

THE “WESTERN MEDITERRANEAN” (WM) BROAD BAND SEISMIC NETWORK.

J. Martín Davila (1), A. Pazos (1), E. Buform (2), A. Udías (2), M. Benzzeghoud (3), M. Harnafi (4), B. Caldeira (3), A. Rimi (4), W. Hanka (5), A. Nadji (6)

- (1) Real Instituto y Observatorio de la Armada, San Fernando, Spain. (mdavila@roa.es and pazos@roa.es)
(2) Departamento de Geofísica y Meteorología, Universidad Complutense, Madrid, Spain (ebuformp@fis.ucm.es)
(3) Physics Department., Universidad de Evora, Evora, Portugal (mourad@uevora.pt)
(4) Institut Scientifique, Université Mohammed V Agdal Rabat, Morocco (harnafi@israbat.ac.ma)
(5) GeoforschungsZentrum, Potsdam, Germany. (hanka@gfz-potsdam.de)
(6) Université d’Oran – Es Sénia, Oran, Algeria (amansour.l@yahoo.fr)

1. INTRODUCTION.

To study the seismicity associated to the Ibero-Maghrebian region, the Real Instituto y Observatorio de la Armada in San Fernando (ROA) has installed, since 1898, different types of seismological stations. At present two networks are in operation: Long Period station and Short Period net (ROA) and Western Mediterranean Broad Band (WM) net (in collaboration among several institutions). The installation of a network of ocean-bottom seismographs (FOMAR) is underway. The Ibero-Maghrebian region corresponds to the western part of the Eurasia-Africa plate boundary and is of great seismological and tectonic interest. It extends from 12°W to 3°E, comprising Southern Iberia and northern Africa, including the Gulf of Cadiz and Alboran Sea (figure 1). Seismicity is characterized by the occurrence of moderate and large magnitude earthquakes at shallow depth, intermediate depth earthquakes ($30 < h < 150$ km) and some very deep events (650 km). The whole area constitutes a broad deformation zone, without a well defined plate boundary line, with a plate convergence in a NNW-SSE direction at a rate of 1 to 5 mm/year (Buform et al., 1995).

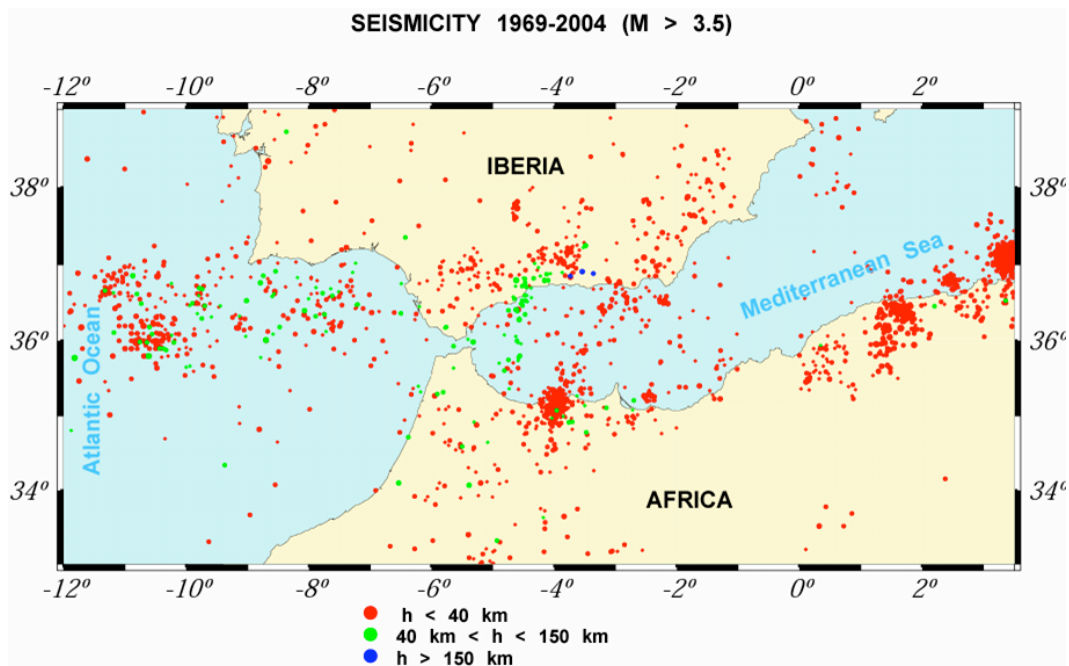


Figure 1: Distribution of epicenters at the Ibero-Maghrebian region (IGN and ROA data files).

