SedDARE-IB: An open access repository of sediment data for Iberia and its continental margins

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Abstract

Sediments provide valuable information for geologists and geophysicists whenever they strive to understand, and reproduce, the geological evolution, lithology, rock properties, seismic response, and geohazards of a region. The analysis of sedimentary sequences is thus useful to the interpretation of depositional environments, sea-level change, climate change, and to a recognition of the sediments' source areas, amongst other aspects. By integrating sedimentary data in geophysical modelling, such interpretations are improved in terms of their accuracy and reliability. To help our further understanding of Iberia's geological evolution, geological resources and geohazards, this work presents to the scientific community the SedDARE-IB data repository. This repository includes available data of the depth to the Base Cenozoic and Top Paleozoic stratigraphic markers for the Iberian Peninsula and surrounding Iberian Western Atlantic Margin and Mediterranean Neogene basins, or to the acoustic basement as interpreted for the Valencia Trough and Alboran Mediterranean basins. As an example of the broad applicability of the data included in SedDARE-IB, we investigate how sediment thickness affects the depth to the 150°C isotherm at specific basins, as commonly used in geothermal exploration. The calculated trend suggests that, given constant measured surface heat flow and thermal conductivity, the 150°C isotherm becomes shallower as the sediment thickness increases, until a critical threshold value is reached for the latter.

SedDARE-IB database has been built thanks to a Portuguese-Spanish collaboration promoting open data exchange among institutions and research groups. SedDARE-IB is freely available at https://doi.org/10.20350/digitalCSIC/16277 (Torné et al., 2024) bringing opportunities to the scientific, industrial, and educational communities for diverse applications.

1. Introduction

Sediments are crucial in our understanding of the geological evolution, lithology, rock properties, subsurface structure, georesources and geohazards affecting particular ~~basins and~~ regions. By analyzing strata and their architecture, geologists can decipher past environmental conditions, changes in the sea level, climate variability and the nature of the rocks in source areas~~sourcing them~~, amongst other factors. Their thickness is often indicative of the presence of important resources such as oil, gas or minerals. Also, sedimentary rocks encompass a wide range of lithologies with distinct physical and mechanical properties, a detailed knowledge ~~whose detailed knowledge~~ is essential in geophysical models. Incorporating sedimentary data in geophysical modelling enhances the accuracy and reliability of subsurface models for subsequent resource exploration. In addition, sediments can contribute to the triggering or amplification of multiple geohazards, e.g. landslides, soil liquefaction and local seismicity~~,~~ ~~which they may amplify~~. By studying properties such as cohesion, shear strength and degree of compaction in sediments, one can assess potential geohazards in a region and develop proper mitigation strategies.

Sediment data curation contributes to ~~is instrumental for~~ scientific research and holds cultural significance, offering glimpses into human history and the development of morphotectonic landscapes over time. Overall, sediment data curation is integral for advancing knowledge, sustainable resource management, environmental protection, and making informed decisions in diverse scientific, economic and social fields. To facilitate our understanding of Iberia's geology, resources and hazards, this work presents SedDARE-IB as a comprehensive repository of: a) depth to the Bbase of ~~the~~ Cenozoic strata deposited in both extensional and compressional basins, and b) the Top of the Paleozoic units for the majority of sedimentary basins spanning the onshore and offshore of Iberia. SedDARE-IB includes sedimentary data on onshore basins as varied as the foreland basins of the Pyrenean-Cantabrian Orogen (Ebro and Duero basins) and Betic Cordillera (Guadalquivir Basin), the Tagus Basin and the Lusitanian and Lower Tagus basins, and many other small basins whose location is shown in Figs. 1b and 2. Offshore, SedDARE-IB comprises data from the Atlantic Margin (Alentejo, Peniche, Northern Lusitanian Basin and deep offshore depocentres), the Gulf of Cadiz region (Algarve Basin and its surroundings) and the Base of the Cenozoic ~~marker~~ for the Western Mediterranean Neogene basins, e.g., Valencia Trough and Alboran Basin, also comprising the acoustic basement for the rest of the Western Mediterranean region (see Figs. 1b and 2 for location).

As an example of the potential uses ~~applicability~~ of the SedDARE-IB data we analyze the depth of the 150°C isotherm for different surface heat-flow ~~density~~ values. Sediments play a crucial role in geothermal

energy assessments as they serve as a natural insulating layer, regulating heat transfer between the subsurface and Earth's surface. Hence, we examine in this work how sediment thickness influences subsurface temperature. SedDARE-IB can be used in geothermal studies as sediments influences heat conduction, reservoir evaluation, temperature distribution, drilling considerations, thermal conductivity, heat flow modeling, resource assessment, and environmental impact assessments. Understanding sediment thickness is therefore essential for an effective planning, development and use of geothermal energy resources.

~~Data included in SedDARE-IB are listed in Table 1, together with the main sources of information from which the data have been gathered, the geological areas covered, and the main references related to the data sets~~. The data included in SedDARE-IB are summarized in Table 1, which details the primary sources of the data, the geological areas covered, and key attributes such as the minimum, maximum, and average thickness ranges, and key references associated with the datasets.

Figure 1 (a) Elevation map of the Alpine-Himalayan Orogenic Belt as shown by the shaded area. Red square highlights the location of the Iberian Peninsula and surrounding margins. (b) Simplified geological map of the Iberian Peninsula. Iberian Massif abbreviations: CZ: Cantabrian Zone, CIZ: Central Iberian Zone; GTMZ: Galicia-Tras-Os-Montes Zone, OMZ: Ossa Morena Zone; SPZ: South Portuguese Zone; VG: Variscan Granitoids, WALZ: Western-Asturian-Leonese Zone. Other abbreviations: Cantabrian M.: Cantabrian Mountains, CCR: Catalan Coastal Ranges, CS: Central System, Guadalquivir B.: Guadalquivir Basin, LTB: Lower Tagus Basin. SC: Setubal Canyon; SVC: Sao Vicente Canyon. Adapted from Torne et al. (2015, 2023).

2. Geological outline of the Iberian Peninsula and its adjacent continental margins.

2.1 The Iberian plate during the Alpine Wilson Cycle

The Iberian Plate, presently attached to Europe along the Pyrenean orogenic system, constitutes the westernmost segment of the 12,000 km long Alpine–Himalayan Orogenic Belt, which was shaped as a result of the Late Cretaceous–Cenozoic closure of the different branches of the Tethys Ocean. Such a process resulted in the continental collision of Africa, Arabia and India with Eurasia (e.g., Dercourt et al. 1986; and many others). During the Variscan Orogenic Cycle, the relatively small Iberian Plate was located in a hinge region between Pangea and Gondwana, with its northern and southern boundaries marked by large transfer faults - currently the Pyrenees and Betic orogenic systems. In spite of having

been relatively bound by the larger Africa and Eurasian plates, the Iberian Plate evolved independently for hundreds of millions of years, a character that shaped its fairly complex Variscan and Alpine systems of basins and mountain chains. Comprehensive data on Iberia's Variscan evolution are given in Friend and Dabrio (1996), Gibbons & Moreno (2002), Vera et al. (2004) and Quesada & Oliveira (2019).

