

SeisDARE: an open access seismic data repository

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

¹Geosciences Barcelona

²Uppsala University

³University of Salamanca

⁴CSIC

⁵Cornell University

November 30, 2022

Abstract

Seismic reflection data (normal incidence and wide-angle) are unique assets for Solid Earth Science. They provide critical information about the physical properties and structure of the lithosphere, and are useful to understand the geometry and evolution of the tectonic plates, and for exploration of natural resources, civil engineering, characterization of seismogenic zones and hazard assessment. The resolution of seismic reflection data is highly appreciated for basic and applied Earth Sciences. However, these datasets are logistically complex and expensive to acquire, and their geographical coverage is limited. In addition, legacy seismic reflection data also have an added value as new information can be retrieved by applying new processing approaches. The preservation and dissemination of seismic open access data is an asset to promote accurate and innovative research. Here, we present 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 digital object identifier (DOI). The datasets included here are accessible online and guarantee the FAIR (Findable, Accessible, Interoperable, Reusable) principles of data management, so that each dataset enters into a statistic referencing database and its impact can be measured. This database has been built thanks to a network of several institutions, promoting a multidisciplinary research, and is open for international data exchange and collaborations. SeisDARE includes deep seismic sounding and high-resolution data acquired in the last three decades in the Iberian Peninsula and Morocco. In addition, as result of fruitful collaborations, we are starting to host data acquired worldwide. Our first incorporation of this kind are seismic profiles recorded in Hardeman County, Texas, within the COCORP project. SeisDARE aims to make easily accessible legacy and recently acquired seismic data and establish a framework for future seismic data management plans. The datasets are available at <https://digital.csic.es/handle/10261/101879>, bringing endless opportunities to the scientific, industrial and educational communities. This research has been funded by EPOS IP 676564, EPOS SP 871121, EIT Raw Materials 17024-SIT4ME and SERA 730900.

SeisDARE: an open access seismic data repository

Irene DeFelipe¹, Juan Alcalde¹, Monika Ivandic², David Martí^{1,3}, Mario Ruiz¹, Ignacio Marzán¹, Jordi Díaz¹, Puy Ayarza⁴, Imma Palomeras⁴, Jose-Luis Fernandez-Turiel¹, Cecilia Molina Fernández⁵, Isabel Bernal⁵, Larry Brown⁶, Roland Roberts², Ramón Carbonell¹

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.

Seismic reflection data (normal incidence and wide-angle) are unique assets for Solid Earth Science. They provide critical information about the physical properties and structure of the lithosphere, and are useful to understand the geometry and evolution of the tectonic plates, and for exploration of natural resources, civil engineering, characterization of seismogenic zones and hazard assessment. The resolution of seismic reflection data is highly appreciated for basic and applied Earth Sciences. However, these datasets are logistically complex and expensive to acquire, and their geographical coverage is limited. In addition, legacy seismic reflection data also have an added value as new information can be retrieved by applying new processing approaches. The preservation and dissemination of seismic open access data is an asset to promote accurate and innovative research. Here, we present 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 digital object identifier (DOI). The datasets included here are accessible online and guarantee the FAIR (Findable, Accessible, Interoperable, Reusable) principles of data management, so that each dataset enters into a statistic referencing database and its impact can be measured. This database has been built thanks to a network of several institutions, promoting a multidisciplinary research, and is open for international data exchange and collaborations. SeisDARE includes deep seismic sounding and high-resolution data acquired in the last three decades in the Iberian Peninsula and Morocco. In addition, as result of fruitful collaborations, we are starting to host data acquired worldwide. Our first incorporation of this kind are seismic profiles recorded in Hardeman County, Texas, within the COCORP project. SeisDARE aims to make easily accessible legacy and recently acquired seismic data and establish a framework for future seismic data management plans. The datasets are available at <https://digital.csic.es/handle/10261/101879>, bringing endless opportunities to the scientific, industrial and educational communities.

This research has been funded by the Projects EPOS IP 676564, EPOS SP 871121, EIT Raw Materials 17024-SIT4ME and SERA 730900.

