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Paleostress and paleoburial history of a post-rift, supra-salt, carbonate reservoir offshore Congo (Atlantic): Insights from calcite twinning and stylolite roughness paleopiezometry.

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Our understanding of the temporal variation of past stress in the crust is usually pictured in relation to tectonic contexts, where it helps decipher the evolution of deformation of rocks at different scales. The paucity of paleostress reconstructions in passive margins makes the knowledge of the origin of stress and of its evolution very incomplete, especially in poorly accessible offshore parts. Moreover, in salt-rich passive margins like the offshore Congo margin, one may question whether the state of stress in supra-salt formations is mainly controlled by salt tectonics, since the salt usually acts as a decoupling level that prevents the transmission and record of far-field crustal stresses. This study focuses on the analysis of an offshore wellbore core of the Albian, post-rift carbonates of the Sendji Fm that directly overlies the salt of the Aptian Loeme Fm in the Lower Congo Basin. Paleopiezometry based on stylolite roughness and mechanical twins in calcite was combined with fracture analysis, laser U-Pb dating of calcite cement, and burial modeling to unravel the tectonic and burial evolution of the Sendji Fm over time. The results of bedding-parallel stylolite roughness inversion constrain the range of depth over which the Sendji Fm strata deformed under a vertical principal stress s_1 to 650-2800 m (median ~1100m). Projection of this depth range onto the Sendji burial model derived from TemisFlow™ basin modelling indicates that pressure solution was active from 105 to 12 Ma. Inversion of calcite mechanical twins measured within the early diagenetic cement (U-Pb age = 100 +/- 1Ma) yields two main states of stress: (1) an extensional stress regime with a horizontal σ_3 trending ~E-W associated with sub-perpendicular N-S compression, and (2) a strike-slip stress regime with a horizontal σ_1 trending ~E-W (changing from pure E-W compression to N-S extension through stress permutations). We interpret the former state of stress as local and related to the complex geometric interactions between moving halokinetic normal faults, while the latter presumably reflects the push effect of the Atlantic ridge, which prevailed from 12 Ma until present-day. Our results highlight that the stress history of the studied part of the offshore Lower Congo Basin passive margin has first been mainly dominated by burial and local normal faulting related to late Cretaceous to Miocene post-rift salt tectonics, then by a regional stress presumably

originated from the far-field ridge push from ~12Ma onwards, which would indicate some mechanical re-coupling between the crust and the sedimentary cover during the Miocene.

Keywords: stress, paleopiezometry, calcite twins, stylolites, passive margin, salt.