Assessing fault criticality using seismic monitoring and fluid pressure analysis

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The stability of a critically stressed fault depends on the surrounding stresses acting on it. Fluids, by reducing the effective normal stress, play a major role. It has been observed that in karstic regions, an increase in groundwater pressure following significant recharge (precipitations and/or seasonal snowmelt) can result in a fault re-activation, inducing microseismicity. This study combines the natural microseismicity and the groundwater level fluctuations observations to estimate the fault criticality. The research is carried out on two major strike-slip faults in the folded Jura in Switzerland – La Lance Fault and La Ferrière Fault – most likely critically stressed according to their position in the global stress-regime. Data acquisition mainly consists in hydrogeologic and seismic monitoring. The objectives are to have continuous discharge rates of the major karstic springs and to produce a seismic catalog for the area of interest. Combining both data sets will allow to determine relations between increasing spring discharge rates and low magnitude earthquakes and eventually to acquire a quantitative knowledge on what pressure change is affecting the fault's stability. This knowledge will be used to develop a straightforward methodology to assess fault criticality. In addition, the study of a possible time lag between aquifer response and fault activation, as well as back-analysis of seismic events can provide, respectively, important information about the deep-seated fluid circulation and the local stress-regime.