Response to reviewer 1:

Interactive comment on “Reassessing the lithosphere: SeisDARE, an open access seismic data repository” by Irene DeFelipe et al.

Anonymous Referee #1

Received and published: 25 October 2020

Our responses to the reviewer’s comments are indicated after each question in bold.

GENERAL COMMENTS

In manuscript essd-2020-208 the authors present a database (SeisDARE) with data of controlled source seismic experiments. Currently, the database contains 19 datasets, most of them covering the Iberian Peninsula and Morocco; it is open for more datsets. The data itself are stored in and accessible at CSIC‘s GEO3BCN database. Each dataset consists of the metadata and the data in standard format (file-based, i.e. SEG-Y). A DOI is attached to each dataset. The metadata of each data set (including authors/creators, title, characteristics, data examples, references and funding information) is visualized as "landing pages“ in the web-browser and so-called index cards (human readable); it can also be accessed in different (machine-readable) formats.

I congratulate the authors for putting together this nice collection of seismic datasets, to preserve them and to make them public for further use following the FAIR idea. The datasets provide a unique opportunity to get insights into the deeper structure of the Iberian Peninsula/Morocco and the processes involved in forming them. Crustal scale seismic profiles are usually very expensive and cannot easily be reproduced. So, keeping and distributing the datasets in this structured way is of high value and is highly interesting for future research (and potentially other purposes).

The article is a good way to support the publication of the datasets. The article is logically structured and reads very easy. References for the individual datasets seem complete (see also one of the issues below). I have found only very few typos (see below). The figures are informative and of high quality as is the whole manuscript. A discussion of the accuracy, calibration, processing, etc. are not in detail given in the article, but references have been made to the original articles (in which these aspects should be presented).

So I think the topic is extremely well suited to be presented in ESSD I found some issues which I feel the authors should address before the manuscript is eventually ready for publication (moderate revision).

We really appreciate the interest shown by the reviewer in our manuscript and the recommendation for publication. We also thank the pertinent comments addressed by the reviewer. Therefore, we will resubmit a new version of the manuscript taking into consideration their suggestions, which greatly improve the original version.

SPECIFIC COMMENTS:

- The technical details describing the archived data should be somewhat extended (it seems that the majority of the metadata is to large extend related to the bibliographical data such as authors, title etc.). Actually this is an issue for both the repository and the article. Most of the data (I have checked a few) are stored in SEG-

Y format, which is a standard exchange format, however, I suggest to add (in addition to the existing reference/link to SEG) a reference to e.g. Barry, K.M.; Cavers, D.A.; Kneale, C.W. (1975): Recommended standards for digital tape formats. Geophysics 40 (2): 344– 352). Other datasets are stored in seismic unix (su) format and I think a link or at least a short description or statement regarding this de facto standard format should be added to the article (e.g., https://wiki.seismic-unix.org/doku.php, but there might be better references). In line 120 it says that "Data are mainly in SEG-Y format...". Since datasets in su format is also found, could you be more complete and specific? Is there a policy of the GEO3BCN repository which formats to use? Can you state more specifically which quality control is performed at the GEO3BCN repository? Any checks or guidelines which header words are set or should be provided? Especially for su-files it would be good to know whether it is "old su" format or XDR format, and whether it is little or big endian. I suggest a subsection "Data format" or "Technical issues of the data" in the article which could have at least some general statement regarding these issues (or where I can find this information in the website of the GEO3BCN repository).

In the new version of the manuscript, a new section has been added: "4 Technical aspects of the data". Here, we briefly discuss the general acquisition parameters of the datasets and the formats of the different files included on the database. References for both SEG-Y and SU formats have been added as suggested. Further information on the details of each dataset can be consulted in the "show full item record" link in the left bottom corner of each dataset and in the publications cited. In addition, part of the information included in section "2 Outline of SeisDARE" has been moved to the current section "4 Technical aspects of the data" for consistency.
Additionally, SU files follow the XDR format and have been produced in Linux workstations operating the little endian convention. Using modern versions of SU, the files should be readable in different platforms (Little or big endian, 32 or 64bit).

- Although I think that su-format is quite handy and widely accepted, it is actually not a standardized exchange format. . . Actually SEG-Y should be preferred...

SU is an open source and well-stablished format seismic processing package and we have added references to it in the new section 4. Furthermore, in our database only two up to 21 datasets are exclusively on SU format. Nevertheless, we are working on the conversion of the files from SU to SEG-Y, but this will be completed in the long-term.

- [more a general comment] I did some spot checks of this large collection of data sets (only spot checks because the data is many hundreds of Gbyte (or even Tbyte); some of the datasets are even embargoed and thus not available). Data conversion and displaying was quite easy e.g. for the IBSERSEIS NI and ILIHA data. Nevertheless, it brings me back to the question which policy and guidelines are present for quality checking... Also in these cases a bit more information on the actual data would generally be helpful (maybe an issue for the future?).

Assessing the quality of the dataset in a completely objective and numerical way is a difficult issue, and currently we are not aware of a simple procedure. The ESFRI EPOS EU e-infrastructure (https://www.epos-eu.org/) is currently trying to address this issue aiming to define numerical indicators to estimate the quality of geophysical data collections, but this is not yet solved. In the meantime, we prefer to leave out any subjective/qualitative assessment of the data quality to avoid biasing the readers. In any case, each dataset contains a list of publications where the users can observe and estimate the quality of the datasets by themselves.

- I noticed that on some of the individual dataset pages the format of the data is set to "unknown“ (for example in the "CIMDEF: a wide-angle deep seismic reflection profile in the Central Iberian Zone“ dataset“, where all su files are set to "unknown“). It‘s probably an automatic association/analysis, however, the authors should consider to add this information.

We have completed the format field in the repository website, as well as the description field.

- I could not find index cards for the still embargoed datasets "3D reflection seismic imaging of the Hontomín CO2 storage site“ and "SIT4ME: Innovative seismic imaging techniques for mining exploration - Sotiel-Elvira (Spain) dataset“. Is this by purpose? Couldn‘t this type of metadata be made publicly available before the end of the embargo? In the text (Line 121) one could get the impression that index cards exist for all datasets.

We would prefer to make the index cards for the embargo datasets available by the time they are released. Nevertheless, it is true that one can get a wrong idea from the text line 121, so we have modified this part of the text to clarify this issue. The new text reads as:
"Additionally, an index card summarizes the information for all projects except for those that are embargoed due to data policy."

- L 117: The paper says that there are currently 19 datasets in SeisDARE, however, when I check https://digital.csic.es/handle/10261/101879 I see 26 datsets? Although I understand that SeisDARE is open for new datasets, I think that the paper instroducing SeisDARE should be up-to-date and list all of the currently contained ones. Furthermore, I noticed that there are some datsets listed which are not all all DSS dats sets, such as "Regional centroid moment tensors for earthquakes in the 2013 CASTOR gas storage seismic crisis“ and "Apatite fission track and zircon (U-Th)/He dataset in the eastern Basque-Cantabrian Zone - western Pyrenees“. Please comment. And there are many more. . . Or is is a mistake? It does not really fit to the other datasets of SeisDARE. . . I assumed that the link https://digital.csic.es/handle/10261/101879 is exclusively pointing to SeisDARE?

In the manuscript, we specified that the GEO3BCN database is multidisciplinary and that SeisDARE is part of it, but as it may lead to some confusion, we have re-organized the database website. In the new interface, there is a collection of data that belongs to SeisDARE and another collection with more

general type of datasets from GEO3BCN. We hope that with this change it would be easier to follow and understand both the manuscript and the database website.

TECHNICAL CORRECTIONS:

L91: insert hyphen in "continental scale“

Done

L61: insert hyphen in "seismic-related“

L61: What is an "active“ data repository? Do you mean voluminous or comprehensive or large data repository?

We meant in terms of the volume of data, but we realize that this sentence might be misleading and we have removed it.

L141: I do not understand ". . . being the latter the external foreland zone...“ Please check.

Within the Iberian Massif only the Cantabrian Zone and the South-Portuguese Zone are external parts of the Variscan orogen. We have clarified it in the text.

L396: insert hyphen in "high-resolution“

We have unified the text to “high-resolution”.

Response to reviewer 2:

Interactive comment on "Reassessing the lithosphere: SeisDARE, an open access seismic data repository" by Irene DeFelipe et al.

Florian Haslinger (Referee)

haslinger@sed.ethz.ch

Received and published: 22 December 2020

The answers to the referee's comments are indicated after each question in bold.

GENERAL COMMENTS

I concur with the observations and support the comments made by Reviewer 1. This paper is a very good introduction of the SeisDARE repository, and the authors are to be congratulated for setting up the repository and introducing it to the community.

We appreciate the interest shown by the reviewer in our manuscript and thank him for the suitable comments addressed. Therefore, we resubmit a new version of the manuscript taking into consideration his comments.

While the paper includes quite a lot of information about the geological / tectonic settings and some main results of the various experiments, it lacks (also noted by Reviewer 1) in my view some further technical description of the datasets and the criteria applied to the datasets for inclusion in the repository. Thus I support the idea of Reviewer 1 to include a section on technical details / data set descriptions, quality assessment etc. and perhaps also add this to the repository website.

In agreement with the comments of Reviewer 1, we have included in the new version of the manuscript a section: "4 Technical aspects of the data". Here, we briefly discuss the general acquisition parameters of the datasets and the formats of the different files included on the database. References for both SEG-Y and SU formats have been added as suggested. We also included the SEG-D format as part of the raw data in the ALCUDIA-NI dataset are in this format. Further information on the details of each dataset can be consulted in the "show full item record" link in the left bottom corner of each dataset and in the publications cited. In addition, part of the information included in section "2 Outline of SeisDARE" has been moved to the current section "4 Technical aspects of the data" for consistency.

SPECIFIC COMMENTS

The consistency between the article and the database is now given, the authors apparently removed the non-fitting datasets noted by Reviewer 1. The currently (Dec 2020) 21 datasets listed in https://digital.csic.es/handle/10261/101879 correspond to the paper, as two were added late 2020, after the submission date. If possible, these two datasets could still be added to the paper for the final version (together with any other that might be included by then).

Indeed, during the discussion phase we enlarged the list of the datasets in the repository with the IBERSEIS-NI (processed files) and MARCONI-WA. We have consequently included these datasets into the manuscript.

As noted above, and in line with the comments from Reviewer 1, an additional section that further describes the technical details of the data sets, any quality check criteria, embargo policies, would be helpful.

The new section "4 Technical aspects of the data" aims to provide technical information of the data. Regarding the data quality, unfortunately there are no completely objective and quantitative ways to assess this. Currently, EPOS is trying to address this issue aiming to define numerical indicators to estimate the quality of geophysical data collections, but this is not yet solved. In the meantime, we prefer to leave out any subjective/qualitative assessment of the data quality to avoid biasing the readers. In any case, each dataset contains a list of publications where the users can observe and estimate the quality of the datasets by themselves.

The embargo comprises a reasonable time period for the use of the data (and potential publication of the main results) by the project members or private companies involved. This has been added to the manuscript for clarity.

TECHNICAL CORRECTIONS

In addition to what was noted by Reviewer 1, I just have one additional editorial remark: line 70/71 - the formulation 'The ESFRI in Earth Sciences is the European Plate Observation System...' is a bit misleading, as ESFRI is the Forum under who's guidance / governance ERICs are set up. It would be more correct to write that EPOS is the European Research Infrastructure Consortium for Earth Sciences established under ESFRI. Also note that EPOS now has a new URL https://epos-eu.org

In the new version of the manuscript we have re-write that sentence and corrected the link to the EPOS website.

COMMENTS TO THE REPOSITORY

From some spot-checks on the repository I noted a couple of items that could be considered (also in addition to what is already noted by Rev 1):

- I am not sure what the purpose of the excel file with the 'list of files' is? These 'Description_ficheros_[experiment].xlsx' files just contain the list of files that are part of the dataset (and the filenames don't match the content of the excel file).

The 'Description_ficheros_[experiment].xlsx' files included are a requirement of the repository's file architecture and unfortunately cannot be removed.

- quite often the file ’Seismic_data_[experiment]_metadata.xlsx’ is missing in the repositories (but is included in the Description_ficheros and Readme... files).

Indeed, as the referee pointed out, there is an inconsistency and we are currently and progressively solving this issue in the repository by updating the ’Description_ficheros_[experiment].xlsx’ and ‘readme’ files.
We started creating the file ’Seismic_data_[experiment]_metadata.xlsx’ to provide further information on the data and therefore, it was also included into the ’Description_ficheros_[experiment].xlsx’. Finally, as most of the data of the ’Seismic_data_[experiment]_metadata.xlsx’ are included along the dataset itself (check the “show full item record” link), we decided not to upload it.

- in the file table (’Files in this item’) the Description field is usually empty, and the ’Format’ field refers to the ’internal’ format of the archive (e.g. a .rar file with trace records has Format entry ’SEGY/su’). While the data file format is an important information, this use of the field is inconsistent and may be confusing (in particular thinking of automatic access & processing). Maybe the internal format could be listed in the description field, and the Format field could specify the actual format of the downloadable file?

The description field in the file table of the repository is being completed with a short and descriptive sentence, and the format field includes the format(s) of the files included.

Reassessing the lithosphere: SeisDARE, an open access seismic data repository

Irene DeFelipe[1], Juan Alcalde[1], Monika Ivandic[2], David Martí[1,3], Mario Ruiz[1], Ignacio Marzán[1], Jordi Diaz[1], Puy Ayarza[4], Imma Palomeras[4], Jose-Luis Fernandez-Turiel[1], Cecilia Molina[5], Isabel Bernal[5], Larry Brown[6], Roland Roberts[2], Ramon Carbonell[1]

[1] Geosciences Barcelona, GEO3BCN, CSIC, c/ Lluís Solé i Sabarís, s/n, 08028, Barcelona, Spain.
[2] Department of Earth Sciences, Uppsala University, 752 36, Uppsala, Sweden.
[3] Now at Lithica SCCL, Av. Farners 16, 17430, Sta. Coloma de Farners, Spain.
[4] Department of Geology, University of Salamanca, Plaza de la Merced s/n, 37008, Salamanca, Spain.
[5] Consejo Superior de Investigaciones Científicas, CSIC, c/Serrano, 117, 28006, Madrid, Spain
[6] Department of Earth and Atmospheric Sciences, Cornell University, 112 Hollister Drive, Ithaca, NY 14853-1504, USA.

Correspondence to: Irene DeFelipe (irene.defelipe@gmail.com)

Abstract. Seismic reflection data (normal incidence and wide-angle) are unique assets for Solid Earth Sciences as they provide critical information about the physical properties and structure of the lithosphere, as well as about the shallow subsurface for exploration purposes. The resolution of these seismic data is highly appreciated, however they are logistically complex and expensive to acquire and their geographical coverage is limited. Therefore, it is essential to make the most of the data that has already been acquired. The collation and dissemination of seismic open access data is then key to promote accurate and innovative research and to enhance new interpretations of legacy data. This work presents the Seismic DAta REpository (SeisDARE), which is, to our knowledge, one of the first comprehensive open access online databases that stores seismic data registered with a permanent identifier (DOI). The datasets included here are openly accessible online and guarantee the FAIR (Findable, Accessible, Interoperable, Reusable) principles of data management, granting the inclusion of each dataset into a statistics referencing database so its impact can be measured. SeisDARE includes seismic data acquired in the last four decades in the Iberian Peninsula and Morocco. These areas have attracted the attention of international researchers in the fields of geology and geophysics due to the exceptional outcrops of the Variscan and Alpine orogens and wide foreland basins; the crustal structure of the offshore margins that resulted from a complex plate kinematic evolution; and the vast quantities of natural resources contained within. This database has been built thanks to a network of national and international institutions, promoting a multidisciplinary research, and is open for international data exchange and collaborations. As part of this international collaboration, and as a model for inclusion of other global seismic datasets, SeisDARE also hosts seismic data acquired in Hardeman County, Texas (USA), within the COCORP project (Consortium for Continental Reflection Profiling). SeisDARE aims to make easily accessible old and recently acquired seismic data and to establish a framework for future

seismic data management plans. The SeisDARE is freely available at https://digital.csic.es/handle/10261/101879, bringing endless research and teaching opportunities to the scientific, industrial and educational communities.

1 Introduction

Controlled source seismology is a fundamental tool for Solid Earth Sciences, as it provides very valuable information about the physical properties and structure of the Earth's crust and upper mantle. Controlled source seismic experiments have been undertaken in all ~~continents, oceans and~~ tectonic settings since the mid-nineteenth century (Mintrop, 1947; Jacob et al., 2000), shedding light on our current understanding of the Earth's interior, from its composition and structure to its evolution. The outputs of these experiments, Deep Seismic Sounding (DSS) data, are generally expensive, logistically complex to acquire, and often result from a huge scientific effort involving national and international institutions. Therefore, it is imperative that legacy and new acquired data are easily available for future generations of geoscientists. Taking into account that data processing algorithms are constantly evolving, new or additional information can be extracted from these data.

Aware of the value of DSS data, Prodehl and Mooney (2012) provided a comprehensive, worldwide history of controlled source seismological studies acquired from 1850 to 2005, highlighting the enormous efforts made in the last 170 years to increase our knowledge of the subsurface. Since the 1970's, ambitious seismic reflection projects were developed worldwide, acquiring unique datasets that targeted key lithosphere structures. These datasets provided unprecedented images of the lithosphere, characterizing crustal discontinuities, major faults, geometry of orogenic belts, and other lithospheric features that had not been envisioned before. Some of these major seismic research programs that acquired DSS normal incidence and wide-angle data include: COCORP (USA); BIRPS (UK); ECORS (France); DEKORP (Germany); ESCI, IAM and ILIHA (Spain); HIRE and FIRE (Finland); ESRU and URSEIS (Russia); INDEPTH (Himalayas); LITHOPROBE (Canada); NFP 20 (Switzerland); and SINOPROBE (China).