105   Permian and Triassic continental rifting in the proto-Atlantic domain culminated with the opening of the Central Atlantic Ocean south of Iberia, with subsequent transtensional motion of Africa and opening of the Ligurian-Tethys starting at c. 156 Ma (Late Jurassic - Vergés and Fernàndez, 2006). This Jurassic oceanized lithosphere shaped the boundaries of Iberia by developing the rift-related Algarve, Prebetic and Subbetic basins to the south, and also the Catalan basin to the east. Such basins were later included as part

110   of the Betic and Catalan Coastal Ranges orogenic systems. The northern propagation of the southern North Atlantic starting at about 118 Ma (Early Cretaceous) occurred along the Iberian Atlantic margin and led to the formation of large rift-related basins of Permo–Triassic and Jurassic–Lower Cretaceous age. Such basins were developed along the Iberian Atlantic margin and form the Alentejo, Lusitanian, Peniche, Porto, Galicia Bank basins (Fig. 1).

115   The opening of the Central and Southern North Atlantic segments initiated the fairly synchronous eastwards drift of both Africa and Iberia with respect to Eurasia along the inherited Variscan northern boundary of Iberia, a phenomenon that started in the Early Cretaceous and ended in the late Santonian time at around 83.5 Ma (Macchiavelli et al., 2017). The salt-richelated, transtensional Basque-Cantabrian basin mostly evolved during this time (Cámara, 2017), together with the Organyà (Casini et al., 2023) and

120   the North Pyrenees basins (Ford and Vergés, 2021).

North-south convergence between Africa and Eurasia started at 83.5 Ma and is still active at present. Africa-Eurasia convergence resulted in significant deformation within Iberia, and affected the previous Iberian Mesozoic rift-related basins. Along the northern margin of Iberia, the Pyrenees Range emerged because of continental collision and limited northward subduction. In the southern margin of Iberia - a

125   more complex region involving the Betics and Rif mountain ranges, the Alboran Sea, and the Gulf of Cadiz - formed the subduction-related Betic-Rif orogenic system. The interior of Iberia was also shortened, mostly along relatively weak intra-continental regions associated with Mesozoic rifting. This triggered tectonic inversion in the E-W Basque-Cantabrian Basin, the NW-SE Iberian and Altomira ranges, the NE-SE Central System and the NE-SW Catalan Coastal Ranges (Muñoz-Martín and De

130   Vicente, 1998; Vergés and Fernàndez, 2006; Casas-Sainz and Faccenna, 2001). All these inversion-related fold-and-thrust systems are linked at their respective connection zones where distinct fold trends coexist. The smooth variations in structural trends among compressive fold-and-thrust belts, as illustrated in the

Iberia Geological Map at the 1:1,000,000 scale (Rodríguez-Fernández et al., 2015), suggest their simultaneous developmentoccurrence, at least to some extent (Anadón and Roca, 1996; Casas-Sainz and
135 Faccenna, 2001; Vergés and Fernàndez, 2006). In such a regional context, the western margin of Iberia along Portugal also shows mild inversion tectonics, which becomes more significant towards the south (e.g., Alves et al. 2003; Zitellini et al. 2004; Terrinha et al, 2009; Ramos et al., 2016; Cunha et al., 2019; Alves, 2024).

2.2 Iberia mainland

140 In mainland Iberia, the SedDARE-IB data were organized in six (6) major areas: a) the Pyrenees and Ebro Basin (PE), b) the Duero and the Basque-Cantabrian basins (DB), c) the Iberian Range and the Tagus and Almazán basins (ITA), d) the Guadalquivir Basin and the External Betics (GB), and the Lower Tagus Cenozoic Basin (LTCB) (Fig. 2). For the Top of Paleozoic marker, the Ebro Basin domain and Tagus and Almazán basins area have been expanded to the Southern Pyrenees and the Iberian Range, respectively.
145 (Fig. 2). Figures 3 and 4 show the location of the points and seismic profiles included in the database, while Figs. 5 and 6 are an example of the grids generated from the database.

Figure 2 Simplified geological map showing the location of the data sets listed in Table 1. Modified from Torne et al. (2015).

150 **2.2.1 Ebro Foreland Basin (EB)**

The Ebro Foreland Basin, spanning approximately 85,500 km^2, is limited by the Pyrenees and the Basque-Cantabrian Fold Belt to the north. The basin represents the latest evolution stage of the long-lived evolution of the Southern Pyrenean foreland basin, which has lasted from the latest Cretaceous until the present day. The Ebro Foreland Basin reached a 5-6 km thick Paleocene-Oligocene sedimentary infill,
155 displayings an irregular geometry in map view, as since it is also boundedlimited by the Catalan Coastal Ranges to the SE and the Iberian Range to the SW. The basin records a long-lasting evolution; was first originated as the Pyrenean foreland basin, and was later filled with shallow- to deep-marine deposits along a tectonic trough that was subparallel to the southern front of the Pyrenees (Puigdefàbregas et al., 1992). The basin changed to an endorheic system at approximately 36 Ma as the Western Pyrenees marine
160 gateway was closed (Costa et al., 2010). Alluvial, fluvial, and lacustrine depositional systems prevailed until the middle to upper Miocene (García-Castellanos et al., 2003).

The Ebro Foreland Basin remained endorheic for about 27 million of years until the Oligo-Miocene opening of the Western Mediterranean basins. This opening triggered the formation of a Mediterranean river system, leading to the capture of its drainage network (Lewis et al., 2000). It also caused significant denudation; an area of 25,000 to 45,000 km² was eroded at a rate of 47-80 mm/kyr, a phenomenon that resulted in the subsequent isostatic rebound of the basin by up to 630 m (García-Castellanos and Larrasoaña, 2015). The depositional record of this erosion is found in the Castellón Group of the Valencia Trough (Martínez Del Olmo, 1996; Arche et al., 2010).

2.2.2 Duero and the Basque-Cantabrian basins (CD)

The intermontane Duero Basin, with an area of approximately 98,500 km², is bounded by several mountain ranges and is one of the highest Alpine intra-mountain basins in Europe (Casas-Sainz and De Vicente, 2009) (Fig. 1B). Its average altitude is in excess of 800 metres. It contains a thicker sedimentary infill in its northern sector, associated with the Alpine fronts of the inverted Basque-Cantabrian Basin and the Alpine reactivation of the Variscan Cantabrian Range. This fill gradually thins outs towards the southern and western boundaries of the basin, on Variscan basement rocks (Civis and Vera, 2004; Herrero et al., 2004; Quesada et al., 2019). Sediment infill above Mesozoic deposits varies across different geological epochs, with changing thicknesses and areal extents. The Paleogene to late Miocene sedimentary infill generally exceeds 2500 meters in the basin centre. Notably, the youngest sedimentary infill in the basin correlates to the top of the fluvial–lacustrine carbonates of the Páramo Formation, which are dated to about 9.6 Ma (Krijgsman et al., 1996; Cunha et al., 2019). The opening of the Duero Basin to the Atlantic Ocean occurred in late Pliocene to Pleistocene times, with further incision occurring later. The exact timing of this opening is still debated, with some suggesting it occurred around 1.1–1.9 Ma, while others propose it might have happened earlier, in the middle Tortonian. Regardless of its age, the opening of the Duero Basin to the Atlantic Ocean marked a significant reorganization of fluvial networks within it (Antón et al., 2012, 2019; Silva et al., 2016; Struth et al., 2019 and 2021).