2. WESTERN MEDITERRANEAN (WM) BROAD-BAND SEISMOLOGICAL NETWORK

From 1996, ROA and the Universidad Complutense de Madrid (UCM), with the support of GeoforschungsZentrum of Potsdam (GFZ), have installed a broad band seismological network with stations located in Southern Spain and Spanish sites located in Northern Africa surrounding the Alboran Sea. This network, initially known as ROA/UCM (Buform et al., 2002), has been renamed as Western Mediterranean network (WM FDSN code) as new stations have been added outside Spanish territory.

The WM network is consequence of several agreements between all participants partners: ROA, UCM, Evora University and ISRABAT (Institut Scientifique of Rabat, Université Mohammed V; Morocco). Being ROA the managing and the coordinator of this network.

At present the stations in operation are the following (figure 2): San Fernando (SFS), Málaga (EMAL), Cartagena (CART) and Evora (Portugal) (EVO) in the Iberian Peninsula, Mahón (MAHO) at Minorca Island, and five stations in Northern Africa, at Melilla (MELI), Peñón de Vélez-Gomera (PVLZ), and Ceuta (CEU) in Spanish places and at Averroes (AVE) and Ifrane (IFR) observatories in Morocco. In most of them permanent geodetic GPS stations are also installed.

All WM Network stations (table I) have Streckeisen STS-2 sensors, Quanterra or Earth Data digitizers, and a Seiscomp system. Data from SFS, EMAL, MELI, EVO, AVE and IFR stations are available in real time (by Internet), data from CART and MAHO stations are about 10 minutes delayed (they are connected by phone modem), and finally PVLZ, and CEU are not in near real time.

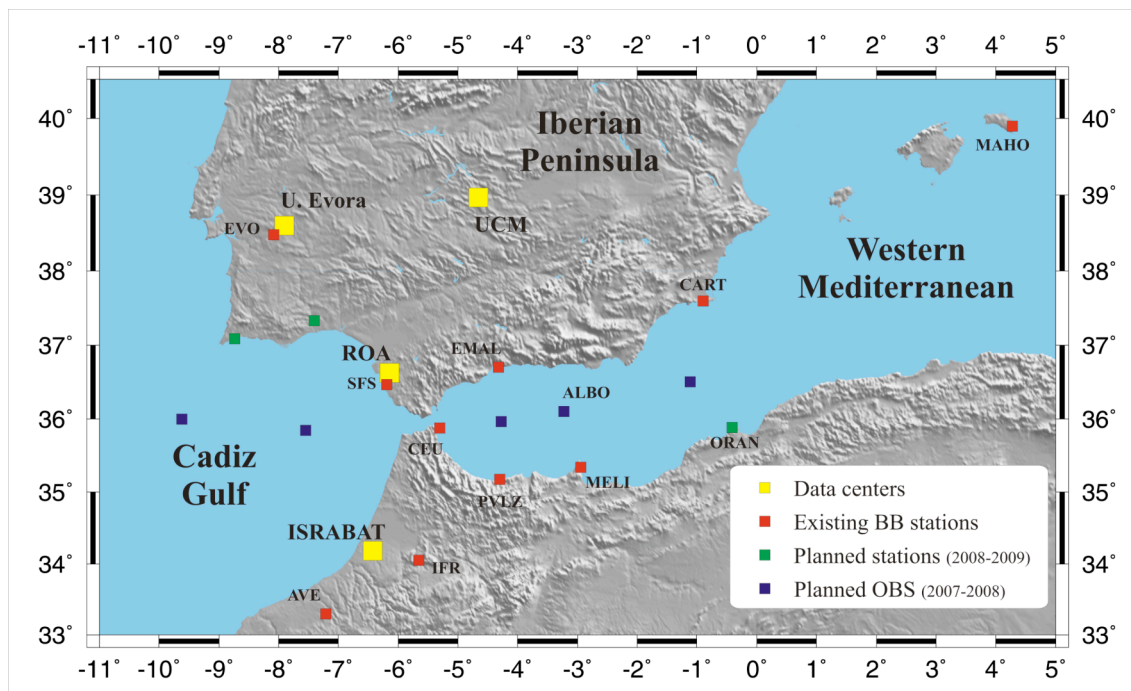


Figure 2: Western Mediterranean (WM) BB seismic network and near future OBS FOMAR network.

