EARTHQUAKE SWARMS IN THE WESTERN PART OF THE BOHEMIAN MASSIF AND THEIR LINK WITH CRUSTAL FLUIDS

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Main investigator: Josef Horálek [1)]

Joint inevestigators: Jiří Málek [2)]

Scientific collaborators: Tomáš Fischer [1)], Alena Boušková [1)], Jan Šílený[1)], Ivan Pšenčík [1)], Petr Jedlička [1)], Jan Mrlina [1)], Jan Burjánek [1)], Zuzana Hudová [1)], Milan Brož [2)], Jaroslav Štrunc [2)], Petr Kolínský [2)] and Mikuláš Gangur [2)]

[1)] *Geophysical Institute, Academy of Sciences of the Czech Republic, v.v i., Boční II 1401, 141 31 Praha 4 – Spořilov*
[2)] *Institute of Rock Structure and Mechanics, Academy of Sciences of the Czech Republic, v.v.i., V Holešovičkách 41, 182 09 Praha 8,* malek@irsm.cas.cz

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The principal aim of the project was to shed light on the fundamental question of how relevant crustal fluids are involved in the processes generating and driving the West Bohemia/Vogtland swarms, and to explain interaction of tectonic stress and fluid pressure perturbations resulting in the earthquake swarm activity. We investigated West Bohemia/Vogtland earthquake swarms from several aspects and have inferred that in the West Bohemia/Vogtland earthquake swarm region crustal fluids play a key role in the alteration of the pre-existing favourably oriented faults from subcritical to critical state due to pore pressure increase and lowering static friction, i.e. fulfilling the Coulomb failure criterion $CFS = s_t - f(s_n - P) > 0$, where s_t and s_n are the shear and normal stresses, respectively, f is the coefficient of friction and P is the pore pressure (Horálek and Fischer, 2008). After bringing the fault to instability, the swarm activity in individual swarm phases is mainly driven by the stress changes due to the co-seismic and post-seismic slips; crustal fluids keep the fault in a critical state. Movements at the fault during earthquakes are controlled by the resultant stress. Pressurized fluids diffuse through the permeable fault and bring further segments to failure, which results in migration of foci and triggering further swarm phases. If the diffusion or pore pressure of fluids is not efficient enough, the swarm activity is stopped. Statistical analysis of the seismic activity in the period between 1991 and 2007 has revealed common triggering force acting in the region which might be the effect of an increase of crustal-fluid pore-pressure affecting a wider epicentral area (Fischer and Michálek, 2008). However, no significant correlations between the earthquake swarm activity and the CO_2 discharge variations or the isotope composition of gases were found.

We also investigated seismograms of local earthquakes in detail and thus revealed significant interfaces in the Earth crust in the region in question at depths of 1 km, 2.8 km, 5 km, 15 km, 18 km and 29 km, some of these interfaces might be connected with paths of fluids. Uppermost crust in West Bohemia was studied with help of surface Rayleigh waves (Kolínský and Brokešová, 2008). Complex crustal anisotropy was found in the region by analysing S-wave splitting in seismograms of local microearthquakes. The results obtained should form an advanced base for further investigations of earthquake swarms in West Bohemia and Vogtland as well as in other European earthquake swarm regions.

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ZEMĚTŘESNÉ ROJE V ZÁPADNÍ ČÁSTI ČESKÉHO MASÍVU A JEJICH SPOJITOST S KOROVÝMI FLUIDY

Josef Horálek, Jiří Málek, Tomáš Fischer, Alena Boušková, Jan Šílený, Ivan Pšenčík, Petr Jedlička, Jan Mrlina, Jan Burjánek, Zuzana Hudová, Milan Brož, Jaroslav Štrunc, Petr Kolínský a Mikuláš Gangur

ABSTRAKT:

Základním cílem projektu bylo posoudit, jakou roli hrají korová fluida při vzniku seismických rojů v západních Čechách. Nejdůležitějším zdrojem dat pro tento výzkum byly seismogramy z lokální seismické sítě WEBNET. Ty byly doplněné o měření vydatnosti CO2 a hladiny podzemní vody. Přímá korelace mezi produkcí CO2 a seismicitou nebyla nalezena. Avšak některé parametry seismických rojů (časové a prostorové rozdělení) ukazují významnost korových fluid při procesech v hypocentrální oblasti. Byla nalezena podobnost mezi režimem seismických rojů a indukovanou seismicitou při injektáži vody v hlubokých vrtech.