SeisDARE: an open access seismic data repository



DeFelipe, I.1, Alcalde, J.1, Ivandic, M.2, Martí, D.1, Ruiz, M.1, Marzán, I.1, Diaz, J.1, Ayarza, P.3, Palomeras, I.3, Fernandez-Turiel, J.-L.1, Molina, C.4, Bernal, I.4, Brow, L. R.5, Roberts, R.2 and Carbonell, R.1

(1) Geosciences Barcelona (GEO3BCN-CSIC), Spain; (2) Uppsala University, Sweden; (3) University of Salamanca, Spain; (4) CSIC, Madrid, Spain; (5) Cornell University, Earth and Atmospheric Sciences, United States.

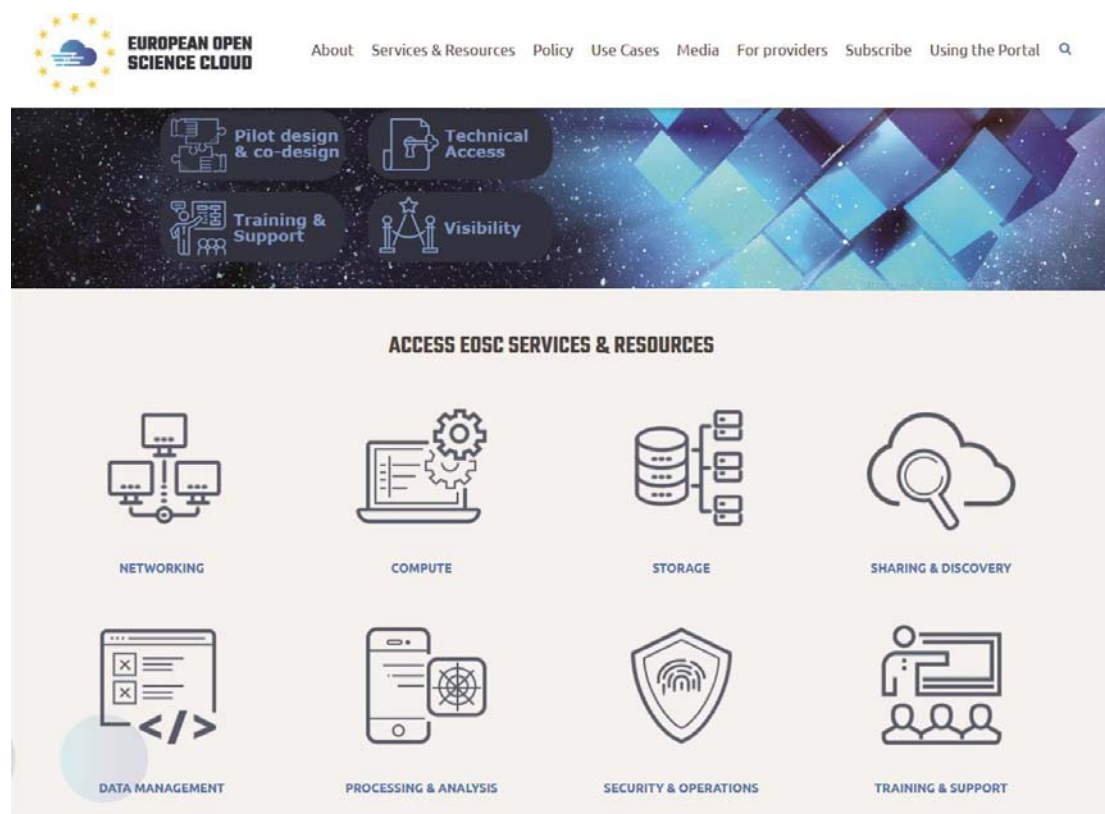
PRESENTED AT:



