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Earthquake swarm 2011 in West Bohemia - new insights to the old problems

T. Fischer (1,2), J. Horálek (1), F. Bouchaala (1), A. Boušková (1), H. Čermáková (1), and J. Michálek (1)

(1) Institute of Geophysics, Acad. Sci, Praha, Czech Republic (tomfis@ig.cas.cz), (2) Faculty of Science, Charles University in Prague, Czech Republic

The seismic activity in West Bohemia/Vogtland woke up again in the end of August 2011 in the form of another large swarm. More than 20 000 events were recorded by the WEBNET seismic network with few the event of $M_L = 3.5$. This happened only several years after the 2008 ($\mathrm{M}_L \leq 3.8), 2000 (\mathrm{M}_L \leq 3.3$), and 1997 ($M_L \leq 2.9$) swarms, which all have occurred in the Nový Kostel epicentral area. This makes the recent period the most seismically active since the large 1985/86 swarm ($M_L \leq 4.6$) and, namely since the period 1897-1908 when several strong earthquake swarms occurred. The short recurrence period of the recent earthquake swarms opens the questions about the origin of the seismic activity and, on the other hand, provides new data to get answers. We relocated the swarm hypocentres using the master-event and hypodd location methods and determined source mechanisms to get insight into the detailed geometry of the fault plane. We find that the new swarm 2011 differs significantly from the swarms in 2000 and 2008. The main characteristics can be summarized as follows.

(i) The 2000 and 2008 swarms occupied the same portion of the steeply dipping fault plane. The 2008 swarm can be understood as a partial reactivation of the 2000 swarm area; the 2008 fault segment being larger (diameter of the oval fault segment 3.5 km compared to 3 km for the 2000 swarm). The activity of both these swarms started at the bottom in the depth of 10 km and migrated upwards (both swarms), and then downwards (2000 swarm). Most focal mechanisms matched the macroscopic fault plane with oblique strike-slip events with a common rake angle of 30°; this angle is also reflected in the elongated streaks of microearthquakes.

(ii) The 2011 swarm represents a continuation of the seismicity to the North. Its activity started at the northern tip of the 2000/2008 fault patch in the 8 km depth and migrated first North-downwards with a plunge of about 40°. A step-wise advance of seismic events across the elongated streaks is observed until the hypocenters hit the area of 1997 swarm, which resulted in accelerating the seismic activity and subsequent migration upwards. While the activated area is similar to that of 2008 swarm, its geometry differs significantly - the upper wing of the V-shaped fault plane matches that of 2000 and 2008 swarms, while the lower wing dips eastward, similar to the 1997 swarm.

Among the three major swarms, the recent 2011 swarm showed the fastest release of seismic moment with the main swarm phase lasting only two weeks, compared to four and ten weeks of the swarms 2008 and 2000, respectively. On the other hand, the decay of swarm activity is extremely slow, with occasional swarm activity lasting for already four months. Statistical analysis of the complete catalog based on automatic detections shows b-values close to one and power-law interevent-time distribution, similar to the previous swarms. Our results point to a complex fault system hosting the earthquake swarm activity in the Nový Kostel area, which partially contradicts the simple fault geometry of the 2000 and 2008 swarms, but was already indicated by the 1997 swarm activity that showed a variety of source mechanisms. Further detailed analysis of the new swarm data is necessary to learn more about the underlying processes responsible for the swarm triggering.