In parallel, the hydrocarbon industry also added value using legacy seismic reflection data (Nicholls et al., 2015) by applying new processing approaches and techniques. Furthermore, reprocessed~~ing of high~~ high-resolution (HR) seismic reflection data have also been used in exploration for mineral resources (Manzi et al., 2019; Donoso et al., 2020), civil engineering (Martí et al., 2008) and are also successful for the characterization of seismogenic zones and hazard assessment (Ercoli et al., 2020). Therefore, legacy data are extremely valuable for basic and applied ~~e~~Earth ~~s~~Sciences, and their ~~preserving~~ preservation and availability ~~making data available~~ constitutes an effort that should contribute to move science forward.

The international community has focused towards the preservation of the data, ~~and~~ facilitating its access. Examples of these efforts include the SIGEOF database (Geological and Mining Institute of Spain) that hosts geophysical data of the Iberian Peninsula (http://info.igme.es/SIGEOF/), OpenFIRE (https://avaa.tdata.fi/web/fire, Finland), ~~and~~ the IRIS-PASSCAL consortia (https://ds.iris.edu/ds/nodes/dmc/, USA), ~~which is probably one of the most active seismic related data repository. In~~

~~addition,~~and the International Geological Correlation Programme (IGCP) initiative (http://www.earthscrust.org.au/) ~~has made widely available some of these unique seismic images~~.

Within the European research community there is a consistent vision of fostering global ~~O~~open ~~S~~science as a driver for enabling a new paradigm of transparent, data-driven science and accelerating innovation. This vision is becoming a reality thanks to a number of ambitious programs internationally supported. The European Open Science Cloud (https://www.eosc-portal.eu/) is driving towards a virtual environment with open and seamless services for storage, management, analysis and reuse of research data by federating existing scientific data infrastructures, currently dispersed across disciplines and European countries. In the same way, the European Strategy Forum on Research Infrastructures (ESFRI) is a strategic instrument to develop the scientific integration of Europe and to strengthen its international outreach. The ~~ESFRI in Earth Sciences is the~~ European Plate Observation System (EPOS, https://www.epos-eu.org/~~https://www.epos-ip.org/~~), established under ESFRI, ~~that~~ was initiated in 2002 to tackle a viable solution for the Solid Earth grand challenges. It is aligned with the Berlin Declaration for the Open Access to Knowledge in the Sciences and Humanities (2003) which stipulates that research data products need to be integrated and made accessible through open access schemes. EPOS aims to ensure a long-term plan to facilitate the integration of data and fosters worldwide interoperability of Earth Sciences services to a broad community of users for innovation in science, education and industry.

In close collaboration with EPOS, the Spanish National Research Council (CSIC) hosts the ‘DIGITAL.CSIC’ repository, where all kinds of scientific data are accessible following the international mandates of open access data and the FAIR principles of data management: findable, accessible, interoperable and reusable (Bernal, 2011; Wilkinson et al., 2016). As part of CSIC, Geosciences Barcelona (GEO3BCN, formerly Institute of Earth Sciences Jaume Almera-ICTJA) has participated in numerous geophysical projects carried out mainly in the Iberian Peninsula and Morocco during its more than 50 years’ history. The unique geological characteristics of these areas (outstanding record of the Variscan orogen and Alpine mountain belts, wide foreland basins, good accessibility and outcrop conditions, etc.) make them an excellent ~~resource~~ target to study the structure of the lithosphere, and the spatial and temporal evolution of tectonic extension, mountain building, plate tectonics and evolution of rifts (Daignières et al., 1981, 1982; Gallart et al., 1980, 1981; Choukroune and ECORS Team, 1989; Roca et al., 2011; Simancas et al., 2013; Martínez Poyatos et al., 2012; Macchiavelli et al., 2017; Ruiz et al., 2017; Cadenas et al., 2018; DeFelipe et al., 2018, 2019). These data ~~jointly with multi-technique seismic acquisitions from other experiments~~ have provided a full picture of the physical structure of the Mohorovičić discontinuity (Carbonell et al., 2014b; Díaz et al., 2016), the accommodation of shortening mechanisms at different crustal levels (Simancas et al., 2003, 2013), the structure of the Iberian margins and mountain ranges (Pedreira et al., 2003; Ayarza et al., 2004; Fernandez-Viejo et al., 2011; Ruiz et al., 2017), and the effect of Alpine reactivation in the Iberian Peninsula (Teixell et al., 2018; Andrés et al., 2019). In addition to those continental-~~-~~scale projects, an increased interest in the study of the shallow subsurface has emerged in the last decade in different areas of the Iberian Peninsula. These interests are related to natural resources exploration and exploitation, geo-energy and permanent storage applications, earthquake hazard assessment or infrastructure planning (Alcalde et al., 2013a, b; Martí et al., 2019).

Here, we report on the readily available database SeisDARE (Seismic DAta REpository), which compiles large geophysical projects developed in the Iberian Peninsula and Morocco. Part of the data comprised in this database were already stored in Geo DB (http://geodb.ictja.csic.es/#dades1). However, they lacked from a permanent Digital Object Identifier (DOI), thus representing an intermediate step in making the datasets FAIR. SeisDARE goes beyond Geo DB by hosting a larger number of datasets, providing them with a DOI and linking them to its scientific literature by means of the Scholix facilities and the DataCite Event Data (Hirsch, 2019, https://search.datacite.org/).

The geoscientific data are the basis for the generation of meaningful geological knowledge (Pérez-Díaz et al., 2020) and therefore, ~~.~~ ~~T~~the idea behind SeisDARE is to treat the data as any scientific publication, making it as relevant as the publication itself (Carbonell et al., 2020; DeFelipe et al., 2020). ~~The data are accessible at different processing stages, as raw data and/or processed forms. Raw data will fulfill the needs of researchers that would like to develop a new processing approach and the already processed data will provide images for scientists aiming to test alternative interpretations.~~ The purpose of this paper is to provide a general overview of the geological setting of the experiments, a brief description of each dataset, and the link to the open access data. This database is the result of a fruitful national and international inter-institutional collaboration, aiming to enhance multidisciplinary research and to promote advanced research networks. Thus, we are actively working in keeping our database updated, gathering more datasets.

2 Outline of SeisDARE

The multidisciplinary GEO3BCN database is being constantly updated, and especially since last years, the efforts put into the dissemination of the data have yielded to a significant increase in the number of ~~the collection~~ views and downloads ~~of all items~~ (Figure 1). The number of view counts has ~~steadily~~ been ~~increased~~ generally increasing with punctual peaks of views and ~~since the beginning of the records in 2015 to mid-2020,~~ with an outstanding amount of views in August 2020. The number of downloads has strikingly increased since October 2019 onwards, reaching the highest value in April 2020, with more than 2,500 downloads. Additional statistics of each item views and downloads are also available and can be consulted straightforward in the statistics facilities of the repository.

~~Within~~ As part of the GEO3BCN database, SeisDARE contains ~~19~~ 21 datasets (last access January 2021) of DSS (normal incidence, NI, and wide-angle, WA) and ~~high resolution~~ HR data (Table 1). Our database comprises the data files together with a comprehensive description of their general characteristics and the acquisition parameters. Furthermore, a list of authors and publications derived from the data are also provided. ~~The data included are mainly in SEG-Y format, the most commonly used format for seismic data (https://seg.org/Publications/SEG-Technical-Standards; Barry et al., 1975) or in SU (https://wiki.seismic-unix.org/doku.php).~~ Additionally, ~~each~~ an index card summarizes the information for all projects except for those that are embargoed due to data policy (i.e. usually a reasonable time period for the use of the data by the project members or private companies involved). ~~is summarized in a file or index card, where the~~ Those files comprise the general information of the data, a location map of the seismic data, an image of the data as an example, references and funding agencies ~~are provided~~. Figure 2 shows an example of the index card of the IBERSEIS-WA project. Ideally, all the content stored in the database is self-explanatory, so that the inexperienced users can handle the datasets straightforwardly.

In general, the philosophy behind SeisDARE is entirely transferable to similar seismic datasets from other areas in the world. The promoters of SeisDARE are actively looking for engagement with other international institutions, either by offering to host their datasets or to serve as a model for the establishment of new similar platforms. This internationalization effort led to the establishment of a collaboration with the Consortium for Continental Reflection Profiling (COCORP), to host the Hardeman County (Texas) dataset. This kind of collaboration adds a great value to the database by expanding the range of geological settings sampled and strengthening the research network between different institutions worldwide.

~~The data included in SeisDARE are in SEG-Y format(https://seg.org/Publications/SEG-Technical-Standards; Barry et al., 1975) or in SU (https://wiki.seismic-unix.org/doku.php; Forel et al., 2008).The data are accessible at different processing stages, as raw data and/or processed forms. Raw data will fulfill the needs of researchers that would like to develop a new processing approach and the already processed data will provide images for scientists aiming to test alternative interpretations.~~

3 Geological setting of the ~~study areas~~Iberian Peninsula and Morocco

The Iberian Peninsula and Morocco have experienced a long and complex geological history since the Paleozoic, resulting in a rich variety of tectono-sedimentary domains. These include the Variscan terrains of the Iberian Massif, Pyrenean Axial Zone and Iberian Chain; broad Mesozoic basins; the Alpine mountain belts; and the Cenozoic foreland basins (Figure 3). In addition, Figure 4 shows the crustal models published based on six datasets belonging to SeisDARE, covering an almost complete section of the Iberian Peninsula (onshore and offshore) and Morocco.

The Variscan orogen resulted from the convergence of the Laurentia-Baltica and Gondwana continents, yielding to the ~~creation of the~~ supercontinent Pangea (e.g., Matte, 1991, 2001; Murphy and Nance, 1991; Simancas et al., 2003; Pérez-Cáceres et al., 2016). In the Iberian Peninsula, the main Variscan rocks outcrop corresponds to the Iberian Massif~~, represents the main outcrop of the Variscan terrains and has been~~ and it is divided in six zones (Julivert, 1972; Figure 3). The West Asturian-Leonese Zone (WALZ) and the Cantabrian Zone (CZ)~~, being the latter the external foreland zone (e.g., Martínez Catalán et al., 1997),~~ are the northernmost zones. The Central Iberian (CIZ) is the largest zone ~~which~~ and includes the entirely allochthonous Galicia Tras-Os-Montes Zone (GTOMZ) towards the northwest (Martínez Catalán et al., 1997; Arenas et al., 2007). South of the CIZ, the Ossa-Morena Zone (OMZ) is a highly deformed area of Upper Proterozoic-Lower Paleozoic rocks (Matte, 2001; Pérez-

Cáceres et al., 2016, 2017). The southernmost zone of the Iberian Massif is the South Portuguese Zone (SPZ)~~, another external zone that~~ and hosts the largest concentration of volcanic massive sulphide deposits worldwide, the Iberian Pyrite Belt (Tornos, 2006). The CZ and the SPZ represent the external zones of the Variscan orogen whereas the rest represent the internal zones (e.g., Martínez Catalán et al., 1997). The structure of the CZ, WALZ, CIZ, OMZ and SPZ has been studied through the ESCI-N, IBERSEIS and ALCUDIA experiments (Figures 4c and 4d). In these areas the Alpine inversion resulted mostly in localized faults and well-defined crustal imbrications, thus the data reflect a nearly complete crustal section of the late Variscan orogen. A main feature observed along the Iberian Massif is the poor coupling existing between the upper and lower ~~crusts~~crustal reflectivity, ~~resulting in different reflectivity patterns~~which has been interpreted as the image of contrasting deformation mechanisms to accommodate shortening at both crustal levels (Simancas et al., 2003, 2013).

Throughout most of the Mesozoic, lithospheric extension in relation to the opening of the Atlantic Ocean and Bay of Biscay gave way to the formation of rift domains of hyperextended crust and exhumed mantle, and deep Cretaceous basins in the Pyrenean-Cantabrian realm (e.g., Ziegler, 1988; García-Mondéjar et al., 1996; Jammes et al., 2009; Pedreira et al., 2015; Tugend et al., 2014, 2015; DeFelipe et al., 2017; Ruiz et al., 2017). The mechanisms and geodynamic evolution of the Iberian Atlantic margin and Bay of Biscay were investigated with the pioneer IAM and ESCI-N projects, followed by the MARCONI initiative (e.g., Banda et al., 1995; Álvarez-Marrón et al., 1995a, b, 1996; Pulgar et al., 1995, 1996; Fernández-Viejo et al., 2011; Ruiz et al., 2017). These projects allowed mapping the offshore distribution of the North Pyrenean basins, to assess the lateral variations of the crust in the North Iberian Margin and to evaluate the inheritance of the extensional structures in the Alpine orogeny (Álvarez-Marrón et al., 1996; Fernández-Viejo et al., 1998; Ferrer et al., 2008; Roca et al., 2011).

From the Late Cretaceous to the Miocene, the Alpine convergence resulted in the tectonic inversion of the Mesozoic basins and mountain building (e.g., Muñoz, 1992; Teixell, 1998; Rosenbaum et al., 2002a; Teixell et al., 2016, 2018; DeFelipe et al., 2018, 2019). Figure 4b shows the crustal structure of the Cantabrian Mountains, the North Iberian Margin and the Duero basin. Seismic imaging in this area allowed interpreting a crustal thickening under the highest peaks of the Cantabrian Mountains, with the Iberian crust subducting towards the north (Pulgar et al., 1996; Gallart et al., 1997a; Pedreira et al., 2003, 2015; Gallastegui et al., 2016). More recently, Teixell et al. (2018) suggested the southwards subduction of the Bay of Biscay crust along the MARCONI-1 profile, although of probable limited extent at this longitude. Towards the west, along the IAM-12 profile, the oceanic crust of the Bay of Biscay subducts towards the south (Teixell et al., 2018). This subduction is also imaged in the ESCI-N3.2 and ESCI-N3.3 profiles as 3D inclined subcrustal reflections ~~and diffractions~~ (Ayarza et al., 2004).

Towards the south of the Iberian Peninsula, the Gibraltar Arc System comprises the Betic Cordillera and the Rif, the westernmost belt of the Alpine chains (Figure 3). It is a broad arcuate collision zone separated by the Alborán Sea that resulted from the convergence between the Eurasian and African plates since the Miocene. This area represents a complex tectonic scenario with periods of compression overprinted by extensional episodes and dextral strike-slip movements of the Iberian subplate (*e.g.*, Sanz de Galdeano, 1990; Carbonell et al., 1997; Rosenbaum et al., 2002b; Platt et al., 2013). South of the Rif, the Atlas Mountains were also formed as a consequence of the Cenozoic to present convergence between Eurasia and Africa.

The Moroccan part of this orogen is formed by two branches, the High and Middle Atlas, that correspond to inverted Mesozoic basins (e.g., Arboleya et al., 2004). The RIFSIS and SIMA projects investigated these areas, sampling the African lithosphere down to the Moroccan Atlas. The topography of the latter is too high when considering the context of limited orogenic shortening featured in this area. Volcanism and intermediate depth seismicity support a model where isostasy is not enough to maintain the orogenic load, thus dynamic topography must have played a key role (Ayarza et al., 2005; Teixell et al., 2005, 2007). The RIFSIS and SIMA experiments shed some light into the P-wave velocity structure of the lithosphere and the Moho topography on this large area improving existing models (Ayarza et al., ~~2010~~2014; Gil et al., 2014; Figure 4e).

4 Technical aspects of the data

The datasets available in SeisDARE comprise controlled source DSS and HR data. All these datasets feature specific acquisition parameters which are detailed in their corresponding bibliography. This section provides a brief summary of the main acquisition characteristics of the different datasets.

For instance, four types of sources were used in the acquisition of the on-land data. For DSS data: i) most of the WA experiments used controlled explosions with charges ranging from 500 to 1000 kg; ii) large quarry blasts were used as energy sources in the acquisition of the ILIHA project; iii) for most of the NI experiments vibroseis trucks (4, 22 or 32 tonnes) were used, although ESCI-N1 and ESCI-N2 were acquired using explosions of 20 kg. For HR data, two types of sources were used: i) 250 kg accelerated-weight drop; and ii) 15-32 tonnes vibroseis trucks. Regarding the DSS offshore data, the energy sources were airgun arrays 2000 psi with different range of volumes depending on the research vessels used in each experiment: MV SeisQuest with a volume of 5490 in^3 (in ESCI-N), the MV Geco Sigma with a volume of 7542 in^3 (in IAM) and the BIO Hesperides with volumes ranging from 2690 to 1435 in^3 (in MARCONI).

The receivers onshore consisted of geophones of 1 or 3 components with sensors from 10 Hz to 20 s. A number of wide-angle experiments (IBERSEIS-WA, ALCUDIA-WA, SIMA, RIFSIS and CIMDEF) used a relatively large number of receivers, equipped with Reftek 125A instruments (also known as TEXANS) that belong to the IRIS-PASSCAL instrument pool. In addition, the CIMDEF experiment also used SERCEL-Unite dataloggers equipped with 10 Hz geophones and WorldSensig SPIDER dataloggers with 2 Hz sensors. For the MARCONI-WA experiment, Reftek 72A and Leas-Hathor dataloggers with sensors of 1s, 5s and 20s were used. The offshore receivers used in for the NI experiments were hydrophone streamers with different lengths. Finally, the WA experiments used Ocean-Bottom Seismometers or Hydrophones (OBS/OBH) as recording devices.

The data included in SeisDARE are in SEG-Y, SEG-D (https://seg.org/Publications/SEG-Technical-Standards; Barry et al., 1975) or in XDR SU format (https://wiki.seismic-unix.org/doku.php; Forel et al., 2008), the most commonly used formats for seismic data. The older datasets (ILIHA, ESCI and IAM) were recorded on magnetic track tapes and were successfully recovered and transformed to readable digital formats (SEG-Y or SU). The datasets are accessible as raw data, and processed stack cross-sections (migrated or not) are also available for some datasets. Raw data will fulfill the needs of researchers that would like to develop new processing approaches and the already processed data will provide images for scientists aiming to test alternative interpretations.

~~4~~ 5 DSS datasets

This section describes the DSS datasets hosted in SeisDARE, ordered by year of acquisition, ~~which were acquired in~~that sampled different parts of the Iberian Peninsula and Morocco~~ (onshore and offshore)~~. Each subsection provides a description of the individual datasets and the most relevant references associated.

