PALEONTOLOGICAL HERITAGE FROM THE ORDOVICIAN OF PENHA GARCIA

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"But in no other place are these trace fossils [Cruziana] as well exposed, well preserved, and diversified as in Penha Garcia."
Adolf Seilacher, 2006

The first fossils were collected in Penha Garcia during September 1883 for the pioneering work of Nery Delgado (1885, 1908) that established the first approach to the Paleoichnology and Stratigraphy of the Ordovician rocks from Penha Garcia-Cañaveral Syncline. The stratigraphy was revised by Perdigão (1971) being the basis for 2 geological maps 1:50000 of a total of 3 that would cover all the Ordovician from this sector (Perdigão, 1976; Sequeira, et al. 1999). The Upper Ordovician sequence was studied in more detail by Young (1985, 1988). From these works were defined a total of 8 formations (i.e., Serra Gorda, Quartzito Armoricano, Brejo Fundeiro, Monte da Sombadeira, Fonte da Horta, Cabril, Louredo and Ribeira da Laje formations) that cover almost all the Ordovician period from Tremadocian? to Ashgillian. Two regional stratotypes, Serra Gorda Formation and Vaca Member from Louredo Formation were defined close to Penha Garcia (Young, 1988; Sequeira, 1993).
Most of the "Bilobites" fossils described by Nery Delgado in his influent monograph of 1885 came from Penha Garcia. This work is still one of the most important classical papers on trace fossils and worldwide known as it is the Portuguese reference for the two volumes of Treatise on Invertebrate Paleontology about trace fossils (Häntzschel, 1962, 1975). Moreover, it was fundamental for the establishment of modern Ichnology by Seilacher (e.g., 1955; resumed in 1970). During the end of the seventies, Roland Goldring visited Penha Garcia for studying *Cruziana* trace fossils with the help of locals. From the sampling season in the Armorican Quartzite Formation, Goldring published a very important paper on the formation of *Cruziana* that was vital for understanding *Cruziana* behaviour, preservation and relationship to trilobites (Goldring, 1985). The abundance, unusual preservation and diversity of trace fossils combined with the wonderful exposure conditions in the Ponsul valley allowed the development of more systematic ichnological studies for a decade with the revision of old collections and description of many new findings (e.g., Neto de Carvalho et al. 1998; Neto de Carvalho, 2003, 2006a). 20 ichnogenera and 24 ichnospecies as well as 20 genera and species ascribed to trilobites, ostracods, phyllocarids, bivalves, brachiopods, bryozoans, graptolites, anemones and worms were already identified and described. Sequeira (1993) reported the oldest fossils in the Ordovician sequence of Penha Garcia as *Skolithos* and horizontal burrows dated from the Tremadocian. Neto de Carvalho (2006a) described in detail an amazing variety of feeding behaviours in *Cruziana*, "nowhere are they as varied as near Penha Garcia" (Seilacher, 2001). Fancy burrowing behaviours were coined by Adolf Seilacher in his Fossil Art exhibition as "The trilobite circus of Penha Garcia". Examples of tunnelling, teichichnoid, circling and gregarious behaviours are evidences for the evolution of the same feeding strategies in different groups of trilobites (Seilacher, 2007). Neto de Carvalho (2006a) also noticed a width span between 2 mm and 240 mm in *Cruziana* burrows which is allowing to track the pattern of ecospace exploitation during

ontogeny of a giant, almost half a meter, producer assigned to asaphid trilobites. Besides the big ichnodiversity made by detritus, filter and suspension feeding burrowers, the first body fossils recovered in the upper member of Armorican Quartzite Formation are giant obolids (brachiopods) confirmed by Neto de Carvalho (2006b).

The acculturation of paleontological information by Penha Garcia inhabitants is also being followed (e.g., Neto de Carvalho and Cachão, 2005). This multidisciplinary work has been the support for the protection of the geological and cultural heritage for the creation of the Fossils Trail in the Penha Garcia Ichnological Park (e.g., Neto de Carvalho, 2004; Sequeira and Serejo Proença, 2004; Neto de Carvalho and Baucon, 2007) as the starting point for building a geopark, which were awarded with the 1st and 4th Geoconservation prizes by ProGEO – Portugal/National Geographic –Portugal (Brilha, 2005). Internationalization of the paleontological heritage from Penha Garcia was conducted both in scientific (Neto de Carvalho, 2006a; Seilacher, 2007) and geotouristic basis as one of the stars of the travelling exhibition Fossil Art of the famous paleobiologist Adolf Seilacher (Seilacher, 2001, 2003, 2005a) and the *ex-libris* of Geopark Naturtejo Meseta Meridional – UNESCO European and Global Geopark (e.g., Neto de Carvalho, 2005; Neto de Carvalho and Martins, 2006). The paleontological heritage from Penha Garcia can now be seen as a successful and every improving tourist attraction (cf. Seilacher, 2005b) and an example of exomuseum (*sensu* Meléndez and Rodrigues, 2008) to be followed in Portugal.

