Closing the Seismic Coverage on Western Iberia: Project WILAS

Nuno A. Dias, Fernando Carrilho, Christian Haberland, Joao Fonseca, Mourad Bezzeghoud, Susana Custódio, Antonio Villaseñor , Conceição Neves, Rui Fernandes and the WILAS team

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I. Introduction

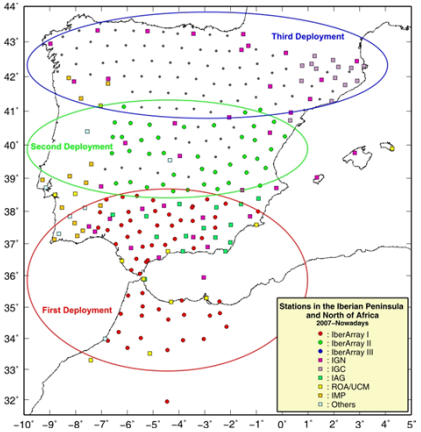
The lithosphere of Iberia has been formed through a number of processes of continental collision and extension: in Lower Paleozoic, the collision of three tectonics blocks produced the Variscan Orogeny, the main event of formation of the lithosphere. The subsequent Mesozoic rifting and breakup of the Pangea had a profound effect on the continental crust of Western Iberia. Since the Miocene, the southern interaction between Africa and Iberia is characterized by a diffuse convergent margin that originates a vast area of deformation. The impact of this complex tectonic in the structure of the Lithosphere remains an incognito, especially in its western part:

Questions unanswered:

1. What is the relation between surface topography and the deep crustal/lithospheric structure? How was it influenced by the past tectonic events?
2. Which was the deep driving factor behind the tectonic units observed at surface: Lithosphere-Astenosphere boundary structure or deeper mantle structure? How the upper mantle and the Lithosphere-Astenosphere transition zone accommodated the past subduction?
3. Which is its role and influence of the several tectonic units, and their contacts, in the present tectonic regime and in the stress field observed today?
4. Is the anomalous seismicity and associated crustal deformation rates, due to an inherited structure from past orogenies? Which is the relation between surface topography, the observed tectonic units and the deep crustal/lithospheric structure?

Similar problems are currently being addressed by programs such US-EarthSCOPE or TOPO-EUROPE.

The Iberian Peninsula is covered by two projects, concentrated in its southern collision margin (TOPO-MED) and the central cratonic Massif (TOPO-IBERIA). Within TOPO-IBERIA (Consolider-Ongenio CSD2006-00041), a roughly 50x50 km dense network of BB seismic stations is being deployed in Spain through 2007-2013, sequentially covering southern, central and northern Spain; however, W Iberia will be widely unsampled.



TOPOIBERIA/IBERArray BB stations, 3 stages (2007-2013) and Portuguese BB permanent network operational in 2009

II. WILAS: aims and scope

3 years project (2010-2012)

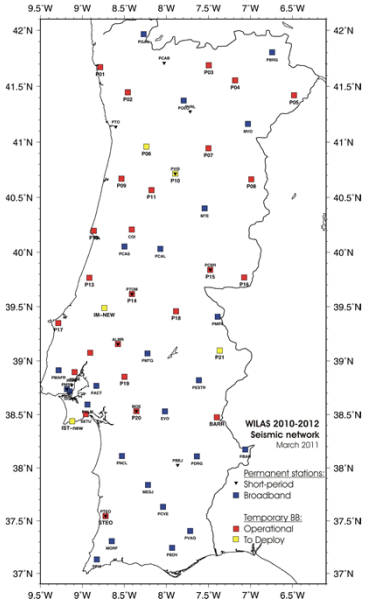
Main targets:

1. Coupled with IBERArray, to achieve BB full coverage of Iberia
2. Integrate the different scale imaging of the Lithosphere – Asthenosphere system in order to produce a 3D reference model of West Iberia.
3. Assess the relation between surface topography and the deep crustal/lithospheric structure and past tectonic events.
4. Mapping of past subduction accommodation and its relation to Lithosphere-Astenosphere structure.
5. Role of inherited structure, tectonic units and their contacts, in the lithosphere response to present stress regime.

