TRIGGERING MECHANISMS OF THE WEST BOHEMIA / VOGTLAND EARTHQUAKE SWARMS

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The distribution of West-Bohemia/Vogtland seismicity is strongly 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 19 years of instrumental observations. The most active is the zone of Nový Kostel, which dominates with 85% of energy release. The two largest recent swarms, the 2000 and 2008 swarms, took place in there (Fischer, 2003; Horálek *et al.*, 2009). The former lasted four months and consisted of more that 8000 M≤3.2 strike-slip micro-earthquakes, which were located along a steeply dipping fault plane at depths 6.5–10.5 km and showed a common rake angle of 30°. The latter swarm lasted less than two months and showed a faster energy release with thousands M≤3.8 events occurring on the same fault plane.

We analysed the statistics of the earthquake space-time distribution, both in the broader area and within individual swarms, at distances from hundreds meters up to tens kilometres and at intervals from fractions of second up to hours.

The analysis within the broader area (Horálek and Fischer, 2008) has revealed that the inter-event times of the seismic activity measured between earthquakes 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. We also investigated the space-time relations between consecutive earthquakes of the 2000 swarm (Fischer and Horálek, 2005). It was 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 generated by a shear 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 2000 swarm included a number of multiple-events generated by multiple episodes of rupturing. Their analysis (Fischer, 2005) showed that the relative distance of the ruptured asperities reach 100 ms in time and 320 m in space; the later ruptures occur near the edge of the previous rupture. Their angular distribution indicates that many of them result from slip-parallel rupture growth, which could be considered an immediate effect of dynamic triggering.

The presence of fast interactions during the swarm is in accordance with the results of our model of the 2000 swarm (Hainzl, 2004), which took into account both the fluid diffusion and stress triggering. The model consisted of a planar brittle patch divided into a 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 pore pressure of diffused fluids brings the cell 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.

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