

COGEAR

MODULE 2:

Seismotectonics of the Valais

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Seismotectonics of the Valais (I. Marschall & N. Deichmann)

The Valais is the most seismically active area in Switzerland. Earthquake epicenters in northern Valais follow a more or less ENE-WSW trending alignment situated north of and parallel to the Rhone Valley, while in the southern Valais and in Haute Savoie (F) seismicity is more scattered (Figure 1). The area is composed of two main tectonic units – the Helvetic domain in northern Valais and in most of the Haute Savoie, and the Penninic domain in southern Valais. In the northern Valais and Haute Savoie, earthquake focal mechanisms are predominantly strike-slip with P-axis orientations mainly NW-SE, while in the southern Valais they show normal faulting with T-axes oriented in a N-S direction. Active fault planes could be identified for 13 different earthquake sequences (Mauvoisin, two sequences of Anzère, Gd. Bornand, Leukerbad, Annecy, Samoëns, Cima di Jazzi, Martigny, Glarey, Derborence, Vallorcine and Sierre) by applying precise relative location procedures (e.g. Maurer & Deichmann, 1995; Maurer et al., 1997; Fréchet et al., 2011) (Figure 2).

At first glance, the orientations of active fault planes identified in the Helvetic domain and in the Aiguilles Rouges Massif seem unsystematic. However, on a regional scale they are compatible with a rotation of the direction of maximum compression from E-W oriented compression south of the Lake of Geneva to NW-SE oriented compression in the Helvetic domain of northern Valais. On a local scale, this would mean that some of the identified fault planes are unfavorably oriented for rupture. Comprehensive analysis of the state of stress in the region based on focal mechanisms available up to 1998 was published by Kastrup et al. (2004).

This analysis was updated including data up to 2011. For the determination of the state of stress in this region a linear stress inversion method after Michael (1984) was applied using parameters of the fault plane solutions as input data. The entire dataset consists of 43 fault plane solutions (Figure 3), however, for the stress inversion the data set was divided into 3 subsets – southern Valais, northern Valais and Haute Savoie. The results basically confirm the studies of Kastrup et al. (2004) – normal faulting for the Penninic domain of the southern Valais with T-axes oriented in a N-S direction, strike slip for the Helvetic domain of the northern Valais with P-axis orientations in NW-SE direction and Haute Savoie with P-axis orientations in WNW-ESE direction (Figure 4, Figure 5).

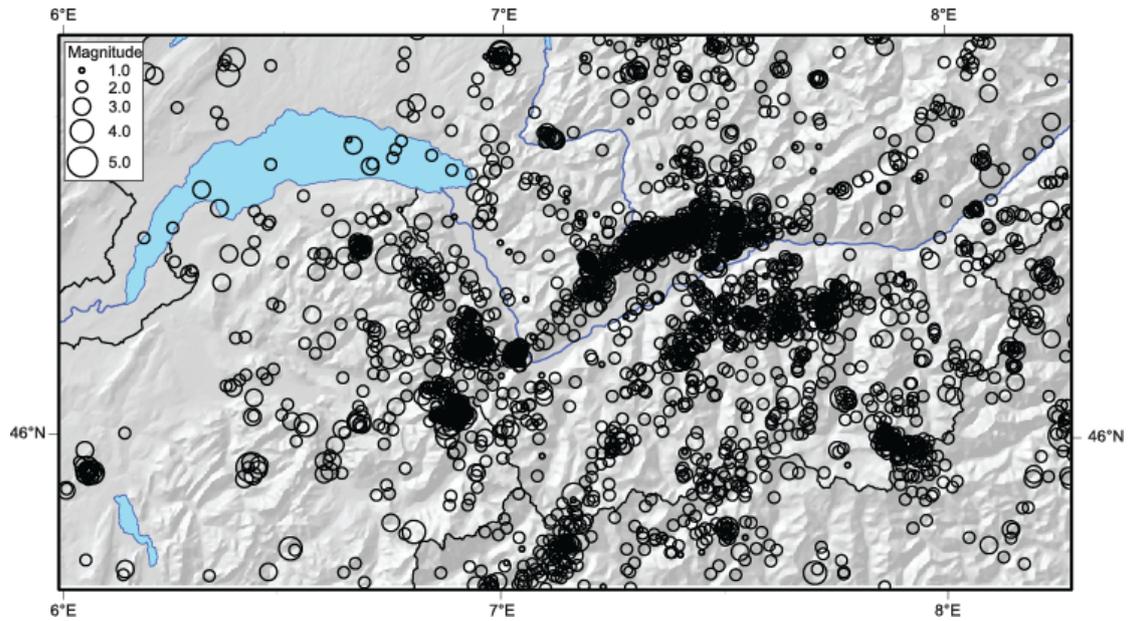


Figure 1: Earthquake epicenter map for the Valais (CH) and Haute Savoie (F) between 1984 and 2011 with $ML \geq 1.0$.

