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# Foliated vs. dilatant fault rocks in deeply buried arkosic turbidites: characterisation of their distinct petrophysical properties. The case of the Gres d'Annot, French Alps

Thibault Cavailhes (1), Pierre Labaume (1), Jean-Pierre Sizun (2), Roger Soliva (1), Claude Gout (3), Alain Chauvet (1), Martine Buatier (2), Jean-Luc Potdevin (4), Delphine Charpentier (2), and Anna Trave (5)

(1) Géosciences Montpellier (UMR 5243), Université Montpellier 2 - CNRS; Montpellier, France / First author is now at Badley-Ashton & Associates (thibaultcavailhes@badley-ashton.co.uk), (2) Chrono-Environnement (UMR6249), Université de Franche-Comté - CNRS; Besançon, France, (3) TOTAL RD, CSTJF, Av. Larribau, 64018 Pau, France, (4) Géosystèmes (FRE 3298), Université Lille 1 - CNRS; Lille, France, (5) Facultat de Geologia, Universitat de Barcelona; Barcelona, Spain

Fault zones are major discontinuities in sedimentary basins. Understanding their role on fluid migrations is an essential issue to (i) characterise the mechanisms and kinematics of deformation and (ii) to determine the parameters which control the distribution of energetic or mineral resources. This work applies to faulting under a temperature range of 200-250°C, corresponding to that of deeply buried reservoirs as well as potentially seismogenic fault zones.

The studied faults are normal faults affecting the "Grès d'Annot" Formation, a Priabonian-Rupelian siliclastic turbidite succession of the Alpine foreland basin. They are located in two distinct areas: the Moutière-Restefond area in the eastern part of the basin and the Estrop area in the western part. Vitrinite reflectance outside fault zones indicates maximal temperatures of 240-260°C at Moutière-Restefond and 170-200°C at Estrop, i.e. burial depths around 8 km and 6 km, respectively, assuming a mean geothermal gradient of 30°C/km. Burial was due to underthrusting below the Embrunais-Ubaye Alpine nappes, the difference in burial between the two areas traducing the westward taper of the nappes front.

The studied faults affect alternating arkosic sandstone beds and pelite layers with offsets from centimeters to decameters. Two types of core zones are recognized: (1) the foliated core zones of the Moutière-Restefond area, where deformation dominated by pressure solution and synkinematic phyllosilicate neoformation resulted in a foliated fabric, and (2) the core zones of the Estrop area, characterized by dilatant quartz-mineralized veins and breccia.

Fault and host rock petrophysical properties were measured on drill plugs, using the water porosity technique and nitrogen permeability technique under 2 Mpa of confining pressure. In the Moutière-Restefond fault zones, plug axes were oriented in three orthogonal directions corresponding to the main deformation axes (X, Y, Z) of the foliated arkose to characterize the effect of structural anisotropy. In the Estrop fault zones, where deformation does not show equivalent anisotropy, the plug axes were oriented according to the main fault plane orientation (i.e. parallel to azimuth, parallel to dip and normal).

In each fault zone, the porosity of fault rocks is equivalent to that of host rocks. In the Moutière-Restefond fault zones, the plugs parallel to the X and Z axes of deformation have a permeability similar to that of the host rocks, whereas permeability parallel to the Y axis (i.e. parallel to the foliation and the main fault plane) is one order of magnitude higher. By contrast, the permeability values in the Estrop fault zones are isotropic and equivalent to the host rock values.

This study highlights the importance of various types of deformation mechanisms and related fluid-rock interactions in determining different fault rock types in a same protolith, ultimately controlling distinct petrophysical properties of fault zones.