

“Real Instituto y Observatorio de la Armada en San Fernando” (Royal Naval Institute and Observatory in San Fernando; ROA) Geophysical/Geodetic activities.

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1.- INTRODUCTION

The "Real Instituto y Observatorio de la Armada" (ROA), is a Spanish Navy Institution located in San Fernando, Cádiz, Spain. This ancient institution, about 250 years old, is nowadays mainly working in four scientific fields: Astronomy, Celestial Mechanics, Time and Frequency and Geophysics-Geodesy (www.roa.es). Focusing on this last field, Geosciences, ROA is involved on several geodetic/geophysical activities and projects, both on land and ashore, to study several areas: a) the Eurasia-Africa plate boundary zone in the so called "Ibero-Maghrebian" region, including South Spain, North Africa, Gulf of Cadiz and Alboran sea; b) The Bransfield Strait area (Antarctica); c) The North Puerto Rico micro plate zone; d) The Spanish Exclusive Economic Zone (ZEEE); etc.

Due to the location of ROA headquarters, the main activities are carried out at the Ibero-Maghrebian area. Among them, Short Period (SP), Long Period (LP) and Very Broad Band (VBB) seismic stations have been installed together with a permanent Geomagnetic station, a permanent GPS network densified by means of periodic GPS campaigns, and a Satellite Laser Ranging (SLR) station. Several on land and marine geophysical/geodetical campaigns have been carried out in the area too. On this paper we will briefly describe the instruments deployed at this area, specially the seismic instrumentation.

2.- ROA GEODETIC AND GEOPHYSICAL ACTIVITIES AT "IBERO-MAGHREBIAN AREA"

The geophysical/geodetical activities of ROA at the Ibero-Maghrebian area have a long tradition, coming from the end of XIX th century (1879) when the first Spanish geomagnetic station (ADIE type) was installed in the vicinities of ROA main building. A few years later, on 1898, the first Spanish seismographic station (Milne horizontal pendulum) was installed on a pier located in the East hall of the main building. By the end of 1950's, a Baker-Nunn camera was installed as a collaboration between ROA and the Smithsonian Institution (USA), first step of

ROA satellite tracking activities, followed by the installation of a Satellite Laser Ranging station (1968), as a collaboration ROA-CNES/CERGA. On those years, the first Very Deep Seismic Soundings profiles were carried out in Spain under the European Geotransverse Project (EGT), in a collaboration among several Spanish institutions.

These activities have continued till nowadays. Its present status is detailed as follows:

2.1 GEOMAGNETIC ACTIVITIES.

ROA has a permanent geomagnetic station (SFS) located about 50 km far away from San Fernando, to avoid the electromagnetic interferences, linked to ROA by phone line. It has installed both absolute and relative instruments:

- Photoelectric variograph PSM8711.
- Fluxgates FGE variograph (DMI).
- PPM and Overhauser magnetometers.
- Declinometer/inclinometer (Diflux), etc.

On the other hand, several on land and on board geomagnetic campaigns have been carried out in the Ibero-Maghrebian region, in collaboration with other institutions, and under several Spanish and E.U. projects.

2.2 SEISMOLOGICAL ACTIVITIES.

To study the seismic activity of this area, ROA has deployed a seismic net with the following instrumentation:

- Short Period net: Deployed from 1986 in the vicinities of Gibraltar Strait, in collaboration with the Spanish IGN and SECEGSA. These are one/three components analog stations linked to ROA via radio UHF/VHF (fig. 1).
- Long Period Station: A three components Sprengnether 5100 type, installed on a pier located in a ROA tunnel.
- Very Broad Band (VBB) "RU" net (FDSN net code): six VBB seismic stations have been deployed since 1996 in a collaboration among

ROA, University Complutense of Madrid (UCM) and the GeoforschungsZentrum of Potsdam (GFZ). These stations, co-located with ROA GPS permanent stations, are installed at San Fernando (SFS), Cartagena (CART, SE Spain), Melilla (MELI, North Africa), Mahon (MAHO, Balearic Is.), Ceuta (CEU, North Africa) and Peñón de Vélez (PVLZ, North Africa). They have Strekeisen STS-2 seismometers and Quanterra data acquisition systems/Earth Data Digitizers and PC Seiscomp. SFUC, CART, MAHO and MELI are real time controlled via phone line.

