Evènements et déformations tardi-métamorphiques dans les segments Ossola - Ticino (Val Vigezzo - Centovalli, Italie - Suisse)

SURACE Ivan ;october 29, 2004

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A wide and complex tectonic zone known as Centovalli line, crosses the Central Alps sector between Domodossola and Locarno.
This area, formed by the Vigezzo Valley and Centovalli valley, constitutes the southernmost termination of the Lepontin dome and represents a portion of the alpine nappes root zone. It belongs to a large and complex shear-zone, partly associated with hydrothermal phenomena of alpine age (< 20 My), which includes the Insubric Line and the Simplon fault zone. Vigezzo Valley and Centovalli constitute a real crossroads between the mains alpines tectonics lines as well as a zone of juxtaposition of the Southalpine basement with the Austroalpin and Pennique root zone. The deformation phases and the geological structures that can be studied between approximately 35 My and the present.
The detailed field study showed the presence of many brittle and ductile deformation structures and fault rocks such as mylonites, cataclasites, pseudotachylites, kakirites, mineralized faults, fault gouges and folds. In the field we could distinguish at least four folds generations related to the various deformation phases. The number and the complexity of these structures indicate a very complicated history, comprising several different stages, that sometimes are related and even superimposed. Part of these deformation structures affect also the sedimentary deposits of quaternary age, in particular the silts and sands lake deposit. These sediments constitute the remainders of a lake basin ascribed to the interglacial Riss/Würm (Eemien, 67.000-120.000 years) and outcroping in the central part of the studied area, in the Eastern part of Santa Maria Maggiore plain. These sediments show a whole series of deformation structures such as inverse fault planes, combined shortening structures and true folds. These faults and folds would represent the surface evidence of a probably active tectonic deformation in quaternary time.
Another rock formation attracted all our attention. It is a body of monogenic peridotite breccia which outcrops in discontinuity along the southernmost slope and the bottom of the Vigezzo valley on approximately 20 km. This breccia lies indifferently on the basement (Finero and Orselina units) or on the lake sediments. They are crossed by fault planes which developed slikenside and fault gouges whose orientation is the same of the faults gouges in the alpine basement. This breccia results from the weathering and the surface modelling of an original tectonic breccia which borders the external part of Finero peridotite body. This breccia deformation structures, like those of the lake sediments, were regarded as the surface interaction of active quaternary tectonics in the area. So the last brittle deformation phases which affects this area seems to be actives in quaternary time.
Theoverall picture of the studied area on a regional scale enables us to point out a complex shear-zone directed E-W, parallel to the axis of the Centovalli and Vigezzo Valley. The field analysis indicates that this shear-zone began under ductile conditions and evolved in several stages to brittle faulting under surface conditions. The analysis of the geodynamic evolution of the area allows to define three different stages which mark the transition of this alpine basement root zone, from deep P-T conditions to P-T surface conditions. In this context on regional scale three principal

deformation phases, which characterize these three stages can be distinguished. The oldest phase consisted of the amphibolitie facies mylonites, associated to dextral strike-slip movements. They are then replaced by green-schists facies mylonites and backfolds related to the backthrusting of the alpines nappes.
A second episode is caracterized by the development of an hydrothermal phase bound to an extensive fault and dextral strike-slip fault system, with E-W, NW-SE and SE-NW principal directionsThe principal neoformed mineral phases related to this event are: K-feldspar (microcline), chlorites (Fe+Mg), epidotes prehnite, zéolites (laumontite), sphene and calcite. In this context, to obtain a better characterization of this hydrothermal event, we have used an chlorite geothermometer, sensitive also to the pressure and has the a(H_2O), which gave downward values ranging between 450-200°C.
The last movements are caracterized by the development of important gouge fault plans, which form a sigmoid structure of kilometric thickness which is recognizable at the valley scale, and is characterized by transpressive movements always with a significant dextral strike-slip component. This deformation phase forms a combined faults system with an average E-W direction, which cuts trough the alpine root zone, the Canavese zone and the Finero ultramafic body. This fault system takes place subparallel to the axis of the valley over several tens of kilometers.
A complete and detailed XRD analysis of the gouges fault showed that the clay fraction (<2µm) contains a very significant neo-formation of illite, chlorites and mixed layered clays such as illite/smectite or chlorite/smectite. The K-Ar datings of the illite fraction <2µm gave values ranging between 12 and 4 My and the illite fraction <0.2µm gave more recents values until to 2,4-0 My. This values represent the age of this last brittle deformation.
The application of the illite crystallinity method (C.I.) allowed evaluating the thermal conditions which characterize this tectonic phase that occured under temperature conditions of the anchizone and diagenesis.
The whole set of deformation structures which we just described, perfectly fit the context of oblique convergence between the Adriatic and the European plate that produced the alpine orogen.
We can regard the Vigezzo valley and Centovalli tectonic structures as the expression of a major "Simplo-Insubric" shear-zone. Structural stacking and tectonic structures that outcrop in the studied area, are the result of the interaction between a transpressive and a transtensve tectonic phases. These two tension fields are antagonistic but they are also connected, in any event, with only one principal dextral strike-slip movement, caused by an oblique convergence between two plates. On the geodynamic evolution scale we can distinguish various stages during which these two tectonic structures fields interact in various ways.
In agreement with the geophysical data and the paleodynamic recostructions taken in the literature we considers that the Rhone-Simplon-Centovalli line are the surface feature of the major collision between the Adriatique and the European plate at depth. The uplift speeds we calculated in this study for this Alpine area give an average value of 0.8 mm/a, which is in good agreement with the data suggested by the literature on this zone.
TheVigezzo Valley and Centovalli zone can therefore be regarded as a geological crossroad where various tectonic phases are superimposed. They represent the evidences of a major and deeper suture between two plates in a continental collision context.