Reviewed research article

Intraplate earthquake swarms in West Bohemia/Vogtland (Central Europe)

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Abstract — *West Bohemia (Czech Republic) and Vogtland (Germany) are among the most active intraplate earthquake-swarm areas in Europe with the largest events mostly of magnitudes M_L<4.0. The principal characteristics of the West Bohemia/Vogtland earthquake swarms are derived on the basis of local observations from the network WEBNET during the period between 1991 and 2009. Swarm microearthquakes clustered in number of small focal areas; however, about 90% of the total seismic moment was released in the Nový Kostel (NK) focal zone, which was formed by an NNW striking and steeply dipping fault plane. The focal depths ranged between 5 and 22 km in the whole region and between 4.5 and 11 km in the NK zone, while most of the swarm events clustered at depths from 8.5 to 9.5 km. All larger earthquake swarms took place in the NK zone; though they were located close, they differed significantly in their evolution. Two swarms, the 2000 ($M_L \leq 3.3$) and 2008 ($M_L \leq 3.8$) swarms were located on the same portion of the NK focal zone which implies reactivation of the same fault segment. Attention was paid to source mechanisms of the 1997 and 2000 swarms, particularly to the non-shear components in the 1997-swarm earthquakes. All the 1997 sources were of dipole character: the slightly compressive dipoles dominating in the first swarm phase were replaced by tensile dipoles in the second phase. On the contrary, the 2000 swarm events possessed pure double-couple sources which resulted in pure shears along the NK fault. We infer that the pure-shear rupturing in the 2000 swarm was on account of the favourably oriented NK fault plane with respect to the local tectonic stress field whereas the additional tensile forces were needed for rupturing due to the unfavourably oriented 1997-swarm fault segments. Further, we analyzed statistic characteristics and we show that the magnitude-frequency distribution with the b-value≈1.0 is typical for the West Bohemia/Vogtland earthquake swarms and that scalar moments M_0 and the WEBNET magnitudes M_L are related according to power-law $M_0 \propto 10^{M_L}$, which is inconsistent with the definition of the moment magnitude $M_0 \propto 10^{1.5 M_w}$ given by Kanamori (1977). We also show that this inconsistency results in a discrepancy in b-value of the magnitude-frequency distribution. Taking into account total seismic moment of the 2000 and 2008 swarms we infer that $M_{L_{MAX}}$ ∼5.0 to 5.3 is the maximum expected magnitude in the main NK focal zone and thus in the whole region. There is still an open question concerning the internal and external triggering of the West Bohemia/Vogtland earthquake swarms. We refer to the results of our recent study and infer that the earthquake swarm probably represents gradually propagating rupture along the fault and that both static and dynamic Coulomb stress changes along the fault plane due to co-seismic slip contribute significantly to triggering of the swarm events. Repeatedly observed almost simultaneous occurrence of seismic activity in different focal zones suggests that common triggering forces act in a broader area of West Bohemia/Vogtland.*