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Deformation rates and structural styles of active deformation in central Slovenia: Strike-slip tectonics vs. reverse faulting

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The territory of Slovenia is situated at the NE corner of the Adria – Europe collison zone. GPS measurments indicate that 2-3 mm/yr of convergence is absorbed in the ∼N-S-oriented transect from the Istria peninsula (rigid Adria outcrop, SW Slovenia and Croatia) towards the Periadriatic fault in northern Slovenia. The most prominent structural feature of SW and central Slovenia are the NW-SE-trending "Dinaric" faults with dextral offsets, which postdate Dinaric and Southalpine thrust systems of Paleogene and Neogene age, respectively. Due to their very clear topographic expression and moderate seismic activity of the area, those faults are traditionally considered to be active, presumably in a dextral to dextral-reverse sense. In central Slovenia, the "Dinaric" faults bound large rectangular depressions of Quaternary age, the Gorenjska basin and the Barje basin. The conspicuous geometry and spatial association with faults led to interpretation that these basins are of pull-apart origin.

We investigated Quaternary sediments, soils and geomorphic surfaces in the southern part of the Gorenjska basin and in the northwestern part of the Barje basin. On the ground of structural and geomorphic evidence, like fault-bend folds in Quaternary strata, topographically associated with anticlinal bulges, stream deflections on alluvial plains associated with thrust-controlled topography, anomalous dip of fluvial terraces, and spatially bound inset terraces, we interpret some of the WSW-ENE- to E-W-trending terrace scarps as geomorphic expression of active south verging reverse faults. Precise timing constraints are not yet available, but the influence of the inferred faults on the the fluvial network and on the spatial arrangement of Quaternary

river terraces clearly implies their recent activity. This is also corroborated by geodetic measurments. A network of 9 GPS sites, spanning accross both basins, indicates $\sim$1 mm/yr of N-S- to NNW-SSE-directed shortening, probably accomodated by active reverse faulting on the faults that we determined. Additionally, a previously published leveling survey study from the Gorenjska basin area revealed several sites of localized uplift, some of which correspond to the location of inferred active reverse faults. From geological evidence we estimate that vertical movements on individual faults fall are in the range of 0,05 to 0,3 mm/yr for the period from Mid Pleistocene to Holocene.

GPS measurments do not indicate any dextral activity of the NW-SE-trending "Dinaric" faults which bound the Quaternary basins in central Slovenia, but instead suggest that the area is currently being shortened in N-S direction, most probably as a consequence of the push of the CCW-rotating Adria microplate, which in the investigated area has the same N-S direction. The only exception is the Sava fault, a member of the Periadriatic fault system, which is situated at the northern boundary of Gorenjska basin, for which the GPS data suggest dextral-transpressive activity of 1-2 mm/yr. Our previously published work already demonstrated active dextral motion on the Slovenian part of the Periadriatic fault system, accomodating ongoing eastward extrusion of the Eastern Alps out of the Adria-Europe collision zone. A question remains whether the rectangular Quaternary basins in central Slovenia originally formed as strike-slip basins and only later underwent a change in deformation regime, or they already originated as compressional basins.