2.2.3 Tagus and Almazán basins (TAB)

The Tagus Basin, located in the center of the Iberian Peninsula and covering approximately 20,000 km², is bordered by the Central System to the north, the Iberian System to the east, and the western sector of the Montes de Toledo to the south. It comprises two distinct sub-basins: the intra-mountainous Madrid Basin and the Loranca (also known as the Intermediate Depression), which comprises a piggy-back depocenter in the eastern part of the Tagus Basin. These basins were individualized due to tectonic uplift of the Sierra de Altomira during the late Paleogene, and their Cenozoic evolution was influenced by

tectonics and climate change (Alonso-Zarza et al., 2004). Sediments in the Tagus Basin consist of Paleogene shales, gypsum, conglomerates and limestones predominantly formed in alluvial fan systems alongside evaporitic lakes and lacustrine marls. The estimated thickness is of up to 3000 m and its maximum deposition occurred during the Miocene period. Miocene sediments comprise alluvial fan and lacustrine facies, which are capped by lacustrine limestones and Pliocene detrital sediments. The Intermediate Depression is a narrow depocentre located to the east of the Madrid Basin, and contains Upper Cretaceous shales and gypsum, younger alluvial and lacustrine fan intervals, fluvial and floodplain sediments, and Pliocene lacustrine sands and limestones (Paramo limestones) alongside other detrital materials (Alonso-Zarza et al., 2004; De Vicente et al., 2004).

2.2.4 Lower Tagus Basin (LTB)

The Lower Tagus Basin is surrounded by Mesozoic sediments of the Lusitanian Basin to the west and pre-Mesozoic igneous and metamorphic rocks to the east. The basin is exclusively Cenozoic in age and sits on Cretaceous strata in its southern part, Middle Jurassic units in its northern part, and Paleozoic rocks in its eastern part. Paleogene continental strata, 200-400 m thick, accumulated first in the basin during the Late Eocene and Oligocene in response to NNE-SSW convergence of Iberia and Africa (Carvalho, 1995; Cabral et al., 2003). Miocene tectonics overprinted the Paleogene structures, with the LTB evolving as a compressive foredeep basin related to tectonic inversion of the Lusitanian Basin under NW-SE compression. Miocene strata, exceeding 800 m in local depocenters near Lisbon (Cabral et al., 2003), include sandstones, clays and limestones deposited in shallow marine, mixed lagoonal, shallow water and continental environments (Pais et al., 2012). Tectonic subsidence in the basin slowed down during the Pliocene, as marked by the deposition of about 300 m of fluvial sediments, mainly sands and clayey or silty sands. Tectonic uplift predominated after the Early Pleistocene, while sands and clays topped by levels of pebbles are typically found in Pleistocene strata. These are overlain by Holocene alluvium deposited by the Tagus River. Tectonic compression continues to the present day, with maximum horizontal compressive stress trending NW-SE to WNW-ESE (e.g. Ribeiro et al., 1996; Borges et al., 2001).

2.2.5 The Guadalquivir Foreland Basin (GB)

The Guadalquivir Foreland Basin, located in the southern part of the Iberian Peninsula and spanning c. 57,000 km², is a foreland basin bounded to the north by the Iberian Massif and to the south by the Betic Cordillera, which continues into the Rif Chain of northern Africa. Like Similarly, to the westernmost part of the Betics, it was influenced by post-Cretaceous tectonic movements between Africa and Eurasia.

Studies suggest significant N-S convergence to have affected the Guadalquivir Basin from mid-Oligocene to the late Miocene, followed by WNW-directed oblique convergence until the present day (Macchiavelli et al., 2017). According to Barnolas et al. (2019) and references therein, the basin can be divided into two zones. The northern one is filled with autochthonous sediments, whereas the southern zone also contains chaotic masses of Mesozoic and Cenozoic allochthonous materials that slid from the Subbetic units during the late Miocene compression in the external Betics. The autochthonous sedimentary infill The basin involvescomprises six (6) Miocene seismic-stratigraphic sequences, ranging in age from middle Miocene (the –late Langhian-early Serravallian) to the late Miocene (Messinian). Overlying these Miocene sequences are Pliocene-Quaternary strata that record westward sediment progradation along the basin axis that are overlain by Pliocene Quaternary strata that record westward sediment progradation along the basin axis (Berástegui et al., 1998). The southern border of the basin involvescomprises several salt diapirs, with Triassic evaporates in their cores, that were tectonically compressed during the Cenozoic. They form multiple frontal imbricate wedges. The frontal imbricates involve late Serravallian to late Tortonian sediments (sequences 3 to 5, as described by Berastegui et al. (1998). In particular, Sequence 6, which spans from the late Tortonian to the late Messinian, clearly postdates all the structural features. This indicates that significant shortening in the External Betics was concluded by approximately 6.3 Ma (Messinian). Tectonic activity, including normal faulting at basement level, occurred during early to middle Serravallian times. The basin primarily originated through orogenic wedge accretion along its active southern margin, with flexural subsidence propagating towards the foreland basin per se (García-Castellanos et al., 2002). The Guadalquivir Foreland Basin depocenter is 600 m thick in the east but is up to 1800 m thick in its western region. Readers are directed to the work of Civis et al. (2004) and Barnolas et al. (2019) for further detail on the basin's sedimentary infill and evolution

Figure 3 Offshore: Location of seismic profiles used forto interpreting and gathering data for the Top of Paleozoic, or Acoustic Basement for most of the Western Mediterranean region. Exceptions are the Valencia Trough and the Alboran Basin, where the Acoustic Basement corresponds to the Base of Cenozoic or the so-called Oligocene unconformity. Onshore: location of x,y,z data obtained from available seismic, log data and geological information

2.3 Iberian offshore basins

2.3.1 IberiaWest Atlantic Margin

The ~~West~~ Iberia Atlantic~~n~~ Margin is, essentially, a divergent margin reactivated tectonically since the end
255   of the Cretaceous. It witnessed continental rifting from the Late Triassic to the Early Cretaceous.
Diachronous continental breakup along this margin occurred over a period spanning from the latest
Jurassic to the Albian/Cenomaniann (Alves and Cunha, 2018). Breakup propagated from southwest to
north Iberia, extending towards the Bay of Biscay (Grevemeyer et al., 2022). Two main episodes of
magmatism are recorded during this process: the first around 200 Ma (Hettangian) associated with the
260   Central Atlantic Magmatic Province (CAMP), and the second during the Valanginian period at 135-130
Ma (Martins et al., 2008).

