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PETRINJA EARTHQUAKE AFTERSHOCKS – LOCATIONS, FOCAL MECHANISMS AND RELATED COULOMB STRESS CHANGE

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The devastating Petrinja earthquake of 29 December 2020 (M_w = 6.4) was followed by a large number of aftershocks. In the first six months of the sequence we were able to hand-pick over a quarter of million earthquake phase onset times, corresponding to 13897 locatable events (Fig. 1, left). Most epicentres lie close to the NW–SE striking right-lateral causative fault, but considerable activity was recorded in the surrounding area up to about 50 km away. The hypocentres reach depths of over 20 km, with most of them located between the depths of 5 and 16 km. Very little activity was recorded around the patch of the largest coseismic displacement on the fault inferred from analyses of DInSar interferograms (Fig. 2).

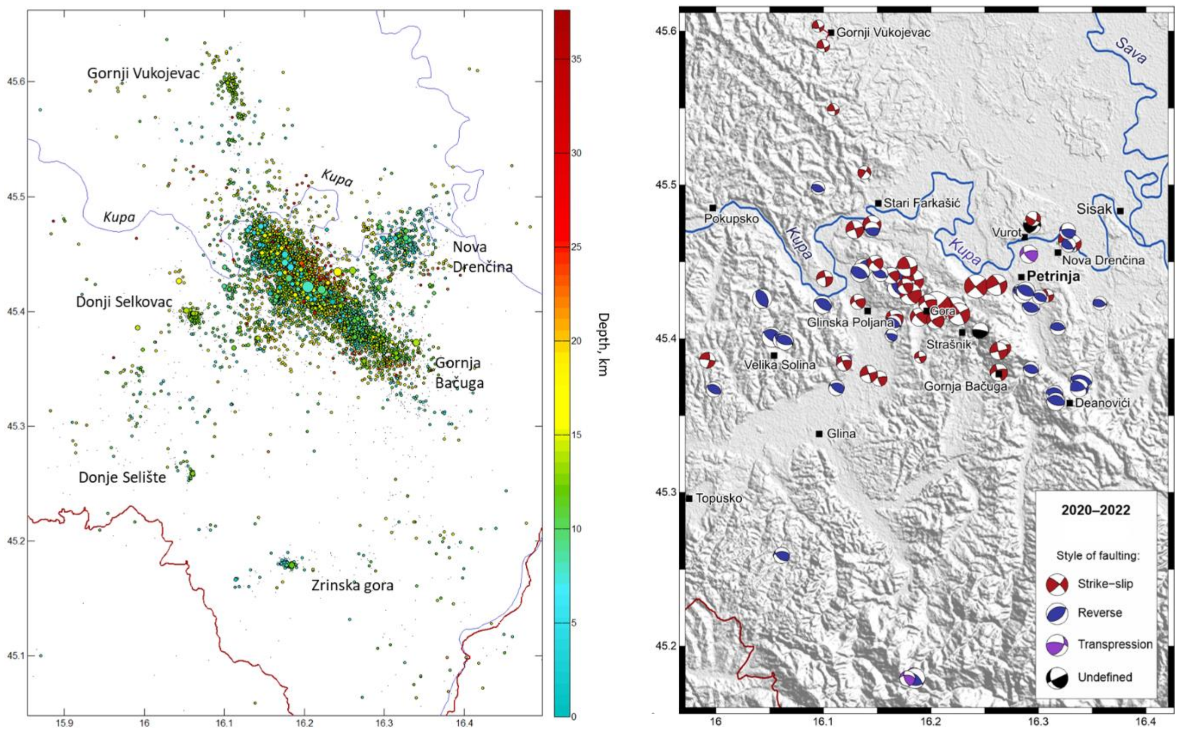

Figure 1. *Left:* Epicentres of all 13897 located events in the period 28 December 2020 – 28 June 2021. *Right:* Beach-ball diagrams of lower hemisphere equal area projections of focal mechanism solutions for 75 events from the Petrinja sequence.

The 75 focal mechanism solutions computed using the first motion polarities read from the seismograms of the local and regional seismic networks, indicate that about half of the aftershocks exceeding magnitude M = 3.0 occurred on strike-slip faults, while the large majority of the remaining ones were due to almost pure reverse dip-slip faulting (Fig. 1, right).

