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The 2012 Mw5.6 earthquake in Sofia seismogenic zone – is it a slow earthquake

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Recently our understanding of tectonic faulting has been shaken by the discoveries of seismic tremor, low frequency earthquakes, slow slip events, and other models of fault slip. These phenomenas represent models of failure that were thought to be non-existent and theoretically impossible only a few years ago. Slow earthquakes are seismic phenomena in which the rupture of geological faults in the earth's crust occurs gradually without creating strong tremors. Despite the growing number of observations of slow earthquakes their origin remains unresolved. Studies show that the duration of slow earthquakes ranges from a few seconds to a few hundred seconds. The regular earthquakes with which most people are familiar release a burst of built-up stress in seconds, slow earthquakes release energy in ways that do little damage.

This study focus on the characteristics of the Mw5.6 earthquake occurred in Sofia seismic zone on May 22nd, 2012. The Sofia area is the most populated, industrial and cultural region of Bulgaria that faces considerable earthquake risk. The Sofia seismic zone is located in South-western Bulgaria – the area with pronounce tectonic activity and proved crustal movement. In 19th century the city of Sofia (situated in the centre of the Sofia seismic zone) has experienced two strong earthquakes with epicentral intensity of 10 MSK. During the 20th century the strongest event occurred in the vicinity of the city of Sofia is the 1917 earthquake with MS=5.3 (I0=7-8 MSK64).The 2012 quake occurs in an area characterized by a long quiescence (of 95 years) for moderate events. Moreover, a reduced number of small earthquakes have also been registered in the recent past.

The Mw5.6 earthquake is largely felt on the territory of Bulgaria and neighbouring countries. No casualties and severe injuries have been reported. Mostly moderate damages were observed in the cities of Pernik and Sofia and their surroundings. These observations could be assumed indicative for a very low rupture velocity. The low rupture velocity can mean slow-faulting, which brings to slow release of accumulated seismic energy. The slow release energy does principally little to moderate damages. Additionally wave form of the earthquake shows low frequency content of P-waves (the maximum P-wave is at 1.19 Hz) and the specific P- wave displacement spectral is characterise with not expressed spectrum plateau and corner frequency. These and other signs suggest us to the conclusion, that the 2012 Mw5.6 earthquake can be considered as types of slow earthquake, like a low frequency quake.

The study is based on data from Bulgarian seismological network (NOTSSI), the local network (LSN) deployed around Kozloduy NPP and System of Accelerographs for Seismic Monitoring of Equipment and Structures (SASMES) installed in the Kozloduy NPP. NOTSSI jointly with LSN and SASMES provide reliable information for multiple studies on seismicity in regional scale.