Completing the BB seismic network in Portugal

Permanent Seismic Network in mainland Portugal:

- 27 operational Broadband stations: IM, IDL, IST, CGE/UE, IGUC
  - 8 STS-2
  - 4 CMG-40T
  - 11 CMG-3ESP
  - 4 CMG-3T
- 10 operational SP stations: IM, IDL



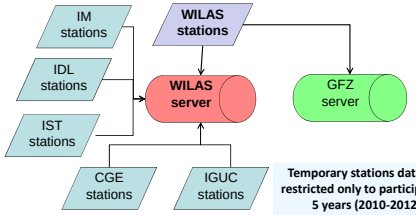
Temporary Seismic Broadband network:

- 2 years deployment, July 2010 – September 2012IGUC
  - Between middle 2010 – early 2011
- Gap filling of the permanent BB monitoring network to obtain a dense array of Broad-Band (30-60 s) and Very Broad-Band (120 s) seismic stations:
  - Average coverage 60x60 km
  - Higher coverage in the Lower Tagus-Valley: 30 x 30 km
- Temporary BB stations Deployment
  - 20 GIPP-GFZ BB stations (2 years)
    - EarthData Recorder PR6-24
    - GÜRALP CMG-3ESP Compact
  - Deployment of additional 10 BB stations by Portuguese partners
    - 1 STS-2
    - 7 CMG-3ESP
    - 2 CMG-40T

Example of a SP station site used for the temporary BB deployment: PTOM/P014

Example of a "free-air" instalation: prototype station installed in IM facilities prior to the real deployment

Data handling and access



Temporary stations data: access restricted only to participants for 5 years (2010-2012+2years)

Example of a temporary station (P03), installed indoors inside an old storage building

Example of a "free-air" instalation (P02)

III. Project Work Plan and Tasks 2010-2013

Different scales, different/complementary methods

Started in 2010:

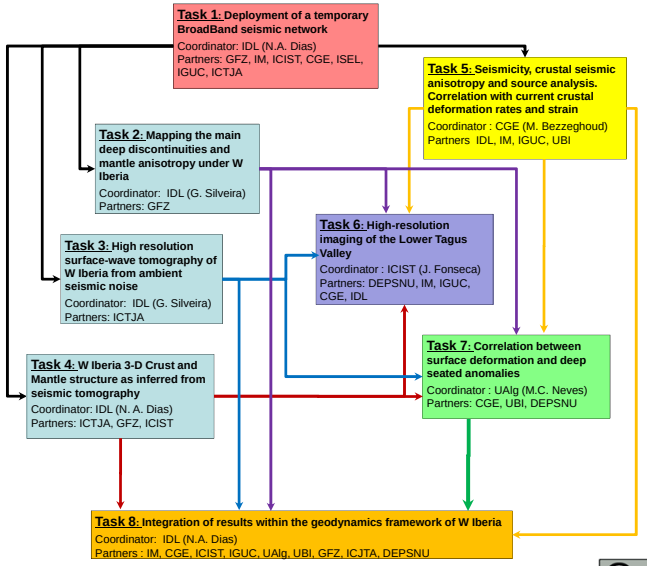
- Task 1: Deployment of a temporary BroadBand Seismic Network, 2010-2012

Starting during 2011:

- Task 2: Mapping the main deep discontinuities and mantle anisotropy under W Iberia
  - Receiver Functions for Lithospheric structure
  - SKS Splitting for seismic anisotropy analysis
- Task 3: High resolution surface-wave tomography of W Iberia from ambient seismic noise
  - Ambient noise tomography for regional crustal structure
- Task 4: W Iberia 3-D Crust and Mantle structure as inferred from seismic tomography
  - Local-Earthquake Tomography for fine structure of seismogenic areas
  - Surface-wave and teleseismic bodywaves tomography for large scale Listosphere-Astenosphere structure
- Task 5: Seismicity, crustal seismic anisotropy and source analysis. Correlation with current crustal deformation rates and strain
  - Seismicity occurrence rates
  - Crustal and Mantle seismic anisotropy analysis, coupled with source analysis
  - Correlation with current geodetic measurements
- Task 6: High-resolution imaging of the Lower Tagus Valley
  - Application of most of the former methods for the fine structure around LTV
- Task 7: Correlation between surface deformation and deep seated anomalies
  - Coupling numerical models of mantle convection and numerical models of lithosphere-scale processes to understand the mechanisms driving deformation in Western Iberia

Starting in 2012:

- Task 8: Integration of results within the geodynamics framework of W Iberia



Acknowledgments

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FCT Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR

*WILAS team
GFZ: M. Weber; IDL: L. Vinnik, E. Stutzmann, I. Rio, I. Morais, A. Afilhado, L. Matias, G. Silveira, J.L. Duarte, J. Simões; IST: J. Narciso, A. Ferreira, S. Vilanova, M. Salah; IM: P. Alves, D. Vales, J. Pena, G. Madureira; IGUC: F. Lopes; CGE/UE: B. Caldeira, J.F. Borges, C. Adam; DEPSNU: S. Stein, S.-J. Chang; ICJTA-CSIC: J. Gallart, J. Diaz,