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Active tectonics of the Insubria region (Central Southern Alps, Italy): the case of the Faloppia Valley at the Lombardia – Ticino border

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The active tectonics of the Central Southern Alps is characterized by the growth of south verging thrust and fold systems located in a belt at the boundary between the morphological front of the Alps and the Po Plain. This tectonic style is illustrated by recent seismic events such as the November 13, 2002, M4.2, Lake Iseo, earthquake, and the November 24, 2004, M5.2, Salò earthquake on the west coast of Lake Garda. While the occurrence of strong earthquakes (magnitude in the range 6.0 to 6.5) characterizes the Southern Alps from the Friuli region to Lake Garda, it is still unclear what is the seismic potential west of Lake Garda (Giardina et al., 2004).

For instance, within the Insubria region, i.e. the area between Lombardia, Piemonte and Ticino, there are no reported historical and instrumental events with epicentral intensity greater than VI (MCS scale). Is this apparent low level of seismicity a real physical feature of the area? Might it be only the effect of long return periods, or of an incomplete historical record, instead? Indeed, even if geological and geomorphological data clearly indicates a tectonic control of the Quaternary relief at several locations (e.g., Zanchi et al., 1997, Bini et al., 2001), the relationships between active tectonic structures and earthquake surface faulting parameters in this region are still very poorly studied.

To attack this issue, we reviewed available literature data and conducted new fieldwork, airphoto interpretation and DEM analyses, in order to select suitable sites where evidence for recent surface faulting can be identified and studied in detail. After this preliminary work, we focused on the Faloppia Valley, which from several points of

view appear to be an excellent study area for understanding Late Quaternary slip rates and the nature of slip on the fault along a prominent tectonic structure of the Insubria region.

The Falloppia Valley lies west of Como, and has a N-S trending drainage. The Faloppia River flows from the south, where the Oligo-Miocene clastics of the "Gonfolite Lombarda" group (Gelati et al., 1988) outcrop, toward the Chiasso basin, bounded to the North by the Mesozoic and Lower Tertiary sequence of the Lombardian Alps foothills (MLTS).

The "Gonfolite Lombarda" deposits terminate northward with a steep, up to 300 m high, range front. This relief is clearly controlled by a backthrust, having an arcuate trace in map view with an average E-W trend. This backthrust was well observed and described during the excavation of the Monte Olimpino 2 railway tunnel, and is the surface outcrop of a regional, 60˚ S-dipping, north verging structure separating the Gonfolite Lombarda Group from the underlying MLTS. The fault plane was also exposed on the walls of an abandoned cement factory near Ponte Chiasso (e.g., Bernoulli et al., 1989). Our new fieldwork shows that near Monte Olimpino the front of the Gonfolite reliefs is in close contact with the MLTS deposits along a 120˚-trending, about 1 km wide strip. In particular, we observed in two points the contact with "Moltrasio Fm." limestones (Lower Lias), and in one point with "Rosso Ammonitico Fm." (Upper Lias). On this basis, in this area it is possible to map the surface trace of the backthrust with an error of few ten meters, mostly due to the strong urban development of the area.

The N-S trending Faloppia Valley at the boundary between Italy and Swizerland breaks the Gonfolite range front and flows across the backthrust trace. The valley has been mostly excavated during the Quaternary by repeated advances and retreats of a marginal glacial lobe of the Abduan ice tongue. Its transverse profile has a typical U-shape, and Early-Mid Pleistocene to LGM glacial, and Holocene alluvial, deposits are preserved on the valley floor and flanks, as described in detail by Bini et al. (2001). Longitudinal topographic profiles show that the valley can be divided in two parts separated by a steep threshold that follows the backthrust trace. The difference in elevation between the southern portion relative to the northern one is about 30 m. The Faloppia River in correspondence of this threshold cuts the Late Glacial and Holocene alluvial sediments generating five orders of terraces. After the threshold, the river makes a meander, and then joins the Breggia River.

Therefore, due to its peculiar geological and geomorphological setting, this valley represents an excellent test site to evaluate the fault behavior and fault capability in this area. Literature data and our preliminary results seem to indicate that the Gonfolite

backthrust was active during Upper Pleistocene to Holocene, and it could be reactivated in the near future. To verify this hypothesis, we are planning detailed field mapping, topographical and geophysical analysis, and development of 3D models through GIS tools, in order to date recent movements and also to select a trench site for assessing:

1. the Late Glacial to Holocene slip rates,
2. the age of the youngest displacement, and, in case of evidence for coseismic slip is found,
3. the amount of displacement per event.

If this research will confirm our hypothesis, this would imply that in the area there is an important seismic gap, and would determine strong re-evaluation of the seismic hazard estimates and building codes for this highly developed area (Giardina et al., 2004).

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