HUNGARIAN CONTRIBUTION TO THE RESEARCH ON EARTH TIDES AND TECTONIC MOVEMENTS OBSERVED BY EXTENSOMETERS – IAG COMMISSION 3

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Recent tectonic movements have been recorded by extensometers in three stations (Budapest, Sopronbánfalva, Vyhne) in the Pannonian Basin (Figure 1) for more than two decades. All extensometers are assembled from quartz tubes of the same parameters. The capacitive sensors of the extensometers and the calibration device and calibration method of the instruments were developed and made in the MTA CSFK Geodetic and Geophysical Institute. This fact renders the consistent measurement of small tectonic movements possible. In addition to the instrumentation, properties of the observatories and the environmental effects, the quality of extensometric measurements strongly depends also on the anelasticity and lateral heterogeneities of the Earth's mantle. Intensive research work was done to investigate the above mentioned effects to increase the reliability of the interpretation of tectonic measurements. In the first step of the research work the results of extensometric measurements obtained in the Sopronbánfalva Geodinamic Observatory (SGO) and in the Mátyáshegy (Budapest) Gravity and Geodynamic Observatory (MGGO) were analysed and compared (Eperné Pápai et al. 2014, Mentes et al. 2014). It was pointed out that the tidal transfer of the MGGO is better than that of the SGO since the tidal transfer in the diurnal tidal range is about 80% of the semidiurnal in the SGO (Figure 2).

Figure 3 shows the long-term strain variations measured in the SGO and in the MGGO by extensometers. The strain rates in both observatories are in good agreement with the strain rates inferred from GPS measurements of the Hungarian GPS Geodynamic Reference Network and the Central European GPS Reference Network (Mentes 2012a, b). The strain rate (-4.88 μstr/y) measured in Sopronbánfalva is much higher than those measured in the MGGO in Budapest which can be attributed to the geographical location of the SGO. The area belongs to the marginal mountainous region of the Pannonian Basin and this East Alpine region is characterized by different vertical deformation velocities compared to the central parts of the basin. The folding and compression of the weak lithosphere absorbs the strain in the Pannonian Basin which explains the small strain rates measured in Budapest (Mentes 2012a, b).

The rock deformation data series collected by extensometers provide an opportunity for studying various changes in the geological properties and rock-physics of the environment, caused by earthquakes (e.g., displacement, deformation of rock mass). Hereby further information can be achieved about the nature of these effects, complementing the analysis of seismograms (as e.g. in the frequency range embraced by extensometers it is possible to record changes with much higher time of periods). The appearance of effects of earthquakes in extensometric data were investigated on data

Figure 1. Location of the Budapest (MGGO), Sopronbánfalva (SGO) and Vyhne extensometric stations

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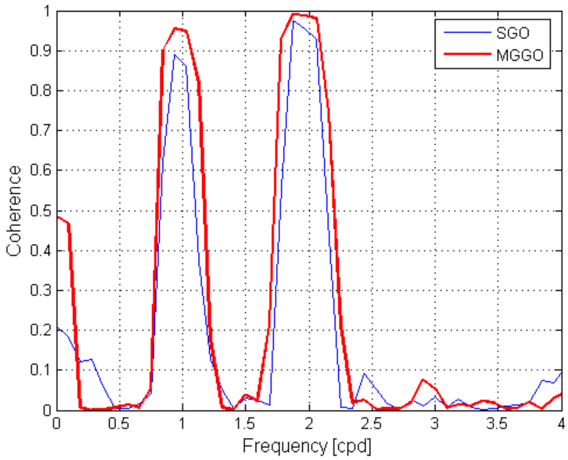

Figure 2. Tidal frequency transfer function of the Budapest (MGGO), and Sopronbánfalva (SGO) extensometric stations

series collected in the Matyashegy Gravity and Geodynamical Observatory in Budapest in the time of significant ($M > 7$) earthquakes, and spectral analysis was carried out (Kis et al. 2014). Results of the examinations were compared to the spectrum of records of a typical, undisturbed lapse of time, as well as to the spectrum calculated from seismograms of Kövesligethy Radó Seismological Observatory in Budapest, nearby the gravity observatory.