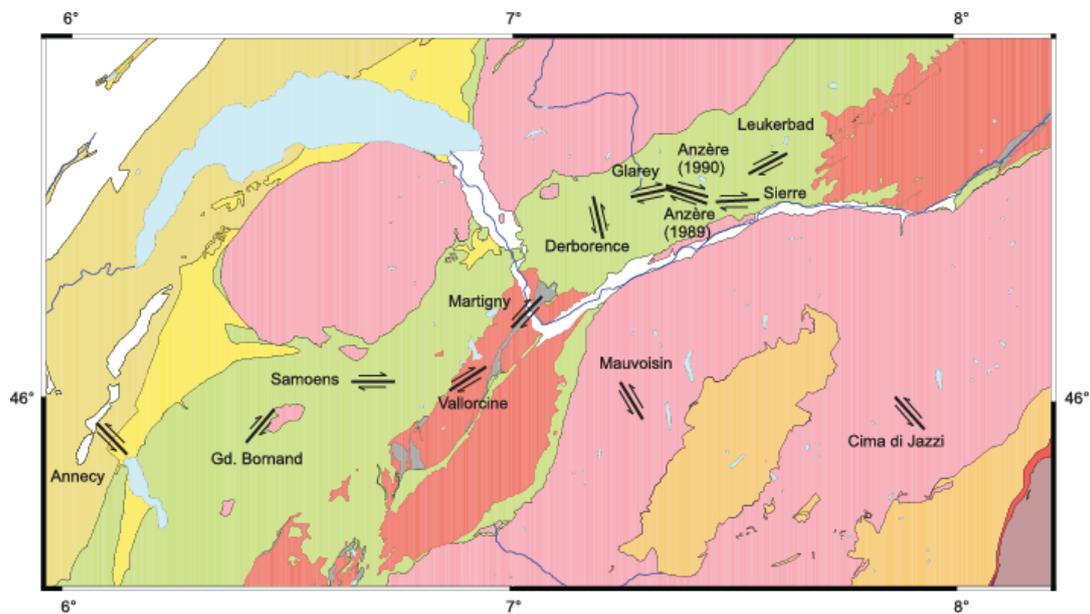


Figure 2: Tectonic map of the Valais (CH) and Haute Savoie (F) and orientation and slip of those active focal mechanism fault planes identified from precise relocations of earthquake sequences. Note that the dimensions of the fault planes are not to scale.

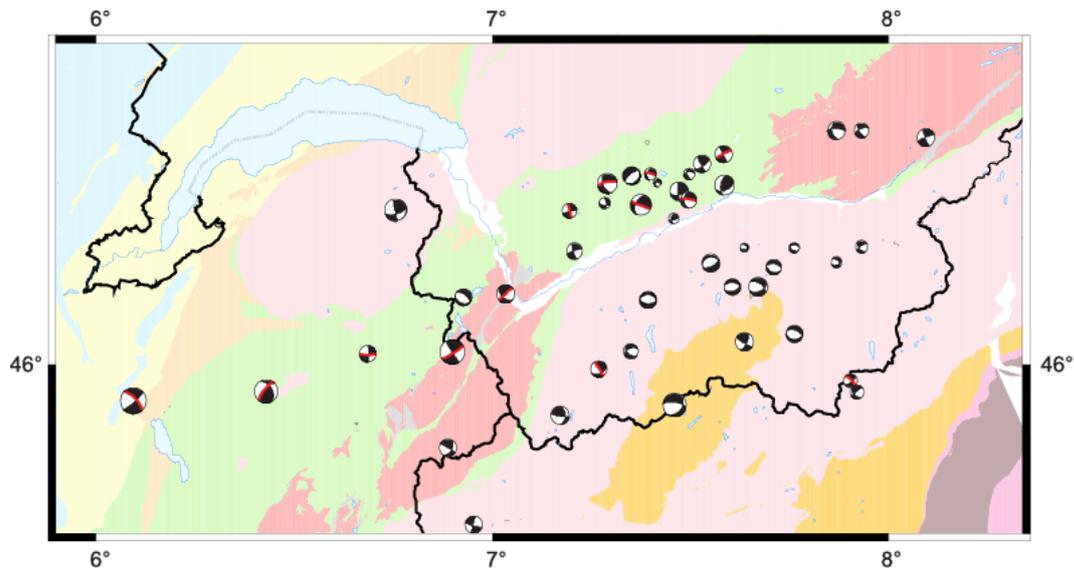


Figure 3: Tectonic map and fault plane solutions of the earthquakes which parameters were used for the stress inversion (red planes indicate active planes).

