Geophysical Research Abstracts
Vol. 13, EGU2011-11966, 2011
EGU General Assembly 2011
© Author(s) 2011

Exploitation of mechanical weaknesses by sandstone intrusions

Denis Bureau (1), Joe Cartwright (2), and Regis Mourgues (1)

(1) L.P.G.N., CNRS UMR 6112, University of Maine, 72085 Le Mans, France, (2) 3D Lab, School of Earth and Ocean Sciences, Cardiff University, Cardiff, UK

Sandstone intrusions have been recognized in outcrops, mines and subsurface data all around the world. They result from the remobilization and injection of unconsolidated sand encased in low-permeability mudstones which often contain pervasive polygonal fault network and require a pore fluid pressure in the source units in excess of lithostatic at the time of remobilization and intrusion to develop. Sandstone intrusions also require a triggering event, such as earthquake, meteorite, asteroid impact, volcanic eruption or landslide. The relations and interactions between hundreds of reservoir-scale conical sandstone intrusions and the pervasive polygonal fault network present within the surrounding encasing host mudstones have been studied using three-dimensional seismic data in Tranche 6 of Faroe-Shetland Basin, on the UK Atlantic margin. The intrusions were injected upwards during the Late Miocene through Eocene/Oligocene claystones and have reached the paleo-seafloor. This period is characterized by a transition from a compressional regime to a regime with no external tectonic stress. The study shows that polygonal fault network and the discordant limbs of conical sandstone intrusions exhibit interrelationships ranging from sandstone intrusion limbs fully or partially intruded into polygonal fault plans to sand injectites stopped by polygonal faults as well as sandstone intrusions limbs developed regardless of polygonal faults. Polygonal fault strikes acting as barriers, i.e. stopping sandstone intrusions have average strikes of N145° whereas polygonal fault strikes intruded by the sand/fluid mixture display a mean strike value of N54°. These two values represent the most dominant trends among polygonal faults strikes in the study area and should therefore be viewed with some caution. However our measurements concerning both polygonal fault strikes exhibit a low standard deviation and lead us to suggest that a compression were still affecting this area during the time of intrusions. Accordingly, compression has likely been the reason why some polygonal faults were intruded during others were not. These observations permit a potentially predictive method for estimation of sandstone intrusion geometries in a basin underlying a compression. Mechanical explanation attempts are also proposed in order to explain why it is easiest for the sand fluid mixture to propagate along pre-existing fractures rather than creating new contemporary mode I fractures. For fluid to open a pre-existing fracture, the fluid pressure (Pf) must exceed the normal stress (σn) acting on a fracture wall. A simple Mohr circle construction providing a fairly answer is presented, drawn on existing theory for Igneous intrusion. Intrusion limbs intruded along polygonal fault plans close to the surface but not in depth in three-dimensional seismic data is also broached mechanically.