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Brittle deformation of the Maurienne valley (Western Alps): Present and past stress states.

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The current state of stress the internal part of the western Alps is dominated by extension perpendicular to the arc of the mountain range as suggested by focal solutions mechanisms of natural seisms and geodesy dataset. Many results on brittle structure have confirmed the extensive character of the paleo-strain state. In the Maurienne valley, the international section of the Lyon Turin railway project consists of a 53 km long tunnel between Saint Jean de Maurienne (France) and Venaus (Italy). In this context, the knowledge of the geometry of the brittle fault network and the brittle tectonic evolution is an important step in the understanding of the underground structure. Here, we present results on the brittle tectonic across the Maurienne valley, including the study of the Modane-Aussois area, and the deformation of quaternary sediments near Lanslebourg.

The study of the brittle deformation of the Modane Aussois area includes the analysis of micro-tectonic stations and the mapping of major brittle structure. Tectonic inversion has been applied to the micro-tectonic dataset and lead to distinguish two main tectonic events. The first one is characterized by a N-S extension with an E-W shortening direction (strike-slip state of stress), the second one is characterised by an E-W extension and N-S to vertical shortening direction. The larger structures are related to both tectonic event and their relative timing is compatible with that observed for the micro-faults.

The Lanslebourg quaternary deposits consist of fluvial and lacustrine sediments filling the bottom of the upper Maurienne Valley. Deposition occurs during the Würm deglaciation. Some faults postdating the whole sediment pile are observed in a quarry.

The faults orientation is independent from the quarry front orientation, suggesting that the faults were not produced by the quarry digging. Faults are underlined by a five millimeter thick level of silt. No striae are preserved along the fault planes. However the contrasted stratigraphic layers permit to determine an apparent vertical throws along the faults. On the basis of fault orientations dips and apparent throws, three groups of faults have been distinguished. The first group is compatible with normal fault characteristics and is possibly formed in a context of ENE-WSW extension and vertical shortening direction. The second and the third groups of faults are compatible with conjugate strike slip fault indicating ENE-WSW extension and SSE-NNE shortening. As no systematic relative chronological relation between normal faulting and lateral slip faults have been observed, we conclude that the Quaternary sediments of Lanslebourg are deformed by a transtensive tectonic event. This event is dominated ENE-WSW extension and SSE-NNE shortening direction. Such a transtensive stress state is in good agreement with focal solution mechanisms of natural seisms that occurred around the studied zone. The brittle deformation of the Lanslebourg sediment appears thus representative of the current stress state of that part of the internal Alps.

The Modane Aussois area records two brittle phases of deformation. The first tectonic phase characterized by a N-S extension and a E-W shortening direction is recognised in the whole northern part of the alpine belt. It is generally considered to be Miocene in age. The second one which is characterized by E-W extension and N-S to horizontal shortening direction is in good agreement with both the transtensive tectonic event dominated ENE-WSW extension and SSE-NNW shortening direction of the Lanslebourg Quaternary sediments, and the earthquakes focal mechanisms. These suggest that the second tectonic phase is still active today. That study allows us to propose a map of the most probable active faults in the Modane Aussois area.