SOURCE MECHANISMS AND THEIR TIME AND SPACE VARIATIONS AS A TOOL FOR REVEALING A ROLE OF CRUSTAL FLUIDS IN THE BOHEMIA/VOGTLAND EARTHQUAKE SWARMS

Josef Horálek, Jan Šílený, and Tomáš Fischer

Institute of Geophysics, Academy of Science, Prague, Czech Republic

The West Bohemia (Czechia) and Vogtland (Saxony, Germany) is well known as an exceptional European region thanks to its geodynamic activity, particularly a periodic occurrence of intraplate earthquake swarms and a high flux of the mantle derived CO_2. The Nový Kostel (NK) focal zone, which dominates the recent seismicity in this region, shows a distinct planar character. Three earthquake swarms of 1997 (M_{Lmax}= 3.0), 2000 (M_{Lmax} = 3.4) and 2008 (M_{Lmax}= 3.8) and numerous micro-swarms took place there in the last fifteen years. The most of the earthquake foci are located on the main fault plane (MFP) at depths between 6 and 11 km. Hypocentres of the 2000 and 2008 swarms fall precisely on the same fault portion of the MFP, whereas the 1997 swarm was located about 1 km apart and formed a wedge-like cluster on the edge of the MFP (Fischer and Horálek, 2003; Horálek *et al.*, 2009a). To get an idea of faulting and driving forces acting in the West Bohemia/Vogtland earthquake swarms we analyzed source mechanisms (in the full moment tensor description) of the 1997 and 2000 swarms and their time and space variations; that of the 2008 swarm is in progress.

We found different patterns of source mechanisms in the 1997 and 2000 swarms, which implies their different development. In the 1997 swarm two different source mechanisms occurred: oblique normal faulting and a pure shear source in the 1st swarm phase and oblique thrust faulting and a combined source containing both shear and tensile components in the 2nd swarm phase (Horálek *et al.*, 2002; Vavryčuk, 2002). However, all the 2000-events were pure shears, with cognate source mechanisms signifying oblique normal faulting parallel to the main fault plane (dip and strike matching geometry of the MFP). The significant non-shear source mechanisms in the 1997 swarm suggest a relevant role of fluids in driving the swarm activity, whereas the 2000-swarm source mechanisms indicate a self-organization due to the stress redistribution (Fischer and Horálek, 2005). It, however, opens a question of relevance of crustal fluids in origination and driving earthquake swarms, if there is any.

To shed light on this issue we analyzed the swarm-like seismicity that was induced by the fluid injection in the Soultz-sous-Forets geothermal field (Alsace) in 2003. We estimated source mechanisms of a set of events covering the whole injection, of magnitudes similar to those of the 1997 and 2000 swarms, and investigated their time-space variations depending on the flow rate and wellhead pressure. We found that the injection activated two segments of the natural faults existing in the area that showed different source mechanism patterns. However, all the analyzed events were pure shears without any non-shear attributes (Horálek *et al.*, 2009b).

Thus we infer that in the case of the favourably oriented fault plane, pressurized fluids play a decisive role in decreasing the strength of interfaces of fractures, which is governed by the Coulomb friction criterion; this can be due to both the decrease of the effective normal stress or to the reduction of the friction coefficient. The running swarm activity is then mainly driven by the stress changes, which can be a case of the 2000 swarm, of the 1st phase of the 1997 swarm and also of the 2003-Soultz induced seismicity. Provided a less favourably oriented fault plane, additional tensile force is needful to bring the fault to rupture, as it happened probably in the 2nd phase of the 1997 swarm (Horálek and Fischer, 2008).

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