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A review of the Ossa-Morena Zone and its limits. Implications for the definition of the Lusitan-Marianic Zone.

Revisión de la Zona de Ossa Morena y de sus límites. Consecuencias para la definición de la Zona Lusitano-Mariánica

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Abstract

The boundary between the Central-Iberian Zone and the Ossa-Morena Zone of the Hesperian Massif has long been placed either in Los Pedroches batholith or in the Badajoz-Cordoba shear zone, using different arguments. Here, based on mainly stratigraphic and paleogeographic criteria, we propose that this boundary is in fact a new zone of the Hesperian Massif, the Lusitan-Marianic Zone, and not just a simple lineament. The northern limit of this zone is at present concealed by the Variscan "Los Pedroches" batholith, and the southern one is the "Malcocinado Fault". The main distinctive geological features of this zone are: 1) The Proterozoic-Lower Cambrian basement rocks are similar to those of the Ossa-Morena Zone. This basement cannot be correlated with Precambrian rocks outcropping north-eastwards of the Los Pedroches batholith, even if the Alcudian-type sediments might have a Central-Iberian equivalent. 2)The Paleozoic sequences younger than Middle/Upper Cambrian, outcropping between the Malcocinado fault and the Pedroches batholith, display however clear Central-Iberian affinities, and have nothing in common with those of SW Ossa Morena. Excepting the Silurian, a persistent paleogeographic high existed in the south of the Lusitan-Marianic Zone that migrated transversally through time.

The proposed new Lusitan-Marianic Zone shows more distinctive properties to be recognised as an independent entity, than other traditionally distinguished zones, e.g., the Cantabrian Zone, West Asturian-Leonese Zone or Central-Iberian Zone, whose boundaries do not correspond to paleogeographic features as significant as those described here.

Keywords: Hesperian Massif, Central-Iberian Zone, Ossa-Morena Zone, Lusitan-Marianic Zone, Proterozoic, Palaeozoic, Stratigraphic correlations, Spain.

Resumen

El límite entre las Zonas Centro-Ibérica y Ossa Morena del Macizo Hespérico se ha descrito y situado, según autores, en la alineación del batolito de Los Pedroches o en la banda de cizalla Badajoz-Córdoba, utilizando distintos argumentos. En el presente trabajo, basándonos fundamentalmente en criterios estratigráficos y paleogeográficos, proponemos y justificamos una nueva zona del Macizo Hespérico. Hay un área cuyo límite norte se encuentra actualmente sellado por el batolito varisco de "Los Pedroches" y que queda limitada al sur por la "Falla de Malcocinado" y que muestra rasgos geológicos principales diferenciales respecto a su entorno y que a continuación se resumen: 1) Las rocas de su basamento Proterozoico-Cámbrico Inferior son típicas de la Zona de Ossa Morena, siendo en cambio incorrelacionables con las rocas del Proterozoico y Cámbrico basal que se encuentran al NE del batolito de los Pedroches, con la dudosa excepción de algunas de las capas más altas del Proterozoico esquisto-grauváquico de tipo Alcudiense. 2) Las sucesiones paleozoicas posteriores al Cámbrico Medio/Superior, tienen afinidades claramente centro-ibéricas y

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no presentan nada en común con las que se encuentran al SO de Ossa Morena, ya que, excepto en el Silúrico, estuvieron separadas por un persistente alto paleogeográfico, barrera que varió posicionalmente en el tiempo al migrar paralelamente a sí misma.

La nueva "Zona Lusitano-Mariánica" que proponemos tiene más características para su diferenciación y consideración como entidad independiente que algunas zonas tradicionalmente separadas de sus entornos, como la Cantábrica, la Asturoccidental-Leonesa o la Centro-Ibérica, cuyos límites internos no tienen rasgos paleogeográficos tan significativos como los de la nueva zona propuesta.

Palabras Clave: Macizo Hespérico, Zona Centro-Ibérica, Zona de Ossa Morena, Zona Lusitano-Mariánica, Proterozoico, Paleozoico, Correlaciones estratigráficas, España.

1. Major paleogeographical outlines of the SW Iberian Massif

The Hesperian (Iberian) Massif constitutes the ancient core of the Iberian Peninsula. It covers about one third of the Iberia surface and is considered to have been relatively stable since late Paleozoic. Its rock record spans in time at least from the Lower Proterozoic (accurate dating is hindered by the superposition of younger dynamothermal events) to the Permian. It has been subdivided in several zones, in the same way as some other massifs as Newfoundland for example. One of these zones is the Ossa-Morena Zone (OMZ) in the SW of the Hesperian Massif (Fig. 1). The Hesperian Massif position has been considered to be peripheral to Gondwana during the major part of the Paleozoic. It was probably located in a conflictive area due to the proximity of this continent to Laurentia. In that mobile area, individualized elements with Gondwanic origin (Avalonia-Armorica) interfered following such suture, and the suture of both with Baltica.

The present work is mainly based on stratigraphic and paleogeographic criteria because it is based on more than 150 stratigraphic sections and logs made by two of the authors on both sides of Los Pedroches batholith, and the reading and interpretation of more than 10.000 km^2 of our own geologic maps and almost 50.000 km^2 of other maps, mainly the 1/50.000 MAGNA edition.

The results of these investigations show that the Ossa-Morena Zone is a terrane which has an ancient core of Proterozoic to Middle Cambrian age with clear north-African affinities. The lowest units display similarities with the pericratonic formations of the Bayuda region (NE Africa), the intermediate ones with those of Uweinat (Lybia), and the youngest ones (Late Precambrian-Lower Cambrian) with those of Morocco. In the South Portuguese Zone, which is the south westernmost zone of the Hesperian Massif (Fig. 1), only Upper Paleozoic rocks outcrop that constitute the filling of a foreland basin whose southern margin remains unknown, but is presumably African.

North-eastwards of the remarkable NWW-SEE geologic lineament represented by the Variscan Los Pedroches batholith (Fig.1), which has long been taken for the north-eastern limit of the OMZ, the Precambrian sequence and that of probable Cambrian age are remarkably different from those of the OMZ. In fact, they have Armorican affinities. Moreover, rocks older than Upper Precambrian (Riphéan - Vendian) have not been recognized north of "Los Pedroches".

Therefore, SW of Los Pedroches axis, a complex Precambrian predominates; it is polymetamorphic and was poly-deformed prior to Paleozoic times. It is topped by volcanic rocks close to the Precambrian-Cambrian boundary and is overlain by Lower Cambrian marine sedimentary rocks with some interbedded volcanics towards the base. Immediately North of Los Pedroches axis, a thick Late Precambrian anchimetamorphic sedimentary complex is found, forming part of the formerly called Schist and Greywackes Complex ("CXG"). The lowest unit, presenting very thick turbiditic sequences was later called Lower Alcudian; its base could be still Riphéan and most likely Vendian but the unit is mainly Upper Vendian. This unit is mainly composed of thick pre- and synorogenic turbidites, related to the deformation of a mobile belt somewhere to the S or the SW. Later on, along the NE side of Los Pedroches lineament, a new basin developed in the Upper Vendian-Lower Cambrian, which shows a regional angular unconformity in the base. The infill of this new basin begun with continental deposits in the southern margin, evolving quickly northwards into shallow marine siliciclastic sediments, and further North even into turbidites. This basin evolved into an extensional basin repeatedly filled with deposits of siliciclastic and carbonatic platforms when Cambrian rifting started. The last shallowing upwards sequence was repeated at least twice; the depocenters migrating progressively northwards. The first sequence is Upper Vendian, the third sequence is undoubtedly dated as Lower Cambrian, however the age of the second one is still under discussion but the most recent data suggest a basal Cambrian age.