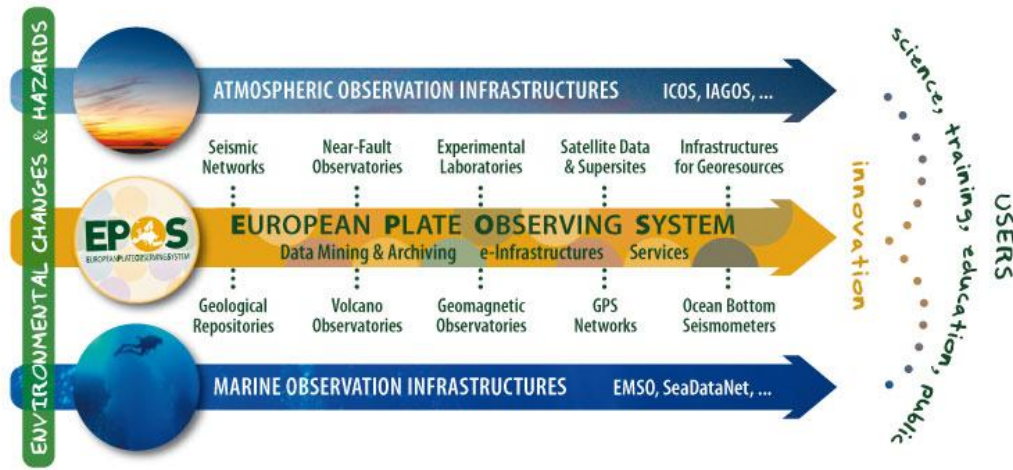
INTRODUCTION

Seismic data provide critical information about the structure of the lithosphere and are the basis for Solid Earth Science. Therefore, it is essential to preserve seismic data for future generations of geoscientists.

Following this philosophy, the European Open Science Cloud (**EOSC** (<https://www.eosc-portal.eu/>)) is driving towards a virtual environment with open and seamless services for storage, management, and reuse of research data by federating existing scientific data infrastructures.



Specifically on Earth Sciences, the European Plate Observation System (**EPOS** (<https://epos-ip.org/>)) was established in 2002 as a multidisciplinary e-infrastructure aiming to facilitate the integrated use of data and data products.



Within EPOS, a thematic core of **Seismology** (<https://epos-ip.org/tcs/seismology>) provide access to seismic and seismological data.