In the Sopronbánfalva Geodynamic Observatory the natural radon concentration is very high and it depend on meteorological parameters (indoor and outdoor temperature, barometric pressure), ventilation of the observatory, etc. Simultaneous strain measurement by extensometer and radon concentration measurement by an ALPHAGuard™ instrument is a unique possibility to study the relationship between rock strain and radon concentration variations in this observatory. The long-periodic part and seasonal variations of the signals were examined by cross-correlation and regression analysis. It was found that the strain induced radon concentration variations are in the order of $10^{-1} – 10^{-2}$ kBq nstr^{-1}, while the concentration variations bear more considerable similarity and relation to the temperature and air pressure variations (Mentes 2012a). The theoretical tidal potential at the location of the measurement site and tidal components computed from strain, meteorological and radon concentration data were compared with each other. The tidal evaluation proved the lack of the principal lunar semidiurnal M2 and diurnal O1 tidal waves, which have the strongest effect on the deformation of the solid Earth, but they are explicit components in the theoretical tidal and rock strain variations. These results does not reveal any connection between radon concentration variations and Earth's tide induced rock strain at the measurement site and the tidal components appearing around the noise level in the radon concentration are presumably due to the random variation of the weather (Figure 4).

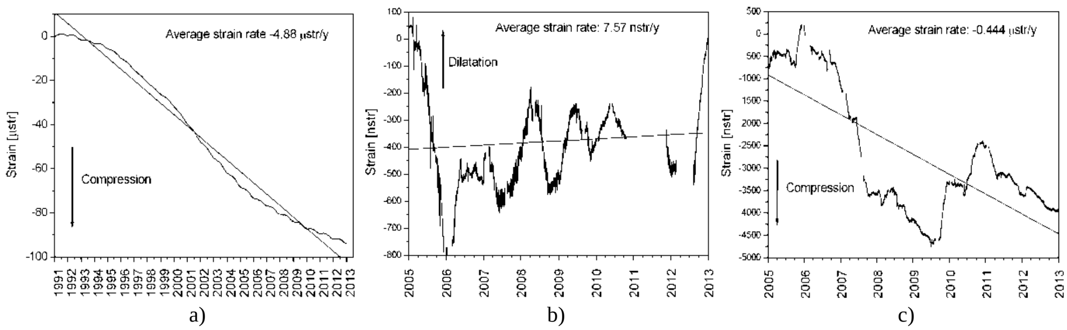

Figure 3. Long-term strain variations measured a) in the SGO (azimuth of the instrument: 116°) and in the MGGO by the extensometers b) E1 (azimuth of the instrument: 114°) and c) E2 (azimuth of the instrument: 38°)

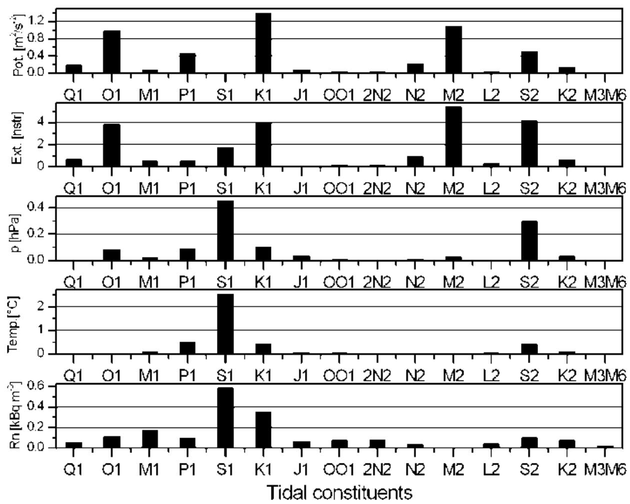

Figure 4. Theoretical tidal potential (Pot.), tidal components calculated from the extensometric (Ext.) barometric pressure (p), temperature (Temp.) and radon concentration (Rn) data

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