We consider the widespread Upper Cambrian stratigraphic gap as related to the final stage of the connection between two terranes of contrasted characteristics and diverse paleogeographic origin (Herranz Araujo *et al.,* 1986). The gap would be caused by a tectonic emersion of the linkage area. Such connection would occur with scarce volcanism, marked emersion and hard local erosion, in an

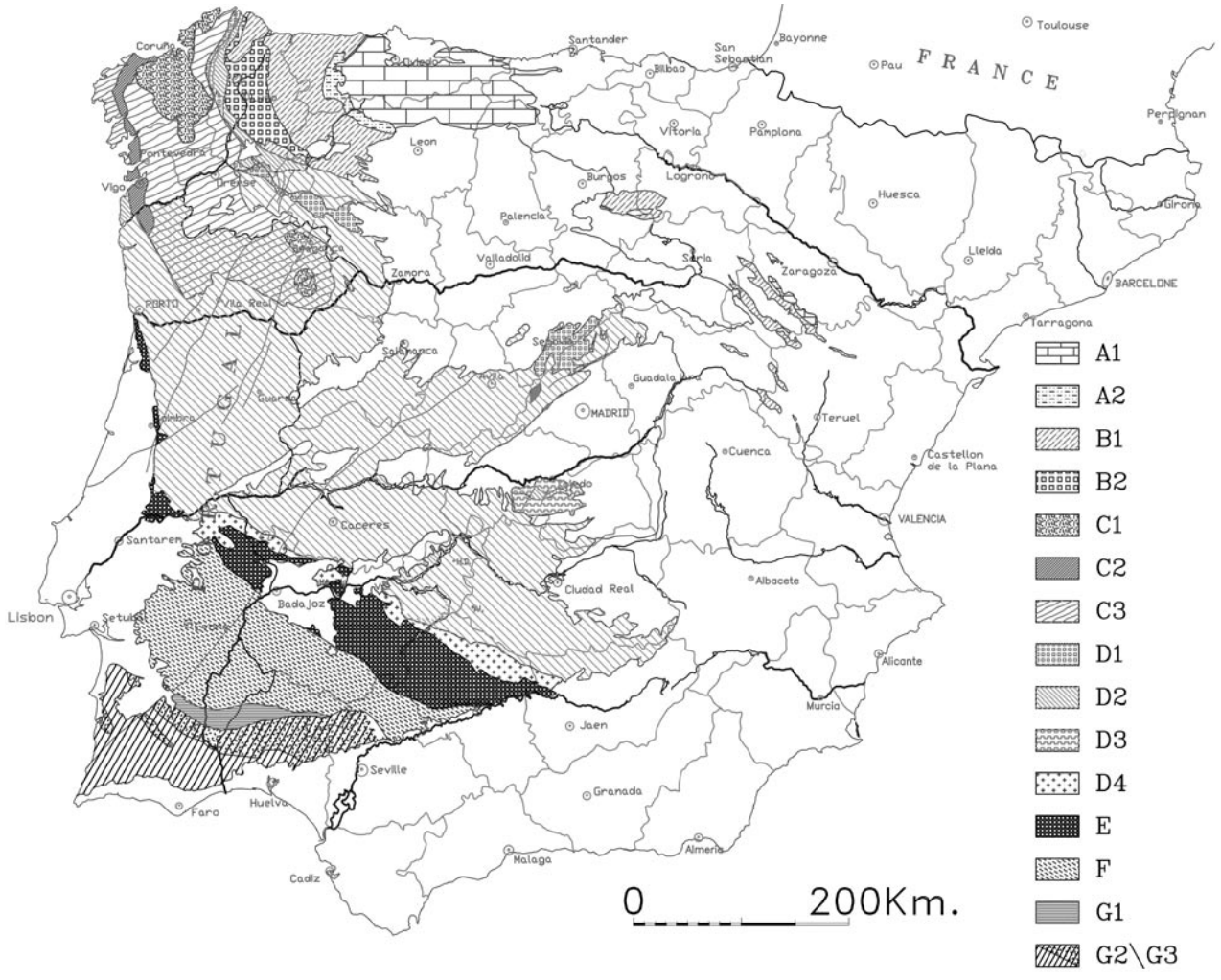


Fig.1.- The division into zones and main sectors of the Hesperian Massif outstanding the new proposed Lusitan-Marianic Zone. A1: Cantabrian zone; A2: Late Precambrian Narcea Anticlyne core; B1: Western Asturian-Leonese zone (WALZ); B2: WALZ Granitoids and Villalba shales (late Precambrian) from Mondoñedo recumbent fold; C1: Galaico-trasmontane zone (GTMZ), catazonal allochthonous units; C2: GTMZ Malpica-Tuy blastomylonitic belt; C3: GTMZ schistose domain; D1: "Ollo de Sapo" and other glandular gneisses (CIZ), D2: Undifferentiated Central Iberian Zone, D3: Toledo metamorphic core; D4: Los Pedroches Axis; E: "Problematic band": Lusitan-Marianic Zone (LMZ); F: Ossa-Morena Zone (*s. restricto*) (OMZ); G1: "Pulo do Lobo" and Beja-Acebuches oceanic belt in the SPZ ; G2: Undifferentiated South Portuguese Zone (SPZ); G3: Pyrite Belt in the SPZ.

Fig.1.- División en zonas y sectores del Macizo Hespérico enfatizando la propuesta Zona Lusitano-Mariánica. A1: Zona Cantábrica; A2: Núcleo anticlinal de las Pizarras del Narcea; B1: Zona Asturoccidental leonesa (ZAOL); B2: ZAOL Granitoides y Pizarras de Villalba del Precámbrico terminal, del pliegue recumbente de Mondoñedo; C1: Zona Galaico-trasmontana (ZGTM), Unidades catazonales alóctonas; C2: ZGTM Banda blastomilonítica Malpica-Tuy; C3: ZGTM dominio esquistoso; D1: "Ollo de Sapo" y otros neises glandulares (ZCI), D2: Materiales indiferenciados de la Zona Centroibérica (ZCI), D3: Núcleo migmatítico de Toledo; D4: Eje de Los Pedroches; E: "Banda Problema": Zona Lusitano-Mariánica (ZLM); F: Zona de Ossa Morena (*s. restricto*) (ZOM); G1: "Pulo do Lobo" y banda oceánica Beja-Acebuches en la ZSP; G2: Zona Sur Portuguesa indiferenciada (ZSP); G3: Faja pirítica en la ZSP.

oblique-sinistral terrane docking regime.

Later on, during the Ordovician, a significant lineament developed parallel to the Pedroches axis some 50 km (present) at the SW. This lineament, a stripe of land in fact, was called the "blastomylonitic Badajoz- Cordoba belt" (i.e. Parga, 1971; Bladier and Laurent, 1974) and formed in a transpressional tectonic setting and acted as a complex horst. The main sense of movement was probably sinistral, and resulted in the exhumation and erosion of the oldest rocks in the region. This new lineament acted as a new paleogeographic barrier, being a persistent horst during the Ordovician and the rest of the Lower Paleozoic.

In this way, while the older "Pedroches axis" constituted a border line during the Proterozoic up to the Lower and Middle Cambrian, the embryonic "Blastomylonitic Badajoz-Cordoba belt" was a barrier for the post-Cambrian Paleozoic successions. Therefore, the Ordovician rocks at the SW of such belt are different in facies and fauna from

the Ordovician rocks north-eastwards of it. From this moment on, both Upper Ordovician and Silurian rocks clearly showed north-Gondwanic affinities.

The closing of an oceanic area opened to the SW of the OMZ, begun in the Devonian, and culminated in Carboniferous times with an oblique collision with subduction towards the current NE. The resulting closure, represented by the Acebuches Ophiolite defines the limit between the South Portuguese Zone (SPZ) and the OMZ. During the closure of the ocean the well-known "pyrite-belt" and the Culm facies of SW Iberia were laid down.

Thus a complex succession of collisions is recorded in the OMZ and neighbouring areas, beginning with the Pan-African II Orogeny and ending with the Early Variscan collision. These events successively amalgamated exotic units with North African affinities and remains of oceanic crust, finally docked to the SW part of the Iberian plate.

2. Traditional definitions and limits of the OMZ

Ancient authors perceived the Iberian Meseta as well as a tectonic and as a morphographic core. This entity was responsible of the main geographic and geologic characteristics of the Iberian Peninsula. However Fischer (1894) separates its tectonic meaning with a specific name, the "Iberian Block". Accepting the traditional name Iberian Meseta, several authors labelled it as "Iberian massif", "Central massif", "Iberian headland", "Great Spanish nucleus", "ancient massif" and so on. Only vague references were made about any possible geological province division, no one concerning the present Ossa Morena as a separate entity.

Hernández Pacheco (1932) defined the Hesperian Massif as a tectonic unit, and even if he established some physiographic divisions of that massif, he considers in the Sierra Morena environment "Los Pedroches" granitic alignment like a "geologic divisor of the Peninsula" (pp 113-114), because it separates two areas of contrasting stratigraphy for the Paleozoic successions, and specially for the Cambrian ones. The southern zone is very varied, tectonically complex and with large outcrops of metamorphic and plutonic rocks towards the South whereas on the zone extended to the North of the "Los Pedroches Axis Band", where the Ordovician shales and quartzites prevail reaching the edge of the Toledanian Meseta in one side, and extending themselves to Salamanca and Portugal by the other side.

Reig Villaplana (1948) explained for the first time the structural evolution of the Iberian Peninsula in terms of what will be called a long time later Plate Tectonics, standing out the length and the extension of a Hercynian folding arch which extends from Coimbra to the upper part of the Guadalquivir river valley.

When Lotze (1945) established the division of the "Variscides" of the Iberian Meseta ancient basement , he separated for the first time what he called "Ossa-Morena Zone"[1], which NE limit "appears to be formed by a large and narrow granitic pluton" (page 158 of the Spanish translation of Lotze's work) "which –eventually narrowed or interrupted- has a strike starting in a region NE of Portalegre (in Portugal), crossing Mérida and Pozoblanco and finally reaching the North of Andújar" (page 157: from the territory to the E of Leiria, crossing Valencia de Alcántara, Don Benito, Castuera, until the eastern part of Sierra Morena). The southern limit which is "less clear", corresponds "more or less" with the "line Alcácer do Sal-Beja- Aracena- Castilblanco (to the N of Seville)" in the southern side of the "Évora – Beja – Aracena Massif" (page 160).

