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Composition of sands injected during the seismic crisis of May 2012 at San Carlo, Ferrara (Italy)

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We analyzed the petrographic composition of sands injected through fractures during the seismic crisis of May 2012 along the paleo-Reno River and sands from subsurface deposits at San Carlo (Ferrara) to define their provenance and provide a contribution to the understanding of the liquefaction mechanism.

The sampling of sand has been done in a trench dug immediately after the seismic event, which allowed the detailed observations of the fluvial sedimentary sequence and of sand dikes down to the depth of about 6 m (Caputo et al., 2012). We sampled also two sand horizons in the subsurface that were crossed by drillings up to the depth of 50 m.

A total of 20 sand samples were analyzed: 9 from the sand dikes, 6 from the cores crossing the upper sand horizon (8-10 m depth) and the lower sand layer dating back to the uppermost Pleistocene, 1 from the paleo-channel fill of the Reno River (diverted at the end of 18th century) and 4 from the modern sands of the present-day Reno River.

The sand samples were analyzed for their grain size distribution and by point-counting under transmitted light microscopy on the 0.125–0.250 mm fraction, according to the Gazzi-Dickinson method (Zuffa, 1985). At least 300 grains were point counted for each section to achieve modal composition.

On the basis of the classification diagram Q+F, L, C (Fig. 1), the sands show a defined trend from lithoarenitic to quartz-feldspar-rich composition. In particular, the sands from the modern Reno River are the most lithoarenitic. The lithoarenitic fragments derive mostly from the erosion of sedimentary rocks such as siltstone, shale and limestone.

The sands filling the dikes show compositions similar to that of the modern Reno River with a slight enrichment in quartz and feldspar grains.

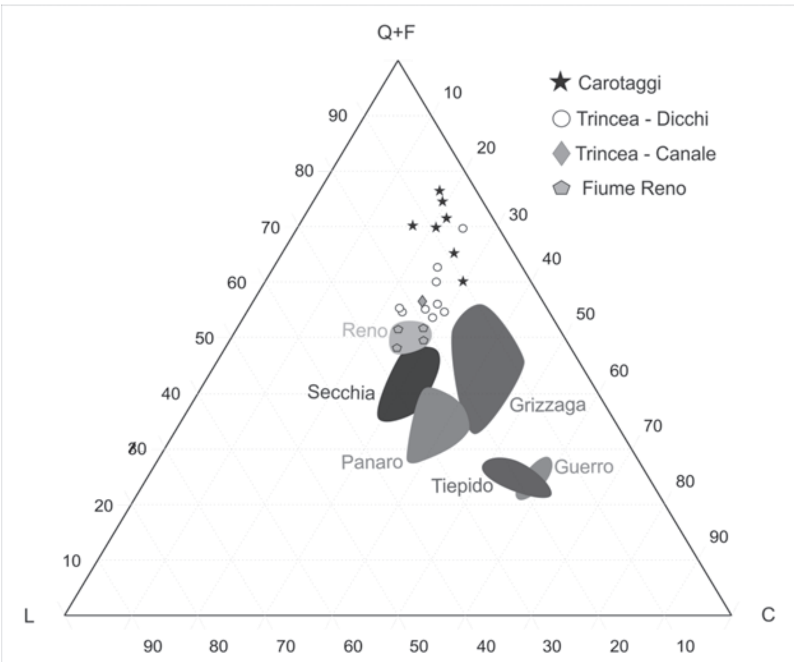

Fig. 1 - Q+F, L, C diagram showing the composition of sands from dikes (circle), from the subsurface sand horizon (star), from the paleo-channel fill of the Reno River (rhombus) and from the modern sands of the Reno River. Composition of sands from the Modena Plain streams are also reported (from Lugli et al., 2007). Q: quartz; F: feldspars; L: siliciclastic rock fragments; C: carbonate rock fragments.

The single sand dikes at different depths show minor, non-systematic, composition variations, in one case due to carbonate content change in another due to quartz and lithic fragments variability.

The sand sample from the paleo-Reno channel fill shows a composition similar to those of the dikes and is slightly impoverished in lithic fragments compared to the modern Reno River sands.

The core samples are enriched in quartz and feldspar and in some cases show a distinct content of metamorphic rock fragments, that may indicate a possible provenance from the Po River or maturation as consequence of climatic weathering that occurred during the last glacial stage (Lugli et al., 2007).

The sand from the dikes fill appear clearly different from the deep sand sampled from the cores at depth, suggesting a relatively shallow source for the blowouts.

Modal analyses of sands from the Modena Plain streams indicate that their provenance signal can be clearly distinguished and that the sand composition of major rivers has not varied during the last ~7 kyr (Lugli et al., 2007). It follows that provenance of older sediments buried in the floodplain can be determined by a simple comparison with modern sand composition. This indicates that we have a powerful tool to reconstruct the evolution of the drainage system that is pivotal for the recognition of potential areas prone to hazardous sand liquefaction phenomena.

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