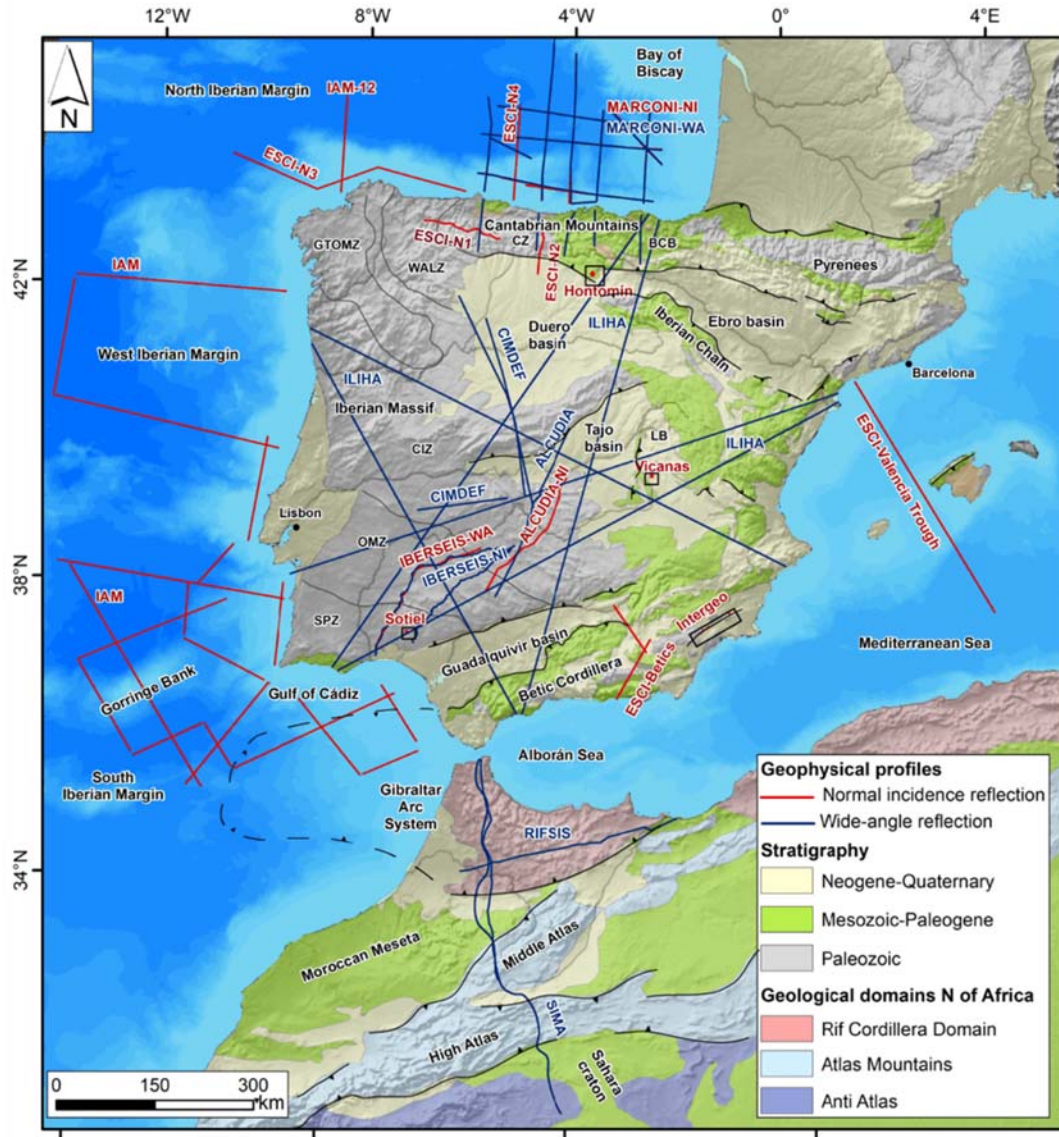
Within the GEO3BCN database, stands out **SeisDARE** (<https://digital.csic.es/handle/10261/101879>), an open access **Seismic Data REpository**. It comprises, until now, 21 seismic datasets.

Here, every dataset is presented in the format of a publication, with the authors, year, title, and DOI. Additionally, we include an index card summarizing the main characteristics of the dataset.