45.1 ILIHA

The pioneer ILIHA (Iberian LIthosphere Heterogeneity and Anisotropy) project was acquired in 1989 and consisted of a star-shape arrangement of six long-range wide-angle reflection profiles covering the entire Iberian Peninsula. It was designed to study the lateral heterogeneity and anisotropy of the deep ~~levels of the~~ lithosphere of the Variscan basement in the Iberian Peninsula. The results of this project suggested a layered lower lithosphere ~~which layering may penetrate to~~reaching at least 90 km depth, contrasting with the heterogeneity of the Variscan surface geology (Díaz et al., 1993, 1996). ~~The dataset is available in Díaz et al. (2020).~~

45.2 ESCI

The ESCI project (*Estudios Sísmicos de la Corteza Ibérica*-Seismic Studies of the Iberian Crust) was conducted to obtain multichannel deep seismic reflection images in three areas of the Iberian Peninsula (Figure 3): the NW of the Iberian Peninsula (ESCI-N), the Gulf of Valencia (ESCI-Valencia Trough), and the Betic Cordillera (ESCI-Betics).

45.2.1 ESCI-N

ESCI-N comprises four multichannel seismic experiments, some of them including also wide-angle reflection datasets. ESCI-N1 is an onshore profile that runs E-W through the Variscan structure of the WALZ and the CZ. ESCI-N2, also onshore, runs with a N-S orientation and was aimed to image the Alpine ~~structure~~ imprint of the Cantabrian Mountains. ESCI-N3 is made up of three seismic ~~lines~~ profiles that follow a swerved line in a mainly E-W direction in the Galicia and west Asturian offshore. Finally, ESCI-N4 runs in a N-S direction offshore (Álvarez-Marrón et al., 1995a, b, 1996, 1997; Gutiérrez-Alonso, 1997). Beneath the CZ, ESCI-N1 shows the presence of a basal gently west dipping detachment identified as the Cantabrian Zone basal detachment. Towards the WALZ, a stack of thrust sheets probably affecting Precambrian rocks is placed above a crustal-scale ramp dipping to the west (Pérez-Estaún et al., 1994, 1997; Gallastegui et al., 1997; Fernández-Viejo and Gallastegui, 2005). The ESCI-N3 depicted a Moho offset between the CIZ and the WALZ, and the southward subduction of the oceanic crust of the Bay of Biscay as a consequence of Alpine shortening (Martínez Catalán et al., 1995; Álvarez-Marrón et al., 1995a, b, 1996; Ayarza et al., 1998, 2004). Furthermore, ESCI-N2 and ESCI-N4 revealed a crustal thickening beneath the highest summits of the Cantabrian Mountains which was interpreted as the northward~~s~~ subduction of the Iberian crust under this mountain range (Pulgar et al., 1995, 1996; Fernández-Viejo and Gallastegui, 2005). ~~The dataset is available in Pérez-Estaún et al. (2019).~~

45.2.2 ESCI Valencia Trough

The Valencia Trough is a NE-SW trending Cenozoic basin in the western Mediterranean Sea bounded by the Betic Cordillera to the southwest, the Iberian Chain to the west and the Pyrenees to the north (Figure 3). Different geodynamic models were proposed for the Valencia Trough during the 1980s and early 1990s, but there was a lack of agreement on its crustal structure and geodynamic evolution. Therefore, ESCI Valencia Trough was conducted to shed light on the structure of the western Mediterranean, providing for the first time a continuous image of this area. This experiment revealed that beneath the Valencia Trough, the crust ~~is of~~has continental ~~type~~ affinity and is strongly attenuated. The Moho is located at 17-18 km depth, thus being the strongest thinning reported so far in comparable passive margins (Gallart et al., 1994, 1997b). ~~The dataset is available in Gallart et al. (1993).~~

45.2.3 ESCI Betics

The ESCI Betics dataset consists of two profiles in the southeast of Spain through the Betic Cordillera (Figure 3). The ESCI Betics 1 is a 90 km long NW-SE ~~oriented~~ profile ~~of 90 km~~ that crosses the Guadalquivir basin, the external part of the Betic Cordillera and the Neogene-Quaternary basin at the limit with the internal zone. The ESCI Betics 2 profile runs for 160 km across the emerged part of the Alborán domain with a NNE-SSW orientation ~~for 106 km~~ (Carbonell et al., 1997; Vegas et al., 1997). The main aim of this project was to image the structure of the crust, as well as to investigate the development of collisional structures, the response to extensional stresses in regions of recently thinned crust, and the correlation between the crustal structure and the distribution of seismicity in a tectonically active area (García-Dueñas et al., 1994). It provided the first complete structural transect of the northern flank of the Gibraltar Arc and the Alpine metamorphic complexes of the Betic Cordillera. ~~The dataset is available in García-Dueñas et al. (1991).~~

45.3 IAM

The IAM (Iberian Atlantic Margin) project comprised 19 offshore reflection seismic profiles covering a total length of ~3,800 km. This project was set to study the deep continental and oceanic crusts in different parts of the Iberian Atlantic margin, thus sampling the north, west and south Iberian margins (Banda et al., 1995; Torné et al., 2018; Figure 3). ~~The full dataset is available in Torné et al. (2018).~~

The North Iberian Margin was imaged by ~~The IAM-12 crosses the North Iberian Margin with~~ a N-S ~~orientation~~profile in the western part of the ~~from near the coastline to the central~~ Bay of Biscay (Fernández-Viejo et al., 1998).~~, revealing~~ It revealed for the first time ~~its~~ the crustal structure in this area and ~~the~~ its nature ~~of its crust~~. Results indicate that ~~T~~the sedimentary infill of the abyssal plain is probably underlain by an oceanic basement (Álvarez-Marrón et al., 1997). The Moho is imaged as a subhorizontal reflection package located on land at 23-26 km (Córdoba et al., 1987) that features a rapid shallowing up to 15 km depth in the abyssal plain.

The West Iberian Margin is structurally divided in four zones: oceanic crust, peridotite ridge, transition zone and thinned continental crust. The crust decreases its thickness progressively to the west towards an oceanic crust of 6.5-7 km thick (Pickup et al., 1996; Sutra and Manatschal, 2012; Sutra et al., 2013). The peridotite ridge is a basement high that coincides with the eastward boundary of the seafloor-spreading magnetic anomalies (Dean et al., 2000). The transition zone has been interpreted as a tectonically exposed upper mantle, extensively serpentinized, that continues laterally to the continental crust.

The Southern Iberian Margin has undergone a complex tectonic history through a sequence of Mesozoic rifting and collisional events associated with the Africa-Eurasia plate convergence (González et al., 1996). This area corresponds to the Azores-Gibraltar seismic zone and comprises two regions: the Gorringe Bank and the Gulf of Cádiz. The Gorringe Bank is characterized by an irregular topography and a large amplitude gravity anomaly (Souriau, 1984; Gràcia et al., 2003; Cunha et al., 2010). It consists of mafic and ultramafic plutonic and extrusive rocks covered by Aptian to Pliocene sediments (Tortella et al., 1997; Jiménez-Munt et al., 2010). On the other hand, the basement of the Gulf of Cádiz is a continental crust that thins progressively from east to west (González-Fernández et al., 2001). The transition from the continental crust of the Gulf of Cádiz to the transitional/oceanic crust of the Gorringe Bank, is imaged as a series of E-W oriented thrusts, folds and diapirs formed during the Cenozoic convergence (Tortella et al., 1997).

45.4 MARCONI

The deep seismic survey MARCONI (North-Iberian COntinental MARgin) was carried out to understand the processes that governed the evolution of the Bay of Biscay and to establish the lithospheric structure of its southeastern part (Gallart et al., 2004). It included the simultaneous acquisition of eleven multichannel and wide-angle deep seismic reflection profiles with a total length of 2,000 km (Fernández-Viejo et al., 2011; Figure 3). This project imaged the sedimentary architecture in this part of the Bay of Biscay where no boreholes or direct geological data were available. The results of the MARCONI project confirmed the existence of compressive N-directed structures ~~resulted from~~related to the Alpine orogeny and developed at the foot of the continental slope, as well as the existence of NNE-SSW oriented transfer zones. Furthermore, it helped to identify the Cretaceous rift domains. The analysis of the velocity-depth profiles and the multichannel seismic data, allowed to conclude that: the SE part of the Bay of Biscay is formed by a stretched/thinned continental crust with the Moho located between 30 and 20 km; the NW part of the study area is interpreted as a transitional from continental to oceanic crust with the Moho identified at less than 20 km; and the on land part of the experiment (imaged only with the wide-angle experiment) showed the continental crust thickening as a consequence of the Alpine orogeny (Ferrer et al., 2008; Fernández-Viejo et al., 2011; Roca et al., 2011; Ruiz, 2007; Ruiz et al., 2017). ~~(Ferrer et al., 2008; Fernández-Viejo et al., 2011; Roca et al., 2011; Ruiz et al., 2017)~~

~~The crust is interpreted to be transitional from continental to oceanic and highly thinned in contrast with the oceanic-type crust towards the west of 6°W, where the lateral termination of the seafloor spreading center is deduced from magnetic anomalies (Ferrer et al., 2008; Fernández-Viejo et al., 2011; Roca et al., 2011; Ruiz et al., 2017). The dataset is available in Gallart et al. (2019).~~

45.5 IBERSEIS

In ~~the~~ SW ~~of the~~ Spain, a NI profile and two WA seismic profiles were acquired in 2001 and 2003 respectively to image the southernmost part of the Iberian Massif in the framework of the IBERSEIS project (Figure 3).

45.5.1 IBERSEIS-NI

IBERSEIS-NI is a 303 km long NE-SW oriented deep seismic reflection profile ~~designed to image the south of the Iberian Massif (Simancas et al., 2003, 2006)~~ that ~~sampling~~ sampled three major tectonic domains: the SPZ, the OMZ and the southernmost part of the CIZ (Figures 3 and 4c; ~~)~~Simancas et al., 2003, 2006). The high-resolution image obtained matched existing ~~field~~ geological cross-sections, and indicated ~~suggesting~~ the ~~existence~~ presence of left-lateral strike-slip displacements of Carboniferous age in the boundaries of the OMZ. The profile also provides an image of the ~~boundary~~ alleged suture between the OMZ and the SPZ, which is formed by a complex accretionary prism of sediments and oceanic basalts. The limit between the OMZ and the CIZ is assembled as an accretionary wedge of high-pressure metamorphic rocks. Fold-and-thrust belts in the upper crust merge downwards in a decoupling horizon between the upper and the lower crust. In the OMZ and CIZ, a 175 km long thick band of relatively high amplitude, the Iberian Reflective Body (IRB), is interpreted as a layered mafic/ultramafic body intruded along a mid-crustal decollement. In all the transect, a horizontal Moho reflection at.10.5 s suggests a 30-33 km thick crust (Simancas et al., 2003; Carbonell et al., 2004; Simancas et al., 2006). ~~The full dataset is available in Pérez-Estaún et al. (2001).~~

45.5.2 IBERSEIS-WA

The IBERSEIS-WA profile was acquired with the aim of providing constraints on the physical properties of the lithosphere beyond the results obtained in the IBERSEIS-NI profile. The IBERSEIS-WA project consisted of two transects running subparallel in a NE-SW to ENE-WSW direction. Transect A coincides with the trace of the IBERSEIS-NI profile and transect B was located farther to the east. Both transects join at their northern end. The main results of this project provided for the first time the P- and S-wave velocity models of the crust and upper mantle in this region. These experiments also allowed modeling the density (Palomeras et al. 2011a) and the Poisson's ratio (Palomeras et al., 2011b), which helped to provide~~d~~ an additional petrological description to estimate the crustal composition. Furthermore, it allowed locating the crust~~- and~~ mantle boundary at a depth of 31-33 km and to identify a subcrustal discontinuity at 66-70 km (Palomeras et al., 2009), later interpreted as the Hales discontinuity or gradient zone (Ayarza et al., 2010). ~~The dataset is available in Palomeras et al. (2003).~~

~~4~~5.6 ALCUDIA

The ALCUDIA dataset consists of two experiments, NI and WA, acquired in 2007 and 2012, respectively. These two experiments sampled the CIZ from the boundary with the OMZ to the ~~Spanish Central System~~northern part of the Tajo basin in approximately a NE-SW direction. It constitutes the northward prolongation of the previously acquired IBERSEIS seismic profiles (Figures 3 and 4c).

~~4~~5.6.1 ALCUDIA-NI

ALCUDIA-NI is a 230 km long NE-SW profile that imaged the lithospheric architecture of the Variscan orogen in the CIZ ~~from the northern boundary of OMZ to the Tajo basin~~ (Martínez Poyatos et al., 2012). The processed ALCUDIA-NI seismic profile shows a Moho discontinuity at ~10 s TWT (two-way time, *ca*. 30 km depth) that overlies a mantle where subhorizontal reflectivity was identified between 14 and 19 s TWT. The most prominent feature is a lower crust tectonic wedge in the southern segment of the transect, causing a local crustal thickening. The interpreted structures, as deduced from surface geology and the seismic image, show that deformation was distributed homogeneously in the upper crust, whereas it was concentrated in wedge/thrust structures at specific sectors in the lower crust (Martínez Poyatos et al., 2012; Simancas et al., 2013~~). The dataset is available in Pérez-Estaún et al. (2007).~~

~~4~~5.6.2 ALCUDIA-WA

The ALCUDIA-WA experiment aimed to constrain the lithospheric structure and resolve the physical properties of the crust and upper mantle in the CIZ. This profile has led to a well-constrained, 280 km long and 50 km deep P-wave velocity model. Its major contribution was to confirm the existence of an incipient crustal thickening ~~in~~ towards the Tajo ~~Basin~~ basin. High velocities towards the northern part of the profile correspond to igneous and/or high-grade metamorphic rocks in agreement with the geology of the Iberian Massif, in the area~~,~~ close to the south of the ~~Spanish~~ Iberian Central System (Ehsan et al., 2015). ~~The dataset is available in Pérez-Estaún et al. (2012).~~ In addition, a new interpretation of these data provides a S-wave model and Poisson's ratio values which allowed for a more accurate model of the nature of the crust (Palomeras et al., submitted).

~~4~~5.7 SIMA

SIMA (Seismic Imaging of the Moroccan Atlas) is a wide-angle reflection seismic experiment that runs through the Rif, Middle and High Atlas and the Sahara craton of Morocco. This project provided the velocity structure of the crust and the geometry of the Moho boundary. Final models image the Atlas limited crustal root, which is defined by the northward imbrication of the Sahara crust underneath the Atlas itself. The limited extension of the crustal root, further supports the need of dynamic topography models to explain the current Atlas topography (Ayarza et al., 2014). In addition, the low P-wave velocities obtained in the lower crust and mantle of the Middle and High Atlas were assigned to the existence of high temperatures and partial melts at these levels, probably a consequence of the ~~Tertiary~~Cenozoic-to-present magmatic activity of the Atlas region due to mantle upwelling. These lower P-wave velocities might indicate slightly lower densities that could modify the existing gravity models (Ayarza et al., 2005). ~~The SIMA dataset can be consulted in Ayarza et al. (2010).~~

~~4~~5.8 RIFSIS

The RIFSIS wide-angle reflection seismic experiment consists of two E-W and N-S oriented profiles, 330 km and 430 km long respectively. This acquisition geometry was designed to target the significant low Bouguer anomaly associated with this mountain range (Hildengrand et al., 1998). This project, which also aimed to improve the geodynamic models of the Gibraltar Arc, identified a 50 km deep crustal root below the Rif that thins rapidly towards the east to 20 km in the contact between the external part of the Rif with the former North African margin~~-~~ (Gil et al., 2014). Jointly, RIFSIS and SIMA provided a 700 km-long profile from the southernmost Iberian Peninsula to the northern Sahara Desert (Carbonell et al., 2013, 2014a). ~~The RIFSIS dataset can be consulted in Gallart et al. (2011).~~

~~4~~5.9 CIMDEF

The most recent wide-angle reflection/refraction experiment in the Iberian Peninsula was acquired as part of the CIMDEF project (Andrés et al., 2019; Carbonell et al., 2020). This project aimed to obtain a P-wave velocity model of the western part of the Duero basin, the CIZ, including that of the ~~Spanish~~ Iberian Central System and the~~-~~ Tajo basin~~western part of the Duero basin~~. This profile was meant to fill the data gap between the ALCUDIA and IBERSEIS profiles in the south and the ESCI-N profiles in the north (Figure 3). The dataset was acquired along two time periods: the seismic survey carried out in 2017 consisted of two profiles, NNW-SSE and E-W oriented of *ca.* 275 and 135 km length respectively. The survey carried out in 2019 consists of a NW-SE 340 km long profile. This dataset~~,~~ is embargoed until the 01/01/2024~~, is available in Ayarza and Carbonell (2019)~~.

~~5~~ 6 ~~High resolution~~HR seismic dataset

In the 2010s, ~~high resolution~~HR reflection seismic experiments were focused on shallow subsurface targets. These ~~high resolution~~ experiments were acquired with different objectives, including reservoir characterization for carbon capture and storage (CCS), nuclear waste storage, mineral resource exploration and seismic hazard assessments. These experiments involved imaging with both controlled and natural seismic sources, and allowed obtaining images and velocity models of the subsurface, from approximately 50 to 2,000 m depth.

~~5~~6.1 HONTOMÍN

To characterize the first Spanish research facility for geological storage of CO_2, a 3D reflection seismic experiment was carried out in Hontomín (~~Burgos, Spain,~~ Figure 3). This area is located in the southwestern part of the Basque-Cantabrian basin (Figure 3), which developed as a thick Mesozoic basin, tectonically inverted during the Alpine orogeny (e.g., DeFelipe et al., 2018, 2019). This experiment targeted a saline aquifer located at 1450 m depth within Lower Jurassic carbonates with a main seal formed by interlayered Lower to Middle Jurassic marl and limestone. The 3D geological structure consists of an asymmetric dome crosscut by a relatively complex fault system (Alcalde et al., 2013a, b, 2014). This study set the basis for the first CSS pilot plant in Spain. The dataset~~,~~ is embargoed until the 01/04/2022~~, is available in Alcalde et al. (2010)~~.

