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# basement reservoir geometry and properties

bastien Walter, yves Geraud, and marc Diraison
Universite de Lorraine, Ecole Nationale Supérieure de Géologie, GeoRessources, vandoeuvre les nancy, France
(yves.geraud@univ-lorraine.fr)

Basement reservoirs are nowadays frequently investigated for deep-seated fluid resources (e.g. geothermal energy, groundwater, hydrocarbons). The term ‘basement‘ generally refers to crystalline and metamorphic formations, where matrix porosity is negligible in fresh basement rocks. Geothermal production of such unconventional reservoirs is controlled by brittle structures and altered rock matrix, resulting of a combination of different tectonic, hydrothermal or weathering phenomena. This work aims to characterize the petro-structural and petrophysical properties of two basement surface analogue case studies in geological extensive setting (the Albert Lake rift in Uganda; the Ifni proximal margin of the South West Morocco Atlantic coast). Different datasets, using field structural study, geophysical acquisition and laboratory petrophysical measurements, were integrated to describe the multi-scale geometry of the porous network of such fractured and weathered basement formations.

This study points out the multi-scale distribution of all the features constituting the reservoir, over ten orders of magnitude from the pluri-kilometric scale of the major tectonics structures to the infra-millimetric scale of the secondary micro-porosity of fractured and weathered basements units. Major fault zones, with relatively thick and impermeable fault core structures, control the ‘compartmentalization’ of the reservoir by dividing it into several structural blocks. The analysis of these fault zones highlights the necessity for the basement reservoirs to be characterized by a highly connected fault and fracture system, where structure intersections represent the main fluid drainage areas between and within the reservoir’s structural blocks. The suitable fluid storage areas in these reservoirs correspond to the damage zone of all the fault structures developed during the tectonic evolution of the basement and the weathered units of the basement roof developed during pre-rift exhumation phases. Macroscopic fracture density is highly dependent on the petrographic nature of the basement, with values up to 80 frac./m in fault damage zones of crystalline rocks. Dense micro-cracks associated to major fault structures can develop porosity and permeability up to 10% and 0.1 D. In some weathered horizons, alteration can develop matrix porosity up to 40% and the permeability reaches up to 1D. This study highlights therefore that basement reservoir properties are the result of the long geodynamic evolution of such formations, and the different fault zone compartments or weathering horizons have to be considered separately for reservoir understanding.