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Sm–Nd isotope geochemistry and tectonic setting of the metasedimentary rocks from the basal allochthonous units of NW Iberia (Variscan suture, Galicia)

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ABSTRACT

The basal units of the allochthonous complexes of NW Iberia are formed by thick metasedimentary rock sequences intruded by granitoids, ranging in composition from calc-alkaline (c. 493 Ma) to minor alkaline–peralkaline massifs (c. 475–470 Ma), and mafic rocks. The granitoids were transformed into variably deformed othogneisses and the associated mafic rocks were transformed into amphibolites, blueschists and eclogites during eo-Variscan high-P metamorphism dated at c. 370 Ma. Two different superimposed metasedimentary rock sequences can be distinguished. The lower sequence (maximum depositional age at c. 560 Ma) is mainly composed of metagreywackes, while the upper sequence (maximum depositional age at c. 500 Ma) consists of mica schists and other minor types. Major and trace element geochemistry of the metagreywackes of the lower sequence suggests that they were generated in relation to a peri-Gondwanan arc system built on the thinned continental margin, although some chemical transition to passive margin greywackes is also observed. This sedimentary sequence was probably deposited in an Ediacaran–Early Cambrian back-arc setting or retro-arc setting, closer to the thinned platform of the continental margin. The geochemical features of the sedimentary rocks of the upper sequence suggest some affinity with passive margin sediments; they were probably deposited closer to the continental domain and to certain distance from the most active zones of the magmatic arc. The Nd model ages of 23 analysed samples are Paleoproterozoic and range between 1782 Ma and 2223 Ma (average value 1919 Ma). The Nd model ages are slightly younger in the upper sequence than in the lower sequence, but altogether they define a single population, and therefore the two metasedimentary rock sequences can be clearly related. Sedimentation probably took place within the same basin located in the continental platform of Gondwana, the main source areas of these sedimentary rocks did not change during the Late Neoproterozoic and Cambrian times. The Nd model ages are very old and they seem to be compatible with Paleoproterozoic or Archean source areas, with only minor participation of younger sources probably represented by intrusive Cadomian–Pan-African granitoids.

1. Introduction

The interpretation of metasedimentary series involved in the suture zone of mountain belts is a key issue to unravel the origin of the most relevant terranes, frequently with different tectonic settings and sometimes characterized by an important exoticism (Hatcher et al., 2007; Merschat and Hatcher, 2007; Searle, 2007). These are generally highly deformed and variably metamorphosed azoic metasedimentary series; consequently little information can be obtained from traditional studies based in paleontology or stratigraphy. In these cases, provenance analysis based in U–Pb dating of detrital zircons can be a complement to major and trace element geochemistry and Sm–Nd systematics (Díez Fernández et al., 2010; Drost et al., 2004; Linnemann and Romer, 2002; Linnemann et al., 2004). In favourable situations, these data allow to determine the tectonic setting and location of the sedimentary paleo-basins. Sedimentary series formed by greywackes are particularly useful for these studies since the analysis of immobile elements during post-sedimentary and orogenic processes has been proven to be suitable for constraining the tectonic setting (Bathia and Crook, 1986).

This paper presents a case-study of the metasedimentary rocks from the basal units of the allochthonous complexes of NW Iberia, one of the far-travelled terranes involved in the Variscan suture that are exposed in southern Europe (Martínez Catalán et al., 2009). The structural and metamorphic characteristics of this crustal-derived terrane indicate

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that it was affected by high-P and low-to-intermediate-T eo-Variscan metamorphism reaching the blueschist and eclogite facies. The origin and geological history of this terrane are still under discussion, and the complex tectonothermal evolution makes difficult to deduce the original setting and provenance of the protoliths of these metasedimentary rock series using traditional techniques. These series include clastic rocks suitable for a provenance study based on geochemical methods. Only few works have applied so far this methodology in the metasedimentary rocks of the Variscan Belt (Fuenlabada et al., 2010; Linnemann et al., 2004, 2007; Ugidos et al., 2003). Moreover, the progressive incoming and comparison of this kind of data may help to correlate the terranes that bound the suture zone of the Variscan Belt.