~~5~~6.2 VICANAS

The increased need of facilities for ~~temporary~~ temporal and long-term storage of radioactive waste has encouraged new geological and geophysical projects to characterize the structure of suitable settings. Within the framework of the VICANAS project, four reflection seismic profiles and a 3D ~~high resolution~~HR seismic tomography ~~survey~~ dataset were acquired in the Loranca Basin (~~Cuenca, Spain,~~ Figure 3). The 2D seismic reflection profiles were intended to characterize the shallow subsurface (up to 1,000 m) at regional level, focusing on faults and fracture networks that could potentially affect the stability of the waste disposal site. The ~~high~~ HR~~resolution~~ seismic tomography survey provided a full 3D P-wave seismic velocity image of an area of 500 x 500 m (Marzán et al., 2016; Martí et al., 2019). This experiment was specially designed to image the upper 100 m that directly interacts with the ongoing construction works. The seismic tomography results combined with geophysical measurements from boreholes and 2D electrical resistivity tomography profiles, provided a detailed mapping of the different lithology contacts that build up the sedimentary sequence filled up to 200 m of fluvial and lacustrine facies sediments (Álvarez-Marrón et al., 2014; Martí et al., 2019; Marzán et al., 2019). Within the scope of this project, Marzán et al. (submitted) reinterpreted the 3D ~~high resolution~~HR seismic dataset to provide a more consistent 3D Vp model by integrating the resistivity model with well-log data. To jointly interpret these data, the authors developed a machine learning scheme that resulted in a 3D lithological model ~~of a high degree of correlation~~highly well correlated with the known geology. ~~The 2D~~

~~reflection seismic dataset is available in Marzán et al. (2013) and the 3D high resolution tomography is available in Marzán et al. (2015).~~

~~5~~6.3 INTERGEO

The INTERGEO dataset aims to characterize the seismogenic behaviour of active faults in strike-slip tectonic contexts. The case study of this project is the Alhama de Murcia Fault (AMF), located in the Betic Cordillera (~~SE Spain;~~ Figure 3). This fault was responsible of one of the most destructive recent earthquakes in Spain (9 fatalities, 300 injuries and serious damages), occurred in May 2011 in Lorca, with Mw 5.2 (Martínez-Díaz et al., 2012). This earthquake was triggered by a rupture area of 3×4 km along the AMF in a transpressive context. Thus, in order to image the complex structure in depth of the southwestern part of the AMF, six NW-SE oriented reflection seismic profiles were successfully acquired. The seismic reflection profiles and travel time tomography allowed identifying and ~~characterize~~ characterizing the contact between the Miocene-Pliocene detrital sediments and the basement~~, and~~ the internal structure of the AMF and its different branches (Gascón Padrón, 2016; Ardanaz et al., 2018). ~~The dataset is available in Martí et al. (2015).~~

~~5~~6.4 SOTIEL

The European Institute of Technology ~~Within~~ through the Raw Materials Program~~, the European Institute of Technology~~ has encouraged the development of cost-effective, sustainable and safe research and innovation solutions for mineral exploration. Within this framework, the SIT4ME project has implemented seismic mineral exploration methods at a reduced cost, analysing the efficiency and capabilities of controlled source (e.g., reflection imaging techniques) and natural source (e.g., ambient noise interferometry) methods in mining areas. For this purpose, a multi-method seismic dataset was acquired in the Sotiel-Coronada mine in the Iberian Pyrite Belt (SPZ) to image a massive sulphide ore body intruded in volcanic and siliciclastic rocks at a depth of 300-500 m (Alcalde et al., 2019). This dataset is~~,~~ embargoed until 01/04/2022~~, is available in Alcalde et al. (2018)~~.

~~6~~ 7 Enlarging borders in DSS data sharing: COCORP Hardeman County, Texas

The Consortium of Continental Reflection Profiling (COCORP, http://www.geo.cornell.edu/geology/cocorp/COCORP.html) was a research group that pioneered seismic reflection profiling of the crust and upper mantle. COCORP worked during the 1970s and 1980s in the acquisition of more than 8,000 km of seismic profiling in the USA (Brown et al., 1987) and stimulated major deep seismic exploration programs in over 20 countries, such as ECORS in France, DEKORP in Germany or LITHOPROBE in Canada. COCORP demonstrated how seismic reflection information on the geological basement can contribute to address~~ing~~ questions in resource exploration (Brown, 1990). In its first experiment COCORP acquired 37 km of CMP stacked seismic reflection profiles in Hardeman County, Texas (Oliver et al., 1976; Schilt et al., 1981). These data imaged the Cambrian to Permian sedimentary rocks lying unconformably over a Precambrian basement intruded by relatively homogeneous igneous plutons (Oliver et al., 1976). Prominent upper basement layering first imaged in Hardeman County was later found to underlie much of the east central USA, perhaps representing major igneous intrusions on a continental scale (Kim and Brown, 2019). Furthermore, the COCORP Hardeman County proved the viability of using the vibroseis~~VIBROSEIS~~ technique to characterize the geological structure of the deep crust, resulting nowadays in a widespread technology of acquisition (Finlayson, 1975). ~~The dataset of COCORP Hardeman County can be accessed in Oliver and Kaufman (1975).~~

~~7~~ 8 Data availability

The SeisDARE is freely available at: https://digital.csic.es/handle/10261/101879 ~~(last access: September 2020)~~.

~~8~~ 9 Conclusions and final considerations

Seismic reflection data (normal incidence and wide-angle) ~~allow~~ provide a ~~high~~ high-resolution image ~~characterization~~ of the lithosphere, and set constraints on the structure and nature of the deep and shallow subsurface. The controlled source seismic data are useful not only in basic science but also in applied science, like in resource exploration and natural hazard assessment. DSS data are expensive and logistically complex to acquire, and often require a huge scientific effort involving several national and international research groups. The reproducibility of scientific results is dependent on the availability of data, which reinforces the paradigm of transparent and open access data-driven science as well as fosters innovation. Legacy data can be useful by itself or by applying the latest innovative processing techniques to generate new meaningful outputs. SeisDARE has been developed to facilitate the preservation and reuse of the existing data by future generations of geoscientists by hosting seismic data in the online institutional repository DIGITAL.CSIC. The SeisDARE database accomplishes the international mandates of open access data and the FAIR principles of data management. It is the result of a close collaboration between national and international institutions and encourages new networks to make seismic data easily available. Currently, SeisDARE contains ~~19~~ 21 seismic datasets of DSS and HR~~high resolution~~ data acquired since the 1980s in the Iberian Peninsula and Morocco. In addition, as a result of this internationalization effort we established a collaboration with the scientists that led the Consortium for Continental Reflection Profiling (COCORP) to host the pioneering Hardeman County dataset. All these datasets aimed to characterize different geological settings, ranging from the continental scale Variscan and Alpine orogens and the offshore Iberian Margins to exploration scale studies. The SeisDARE is being constantly updated and can be accessible via a web browser. It is free and open, bringing endless research and teaching opportunities to the scientific, industrial and educational communities.

Author contribution

IDF, JA, MI, DM, MR, IM, JD, PA, IP, JLFT, RR and RC worked on the data acquisition, compilation, collation and dissemination of the datasets. CM and IB provided the facilities to upload the datasets into DIGITAL.CSIC. LB provided with additional data to enlarge our database. IDF prepared the manuscript with contributions from all co-authors.

Competing interest

The authors declare that they have no conflict of interest.

Acknowledgements

This research has been funded by the Projects EPOS IP 676564, EPOS SP 871121, EIT Raw Materials 17024 (SIT4ME) and SERA 730900. JA received funding by EIT Raw Materials 17024 (SIT4ME) and is now funded by MICINN (Juan de la Cierva fellowship - IJC2018-036074-I). We acknowledge support of the publication fee by the CSIC Open Access Publication Support Initiative through its Unit of Information Resources for Research (URICI). We thank Florian Haslinger and an anonymous reviewer for their constructive comments that greatly improved the manuscript.

References

Alcalde, J., Martí, D., Calahorrano, A., Marzán, I., Ayarza, P., Carbonell, R., Juhlin, C., and Pérez-Estaún, A.: Active seismic characterization experiments of the Hontomín research facility for geological storage of CO_2, Spain. International Journal of Greenhouse Gas Control 19, 785-795, http://dx.doi.org/10.1016/j.ijggc.2013.01.039, 2013a.

Alcalde, J., Martí, D., Juhlin, C., Malehmir, A., Sopher, D., Saura, E., Marzán, I., Ayarza, P., Calahorrano, A., Pérez-Estaún, A., and Carbonell, R.: 3-D reflection seismic imaging of the Hontomín structure in the Basque–Cantabrian Basin (Spain). Solid Earth, 4, 481-496, doi:10.5194/se-4-481-2013, 2013b.

Alcalde, J., Martí, D., Pérez-Estaún, A., and Carbonell, R.: 3D reflection seismic imaging of the Hontomín CO_2 storage site [Dataset]; DIGITAL.CSIC, http://dx.doi.org/10.20350/digitalCSIC/9906, 2010.

Alcalde, J., Martínez, Y., Martí, D.; Ayarza, P., Ruiz, M., Marzán, I., Tornos, F., Malehmir, A., Gil, A., Buske, S., Orlowsky, D., and Carbonell, R.: SIT4ME: Innovative seismic imaging techniques for mining exploration - Sotiel-Elvira (Spain) dataset. DIGITAL.CSIC, http://dx.doi.org/10.20350/digitalCSIC/8633, 2018.

Alcalde, J., Martínez, Y., Martí, D.; Ayarza, P., Ruiz, M., Marzán, I., Tornos, F., Malehmir, A., Gil, A., Buske, S., Orlowsky, D., and Carbonell, R.: SIT4ME: seismic imaging for mining exploration in Sotiel-Elvira (Spain). Geophysical Research Abstracts vol. 21, EGU2019-15568, 2019.

Alcalde, J., Marzán, I., Saura, E., Martí, D., Ayarza, P., Juhlin, C., Pérez-Estaún, A, and Carbonell, R.: 3D geological characterization of the Hontomín CO2 storage site, Spain: Multidisciplinary approach from seismic, well-log and regional data. Tectonophysics, 627, 6-25. https://doi.org/10.1016/j.tecto.2014.04.025, 2014.

Álvarez-Marrón, J., Pérez-Estaún, A., Carbonell, R., Marzán, I., Martí, D., Brown, D., and Pineda, A.: Intraplate strike-slip tectonics accommodating late Cenozoic shortening in the southern Iberian Range (Loranca Basin, Spain). 16th Edition of the Deep SEISMIX International Symposium on Multi-Scale Seismic Imaging of the Earth's crust and Upper Mantle. Castelldefels, Barcelona, 2014.

Álvarez-Marrón, J., Pérez-Estaún, A., Dañobeitia, J. J., Pulgar, J. A., Martínez Catalán, J. R., Marcos, A., Bastida, F., Aller, J., Ayarza Arribas, P., Gallart, J., González-Lodeiro, F., Banda, E., Comas, M. C., and Córdoba, D.: Results from the ESCI-N3.1 and ESCI-N3.2 marine deep seismic profiles in the northwestern Galicia Margin. Rev. Soc. Geol. España 8 (4), 331-339, 1995a.

Álvarez-Marrón, J., Pérez-Estaún, A., Dañobeitia, J. J., Pulgar, J. A., Martínez Catalán, J. R., Marcos, A., Bastida, F., Ayarza Arribas, P., Aller, J., Gallart, J., González-Lodeiro, F., Banda, E., Comas, M. C., and Córdoba, D.: Seismic structure of the northern continental margin of Spain from ESCIN Deep seismic profiles. Tectonophysics, 264, 153-174, 1996.

Álvarez-Marrón, J., Pulgar, J.A., Dañobeitia, J.J., Pérez-Estaún, A., Gallastegui, J., Martínez Catalán, J. R., Banda, E., Comas, M.C., and Córdoba, D.: Results from the ESCIN-4 marine deep seismic profile in the Northern Iberian Margin. Rev. Soc. Geol. España, 8 (4): 355-363, 1995b.

Álvarez-Marrón, J., Rubio, E., and Torné, M.: Subduction-related structures in the North Iberian Margin. Journal of Geophysical Research, vol. 102, no. B10, p. 22, 497-22, 511, 1997.

Andrés, J., Draganov, D., Schimmel, M., Ayarza, P., Palomeras, I., Ruiz, M., and Carbonell, R.: Lithospheric image of the Central Iberian Zone (Iberian Massif) using global-phase seismic interferometry. Solid Earth, 10, 1937-1950, https://doi.org/10.5194/se-10-1937-2019, 2019.

Arboleya, M. L., Teixell, A., Charroud, M., and Julivert, M.: A structural transect through the High and Middle Atlas of Morocco. Journal of African Earth Sciences 39, 319-327, doi:10.1016/j.jafrearsci.2004.07.036.

Ardanaz, O., Dávila, L., Teixidó, T., Martí, D., Martí, A., Queralt, P., Rodríguez Escudero, E., Camacho, J., Martínez-Díaz, J.J., and Carbonell, R.: Caracterización geofísica de la falla de Alhama de Murcia en el sector de la Torrecilla. Iberfault, Alicante, 07/2018. Resúmenes de la III Reunión Ibérica sobre Fallas Activas y Paleosismología. In: Una aproximación multidisciplinar al estudio de las fallas activas, los terremotos y el riesgo sísmico. Ed.: Canora Catalán, C., Martín González, F., Masana, E., Pérez-López, R., and Ortuño, M, 2018.

Arenas, R., Martínez Catalán, J. R., Martínez Sánchez, S., Fernández Suárez, J., Andonaegui, P., and Pearce, J. A.: The Vila de Cruces ophiolite: A remnant of the early Rheic Ocean in the Variscan suture of Galicia (northwest Iberian Massif), J. Geol., 115(2), 129–148, doi:10.1086/510645, 2007.

Ayarza, P., Alvarez-Lobato, F., Teixell, A., Arboleya, M. L., Teson, E., Julivert, M., and Charroud, M.: Crustal structure under the central High Atlas Mountains (Morocco) from geological and gravity data, Tectonophysics, 400, 67–84. https://doi.org/10.1016/j.tecto.2005.02.009, 2005.

Ayarza, P., and Carbonell, R.: CIMDEF: a wide-angle deep seismic reflection profile in the Central Iberian Zone [Dataset], DIGITAL.CSIC, http://dx.doi.org/10.20350/digitalCSIC/10528, 2019.

Ayarza, P., Carbonell, R., Teixell, A., Palomeras, I., Martí, D., Kchikach, A., Harnafi, M., Levander, A., Gallart, J., Arboleya, M. L., Alcalde, J., Fernandez, M., Charroud, M., and Amrhar, M.: Crustal thickness and velocity structure across the Moroccan Atlas from long offset wide-angle reflection seismic data: The SIMA experiment, Geochem. Geophys. Geosyst., 15, 1698–1717, doi:10.1002/ 2013GC005164, 2014.

Ayarza, P., Martínez Catalán, J. R., Álvarez-Marrón, J., Zeyen, H., and Juhlin, C.: Geophysical constraints on the deep structure of a limited ocean-continental subduction zone at the North Iberian Margin. Tectonics, vol. 23, TC1010, doi:10.1029/2002TC001487, 2004.

Ayarza, P., Martínez Catalán, J. R., Gallart, J., Pulgar, J. A., and Dañobeitia, J.J.: Estudio sísmico de la Corteza Ibérica Norte 3.3: a seismic image of the Variscan crust in the hinterland of the NW Iberian Massif. Tectonics, vol. 17, no. 2, 171-186, 1998.

Ayarza, P., Palomeras, I., Carbonell, R., Afonso, J. C., and Simancas, F.: A wide-angle upper mantle reflector in SW Iberia: Some constraints on its nature. Physics of the Earth and Planetary Interiors 181, 88-102, doi:10.1016/j.pepi.2010.05.004, 2010.

Ayarza, P., Teixell, A., and Carbonell, R.: Seismic Imaging of the Moroccan Atlas (SIMA): a wide-angle reflection profile. [Dataset] DIGITAL.CSIC, http://dx.doi.org/10.20350/digitalCSIC/12532, 2010.

Banda, E., Torne, M., and the Iberian Atlantic Margins Group: Iberian Atlantic Margins Group investigates deep structure of ocean margins. Eos. 76.3: 25-29, DOI: 10.1029/EO076i003p00025, 1995.

Barry, K.M., Cavers, D. A., and Kneale, C. W.: Recommended standards for digital tape formats. Geophysics 40 (2): 344–352, https://doi.org/10.1190/1.1440530, 1975.

Berlin Declaration: Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities [online], 2003, available at: https://openaccess.mpg.de/Berlin-Declaration (last access ~~July~~ November 2020).

Bernal, I.: Digital.CSIC: Making the Case for Open Access at CSIC, Serials Review, 37:1, 3-8. https://doi.org/10.1080/00987913.2011.10765338, 2011.

Brown, L.: COCORP, crustal structure and hydrocarbon exploration. The Potential of Deep Seismic Profiling for Hydrocarbon Exploration. B. Pinet, C. Bois (Ed.) and Editions Technip, pp. 135-139, Paris, 1990.

Brown, L., Wille, D., Zheng, L., DeVoogd, B., Mayer, J., Hearn, T., Sanford, W., Caruso, C., Zhu, T.-F., Nelson, D., Potter, C., Hauser, E., Klemperer, S., Kaufman, S., and Oliver, J.: COCORP: new perspectives on the deep crust, Geophysical Journal International, Volume 89, Issue 1, Pages 47–54, https://doi.org/10.1111/j.1365-246X.1987.tb04386.x, 1987.

Cadenas, P., Fernández-Viejo, G., Pulgar, J. A., Tugend, J., Manatschal, G., and Minshull, T. A.: Constraints imposed by rift inheritance on the compressional reactivation of a hyperextended margin: Mapping rift domains in the North Iberian margin and in the Cantabrian Mountains. Tectonics, 37, 758–785. https://doi.org/ 10.1002/2016TC004454, 2018.

