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Crustal stretching, pre-salt tectono-stratigraphy and early salt movement in the Lower-Congo and Kwanza Basins offshore Angola

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As Exploration offshore Angola ventures into Ultra Deep Water (UDW) areas, the post-salt overburden thins and maturation of post-salt source rocks becomes increasingly risky. On the other hand shore petroleum systems in Angola are sourced from pre-salt lacustrine sources. If pre-salt source is present also in the UDW area, it may form the basis for working petroleum systems where post-salt source is immature. Seismic data of 10 stwt or more record length have the potential to map the pre-salt tectono-stratigraphy beneath the UDW areas. However, seismic imaging of the pre-salt on these data is generally very poor, and targeted reprocessing is necessary.

Here we use reprocessed 2D seismic data across a rare "seismic window" on the pre-salt strata in the UDW in the southern Lower Congo Basin offshore Angola, to interpret the pre-salt and immediate post-salt tectono-stratigraphic evolution and divide it into phases as follows:

Pre-salt phase 1: Initial rifting. Formation of half-grabens. Sedimentation kept up with accommodation space.

Pre-salt phase 2: Main rift event. Strong tilting of underlying layers. Major paleobathymetric/topographic relief formed. Some evidence exist for magmatism associated with this event: (i)A seismic sequence thickest on the crest of a half-graben and thinning towards the foot-wall fault, is interpreted as possible volcanic rocks. (ii)A deep (9 stwt) intra-crustal reflector may also be of magmatic origin. Otherwise little sediment accumulated in the half-garbens during this period, indicating a short duration of the main rift event. Crustal extension by a factor of ca. 2.5 - 3, fits the estimates for present tectonic subsidence along the studied line, and most of this extension occurred during this phase.

Pre-salt phase 3: Infilling of the half-graben relief formed during phase 2. Seismic sequences onlapping hanging-wall block and foot-wall fault. Small or lacking present rotation of these layers indicates that they were deposited after the main rift phase.

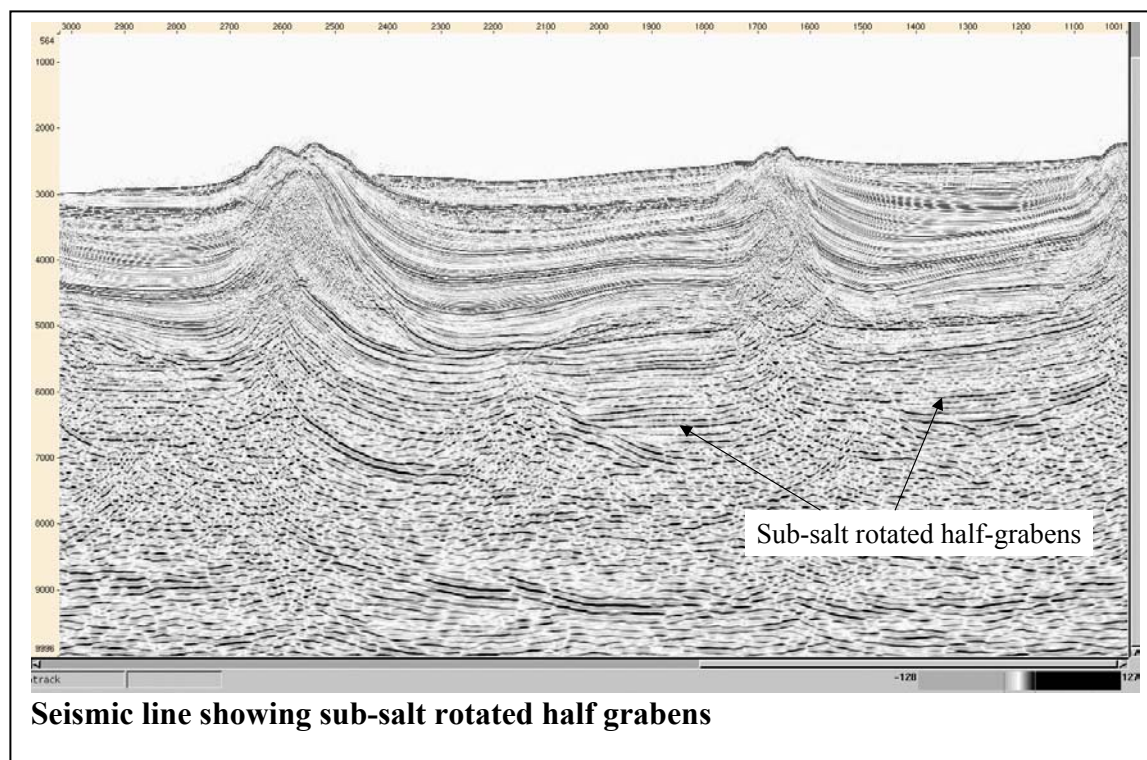
Pre-salt phase 4: Represented by a more regional "sag" type seismic sequence deposited after the half-grabens were filled in. This was a period of relative tectonic quiescence.

Post-salt phase 1: Based on 3D seismic data in the southern Lower Congo basin, it is inferred that salt started to move immediately after deposition. Large salt pillows probably existed as "islands" in the immediate post-salt (carbonate?) deposits.

Except for the Aptian salt, the age and temporal relationships of the mapped sediments are not known for lack of well control. However, the observed tectono-stratigraphy fits well with tectono-stratigraphy established in the near-shore areas of Angola, where well control exists. Using this analogy, pre-salt phase 1 correspond to the Lucula Fm; pre-salt phase 2 correspond to the main rift and magmatic event; pre-salt phase 3 correspond to the Bucomazi Fm with its rich

source potential; pre-salt phase 4 correspond to the Cuovo and Chela Fm; whereas post-salt phase 1 correspond to the early Pinda carbonates. The main rift episode probably occurred in the late Neocomian.

Assuming that the analogy to the near-shore tectono-stratigraphy is valid, it is likely that pre-salt petroleum-systems exist or existed in the UDW area offshore Angola. In particular the thick sequences analogous to the Bucomazi and Cuovo Fms suggest the presence of ample source rock. On the other hand timing of maturation of these strata may be critical because of rapid early burial during the early post-rift period with high heat-flow. In this context the distribution of eventual underplated magmatic bodies may also be important



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