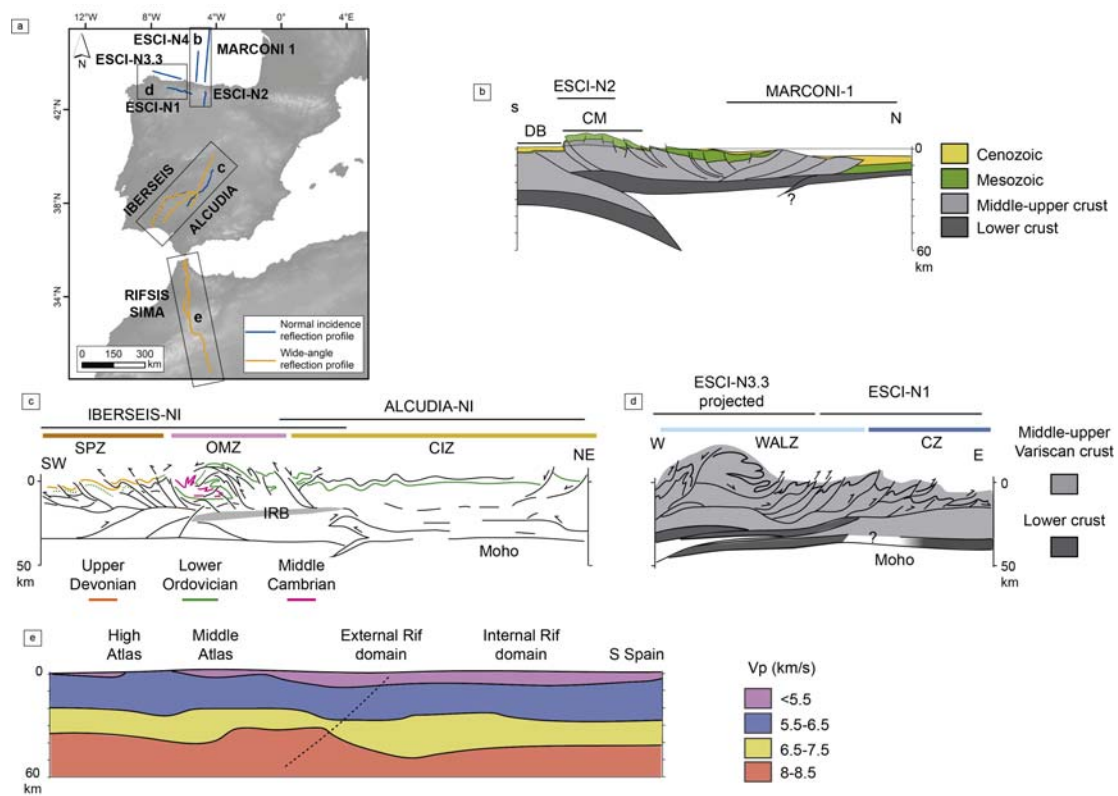
SEISDARE: GEOLOGICAL COVERAGE

SeisDARE comprises Deep Seismic Sounding (DSS) and high-resolution (HR) data acquired in the Iberian Peninsula and Morocco since the 1980's.

DSS data aim to characterize the structure of the lithosphere and HR data are focused on the shallow subsurface for exploration purposes.



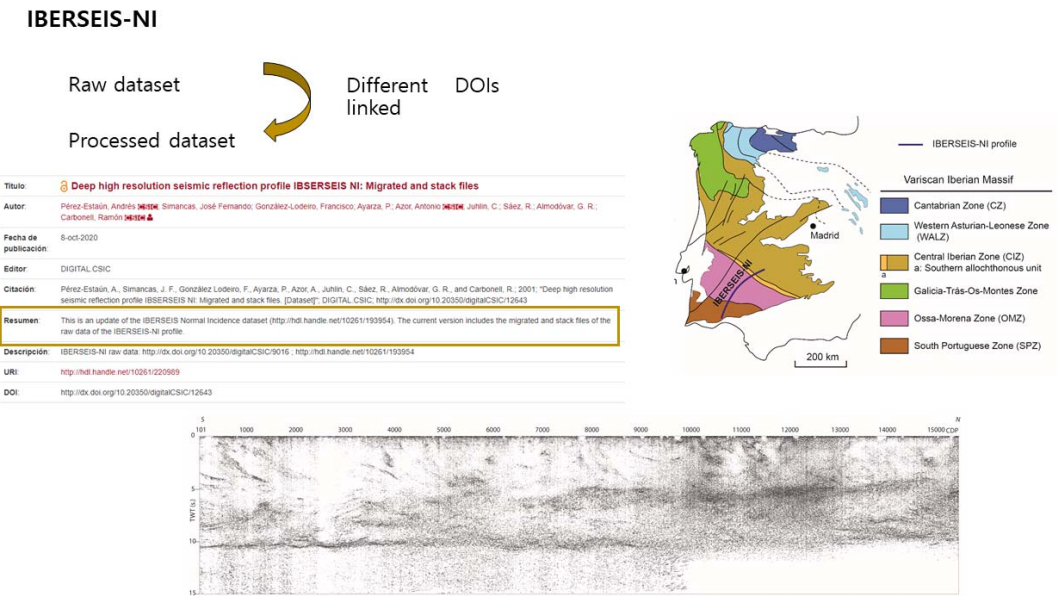
Geological map of the Iberian Peninsula and north of Africa with the seismic profiles provided in the SeisDARE (DeFelipe et al., 2020).