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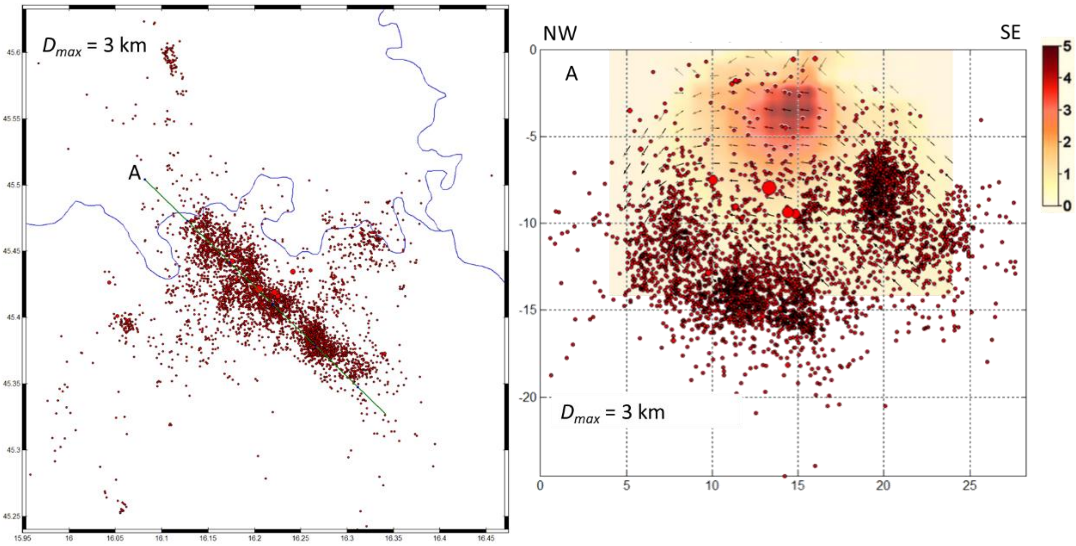

Figure 2. *Left:* Epicentres of the most reliably located events, with the green trace (A) of the cross-section through the hypocentral volume. *Right:* Vertical cross-section showing events in a 6 km wide corridor around the trace in the left sub-plot. The colour scale of the coseismic displacement on the fault after [1] is in meters.

Analyses of the Coulomb stress change on optimally oriented strike-slip and dip-slip faults following the mainshock rupture, reveals that a large majority of aftershocks occurred in the volumes characterised by the Coulomb static stress increase, whereas the areas where the effective stress decreased remained mostly quiet (Fig. 3). The distribution and preferred strike directions of strike-slip and reverse faulting inferred by the Coulomb stress transfer analyses are also in good agreement with individual focal mechanisms.

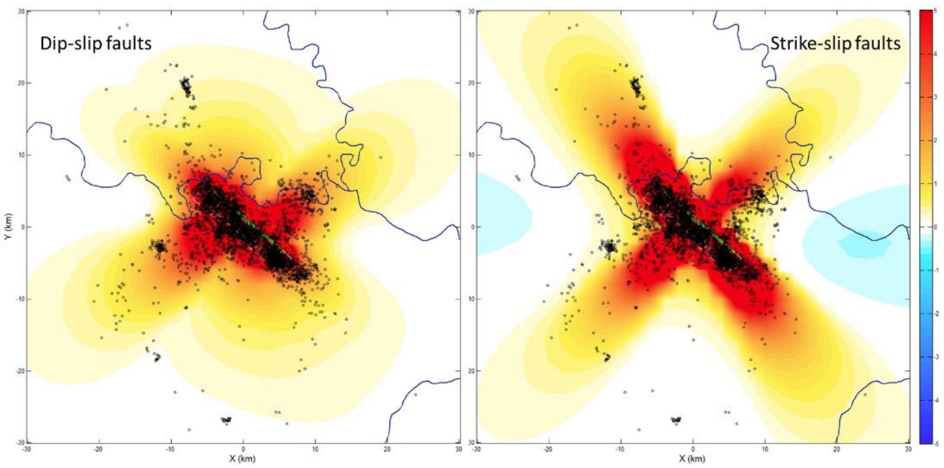

Figure 3. Maximum Coulomb stress change (in bars) considering depths 0–20 km for optimally oriented dip-slip faults (*left*) and strike-slip faults (*right*), assuming the source model presented in [1]. Warm colours indicate areas where optimally oriented existing faults were brought closer to rupture and where aftershocks are thus more likely than in the the white–blue regions. Small black circles are aftershock epicentres from Fig. 2.

Reference

[1] Kastelic, V., Atzori, S., Carafa, M.M.C., Govorčin, M., Herak, M., Herak, D., Matoš, B., Stipčević, J., Tomljenović, B. (2021): Petrinja Seismogenic Source and its 2020-2021 Earthquake Sequence (Central Croatia), *Book of Abstracts, EGU General Assembl*y, Vienna, Austria, p. EGU21-16579.