Monitoring of recent tectonic activity in Italy

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1. Introduction

Precise monitoring of recent tectonic movements has been established on several active faults in Italy over the last few years (Photo 1). Striations documented the direction of tectonic movements. A special Crack Gauge TM 71 device (Photo 2), which is able to operate in the field and provide 3-D monitoring, was installed on selected faults - at the Gargano Peninsula, Norcia and the Colfiorito Basins and the Central Apennines. The device provides three-dimensional results in horizontal and vertical planes supplemented with angular deviations. It works on the optical–mechanical principle with accuracy 0,01 mm.

2. Methodology

All selected sites have recently suffered by earthquakes (Photo 3) and all selected localities had been studied geomorphologically before monitoring equipment was installed to avoid disturbing effects like slope movements (Photo 4). Geomorphological evidence of seismic effects was investigated on the fault zones as well. Various types of tectonic contacts could be used for installation: a) hard rock – sediment (common, Photo 5), b) sediment – sediment, c) hard rock – hard rock (seldom). Climatic effects are also taken into account.

3. Case study at the Gargano Peninsula

A fault slope by Mattinata was selected after preliminary field investigations (Photo 6). Next to this fault plane a house was built and the crack gauge TM 71 was installed across the fault plane in the cellar. Relative movements along *x, y, z* axes are presented in Fig. 1.

The results of field inventory are as follows: a) 20 km long normal fault zone with W–E orientation, locally en-echelon; b) inclination of fault scarp 80–85° and fault plane striations, c) documentation sites – in ravines, fault scarp or breccia; d) slope movements originate only at seashore, where they are influenced by wave abrasion; e) fault zone younger than river network of NW–SE trend.

Comparison between the monitoring results and landscape evolution of the area under study may improve our understanding of the dynamics of the fault structure development, as well as of related seismic energy release. The research in Italy follows investigation of other similar localities characteristic of high or middle intensity of

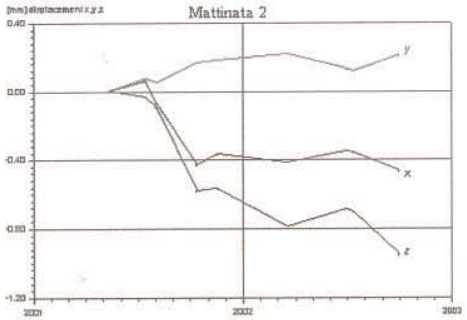

Fig. 1 Preliminary results from Crack Gauge TM 71 from Gargano Peninsula (after B. Košťák)

tectonic activity that are under study in Cordillera Blanca (Peru), in Gulf of Corinth (Greece) and in Bohemian Massif (Czech Republic). The research has been initiated and is being carried out within European Action Project COST-625 "3D monitoring of active tectonic structures".

4. Conclusions

Recent tectonic movements were quantified and interpreted on the background of landscape evolution of a broader area. The relation between earthquakes and deformations on cracks – e.g. during the 31st October 2002 earthquake at Campobasso (Fig. 2) was found. The movement of fault scarp had been registered before (!) the

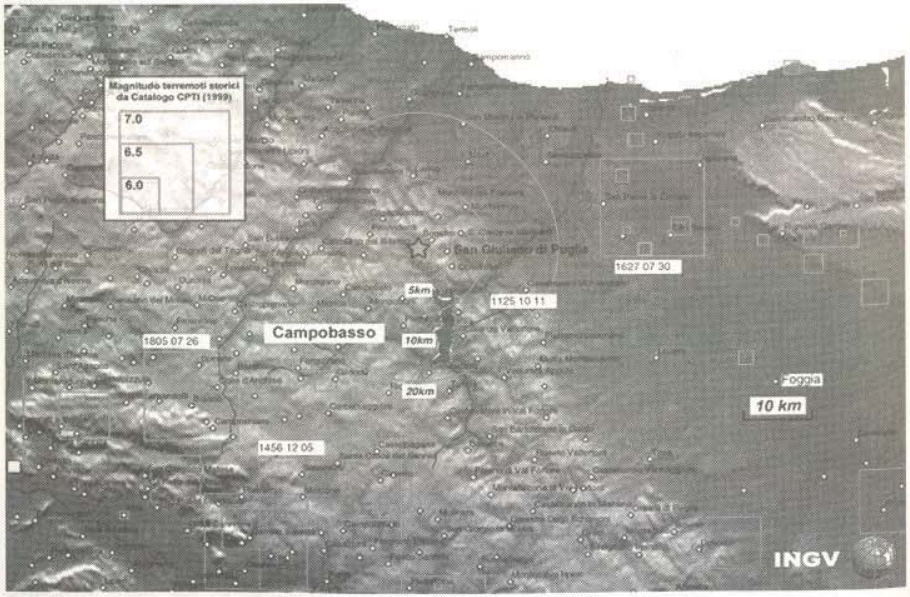

Fig. 2 The continuation of the active fault from Gargano Peninsula is in direction to the earthquake epicentre by Campobasso (e.g. Bore et al. 2003)

event, not during or after it. Moreover, difference between slow tectonic creep and sudden movements connected with seismic activity is conspicuous.