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 obtained from the wide-angle reflection data of RIFSIS and SIMA (simplified from Ayarza et al., 2014; Gil et al., 2014) (DeFelipe et al., 2020).

SEISDARE: DATA EXAMPLES

As an example of DSS data, IBERSEIS-NI was acquired in the Iberian Massif and is accesible by raw and processed files (Pérez-Estaún et al., 2001a, b). Complementary, a wide-angle reflection experiment was carried out to obtain a velocity model along the IBERSEIS profile (Palomeras et al., 2003).

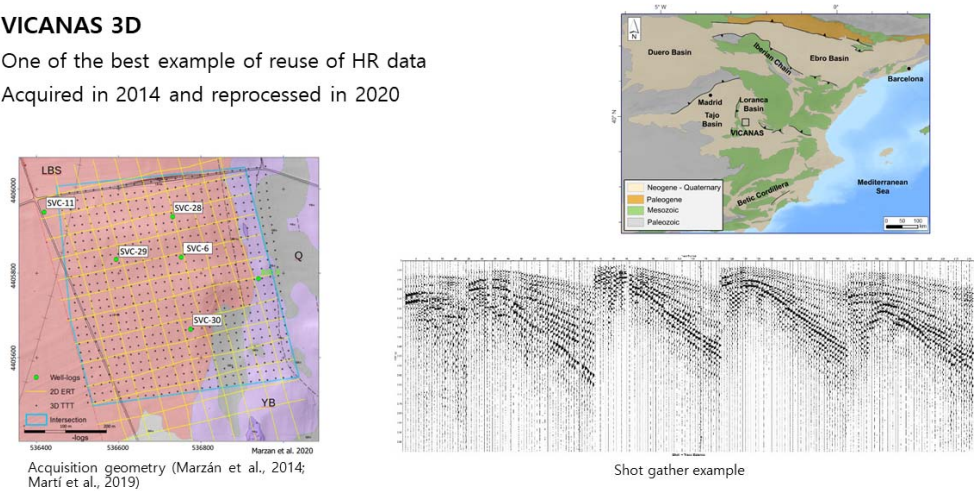


As an example of HR data, VICANAS was acquired to characterize a nuclear waste geological storage in the center of Spain. This HR dataset is one of the best examples of reuse of data as the original data have been re-processed and the results are submitted for publication (Marzán et al., 2014).

VICANAS 3D

One of the best example of reuse of HR data

Acquired in 2014 and reprocessed in 2020

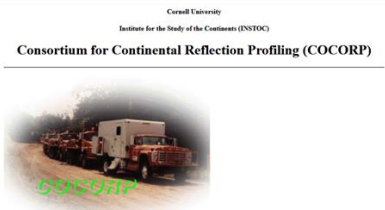


As a result of a fruitful international collaboration, and as a model for inclusion of other global seismic datasets, SeisDARE also hosts seismic data acquired in Hardeman County, Texas, within the COCORP project (Consortium for Continental Reflection Profiling) (Oliver and Kaufman, 1975).

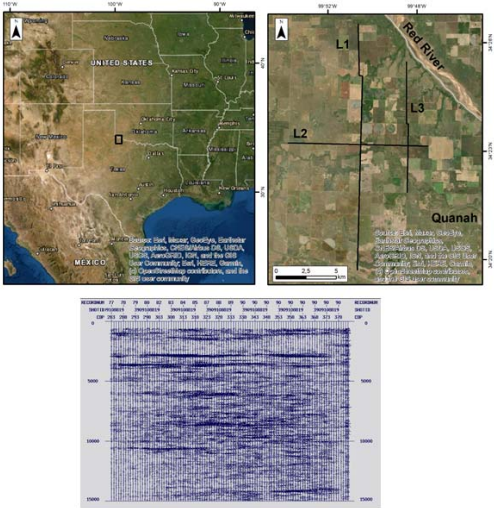
COCORP

Pioneer in the use of multichannel seismic reflection for exploration of the lithosphere.

In 1975, 37 km of deep seismic profiling were acquired in Texas.



