Diachronous Minibasin Welding Controls Hydrocarbon Migration and Trapping

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Abstract

Minibasins are important hydrocarbon targets holding a significant amount of natural resources. However, current models of minibasin evolution do not fully address the 3D structural and stratigraphic complexity thus hinder effective exploration in related settings. Using high-quality seismic data from the Lower Congo Basin, offshore Angola, we integrate time-structure and time-thickness map and cross-section analysis to demonstrate the complex tectono-stratigraphy of the minibasins and associated salt tectonics. After a quiescent stage of the Albian, when the salt tectonic activity was limited, minibasin initiated in Cenomanian as a normal-fault bounded depocentre. As the Cenomanian depocentre welded, the depocentres shifted along strike toward the southwest from Turonian to Coniacian until the salt was largely expelled in the east. The new depocentres subsequently migrated across strike to the west where salt was still available. During the migration process, the salt-cored structures under the minibasin also gradually formed. Later, as the western depocentres welded again, the next generation of depocentres migrated further toward to the flanks of the minibasins, forming turtle structures. Only when regional tilting and contraction took over in Miocene, the uprising salt walls confined the depocentre and forced them to migrate from the west to the east. The study shows that the salt weld is not only a result of minibasin maturation but also an important control on depocentre migration, shaping the geometry of the minibasins. Consequently, the distribution of sedimentary systems within the minibasin are also strongly influenced by salt welding processes. Moreover, as the salt weld may act as hydrocarbon pathways due to the thin or absent salt, the time-protracted and location-shifting of salt weld

over tens of million years in various locations indicates the process of hydrocarbon migration through salt weld into overlying minibasin can be temporally and spatial complex and hard to predict. Therefore, a detailed analysis of minibasin stratigraphy and its associated welding processes are pivotal to better constrain the reservoir distribution and hydrocarbon migration in minibasins.