Lotze describes Ossa Morena as "the most varied, coloured, and moved zone of the whole Iberian Meseta" and "it is formed by metamorphic and sedimentary rocks of a recent Precambrian (Algonquian)", Cambrian or Devonian in varied facies with large episodes of submarine volcanism, Carboniferous forming narrow basins or isolated spots, up to Lower Permian as those in the Viar River Basin. This varied ensemble has been deformed by pre-Carboniferous (pre-Culm) phases, that means "Bretonian" and intra-Carboniferous "Sudetic", even Asturic phases and younger than Lower Permian. All these phases but the last ones originated folds and thrusts verging towards SW and exceptionally towards NE. The plutonism, concordant with the folding structures, is syn-, late- and postorogenic. Surprisingly, Lotze does not mention in any place neither the character of the metamorphism nor its relation either with folding or with plutonism.

Solé Sabaris *et al*. (1952) extend the Iberian Meseta tectonic meaning to include the Celtiberian basement and state the "Paleozoic geosyncline southern border along a line starting in Tomar, in Portugal extending to Mérida and Montoro in Spain. Afterwards, Lautensach and Mayer (1961) return to an exclusively morphographic conception of the Iberian Meseta revitalizing the ancient informal concept of the Iberian Massif to name the incessantly outcropping basement in the W part of the Iberian Peninsula following Lotze's conception and the geological division

[1] The name of the Ossa-Morena Zone undoubtedly derived from a combination of the geographic name of the "Serra de Ossa", located at the SW of Estremoz in Portugal and from Sierra Morena in southern Spain. But while the first component of the name corresponds to a very precise geographic location, the second refers to a large extension geographic accident with vague limits. This name is generally applied to the highs formed by the old materials of the Hesperian Massif when their strike hits obliquely the Guadalquivir river depression; these highs extend from the N of Seville up to the Alcaraz region in Albacete province and they comprise at least four zones of the Hesperian Massif. This name is also lyrically misapplied to the Prebetic mountainous region in Córdoba

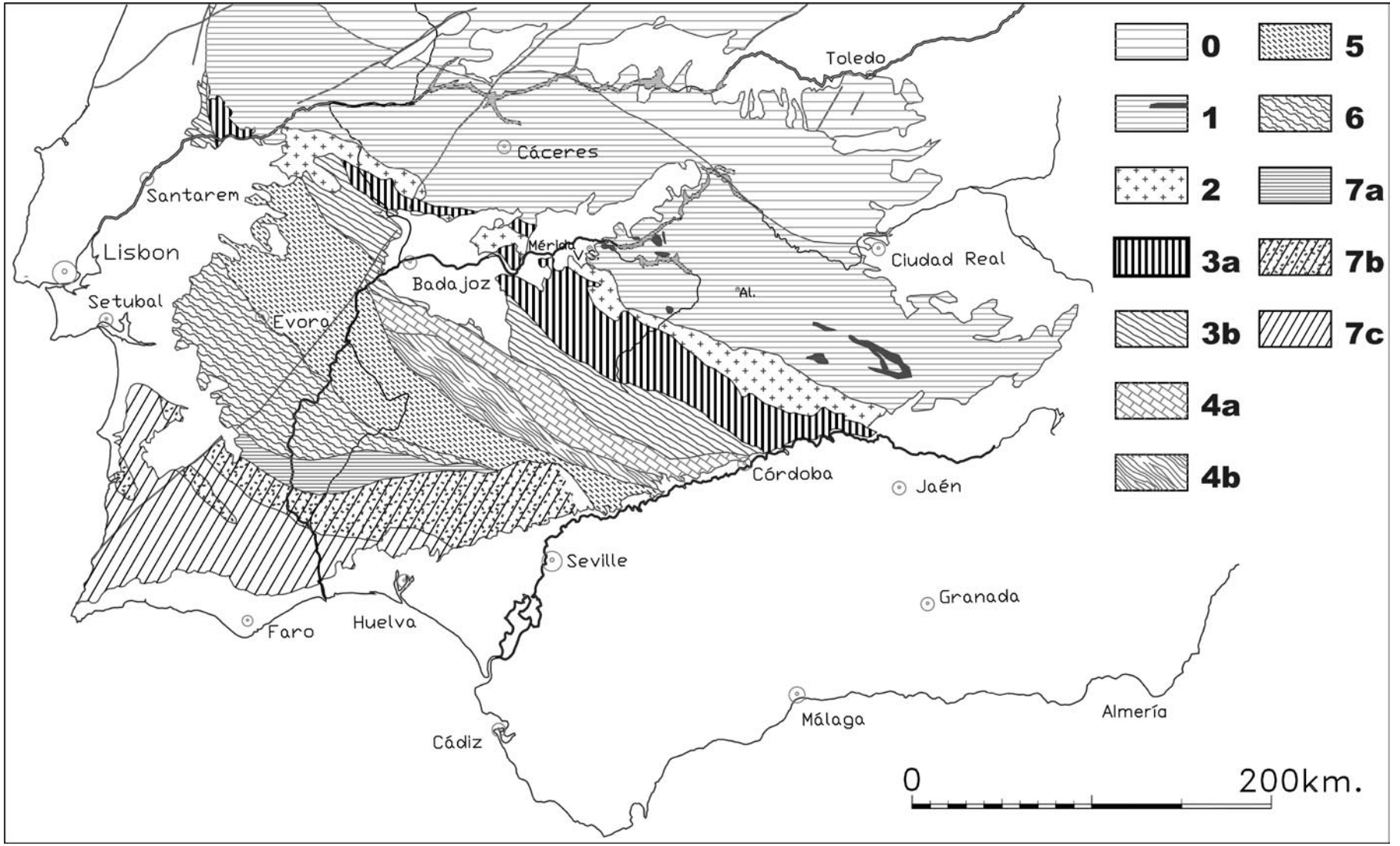


Fig.2.- Division in bands of the SW Hesperian Massif. **Central-Iberian Zone:** 0: Montes de Toledo domain; 1: Alcudia-Alta Extremadura domain; the Upper Alcudian continental deposits are shaded in dark tones; 2: Los Pedroches Axis. **Lusitan-Marianic Zone:** 3a: Obejo-Valsequillo domain; 3b Badajoz Córdoba Axis and Sierra Albarrana domain. **Ossa-Morena Zone:** 4a: Zafra-Llerena-Alanís band; 4b: Olivenza-Monesterio core; 5: Cheles-Barrancos band; 6: Évora-Beja-Aracena massif. **South-Portuguese Zone:** 7a: "Pulo do Lobo"; 7b: Pyrite Belt; 7c: Undifferentiated SPZ.

Fig.2.- División en bandas del SW del Macizo Hespérico. **Zona Centro Ibérica:** 0: Dominio de Montes de Toledo; 1: Alcudia-Alta Extremadura; en negro depósitos continentales del Alcudiense Superior; 2: Eje de Los Pedroches. **3: Zona Lusitano-Marianica.** 3a: Dominio de Obejo-Valsequillo; 3b Eje Badajoz-Córdoba y dominio de Sierra Albarrana. **Zona de Ossa Morena:** 4a: Banda Zafra-Llerena-Alanís; 4b: Núcleo Olivenza-Monesterio; 5: Banda Cheles-Barrancos; 6: Macizo Évora-Beja-Aracena; **Zona Sur-Portuguesa:** 7 a: "Pulo do Lobo"; 7 b: Faja pirítica; 7 c: ZSP indiferenciada.

in zones.

Parga (1970) updates the Hesperian Massif concept, dividing it in six zones based in Lotze's division, further subdivided in eleven new sub-zones, locating then Ossa Morena in the Hercynian eugeosyncline pre-Devonian border land, including the Abrantes- Portalegre- Elvas-Aceuchal- Azuaga pre-Hercynian orthogneissic belt. In his figure 1, Parga was the first to depict the northern boundary of the Ossa-Morena Zone in the Tomar- Badajoz- Cordoba belt.

Julivert *et al.* (1974) in the "Tectonic Map of the Iberian Peninsula and the Balearic Islands" explicative memory, adopt for their "Iberian Massif" (which they textually consider equal to the Hesperian Massif) a zoning based in Lotze's divisions but with some variations. They merge the primitive Galician-Castilian and Lusitanian-Alcudian zones in a single Central Iberian Zone. Regarding the Ossa-Morena Zone they propose for the Northern limit in Spain Los Pedroches batholith and in Portugal "Ferreira do Zêzere thrust"… "and the faults which can be traced further North up to the region of Porto". In the south-western limit "Ficalho thrust, the southern margin of Aracena metamorphic band and the faults which… reach the Guadalquivir river depression in the Viar river valley".

