Geophysical Research Abstracts
Vol. 19, EGU2017-18673, 2017
EGU General Assembly 2017

Fault segmentation and fluid flow in the Geneva Basin (France & Switzerland)

Giovanni Luca Cardello (1), Matteo Lupi (1), Yasin Makhloufi (1), Damien Do Couto (1), Nicolas Clerc (1), Mario Sartori (1), Elias Samankassou (1), Andrea Moscariello (1), Georges Gorin (1), and Michel Meyer (2)

(1) Université de Genève, Earth and Environmental Sciences Division, Genève, Switzerland (luca.cardello@unige.ch), (2) Services Industriels de Genève (SIG)

The Geneva Basin (GB) is an Oligo-Miocene siliciclastic basin tightened between the Alps and the southern Jura fold-and-thrust belt, whose carbonate reservoir is crossed by faults of uncertain continuity. In the frame of the geothermal exploration of the GB, the associated side risks, i.e. maximum expected earthquake magnitude, and the best suitable geothermal structures need to be determined. The outcropping relieves represent good field analogues of buried structures identified after seismo-stratigraphic analysis. In this frame, we review the regional tectonics to define the i) present-day setting, ii) fault properties and; iii) preferential paths for fluid flow.

Field and geophysical data confirmed that during the late Oligocene-early Miocene the Molasse siliciclastic deposits progressively sealed the growing anticlines consisting of Mesozoic carbonates. Those are shaped by a series of fore- and back-thrusts, which we have identified also within the Molasse. As shortening is accommodated by bed-to-bed flexural-slip within shale-rich interlayers, usually having scarce hydraulic inter-connectivity, syn-kinematic mineralization massively concentrates instead within two strike-slip sets. The "wet" faults can be distinguished on the base of: orientation, amount of displacement and fabric. The first set (1) is constituted by left-lateral NNW-striking faults. The most remarkable of those, the Vuache Fault, is about 20 km long, determining a pop-up structure plunging to the SE. Minor structures, up to 5 km long, are the tear-faults dissecting the Salève antiform. In places, those are associated with brittle-ductile transition textures and crack-and-seal mineralization. Set (1) later evolved into discrete and still segmented faulting as it is traced by earthquakes nucleated at less than 5 km of depth (ML 5.3, Epagny 1996). The second set (2) is constituted by W/NW-striking right-lateral faults, up to 10 km long, associated in places with thick polyphase breccia. Cathodoluminescence analysis show that cataclasite mineralization from both the "wet" sets (1) and (2) show fluid evolution through time, possibly from more calcitic to dolomitic composition, testifying for fluids crossing the entire Meso-Cenozoic sequence. Two "dry" fault sets characterized by fault length up to 4 km and N- and NE-strike occur, as they are associated with tightly spaced (5-10 cm) open joints and karstic forms.

Locally, a consistent transition from less to well-developed en échelon fracture sets can be recognized both at vertical (plan) and horizontal view. While the study of their arrangement at the plan view leads to a regional fault-evolution model, the horizontal view brings to a more general fault-evolution model in carbonates, where the coalescence of Mode-I veins is associated with larger amount of accumulated displacement. In both views, faulting is the result of strain localization and changing fluid circulation, accompanying the activity of progressively longer and mature faults.

In conclusion, our observations show that: 1) faults are segmented in the basin as on the relieves, thus not providing structure capable of giving any earthquake significantly larger than the already measured ones; 2) NNW- and W/NW- striking systems are vein-rich and therefore "wet" whereas N- and NE-striking systems are "dry" although they may work with opposite fluid-flow vertical directivity.