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Determining the Sava fault cumulative displacement and its seismogenic potential for the Ljubljana Basin, Slovenia

Petra Jamšek Rupnik (1), Lucilla Benedetti (2), Adrien Moulin (2), Miloš Bavec (1), and Marko Vrabec (3)

(1) Geological Survey of Slovenia, Dimičeva 14, 1000 Ljubljana, Slovenia (petra.jamsek@geo-zs.si), (2) Aix-Marseille Université, CEREGE CNRS-IRD UMR 34, 13545 Aix en Provence, France, (3) University of Ljubljana, Faculty of Natural Sciences and Engineering, Department of Geology, Aškerčeva 12, 1000 Ljubljana, Slovenia

The right lateral transpressive, 200 km long, Sava fault in northern Slovenia is at the eastern part of the Periadriatic fault system. The fault strikes NW-SE to E-W and dips steeply towards the north. Upper Oligocene volcano-clastic rocks are apparently displaced by 25-70 km along strike (Placer, 1996) suggesting a long-term slip-rate between 1 and 5 mm/yr over the last 20 Ma (Jamšek Rupnik et al., 2012). On the other hand, GPS measurements yield a slip-rate of about 1 mm/yr (Vrabec et al., 2006). Moreover, no large earthquakes (M>5) have been reported on this major fault over the last 1000 yrs. To constrain the seismic hazard in this densely populated region of Europe, we studied the western part of the Sava fault between Jesenice and Kamnik to identify geomorphic indicators of its Quaternary activity, to determine the organization and hierarchy of the overall fault network, and to quantitatively constrain the displacement on this portion of the fault.

From Jesenice to Preddvor, the NW-striking fault trace is almost rectilinear. Southeastward, the fault splays into multiple E-W striking branches. The fault also appears divided into several disconnected segments that are both right-stepping and left-stepping along the mean strike of the fault zone. These geometrical arrangements suggest that the fault segments west of Preddvor have a vertical component of slip in addition to their dominant right lateral one, while the vertical component appears to be the dominant one southeast. The segments are 3.5 to 15.5 km long and according to scaling laws, they could produce earthquakes with magnitude 5.6 to 6.5.

Dextral bending for 1.3 to 5.4 km of all major rivers crossing the fault are evidences of the fault activity over several thousands of years. Changes in river regime with incision north of the fault and active aggradation with inset terrace formation south of it also suggest ongoing vertical displacement which is yet to be quantified. Three sites near Tržič, Preddvor and Kamnik, where the fault trace is particularly sharp, have been investigated in detail. Fluvial terraces appear displaced and on the eastern portion of the fault, near Cerklje several parallel faults segments with a clear reverse component are observed. The southernmost segment offsets vertically the Kokra alluvial fan with a maximum displacement of 5 m. In the future we will date those alluvial surfaces and perform paleoseismological studies.

References

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