Post-rift magmatism occurred after 80 Ma (Campanian) and was predominantly alkaline. It is recorded
onshore by sub-volcanic complexes near Sintra, Sines, and Monchique, with volcanic complexes also
present near Lisbon and offshore Algarve (Terrinha et al., 2009). Also, onshore, Lower Cretaceous
265   magmatism has been dated as spanning 94 to 69 Ma in Portugal, and occurring at c. 79 Ma in northeast
Spain (Ubide et al., 2014).

At present, the continental slope of Iberia dips abruptly to the west in its northwest part but is gentler in
its central and southwest parts due to the accumulation of thick Cretaceous-Cenozoic strata (Alves et al.,
2009). Late Cretaceous-Cenozoic exhumation and erosion are evident, particularly on the proximal part
270   of the slope (Terrinha et al., 2002; Pereira et al., 2013; Alves, 2024). The Estremadura Spur, separating
southwest Iberia from its northwest part, has experienced significant post-rift tectonics and magmatism
(Miranda et al., 2009), associated with compressional tectonics and tectonic inversion (Ribeiro et al.,
1990) (Fig. 1).

In summary, the Iberia ~~West~~ Atlantic Margin features a relatively narrow, westerly-tilted continental shelf,
275   with major rivers contributing sediment north of 41°N. Sediment accumulation is significant in estuaries
south of this latitude (Dias and Nittrouer, 1984). During sea-level lowstands, sediment bypass the
shallower zones of the margin through large submarine canyons, leading to reduced terrigenous sediment
contribution to the outer shelf region (Dias and Nittrouer, 1984, Dias et al., 2002). Sediment composition
on the shelf varies with depth, from fine micaceous sand at shallow depths to biogenic carbonate at greater
280   depths (Dias and Nittrouer, 1984). The shelf edge comprises rocky outcrops and fine-grained sediment,
resembling the gentler Alentejo continental margin (Drago et al., 2000). The continental slope is narrow
and steep, bounded by north- to north-northeast-trending faults (Mougenot, 1989), except for the wider
and structurally deformed Estremadura Spur. The continental rise is relatively wide, featuring multiple
seamounts and prominent fault-bounded depressions between seamounts where sediment transported by
285   submarine canyons is accumulated (Mougenot, 1989; Alves et al., 2003).

2.3.2 Alentejo Basin

The offshore Alentejo region is characterized by its broad continental shelf, which blends with a gentle continental slope (~0.5°) due to thick Cenozoic sediment deposition west of 10ºW (Mougenot, 1988). Steeper gradients (>2°) occur near seamounts in areas of localized deformation (Coppier and Mougenot, 1982, Mougenot, 1988; Alves et al., 2003). Alves et al. (2003) recognized three main types of Cenozoic deposits on the Alentejo Margin: shelf-related, turbidite, and contourite/canyon-fill. A wide range of sedimentary deposits, from deep marine turbidites to fluvial/deltaic sequences (Shanmugam and Moiola, 1988) haves been identified on seismic data crossing the continental slope of Alentejo. However, dredge samples near the shelf break contain shallow marine to shelf-break limestones rich in foraminifera (Mougenot et al., 1989). Deep-marine deposits, including mass-flow and channel-fill deposits, are common in more distal parts of the margin, while shallow-marine breccias are common on the continental slope (Mougenot et al., 1989, Coppier and Mougenot, 1982).

The Alentejo Basin, structured during the Upper Jurassic, is delimited by the Setúbal and São Vicente canyons. Limited exploratory drilling has revealed Hettangian-Triassic evaporites, suggesting the Alentejo Basin to constitute the southern continuation of the Lusitanian Basin (Mougenot, 1989). Extensive Late Cretaceous magmatic activity led to the emplacement of the Sines and underwater Côvo igneous complexes (Neres et al., 2023) when crustal extension shifted to compression tectonics, reactivating crustal faults (Alves, 2024). Several compressional pulses with different directions affected the region, driven by interactions between Iberia, the Nubia microplate, and the larger European and African tectonic plates (e.g., Juarez et al. 1998; Rosenbaum, 2002; Vissers and Meijer, 2012).

2.3.3 Algarve Basin

The Algarve Basin, located in southwest Iberia, originated during Mesozoic rifting due to the Atlantic/Neo-Tethys opening; it later experienced tectonic inversion during the Alpine orogeny (Terrinha et al., 2019). This basin trends E-W and extends for about 150 km, reaching a maximum width of 25 km in its onshore portion and about 100 km offshore. Bounded by Carboniferous basement rocks to the north and the Guadalquivir Bank to the south, crustal extension was accommodated by N-S and NE-SW structures in the westernmost part of the basin and ENE-WSW to E-W structures in the central and eastern parts. N-S to NW-SE striking faults bound main grabens and half-grabens (Terrinha et al., 2019; 2022). Five main extensional episodes occurred from Late Triassic to Cenomanian times and were interspersed with transient compressive events that resulted in depositional hiatuses throughout the basin.

Paleozoic rocks below the Algarve Basin consist of low-grade metamorphic rocks (shales and graywackes) part of the Baixo Alentejo Flysch Group. In the basin per se, the oldest deposits are Lower Triassic in age (red mudstones) overlain by conglomerates and red clays of the "Silves sandstones" (Palain, 1976). ~~S~~Mesozoic ~~s~~edimentation continued through the Mesozoic ~~followed~~ and wa~~s~~is

320 characterized by the accumulation on alternati~~ng~~ons ~~of~~ carbonate and siliciclastic units~~facies~~, indicating shallow marine to continental environments. It was interrupted in the Cretaceous by t~~T~~ectonic inversion, resulting from oblique convergence ~~occurring in the Algarve Basin since the Late Cretaceous, resulted from oblique convergence~~ between northwest Africa and Iberia, causing important depositional hiatuses and unconformities. The oldest o~~O~~ffshore~~, the oldest~~ Cenozoic deposits in the Algarve Basin are dated

325 ~~are~~ Paleocene to Oligocene, lying ~~in age and lie~~ unconformably over folded Lower Cretaceous strata (Terrinha, 1998; Lopes et al., 2006; Roque, 2007, Matias, 2007).

In summary, Cenozoic~~Neogene~~ strata overlay folded and thrusted older units, suggesting that tectonic inversion occurred predominantly after the Cenomanian and lasted until the late Oligocene-Aquitanian. Nevertheless, p~~P~~resent-day compression is still recorded in the Algarve Basin, being NW-SE oriented,

330 and driven by oblique collision between northwest Africa and southwest Eurasia (Ribeiro et al., 1996).

