Borehole Breakout Analysis Characterizes Present-Day Stress Field in the Alboran Sea and the Betics

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We select a group of 12 data sets coming from commercial and scientific wells drilled through the main geological domains of the north branch of the Gibraltar Arc to characterize the present-day stress field. We established the orientation of breakouts using data coming from the four-arm caliper tool. Zones of wellbore enlargement were recognized in 11 of the 12 selected wells to depths up to 3450 m. Mean orientation and standard deviation of breakouts at each well have been used to assess the borehole quality following ranking criteria of the World Stress Map (WSM).

Stress inversion performed in these wells evidences that maximum horizontal stress (SHmax) tend to parallel coast strike, resulting in a roughly E-W orientation along the northern margin of the Alboran Sea. In some wells, it is observed local stress rotations that can be correlated with discrete active fault zones or interbedded salt layers.

These data have been gathered with other stress indicators to reconstruct the present-day tectonic stress in the region. The Gibraltar Arc shows a complex stress pattern with major rotations with respect to the stress field imposed by the ongoing Africa-Eurasia convergence. Differential stress rotations are deeply controlled by crustal structure and by differential loading imposed from the high sediment thickness in basin depocenters.

With these results we expect to add valuable data for establishing the nature and partitioning of deformation in the Gibraltar Arc. However, further work deserves to be done in the Rif region and in the southern Alboran Sea, where some oil well data are matter of potential interest since they may help to better constrain the present-day deformation processes in the western Mediterranean.

Key words: borehole breakouts, stress field, stress rotations, active tectonics, Gibraltar Arc.