Abstract

Geothermal and water management projects are developing in the Geneva region with the objective of natural resource sustainable exploitation. Fluid circulation is tightly correlated with fracture networks in rocks, whose brittle deformations can greatly enhance or reduce it. The Jura Mountains' *Haute-Chaîne* borders on the Geneva Basin and its looming relief contains the marks of the region's deformation. However, no fracture network or structural study were performed on the *Haute-Chaîne*, and its kinematic evolution is still poorly understood.

To determine the strain that the *Haute-Chaîne* suffered, this study focuses on analyzing its kinematics, by the means of a coupled on-field geological study and lineament interpretation analyses based on *Digital Elevation Models*. Two lineament interpretations are manually extracted from the setting's exposed fracture network, which is used for qualitative and quantitative fracture analyses, where geometrical, topological, chronologic, and kinematic properties are derived. The results are gathered to create the *Haute-Chaîne* kinematic model, and the fluid flow properties of the fracture network are used to estimate the hydrogeological potential of the Haute-Chaîne and the Geneva Basin.

The results of the *Haute-Chaîne* fracture network characterization indicate six deformation phases. A major NW-SE strike-slip fault regime is responsible for the main fracture occurrences along large strike-slip faults and transcurrent structures caused by fault stepovers. This regime predated and outlasted the Jura Mountains folding phase and it also caused the 11° clockwise rotation of the *Haute-Chaîne* anticline. Fracture intensity and connectivity are higher in four clusters of the fracture network, which coincide with well-known deformation zones of the Geneva Basin. These zones are therefore extended to the *Haute-Chaîne*, and they probably delimit the areas of maximal fluid flow potential in both settings. The lineament analyses also demonstrate the dominant impact of the NW-SE fracture set on permeability anisotropy estimations, which confirms the major role of these structures on strain and hydrogeological properties of the Geneva region.

Keywords: Jura Mountains, Fracture Networks, Lineament Analysis, Kinematics, Fluid Flow