For Julivert *et al.* the main characteristics of this zone are: "the large extension of Precambrian and Cambrian outcrops, the noticeable development of the plutonism and volcanism following large and narrow bands neatly individualized and the age of the main 'Hercynian' folding phases which is clearly Lower Carboniferous". The structure of the syn-schistose folds and the thrusts verging South-westwards (eventually North-eastwards) was developed in three phases, the last of them characterized by transcurrent faults. The Hercynian plutonism which is also developed following bands comprises two groups of different composition, syn- or late- and post-tectonic. The metamorphism shows a varying grade and two should be pointed out: the one related with the "Badajoz- Fuenteovejuna- Cordoba Axis" with an intermediate pressure paragenesis and Aracena metamorphism of very high temperature and increasing pressure. They add to these peculiarities (page 24) the existence of a "heavily subsiding large trench" filled with a Devonian-Dinantian flysch and basic and ultrabasic rocks "close to Los Pedroches Batholith".

Robardet (1976) based on the stratigraphic close resemblance between the Lower Paleozoic succession and the Carboniferous cover on both sides of Los Pedroches batholith, and mainly following the tectonic proposals of Bard (1971, 1973), Bladier and Laurent (1974), Capdevila (1976) and Arthaud and Matte (1975), redraw the OMZ-CIZ boundary along the Portalegre- Badajoz- Cordoba anticline.

Herranz *et al.* (1977) assume Lotze's Ossa Morena boundaries, standing out the obvious differences present at both sides of Los Pedroches batholith. North-eastwards wide Precambrian cored anticlinorium structures predominate separated by narrow synclines where unconformable monotonous Lower and Middle Paleozoic sequences crop out. Metamorphism is weak or non-existent and the magmatism and the main fractures are tardy-Hercynian. South-westwards the stratigraphic succession is much more varied and complete, presenting from a basal metamorphic Precambrian to a post-paroxysmal Upper Paleozoic, which ca be divided in several unconformable sequences. Metamorphism is polyphasic and variable in type and intensity and the magmatism and fracturing are mainly syn- to tardy-orogenic. An important fact is that the metamorphic Precambrian basement crops out even in the closer neighbourhood at the S of Pedroches batholith, but never northwards (p. 332). This, points out the significance of the "Pedroches Axis" separating regions with such a different basement. Herranz *et al.* (1977) divide this area in seven bands, based in the domains made considering the Precambrian-Cambrian relations, marking the different characteristics in the Precambrians and the presence or absence of Cambrian rocks. For these authors the domains 1 and 2 are Central-Iberian, 3 forms the border, and 4 to 7 are the OMZ. 4 and 5 almost coincide with the recently proposed Lusitan-Marianic Zone, as depicted in their figure 1.

Chacón and Pascual (1978) support Robardet's proposal, locating the CIZ-OMZ boundary along the S border of the Portalegre- Badajoz- Cordoba anticlinorium which corresponds to Azuaga Fault (Fig. 4).

Julivert *et al.* (1980) reiterate the former concept and zoning of the Iberian Massif. As for the concerning to Ossa Morena they recognize that the "Cordoba-Abrantes belt" is the dividing line for the vergences and they indicate that the limit with the Central Iberian Zone in Portugal "is situated along a 5 km large blastomylonitic belt" (Oliveira de Azemeis belt) which forms the intermediate relief between western Galicia "blastomylonitic grabben" and the Cordoba-Abrantes belt, whereas in Spain the limit is less brusque and it is considered to be in Los Pedroches batholith. The southern limit is a "main thrust verging towards SW" which corresponds to a sheared mylonitic belt which is more than one km thick and which is bordered by "synmetamorphic flaser-gabbros and serpentinite intrusions which suggest that this is a very deep accident crossing the whole crust". For Julivert *et al.* (1980) the Ossa-Morena Zone with the South-Portuguese Zone constitutes the southern branch of the Hercynian Orogen and they relate Ossa Morena structure to two syn-schistose deformation phases. From the metamorphism they em-

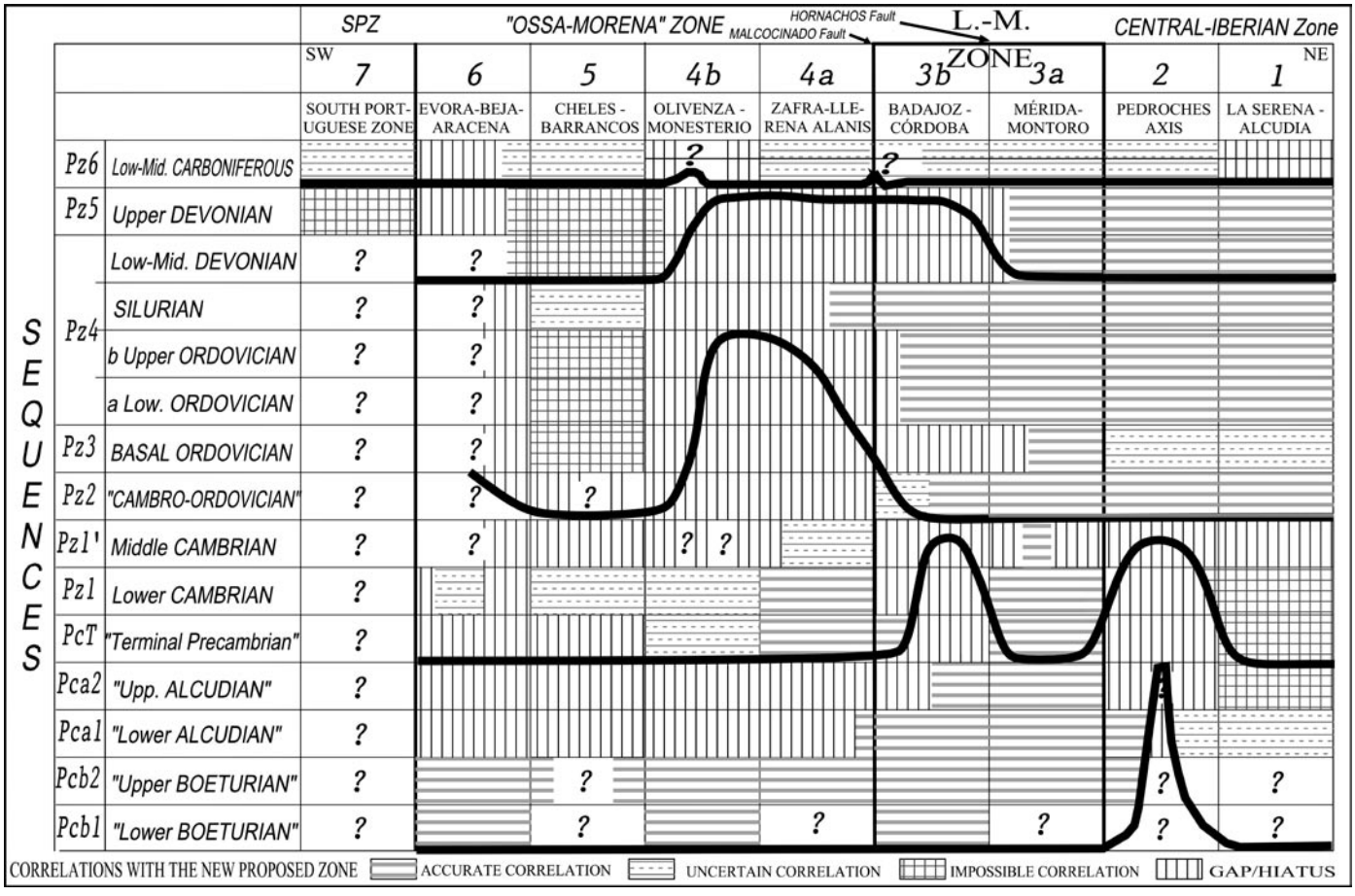


Fig.3.- Correlation possibilities of the great regional lithostratigraphic units with the proposed Lusitan-Marianic Zone (band 3). We have differentiated between physical continuity or accurate correlation, uncertain correlation and impossible correlation. The areas with gaps, hiatus or no deposition are marked for the different intervals of time. We have also indicated with a thick black line the position of highs which would mark the position of the paleogeographic barriers for the different stages.

Fig.3.- Tipos de correlación de las grandes unidades litoestratigráficas regionales con respecto a la Zona Lusitano-Mariánica propuesta (banda 3). Se distingue entre correlación segura o continuidad física, correlación incierta con reservas e imposibilidad de correlación. Se indican además las zonas con lagunas, hiatos o zonas sin depósito. Se marca con la línea gruesa la situación de umbrales que marcarían la posición de barreras paleogeográficas para las distintas etapas.

phasize the SE-NW Cordoba-Abrantes blastomylonitic belt and its similarity with the western Galicia one. As for the regional metamorphism it occurs in two bands, the first one in the North of Barrovian-type, between Cordoba and Abrantes which extends to Albergaría a Velha-Porto. The other band is in the South, Aracena-Évora-Beja, of the low pressure/high temperature type, which age is controversial because there are evidences of two superposed metamorphisms at least, Precambrian ("even pre-Brioverian") and Hercynian. The magmatism is syn- to tardyorogenic, more and more basic as going towards SW, whereas to the NE it matches in the general model accepted for the rest of the Iberian Massif.