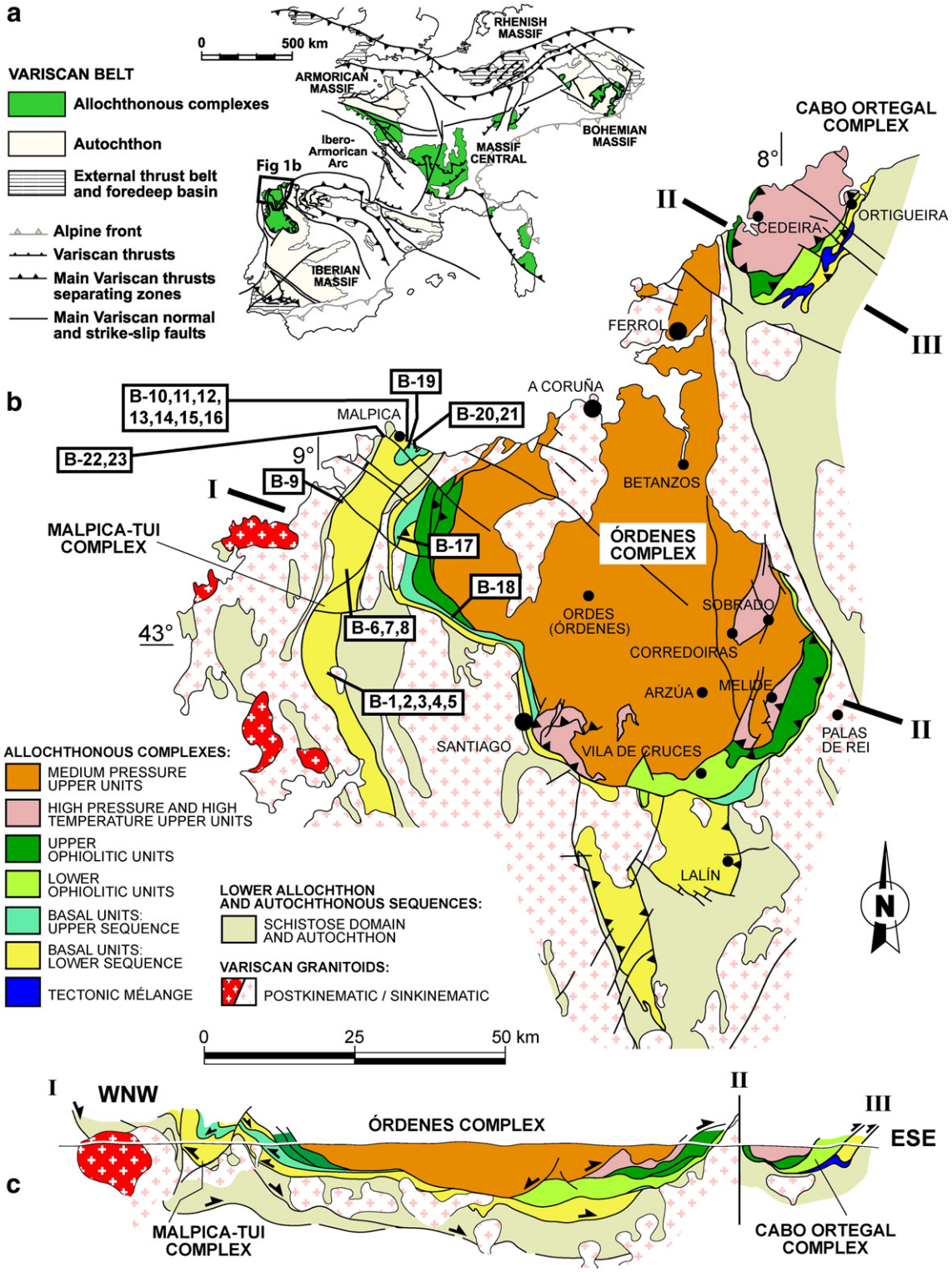

Fig. 1. (a) Location of the study area in the Variscan belt. (b) Map showing the terranes involved in the Variscan suture exposed in NW Iberia and the location of the analysed samples. (c) Representative cross section showing the general structure. Note the nappe stacking and the position of the lower and upper metasedimentary rock sequences. Top-to-the-ESE kinematics often represents thrusting, whereas top-to-the-WNW movements are related to post-nappe stacking gravitational extension. The general map and section of NW Iberia are based in previous data and maps by Díaz Garcia et al. (1999), Arenas et al. (2009), Martínez Catalán et al. (2009) and Díez Fernández et al. (2010).