THE STUDY OF KARSTIC AQUIFERS BY GEODETIC MEASUREMENTS

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SUMMARY

We propose to study a karstic aquifer by using tiltmeter observations from the underground geodetic station of Bus de la Genziana (1000VTV) located in the Natural Hypogeum Reserve in Cansiglio (Eastern Veneto, Italy). The location of this cavity, situated in a known seismic zone on the Cansiglio Plateau in Fregona (Treviso), completes the network of tiltmeter stations of the Department of Earth Sciences (DST), University of Trieste. The network includes two further stations in Friuli Venezia Giulia (Grotta Gigante in Trieste and Grotta Nuova of Villanova in Tarcento, Udine). All the stations are set in a natural cavity that is part of an area of particular hydro-geologic importance. In the specific case of the Cansiglio-massif, the River Livenza springs at its foot-slopes. By means of comparison of the observed tilt-signal recorded in the Genziana station with the pluviometrical records provided by ARPA Veneto, local hydrologic effects have been recognised and interpretations have been proposed. The purpose of this talk is to open a new multidisciplinary frontier between the geodetic studies and the karstic system to obtain a more complete geologic description.

HYDROLOGIC EFFECTS ON TILT OBSERVATIONS

The tiltmeter station of Grotta Genziana, a cavity managed by the Corps of Foresters of the State and the Natural Hypogeum Reserve according to D.M. 1987, is active from December 2005 (BRAITENBERG *et alii*, 2007). It is situated in a seismic zone in the Cansiglio Plateau and belongs to the town of Fregona (Treviso). It is part of the tiltmeter-network of the DST, University of Trieste which has two stations in Friuli – Venezia Giulia Province (Grotta Gigante in Trieste and Grotta Nuova of Villanova in Tarcento of Udine), which are situated in interesting karstic areas. In particular from the Friuli slopes of the carbonatic Massif of Cansiglio - Cavallo the River Livenza is born.

The slow movement recorded by the instruments is the sum of a tectonic deformation and a yearly deformation due to temperature and subsurface waters (ZADRO E BRAITENBERG, 1999). Usually the yearly cycle of the other two stations of the network Grotta Gigante (TS) and Grotta Nuova of Villanova (UD), complete a closed tiltsignal, usually elliptical (BRAITENBERG *ET ALII*, 2005 (A), BRAITENBERG *ET ALII*, 2005 (B),). In the case of the Genziana station the seasonal signal is hardly recognised. Instead, the seasonal signal indicates only a semi-ellipse and a southward tilting is preponderant on the cycle.

In the Genziana station the inclinations caused by the underground run-off of rainwater are very evident and of an anomalously impulsive and faster response than the other two stations (BRAITENBERG, 1999; DAL MORO AND ZADRO, 1998). From a hydrologic point of view it seems that the massif has the tendency to load quickly and to unload slowly (ARPA. F.V.G., 2006) which would account for the fact that the response of the tiltmeters to the atmospheric events is immediate. The tiltmeters record both snow and rain with a characteristic azimuth of the main signal, which changes during the year. The direction of the induced signal could be interpreted in the sense that the run-off of rainwater is mainly directed along the NS direction. Considering the year 2008 as period of analysis, we find that from January to April the direction of unloading waters is NNW-SSE and from October to December, months exceptionally rainy compared to the previous years, it is NS oriented. The variation of direction could have origin in the hydrology of the non-homogeneous massif.

We find that the sensitivity of the instruments to hydrologic effects can be used to understand the underground water circulation. The multidisciplinary approach is very useful and opens new interpretative horizons.

THE TECTONIC MOVEMENT

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Lavoro eseguito con il contributo finanziario dell'Istituto Nazionale di Geofisica e Vulcanologia e del Dipartimento per la Protezione Civile.

From February 2006 until now the direction of the average tectonic tilting is southward oriented. An exceptional case has been registered on the 3rd of September 2006, when the instruments recorded a sudden tilting towards SE (duration less then 1 hour), preceded by an accelerated southward movement in the previous 14 days. Altogether the movement was 4.75 microrad southwards and 2.75 microrad eastwards in the period between 20 August and 3 September. This signal can be attributed to a tectonic movement, which occurred a-seismically, without an appraisable seismic event. We can exclude that this movement has an instrumental origin, because it was observed by two independent instruments. Following this event the tilt-movement has continued in the southward direction.

THANKS

We thank Alberto Casagrande for the constant engagement and for the precious collaboration, l'ARPA. Veneto, Centro Meteorologico of Teolo for the concession of meteorologic data and the Commando Forestale of Cansiglio Plateau for the hospitality and courtesy.

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