



Degradation processes and consolidation of Late Jurassic sandstone dinosaur tracks in museum environment (Museum of Lourinhã, Portugal)

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The current study aims to conciliate conservation and restoration museology diagnosis with paleontological and geological curational needs and has, as subject of study, dinosaur footprints (vertebrates fossils). The footprints have been being exposed since 2004 in the paleontology hall of the Museum of Lourinhã, Portugal, and are part of a important paleontological collection of Late Jurassic vertebrate fossils from Lourinhã Formation. Presently, it is considered a unique heritage in danger of disappearing due to high decay level of disaggregation of its geological structure.

The dinosaur footprints, (ML557) found, more precisely, on a coastline cliff in Lourinhã, Porto das Barcas, Lagido do Forno (coordinate 39° 14. 178'N, 9° 20. 397'W), Jurassic period, on the 5th of June 2001, by Jesper Milàn. This cliff of high slope presents sedimentary stratigraphic characteristics of a sandstone/siltstone of gray and red colors, by the "Munsell scale and Color Chart". Geological the tracks are Late Jurassic in age, and collected in the Lourinhã Formation, Praia Azul Member, of the Lusitanian Basin.

There are three natural infills tridactyl tracks, possibly ascribed to ornithopod, a bipedal herbivore, resultant of a left foot movement, right and left. Footprints have 300-400mm of wide and 330-360mm of height with round fingers, which are elongated due to some degradation/erosion. In 2001, the footprints were collected from the field, cleaned, consolidated and glued in the laboratory of the Museum of Lourinhã before being exhibited in a museum display. Stone matrix was removed and a consolidation product applied, probably a polyvinyl acetate, of the brand Plexigum. The footprint with broken central digit was glued with an epoxy resin, Araldite. Both applied products were confirmed by analysis of μ -FTIR (Fourier Transform Infrared Spectroscopy) and both presented colour change and detachment surface problems.

After collecting and storing, in 2004, footprints were transferred to the current public paleontology hall, ground floor, placed on the floor without any protection framework or environmental control (temperature and relative humidity).

Presently, footprints show major geological structure disintegration/deterioration problems and were diagnosed several pathologies : "Blistering", "Powdering", "Exfoliation" as well as "Dirt", "Fracture", "Inscriptions", "Consolidates" and "Adhesives".

Several laboratorial analysed were conducted to evaluate the presence of salts. Moreover a microclimatic study was conducted inside the museum to evaluate the influence of thermohygrometric parameters on the decay processes observed.

As future procedures, all tracks will suffer a superficial cleaning (dust removal) with brush without any solvent and also the application of a consolidant aiming to restore some cohesion of these footprints. Since stone consolidation is a very risky intervention, several laboratory tests are being conducted with stone samples taken from the same layer and location from Porto das Barcas and using different commercial consolidation products.