<http://www.geo.cornell.edu/geology/cocorp/COCORP.html>



Oliver and Kaufman (1975)

DIGITAL.CSIC

In close collaboration with EPOS, **Digital.CSIC** (<https://digital.csic.es/>) is an institutional repository that stores multidisciplinary data following the FAIR (Findable, Accessible, Interoperable and Reusable) principles of data management.

Within digital.CSIC, the institute Geosciences Barcelona (**Geo3BCN** (<https://geo3bcn.csic.es/>)) hosts a website where information about the research carried out, can be easily accessed.

Institute's website → <http://www.ictja.csic.es/>

Authors's profile → [Perfiles de investigadores ICTJA en DIGITAL.CSIC](#)

Browse by →

- Fecha Publicación
- Autor
- Título
- Palabras Clave
- Agencia Financiadora
- Fecha Envío

This collection comprises a wide variety of research data and products.

Collections in this community	
(Geo3Bcn) Artículos [1755]	Articles and Abstracts
(Geo3Bcn) Comunicaciones congresos [734]	
(Geo3Bcn) Conjuntos de datos [6]	Datasets
(Geo3Bcn) Cursos-Material didáctico [61]	Teaching material
(Geo3Bcn) Informes y documentos de trabajo [18]	Project reports
(Geo3Bcn) Libros y partes de libros [201]	Books
(Geo3Bcn) Material de divulgación [16]	Outreach material
(Geo3Bcn) Memorias [9]	Reports
(Geo3Bcn) Patentes [2]	Patents
(Geo3Bcn) Programas informáticos [1]	Software and scripts
(Geo3Bcn) SeisDARE [20]	SeisDARE
(Geo3Bcn) Tesis [71]	Thesis

<https://digital.csic.es/handle/10261/82>

DC

Producción CSIC · Pasarela · Estadísticas · Contacto

Buscar en DSpace

DIGITAL.CSIC

Q

Servicios

DIGITAL.CSIC / Recursos Naturales / Geociencias Barcelona (Geo3Bcn)

English español

(Geo3Bcn) SeisDARE : [21]

SeisDARE (Seismic Data REpository) is an open access database that stores Deep Seismic Sounding and high-resolution seismic data. The collected data are used to study the structure of the lithosphere and for exploration of natural resources, characterization of seismogenic zones and hazard assessment. SeisDARE stores normal incidence and wide-angle reflection data that cover a wide variety of geological settings, both offshore and onshore. By following the FAIR (Findable, Accessible, Interoperable and Reusable) principles of data management and having regular updates, it brings endless research and teaching opportunities to the scientific, industrial and educational communities.

Explorar

Autor

Carbonell, Ramón

13

Ayarza, P.

