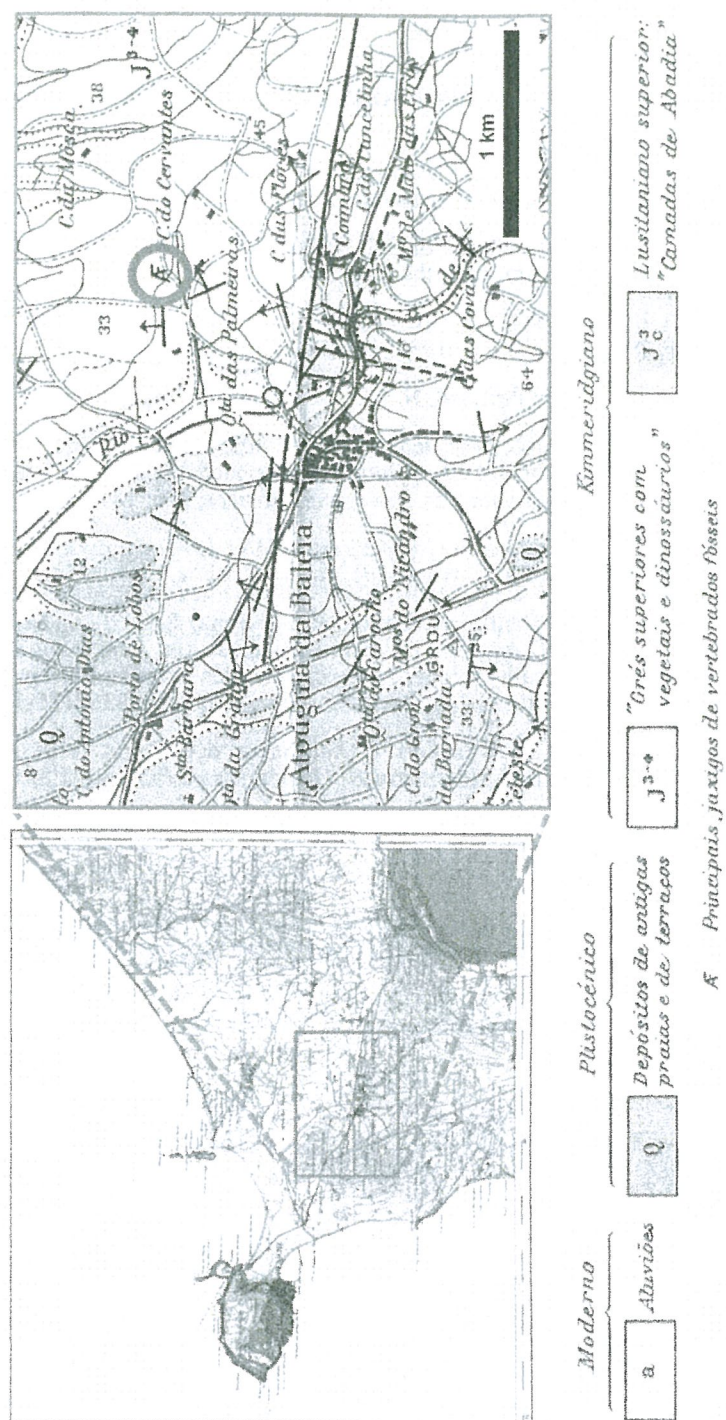
saur is a muddy sandstone lower on quartz. But some blocks were more ambiguous, and preparing all was not an affordable option timewise, so additional methods had to be applied for further separation. Hydrochloric acid (HCl) was tested over the sediment, which reacts with the stegosaur sediment (including that contiguous to bones already prepared and identified) but not the ankylosaur. However, this method was not always reliable. A handheld portable X-ray fluorescence spectrometer (p-XRF) was used directly over the unaltered matrix of seven blocks with definitely *Dracopelta* material, 26 either definitely or possibly stegosaurian and a sediment sample collected in Atouguia da Baleia (in the coordinate signaled above).

The results were compared with chemical analysis of samples of each block obtained with XRF laboratorial equipment and complemented by the mineralogical study through X-ray diffraction (XRD). The spectra obtained showed differences mainly in the ratio of K/Ca, of under 0.5 for the stegosaur (including the location sample) and much higher than 1 for *Dracopelta*. The difference observed in the mineralogical constitution of the sedimentary matrix from the two localities (mainly quartz, calcite, feldspars and micas with variable content) explains the variation in the values found for the ratio of K/Ca, including the reaction of HCl. Except for one *Dracopelta* sample with a 0.4 ratio of K/Ca, all material with values under 0.5 was, after preparation, confirmed as stegosaurian, evidencing the reliability of the method for distinguishing fossils mixed and mis-stored, as long as the sedimentology of the matrix is dissimilar enough.

CONCLUSION

This case clearly shows the importance of record-keeping in palaeontology, including field-work notes and reports. Further information about the collecting of the MG 4863 is potentially in the field books of Georges Zbyszewski, which are in family custody and not publically available.

Figure 2 (next page). Adapted Geologic Map of Portugal at scale 1:50 000, sheet 26-C (Peniche) with area of mainland Peniche (top left), detail of area including Atouguia da Baleia and the suspected provenance of MG 4863 (top right, coordinate rounded in red) and simplified label referable to the detailed area (bottom).



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