Chacón *et al.* (1983), determinedly assumed the new boundary that they placed along the Hornachos- Villaharta Fault maintaining the widely accepted Ficalho Fault for the southern limit, confirming the double vergence as the main structural characteristic feature of the zone. However these authors acknowledged the stratigraphic singularity of the area comprised between Los Pedroches Batholith and the Abrantes- Badajoz- Cordoba blastomylonitic belt (Fig. 4).

Apalategui and Pérez-Lorente (1983) emphasized the Central Iberian character of the Obejo- Valsequillo- Puebla de la Reina domain, and located Ossa Morena northern boundary along the thrusted southern flank of Peñarroya Coalfield.

Since the combined works of Robardet (1976) and Herranz *et al.* (1977) it was already clearly stated that this region was then constituted by three differentiated areas: a genuine Central Iberian northwards, another true Ossa Morena southwards, and between them another zone with Ossa Morena type basement and a Central-Iberian-like Paleozoic cover. But interest of the geological scientific

community had other focus and the opportunity passed away. Only in 1985, during the VII G.O.M. (Ossa Morena work Group) held at Villafranca de los Barros (Badajoz) this three-fold subdivision was shown to the participants (Herranz Araújo, 1985: proceedings and field-trips) and later in the International Conference on Iberian Terranes held in Oviedo (Herranz Araújo *et al.,* 1986).

It seems apparent that the works of Robardet (1976) are the origin of the change of position of the limit between the Central-Iberian and the Ossa-Morena Zones to the boundary which is at present in vogue located in the Badajoz/ Cordoba Axis as it may be stated by its increasing and widespread acceptation in the general books of Dallmeyer and Martínez García (eds., 1990) and Gutiérrez-Marco, Saavedra and Rábano (eds., 1992), and more recent specialized literature. However, the new "extended" part of the CIZ (called Lusitan-Marianic Zone in this paper) and the remaining southern part of Ossa Morena share the same type of pre-Paleozoic basement. This fact is against the existence of a presumed and later occluded oceanic area between them, and then the individuality of such zones, in the original Lotze's sense should be disregarded.

3. Division in zones: the problem of the limits

The subdivision in zones of modern or ancient folded belts, is based on the confirmation that their lineal structure is due to the existence of juxtaposed longitudinal bands which stratigraphic and paleogeographic characteristics, as well as the metamorphic and magmatic features, tend to remain constant along the belt layout, but they differentiate from those of the adjacent areas in a sense transverse to the structures (Julivert, 1983). The limits between these Zones should be, as long as possible, tectonic accidents, the only elements with the capability to juxtapose rocks and sequences corresponding to different paleogeographic and (or) dynamothermal environments. These bands can be further divided in domains, only and exclusively in function of the actuation ambit of determined phenomena. In such a case the limits must not be anymore necessarily tectonic (Fig 1).

A geologic entity with Hesperian Massif dimensions, and with such a long and complex geologic history, has to be necessarily heterogeneous (Quesada, 1992). In the proportion that the knowledge upon the characteristics and evolution of the Hesperian Massif has been advancing, some large rank subdivisions were proposed, like those of Lotze (1945), Julivert *et al.* (1972), Farias *et al.* (1987), Apalategui *et al*. (1990), etc ..., based on varied nature criteria: stratigraphic, structural, magmatic, etc... (Julivert, 1983, p.67). But as well as some of these zones have in their bounds with the neighbouring ones net structural limits, with a paleogeographic transcendence, the boundaries of some other zones are less significant, or more difficult to establish (for example the limits between the Cantabrian Zone and the Western-Asturian Leonese Zone, and specially between this latter and the Central Iberian Zone), and this fact has not diminished the individuality of those zones.

Quesada (1991) gathering the concept of "Tectono-stratigraphic Terranes" of Coney *et al*. (1980), proposes a "Tectono-stratigraphic Terrane Map of the Hesperian Massif" which globalizes and gives a new signification to the former subdivisions, completing his proposal in 1992. To start with, Quesada defines an "Autochthonous Iberian Block", formed by a "Proterozoic Iberian Autochthon" to which is affixed the "Ossa Morena Terrane" during the Vendian. The Hesperian Massif would be completed with the "Ophiolitic Terranes", the "North-western Polymetamorphic Terrane", the "Pulo do Lobo Terrane" and the "South-Portuguese Terrane", which were juxtaposed during different stages of the Variscan Orogen.

In the scheme and within the "Autochthonous Iberian Block", the "Porto-Badajoz- Cordoba shear band" would be the structure forming the limit between the "Ossa Morena Terrane" and the "Proterozoic Iberian Autochthonous block" (for which we like better the name "Cadomian Iberian Autochthonous") in a cycle which reaches the Lower Paleozoic, and at the end of the cycle the block is finally structured. However the significance of the "Porto-Badajoz- Cordoba shear band" is at present again under discussion, and in the new postulates it has a smaller significance.

Nevertheless, in areas located either northwards or southwards of the Shear Zone or "Badajoz- Cordoba axis", we can find several common elements but distinctive in relation with adjacent areas (see Robardet, 1976, Herranz *et al.* 1977), which in addition to the existence of sharp structural limits with them, lead us to make the proposal of considering a new zone of the Hesperian Massif, having the same entity as the remaining zones and based in the same kind of arguments than those used to define the Cantabrian, West Asturian-Leonese, Central-Iberian zones, etc.., previously established. This new zone, for which we propose the name "Lusitan-Marianic Zone"[2], is limited by accidents which have a large evolutionary history and which partially are as well responsible for the individuality of its characteristics. This new zone mainly corresponds with the well known Obejo-Valsequillo Domain, but to our understanding it must also include some other bands, originally depicted by Herranz *et al.* (1977), and described below.

4. Limits and stratigraphic characteristics of Ossa Morena: proposal of the Lusitan-Marianic Zone.

For Ossa Morena we mean here the zone with the NE limit proposed by Lotze (1945) whose conception has been later used again or precised by several authors. Some other meanings of Ossa Morena (based only in the Paleozoic rocks or in the vergence of the folds) mark the position of the north-eastern boundary in the Badajoz- Cordoba Axis or in Malcocinado Fault.

Whereas the Southern limit of the Ossa-Morena Zone since Lotze's initial proposal has not been significantly modified, and most authors identify this boundary with "Ficalho-Almonaster Fault" and the "Beja-Acebuches Ophiolite", the Northern limit however, has been the subject of continuous discussions and modifications.

According to Julivert (1983, pp 67-68), the limits between the Hesperian Massif zones, should be also the boundaries between different structural domains, and if possible, coincide with some important structural features. In the case of the new Lusitan-Marianic Zone proposed here, the limits coincide with the northern boundary of the "Obejo-Valsequillo-Puebla de la Reina domain", that several authors consider at present as forming part of the Central Iberian Zone, and the southern limit of the "Sierra Albarrana domain" (Apalategui *et al*., 1990).

These limits correspond in fact to structural features that were real paleogeographic barriers during several stages of the geologic history of this area. Moreover the region between these two limits shows long known structural and metamorphic-magmatic singularities (even a metallogenic singularity) largely demonstrated (Chacón *et al.*., 1974; Apalategui *et al.*, 1990; Sánchez Carretero *et al*., 1990; Locutura *et al*., 1990; Ábalos and Eguiluz, 1992; etc...) which strengthen the hypothesis that this zone would be a differentiated zone in the Hesperian Massif. The northern limit coincides with the igneous alignment of "Los Pedroches Axis", the classic boundary of Lotze's (1945) subdivision, later assumed by Julivert *et al*. (1972). The southern limit is the Malcocinado fault, beyond which the stratigraphic and paleogeographic characteristics are differentiated, extended and maintained until the southern Ossa Morena limit (Fig 2). The exact location of the Malcocinado Fault is detailed in Ábalos and Díaz Cusí (1995).

[2] Lusitan-Marianic: name based on the Lusitans, pre-roman people who lived in Central Portugal as well as in Zamora, Salamanca and Extremadura in present Spain. The second word of the name is taken from the Latin "Marianus Mons", the mountainous metalliferous ore district that extended on the north side of the Betis river (present Guadalquivir river) valley from the north of present Huelva province and beyond Andújar (Jaén province) to Alcaraz (Albacete province). The name has then an ethno-geographic character as the other zones.