8

Pérez-Estaún, Andrés

7

Gallart Muset, Josep

6

<https://digital.csic.es/handle/10261/101879>

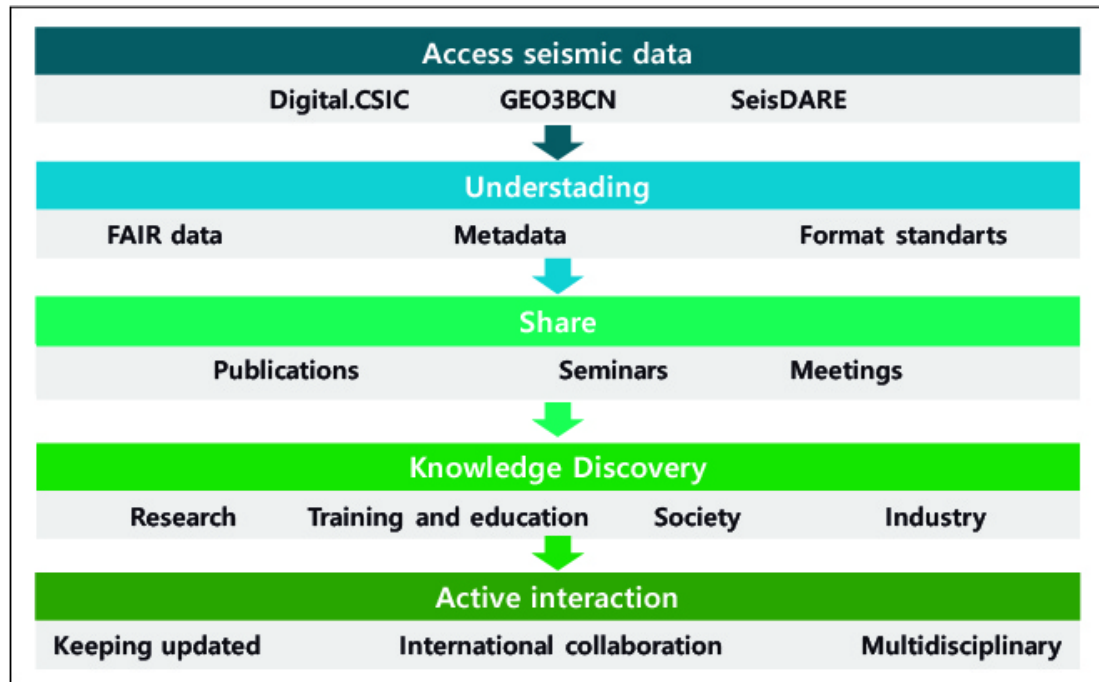
<https://agu2020fallmeeting-agu.ipostersessions.com/Default.aspx?s=4C-5A-E8-41-5C-A6-05-67-AC-2A-74-6E-1E-4B-54-EF&pdfprint=true&gu...> 10/12

CONCLUSIONS

SeisDARE is an open access Seismic DAta REpository that stores DSS and HR seismic data acquired in the Iberian Peninsula and Morocco since the 1980's.

This database has been built thanks to a network of institutions and is open for international data exchange and collaborations.

By following the FAIR (Findable, Accessible, Interoperable and Reusable) principles of data management and having regular updates, it brings endless research and teaching opportunities to the scientific, industrial and educational communities.



Acknowledgments

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).

REFERENCES

- Ayarza, P., Carbonell, R., Teixell, A., Palomeras, I., Martí, D., Kchikach, A., Harnafi, M., Levander, A., Gallart, J., Arbolea, 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., 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.
- DeFelipe, I., Alcalde, J., Ivandic, M., Martí, D., Ruiz, M., Marzán, I., Diaz, J., Ayarza, P., Palomeras, I., Fernandez-Turiel, J.-L., Molina, C., Bernal, I., Brown, L., Roberts, R., and Carbonell, R. Reassessing the lithosphere: SeisDARE, an open access seismic data repository. ESSD discussion, <https://doi.org/10.5194/essd-2020-208>.
- 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.
- 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.
- 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.
- Marzán, Ignacio; Martí, David; Torné, Montserrat; Ruiz Fernández, Mario; Carbonell, Ramón. High resolution seismic characterization of the shallow subsurface of the Loranca Basin (Spain): high resolution 3D. 2014. DIGITAL.CSIC. <http://dx.doi.org/10.20350/digitalCSIC/8636>
- Oliver, J., 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., Simancas, J. F., Ayarza, P., González Lodeiro, F., Pérez-Estaún, A., Azor, A., and Carbonell, R.: Wide-angle deep seismic reflection profile (IBSERSEIS Wide-Angle Transect) [Dataset]; DIGITAL.CSIC; <http://dx.doi.org/10.20350/digitalCSIC/9018>, 2003.
- Pedreira, D., Afonso, J. C., Pulgar, J. A., Gallastegui, J., Carballo, A., Fernández, 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,
- 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 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 IBERSEIS NI: Migrated and stack files. [Dataset]; DIGITAL.CSIC; <http://dx.doi.org/10.20350/digitalCSIC/12643>, 2001b.
- 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. <http://dx.doi.org/10.1016/j.lithos.2015.04.018>, 2015.
- Teixell, A., Labaume, P., Ayarza, P., Espurt, N., De Saint Blanquat, M., and Lagabriele, 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.