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Surface faulting during the 29 December 2020 Mw 6.4 Petrinja earthquake (Croatia)

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The 29 December 2020, Mw 6.4 Petrinja earthquake nucleated at a depth of ~10 km in the Sisak-Moslavina County in northern Croatia, ~6 km WSW of the Petrinja town. Focal mechanisms, aftershocks distribution, and preliminary Sentinel-1 InSAR interferogram suggest that the NW-SE right-lateral strike-slip Pokupsko-Petrinja fault was the source of this event.
The Croatian Geological Survey, joined by a European team of earthquake geologists from France, Slovenia and Italy, performed a prompt systematic survey of the area to map the surface effects of the earthquake. The field survey was guided by geological maps, preliminary morphotectonic mapping based on 1:5,000 topographical maps and InSAR interferogram. Locally, field mapping was aided by drone survey.
We mapped unambiguous evidence of surface faulting at several sites between Župić to the NW and Hrastovica to the SE, in the central part of the Pokupsko-Petrinja fault, for a total length of ~6.5 km. This is probably a minimum length since several portions of the fault have not been explored yet, and in part crossing forbidden uncleared minefields. Surface faulting was observed on anthropic features (roads, walls) and on Quaternary sediments (soft colluvium and alluvium) and Miocene bedrock (calcarenites). The observed ruptures strike mostly NW-SE, with evidences of strike-slip right-lateral displacement and zones of extension (opening) or contraction (small pressure ridges, moletracks) at
local bends of the rupture trace. Those ruptures are interpreted as evidences of coseismic surface

faulting (primary effects) as they affect the morphology independently from the slope direction. Ground failures due to gravitational sliding and liquefaction occurrences were also observed, mapped and interpreted as secondary effects (see Amoroso et al., and Vukovski et al., this session). SE of Križ, the rupture broke a water pipeline with a right-lateral offset of several centimetres. Measured right-lateral net displacement varies from a few centimetres up to ~35 cm. A portion of the maximum measured displacement could be due to afterlisp, as it was mapped several days after the main shock. Hybrid surface ruptures (shear plus opening and liquefaction), striking SW-NE, with cm-size left-lateral strike-slip offsets were mapped on the northern side of the Petrinja town, ~3 km NE of the main fault.

Overall, the rupture zone appears discontinuous. Several factors might be inferred to explain this pattern such as incomplete mapping of the rupture, inherited structural discontinuities within the Pokupsko-Petrinja fault system, or specific mechanical properties of the Neogene-Quaternary strata