4.3.6. MONITORING OF ACTIVE FAULTS ALONG THE STROUMA FAULT ZONE, SW BULGARIA

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4.3.6.1. Introduction

A very complex fault structure characterizes the SW part of Bulgaria. It is the most seismoactive region in Bulgaria. The epicentral zone of the one of the largest European earthquakes is located here. Several main fault structures build this region (Fig. 4.3.6.1.). The Kroupnik and Strouma fault zones are the most significant of them. The Kroupnik fault is assumed to be the most active fault structure in Bulgaria. During the Neotectonic stage, the realized vertical movement along this fault is estimated as 3400 m (Vrablyanski, Milev, 1993). The strongest earthquake of 4 April 1904 (M=7.8) was connected with the activity just along this fault.

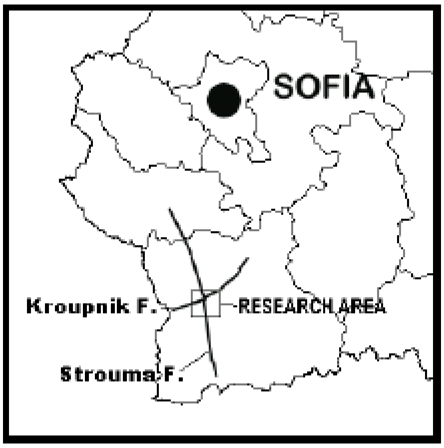

Fig. 4.3.6.1. Location of the research area

The Strouma fault zone follows a general direction of 150-170º. It extends from the Chalkidiki Peninsula to the SW parts of Serbia (Zagorcev, 1992, etc.). It is highly expressed in SW Bulgaria, especially at the 20 km long Kresna gorge. A number of parallel faults compose this zone, which is about 10 km wide. During the Neotectonic stage, the realized movement along the Strouma fault is estimated as 1600 m (Vrablyanski, Milev, 1993). Geodetic observations (including GPS ones) show variable rates of vertical movements along the Strouma Valley between the town of Simitli and Gara Yavorov. Slickenside analysis shows also variable results from different tectonic stress fields during the geological periods. The predominant part of them reveals dextral movements as well as thrusting of the East block. Up to the present, the problem with the recent activity of the Strouma fault zone has not been clarified yet. It is assumed that the whole area is uplifting. It is an irregular uplifting characterized by

uplifting of the western part with 2-3 mm per year, and the of the eastern one – with 1-2 mm per year (Vrablyanski, Milev, 1993).

For this reason, the purpose of the study is to detect real rates of fault movements along the Strouma fault zone. The fault structures along the Kresna gorge have been studied. After the analyses the most appropriate site was selected for installation of the monitoring device, having the possibilities of detecting the fault movements.

4.3.6.2. Instrumentation

The measurements were performed by extensometers TM-71, Czech product (Kostak, 1991). These devices have large application in the Czech Republic, Bulgaria and other countries during the last decades. Each device consists of two planar indicators, their presence ensuring the registration of the displacements in three spatial directions – X (opening or compressing of the fault zone), Y (strike-slip movement) and Z (vertical movement). The device was installed on steel holders made of thick tubes and cemented to drilled holes. The holders bridge the walls of the fracture (fault) with the gauge. The accuracy of the devices is 0.01 mm. The gauges had been used for research of fault movements at selected sites from active faults since 1982 when this experiment started in Bulgaria. Before that, the gauge was successfully applied for detecting barely discernible movements of large landslides or rock topples. The detailed description of the monitoring sites has been already published (Kostak, Avramova-Tacheva, 1988, Dobrev, Kostak, 2000).

