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# Geological evidence of pre-2012 Emilia, Italy, seismic events

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In May 2012, two moderate (ML = 5.9 and 5.8) earthquakes, associated with a noticeable aftershock sequence, affected the eastern sector of the Po Plain, Italy. The causative faults are two segments of the Ferrara Arc thrust system representing the most frontal portion of the buried Northern Apennines fold-and-thrust belt. Few weeks after the earthquake, a palaeoseismological trench was excavated south of the San Carlo village (western Ferrara Province), where a system of aligned ground ruptures were observed. In the trench walls we observed several features documenting the occurrence of past liquefaction events affecting the same site. For example, i) 10 cm-thick dikes filled with injected sand and associated with vertical displacements have no correspondence with the fractures mapped at the surface before the excavation; ii) some thick dikes are arrested below the ploughed level or even by older sedimentary layers; iii) along the internal slope of the palaeo-channel exposed by the trench, load structures and slided blocks are observed; iv) in correspondence with the ground fractures characterised by vertical displacement and opening occurred during the 2012 earthquake and thick dikes, observed at the surface and in the trench's walls, respectively, sand and water ejection did not occur. In conclusion, the results of the palaeoseismological investigation document for the first time that shacking (i.e. seismic) events occurred in the past producing a sufficient ground motion capable of triggering liquefaction phenomena prior to, but likely stronger than, the May 2012 earthquake. A likely candidate is the November 17, 1570 Ferrara earthquake.