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Surface manifestations of the Ghawar Structure, Saudi Arabia

The Ghawar anticline is approximately 225-kilometer long and 25-kilometer wide in the subsurface, but the surface structural expression is not clear. Identifying subtle structural imprints in the young Mio-Pliocene sedimentary cover is therefore of great importance in developing a structural model for the Ghawar field.

The Ghawar area, between the Jafurah sand desert to the east and the Rubayda (Dahna) sand deserts to the west, is characterized by a rougher topography when compared to the surrounding rather smooth, flat areas. This rough geomorphology of the structure can also be noticed on the satellite images. A geomorphologic elevation map of the area and a subsurface structural contour map of the top Arab-D (Upper Jurassic) reservoir reveal very similar geometric shapes.

Calcareous sandstone deposits of the youngest Hofuf Formation (Mio-Pliocene) cap the structural highs along the axis of the anticline and spectacular fractures including caves, mesa hills, and monumental geomorphologic features have developed in the escarpments. Fractures in the Dam Formation (Middle Miocene) are not so conspicuous as in the Hofuf Formation, but indigenous fractures are recognized in this formation. A match between the directions of some topographic lineaments and projected surface traces of subsurface faults from seismic cross sections, is also observed. However, at the field locations, faults have yet to be defined on the surface.

Surface indications suggest that the structure has been active until the present day. Elevations of a bedding plane on the Shedgum plateau reveal a 0.25-degree dip angle, which cannot be distinguished on the surface by the human eye. The movements that occurred during the 4 million years since the Pliocene period reveal an average tilting of 0.06 degree per one million years.