RU net is associated to GEOFON net. Data from SFS and MAHO stations are also available at ORFEUS data center and MAHO is associated to IRIS net too (fig.1).

Next steps at RU net: A new station will be installed before the end 2005 at Malaga (MALA, South Spain), and a permanent OBS will be also installed, by mid 2006, in the vicinities of Alboran island (mid Alboran sea). Within this year, two more BB stations are also planned to be installed at Morocco and Argelia, as a ROA/UCM/GFZ collaboration together with local institutions.

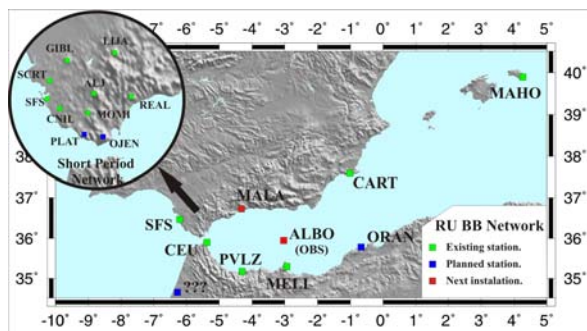


Fig. 1: ROA SP seismic net and "RU" BB Seismic net (ROA/UCM/GFZ).

As it was mentioned above, ROA has organize and also participated in several Seismic Refraction/Wide Angle Reflection campaigns at different areas, in collaboration with other institutions. As a result of those campaigns several crust and upper mantle models have been developed for that regions.

2.3 SLR AND GPS ACTIVITIES.

Nowadays, ROA has a new Satellites Laser Ranging station, member of the International Laser Ranging Service (ILRS), with a Cassegrain telescope, a Quantel Yag-Nd ⁺⁺ laser and a reception system based a Single Photon Acquisition Detector (<http://ilrs.gsfc.nasa.gov/>).

ROA geodetic GPS activities in the Ibero-Maghrebian area, started when ROA was included in

EUREF'89 campaign. Later on, in order to study the deformations associated to this area, a GPS Geodynamic Network was designed covering South Spain and North Africa: eight selected sites located in the Betic Cordillera and two additional sites located North Africa (Ceuta and Melilla), were monumented and first GPS observed on July 1994. Since then, several reobservation field campaigns have been carried out.

Since 1995, a permanent GPS tracking station (Trimble 4000 ssi and Choke-ring antenna), called SFER was installed at ROA, which has been included in the International GPS for Geodynamics Service (IGS) on 1996. Since then, in order to implement a continuous representation of the geodynamic evolution of this area, a permanent GPS net was designed and deployed. Till now, seven permanent GPS stations have been installed, additionally to SFER (fig. 2) at Cartagena (CART), Melilla (MELI), Mahon (MAHO), Granada (GRAN), Alboran Island (ALBO), Ceuta (CEUD) and Peñón de Vélez (PVLZ). Most the stations are controlled from ROA via telephone modem, and are co-installed with the above mentioned VBB seismic stations.



Fig. 2: ROA Permanent (red) and Temporary (blue) GPS nets.

3.- CONCLUSIONS.

The "Real Instituto y Observatorio de la Armada en San Fernando" (Royal Naval Institute and Observatory in San Fernando; ROA) has been carrying out Geophysical and Geodetical activities at different areas, specially at the so called "Ibero-Maghrebian" region, since the end of XIX th century, by deploying seismic, geomagnetic and geodetic instruments (SLR and GPS), and carrying out both on land and marine campaigns. As a result of those activities seismic maps, geomagnetic anomaly maps, crustal and upper mantel models, geodynamic models, etc, have been published.