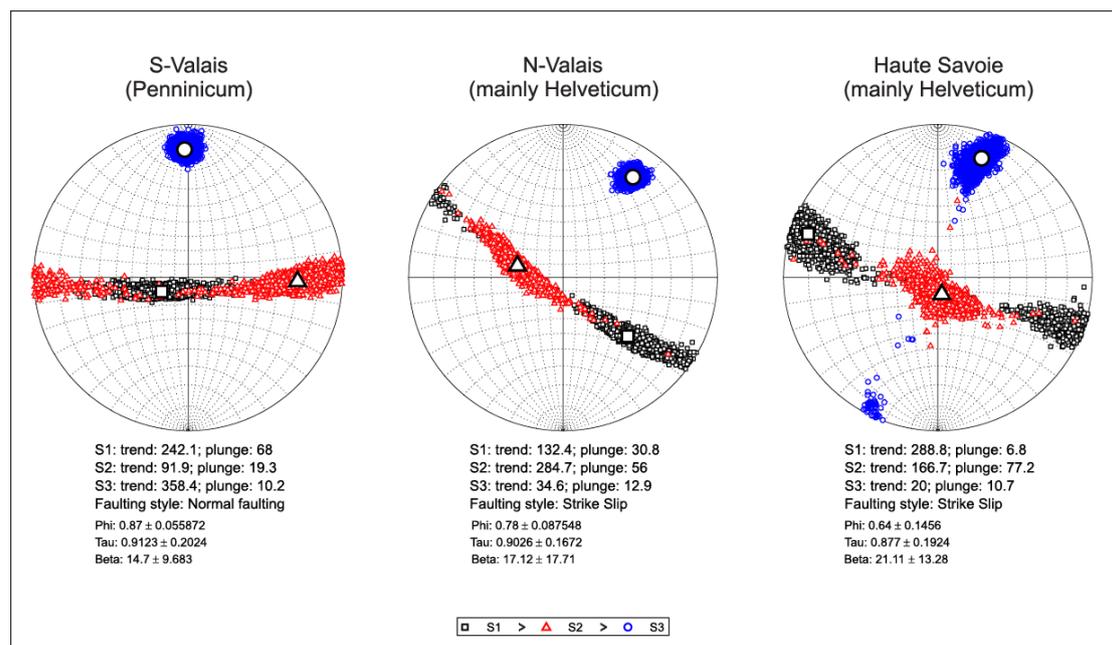


Figure 4: Results of the stress inversion: normal faulting for the southern Valais (left), strike slip for the northern Valais (middle) and Haute Savoie (right).

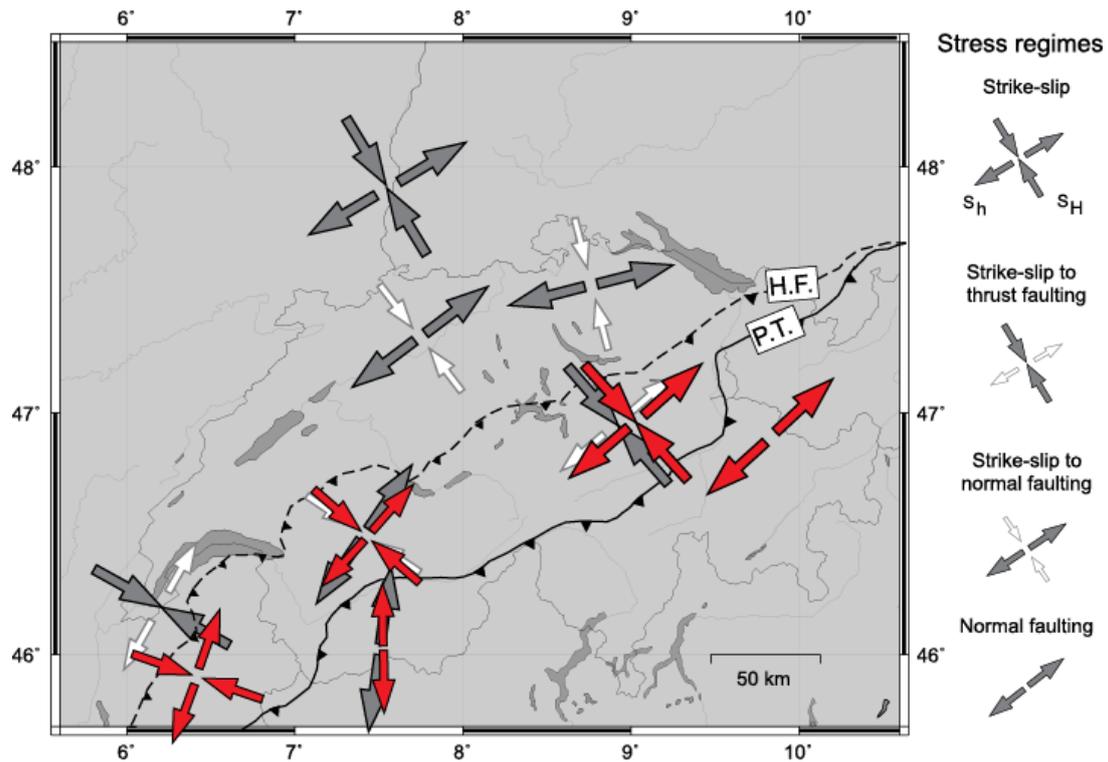


Figure 5: Stress orientations of Switzerland, grey arrows: analysed by Kastrup et al. (2004), red arrows: updated results by Marschall (2012).

References:

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