The name Lusitan-Marianic Zone was used for the first time during the proposal of the new zone during a congress by Herranz Araújo *et al.* (1999), and it has been already considered by Gutiérrez-Marco *et al.* (2002) and García-Alcalde *et al.* (2002), where the name is considered as well in the book index (page 630). García-Alcalde *et al.* (*op. cit.*, page 82) states new differential characteristics for the Devonian series of the Obejo-Valsequillo domain and in consequence for the Lusitan-Marianic Zone.

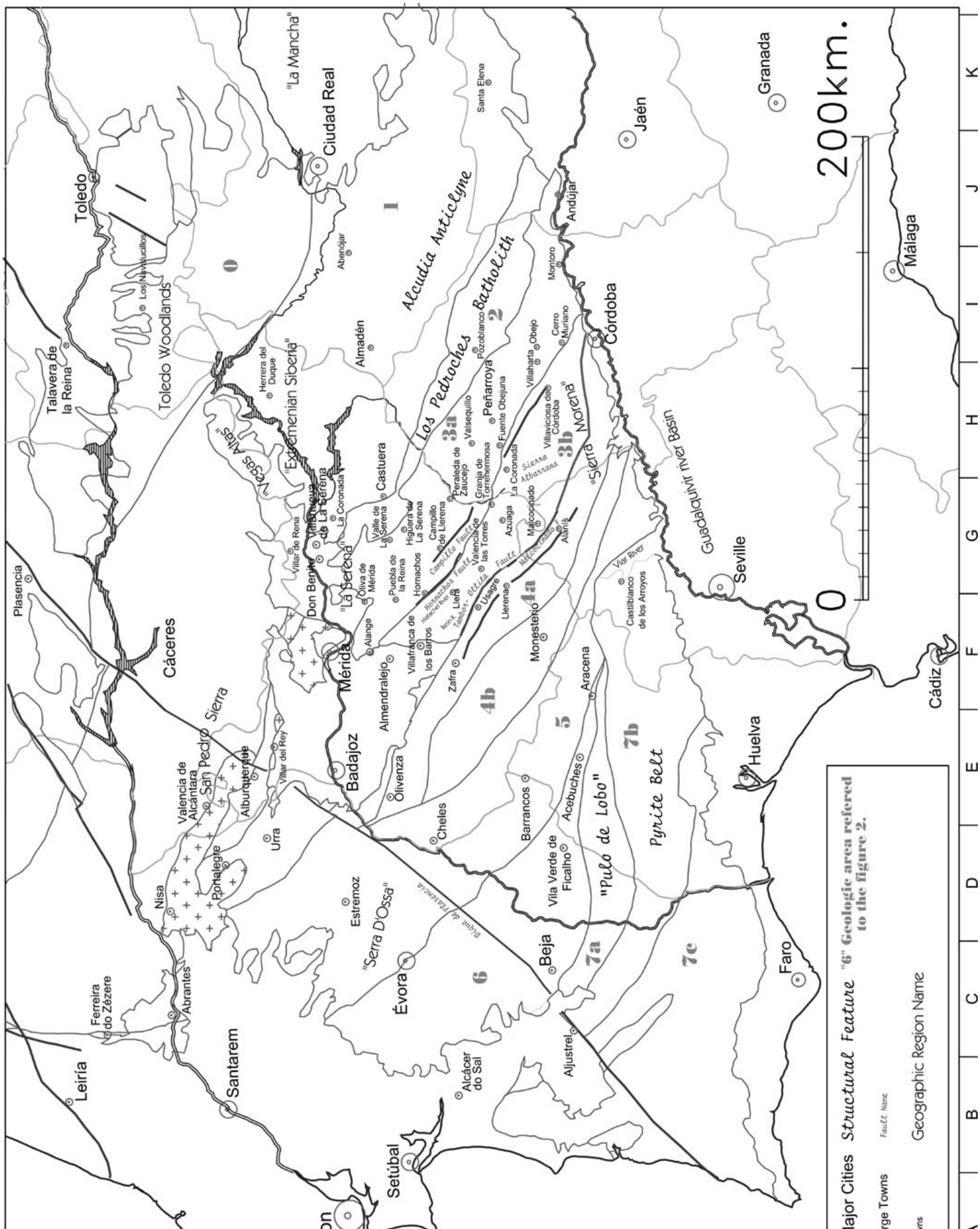
The main stratigraphic characteristics of this new zone which make it different from the limiting areas are the coexistence of Proterozoic rocks with typical Ossa Morena affinities and the presence of post-Cambrian Paleozoic rocks which are alike to those of the neighbouring Central Iberian Zone (*sensu* Lotze 1945, and Julivert *et al*. 1974). These rocks are also completely different from those appearing in the closest outcrops to the South of Malcocinado Fault. In more detail, the stratigraphic features of this zone can be resumed as follows (units advanced by Herranz *et al.* (1977) and described by Herranz Araújo (1984; 1985) (Fig. 3):

-The Precambrian polymetamorphic complex (Lower Bæturian) does not crop out to the North of Campillo Fault.

-The metasedimentary Upper Bæturian consisting of black laminated quartzites, limestones, metalydites and meta-ampelites (corresponding to the outstanding part of the formerly called "Serie Negra") appears in this zone even in structures located very close to its northern boundary (as Peraleda, Valle and Oliva de Mérida anticlines). These metamorphic rocks never surpass the "Pedroches axis" or its north-westerly prolongation, as stated by Herranz *et al.* (1977).

It is very important to point out that the Precambrian and some Lower Cambrian rocks were affected both in Ossa Morena and in the proposed Lusitan-Marianic Zone by the Cadomian orogeny. The latter, produced deformation, with folding and schistosity and metamorphism, volcanism and plutonism. A Precambrian deformation accompanied by metamorphism and schistosity was first recognized by Llopis *et al.* (1970) who considered the existence of a Precambrian Orogen (not yet called Cadomian) in the nucleus of the Peraleda anticline. Llopis *et al.* (p.28) also stated that a "highly tectonised meta-schist basement" (Mv-Cl quartz-schists with Q-pegmatite segregation and Biotite relics) was affected by NE-SW m-scale major folding, and cm-scale homo-axial refolding.

The first isotopic dating of this Cadomian metamorphism was obtained using the $^{40}Ar/^{39}Ar$ technique (Blatrix and Burg, 1981). They dated one muscovite concentrate from schist from the core of the Peraleda anticline corresponding to the "Serie Negra" and more specifically to


Toledo
Ciudad Real
"La Mancha"
Talavera de la Reina
Toledo Woodlands
Los Navalucillos
Almadén
Abenójar
Alcudia Anticlyne
Batholith
Los Pedroches
"Extremenian Siberia"
"Vegas Altas"
Herrera del Duque
Castuera
Peñarroya
Pozoblanco
Córdoba
Montoro
Andújar
Jaén
Granada
Santa Elena
Cerro Muriano
Obejo
Villaharta
Fuente Obejuna
Valsequillo
Villaviciosa de Córdoba
"Sierra Morena"
Sierra Albarrana
La Coronada
Granja de Torrehermosa
Peraleda de Zaucejo
Azuaga
Malcocinado
Alanís
Campillo de Llerena
Higuera de La Serena
Valle de La Serena
Villanueva de La Serena
Don Benito
"La Serena"
Villar de Rena
Oliva de Mérida
Puebla de la Reina
Hornachos
Campillo Fault
Hornachos Fault
Valencia de las Torres
Llera
Usagre
Llerena
Monesterio
Villafranca de los Barros
Zafra
Alange
Mérida
Almendralejo
Badajoz
Olivenza
Cheles
Barrancos
Acebuches
Aracena
Castilblanco de los Arroyos
Viar River
Guadalquivir river Basin
Seville
Cádiz
Huelva
Pyrite Belt
"Pulo de Lobo"
Vila Verde de Ficalho
Beja
Faro
Aljustrel
Alcácer do Sal
Setúbal
Lisbon
Santarem
Leiria
Ferreira do Zêzere
Abrantes
Évora
"Serra D'Ossa"
Estremoz
Portalegre
Nisa
Urra
Valencia de Alcántara
San Pedro Sierra
Alburquerque
Villar del Rey
Cáceres
Plasencia
Málaga
Dique de Plasencia
200km.
0
Major Cities
Large Towns
Towns
Structural Feature
Fault Name
Geographic Region Name
"6" Geologic area refered to the figure 2.
0
1
2
3a
3b
4a
4b
5
6
7a
7b
7c
A
B
C
D
E
F
G
H
I
J
K
1
2
3
4
5
6
7
8

