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MOVEMENT MEASUREMENTS OF LANDSLIDES TRIGGERED BY ACTIVE FAULTS IN THE WESTERN CARPATHIANS

CONTENTS

ABSTRACT

In this paper we describe the monitoring of movements of landslides located along an active faults in the Western Carpathians (Slovakia). The monitoring on selected sites has been covered by national projects of the Ministry of the Environment since 1980, partially from the Ministry of Education (VEGA grant project No. 1/9159/02) since 2002, as well as by COST Action 625 since 2000. Two types of devices were applied for movement measurements: the TM-71 mechanical-optical extensometer and demountable mechanical crack gauge (SOMET type). The sites are located mostly under historic structures, in the nature protected areas as well as inside two investigation tunnels. The long-term monitoring results confirmed the reliability of TM-71 for extremely slow movement monitoring in severe outdoor conditions with resolution of 0.1 mm/year. Among several sites included in the monitoring net, one site near Kosicky Klecenov village indicates that the slope movement can be triggered by tectonic activity.

KEY WORDS: Western Carpathians, landslides, active faults, monitoring, crack-gauge

1. INTRODUCTION

Landslides (lateral spreads) and active faults represent a significant, in many cases interconnected, geodynamic phenomena in the Western Carpathians. Landslides are concentrated mainly in the areas built by Neogene volcanics, Mesozoic carbonate and marly sediments, Paleogene flysh rocks and Quaternary soils. Active faults are mostly concentrated along the margins of mountains as well as in the intramontane depressions. The strongest historical earthquakes have been recorded near Komarno town (9° MSK), Dobra Voda and Zilina (8° MSK). Both landslides and/or lateral spreads and tectonic movements negatively affect engineering structures of various types. A great number of historic structures and/or modern buildings, roads, railways, pipelines or other special structures are threatened or disturbed by movements mentioned above.

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2. MONITORING SYSTEM IN THE WESTERN CARPATHIANS

A monitoring technique using precise extensometers (crack gauges) for detection and quantification of extremely slow (mm/year) block and/or tectonic movements is carried out in Slovakia since 1980. Two types of devices are used for movement measurements: the mechanical-optical extensometer type TM-71 and the demountable mechanical crack gauge (SOMET type). They are placed within selected historic sites as well as on sites in nature protected areas and investigation tunnels.

Application of monitoring techniques started in at Spis Castle, a historic site that belongs to the World Cultural Heritage, as well as at Orava Castle. Later on several other historic structures, mainly medieval castles (VLCKO, 2002) have been selected to record exteremely slow movements (e.g. Strecno and Lietava medieval castles, Skalka Monastery, Kostolany pod Tribecom). Since 1992, a monitoring net comprising 8 historic sites was created.

Displacements of andesite blocks in the lateral spreads at three sites (Velká Izra, Sokol and Kosicky Klecenov) in nature protected areas of the Slanske vrchy Mts. (Eastern Slovakia) are monitored since 1990. Recent monitoring records from the Kosicky Klecenov site are shown on the Fig. 1.

Installation of the majority of TM-71 extensometers in the Slovakia as well as monitoring result interpretations were consulted with the Institute of Rock Structure and Mechanics (Academy of Sciences of Czech Republic) in Prague.

The monitoring results have confirmed displacements of some blocks especially on the Spis Castle by several millimeters since 1980 (VLCKO *et alii*, 1998; VLCKO & PETRO, 2002), as well as recent vertical movement of marginal blocks caused by tectonic uplift of the volcanic mountains near Kosicky Klecenov village (PETRO *et alii*, 1999; PETRO & POLASCINOVA, 2000).

Awareness of block movements on some of the above-mentioned sites as revealed by TM-71 extensometers can by applied for planning of effective remedial works.

Three new sites (Branisko investigation tunnel, Demanovska jaskyna cave and Ipel investigation tunnel have been selected since the beginning the COST 625 project (September 2000). They are located along a regional fault system that are supposed to be active. The short-term monitoring results do not allow us to make any reliable interpretation until now.

