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Modelling the late Alpine/early Apennine structural evolution in the "Ligurian Knot" (Voltri Massif, NW Italy)

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The metaophiolitic Voltri Massif is located in the linking area between the Northern Apennines and the Ligurian Alps (cf. "Ligurian knot" of Laubscher et al., 1992). This Massif underwent a complex tectono-metamorphic evolution, starting from subduction to collisional events during the Alpine orogenic cycle and was subsequently involved in the first stages of the Apennine orogeny.

Here we focus on the upper crustal deformations (UCD) that characterize the Voltri Massif to investigate the late-orogenic Alpine tectonics and its time relationship with the first Apenninic deformation events.

In the Voltri Massif UCD consist of poliphasic superpositions of ductile, brittle-ductile and brittle structures. UCD ductile structures, coeval with low-greenschist to zeolite facies metamorphic conditions, developed during the late-Alpine/early-Apennine tectonics and are referred to D3 and D4 deformational events in literature (Capponi & Crispini, 2002). Moreover we recognized systems of superposed brittle-ductile reverse shear zones (RSZ) and regional scale strike-slip/transpressive structures that can be referred to the D3/D4 deformational events. These systems are significant at the regional scale and develop during the first stages of this UCD history. Later stages of late-Alpine/early-Apennine structural evolution have normal and transtensional brittle structures that often reactivate older ones.

The RSZs can be clustered in two systems (RSZ1 and RSZ2) that are characterized by opposite sense of shear and different features. Several types of fault rocks, linked to different structural levels and stress regimes, overprint in single shear zones; this

testify to a long period of activity and multiple reactivations of RSZ1 and RSZ2.

The first set of shear zones (RSZ1) is characterized by ductile to brittle-ductile behavior under metamorphic conditions evolving from greenschist to low- greenschist facies. It is associated with gold-bearing quartz and carbonate veins, metasomatic alterations of host rocks and listvenites in places. RSZ1 have main top to N-NW sense of shear in the eastern sector of the Voltri Massif, and main top to SW transport directions in the western sectors.

The second set of shear zones (RSZ2) is characterized by more brittle behaviour under zeolite facies metamorphic conditions and huge volume of fault rocks and metasomatic alteration products. It has top to E-NE sense of shear and often reactivate older structures. RSZ2 represent structures associated with regional scale strike-slip and transpressive systems. These systems have main N-S orientation, with minor Riedel's faults associated, and they are widely developed in the Voltri Massif.

We discuss relative timing of these different structures and regional implications. In the frame of Eocene to Present geodynamic setting we propose a model for the late-Alpine/early-Apennine structural evolution of the Voltri Massif (Spagnolo et al., *submitted*).

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