Carbonell, R., Ayarza, P., Gallart, J., Diaz, J., Harnafi, M., Levander, A., and Teixell, A.: From the Atlas to the Rif a Crustal seismic image across Morocco: The SIMA & RIFSEIS control source wide-angle seismic reflection data, paper presented at EGU General Assembly, Eur. Geosci. Union, Vienna, Vol. 16, EGU2014-6303, 2014a.

Carbonell, R., Gallart, J., Díaz, J., Gil, A., Harnafi, M., Ouraini, F., Ayarza, P., Teixell, A., Arboleya, M. L., Palomeras, I., and Levander, A.: A 700 km long crustal transect across northern Morocco, Geophysical Research Abstracts, vol. 15, EGU2013-8313, 2013.

Carbonell, R., DeFelipe, I., Alcalde, J., Ivandic, M., and Roberts, R.: Towards an Open Access European Database for Deep Seismic Sounding data, EGU General Assembly 2020, Online, 4–8 May 2020, EGU2020-7929, https://doi.org/10.5194/egusphere-egu2020-7929, 2020.

Carbonell, R., DeFelipe, I., Andrés, J., Alcalde, J., Ayarza, P., Palomeras, I., Ruiz, M., Martínez Poyatos, D., González-Lodeiro, F., Granja-Bruña, J. L., Torné, M., and R. Rodríguez-Fernández: Crustal structure under the Central Iberian Zone (Iberian Massif, Spain): the wide-angle seismic reflection CIMDEF experiment, AGU Fall Meeting, http://hdl.handle.net/10261/224742, 2020.

Carbonell, R., Levander, A., and Kind, R.: The Mohorovičić discontinuity beneath the continental crust: An overview of seismic constraints, Tectonophysics 609, 353-376, http://dx.doi.org/10.1016/j.tecto.2013.08.037, 2014b.

Carbonell, R., Simancas, F., Juhlin, C., Pous, J., Pérez-Estaún, A., González-Lodeiro, F., Muñoz, G., Heise, W., and Ayarza, P.: Geophysical evidence of a mantle derived intrusion in SW Iberia. Gephysical Research Letters, vol. 31, L11601, doi:10.1029/2004GL019684, 2004.

Carbonell, R., Torné, M., García Dueñas, V., Moya, R., and Banda, E.: The ESCI-Béticas: a seismic reflection image of the Betics orogen. Rev. Soc. Geol. España, 8(4), 1995: 503-512, 1997.

Choukroune, P., and the ECORS Team: The ECORS Pyrenean deep seismic profile reflection data and the overall structure of an orogenic belt. Tectonics, 8, 23-39, 1989.

Córdoba, D., Banda, E., and Ansorge, J.: The Hercynian crust in northwestern Spain: a seismic survey. Tectonophysics, 132, 321-333, https://doi.org/10.1016/0040-1951(87)90351-9, 1987.

Cunha, T. A., Watts, A. B., Pinheiro, L. M., and Myklebust, R.: Seismic and gravity anomaly evidence of large-scale compressional deformation off SW Portugal. Earth and Planetary Science Letters 293, 171-179, doi:10.1016/j.epsl.2010.01.047, 2010.

Daignières, M., Gallart, J., and Banda, E.: Lateral variation of the crust in the North Pyrenean Zone. Ann. Géophys. 37 (3), 435-456, http://hdl.handle.net/10261/171179, 1981.

Daignières, M., Gallart, J., Banda, E., and Hirn, A.: Implications of the seismic structure for the orogenic evolution of the Pyrenees range. Earth Planet. Sci. Lett., 57: 88-110, https://doi.org/10.1016/0012-821X(82)90175-3, 1982.

Dean, S.M., Minshull, T. A., Whitmarsh, R. B., and Louden, K. E.: Deep structure of the ocean-continent transition in the southern Iberia Abyssal Plain from seismic refraction profiles: the IAM-9 transect at 40º20’N. Journal of Geophysical Research, vol. 105, no. B3, 5859-5885, https://doi.org/10.1029/1999JB900301, 2000.

DeFelipe, I., Alcalde, J., Fernandez-Turiel, J. L., Diaz, J., Geyer, A., Molina, C., Bernal, I., Fernandez, J., and Carbonell, R.: The Spanish node of the multidisciplinary integrated e-infrastructure EPOS, EGU General Assembly 2020, Online, 4–8 May 2020, EGU2020-7692, https://doi.org/10.5194/egusphere-egu2020-7692, 2020.

DeFelipe, I., Pedreira, D., Pulgar, J. A., Iriarte, E., and Mendia, M.: Mantle exhumation and metamorphism in the Basque-Cantabrian Basin (N Spain). Stable and clumped isotopic analysis in carbonates and comparison with ophicalcites in the North-Pyrenean Zone (Urdach and Lherz). Geochemistry, Geophysics, Geosystems, 18, doi:10.1002/2016GC006690, 2017.

DeFelipe, I., Pedreira, D., Pulgar, J. A., van der Beek, P. A, Bernet, M., and Pik, R.: Unravelling the Mesozoic and Cenozoic tectonothermal Evolution of the Eastern Basque-Cantabrian Zone − Western Pyrenees by Low-Temperature Thermochronology, Tectonics 38, https://doi.org/10.1029/2019TC005532, 2019.

DeFelipe, I., Pulgar, J. A., and Pedreira, D.: Crustal structure of the Eastern Basque-Cantabrian Zone/western Pyrenees: from the Cretaceous hyperextension to the Cenozoic inversion. Revista de la Sociedad Geológica de España, 31(2), 2018.

Díaz, J., Gallart, J., and Carbonell, R.: Moho topography beneath the Iberian-Western Mediterranean region mapped from controlled-source and natural seismicity surveys, Tectonophysics vol. 692, part A, 74-85, https://doi.org/10.1016/j.tecto.2016.08.023, 2016.

Díaz, J., Gallart, J., Córdoba, D., Senos, L., Matias, L., Suriñach, E., Hirn, A., and Maguire, P.: A deep seismic sounding investigation of lithospheric heterogeneity and anisotropy beneath the Iberian Peninsula. Tectonophysics, 221, 35-51, https://doi.org/10.1016/0040-1951(93)90026-G, 1993.

Díaz, J., Gallart, J., Córdoba, D., Senos, L., Matias, L., Suriñach, E., Hirn, A., and Maguire, P: The ILIHA deep seismic sounding experiment (Iberian LIthosphere Heterogeneity and Anisotropy). [Dataset] DIGITAL.CSIC, http://dx.doi.org/10.20350/digitalCSIC/12623, 2020.

Díaz, J., Hirn, A., Gallart, J., and Abalos, B.: Upper-mantle anisotropy in SW Iberia from long-range seismic profiles and teleseismic shear-wave data. Physics of the Earth and Planetary Interiors 95, 153-166, https://doi.org/10.1016/0031-9201(95)03127-8, 1996.

Donoso, G.A., Malehmir, A., Pacheco, N., Araujo, V., Penney, M., Carvalho, J., Spicer, B. and Beach, S.: Potential of legacy 2D seismic data for deep targeting and structural imaging at the Neves–Corvo massive sulphide-bearing deposit, Portugal. Geophysical Prospecting, 68: 44-61. doi:10.1111/1365-2478.12861, 2020

Ehsan, S. A., Carbonell, R., Ayarza, P., Martí, D., Martínez-Poyatos, D., Simancas, J. F., Azor, A., Ayala, C., Torné, M., and Pérez-Estaún, A.: Lithospheric velocity model across the Southern Central Iberian Zone (Variscan Iberian Massif): The ALCUDIA wide-angle seismic reflection transect. Tectonics, 34, 535-554, doi:10.1002/2014TC003661, 2015.

Ercoli, M., Forte, E., Porreca, M., Carbonell, R., Pauselli, C., Minelli, G., and Barchi, M. R.: Using seismic attributes in seismotectonic research: an application to the Norcia Mw = 6.5 earthquake (30 October 2016) in central Italy, Solid Earth, 11, 329–348, https://doi.org/10.5194/se-11-329-2020, 2020.

Fernández-Viejo, G., Gallart, J., Pulgar, J. A., Gallastegui J., Dañobeitia, J. J., and Córdoba, D.: Crustal transition between continental and oceanic domains along the North Iberian margin from wide angle seismic and gravity data. Geophysical Research Letters, vol. 25, no. 23, 4249-4252, https://doi.org/10.1029/1998GL900149, 1998.

Fernández-Viejo, G., and Gallastegui, J.: The ESCI-N Project after a decade: a synthesis of the results and open questions. Trabajos de Geología, Universidad de Oviedo, 25: 9-25, 2005.

Fernández-Viejo, G., Gallastegui J., Pulgar, J. A., and Gallart, J.: The MARCONI reflection seismic data: A view into the eastern part of the Bay of Biscay, Tectonophysics 508, 34-41, doi:10.1016/j.tecto.2010.06.020, 2011.

Ferrer, O., Roca, E., Benjumea, B., Muñoz, J. A., Ellouz, N., and MARCONI Team: The deep seismic reflection MARCONI-3 profile: Role of extensional Mesozoic structure during the Pyrenean contractional deformation at the eastern part of the Bay of Biscay, Marine and Petroleum Geology 25, 714-730, doi:10.1016/j.marpetgeo.2008.06.002, 2008.

Finlayson, D. M.: COCORP startup: the first deep seismic profiling of the continental crust in USA, Hardeman County, Texas, http://www.earthscrust.org.au/science/startups/cocorp-su.html, 1975.

Forel, D., Benz, T., and Pennington, W. D.: Seismic Data Processing with Seismic Un*x. A 2D Seismic Data Processing Primer. Michigan Technological University, Society of Exploration Geophysicists, ISBN 978-1-56080-134-4 (Volume), 2008.

Gallart, J., Banda, E., and Daignières, M.: Crustal structure of the Paleozoic Axial Zone of the Pyrenees and transition to the North Pyrenean Zone. Ann. Géophys., 37 (3): 457-480, 1981.

Gallart, J., Daignières, M., Banda, E., Suriñach, E., and Hirn, A.: The eastern Pyrenean domain: lateral variations at crust-mantle level. Ann. Géophys., 36 (29): 141-158, 1980.

Gallart, J., Diaz, J., and Carbonell, R.: The RIFSIS wide-angle reflection experiment through the Rif Cordillera (N Morocco). [Dataset], digital.CSIC, http://dx.doi.org/10.20350/digitalCSIC/12531, 2011.

Gallart, J., Fernández-Viejo, G., Díaz, J., Vidal, N., and Pulgar, J.A.: Deep structure of the transition between the Cantabrian Mountains and the North Iberian Margin from wide-angle ESCI-N data. Rev. Soc. Geol. España, 8(4), 1995: 365-382, 1997a.

Gallart, J., Pulgar, J.A., Muñoz, J.A., and Díaz, J.: Lithospheric structure of the Cantabrian Margin – Bay of Biscay (MARCONI), http://dx.doi.org/10.20350/digitalCSIC/8972, 2019a.

Gallart, J., Pulgar, J.A., Muñoz, J.A., Díaz, J., and Ruiz, M.: Lithospheric Structure of the North Iberian Margin: MARCONI-WA reflection profiles, Dataset, http://dx.doi.org/10.20350/digitalCSIC/12685, 2020.

Gallart, J., Pulgar, J.A., Muñoz, J.A., and MARCONI Team: Integrated studies on the lithospheric structure and Geodynamics of the North Iberian Continental Margin: the Marconi project. Geophysical Research Abstracts 6, 04196. SRef-ID: 1607–7962/gra/EGU04-A-04196. European Geosciences Union, 2004.

Gallart, J., Vidal, N., Dañobeitia, J.J., and the ESCI-Valencia Trough Working Group: Lateral variations in the deep crustal structure at the Iberian margin of the Valencia trough imaged from seismic reflection methods, Tectonophysics, 232, 59-75, https://doi.org/10.1016/0040-1951(94)90076-0, 1994.

Gallart, J., Vidal, N., Dañobeitia, J.J., Sàbat, F., Pous, J., Suriñach, E., Estevez, A., and Santisteban, C.: Seismic Study of the Iberian Crust, ESCI Valencia Trough survey. [Dataset], DIGITAL.CSIC; http://dx.doi.org/10.20350/digitalCSIC/9937, 1993.

Gallart, J., Vidal, N., Estévez, A., Pous, J., Sàbat, F., Santisteban, C., Suriñach, E., and the ESCI-València Trough Group: The ESCI-València Trough vertical reflection experiment: a seismic image of the crust from the Iberian Peninsula to the Western Mediterranean. Revista de la Sociedad Geológica de España, 8 (4), 1995: 401-415, 1997b.

Gallastegui, J., Pulgar, J. A., and Álvarez-Marrón, J.: 2-D seismic modeling of the Variscan foreland thrust and fold belt crust in NW Spain from ESCIN-1 deep seismic reflection data. Tectonophysics, 269, 21-32, 1997.

Gallastegui, J., Pulgar, J. A., and Gallart, J.: Alpine tectonic wedging and crustal delamination in the Cantabrian Mountains (NW Spain). Solid Earth, 7, 1043-1057, doi:10.5194/se-7-1043-2016, 2016.

García-Dueñas, V., Banda, E., Torné, M., Córdoba, D., and ESCI BETICAS working group: A deep seismic reflection survey across the Betic Chain (southern Spain): first results, Tectonophysics, 232, 77-89. https://doi.org/10.1016/0040-1951(94)90077-9, 1994.

García-Dueñas, V., Banda, E., Torné, M., Córdoba, D., Comas, M. C., González-Lodeiro, F., Maldonado, A., Muñoz, M., Orozco, M., Sanz de Galdeano, C., Suriñach, E., Tubía, J. M., and Vegas, R.: Seismic Study of the Iberian Crust, ESCI-Betics survey. [Dataset] DIGITAL.CSIC; http://dx.doi.org/10.20350/digitalCSIC/9925, 1991.

García-Mondéjar, J., Agirrezabala, L. M., Aranburu, A., Fernández-Mendiola, P. A., Gómez-Pérez, I., López-Horgue, M., and Rosales, I.: Aptian-Albian tectonic pattern of the Basque-Cantabrian Basin (northern Spain). Geological Journal, 31, 13–45, 1996.

Gascón Padrón, R.: Seismic Reflection imaging of the Alhama de Murcia Fault (Epicentral area of the Lorca 2011 Earthquake). MSc. Project. Universitat de Barcelona and Universitat Autònoma de Barcelona, 2016.

Gil, A., Gallart, J., Diaz, J., Carbonell, R., Torne, M., Levander, A., and Harnafi, M.: Crustal structure beneath the Rif Cordillera, North Morocco, from the RIFSIS wide-angle reflection seismic experiment, Geochem. Geophys. Geosyst., 15, 4712–4733, doi:10.1002/ 2014GC005485, 2014.

González, A., Torné, M., Córdoba, D., Vidal, N., Matias, L.M., and Díaz, J.: Crustal thinning in the Southwestern Iberia Margin. Geophysical Research Letters, vol. 23, no. 18, 2477-2480, https://doi.org/10.1029/96GL02299, 1996.

González-Fernández, A., Córdoba, D., Matias, L.M. and Torné, M.: Seismic crustal structure in the Gulf of Cadiz (SW Iberian Peninsula). Marine Geophysical Researchers, 22: 207-223, DOI: 10.1023/A:1012254420429, 2001.

Gràcia, E., Dañobeitia, J., Vergés, J., and Bartolomé, R.: Crustal architecture and tectonic evolution of the Gulf of Cadiz (SW Iberian margin) at the convergence of the Eurasian and African plates. Tectonics, vol. 22, no. 4, 1033, doi:10.1029/2001TC901045, 2003.

Gutiérrez-Alonso, G.: Structure of the Internal-External Transition Zone in the northern Iberian Massif: implications for the interpretation of deep crustal seismic profiles. Rev. Soc. Geol. España 8 (4): 321-330, 1997.

Hildengrand, T. G., Kucks, R. P., Hamouda, M. F., and Bellot, A.: Bouguer gravity map and related filtered anomaly maps of Morocco, U.S. Geol. Surv. Open-File Report: 88–517, 15 pp., 1988.

Hirsch, M.: “Let’s make data count”: los datos, un producto de la investigación vital para la ciencia abierta. 5as Jornadas de Análisis de la Red de Bibliotecas y Archivos del CSIC, http://dx.doi.org/10.20350/digitalCSIC/9957, 2019.

Jacob, A.W.B., Bean, C.J., and Jacob, S.T.F.: Active and passive seismic techniques reviewed. Proceedings of the 1999 CCSS Workshop, Dublin, Ireland: Communications of the Dublin Institute for Advanced Studies, Series D, Geophysical Bulletin, v. 49: 117 p., 2000.

Jammes, S., Manatschal, G., Lavier, L., and Masini, E.: Tectonosedimentary evolution related to extreme crustal thinning ahead of a propagating ocean: Example of the western Pyrenees. Tectonics, 28(4). doi:10.1029/2008TC002406, 2009.

Jiménez-Munt, I., Fernàndez M., Vergés J., Afonso J. C., Garcia-Castellanos D., and Fullea J.: Lithospheric structure of the Gorringe Bank: Insights into its origin and tectonic evolution. Tectonics, vol. 29, TC5019, doi:10.1029/2009TC002458, 2010.

Julivert, M., Fontboté, J. M., Ribeiro, A., and Conde, L. S.: Mapa Tectónico de la Península Ibérica y Baleares E:1/ 1.000.000; Servicio de Publicaciones del Ministerio de Industria, Madrid, 1972.

Kim, D.K., and Brown, L.D.: From Trash to Treasure: Three dimensional basement imaging from with “excess” data collected with from oil and gas exploration, American Association of Petroleum Geologists Bulletin, v. 103, 1691-1701, DOI:10.1306/12191817420, 2019.

