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GEOMORPHOLOGICAL INVESTIGATION AND MONITORING OF LATERAL SPREADING ALONG THE NORTH-WEST COAST OF MALTA

ABSTRACT: MAGRI O., MANTOVANI M., PASUTO A. & SOLDATI M., *Geomorphological investigation and monitoring of lateral spreading along the north-west coast of Malta*. (IT ISSN 0391-9838, 2008).

The north-west coast of Malta is characterized by lateral spreading phenomena which occur within the brittle Upper Coralline Limestone formation (Upper Miocene) overlying the Blue Clay formation (Middle Miocene), the latter being a softer and unconsolidated material. Upper Coralline Limestone features a prominent plateau scarp face, whereas Blue Clay produces slopes which in most cases extend from the base of the Upper Coralline Limestone scarp face to sea level. The Upper Coralline Limestone plateau is heavily jointed and faulted, resulting from past tectonic activity. Chemical weathering, especially solution processes, have produced a karst terrain which aids in further widening the joints and faults and allows deeper infiltration of rainwater. These two geological formations have diverse hydrogeological characteristics which favour mass movement processes and landslide activity. Upper Coralline Limestone is a permeable material, allowing water to pass through, whereas Blue Clay is an impermeable material which retains water. This property renders the Blue Clay plastic when it is wet and causes lateral spreading in the above layer of limestone.

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In September 2005, a GPS network was set up consisting of 24 GPS benchmarks installed in unstable areas at three field sites along the northwest coast to determine with high accuracy any displacement in the landslides and the state of activity of lateral spreading. These field sites include Il-Prajjet, Rdum id-Delli and Ghajn Tuffieha Bay incorporating also Il-Qarraba. They provide the best examples of lateral spreading phenomena from a scientific point of view and also present the issues of hazard and risk regarding the damage of the coastal tower at Ghajn Tuffieha Bay built in 1637 by Grand Master Lascaris for defence purposes and Popeye's Village, which constitutes one of the main tourist attractions in the Maltese Islands.

During the first survey that was carried out at the end of September 2005, the baselines between each benchmark and its reference point have been measured. Four other surveys have been conducted in April 2006, October 2006, February/March 2007 and October 2007. By comparing the differences in the baselines measured during the surveys it was possible to detect and quantify the displacements caused by the landslides in the elapsed time with millimetre accuracy. Preliminary results indicate that the coastal landslides are active. The displacements recorded so far from the GPS benchmarks range from 0.54 cm to 1.73 cm. It is intended that further results will be correlated with rainfall data and the behaviour of the Blue Clay material, especially geotechnical and mineralogical properties, to understand the causes of such displacements and activity of the landslides.

KEY WORDS: Coastal landslides, Lateral spreading, GPS monitoring, Malta.