THE CuaTeNeo(*) GPS NETWORK TO QUANTIFY HORIZONTAL MOVEMENTS IN THE SOUTHEASTERN PART OF THE IBERIAN PENINSULA.

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ABSTRACT

A GPS network has been set up in a collaboration between different specialists in Earth Sciences in order to quantify the present deformation rates in the southeastern border of the Iberian Peninsula.

The area selected, the eastern Betics, is interesting as regards earthquake hazard. Despite the fact that the area is characterised by tectonic activity with moderate deformation rates, the values of this rates are locally high.

The network was designed to control the most active fractures of the area bearing in mind the historical and recent seismic information and the deformation of recent sediments.

Key words: GPS network, Neotectonics, earthquake hazard, Iberian Peninsula.

1 INTRODUCTION

In the western Mediterranean, the African and Eurasian plates converge in a NS to NNW-SSE direction at a velocity of about 1 cm/year (DeMeets et al. 1990). Neotectonics and seismicity indicate that a moderate compressive deformation is concentrated along the Pyrenees and the Betics. (Masana 1995,1996; Goula et al.1992a; Galindo-Zaldívar, González-Lodeiro and Jabaloy 1993; Sanz de Galdeano 1990).

The CuaTeNeo(*) project was designed to quantify the tectonic deformation in the eastern part of the Iberian Peninsula. A GPS network was set up within the framework of this project in a collaboration between different specialists in Earth Sciences (geodesists, geologists and geophysicists) in order to characterize the current horizontal deformations in the eastern Betics. This network was designed to control the most active fractures of the area bearing in mind the historical and recent seismic information and the deformation of recent sediments.

2 SETTING

In accordance with geomorphologic analysis and structural data, most authors agree that in the eastern Betics, a strike-slip and reverse fault systems have been active under the present day tectonic regime since the late Miocene (Bousquet & Philip 1976; Bell, Amelung, and King 1997; Silva et al. 1993, 1997). NNE-SSW trending faults have been functioning as sinistral strike-slip faults, whereas E-W trending faults have been acting as reverse faults. The Carboneras and Palomares faults constitute two of the most conspicuous sinistral NNE-SSW strike-slip faults of the system. To the North, the faults acquire an E-W trend and further to the East they become NNW-SSE oriented forming the so called Arco de Águilas. This system limits to the SE, the Guadalentin Valley, which is bounded to the NW by the Lorca-Totana or Alhama de Murcia fault, a NNE-SSW sinistral strike-slip fault (Fig.1).

As for the seismicity, the area has been subjected in historical times to destructive earthquakes (I> VIII (MSK)) and the instrumental seismicity indicates some earthquakes of a magnitude higher than 4.(I.G.N. 1983).

Comparison of high precision levelling data carried out by the Instituto Geográfico Nacional (I.G.N.) in different epochs over the last 125 years has allowed the identification of recent vertical deformations related to tectonic activity in the area limited by the network (i.e. 1 mm/y in the Cocón-Terreros fault, near Águilas and 1 mm/y in the Lorca fault near the Lorquí-Murcia area)(Giménez 1997; Giménez, Suriñach and Goula 1998).

3 THE CUATENEO NETWORK

The GPS network was designed to control mainly the Alhama de Murcia, Palomares and Carboneras faults. The network should allow the determination of the horizontal movements caused by the whole fault system as well as by the movements of individual faults if significant enough.

The GPS network consists of 15 geodetic points distributed in the provinces of Almería and Murcia (Fig. 2). It covers an area of 40 km x 150 km. The points were selected taking into account geodetic and geologic criteria. The minimum and maximum distances between points are 12.760 km and 44.932 km respectively with an average distance of 25 km between points. The minimum and maximum differences in altitude between points are 5 m and 1115 m respectively. The points have always been constructed on hard rock, avoiding Quaternary soft sediments and Triassic formations given its marls, clays and gypsum content (Fig. 3).

For the selection and construction of the points we followed the same methodology as in other similar projects such as PotSis or ResPyr networks (Fleta et al. 1996; Goula et al. 1992b). These networks are placed in the Pyrenees and were monitored in PotSis'92, PotSis'94 and ResPyr'95 and ResPyr'97 campaigns respectively (Goula et al. 1996; Grellet et al. 1993). The signals are of two types: eleven pillars made of reinforced concrete and anchored into the ground (Fig. 4) and four benchmarks made of steel directly fixed into the rock (Fig. 5).

The first GPS campaign (CuaTeneo epoch 0) was carried out from April, 21st to April, 27th 1997. Observations consisted of daily sessions of approx. 16 hours using seven TRIMBLE SSE receivers.

4 CONCLUDING REMARKS

Owing the CuaTeNeo project, an infrastructure consisting of 15 lasting geodetic points has been set up in the southeastern Betics to monitor the fault system of the area and the first GPS campaign (epoch 0) has already been carried out to start measurements.

