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Space and time distribution of foci and source mechanisms of West-Bohemia/Vogtland earthquake swarms - a tool for understanding of their origin

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The origin of earthquake swarms remains still an enigma. The swarms typically accompany volcanic activity at the plate margins but also occur in intracontinental areas. West Bohemia-Vogtland (border area between Czech Republic and Germany) represents one of the most active intraplate earthquake-swarm regions in Europe. Above, this area is characteristic by high activity of crustal fluids. Swarm earthquakes occur persistently in the area of about 3 000 km^2. However, the Nový Kostel focal zone (NK), which shows a few tens of thousands events within the last twenty years, dominates the recent seismicity of the whole region. There were swarms in 1997, 2000, 2008 and 20011 followed by reactivation in 2013, and a few tens of microswarms which forming a focal belt of about 15 x 6 km. We analyse geometry of the NK focal zone applying the double-difference method to seismicity in the period 1997 - 2013. The swarms are located close to each other in at depths from 6 to 13 km. The 2000 (M_{Lmax} = 3.3) and 2008 (M_{Lmax} = 3.8) swarms are "twins" i.e. their hypocenters fall precisely on the same portion of the NK fault; similarly the 1997 (M_{Lmax} = 2.9), 2011 (M_{Lmax} = 3.6) and 2013 (M_{Lmax} = 2.4) swarms also occurred on the same fault segment. However, the individual swarms differ considerably in their evolution, mainly in the rate of the seismic-moment release and foci migration. Source mechanisms (in the full moment-tensor description) and their time and space variations also show different patterns. All the 2000- and 2008-swarm events are pure shears, signifying both oblique-normal and oblique-thrust faulting but the former prevails. We found a several families of source mechanisms, which fit well geometry of respective fault segments being determined on the basis of the event location: The 2000 and 2008 swarms activated the same portion of the NK fault, hence the source mechanisms are similar. The 1997 and 2011 swarms took place on two differently oriented fault segments, thus two different source mechanisms occurred: the oblique-normal on the one segment and the oblique-thrust type on the other one.

Furthermore, we disclose that all the $M_L \geq 2.7$ swarm events, which occurred in the given time span, are located in a few dense clusters. It implies that the most of seismic energy in the individual swarms has been released in step by step rupturing of one or a few asperities.

The existing results do not allow us to explain properly an origin of earthquake swarms. Nevertheless, some results point to a connection between pressurized fluids in the crust and the earthquake swarm occurrence. Taking this into account, we may infer that earthquake swarms occur on short fault segments with heterogeneous stress and strength, which are affected by crustal fluids. Pressurized fluids reduced normal component of the tectonic stress and lower friction. Thus, critically loaded and favourably oriented faults are brought to failure and the swarm activity is driven by the differential local stress.