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In order to disseminate the geological heritage of Monsagro and the marine nature of the rocks forming the area, a 630 m long georoute across the village was created in 2015 (Martínez-Graña et al., 2017a, b). The aim of this activity is also to encourage the visit of tourists to a mountain region with serious problems of depopulation, and attempt to improve its local socio-economic development through geotourism and job creation. Under the logo of a Cretaceous and the trilobite that made it, the georoute was called “Route of the Trace Fossils” (Fig. 1). It comprises six outdoor selected locations for setting various educational-interpretative panels written in both Spanish and English, 50 × 34 cm in size (Fig. 2A). Three of them are dedicated to the most spectacular trace fossils, two others of greater size (168 × 147 cm) to the beginning and ending points of the route, and one at a gazoeb with a panoramic view of the surrounding relief and the remarkable tourist landmark that is the Peña de Francia. For optional visits, another additional six points of geological interest, outside the georoute, were indicated as landmarks at ground level, as well as number of eye level directional signs indicating the correct sense of the visit. The classical methodology of signage and explanation was complemented with the publication of a pocket-sized folding brochure to facilitate advertising of the georoute in tourist offices, community centres, etc., offering a guide of complementary tourist attractions and to publicize the village of Monsagro. Also a ‘Museum of the Ancient Seas’ was recently inaugurated to explain the marine past of the area (Fig. 1). But the digital technologies applied here to geotourism constitute one of the experiences with the widest impact, especially amongst the youngsters. Thus, every panel includes one or more QR codes that, using the free Wi-Fi of the village, provide complementary information in the form of videos, pdf documents and photographs. The other resources created for digital multimedia entertainment were an interactive Geoapp and two video games of paleontological content dealing with Ordovician seas, and also a virtual reality presentation in the museum.

As summarized by Martínez-Graña et al. (2017b) in Monsagro, in an entertaining way, we can take a journey into the past discovering traces of different marine organisms and processes on a cold-water sea-floor 475 million years ago, when the proto-Iberia was located at a high latitude in a different hemisphere, and we can imagine how it has journeyed to its current position due to continental drift.

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Fig. 3. Examples of Lower Ordovician trace fossils preserved on the walls.
A – overlapping specimens of *Cruziana goldfussi* and *C. fucifera*, cross-cut by *Skolithos*, *Palaeophycus* and *Lockeia*;
B – Outstanding concentration of narrow elongated, ribbon specimens of *C. goldfussi* – partly with a scribble-like pattern, and in a single interaction with the large *C. rugosa/fucifera* of centre down; C – circling to sinusoidal behaviour of deep ploughing specimens of *C. cf. goldfussi*; D – ‘pipe-rock’ formed by *Skolithos linearis* Haldeman; E – transverse sections of *Daedalus desglandi* (Rouault); F – id. of *D. halli* (Rouault). Scale bars, 50 mm.

cia, in the continuity of the Sierra del Guindo about 8.5 km to the east (Hernández-Pacheco, 1910; Meléndez, 1954; Kindelán y Duany, 1957; Pikerill et al., 1984). The latter paper includes the description of representatives of a dozen ichnogenera, among which are described three ichnospecies of *Cruziana*.

Thanks to the use of blocks with ichnofossils as building material, the streets of Monsagro are a true open-air museum for tourists and also for scientists, often with well-preserved specimens that are very difficult to find in situ in the natural outcrops.

The most attractive blocks which were selectively collected by the inhabitants of Monsagro as building material are, by far, the surfaces of all sizes covered by *Cruziana* and few other elements of the *Cruziana* ichnofacies. We recognized among them the following ichnotaxa:

*Cruziana fucifera* d’Orbigny, *C. rugosa* d’Orbigny (Fig. 3B), *C. goldfussi* (Rouault) (Fig. 3A), *C. rouaulti* Lebesconte, *C. problematica* (Schindewolf), *Rusophycus* cf. *latus* Webby, *Rusophycus* issp., *Didymichmus* issp., *Monomorphichmus* issp., *Diplichnites* issp., *Teichichmus* issp. and *Palaeophycus tubularis* Hall. The *Skolithos* ichnofacies is also represented in some blocks by the presence of *Skolithos linearis* Haldeman (both occurring as individual burrows or in dense clusters as ‘pipe rocks’, Fig. 3D), *Daedalus desglandi* (Rouault) (Fig. 3E), *D. halli* (Rouault) (Fig. 3F), *Monocraterion* issp., *Rosselia* issp., *Arenicolites* cf. *sparsus* Salters, *Bergaueria* sp. and *Lockeia* issp., which are preferably seen as transverse sections of vertical traces.