Bearing in mind the values of movement expected for the area and the experience obtained from other existing networks (PotSis or ResPyr) GPS measurements have been planned to take place at intervals of four years.

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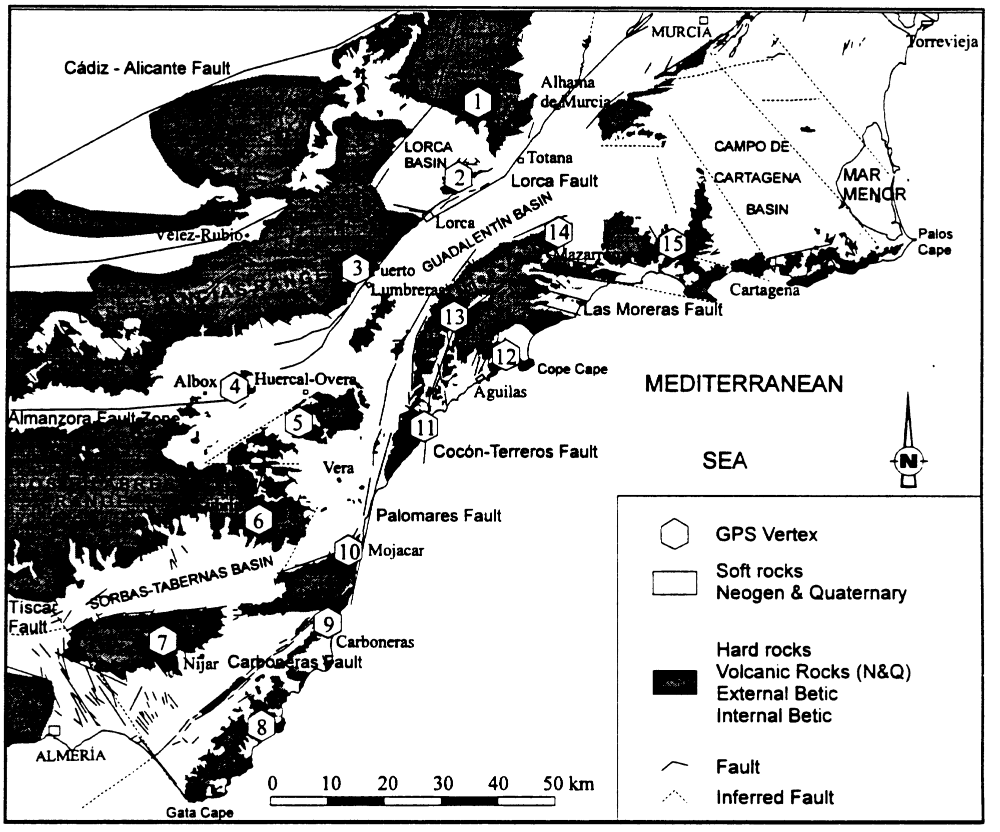

Figure 1. Distribution of the CuaTeNeo GPS points on a geological map of the eastern part of the Betics.

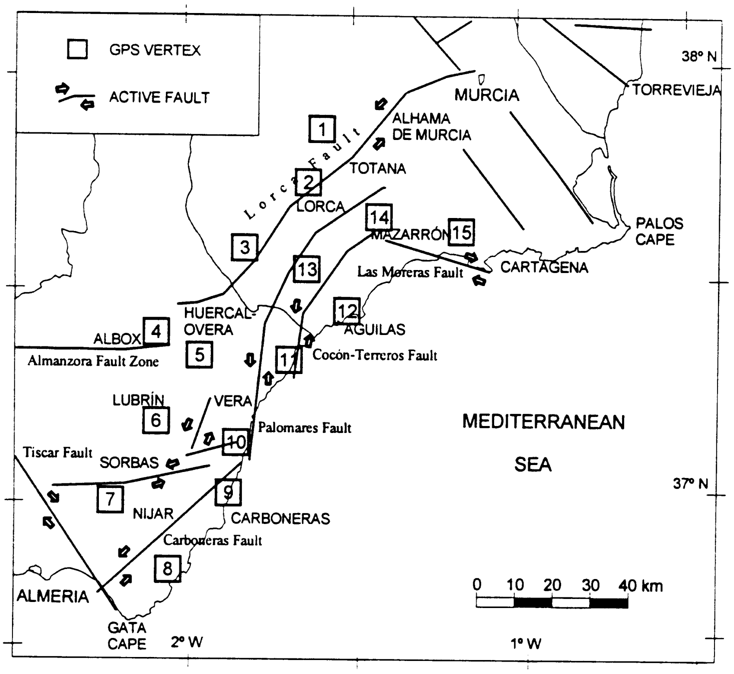

Figure 2. Distribution of the CuaTeNeo GPS points on a sketched map where the monitored with the expected movements are indicated