Station	Location	Code	Lat	Lon
EUROPE				
Cartagena	Spain	CART	37,59	-1,00
Mahon, Menorca	Spain	MAHO	39,90	4,27
Malaga	Spain	EMAL	36,73	-4,11
Mellila	Spain	MELI	35,29	-2,94
San Fernando	Spain	SFUC	36,64	-6,18
		SFS	36,47	-6,21
Ceuta	Spain	CEU	35,90	-5,37
Peñón de Vélez-Gomera	Spain	PVLZ	35,17	-4,30
Evora	Portugal	EVO	38,53	-8,01
AFRICA				
Averroes	Morocco	AVE	33,30	-7,41
Ifrane	Morocco	IFR	33,52	-5,13

Table I: Western Mediterranean (WM) BB seismic network station list.

3. FUTURE PLANS ABOUT WM NETWORK.

Plans, for the next one or two years, are focusing on three lines: land installations, off shore deployments and real time communication.

About land installations, the objective is to extend the net to have a good cover along the Alborán sea and also in the Gulf of Cádiz. In the East part, we are planning a new permanent BB seismic station close to ORAN (see figure 2), which will provide better azimuthal coverage on Alborán and Algeria earthquakes. Toward the West, in the Gulf of Cádiz, one or two new installations are planned in the South Portugal, one near San Vicente cape and other near the Portugal-Spain border (see figure 2). A third station in Morocco is also planned to be installed in TIO observatory from the ISRABAT (not included in figure 2, out of the map).

The off shore plans will be detailed in next point.

Finally, a large effort is being done toward real time. We plan to get CEU and PVLZ along next year and change CART and MAHO from phone to internet in next two years.

4. “FOMAR” OCEAN BOTTOM (OBS) SEISMIC NETWORK

Due to the fact that part of the seismic activity is located at marine areas (figure 1), and the poor geographic azimuthal coverage at some zones provided by the land stations, in order to complement the WM broad-band network, ROA and UCM will deploy an OBS network with a permanent OBS near the Alborán island (OBS ALBORAN), linked to land by an underwater cable, and four temporary (three years) OBS in the Gulf of Cadiz and Alboran Sea (FOMAR network) (OBS are mapped in blue in figure 2). The deployment of the OBS will be carried out within 2007-2008 with the support of the Spanish Navy.

5. CONCLUSIONS

In order to study the seismicity associated to the western part of the Eurasia-Africa plate boundary at the Ibero-Maghrebiam region, ROA in collaboration with UCM and the support of GFZ have deployed, since 1996, a Broad-Band seismic network with stations installed in Southern Spain and Spanish sites in Northern Africa. This network has been expanded with a station in Evora (Universidad de Evora), Portugal, and others in Averroes and Ifrane (Université Mohammed V), Morocco, forming the new Western Mediterranean Network (WM). It's planned to install, in the near future, four stations, in Tiouin (Morocco), Oran (Algeria) in collaboration with the Université d'Oran, and two more in South Portugal in collaboration with the Evora University.

In order to improve the WM network, five Ocean Bottom Seismographs (OBS) will be deployed in the Gulf of Cadiz and Alboran Sea, including a permanent station (OBS ALBORAN) and four (FOMAR net) semi-permanent stations. Deployment of OBS is planned to be carried out on 2007-2008.

6. ACKNOWLEDGEMENTS

This work has been partly funded by the Spanish Ministry of Education and Science (MEC) through the projects: RIOA05-23-002 (OBS ALBORAN), CGL2005-24194-E (RED FOMAR) and REN2006-10311-C03-01/02 (RISTE) and UCM projects UCM, AE10/05-13867

7. BIBLIOGRAPHY

Bufo, E., Sanz de Galdeano, C. and Udías, A., 1995. Seismotectonics of the Ibero-Maghrebiam region. *Tectonophysics*, 248, 247-261.

Bufo, E., Udías, A., Martín Davila, J., Hanka, W., and Pazos, A. (2002). Broadband station network ROA/UCM/GFZ in south Spain and northern Africa. *Seismological Research Letters*, 73, 2, 173-176