Besides the trace fossils, other surfaces of the blocks incorporated to the walls show a variety of wrinkle structures related to microbial mats, linguoid and interference wave and oscillation ripples, load structures, mineral crusts, etc.
Fig. 2. A – interpretative panel of trace fossils recognized in the adjacent building stones. B–F – facades built in different epochs to show alternative modes or ornament with Armorican Quartzite blocks containing beautiful specimens of *Cruziana*.

did not go unnoticed and a selective search was launched for ornamental purposes. And, instead of building with the smooth and homogeneous parts of the stone blocks facing outwards, in Monsagro the trace fossils and the ancient ripple marks were set to be shown to the observer, in an attempt to embellish the facades, the streets, the communal fountains and even the walls of the church. Fig. 2 shows a selection of rustic architecture examples with different prominence of the trace fossils as ornamental elements on the facades of the houses. The result is an authentic ‘ichnological festival’ that is recently being implemented with great success by the authorities and has turned Monsagro into one of the most unique geotourism destinations in Spain.

From the geological point of view, the source of the fossiliferous blocks are the outcrops of the Armorican Quartzite sensu lato (units II and III of Bascones Alvira and Rodríguez-Alonso, 1990) that constitute the Sierra del Guindo immediately north of Monsagro. These correspond to the southern flank of the Variscan Peña de Francia syncline. The Armorican Quartzite is one of the most characteristic units of the Palaeozoic of southwestern Europe, being represented in the Lower Ordovician succession over most of the Iberian Peninsula (Gutiérrez-Marco et al. 2002). It comprises shallow marine deposits rich in trace fossils of the *Skolithos* and *Cruziana* ichnofacies, being representative of a mainly transgressive sequence developed during the Floian.

The first scientific mention about the presence of quartzites with *Cruziana* and *Skolithos* in Monsagro is due to Gil y Maestre (1880, p. 152), but almost all subsequent studies were concentrated in the area of the Peña de Fran-
MONSAGRO (SALAMANCA, SPAIN): AN 'ORDOVICIAN VILLAGE' BUILT WITH CRUZIANA AND OTHER TRACE FOSSILS FROM THE ARMORICAN QUARTZITE

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There is an 'Ordovician village' in the world and it is in Spain (40° 30' 12" N, 6° 16' 15" W). It is called Monsagro and is located in the mountains of the province of Salamanca, not far (45 km) from the border with Portugal (Fig. 1).

Monsagro is a small municipality with a population of less than 150 inhabitants. It is part of the Natural Park of Las Batuecas – Sierra de Francia, a protected natural space of great environmental and tourist value, renown especially for the nearby Church Sanctuary of Our Lady of the Peña (= rock hill) of France, built between the 15th and 18th centuries in the highest peak of the region (1,728 m). The foundation of Monsagro goes back to the repopulation instigated by the kings of León in the Middle Age. It was then that the original settlers began to build their houses using the abundant blocks of loose stones derived from the high peaks of Ordovician quartzites that surround the locality, mainly in the north.

Towards the middle of the 19th century, Madoz (1848) described the village as follows: 'Monsagro is in very rugged terrain surrounded by very steep rocky slopes [...] it consists of 122 houses poorly built, usually two-story, the lower level is used to gather the cattle [...] communicated by paths with horseshoe curves [...] 443 inhabitants'.

From generations, the loose blocks of Ordovician quartzite collected in the colluvial deposits that descend from the hillsides of the northern mountains have been used by the inhabitants of Monsagro to build their houses. But what makes this town different is that the presence of ichnofossils or nice sedimentary structures in many of these stones

Fig. 1. Monsagro street map showing the official georoute of the trace fossils, with the location of the interpretive panels and other points of interest. In the upper right corner is a photograph of the exterior of the 'Museum of the Ancient Seas'.