*G. MANIATIS, CH. LEMPP, H. HEINISCH

3D MONITORING OF ONSHORE ACTIVE FAULTS IN THE REGION OF THE GULF OF CORINTH (GREECE)

CONTENTS

ABSTRACT

The Gulf of Corinth is the most active extensional feature in Europe with extension rates of 7-16 mm/year in N-S direction (ARMIJO *et alii*, 1996, DAVIES *et alii*, 1997). This extensional activity is accommodated on both offshore and onshore WNW-ESE trending faults. Our project concerns with the 3D monitoring of onshore fault displacements at a sub-millimetre scale. The aim is to quantify tectonic activity of fault scarps in this region by correlating fault displacements with seismic activity. This will also lead to conclusions concerning the nature of the fault displacements (seismic or aseismic creeping movements) as well as the potential relation between tectonic activity and slope instability phenomena which are observed in many areas.

KEYWORDS: Active faults, Gulf of Corinth

1. AREA OF STUDY

After an extensive fieldwork in 2001 three areas were distinguished according to their density of faults and tectonic fractures, the quality of their outcrops and the presence of morphological features indicating recent tectonic activity (Fig. 1):

1.The area of Aigion where three prominent north dipping faults, the Aigion, the Helike, and the Pyrgaki fault control the morphology. The faults cut through the Pindos unit and plio-pleistocenic (shallow marine to lacustrine-continental) deposits often bringing these two formations into contact at the surface. The hanging walls of these faults demonstrate minor south dipping antithetic faults and roll over anticline structures with the sediments back tilting to the south.

2.The area of Xylokastro where the north-dipping Xylokastro fault strikes through Pindos limestones uplifting them next to plio-pleistocenic deposits at the north and thus forming a prominent escarpment. In the same area a series of fractures in pleistocenic conglomerates near Krathis river and the frequent presence of minor faults within the plio-pleisstocenic formations demonstrate recent extensional displacements. These minor faults control the geometry and mechanism of landslides in the area to a great degree.

3.The Perachora Peninsula where a complex tectonic regime consists of NE-SW and E-W striking main faults together with minor faults striking in various directions. Several of these faults including the prominent Pisia fault accommodated displacements during the 1981 earthquakes. The lithologies comprise of thick-bedded limestones, ophiolites as well as marine pleistocenic deposits. At the Perachora peninsula 2 instruments have been installed as a pilot phase.

2. MONITORING TECHNIQUES

Depending on the lithologies of the hanging wall and footwall and the significance of the fault, different monitoring techniques can be implemented. For example, in cases of fault planes within hard rock 3D instruments such as TM 71 (KOSTAK, 1991) or fissurometers can be used. In cases of unconsolidated sediments against similar sediments or hard rock, alternative solutions such as fibre optics (Bragg Gitter extensometers) (SCHMIDT-HATTENBERGER & BORM, 1998) or distometers based on invar wires can be applied. Finally in cases of less significant faults or as additional monitoring attempts at the same locations with the above mentioned instruments, simpler monitoring techniques such as reference bolts, gypsum marks etc. can be used. Apart from monitoring the fault activity of the region the aim is also to compare the different monitoring techniques.

3. MONITORING SITE

The pilot monitoring site at the Perachora peninsula comprises of a TM71 monitoring device and a Bragg Gitter extensometer installed on a north dipping and SW-NE striking normal fault segment near Pisia village. The installation took place at the end of February 2002. The selection of that particular site was based on several factors such as the recent earthquake activity in 1981, the occurrence of coseismic surface ruptures and the nature of the striations on the fault escarpment. Furthermore, the monitoring site was easily accessible and the installation did not require a trench excavation. The fault plane, at the selected site, is nicely exposed and shows an E-W orientation with a dip direction of 355/40. As can be seen in the geological cross section of Fig. 2, the fault puts into contact Triassic limestone units with highly consolidated Pleistocene deposits containing limestone blocks of various sizes.

4. MEASURING DEVICES, INSTALLATION

The TM71 extensometers are based on an effect of mechanical interference known as the Moiré effect (KOSTAK, 1991). Such a monitoring device was installed at

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* Martin-Luther-Universität Halle-Wittenberg, Institut für Geologische Wissenschaften und Geiseltalmuseum, Halle, Germany. E-mail: maniatis@geologie.uni-halle.de

the above described monitoring site between the footwall and the hanging wall by means of two steel bars. One bar was cemented in a short borehole in the footwall which is solid limestone and the other steel bar in a limestone block embedded within the Pleistocene deposits of the hanging wall (Fig. 3). The TM71 extensometer can measure micro-displacements along 3 directions. At the monitoring site the position of the TM71 device is such so that its x, y, and z components correspond to the direction perpendicular to the fault, the strike slip direction along the fault surface and the dip slip component of motion respectively.

The Bragg Gitter extensometer consists of an optic fibre containing a Bragg Gitter sensor. This optic fibre is embedded along a simple rod made of fibreglass the ends of which are fixed with cement in the hanging wall (limestone block) and the footwall (limestone) respectively (fig. 3). The sensor is sensitive to deformation and reflects light with a specific wavelength back to a portable readout unit. The wavelength of the reflected light is deformation depended. Therefore, changes of wavelength can be interpreted as strain changes on the rod. (SCHMIDT-HATTENBERGER & BORM, 1998)

