The role of pre-existing basement structures during rifting: examples from the Suez, East African and Recôncavo-Tucano rifts and the Canyonlands National Park, USA.

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A long-standing question in the formation of rift basins is the role of pre-existing brittle and ductile structures in underlying basement. In other words, to what extent do basement structures and fabrics influence or control the location, distribution, orientation and growth of rift-related normal faults, and thereby the overall rift geometry and petroleum distribution.

In this work we present the result of basement lineament interpretation based on remote-sensing data from the eastern basement shoulder of the Oligo-Miocene Suez Rift, and compare these results to the structural trends observed in the rift basin itself. In particular, we have focused on the trends of faults and dikes in the basement that are fairly straight lineaments at the scale of satellite images, with preferred orientations that are presented by means of rose diagrams. The rift faults that formed in the pre- to syn-rift sequence in the Suez rift are on average oriented parallel to the rift axis, but show many abrupt steps with subordinate segments or steps with odd orientations that closely match the trends of the basement lineaments. This produces very angular fault traces in map view that we attribute to basement reactivation during fault segment linkage.

Similar angular fault traces are seen in the East African rift system where a combination of basement fabrics and brittle faults and fractures are reactivated. Examples from the Chow Bahir basin, South Ethiopian rift illustrate well how angular or zig-zag fault pattern can emerge from the exploitation of basement structure.

Similar examples are found in the Grabens area of Canyonlands National Park in the USA. In this case graben formation occurs in a 500 m thick layer of jointed sedimentary sequence resting on a ductile evaporite layer. Two sets of joints guide the formation of steep extensional faults related to gravity-driven salt movements, again creating zig-zag fault patterns, particularly in areas of fault interaction and graben stepovers.

Rift-scale transfer zones are also controlled by basement structures in many cases, although sometimes in a more diffuse way. A well-known Brazilian example is the transfer zones of the Recôncavo-Tucano rift, where ductile fabrics or shear zones in the basement control more diffuse transfer zones. The rift setting resembles that of the Suez rift, where the Sinai microplate at the northern end of the Red Sea was rotated counterclockwise and later abandoned in favor of activity farther east.

Our conclusion is that preexisting basement structures can have rather profound influence on the location and geometry of rift-related faults, although the actual effect will depend on the orientation, dip, strength, continuity and size of the preexisting structure.

Key-Words: Fault reactivation; preexisting structures; rifting; basement inheritance