Salt Ridges Along Extensional Faults: A Kinematic Indicator

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Abstract

Extensional domains in salt basins such as the Santos Basin and the South Gabon Basin are characterized by lystric normal faults rooting into the basal section of the Mid Cretaceous salt layer. Along the faults, salt ridges of varying scales are imaged by modern broadband seismic data. The salt ridges extend sub-perpendicular to extensional faults and are associated with salt-rollers at their footwall. The orientation of the ridges suggests that those may serve as kinematic indicators for the fault movement. In order to shed light on the development of the salt ridges in context with the fault evolution, two end members are considered: (i) corrugation of the normal fault surface and (ii) mega-striations related to local fault discontinuities. Capturing these salt features is relevant for the assessment of post-salt fault kinematics, associated salt movement, and affects the top seal capability related to pre-salt hydrocarbon exploration. Studies on normal faults recognize corrugation of the fault plane as a result of linked fault segments while large scale corrugations are mostly attributed to syn-extension folding of the fault plane. The latter is controversial though strain compatibility would allow shortening perpendicular to the principal extension direction. Striations are common features along fault planes and are often amplified by mineralization of shadow zones behind local irregularities. In such situations, the salt ridges would represent secondary salt accumulations along the fault plane. The morphology of the analyzed salt ridges range from meters to 1000m in height relative to neighboring, sometimes welded synforms. The lateral extension of the ridges are in the kilometer range with an aspect ratio of 2:1 to 3:1. The ridges are linear in shape and appear symmetric in profile section. The salt ridges observed in the South Gabon Basin reach hundreds of meters to a kilometer in height and extend kilometers in longitudinal direction. The ridges are accompanied

by crestal normal faults, which are attributed to either reactive diapirism or tangential longitudinal strain in the cover sequences above the ridge crest. Post-salt sediments occupy the synforms between ridges where salt is frequently welded out. In the Santos Basin, salt ridges are tens of meters to hundreds of meters in height but still kilometers long. Salt serves as the immediate substratum beneath, and at low-angle extensional faults in salt basins while previous studies on fault morphologies focus on igneous or metamorphic domains. Salt is a mobile material sensitive to differential stress and its accumulation at salt ridge may be a proxy for the heterogeneous stress distribution along low-angle extensional fault systems. In this context the salt ridge morphology may provide insight into the stress distribution, associated drilling risk and improved assessment of hydrocarbon potential in exploration and development.