Figures 3 and 4 show the location of the points and seismic profiles included in the database, while Figs. 5 and 6 are an example of the grids generated from the database.

Figure 4 Offshore: Location of seismic profiles used for interpreting ~~to interpret~~ and gathering data on

335 the Base of Cenozoic ~~marker~~. Onshore: location of x,y,z data obtained from available seismic, well log data and geological information. Main references from which data have been gathered are shown in Table 1. Additional references can also be found throughout the text.

3. Technical aspects of the data

3.1 Iberia mainland

340 The compilation of the Top Paleozoic and Base Cenozoic stratigraphic markers for the Spanish sedimentary basins has been carried out by the Instituto Geológico y Minero de España (IGME), complemented with a significant number of subsurface information from the Hydrocarbons Service of the former Ministry of Industry, Tourism, and Commerce (ATH), as well as studies from Empresa Nacional de Residuos Radioactivos SA (ENRESA), Universities, Associations, Working Groups, and Research and

345 Development projects stemming from the ALGECO2 project (García-Lobón, 2010a). The objective of

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the project was the selection and characterization of areas and structures favorable for CO_2 storage of in Spain. Location of data points and seismic profiles included in the database are shown in Figs. 3 and 4.

For that purpose, the analysis and geoscientific information included a review of about 50,000 km of seismic lines and 400 exploration wells, in addition to the available regional cross-sections and subsurface maps largely derived from historical petroleum exploration. For further details on the digital geological reference mapping, data from oil wells, seismic data, reference surfaces, and other information, the reader is referred to the work of García-Lobón et al. (2010a) and references therein.

3.1.1 Ebro Basin

Data on the Ebro Basin was extracted mainly from regional and geological studies at various scales (García-Lobón et al., 2010b), including the MAGNA Projects, and from geological maps at a 1:400,000 and 1:50,000 scale. Additionally, geophysical information and deep drilling data were considered together with information gathered in the "Documents on the Subsurface Geology of Spain (IGME 1992)" (7 documents) and the Subsurface Geology of Spain (ITGE). IGME's geophysical iInformation include, all drilling documentation (Composite and Master logs) from hydrocarbon exploration in the Technical Archive of the Ministry of Industry (which contains information of mining boreholes with depths up to 2500 m and oil boreholes with depths up to c. 5400 m), as well as the deepest boreholes from the Database of the Ebro Hydrographic Confederation, with depths up to 1658 m, which were re-analyzed in this work. In addition, over forty PhD and MSc-level theses, along with more than a hundred research articles were re-examined, with particular focus on those completing regional structural analyses and geological cross-sections. This approach was especially relevant in regions with limited well data such as the shoulder areas of the Ebro Basin. Other data sources such as the databases of CHE (Ebro Hidrogaphycal Confederation), Gessal, Repsol, Enresa, Union Texas, etc., were also consulted, providing relevant data for updating previous published maps. Subsequently, the interpretation of seismic lines and wells, in accordance with these cross-sections, led to the generation of maps of the depth contours (isobaths) presented in this study.

As pointed out by García-Lobón et al. (2010b), the isobath map of the Base of Cenozoic stratigraphic marker is not consistently defined due to discrepancies arising from both multiple unconformities in syntectonic depositional sequences and potential blind thrusts along the boundaries of the basin. These makes difficult the correlation between subsurface and surface outcrops. For a complete list of references and technical details, the reader is referred to the work of García-Lobón et al. (2010b).

3.1.2 Duero and Basque-Cantabrian basins

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Isobath maps for these two basins were compiled based on information from 239 hydrocarbon exploration wells reaching depths between 500 m and >2500 m. The available borehole data allowed the identification of multiple stratigraphic tops in the Mesozoic sequence. Additionally, reference points from regional cross-sections and isobath data from previous works were used to create new ~~differing~~ isobath maps. Using these same data sets, contour lines were generated and later edited to test the presence (and effect) of multiple geological structures based on the existing geological and structural data for the Basque-Cantabrian and Duero Basins. This process allowed the creation of isobath maps for the Base of Cenozoic base and Top of Paleozoic ~~markers~~, adjusting them to main faults and structures identified in regional geological maps. For the eastern and northeastern part of the Duero Basin, the calculated isobaths include subsurface information from oil exploration wells. For a complete reference list and additional technical details, the reader is referred to García-Lobón et al. (2010c).

3.1.3 Tagus-Almazán basins

For the creation of isobath maps in the Iberian Chain and the Tagus and Almazán Basins, two different approaches were developed based on the available data on these two Tertiary basins, their reliability, and spatial distribution. Thus, data presented in this study for these areas were mainly constrained by geological cross-sections, as there was a scarcity of subsurface data and from available reflection seismic cross-sections and borehole information. An effort was made to ensure the consistency of all final products at the regional scale considered in this work.

Geological cross-sections were primarily sourced from pre-existing or new cross-sections, with the latter predominantly derived from boreholes and pre-existing isobath maps. Where there was a scarcity of data and structural information, i.e. in the Iberian Range, an effort was made to increase data density from surface cartography, boreholes and regional cross-sections. For a complete reference list and additional technical details, the reader is referred to García-Lobón et al.~~,~~ (2010d).

3.1.4 Guadalquivir Basin

Stratigraphic information from the Guadalquivir Basin was gathered after re-assessing of surface and subsurface exploration data. Primary sources of this information consisted of~~were~~ reports and databases from the IGME. This dataset was further enriched by substantial subsurface documents and data acquired from the Hydrocarbons Service of the former Ministry of Industry, Tourism, and Commerce, together with contributions from various public entities, universities, associations, and working groups participating in research and development projects, including the ALGECO2 project (García-Lobón, 2010a).

In addition to these data, regional geological cross-sections were compiled using the available geological maps and subsurface data, particularly those where seismic profiles and boreholes exist. Notably, the Guadalquivir Basin has limited ~~limitations in terms of~~ seismic grid coverage and borehole control, particularly when one considers the stratigraphic markers of interest to this work. Consequently, the accuracy of these isobath maps is variable across different locations. For a complete reference list and additional technical details, the reader is led to García-Lobón et al. (2010e).

3.1.5 Lower Tagus Basin

The depth to the Base of Cenozoic ~~marker~~ in this area was obtained using seismic reflection data calibrated by exploration boreholes, by modeling land gravimetric data, and via geological outcrop data. Seismic reflection data comprise legacy surveys acquired with distinct geometries and sources for the oil industry from the mid 50's until 1982. These surveys were reprocessed and reinterpreted in Carvalho et al. (2005,~~;~~ 2017). Gravimetric data of the national Portuguese grid were~~as~~ also used to increase the geographical coverage of the existing seismic data, which was limited to the western part and central part of the Lower Tagus Basin (Carvalho et al.,~~.~~ 2017).

