Geophysical Research Abstracts, Vol. 5, 13108, 2003

CAN EARTHQUAKES BE TRIGGERED BY DIURNAL GEOMAGNETIC VARIATIONS? OBSERVATIONAL EVIDENCE FROM GREECE AND ABROAD

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It has recently been pointed out that diurnal geomagnetic variations correlate well with diurnal changes in earthquake activity (e.g. Duma and Vilardo, Phys. Chem. Earth, 23, 927-931, 1998). This correlation has been shown to be global and a model to explain this possible correlation has also been proposed by Duma and Ruzhin (Natural Hazards and Earth System Science, 2003, in press). This model posits that the current vortices induced by Sq variations in the lithospheric layer, flowing across the horizontal component of the geomagnetic field generate a torque which can be added to the tectonic loading stress and may help trigger instability in a fault approaching the failure threshold.

This correlation has been tested in detail with seismicity data from the National observatory of Athens (http://www.gein.noa.gr/services/cat.html) and with geomagnetic data from the Penteli Magnetic Observatory, operated by the Institute of Geology and Mineral Exploration, Athens, Greece, http://www.igme.gr/MAGNETIC.htm). Only concurrent geomagnetic and seismicity data were taken into consideration.

In general, it appears that there is a coherent variation of diurnal earthquake activity and Sq variations. The correlation is stronger in the neighbourhood of the Penteli Observatory and deteriorates rapidly with distance; the optimal correlation is observed at a radius of 250km from Penteli. This would imply that the purported triggering mechanism has a definite latitudinal dependence, possibly in response to the corresponding changes in Sq variations. The correlation also appears to hold when the seismicity data are winnowed by magnitude, but the statistical sample at

the larger magnitude range (M>5.5) is too small to allow a sound inference. If the Duma- Ruzhin mechanism is indeed the underlying process, then statistical analysis indicates that this kind of earthquake triggering is relatively rare, but still thereŠs a distinct probability that more earthquakes will tend to occur during the hours of higher Sq intensities (mid-day and mid-night).

Surprising clusterings of earthquake occurrences as a function of the hour-of-day are also observed. For instance, there appears to be an abnormal number of occurring between 19:00-21:00, independently of size or season. ThereŠs no clear explanation of such phenomena as yet, and as the preliminary analysis shows, they cannot be directly correlated with Earth Tides.

If operative, the Duma- Ruzhin mechanism would be expected to produce a seasonal variation of earthquake activity, since Sq variations are more intense at summertime. This turns out to be generally true for Greek seismicity data.

The investigations have now been extended to data from overseas and a preliminary analysis shows similar patterns of coherent Sq and diurnal seismicity earthquake variations.

As a first (but certainly not definite) conclusion, it appears that the Duma Ű Ruzhin model may be operative, at least in the area of Greece, and may comprise an additional and plausible earthquake triggering mechanism. This, in turn, implies that seismic activity is modulated by several, possibly interacting effects, the physics of which are still poorly understood and open to investigation.

Acknowledgement: This work has been supported by the Special Account for Research Grants, of the National and Kapodistrian University of Athens, by means of grant 70/4/6428.