

Highlighting geological structures under deep coverages using morphostructural analysis of SPOT 5 HRG imagery and associated DTM

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Discovery of new oil fields requires geological exploration of areas facing increasingly hard access. On shore, presence of recent sedimentary deposits over large areas is a significant hindrance to the acquisition and interpretation of underlying formations structural data. This information is essential to a proper understanding of the geological context (prior to geophysical survey and interpretation). With DTM and optical remote sensing data, most authors consider that in such difficult areas, sedimentary deposits forbid to get more than subsurface information and neotectonics events, and not the deeper structures. Our work, based on Spot 5 HRG imagery and associated DTM morphostructural analysis, ensure to fill this lack.

In the context of deep storage sites investigation in France, and oil deposits in North Africa, morphostructural analysis of satellite imagery shows that the expansion limits and dune shapes are constrained by structural geometry of the substratum. In the first case, the sand had settled on a peneplain with very low relief contrasts. In this area, parabolic dunes are the oldest and the furthest from the shore. They are put in place during rhexistasy period, under the influence of sea winds coming from the West. The maximum edge extension draws regular curves. This geometry emphasizes the residual relief's presence on which the sands will flatten. The parallel deposit alignments coincide with the organization of the hydrographical network, characteristic of very low amplitude folds. The sand distribution appears inherited from periclinal endings. In the North Africa deserts, the major obstacle to the structural interpretation is the wind deposit thickness. In areas not covered by sands, ground irregularities are important and mostly associated with the fault throw which builds up horst and graben structures. The only relief on the erg is set up by the different dune morphologies. A systematic cartographic restitution of dunes ridge lines shows torsions drawing regular alignments. They extend over long distances and connect, on the erg edge, with the substratum structures. Orientations and distribution coincide. On ergs, these morphological structures appear to inherit from deep paleoreliefs linked to the differential erosion or tectonic shifts disrupting the surface where the sands were deposited.

The morphostructural analysis of the Spot 5 HRG imagery and DTM contribution is an necessary complementary approach to traditional exploration methods. It highlights the tectonic deep structure geometries. This approach has been confronted and validated with multispectral interpretations (near infra-red and thermal) using Landsat and Aster imageries. In order to optimize time and cost, that interpretation has its best potential prior to upstream geophysical data acquisition phases.