

Evaluation of the Rock Properties of the Structurally Deformed Areas Based on Outcrop Analogues in Azerbaijan

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ABSTRACT

Deformation bands have been evidenced from both outcrop observations and subsurface data worldwide. These features formed due to regional contractional tectonic processes are known to influence the rock properties in various ways. The aim of this study is to quantify the impact of deformation bands and their kinematics on rock properties for a wide range of rock types based on the field measurements in the outcrops of Yasamal Valley located in the western part of the South Caspian Basin. The study reveals deterioration and potential enhancement of the rock properties through deformation bands dependant on several structural, lithological and petrophysical factors. An integrated approach was put together to understand the impact of these factors including the measurements of natural gamma radioactivity, permeability, dips and strikes across the range of facies and distribution of deformation bands using portable tools. Additionally, Routine and Special Core Analyses were performed on the outcrop plugs with and without deformation bands to estimate the alteration of the rock properties at the micro-level supported by petrographical description, SEM, XRD and CT scan tests. Interpretation of data shows that no deformation bands occur in the rocks with shale volume greater than 32% as determined from the field gamma ray measurements. Moreover, an exponential decline of the probability function of the band occurrence was determined. Rocks with high amount of calcite were observed in the field which appears to increase the number of deformation bands and significantly decrease porosity and permeability. Mineralogical composition allows to determine what dictates rock properties' degradation. Laboratory results of the core plugs taken from the outcrops with a single deformation band show 36% and 10% decrease in permeability and porosity, respectively, in comparison with the adjacent host rock plug without deformation band. No obvious correlation between bed dip and strike with concentration of deformation bands could be identified. The occurrence of deformation bands and their subsequent influence on rock properties is a complex function of several factors that either counteract or enhance each other. Nevertheless, clay content is amongst the dominating parameters affecting the occurrence, concentration and the type of deformation bands. Meanwhile, macro scale permeability influence would require either whole core flooding or numerical modeling.