Seismic reflection data were used, where available, to determine the depth of the Base of the Mesozoic, which was only reached by a few exploration wells. In contrast, aeromagnetic data were used across the entire basin (Carvalho et al. 2014). These datasets do not allow a precise estimate to the depth of pre-Mesozoic rocks; in fact, the acoustic basement in seismic data is often coincident with the Top Dagorda salt member (Hettangian) (e.g., Watkinson, 1989; Carvalho et al., 2005; Alves et al., 2003) and, occasionally, the Triassic Silves Formation. In the areas where the basement was estimated via magnetic data models, errors are also expected due to the non-uniqueness of potential-field methods. Despite the calibration of seismic and magnetic data with some sparse boreholes, depth errors in the top of the pre-Mesozoic rocks may reach a few hundred meters in some areas.

Figure 5 Offshore: Depth to the Top of Paleozoic ~~marker~~, or Acoustic Basement ~~marker~~ for the majority of the Western Mediterranean region. Exceptions are the Valencia Trough and the Alboran Basin (see Fig. 1 for location), where the top of the basement ~~marker~~ corresponds to the Base of Cenozoic ~~marker~~ or the so-called Oligocene unconformity. Onshore: Depth to the Top of the Paleozoic Basement interpreted as the Paleozoic-cover sequence boundary or Hercynian discordance (Garcia-Lobón et al., 2020 and references therein).

3.2 Offshore Iberia

3.2.1 Iberia~~West~~ Atlantic margin

The interpreted 2D multi-client seismic reflection data corresponds to a reprocessed seismic grid acquired from TGS during the PDT00 and PD000 cruises and from the IAM seismic survey profiles (IAM-4, 5, 8, 9, 10, 11, T1, T2, GB1, GB2, GB3). Details on the acquisition parameters and processing data for the two cruises can be found in ~~(~~TGS (~~,~~ 2001)~~, and~~ Banda et al. (1995) and Torne et al. (2018), respectively. Figures 3 and 4 show the location of seismic profiles included in the database.

The interpretation of the Base of Cenozoic and Top of Paleozoic ~~markers~~ is based on regional (2-D) seismic data together with unpublished outcrop and well data (Figs. 5 and 6). The new data are of good enough quality for interpreters to mark a Top Basement stratigraphic marker with confidence, though the real morphology of such a basal horizon is somehow masked by the poor resolution of the data at its depth of occurrence. Nevertheless, the Base of Meso-Cenozoic strata is clear on the new, reprocessed TGS data. In this work, the criteria of Driscoll et al. (1995), Sinclair et al. (1995), Alves et al. (2009) and Soares et al. (2012) were used in the identification of key tectonic events affecting the North Atlantic region. Therefore, the two stratigraphic markers mapped in the available dataset were correlated with borehole and outcrop data acquired from published and unpublished information from the Lusitanian Basin (Atrops and Marques, 1986; Wilson et al., 1989; Hiscott et al., 1990; Alves et al., 2002, 2003; Dinis et al., 2008), Porto Basin (Moita et al., 1996), Iberia Abyssal Plain (Wilson et al., 1996, 2001; Eddy et al., 2017), and proximal NW Iberia (Groupe Galice, 1979; Boillot et al., 1989; Murillas et al., 1990, Tucholke et al., 2007).

Unpublished information from exploration wells Pe-1, Go-1, 20B-1, 5A-1 and Lu-1 in West Iberia, together with dredge data published in Mougenot et al. (1989), were used locally to corroborate our seismic-stratigraphic interpretations. DSDP Site 398 and ODP Sites 637-641, 897-901 and 1065-1070 provide~~comprise~~ important information used to correlate seismic-stratigraphic units across the study area (Fig. 1b). These data are complemented with information from DSDP Site 120 and IODP Sites U1385, U1391 and U1588 which recently drilled the SW Iberian margin (Hernández-Molina et al., 2013; Hodell et al., 2023) (Fig. 1). All data were integrated in a Schlumberger's Petrel® project so that structural, magnetic and seismic stratigraphic data could be analyzed together.

3.2.2 Alentejo Basin (continental shelf)

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The Top of the Paleozoic Basement and the Base of Cenozoic stratigraphic markers were gathered from the interpretation of the 1984 acquired GSI seismic reflection profiles (Carvalho, 1995), calibrated by
470 available well data (GPEP, 1986), and geological outcrop information obtained from dragging and multi-channel seismic reflection data of Mougenot (1989). The seismic reflection data interpretation was assisted with gravimetric data (free air anomaly data collected also along the GSI profiles) and aeromagnetic data acquired in 1969 by Fairey Surveys Limited. Descriptions of the seismic and potential field datasets can be found in Carvalho (1995). Location of seismic lines included in the database are
475 shown in Figs. 3 and 4.

Potential field data allowed the identification and separation of basement uprises or lows (pre-Mesozoic units), from salt and igneous structures. The structural interpretation obtained from seismic data was also compared with derivative maps of the gravimetric and magnetic anomaly maps, such as analytical continuations to several altitudes, horizontal derivatives, vertical derivatives, shaded relief, etc. Seismic
480 interpretation was used afterwards as a starting point for the joint 2.5D forward modeling of magnetic and gravimetric data using freeware software (Webring, 1985). The base of the Mesozoic horizon was further corroborated by 3D gravimetric modeling using the software of Broome (1991), which uses the method of Plouff (1976).

3.2.3 Algarve Basin

485 The geophysical data used to define the Top of Paleozoic Basement and Base of Cenozoic markers consist of a high-resolution marine gravity survey and a 2D regional seismic reflection survey (TGS, 2001) and represent a total coverage (58 lines; 5,820 km) of 17,890 km^2, extending from the shelf to the deep part of the Algarve Basin (Fig.ure 2). The gravity data provided by TGS has been used to further constrain the top of basement data in areas where seismic data coverage was poor or lacked resolution. Well data
490 provided by DGGE (Direcção Geral de Geologia e Energia) and from Lanaja et al. (1987) were used as constraints.

The seismic-stratigraphic framework was simplified and divided into four seismic–stratigraphic units based on their seismic character and well to seismic calibration (Matias, 2005; 2007), spanning from the Paleozoic basement to Late Cenozoic sediments. Mapping of the top of the basement was aided by the
495 results from gravity enhancement maps and inversion (Matias, 2007). A time-to-depth conversion of the interpreted horizons was performed using a layer-cake approach, as detailed in Matias (2007). Location of seismic lines included in the database are shown in Figs. 3 and 4.

3.2.4 Western Mediterranean

Data of the depth to the acoustic basement for the Western Mediterranean region have been downloaded from SEOANE (Sea Scientific Open Data Publication; Bellucci et al. (2021), doi: 10.17882/80128). These data derive from the compilation and reprocessing, and in some cases digitalization, of available industry and academia multichannel seismic profiles and well log suites. All these data have been acquired since the 1960's and cover the westernmost Mediterranean Neogene basins, namely the Valencia Trough and the Algerian and Alboran basins. As detailed in Belluci et al. (2021), the interpretation of the Top of Basement ~~marker~~ extends across all geomorphological domains, ranging from the shelf to the deep basin (Fig. 2). It is identified~~serves~~ as the boundary separating the chaotic seismic facies of the substratum from the stratified seismic facies of the sedimentary column. In the Alboran and Valencia basins, the t~~T~~op ~~b~~of the acoustic ~~b~~Basement ~~horizon~~ coincides either with the Base of Cenozoic or the so-called Oligocene unconformity, as documented in studies such as Do Couto et al. (2014), Pellen et al. (2016), and Etheve et al. (2016) (Figs. 3 and 4). For more detailed information the reader is referred to the work of Belluci et al. (2021) and references therein.