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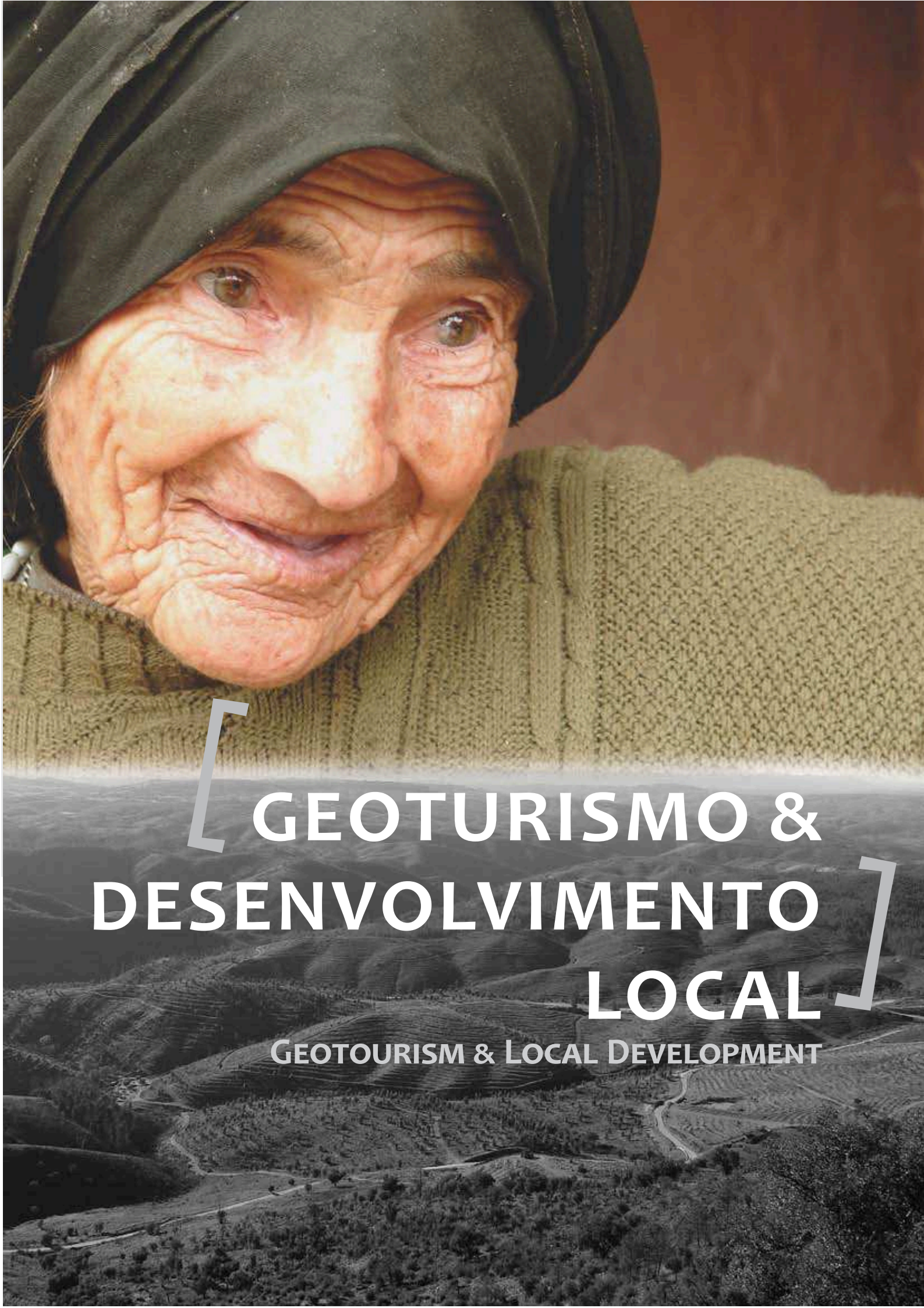

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