Glossary of Geographic and Geologic names and their coordinates in the map

Abenójar I6
Abrantes C7
Acebuches E4
Alange F6
Alanís G4
Alburquerque E7
Alcácer do Sal B5
Alcudia Anticline I5
Almadén I6
Aljustrel C4
Andújar J4
Aracena F4
Azuaga G4
Barrancos E4
Beja C4
Cáceres F7
Campillo de Llerena G5
Campillo Fault G5
Castilblanco de los Arroyos G3
Castuera G5
Cerro Muriano I4
Cerrón del Hornillo syncline G3
Cheles D5
Córdoba I4
Don Benito G6
Estremoz D6
Évora C5
Ferreira do Zêzere C8
Ficalho D4
Fuenteobejuna H5
Granja de Torrehermosa G5
Guadalmez H6
Guadalquivir depression G3
Herrera del Duque H7
Higuera de Llerena G5
Hornachos Fault G5
La Coronada G6
La Serena G6
Leiria B8
Llera F5
Los Pedroches batholithic complex H5
Malcocinado G4
Malcocinado Fault G4
Matachel river G5
Mérida F6
Monesterio F4
Montoro I4
Navalucillos I8
Nisa D7
Obejo I4
Oliva de Mérida F6
Olivenza E5
Peñarroya H5
Peraleda de Zaucejo G5
Portalegre D7
Porto (see Fig. 1)
Pozoblanco I5
Puebla de la Reina F5
Pulo do Lobo D4
Pyrite belt E3
Retín river F5
San Pedro Sierra E7
Santa Elena K5
Serra D'Ossa C6
Seville G3
Sierra Albarrana H4
Sierra Morena H4
South Portuguese Zone C3
Tambor-Ollita Fault F5
Toledo J8
Urra D6
Usagre F5
Valencia de Alcántara E7
Valencia de las Torres G5
Valle de la Serena G5
Valsequillo H5
Vegas Altas H7
Viar river G3
Villafranca de los Barros F5
Villaharta I4
Villanueva de la Serena G6
Villar de Rena G6
Villar del Rey E6
Villaviciosa H4
Zafra F5.

Fig.4.- General location map, based in figure 2, in which the geographic and geologic names mentioned in the text have been included.
Fig.4.- Esquema geográfico con indicación de las poblaciones mencionadas en el texto, así como accidentes geográficos y principales estructuras tectónicas, con una cuadrícula de referencia. El mapa base corresponde a la figura 2, suprimiendo las tramas y conservando los límites de las bandas.

Bæturian P5 (Herranz Araújo, 1984, 1985). A cooling age of 550 ± 10 M.a. proves the existence of a deformation accompanied by regional metamorphism during Upper Precambrian, which can be considered Cadomian or related with the Pan-African II phase. The remaining ages obtained by Blatrix and Burg (1981) were cooling ages from 295 to 334 Ma which prove the overprinting by a low grade Variscan metamorphism with sericite as index mineral. It probably did not affect to a significant extent the Ar systematics of the muscovite sample from Peraleda. Moreover Blatrix and Burg (1981) stated that "the dated mica lies within the axial plane cleavage of second phase isoclinal folds. The formation of these micas corresponds to the last metamorphic event which affected these rocks", which implies that the "Serie Negra" underwent deformation and metamorphic events older than 550 Ma (i.e. the biotite relics related with the m-scale major folding, from Llopis *et al.,* 1970).

-A possible regional equivalent to the Lower Alcudian of the neighbouring Central-Iberian Zone lies here upon a patent angular unconformity upon Upper Bæturian rocks accompanied by a metamorphic discontinuity. It shows a basal conglomerate with pebbles of Bæturian rocks in the band "Urra-Villar del Rey- Sierra Negra". Both "Lower Alcudian" units, the genuine from the Central Iberian Zone and the one from the LMZ here discussed, could represent different paleogeographic sceneries, because they may have been deposited in separated basins with different tectonic settings but both synorogenic. This "Lower Alcudian" unit occurs widespread in the LMZ between the "Pedroches axis" and the Malcocinado Fault, but it never reappears to the SW of this fault.

-There is also another unit which might be an "Upper Alcudian" time equivalent of Central Iberian Zone rocks. It crops out only in restricted areas between the "Badajoz-Cordoba axis" and the Pedroches axis. In this unit, facies are increasingly distal towards the NE as approaching the Pedroches axis. Contrarily, just to the North of that axis, in the region known as La Serena, the local Upper Alcudian consists of littoral facies and even continental deposits deepening towards the N and the NE (Pieren *et al.*, 1991; Pieren, 2000). Still northern, the Upper Alcudian from the type area in the Alcudia Anticline is a little younger. It is already Lower Cambrian from the same base (Nemakitian-Daldynian to Atdabanian), and its facies are also very shallow marine with some continental prograding pulses (Pieren and García-Hidalgo, 1999). The Upper Alcudian group, in the last two mentioned areas, depicts a basin with a margin in the South and becoming increasingly deeper towards the NE.

-Unconformably overlaying the units referred there are volcanic rocks close to the Precambrian-Cambrian boundary. These were called "Terminal Precambrian Vulcanites" by Herranz Araújo (1984, 1985) but recent local dating suggests a Lower Cambrian age (520 M.a., Eguiluz *et al.*, 1999). This kind of rocks does not exist to the N of the Pedroches axis. These volcanics are predominantly andesites with subordinated rhyolites, and are known as the Malcocinado Fm. and equivalent formations. They are found broadly over the whole Ossa-Morena Zone, as north as the Valle-Higuera core, close to Pedroches lineation, but never beyond.

-Some other marine Cambrian outcrops are locally found in this zone. However a paleo-connection between the Cambrian rocks in the Usagre area (immediately to the South of the Malcocinado Fault) and the outcrops of Puebla de la Reina- Campillo within the new zone herein proposed cannot be confirmed at present. The outcrops of Puebla de la Reina, where a volcanosedimentary complex occurs cannot be distinguished from the Lower Cambrian vulcanites mentioned in the previous paragraph. The northernmost Cambrian outcrop which is also the closest to the Pedroches Axis are the marine Lower Cambrian rocks found at Alange. Just 200 km further NE, in the Navalucillos region, evoking marine Cambrian succesions can be found. Some other Cambrian marine outcrops can be also found in the Alcudia anticline, but in both cases the succession and the chronology are different.

The Lower Cambrian succession from Alange and Puebla de la Reina-Campillo is privative of the proposed Zone and does not have any direct correlation neither with the equivalents in Los Navalucillos region, nor in La Serena-Alcudia-Abenójar regions (both in the CIZ), nor with those immediately located towards the South of Malcocinado Fault (in the OMZ).

-There is an important stratigraphic gap corresponding to the Middle and the Upper Cambrian, but the chronological limits of this gap remain still uncertain in the Lusitan-Marianic Zone. Contrarily, immediately south of the Malcocinado Fault, the Middle Cambrian is widely represented by fossil-rich terrigenous and volcanoclastic facies which can reach up to the early Upper Cambrian.

-In the Lusitan-Marianic Zone, in contrast to the contiguous zones, there is a remarkable thick and characteristic succession of alternating shales and metric quartzite beds, which is considered of Upper Cambrian-Lowermost Ordovician. It was laid down in several subsiding trenches most of them located between the Malcocinado Fault and the Pedroches Axis. Similar deposits have just been found to the North of Los Pedroches in the small hills near Villar de Rena, close to Villanueva de la Serena.

-Another characteristic of this zone is the existence of a "Basal Ordovician" succession, underlying the "Armorican Quartzite". It has a marked volcanoclastic

composition and it appears relaying the Upper Cambrian quartz-pelitic succession referred to above, preserved in diverse paleo-trenches. It is never found to the SW of the Hornachos Fault. Although a similar succession can be recognized NW of the "Pedroches Axis" it appears to be of minor importance and to be anomalous in sequences and facies. This is thus a unit which is almost privative of the Lusitan-Marianic Zone.

-The rest of the Ordovician, begins with the diachronic "Armorican Quartzite", which becomes younger as we move southwards but disappearing completely beyond the Badajoz- Cordoba Axis". Very probably this remarkable formation never surpassed this axis, and was never connected with the Ordovician rocks exposed south of the Malcocinado Fault. The latter rocks are different in age and facies (Barrancos, Barriga, Serra Colorada and Xistos de Moura Fms.). On the contrary, this formation shows similar age, thickness and facies as the corresponding formation of the Central Iberian Zone, although it shows more frequent and larger discontinuities.

-In addition there also exist, in the south-eastern Lusitan-Marianic Zone some Ordovician anomalous facies, such as some Arenig limestones with trilobites, ostracodes and conodonts (Gutiérrez Marco and Sarmiento: *pers. com.*), which do not exist in the Central Iberian Zone and which are also different in age and facies to those outcropping in the North of the Seville province, in the neighbouring Ossa-Morena Zone.

-There is strong evidence that the extensive Silurian deposits surpassed the "Badajoz-Cordoba axis" (continuously or perhaps discontinuously) and were deposited to the south of it directly on an eroded basement formed by the levelled oldest Precambrian substratum. The Silurian rocks show then a continuity in the CIZ, the LMZ and in Ossa Morena, but it is only in the OMZ where they directly lye on the metamorphosed Precambrian basement marking an important stratigraphic and metamorphic discontinuity. In the CIZ and the LMZ it overlies paraconformably the Ordovician deposits.

