Geophysical Research Abstracts
Vol. 18, EGU2016-13502, 2016
EGU General Assembly 2016

Morphostructural study of the Belledonne faults system (French Alps).

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The NE trending Belledonne faults system, located in the Alps, is a potentially active faults system that extends from the Aiguilles Rouges and Mont Blanc massifs in the NE to the Vercors massif in the SW (subalpine massifs). It includes the Belledonne border fault (BBF), defined by an alignment of micro earthquakes (ML$\leq$3.5) along the eastern part of the Grésivaudan valley (Thouvenot et al., 2003). Focal mechanisms and their respective depths tend to confirm a dextral strike-slip faulting at crustal scale.

In the scope of the Sigma project (http://projet-sigma.com/index.html, EDF), this study aims at better constraining the geometry, kinematic and seismogenic potential of the constitutive faults of the Belledonne fault system, by using a multidisciplinary approach that includes tectonics, geomorphology and geophysics.

Fault kinematic analysis along the BBF (Billant et al., 2015) and the Jasneuf fault allows the determination of a strike-slip tectonic regime characterised by an ENE trending σ1 stress axes, which is consistent with stress state deduced from the focal mechanisms.
Although no morphological anomalies could be related to recent faulting along the BBF, new clues of potential Quaternary deformations were observed along the other faults of the system:
-right lateral offset of morphologic markers (talwegs...) along the NE trending Arcalod fault located at the north-eastern terminations of the BBF;
-left lateral offset of the valley formed by the Isère glacier along the NW trending Brion fault which is consistent with its left-lateral slip inferred from the focal mechanisms;
-fault scarps and right lateral offsets of cliffs bordering a calcareous plateau and talwegs along the four fault segments of the NE trending Jasneuf fault located at the south-western termination of the BBF in the Vercors massif. Some offsets were measured using a new method that does not require the identification of piercing points and take advantage of the high resolution topographic data that we obtained using photogrammetry.

Fault slip rates cannot be reliably assessed because of the lack of morphologic features that can be dated. For the Arcalod and Brion faults, when considering that the observed offset are inherited from Würm, the calculated fault slip rates are much larger than those deduced for other faults in France suggesting that the studied morphologic markers are older than the Würm. For the Jasneuf fault, assuming a constant long term (since Messinian) fault slip rate, the comparison of the long term offset (measured using cliff offsets) and short term offset (measured using stream offsets and fault scarps) yields a fault slip rate which is of 0.13$\pm$0.03 mm/yr. The extension of the fault is poorly constrained and we can not ascertain the prolongation of the Jasneuf fault outside of the Vercors plateau nor in depth. Nevertheless, if this fault is limited to the sedimentary cover and do not extend outside of the Vercors plateau, it could generate Mw 5.7 earthquakes each $\sim$500 years. On the other hand we can not exclude that a large part of the deformation could be accommodated by aseismic creep as indicated by pressure solution features (Gratier et al.,2003).