Geomorphological pronounciation of recent tectonic movements in the landscape was identified. In general, not only absolute rate of movement is important, but also trends of movements are significant. It is suggested to incorporate this type of precise measurements in multidisciplinary investigations e.g. to compare them with GPS monitoring, geodetic measurements and geophysical data.

Acknowledgements

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References

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Photo 1 Monitoring of recent tectonic activity started on the transtensional NNW-SSE border fault of the Castel Santa Maria basin (S from Norcia) in 2002 (Photo by V. Vilímek)

Photo 2 A Crack Gauge TM 71 installed in the Colfiorito Basin (Photo by V. Vilímek)

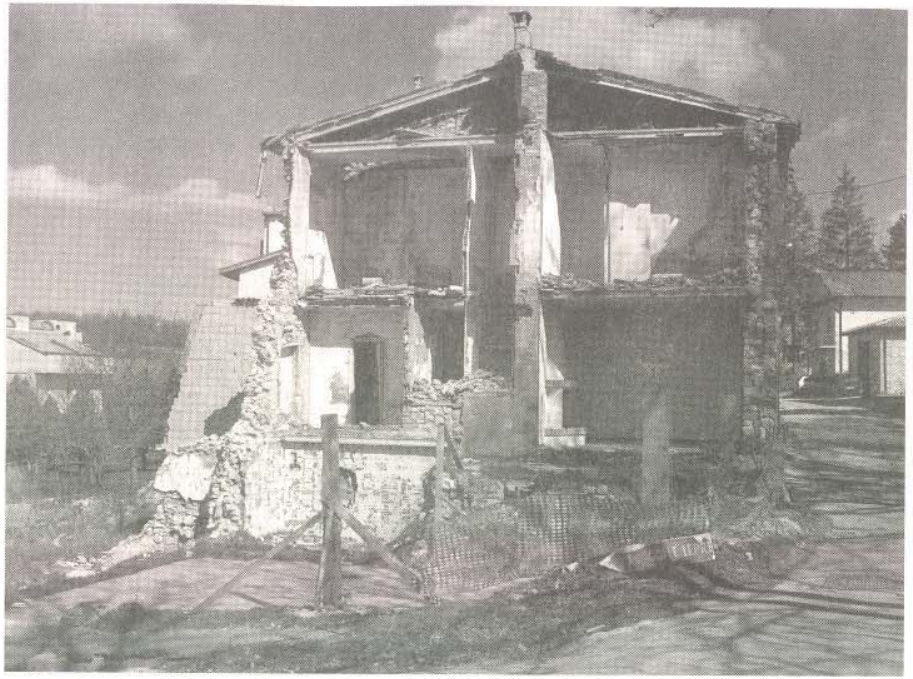

Photo 3 A lot of houses were damaged on the Cosa – Cesti fault in Colfiorito Basin during the 26th September 1997 earthquake (Photo by V. Vilímek)

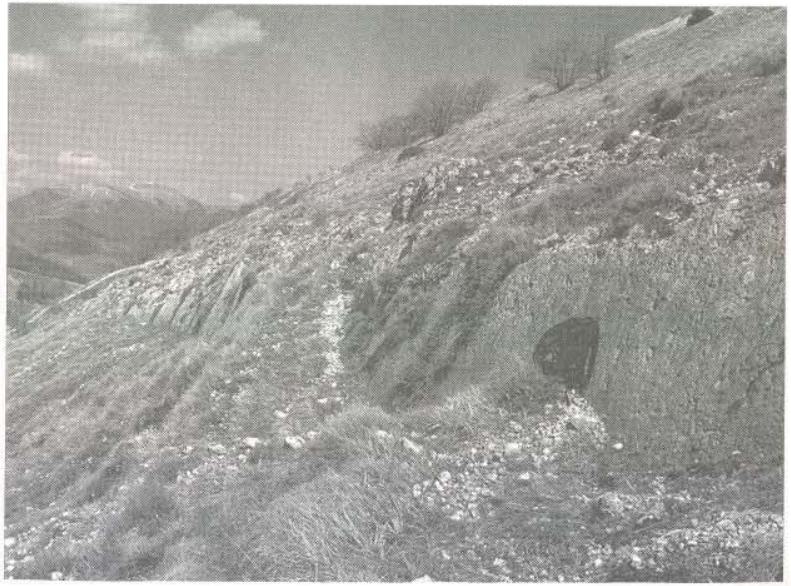

Photo 4 Locality where the Crack Gauge TM 71 was installed on an 8 km long fault trending N–S. The area did not show any signs of slope movements which could affect the monitoring (Photo by V. Vilímek)

Photo 5 A common situation of the fault scarp, where one site of the crack gauge is installed into the hard rock and second one into the sediment (Photo by V. Vilímek)

▼*Photo 6* The E–W trending active fault system of Mattinata (at Gargano Peninsula) is documented by well-expressed fault scarp. Several destructive earthquakes took place on it in 1627 and 1893 (Photo by V. Vilímek)