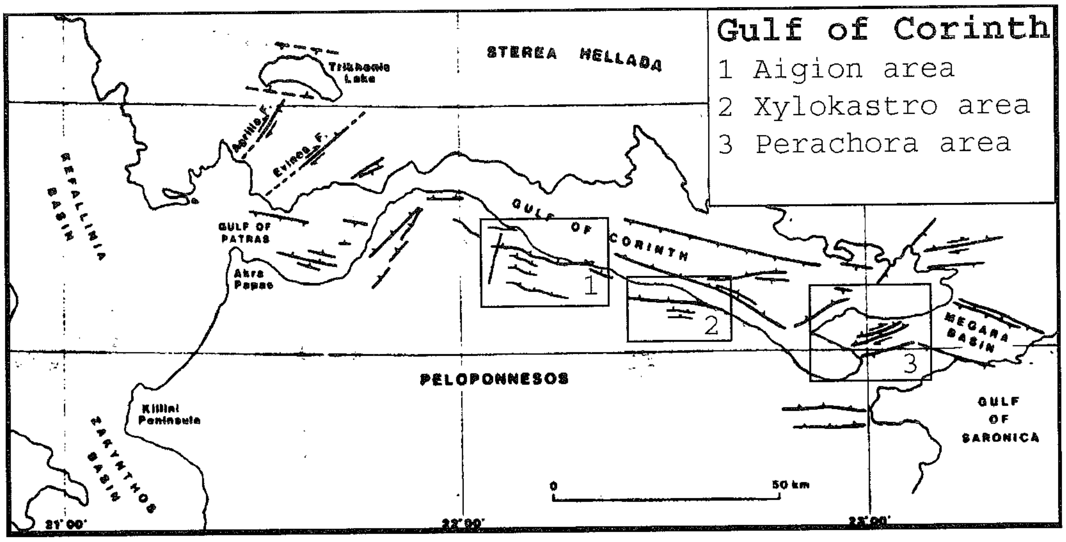

Fig. 1 - Simplified structural map of the Gulf of Corinth based on fieldwork observations and published data from FERENTINOS *et alii*, (1985).

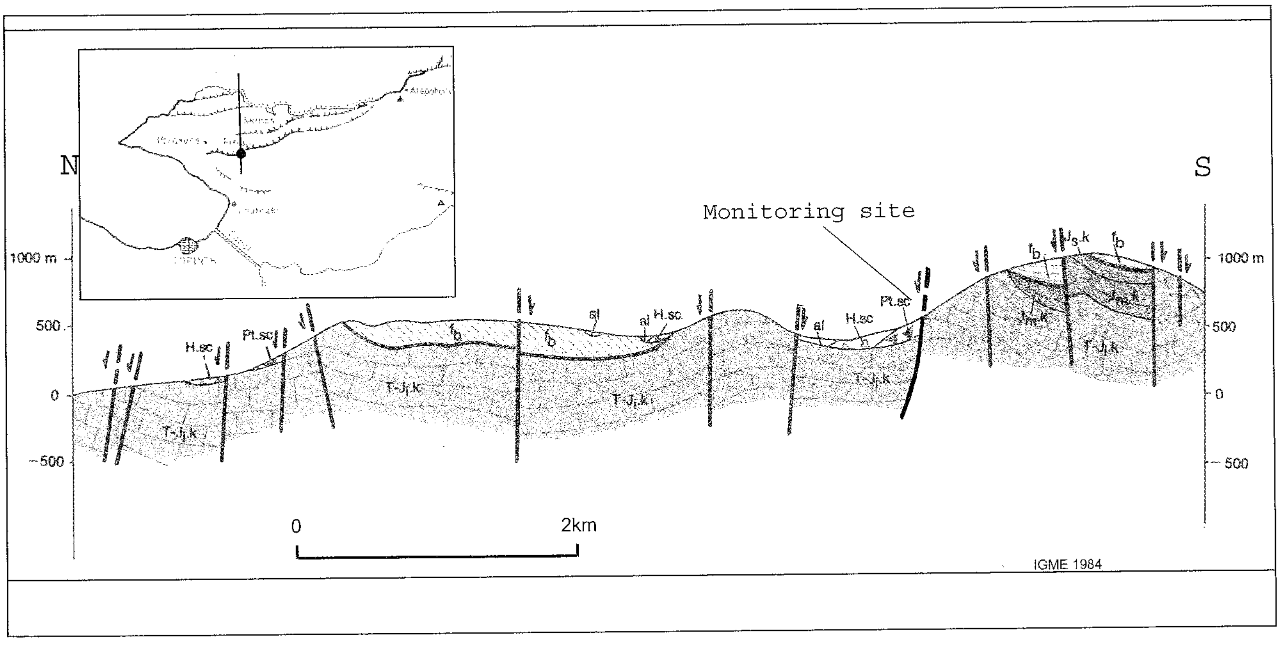

Fig. 2 - Overview map and geological cross section at the monitoring site. (I.G.M.E. 1984). (H.sc.: Holocenic scree, Pt.sc.: pleistocenic consolidated scree, fb: Lower Cretaceous flysch, Jm.k: Jurassic limestones, T-Ji.k: Triassic-Lower Jurassic limestones.).

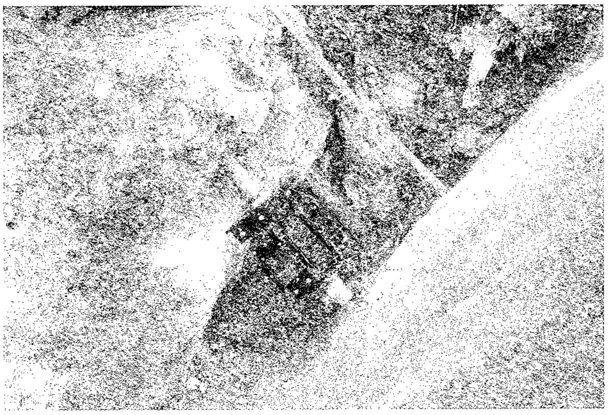

Fig. 3 - The TM71 instrument installed between the footwall and hanging wall and behind it the Bragg Gitter extensometer (the grey protective tube is visible).

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