Geophysical Research Abstracts
Vol. 17, EGU2015-3672, 2015
EGU General Assembly 2015

Implications of mainshock-aftershocks interactions during the 2013 Ebreichsdorf sequence, Austria

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The Vienna basin is a pull-apart basin located at the contact between the Alpine arc and the Eurasian plate, with the Eastern Alps to the West, the Western Carpathian to the East, the Bohemian massif to the North, and the Pannonian basin to the South. The southern border of this basin, called the Vienna Basin Fault System (VBFS), is accommodating part of the extrusion of the Pannonian basin ($\sim$1-2 mm/yr) due to the convergence between the Adriatic microplate and the Eurasian plate. The VBFS is a sinistral strike-slip fault and one of the most active fault in Austria.

Along the VBFS, the seismicity is mainly concentrated in separate clusters with a spacing of approximately 20 km. In 2000 and 2013, two sequences constituted by two main shocks and 20-30 aftershocks occurred in one of these clusters located close to Ebreichsdorf, approximately 30 km south of Vienna. We focus here on the sequence of 2013 whose earthquakes were relocated using the double-difference method. The two main shocks, with local magnitudes of 4.2 and very similar focal mechanisms (N63, sinistral strike-slip), seem to be almost collocated. The aftershocks are located mainly to the northwest and at shallower depths compared with the main shocks.

In order to better understand the relationships between the two main shocks and their aftershocks, we use two simple models of Coulomb failure stress to investigate possible coseismic static stress transfer between the main shocks and the aftershocks: the constant apparent friction model and the isotropic poroelastic model. The Coulomb failure stress change at the location of most aftershocks is positive but under 0.01 MPa. Aftershock triggering due to coseismic static stress is then unlikely. On the other hand, two other mechanisms could drive this sequence i.e. rapid non-linear pore pressure diffusion along the fault plane or aseismic slip. Given inter-event distances and times of $\sim$0.5-1 km and hours to days, respectively, a high hydraulic diffusivity of 1-10 m2/s would be necessary. The upward migration of fluids could then have triggered the aftershocks. However, no water-level fluctuations in shallow wells related unambiguously to this aftershocks sequence were observed in the region of Ebreichsdorf.

Interestingly, the collocation of the two main shocks with very similar waveforms and focal mechanisms seems similar to the case of seismic repeaters, and could indicate the presence of aseismic creep at depth. Still, other explanations are possible such as an inhomogeneous stress drop distribution on the fault plane or dynamic weakening effects of the fault plane properties. The presence of pressurized fluids or aseismic creep along the VBFS would also be important for the assessment of the current seismic hazard associated with this fault system.