Macchiavelli, C., Vergés, J., Schettino, A., Fernàndez, M., Turco, E., Casciello, E., Torne, M., Pierantoni, P. P., and Tunini, L.: A new southern North Atlantic isochron map: Insights into the drift of the Iberian plate since the Late Cretaceous. Journal of Geophysical Research: Solid Earth, 122, 9603–9626. https://doi.org/10.1002/2017JB014769, 2017.

Manzi, M., Malehmir, A., and Durrheim, R.: Giving the legacy seismic data the attention they deserve First Break, Volume 37, Issue 8, Aug 2019, p. 89 - 96; DOI: 10.3997/1365-2397.n0050, 2019.

Martí, D., Carbonell, R., Flecha, I., Palomeras, I., Vázquez-Suñé, E., Font-Capó, J., and Pérez-Estaún, A.: High-resolution seismic characterization in an urban area: subway tunnel construction in Barcelona, Spain. Geophysics 73, Issue 2, B41-B50, http://dx.doi.org/10.1190/1.2832626, 2008.

Martí, D., Marzán, I., Sachsenhausen, J., Ruiz, M., Torné, M., Mendes, M., and Carbonell, R.: 3-D seismic travel-time tomography validation of a detailed subsurface model: the case study of the Záncara River (Cuenca, Spain). Solid Earth, 10, 177-192, https://doi.org/10.5194/se-10-177-2019, 2019.

Martí, D., Teixidó, T., Ardanaz, O., Dávila, L., Martínez-Díaz, J., Mendes, M., and Carbonell, R.: Characterization of the 3D internal structure of the Alhama de Murcia Fault (FAM) in the segments Goñar-Lorca, Lorca-Totana and Totana-Alhama, DIGITAL.CSIC, http://dx.doi.org/10.20350/digitalCSIC/8632, 2015.

Martínez-Díaz, J. J., Bejar-Pizarro, M., Álvarez-Gómez, J. A., de Lis Mancilla, F., Stich, D., Herrera, G., and Morales, J.: Tectonic and seismic implications of an intersegment rupture: The damaging May 11th 2011 Mw 5.2 Lorca, Spain, earthquake. Tectonophysics, 546, 28-37, https://doi.org/10.1016/j.tecto.2012.04.010, 2012.

Martínez Catalán, J.R., Arenas, R., Díaz García, F., and Abati, J.: Variscan accretionary complex of northwest Iberia: Terrane correlation and succession of tectonothermal events. Geology 25, 1103–1106, https://doi.org/10.1130/0091-7613(1997)025<1103:VACONI>2.3.CO;2, 1997.

Martínez Catalán, J. R., Ayarza Arribas, P., Pulgar, J.A., Pérez-Estaún, A., Gallart, J., Marcos, A., Bastida, F., Álvarez-Marrón, J., González-Lodeiro, F., Aller, J., Dañobeitia, J.J., Banda, E., Córdoba, D., and Comas, M.C.: Results from the ESCI-N3.3 marine deep seismic profile along the Cantabrian continental margin. Rev. Soc. Geol. España 8(4), 341-354, 1995.

Martínez Poyatos, D., Carbonell, R., Palomeras, I., Simancas, J. F., Ayarza, P., Martí, D., Azor, A., Jabaloy, A., González Cuadra, P., Tejero, R., Martín Parra, L.M., Matas, J., González Lodeiro, F., Pérez-Estaún, A., García Lobón, J. L., and Mansilla, L.: Imaging the curstal structure of the Central Iberian Zone (Variscan Belt): The ALCUDIA deep seismic reflection transect. Tectonics, vol. 31, TC3017, https://doi.org/10.1029/2011TC002995, 2012.

Marzán, I., Martí, D., Álvarez-Marrón, J., Lobo, A., Ruiz, M., Torné, M., and Carbonell, R.: Detailed 3D Subsurface Geophysical Model: Data Integration, Multi-parameter Inversion and Statistical Integrated Interpretation: The case study of the Zancara River Basin (Cuenca, Spain). Acta Geologica Sinica, vol. 93(S1), https://doi.org/10.1111/1755-6724.14099, 2019.

Marzán, I., Martí, D., Lobo, A., Kormann, J., Álvarez-Marrón, J., and Carbonell, R.: Joint interpretation of velocity and resistivity 3D models through statistical classification. Geo-Temas, 16(1), ISSN 1576-5172, 2016.

Marzán, I., Martí, D., Lobo, A., Ruiz, M., Alcalde, J., Alvarez-Marron, J., and Carbonell, R.: Joint interpretation of multidisciplinary geophysical datasets: Applying machine learning to 3D model building. Submitted to Engineering Geology.

Marzán, I., Martí, D., Torné, M., Ruiz, M., and Carbonell, R.: High resolution seismic characterization of the shallow subsurface of the Loranca Basin (Spain): local 2D transects. DIGITAL.CSIC, http://dx.doi.org/10.20350/digitalCSIC/8635, 2013.

Marzán, I., Martí, D., Torné, M., Ruiz, M., and Carbonell, R.: High resolution seismic characterization of the shallow subsurface of the Loranca Basin (Spain): high resolution 3D. DIGITAL.CSIC. http://dx.doi.org/10.20350/digitalCSIC/8636, 2015.

Matte, P.: Accretionary history and crustal evolution of the Variscan belt in Western Europe, Tectonophysics, 196, 309–337, https://doi.org/10.1016/0040-1951(91)90328-P, 1991.

Matte, P.: The Variscan collage and orogeny (480-290 Ma) and the tectonic definition of the Armorica microplate: A review, Terra Nova, 13, 122 – 128, https://doi.org/10.1046/j.1365-3121.2001.00327.x, 2001.

Mintrop, L.: 100 Jahre physikalische Erdbebenforschung und Spreng-seismik. Die Naturwissenschaften, v. 34, p. 257–262, 289–295, doi:10.1007/BF00589855, 1947.

Muñoz, J. A.: Evolution of a continental collision belt: ECORS-Pyrenees crustal balanced cross-section. In: McClay K.R. (eds) Thrust Tectonics. Springer, Dordrecht, https://doi.org/10.1007/978-94-011-3066-0_21, 1992.

Murphy, J. B., and Nance, R. D.: Supercontinent model for the contrasting character of Late Proterozoic orogenic belts, Geology, 19 (5), 469 – 472, https://doi.org/10.1130/0091-7613(1991)019<0469:SMFTCC>2.3.CO;2, 1991.

Nicholls, H., L., Penn, A. Marszalek, P. Esestime, K. Rodriguez, C. Benson, and M. Cvetkovic: The role of legacy seismic in exploring new offshore hydrocarbon provinces – or can you "teach" old data new tricks (technologies)? SEG Technical Program Expanded Abstracts: 1917-1921. doi: 10.1190/segam2015-5875295.1, 2015.

Oliver, J., Bobrin, M., Kaufman, S., Meyer, R., and Phinney, R.: Continuous seismic reflection profiling of the deep basement, Hardeman County, Texas. Geological Society of America Bulletin, v.87 (11), p. 1537-1546, https://doi.org/10.1130/0016-7606(1976)87<1537:CSRPOT>2.0.CO;2, 1976.

Oliver, J., and Kaufman, S.: Consortium for Continental Reflection Profiling: COCORP Hardeman County, Texas. [Dataset], digital.CSIC, http://dx.doi.org/10.20350/digitalCSIC/12530, 1975.

Palomeras, I., Carbonell, R., Ayarza, P., Fernàndez, M., Simancas, J.F., Martínez Poyatos, D., González Lodeiro, F., and Pérez-Estaún, A.: Geophysical model of the lithosphere across the Variscan Belt of SW-Iberia: multidisciplinary assessment. Tectonophysics, 508, pp 42-51, DOI: 10.1016/j.tecto.2010.07.010, 2011a.

Palomeras, I., Carbonell, R., Ayarza, P., Martí, D., Brown, D., and Simancas, F.: Shear wave modeling and Poisson's ratio in the Variscan Belt of SW Iberia. Geochemistry, Geophysics, Geosystems, vol. 12, n. 7, doi:10.1029/2011GC003577, 2011b.

Palomeras, I., Carbonell, R., Flecha, I., Simancas, F., Ayarza, P., Matas, J., Martínez Poyatos, D., Azor, A., González Lodeiro, F., and Pérez-Estaún, A.: Nature of the lithosphere across the Variscan orogen of SW Iberia: Dense wide-angle seismic reflection data. Journal of Geophysical Research, vol. 114, B02302, doi:10.1029/2007JB005050, 2009.

Palomeras, I., Ehsan, E. A., Martínez Poyatos, D. J., Ayarza, P., Martí, D., Carbonell, R., Azor, A., Parra, L. M., and Marzan, I.: Seismic Structure and Composition of the Southern Central Iberian Crust: the ALCUDIA Wide-angle Seismic Reflection Transect. Submitted to Tectonophysics.

Palomeras, I., Simancas, J. F., Ayarza, P., González Lodeiro, F., Pérez-Estaún, A., Azor, A., and Carbonell, R.: Wide-angle deep seismic reflection profile (IBERSEIS Wide-Angle Transect) [Dataset], DIGITAL.CSIC; http://dx.doi.org/10.20350/digitalCSIC/9018, 2003.

Pedreira, D., Pulgar, J. A., Gallart, J., and Díaz, J.: Seismic evidence of Alpine crustal thickening and wedging from the western Pyrenees to the Cantabrian Mountains (north Iberia). Journal of Geophysical Research, vol. 108 NO. B4, 2204, doi:10.1029/2001JB001667, 2003.

Pedreira, D., Afonso, J. C., Pulgar, J. A., Gallastegui, J., Carballo, A., Fernàndez, M., Garcia-Castellanos, D., Jiménez-Munt, I., Semprich, J., and García-Moreno, O.: Geophysical-petrological modeling of the lithosphere beneath the Cantabrian Mountains and the North-Iberian margin: geodynamic implications. Lithos 230, 46-68, http://dx.doi.org/10.1016/j.lithos.2015.04.018, 2015.

Pérez-Cáceres, I., Simancas, J. F., Martínez Poyatos, D., Azor, A., and González Lodeiro, F.: Oblique collision and deformation partitioning in the SW Iberian Variscides. Solid Earth, 7, 857-872, www.solid-earth.net/7/857/2016/, 2016.

Pérez-Cáceres, I., Martínez Poyatos, D., Simanca,s J. F., and Azor, A.: Testing the Avalonian affinity of the South Portuguese Zone and the Neoproterozoic evolution of SW Iberia through detrital zircon populations. Gondwana Research 42C,177-192, doi: 10.1016/j.gr.2016.10.010, 2017.

Pérez-Díaz, L., Alcalde, J., and Bond, C. E.: Introduction: Handling uncertainty in the geosciences: identification, mitigation and communication. Solid Earth, 11(3), 889-889, https://doi.org/10.5194/se-11-889-2020, 2020.

Pérez-Estaún, A., Ayarza, P., Martínez Poyatos, D., Simancas, J. F., Azor, A., and Carbonell, R.: Wide-angle deep seismic reflection profile (ALCUDIA Wide-Angle Transect). [Dataset], DIGITAL.CSIC, http://dx.doi.org/10.20350/digitalCSIC/9061, 2012.

Pérez-Estaún, A., Gallart, J., Pulgar, J. A., and Álvarez-Marrón, J.: Seismic Study of the Iberian Crust, ESCI-North survey. [Dataset] DIGITAL.CSIC; http://dx.doi.org/10.20350/digitalCSIC/9894, 2019.

Pérez-Estaún, A., Pulgar, J. A., Álvarez-Marrón, J., and ESCIN Group: Crustal structure of the Cantabrian Zone: seismic image of a Variscan foreland thrust and fold belt (NW Spain). Rev. Soc. Geol. España 8(4), 1995, 307-319, 1997.

Pérez-Estaún, A., Pulgar, J. A., Banda, E., Álvarez-Marrón, J., and ESCIN Group: Crustal structure of the external variscides in northwest Spain from Deep seismic reflection profiling. Tectonophysics, 232, 91-118, 1994.

Pérez-Estaún, A., Simancas, J. F., González Lodeiro, F., Ayarza, P., Azor, A., Juhlin, C., Sáez, R., Almodóvar, G. R., and Carbonell, R.: Deep high resolution seismic reflection profile (IBERSEIS Normal Incidence Transect). [Dataset] DIGITAL.CSIC, http://dx.doi.org/10.20350/digitalCSIC/9016, 2001a.

Pérez-Estaún, A., Simancas, J. F., González Lodeiro, F., Ayarza, P., Azor, A., Juhlin, C., Sáez, R., Almodóvar, G. R., and Carbonell, R.: Deep high resolution seismic reflection profile IBSERSEIS NI: Migrated and stack files. [Dataset] DIGITAL.CSIC, http://dx.doi.org/10.20350/digitalCSIC/12643, 2001b.

Pérez-Estaún, A., Simancas, J. F., González Lodeiro, F., Ayarza, P., Azor, A., Martínez Poyatos, D., and Carbonell, R.: Deep seismic reflection profile (ALCUDIA Normal Incidence transect). [Dataset] DIGITAL.CSIC, http://dx.doi.org/10.20350/digitalCSIC/9049, 2007.

Pickup, S. L. B., Whitmarsh, R. B., Fowler, C. M. R., and Reston, T. J.: Insight into the nature of the ocean-continent transition off West Iberia from a deep multichannel seismic reflection profile. Geology, 24 (12): 1079-1082, 1996.

Platt, J. P., Behr, W. M., Johanesen, K. and Williams, J. R.: The Betic-Rif Arc and its Orogenic Hinterland: A review, Annu. Rev. Earth Planet. Sci., 41, 313–357, doi:10.1146/annurev-earth-050212-123951, 2013.

Prodehl, C., and Mooney, W. D.: Exploring the Earth's Crust—History and Results of Controlled-Source Seismology. The Geological Society of America, vol. 208, https://doi.org/10.1130/MEM208, 2012.

Pulgar, J. A., Gallart, J., Fernández-Viejo, G., Pérez-Estaún, A., Álvarez-Marrón, J., and ESCIN Group: Seismic image of the Cantabrian Mountains in the western extension of the Pyrenees from integrated ESCIN reflection and refraction data. Tectonophysics 264, 1-19, https://doi.org/10.1016/S0040-1951(96)00114-X, 1996.

Pulgar, J.A., Pérez-Estaún, A., Gallart, J., Álvarez-Marrón, J., Gallastegui, J., Alonso, J. L., and ESCIN Group: The ESCI-N2 deep seismic reflection profile: a traverse across the Cantabrian Mountains and adjacent Duero basin. Rev. Soc. Geol. España 8(4), 383-394, 1995.

Roca, E., Muñoz, J. A., Ferrer, O., and Ellouz, N.: The role of the Bay of Biscay Mesozoic extensional structure in the configuration of the Pyrenean orogen: Constraints from the MARCONI deep seismic reflection survey. Tectonics, vol. 30, 0278-7407/11/2010TC002735, 2011.

Rodríguez Fernández, L.R., López Olmedo, F., Oliveira, J.T., Matas, J., Martín-Serrano, A., Martín Parra, L.M., Rubio, F., Marín, C., Montes, M., Nozal, F., Medialdea, T., and Terrinha, P.: Mapa Geológico de España y Portugal E 1: 1.000.000. In: Rodríguez Fernández, L.R., Oliveira, J.T. (Eds.). IGME-LNEG, 2014.

Rosenbaum, G., Lister, G. S., and Duboz, C.: Relative motions of Africa, Iberian and Europe during Alpine orogeny, Tectonophysics 359, 117-129, https://doi.org/10.1016/S0040-1951(02)00442-0, 2002a.

Rosenbaum, G., Lister, G. S., and Duboz, C.: Reconstruction of the tectonic evolution of the western Mediterranean since the Oligocene. In: Rosenbaum, G. and Lister, G. S. 2002. Reconstruction of the evolution of the Alpine-Himalayan Orogen. Journal of the Virtual Explorer, 8, 107 – 130, 2002b.

Ruiz, M.: Caracterització estructural i sismotectònica de la litosfera en el Domini Pirenaico-Cantàbric a partir de mètodes de sísmica activa i passiva. PhD thesis, Universitat de Barcelona, 354 pp, http://hdl.handle.net/10803/1923, 2007.

Ruiz, M., Díaz, J., Pedreira, D., Gallart, J., and Pulgar, J. A.: Crustal structure of the North Iberian continental margin from seismic refraction/wide-angle reflection profiles. Tectonophysics 717, 65-82, http://dx.doi.org/10.1016/j.tecto.2017.07.008, 2017.

Sanz de Galdeano, C.: Geological evolution of the Betic Cordilleras in the Western Mediterranean, Miocene to the present. Tectonophysics, 172, 107-119, https://doi.org/10.1016/0040-1951(90)90062-D, 1990.

Schilt, F. S., Kaufman, S., and Long, G. H.: A three-dimensional study of seismic diffraction patterns from deep basement sources. Geophysics, vol. 46(12): 1673, https://doi.org/10.1190/1.1441175, 1981.

Simancas, J.F., Ayarza, P., Azor, A., Carbonell, R., Martínez Poyatos, D., Pérez Estaún, A., and González Lodeiro, F.: A seismic geotraverse across the Iberian Variscides: Orogenic shortening, collisional magmatism, and orocline development. Tectonics, vol. 32, 417-432, doi:10.1002/tect.20035, 2013.

Simancas, J.F., Carbonell, R., González Lodeiro, F., Pérez Estaún, A., Juhlin, C., Ayarza, P., Kashubin, A., Azor, A., Martínez Poyatos, D., Almodóvar, G. R., Pascual, E., Sáez, R., and Expósito, I.: Crustal structure of the transpressional Variscan orogen of SW Iberia: SW Iberia deep seismic reflection profile (IBERSEIS). Tectonics, vol. 2, no. 6, 1062, https://doi.org/10.1029/2002TC001479, 2003.

Simancas, J.F., Carbonell, R., González Lodeiro, F., Pérez Estaún, A., Juhlin, C., Ayarza, P., Kashubin, A., Azor, A., Martínez Poyatos, D., Sáez, R., Almodóvar, G. R., Pascual, E., Flecha, I., and Martí, D.: Transpressional collision tectonics and mantle plume dynamics: the Variscides of southwestern Iberia. From: Gee, F. G. & Stephensin, R. A. (eds). European Lithosphere Dynamics, Geological Society, London, Memoirs, 32, 345-354, 2006.