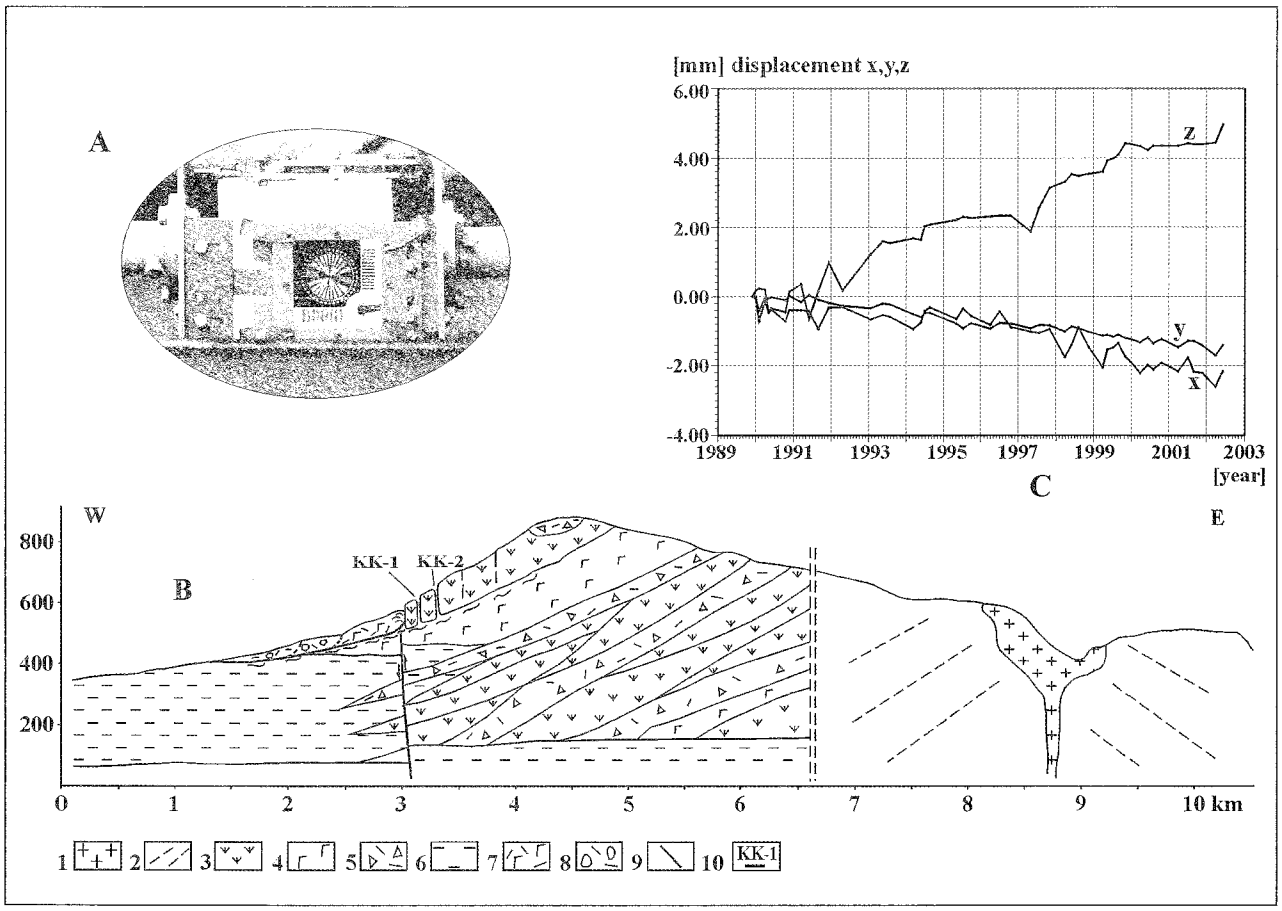

Fig. 1 - Kosicky Klecenov landslide (Eastern Slovakia). A – The TM-71 three-dimensional crack-gauge; B – Geological cross section of the Strechovy vrch stratovolcano with lateral spreading position and location of crack-gauges KK-1 and KK-2. 1 – diorite porphyrite intrusion, 2 – alternation of lava flows and pyroclastics (undivided), 3 – andesite lava flow, 4 – pyroclastics (undivided), 5 –redeposited andesite pyroclastics, 6 – Neogene clays, 7 – redeposited andesite tuffs, 8 – debris with fine soil matrix, 9 – active fault, 10 – location of crack-gauges KK-1 and KK-2; C – Displacement records of block movements monitoring by crack-gauge KK-1 since 1990.

ACKNOWLEDGEMENT

This paper was prepared as a part of the framework of Partial monitoring system of geological factors of the environment in Slovakia project, VEGA grant project No. 1/9159/02 as well as COST Action 625. The authors are thankful to the Ministry of the Environment of the Slovak Republic, Geological Survey of Slovak Republic and grant agency VEGA for their kind support.

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