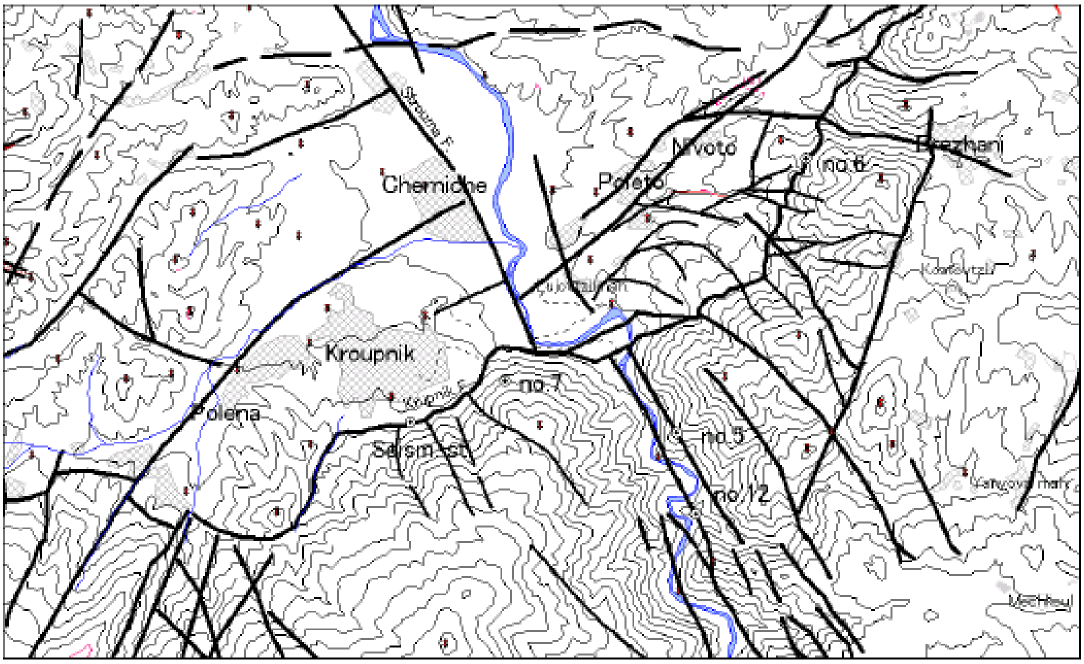

Fig. 4.3.6.2. Situation of the monitoring points in the northern part of the Kresna gorge

The most expressive device (monitoring site No 6) has been arranged along the Kroupnik fault, which is transversal to the Strouma fault system. The total displacement till now – after 21 years of monitoring, shows 43 mm of sinistral displacement, and about 35 mm of thrusting. Only a single extensometric point observes the movements along the Strouma fault zone. It is performed by monitoring site No 5, which is located about 1.2 km to the south from the northernen trance of the Kresna gorge (Fig. 4.3.6.2). The results from the monthly observations are shown in Fig. 4.3.6.3.

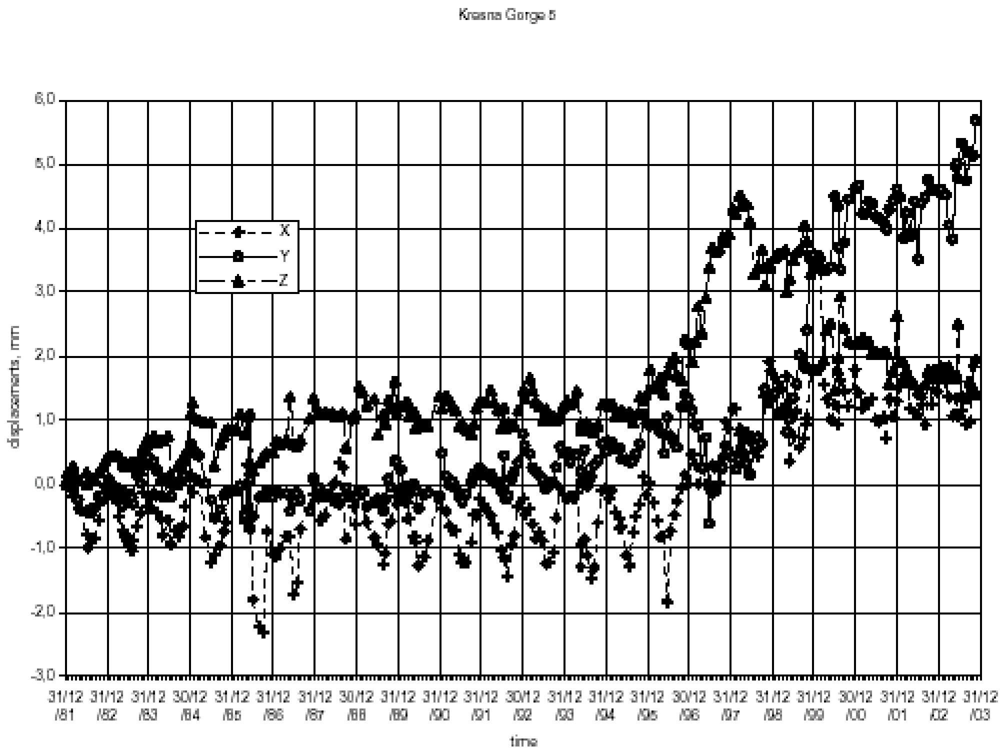

Fig. 4.3.6.3. Diagram of displacements found at Point No 5. The meanings of the displacements are as follows: +X – widening of the fault zone, +Y – sinistral movement (SW block to 135º), +Z – subsidence of the SW block