Souriau, A.: Geoid anomalies over Gorringe Ridge, North Atlantic Ocean, Earth Planet. Sci. Lett., 68, 101 – 114, https://doi.org/10.1016/0012-821X(84)90143-2, 1984.

Sutra, E., and Manatschal, G.: How does the continental crust thin in a hyperextended rifted margin? Insights from the Iberia margin. Geology, v. 40; no. 2; p. 139-142, doi:10.1130/G32786.1, 2012.

Sutra, E., Manatschal, G., Mohn, G., and Unternehr, P.: Quantification and restoration of extensional deformation along the Western Iberia and Newfoundland rifted margins. Geochemistry, Geophysics, Geosystems, v. 14, no. 8, p. 2575-2597. doi: 10.1002/ggge.20135, 2013.

Teixell, A.: Crustal structure and orogenic material budget in the west central Pyrenees: Tectonics, vol. 17, no.3, 395-406, DOI: 10.1029/98TC00561, 1998.

Teixell, A., Ayarza, P., Teson, E., Babault, J., Alvarez-Lobato, F., Charroud, M., Julivert, M., Barbero, L., Amrhar, M., and Arboleya, M. L.: Geodinámica de las cordilleras del Alto y Medio Atlas: Síntesis de los conocimientos actuales, Rev. Soc. Geol. España, 20, 119–135, 2007.

Teixell, A., Ayarza, P., Zeyen, H., Fernàndez, M., Arboleya, M.-L.: Effects of mantle upwelling in a compressional setting: the Atlas Mountains of Morocco. Terra Nova, 17, 456-461, doi: 10.1111/j.1365-3121.2005.00633.x, 2005.

Teixell, A., Labaume, P., Ayarza, P., Espurt, N., De Saint Blanquat, M., and Lagabrielle, Y.: Crustal structure and evolution of the Pyrenean-Cantabrian belt: A review and new interpretations from recent concepts and data. Tectonophysics. doi:10.1016/j.tecto.2018.01.009, 2018.

Teixell, A., Labaume, P., and Lagabrielle, Y.: The crustal evolution of the west-central Pyrenees revisited: Inferences from a new kinematic scenario. Comptes Rendus Geoscience 348, 257-267. http://dx.doi.org/10.1016/j.crte.2015.10.010, 2016.

Torné, M., Banda, E., Sibuet, J.C., Mendes-Victor, L., Senos, M.L., Long, R., and Watts, A. B.: Iberian Atlantic Margins, IAM_Project Final Scientific Report, http://dx.doi.org/10.20350/digitalCSIC/8566, 1995.

Torné, M., Banda, E., Sibuet, J.C., Mendes-Victor, L., Senos, M.L., Long, R., and Watts, A. B.: Multichannel seismic reflection and wide-angle and refraction data acquisition along the Iberian Atlantic Margins. DIGITAL.CSIC, http://dx.doi.org/10.20350/digitalCSIC/8549, 2018.

Tornos, F.: Environment of formation and styles of volcanogenic massive sulfides: The Iberian Pyrite Belt, Ore Geology Reviews, 28, 259-307, doi:10.1016/j.oregeorev.2004.12.005, 2006.

Tortella, D., Torné, M., and Pérez-Estaún, A.: Geodynamic Evolution of the Eastern Segment of the Azores-Gibraltar Zone: The Gorringe Bank and the Gulf of Cadiz Region. Marine Geophysical Researches 19: 211–230, https://doi.org/10.1023/A:1004258510797, 1997.

Tugend, J., Manatschal, G., and Kusznir, N. J.: Spatial and temporal evolution of hyperextended rift systems: Implication for the nature, kinematics, and timing of the Iberian-European plate boundary. Geology, 43(1), 15–18, https://doi.org/10.1130/G36072.1, 2015.

Tugend, J., Manatschal, G., Kusznir, N. J., Masini, E., Mohn, G., and Thinon, I.: Formation and deformation of hyperextended rift systems: Insights from rift domain mapping in the Bay of Biscay Pyrenees. AGU Publications, 1–38, 2014.

Vegas, R., Vázquez, J. T., Medialdea, T., and Suriñach, E.: Seismic and tectonic interpretation of the ESCI -Béticas and ESCI-Alborán deep seismie refleetion profiles: structure of the crust and geodynamic implications. Rev. Soc. Geol. España 8(4): 449-460, 1997.

Wilkinson, M., Dumontier, M., Aalbersberg, I. et al.: The FAIR Guiding Principles for scientific data management and stewardship. Sci Data 3, 160018. https://doi.org/10.1038/sdata.2016.18, 2016.

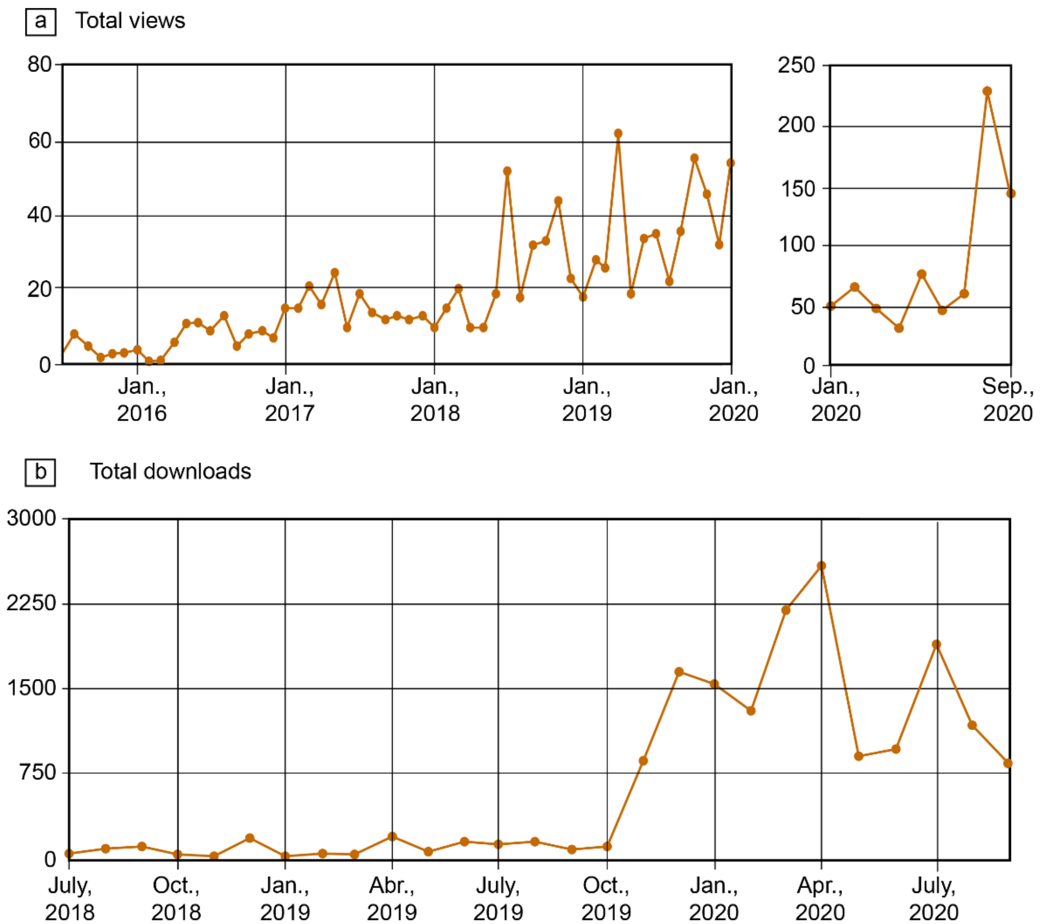
Ziegler, P. A.: Evolution of the North Atlantic: An overview. Extensional tectonics and stratigraphy of the North Atlantic margins. AAPG Mem. 46: 111-129, 1988.

Table 1: Seismic ~~campaigns~~ datasets comprised in SeisDARE (DSS: deep seismic sounding; HR: ~~high~~ high-resolution). The location of the seismic datasets is shown in Figure 3. Note that ESCI, MARCONI, IBERSEIS, ALCUDIA and VICANAS comprise two or three datasets (see text for details).

Dataset	Year	Seismic data	Onshore/offshore	Research target	Section	Dataset reference

ILIHA	1989	DSS Wide-Angle	Onshore	Iberian Massif	~~4.1~~5.1	Díaz et al. (2020)
ESCI-N **ESCI Valencia Trough** **ESCI Betics**	1991-1993	DSS Normal Incidence	Onshore and offshore	Iberian Massif Bay of Biscay Cantabrian Mountains Valencia Trough Betic Cordillera	~~4.2~~5.2	Pérez-Estaún et al. (2019) Gallart et al. (1993) García-Dueñas et al. (1991)
IAM	1993	DSS Normal incidence	Offshore	Iberian Atlantic Margin	~~4.3~~5.3	Torné et al. (2018)
MARCONI	2003	DSS Normal Incidence and Wide-Angle	Offshore and onshore	Bay of Biscay	~~4.4~~5.4	Gallart et al. (2019, 2020)
IBERSEIS	2001 and 2003	DSS Normal Incidence and Wide-Angle	Onshore	Iberian Massif (South Portuguese Zone, Ossa-Morena Zone and Central Iberian Zone)	~~4.5~~5.5	Pérez-Estaún et al. (2001a, b) Palomeras et al. (2003)
ALCUDIA	2007 and 2012	DSS Normal Incidence and Wide-Angle	Onshore	Iberian Massif (Ossa-Morena Zone and Central Iberian Zone)	~~4.6~~5.6	Pérez-Estaún et al. (2007) Pérez-Estaún et al. (2012)
SIMA	2010	DSS Wide-Angle	Onshore	Rif Cordillera and Atlas Mountains	~~4.7~~5.7	Ayarza et al. (2010)
RIFSIS	2011	DSS Wide-Angle	Onshore	Rif Cordillera	~~4.8~~5.8	Gallart et al. (2011)
CIMDEF	2017 and 2019	DSS Wide-Angle	Onshore	Duero basin, Central Iberian Zone and Tajo basin	~~4.9~~5.9	Ayarza and Carbonell (2019)
HONTOMÍN	2010	HR Normal Incidence	Onshore	CO_2 storage site characterization	~~5.1~~6.1	Alcalde et al. (2010)
VICANAS	2014	HR Normal Incidence	Onshore	Nuclear waste disposal site characterization	~~5.2~~6.2	Marzán et al. (2013, 2015)

INTERGEO	2015	HR Normal Incidence	Onshore	Quaternary seismicity in the Alhama de Murcia Fault	~~5.3~~6.3	Martí et al. (2015)
SOTIEL	2018	HR Normal Incidence	Onshore	Mining exploration in the Iberian Pyrite Belt	~~5.4~~6.4	Alcalde et al. (2018)
COCORP Hardeman County	1975	DSS Normal Incidence	Onshore	Hardeman County (Texas, USA)	~~6~~7	Oliver and Kaufman (1975)



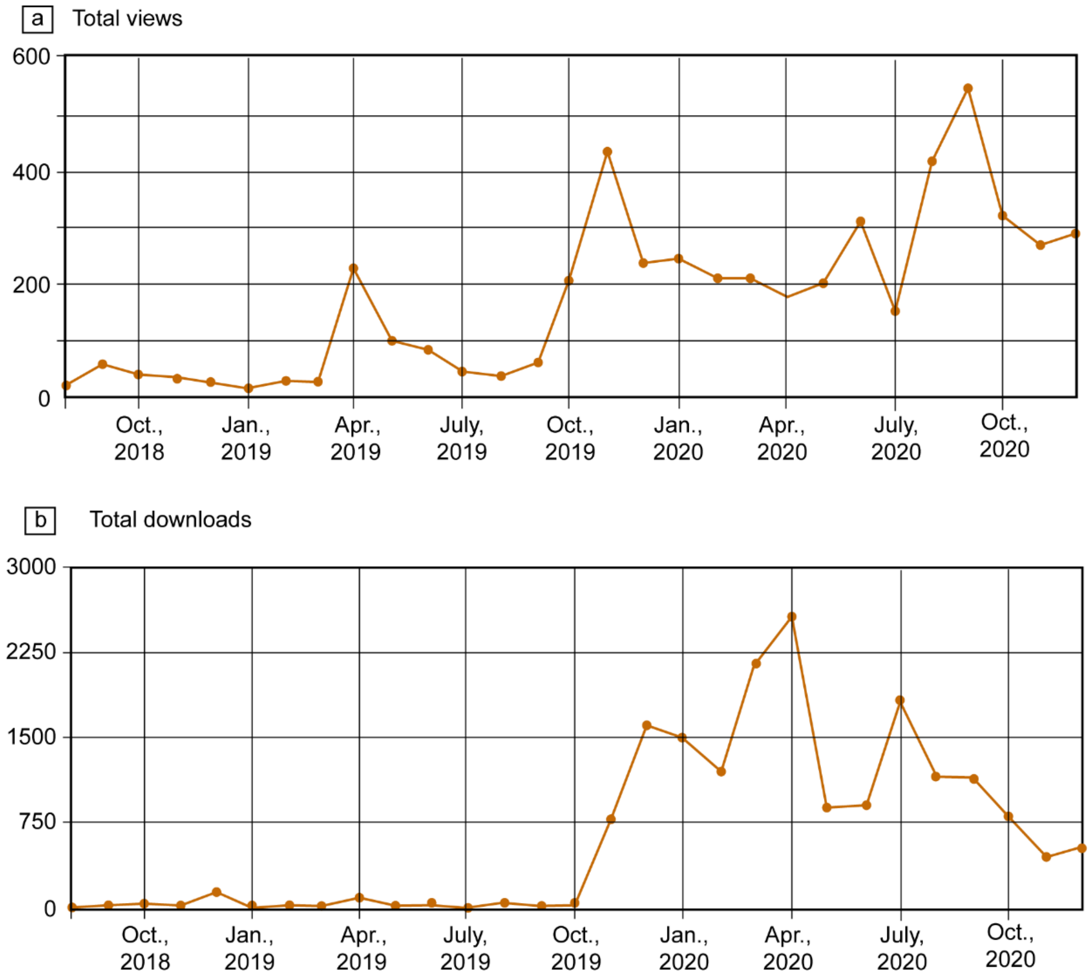


Figure 1: a) Total views ~~(note the change of the vertical scale from January 2020 onwards)~~ and b) total downloads of all datasets from the GEO3BCN database (https://digital.csic.es/handle/10261/101879, last access ~~September~~ January ~~2020~~2021).

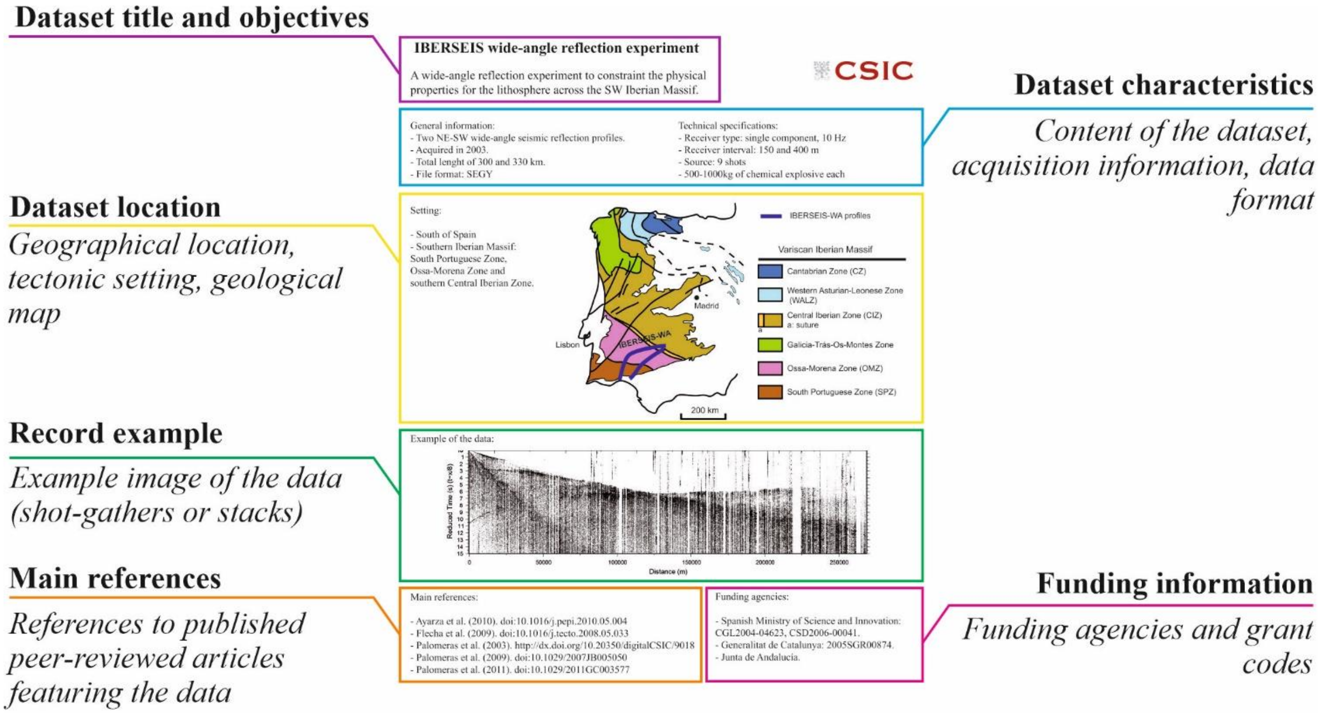
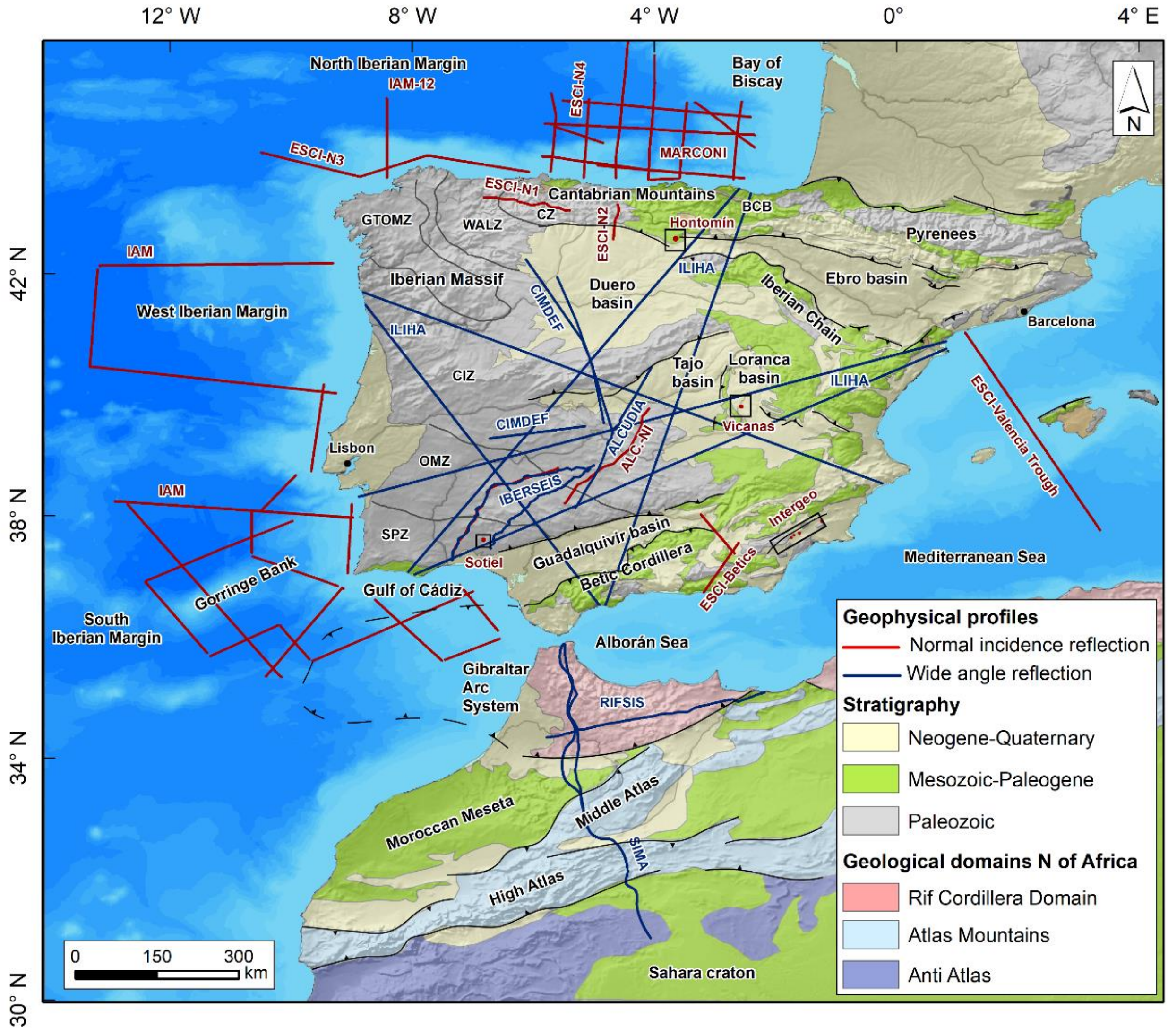