-Lower Devonian deposits of the Lusitan-Marianic Zone do not extend SW of the Hornachos and Malcocinado faults; however they do extend beyond the Pedroches Axis. These deposits show local facies variations with respect to the typical Central Iberian facies, as stated by Pardo (1999) and García-Alcalde *et al.* (2002). On the other hand they are radically different from the Lower Devonian succession which crops out in "El Valle" and "Cerrón del Hornillo" synclines in southern Ossa Morena.

-Upper Devonian sedimentary rocks do not extend south of the Hornachos Fault. Moreover their facies and characteristics are different from those of the Upper Devonian deposits in the Ossa Morena and South-Portuguese Zones. Towards the NE, rocks of this age can be found near the Pedroches Axis, showing similarities with correlative Upper Devonian deposits in synclines of the neighbouring Central Iberian Zone (Guadalmez, Almadén, Herrera del Duque, Cáceres and Sierra de San Pedro synclines). In the Pedroches axis, the characteristics and facies of the Upper Devonian succession make it sometimes difficult to distinguish it from the Carboniferous Culm sequence. Depending on the areas the Upper Devonian succession may directly overlie the metamorphosed Precambrian basement ("Serie Negra") or rest on rocks as young as Early Devonian. This fact proves the existence of a previous folding phase producing large folds that were deeply eroded before the Upper Devonian.

-In the Lusitan-Marianic Zone, Carboniferous rocks do not present characteristics different from those of neighbouring areas. The structure of the area was almost ended, in the late or posthumous phases when the Carboniferous series were deposited. This probably explains why some Carboniferous units and some large outcrops of this age are found on both sides of the zone boundaries (for example the "Culm" sediments surrounding the Pedroches batholith, are present in both the Central Iberian and in the Lusitan-Marianic Zones), indicating that during the deposition of such units the main regional geological units where already outlined and the old basement emerged. Excepting the "Culm", the Early Carboniferous rocks in this zone occur filling zones that were morphotectonically depressed. The deposits are continental sedimentary rocks that evolved in time into extensive marine facies. Early Carboniferous deposits often occur in disperse outcrops, sometimes sheltered by NE-wards overthrusts that developed during the posthumous transpressive tectonic stages of the Variscan orogeny, and were also related with a calc-alkaline volcanism. The marginal facies were debris flows associated with deposits with olistolithic character that in addition to the volcanic occurrences confirm the importance of a synsedimentary tectonic activity by transcurrent faulting which persisted during the Stephanian B and C (Gonzalo, 1989). Transcurrent faults are younger than the thrusts which only occur in the southern limb of the Carboniferous rocks outcrops, but all faults have the same direction; the Lower Carboniferous deposits were controlled and limited by these two kinds of faults. This type of tectonic setting for the Lower Carboniferous deposits is exclusive of the Lusitan-Marianic Zone.

From the above information we can draw the conclusion that there was a paleogeographic barrier separating one part of Iberia with middle-European affinities from another of Tethysian- African affinities. This barrier, active since the Ordovician, may not have been far away, but during that time it was likely placed beyond the limits of the proposed

Lusitan-Marianic Zone, very likely in the core of Ossa Morena. The possibility or impossibility (which is in this case more important) to establish an accurate correlation with the neighbouring areas is summarized in the figure 3, where the successive positions of the mentioned barriers separating paleogeographic domains is also indicated.

The band 3a presented in the figure 3 (equivalent to the Mérida-Montoro band or to the well-known Obejo Valsequillo domain), matches specifically the conditions that we have stated to describe the new Lusitan-Marianic Zone. However the band 3b also corresponds to the concepts described regarding the Precambrian substratum but it has "Lower Paleozoic" outcrops which are problematic either for their Paleozoic age which is not properly dated or for their ascription to the Central-Iberian type. In most of the 1/50.000 geological maps (MAGNA) they have been differentiated for their lithology but they have been tentatively or doubtfully ascribed to a possible and undifferentiated Precambrian age. These outcrops are those from the Matachel river valley (South of Hornachos), the Retín river Valley (South of Higuera de LLerena and Llera) and the Sierra Albarrana (Fig. 4).

Thus, this band 3b apparently verifies the conditions. Logically the Hornachos Fault line could not be a sharp barrier during the whole Ordovician and persisting until the Upper Devonian; this barrier would be surpassed towards the SW until the "Ossa Morena" core. The Malcocinado Fault could then be the definitive barrier located in the SW. Thus, using the present cartographic criterion, the SW limit is in the Hornachos Fault and its prolongation through Granja de Torrehermosa. If we use a large paleogeographic criterion the limit would be in Malcocinado Fault (or Tambor-Ollita Fault, Herranz Araújo, 1984), or perhaps, even a little southwards beyond.

5. Conclusions

Considering a classical subdivision into zones of the Hesperian Massif, the traditional boundary between the "Central Iberian" and "Ossa Morena" zones was an elongated late Variscan plutonic complex, with a 120º strike, known as Los Pedroches Batholith.

Later authors have proposed or admitted the substitution of such limit by a sub-parallel line located 50 (present) km towards the SSW of the former one. The new limit is a straight band initially interpreted as a great Variscan synmetamorphic sinistral wrench fault known with several names among which the most significant is "Badajoz-Cordoba blastomylonitic belt". Several papers have discussed during the last 35 years the age, structure, significance, characteristics and the geographic reach towards NW of this large transcurrent fault.

In this work as well as in some former articles of the same authors, the validity of this new boundary is denied, insisting in the former limit of "Los Pedroches axis", but as a structure older than the batholithic complex which would only be the late seal of a linear pre-Variscan megastructure.

We propose here a new turn for the polemic on the limit of the Ossa-Morena Zone (OMZ) and the Central-Iberian Zone (CIZ) distinguishing a new zone with a hybrid character, at the expense of the first one, with the form of a longitudinal band which NNE limit would be the mentioned "Pedroches Axis" and the SSW one the "Malcocinado Fault", presently located 20 km at the SSW of the "Badajoz-Cordoba band", with a sub-parallel strike even if both extremes approach asymptotically this band.

Using stratigraphic data and arguments (which do not imply ignoring the most fundamental interpretations of the zone), the main features characterizing the proposed zone and individualizing it from its surroundings are:

1) The basement series (Proterozoic, Lower Cambrian and part of the Middle Cambrian) are identical and do even have continuity with those of the genuine and never-discussed OMZ. On the other side they are totally disparate and non-correlating with the successions forming the pre-Ordovician basement of the presently contiguous southern CIZ. This shocking disparity relates to lithostratigraphy, chronostratigraphy, discontinuities and evolutionary history, in addition to the structural and petrologic aspects. Just some levels of schists and greywackes could be "equivalent" in the OMZ to a part of the Central-Iberian Alcudian facies.

2) After an evident gap (reported but not precisely delimited) affecting part of the Middle and Upper Cambrian, complex successions of Cambro-Ordovician, Ordovician, Silurian and Devonian age are deposited in the proposed zone. These cannot be correlated with those from the SSW flank of Ossa Morena and do not exist in its nucleus or central part. Nevertheless they can be perfectly correlated with those from the neighbouring CIZ. As for the Carboniferous synorogenic successions of the OMZ and the CIZ, the present knowledge about them and the spreading of their fragmentary outcrops do not allow a thorough comparison. However the trench located in their limiting sector (Pedroches) has a physical continuity between both zones.

3) During the uppermost Proterozoic and a large part of the Cambrian, the present "Pedroches axis" corresponded to a paleogeographic barrier which tectonic significance is not considered here. During part of the Ordovician and at least until the base of Lower Carboniferous, the paleogeographic high changed its entity and precise location and migrated southwards to the core of Ossa Morena. At the

same time the former high in Los Pedroches was transformed into an important and persistent trench.

4) The new "Lusitan-Marianic Zone" proposed (LMZ) corresponds to the NNE sector of the classic OMZ located between both paleogeographic barriers. Regarding the pre-Ordovician basement it is typically from Ossa Morena and it is affected by Cadomian deformation, metamorphism, volcanism and plutonism. If we consider the post-Cambrian sequences, these are Central-Iberian but with varying and anomalous thickness. We think that this new LMZ has such a geographic-geologic entity, singularity regarding its neighbourhood and sharpness in the boundaries, that it can be considered with the rank of a new Zone of the Hesperian Massif, with an entity which is even more important than some of the traditional zones of the northern part of the Massif which limits are not so neat and significant.

Independently from its nature and genesis, the Cadomian paleo-connection line which follows the strike of "Los Pedroches axis" implies the boundary between the Iberotypic Proterozoic and Lower Cambrian successions and those having the same age and characteristic from "Ossa Morena", the latter having Nor-African affinities. During the post-Cambrian Paleozoic, the dividing line is established in Ossa Morena nucleus in the form of a complex high, which also separates the Paleozoic successions of both types.

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