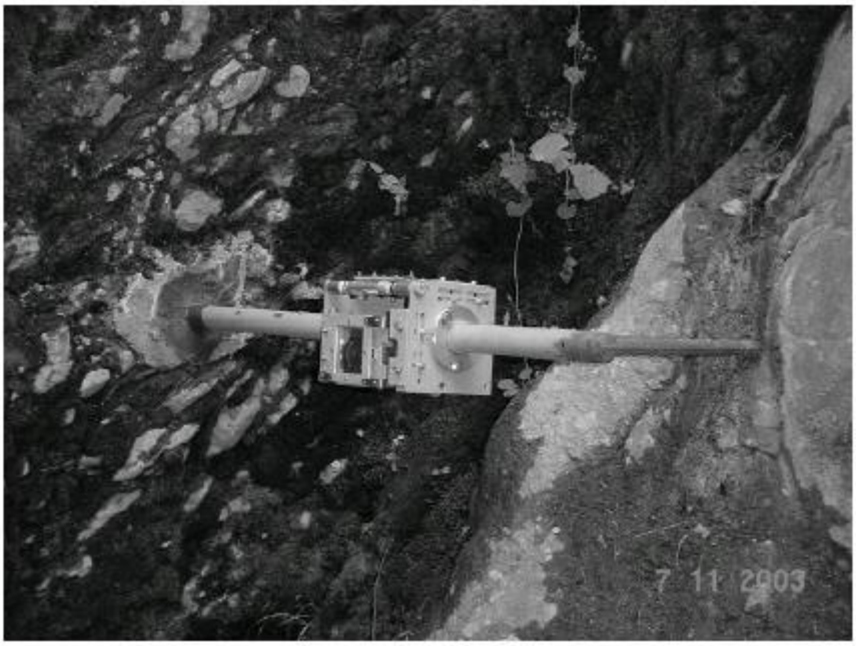

Fig. 4.3.6.4. General view of the new extensometer for monitoring of movements along the Strouma fault zone

It is clear that only a single point is not sufficient to provide reliable results for the dynamics of the faults in the Kresna gorge. For this reason, it was decided to install a new point. This was done after a detailed selection among several suitable sites (Fig. 4.3.6.4.).

The new site is located at about 780 m in southern direction from point 5, in a parallel fault structure. The new site is characterized by:

- **Date of installation: 7 November 2003**
- **Coordinates: 23.157ºE/43.833ºN**
- **Altitude: 277 m A.S.L.**
- **Geology: granite (Pirin type) massif of the Upper Cretaceous age**
- **Local fault elements: azimuth N150º, dip 60º NE**
- **Total length of steel tubes: 0.73 m**

4.3.6.3. Results and comments

The rates of the fault movements along the Strouma fault, found at monitoring site No 5, have been already established by Dobrev, Kostak (2000). The periodical changing of rates or direction of fault movements during different periods (from few months to few years) were divided. Generally, the last period (since 1999) could be characterized by:

- **Movements along X-axis – there is no trend. Temperature fluctuations are available**
- **Movements along Y-axis – left lateral movement of 0.62 mm/year**
- **Movements along Z-axis – uplift of NE block of 0.44 mm/year**

For the new monitoring site, reliable results will be available after 2-3 years of regular monitoring. The seasonal and daily temperature fluctuations could be recognized and compensated in the data from the measurements.

The enlargement of the existing monitoring system is necessary. Appropriate sites could be arranged for other parallel structures in the Strouma fault zone including those situated on Greek territory. This could be performed after comprehensive analyses over the whole area using detailed filed studies, tectonic stress fields, local earthquake distribution and geomorphology.

4.3.6.4. Acknowledgement

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4.3.6.5. References

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