As the original data file presents different information relative to the age of the acoustic basement, we split the original file into three subfiles corresponding to the Valencia Trough and Alboran Basin regions (Base of Cenozoic or the Oligocene unconformity) and the Algerian basin (boundary between chaotic and stratified seismic facies). For more details, please refer to Table 1. Location of seismic lines included in the database are shown in Figs. 3 and 4.

Figure 6 Offshore and onshore depth to the Base of Cenozoic ~~marker~~. Main references from which data have been gathered are shown in Table 1. Additional references can also be found throughout the text. Data from the Western Mediterranean have been taken form (Belluci et al., 2021, and references therein).

4. Influence of sediment thickness and nature on geothermal potential

~~While it is generally acknowledged that sediments can function as thermal insulators, impeding the upward heat transfer from deeper layers, the thermal conditions at a specific site - including surface heat flow, sediment and underlying layer thermal conductivity, and also radiogenic heat production - exert a profound influence on subsurface temperature distribution.~~ Sediments are widely recognized for their capacity to act as thermal insulators, thereby attenuating the vertical transfer of heat from deeper geologic strata. However, the thermal regime at a given site is governed by a complex interplay of factors, including surface heat flow, the thermal conductivity of both sedimentary deposits and underlying lithologies, and the radiogenic heat production of these materials. Collectively, these parameters exert a significant

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530 influence on the thermal gradient and subsurface temperature distribution. To assess the investigate how influence of sediments on may influence the thermal field, we have systematically calculated the depth variability variation in the depth of the 150ºC isotherm under different conditions. These conditions included variable considering variable surface heat flow values, sediment thickness, thermal conductivity variations, and a fixed radiogenic heat production rate. Temperature profiles have been computed in one

535 dimension, considering surface heat flow values ranging from 40 to 120 mW/m^2 (e.g., Fernàndez et al., 1998) and the International Heat Flow Commission (Fuchs et al., 2023), a range that is representative of the mean and maximum heat-flow values recorded in the Iberian Peninsula. We have also considered standard values of radiogenic heat production for sediments and crust at, respectively, 1 µW/m^3 and $3\times e^{(z/10)}$ µW/m^3. Other parameters considered were a constant crustal thermal conductivity of 3.1 W/mK

540 and a constant mean surface temperature of 15ºC.

Figure 7 shows the variations in the depth of the 150ºC isotherm in relation to sediment thickness, surface heat flow, and four different thermal conductivity values for the sediments (panels Fig. 7A to D). The calculated trend indicates that, for a constant measured surface heat flow and constant thermal conductivity, the isotherm depth decreases as sediment thickness increases until it reaches a critical

545 threshold depth. Beyond this depth value, the isotherm becomes is stable. Our results also show that, as expected, for a given thermal conductivity, an increase in surface heat flow leads to a relative shallowing of the isotherm, while a decrease in surface heat flow produces the opposite effect. Notably, an increase in thermal conductivity is associated with greater deepening of the 150ºC isotherm for the same heat flow and sediment thickness values. The crustal thermal conductivity value of 3.1 W/m·K, which is within the

550 upper range of typical values, was selected to provide a broader range for assessing the influence of sediment thermal conductivity on subsurface thermal gradients. Importantly, this threshold depth is independent of the crustal conductivity. However, lower crustal conductivity values would result in a shallower depth of the 150ºC isotherm in regions where the sediment thicknesses are below the threshold depth.

555 Comparing Fig. 7A (showing the minima in conductivity values) and Fig. 7D (representing the maxima in conductivity values), one observes that for a constant heat flow value, say 70 mW/m^2, the 150°C the isotherm is significantly deepened as conductivity increases. Additionally, we observe that changes in sediment thickness wield more influence at lower thermal conductivity values. For instance, is one assumes a thermal conductivity of 1.27 W/mK and a surface heat flow of 70 mW/m^2, the isotherm depth

560 is reduced until sediment thickness reaches approximately 3.5 km. Beyond this point, the isotherm stabilizes at a constant depth (Fig. 7A). Conversely, when assuming higher conductivity values, e.g.

approaching the conductivity of the crust (e.g., 3.0 W/mK), the effect of any increase in sediment thickness is notably reduced (Fig. 7D).

565 **Figure 7** Depth to the 150ºC isotherm as a function of sediment thickness and surface heat flow, assuming four different thermal conductivities for sediments: (A) 1.27 W/m K, (B) 2.0 W/m K, (C) 2.5 W/m K and (D) 3.0 W/m K. Crustal conductivity is kept constant at 3.1 W/m K. Radiogenic heat production is 1 μ W/m3 and 3×e(z/10) μ W/m3 for the sediments and crust, respectively. Each basin is shown by a horizontal grey line indicating the average surface heat flow value and average sediment thickness at the

570 calculated site (grey dot). The minimum to maximum sediment thickness in the basin is indicated with the grey line.

Based on the findings presented in Fig. 7, we have computed an initial estimate of the depth of the 150°C isotherm for the onshore basins presented in this study, where surface heat flow is known, following the published values from Fernàndez et al., (1998) and compiled in the International Heat Flow Commission

575 (Fuchs et al., 2023). As for thermal conductivities, we have taken the average thermal conductivities values in Torne et al. (2023). For instance, considering the Ebro Basin and the Guadalquivir Basin as end-members for relatively high and low average heat flow values, respectively 75 mW/m² and 62 mW/m², we observe that for a constant conductivity of 2.0 W/mK, the depth of the isotherm in the Ebro Basin is considerably shallower (ranging from 6 km with no sediments to 3.75 km for a sediment thickness of 3.75

580 km) compared to the Guadalquivir Basin. In the Guadalquivir Basin, for equivalent sediment thickness values, the isotherm depth fluctuates between 7.75 km and 4.50 km, respectively. This difference is attributed to the higher average heat flow values observed in the Ebro Basin compared to the Guadalquivir Basin. Additionally, increases in thermal conductivity ~~lead~~led to ~~an increase~~a rise in the isotherm depth, shifting to 6 km and 4.6 km in the Ebro Basin and to 7.75 and 5.70 km in the Guadalquivir Basin. However,

585 it is important to stress that in both basins the impact of increasing conductivity results in the isotherm being situated at a greater depth, with it being less sensitive to variations in sediment thickness; this is clear when one compares panels A to D in Fig. 7. Such an observation generally confirms the impact of sediment thickness and thermal conductivity on the spatial distribution of the 150ºC isotherm, with a heightened significance in areas characterized by lower heat flow values and low thermal conductivities.

