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# Seismicity patterns of earthquake swarms in the West-Bohemia/Vogtland as a hint to their triggering mechanisms

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The distribution of West-Bohemia/Vogtland seismicity is clustered both in time and space. The time occurrence is manifested in a variety of forms including both swarms with fast and with slow energy release that last from hours to months and also solitary events. The lateral distribution of seismicity is limited to a small number of focal zones, which have been periodically reactivated during the past 18 years of instrumental observations. We don't observe an apparent migration of seismic activity. Instead, the activity has been switching between the focal zones with its largest part residing in the area of Nový Kostel, which dominates with 85% of energy release.

Analysis of the activity in the period 1991-2007 has revealed that the interevent times of the seismic activity measured between events in separated focal zones show increased occurrence for time intervals below 8 hours. This fast switching of activity among focal zones with mutual distances above 10 km shows that the seismicity is correlated in a broader area and points to a common triggering force acting in the whole region of West-Bohemia/Vogtland. This force could be stress changes due to earth tides, barometric pressure disturbances, or an abrupt change of the crustal fluid pore pressure. It would trigger the activity in the focal zones which are close to failure. Depending on the local stress and mechanical conditions in each zone, the activity could either cease or an earthquake swarm could be initiated.

To disclose the forces governing the already running swarm activity we investigated the space-time relations between consecutive earthquakes of the 2000 swarm. The swarm lasted four months and consisted of more that 8000 M=3.3 strike-slip microearthquakes, which were located along a fault plane at depths 6.5–10.5 km and showed a common rake angle of 30°. We found that the relative positions of consecutive event pairs showed maximum occurrence in the slip-parallel directions. Comparison with the complete Coulomb stress change upon the fault plane due to a typical rupture showed that the observed elongation of the space-time distribution of the relative positions can be explained by a common effect of both static and dynamic stress changes, which act on different distance and timescale. The relatively small magnitudes of the Coulomb stress changes upon the fault plane in the order of 10 kPa, which are supposed to trigger the swarm events, support the idea that high pressurized crustal fluids increase the pore pressure and bring the fault close to its critical state.

This is in accordance with the results of our model of the 2000 swarm which took into account both the fluid diffusion and stress triggering. The model consisted of a planar brittle patch placed in a 3-D elastic half-space divided into the number of cells with variable strength. The individual cells rupture when the Coulomb failure criterion including both shear stress and pore pressure is fulfilled. The initial tectonic loading of the patch is presumed subcritical until the pore pressure of diffused fluids brings it into a critical state. Then the earthquake activity is governed by the stress changes due to the co-seismic and post-seismic slip, so that mutual triggering between ruptured cells occurs. It turns out that once the pressurized crustal fluids bring a fault from a subcritical steady-state into a critical state, the self-organization prevails in governing the swarm activity. This is in accordance with the possible effect of a regionally scaled force bringing one or multiple focal zones to the critical state and trigger seismicity.

The recent M=3.7 swarm from October 2008 occurred at the identical fault plane as the 2000 swarm and showed a similar areal extent of the ruptured area. The overall migration of activity with first events at the bottom of the activated fault patch and the last events in the northward tail at its top indicates similar triggering scenario. However, the step-wise monotonous event migration in the first swarm period differs significantly from the complex migration patterns of the 2000 swarm, A further analysis is needed to learn if such a pattern could be due to a fluid or magma propagation along the fault plane.