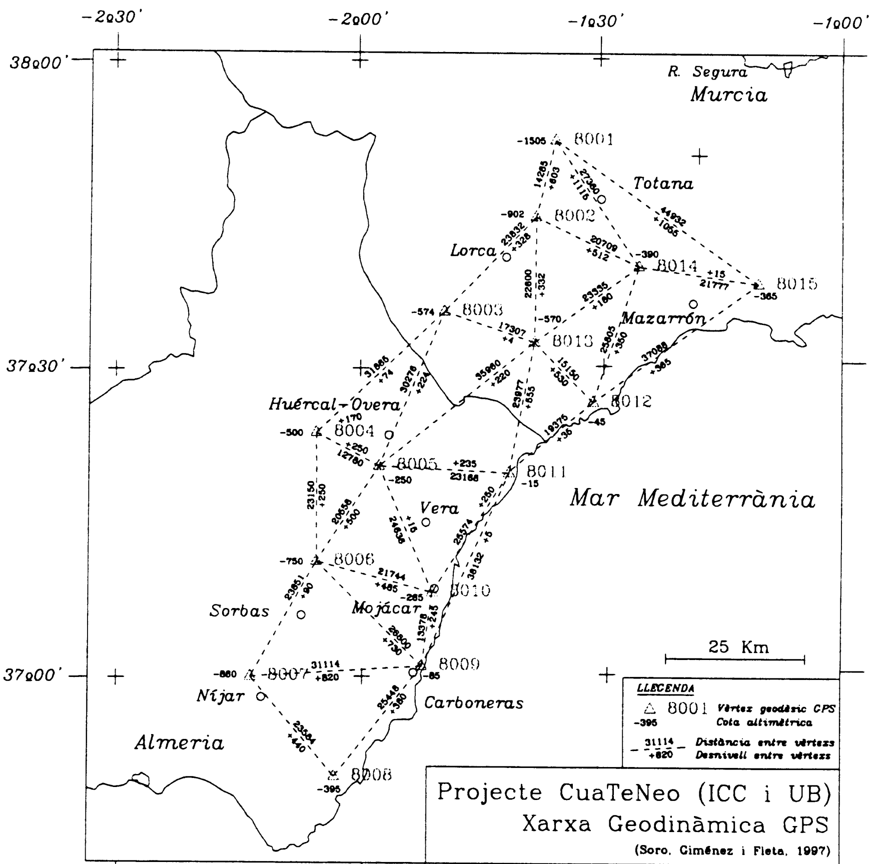

Figure 3: Characteristics of the CuaTeNeo GPS network.

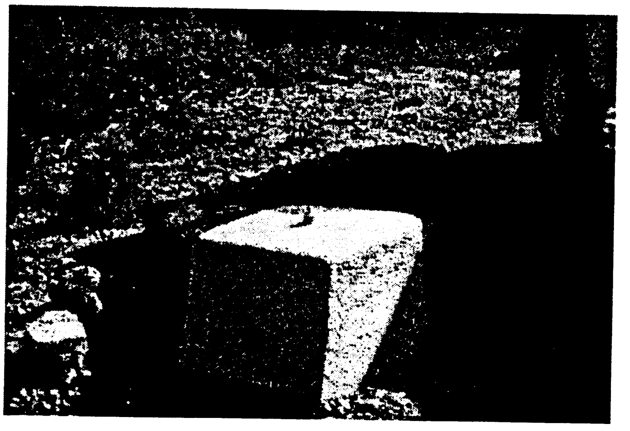

Figure 4 . Point with pillar Num. 8002 at Sierra de la Tercia on Triasic terrains controlling the Lorca fault.

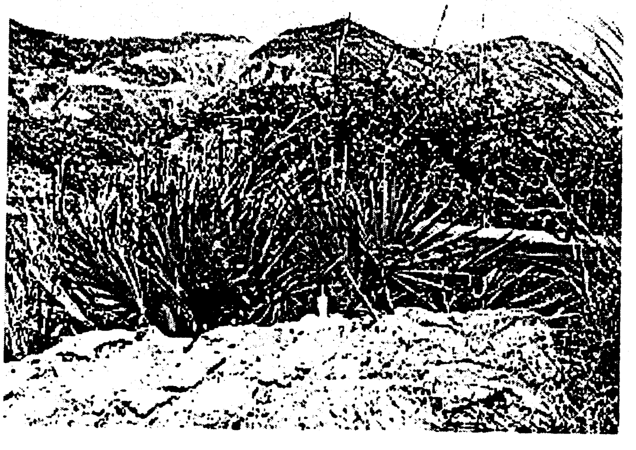

Figure 5. Point with benchmark Num 8009 at Carboneras on Miocene-Pliocene terrains controlling the Carboneras fault.