590 **5. Data availability**

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The SedDARE is available in the Spanish National Research Council repository, DIGITAL.CSIC (https://doi.org/10.20350/digitalCSIC/16277, DIGITAL.CSIC, 2024). A detailed list of the datasets can be found in Table 1.

6. Conclusions

595 Analyzing sediments is crucial for understanding a region's geological history, subsurface structure, and potential resources. The thickness and properties of sediment layers play a crucial role in subsurface exploration, providing valuable insights for building more accurate geophysical models. Additionally, studying sediment properties is essential for assessing and mitigating geohazards, and informing infrastructure planning and engineering. In summary, curating sediment data is essential for advancing

600 knowledge and sustainable management of resources, protecting the environment, and making informed decisions across various scientific, economic, and social domains.

SedDARE-IB database has been created to facilitate the reuse and preservation of existing data by future generations of geoscientists. It achieves this by hosting sediment data in the online institutional repository DIGITAL.CSIC. The database accomplishes the international mandates of open-access data and the FAIR

605 principles of data management. The database is a result of close collaboration between Portuguese and Spanish research teams, aiming to make available sediment data of the Iberian Peninsula easily accessible. Presently, SedDARE contains 29 datasets of isobath maps depicting the Top of Basement and the Base of Cenozoic stratigraphic markers of the Iberian Peninsula and its surrounding margins.

As an example of the use of the data set, we conducted a systematic thermal analysis examining the

610 influence of the sediment thickness on the depth location of the 150ºC isotherm. The obtained results indicate a complex relationship between isotherm depth and sediment thickness. While an increase in sediment thickness initially results in higher temperatures at relatively shallow depths, there is a critical threshold value in sediment thickness beyond which the 150ºC isotherm stabilizes at a constant depth. Moreover, an increase in thermal conductivity correlates with a deepening of the 150ºC isotherm, while

615 an increase in heat flow leads to the opposite effect.

When comparing the Ebro and the Guadalquivir basins as end-members of basins with relatively high and low average heat flow values (75 mW/m² and 62 mW/m², respectively), one records differences in the depth of the 150ºC isotherm between 1 and 1.5 km. The trend is one of a deeper 150ºC isotherm whenever a relatively higher thermal conductivity is recorded.

The spatial distribution of the 150ºC isotherm is notably affected by variations in thermal conductivity, with a heightened significance in those basins characterized by lower heat flow values. Here, the impact of thermal conductivity is particularly pronounced, influencing the isotherm depth to a greater extent than variations in sediment thickness.

Author contributions

MT, IJ-M, AM-GG, TA, JC and ER conceived the idea. MT, CA, HH, AB worked on the data curation and collation of the datasets of the Iberia Alpine foreland basins (JLGL, CA, MT, AB) and Western Mediterranean basins (HH, MT). TS, JC, ER, HM worked on the data curation and collation of the datasets of the deep offshore Atlantic Margin, Alentejo and Algarve basins. IJ-M and MT conducted the thermal calculations. JC, JV, TA, HH, and ER prepared the geological section of the paper. MT and AB managed the uploading of datasets into DIGITAL.CSIC. MT prepared the original manuscript; all authors contributed to the review and editing. TA handled English editing of the manuscript.

Competing interests

The contact author has declared that none of the authors has any competing interests.

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Figure captions

Figure 1 (a) Elevation map of the Alpine-Himalayan Orogenic Belt as shown by the shaded area. Red square highlights the location of the Iberian Peninsula and surrounding margins. **(b)** Simplified geological map of the Iberian Peninsula. Iberian Massif abbreviations: CZ: Cantabrian Zone, CIZ: Central Iberian Zone; GTMZ: Galicia-Tras-Os-Montes Zone, OMZ: Ossa Morena Zone; SPZ: South Portuguese Zone; VG: Variscan Granitoids, WALZ: Western-Asturian-Leonese Zone. Other abbreviations: Cantabrian M.: Cantabrian Mountains, CCR: Catalan Coastal Ranges, CS: Central System, Guadalquivir B.: Guadalquivir Basin, LTB: Lower Tagus Basin, SC: Setubal Canyon, SVC: Sao Vicente Canyon. Adapted from Torne et al. (2015, 2023).

Figure 2 Simplified geological map showing location of the data sets listed in Table 1. Modified from Torne et al. (2015).

Figure 3 Offshore: Location of seismic profiles used for~~to~~ interpret~~ing~~ and gather~~ing~~ data for the Top Paleozoic ~~marker~~, or Acoustic Basement ~~marker~~ for most of the Western Mediterranean region. Exceptions are the Valencia Trough and the Alboran Basin (see Fig. 1 for location), where the Acoustic Basement corresponds to the Base of Cenozoic or the so-called Oligocene unconformity Onshore: location of x,y,z data obtained from available seismic, log data and geological information

Figure 4 Offshore: Location of seismic profiles used for~~to~~ interpret~~ing~~ and gather~~ing~~ data on the Base of Cenozoic ~~marker~~. Onshore: location of x,y,z data obtained from available seismic, well log data and geological information. Main references from which data have been gathered are shown in Table 1. Additional references can also be found throughout the text.

Figure 5 Offshore: Depth to the Top Paleozoic ~~marke~~r, or Acoustic Basement ~~marker~~ for the majority of the Western Mediterranean region. Exceptions are the Valencia Trough and the Alboran Basin (see Fig. 1 for location), where the Top of B~~b~~asement ~~marker~~ corresponds to the Base of Cenozoic ~~marker~~ or the so-called Oligocene unconformity. Onshore: Depth to the T~~t~~op of the Paleozoic Basement interpreted as the Paleozoic-cover sequence boundary or Hercynian discordance (Garcia-Lobón et al., 2020 and references therein).

Figure 6 Offshore and onshore depth to the Base of Cenozoic ~~marker (Belluci et al., 2021, and references therein).~~ Main references from which data have been gathered are shown in Table 1. Additional references can also be found throughout the text. Data from the Western Mediterranean have been taken form (Belluci et al., 2021, and references therein).

1145 **Figure 7** Depth to the 150ºC isotherm as a function of sediment thickness and surface heat flow, assuming four different thermal conductivities for sediments: (A) 1.27 W/m K, (B) 2.0 W/m K, (C) 2.5 W/m K and (D) 3.0 W/m K. Crustal conductivity is kept constant at 3.1 W/m K. Radiogenic heat production is 1 μ W/m3 and $3 \times e^{(z/10)}$ μ W/m^3 for the sediments and crust, respectively. Each basin is shown by a horizontal grey line indicating the average surface heat flow value and average sediment thickness at the calculated

1150 site (grey dot). The minimum to maximum sediment thickness in the basin is indicated with the grey line.

Table 1 Detailed list of the information included in the database presented in this work.