Figure 2: Example of the index card containing the IBERSEIS-WA project (section 4.5.2) information.



12° W
8° W
4° W
0°
4° E
42° N
38° N
34° N
30° N
North Iberian Margin
IAM-12
ESCI-N3
ESCI-N4
Bay of Biscay
MARCONI
ESCI-N1
Cantabrian Mountains
CZ
GTOMZ
WALZ
ESCI-N2
Hontomín
BCB
Pyrenees
IAM
Iberian Massif
ILIHA
Duero basin
CIMDEF
Ebro basin
Iberian Chain
West Iberian Margin
Barcelona
CIZ
Tajo basin
Loranca basin
ESCI-Valencia Trough
CIMDEF
ALCUDIA
ALC-NI
Vicanas
Lisbon
OMZ
IBERSEIS
IAM
SPZ
Sotiel
Guadalquivir basin
Betic Cordillera
Intergeo
ESCI-Betics
Mediterranean Sea
Gorringe Bank
Gulf of Cádiz
South Iberian Margin
Alborán Sea
Gibraltar Arc System
RIFSIS
Moroccan Meseta
Middle Atlas
SIMA
High Atlas
Sahara craton
N
0
150
300
km
Geophysical profiles
Normal incidence reflection
Wide angle reflection
Stratigraphy
Neogene-Quaternary
Mesozoic-Paleogene
Paleozoic
Geological domains N of Africa
Rif Cordillera Domain
Atlas Mountains
Anti Atlas

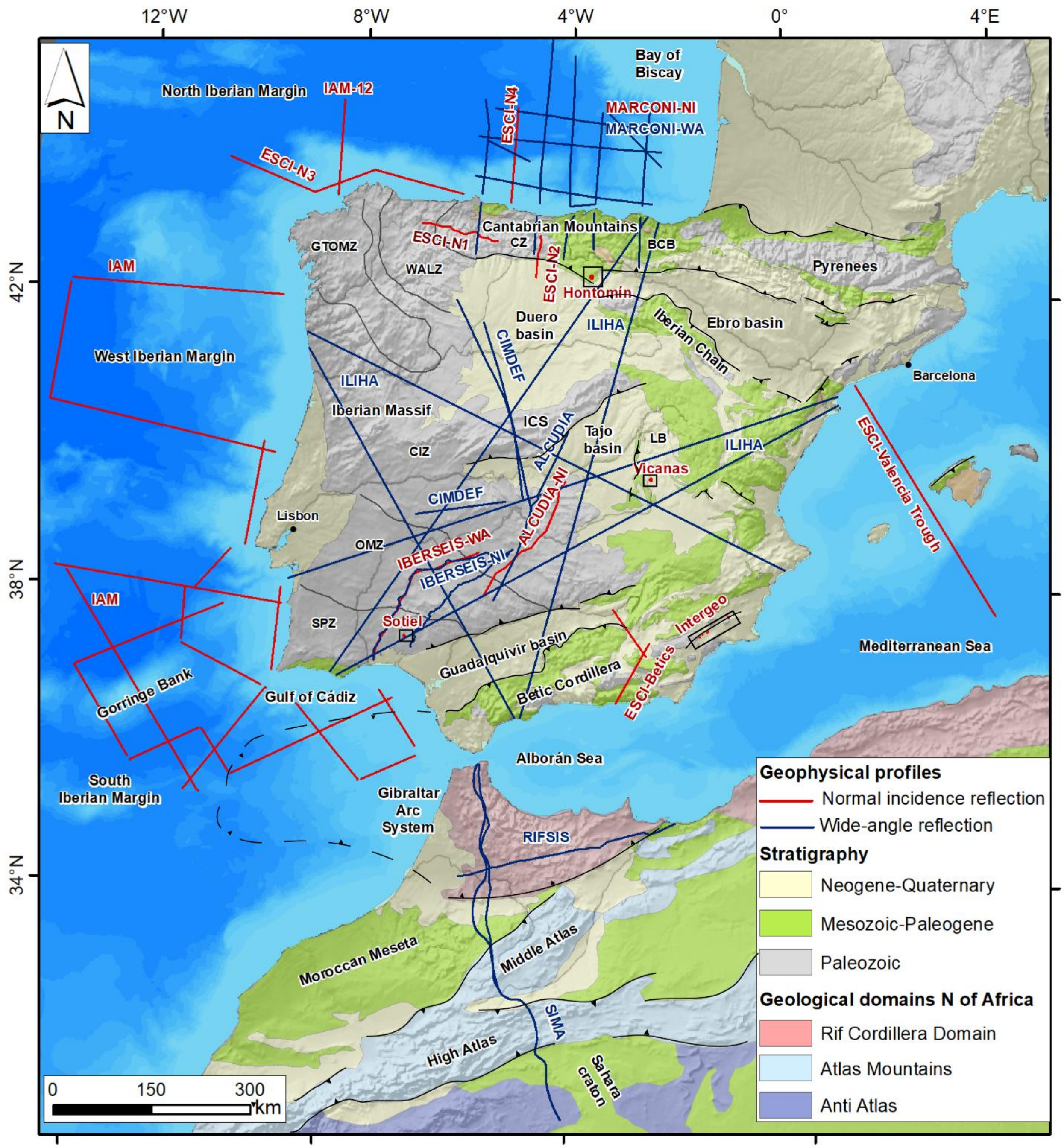
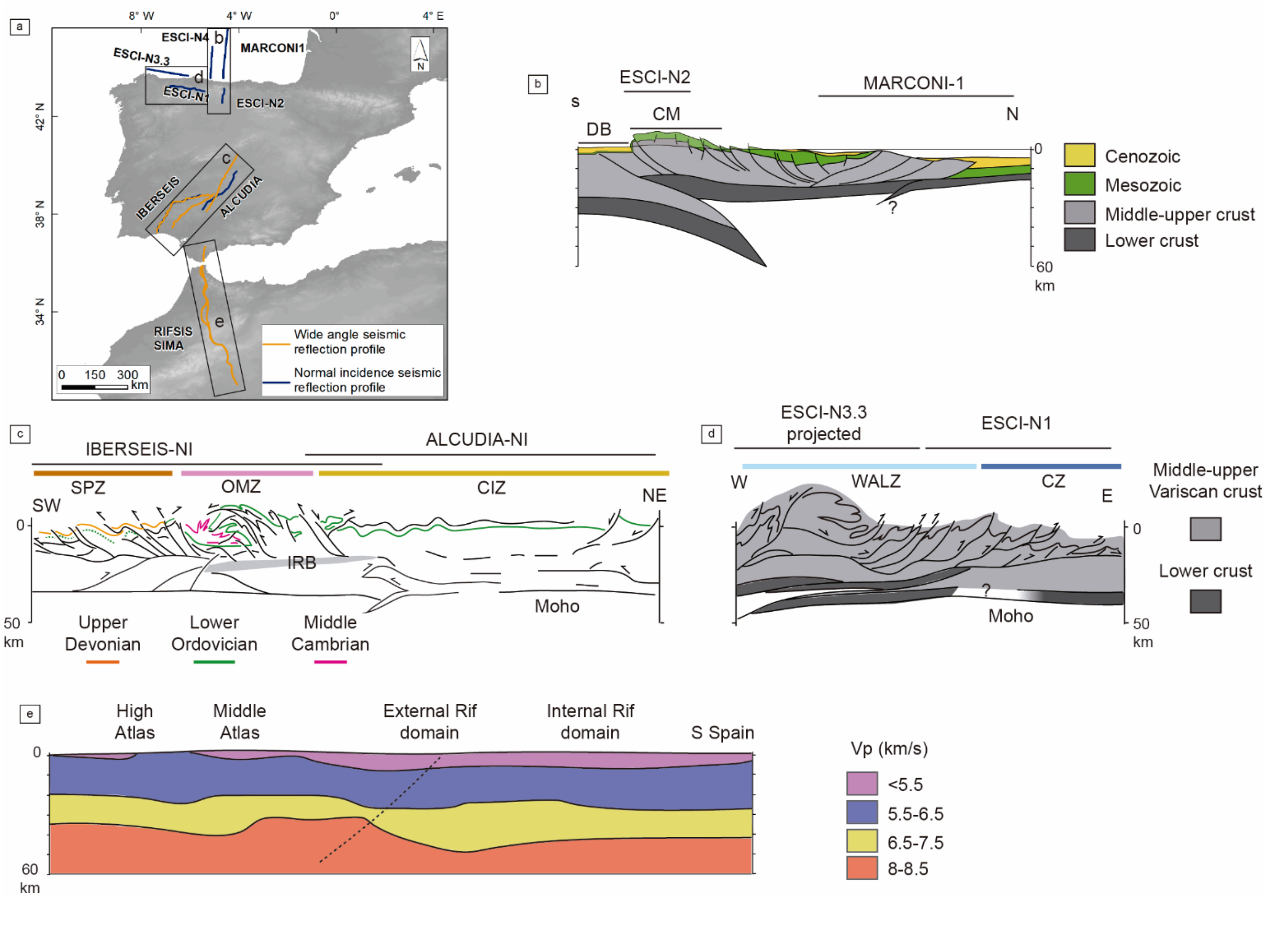


Figure 3: Geological map of the Iberian Peninsula and north of Africa with the seismic profiles provided in the SeisDARE. The geological units are simplified from the IGME Geological Map of the Iberian Peninsula 1:1.000.000 (Rodríguez Fernández et al.,

2014). Note that the MARCONI offshore experiment acquired simultaneously normal incidence and wide-angle reflection, whereas on land, only wide-angle data were acquired. BCB: Basque-Cantabrian basin; CZ: Cantabrian Zone; WALZ: West Asturian Leonese Zone; GTOMZ: Galicia-Tras-Os-Montes Zone; CIZ: Central Iberian Zone; OMZ: Ossa Morena Zone; SPZ: South Portuguese Zone; ICS: Iberian Central System; LR: Loranca Basin.



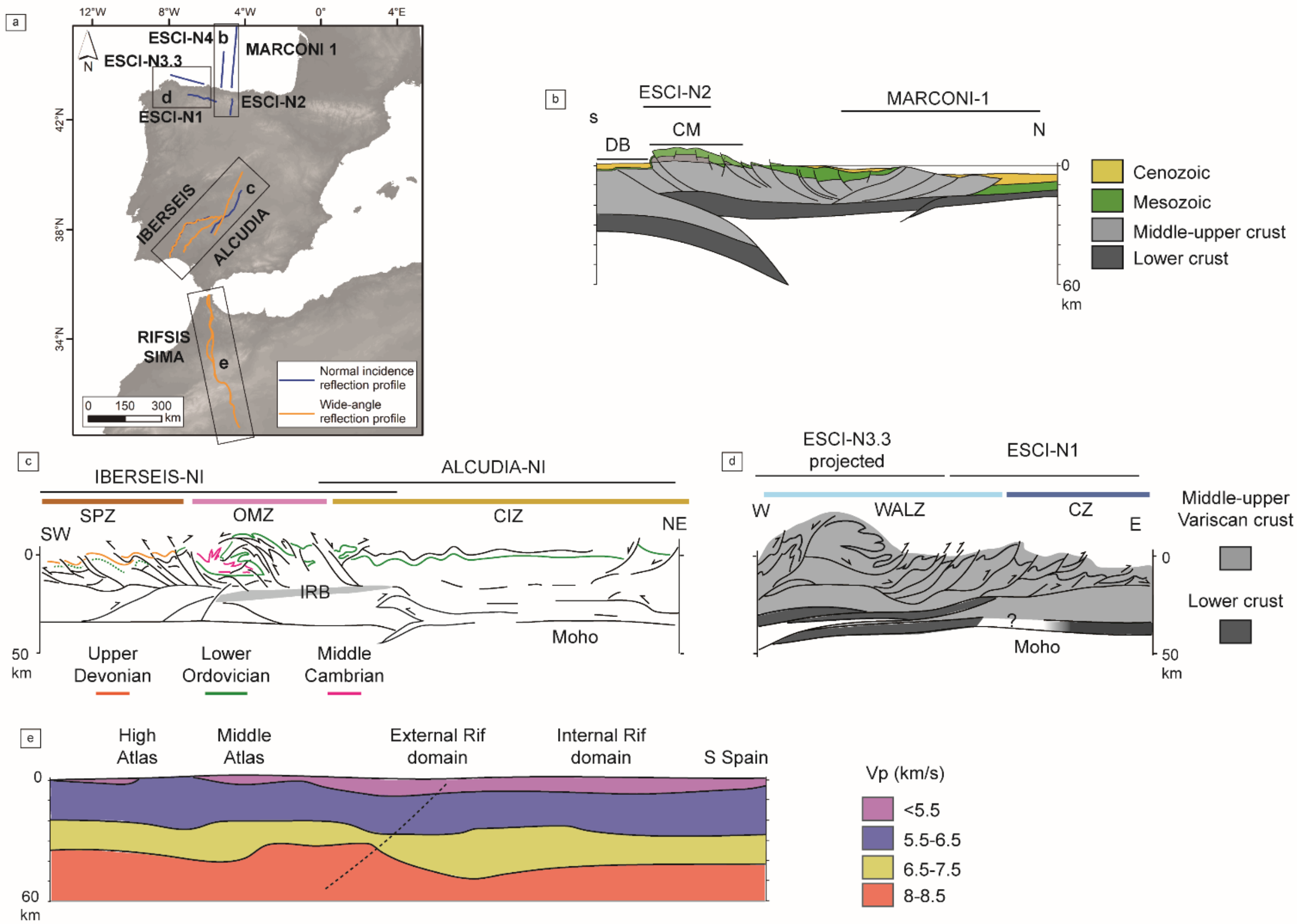


Figure 4: a) map of the Iberian Peninsula and north of Africa with the location of the ESCI-N, MARCONI 1, IBERSEIS, ALCUDIA, RIFSIS and SIMA projects; b) crustal structure of the Cantabrian Mountains (CM), Duero basin (DB), and Bay of Biscay based on ESCI-N and MARCONI data (after Pedreira et al., 2015; Gallastegui et al., 2016; Teixell et al., 2018); c) crustal structure of the southern Iberian Massif (SPZ: South Portuguese Zone; OMZ: Ossa Morena Zone; and CIZ: Central Iberian Zone; IRB: Iberian Reflective Body) revealed by the IBERSEIS and ALCUDIA projects (after Simancas et al., 2013); d) crustal structure of the northern Iberian Massif revealed by the ESCI-N1 and N3.3 profiles (after Ayarza et al., 1998; Fernández-Viejo and Gallastegui, 2005; Simancas et al., 2013); and e) P-wave velocity model obtain from the wide-angle reflection data of RIFSIS and SIMA (simplified from Ayarza et al., 2014; Gil et al., 2014).