# The Al-Kahfah Anticline: an Outcrop Analog for Paleozoic Structural Folds in Saudi Arabia

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## Abstract

In Saudi Arabia, Paleozoic structural folds evolved as a result of several compressive tectonic episodes, on local basement fabric, from the Carboniferous through to the Tertiary. These structural folds are widely distributed, from the offshore Arabian Gulf in the east, to the area adjacent to the basement outcrops in the west where the Al-Kahfah anticline study area is located. This study describes the Al-Kahfah anticline in terms of remote sensing, geophysical and outcrop data and serves as an outcrop analog for subsurface structural folds. This outcrop, ground-truthed interpretation, of geophysical data serves as a guide for geophysical interpretation of buried structural folds. The Al-Kahfah anticline is located in the northern part of the Qasim region of Central Saudi Arabia. Analysis of satellite images and field mapping of the Al-Kahfah area has helped to unravel the geometry of the anticline and the outcropping faults. The alternating thinly bedded ductile shale and sandstone sequences of the Upper Ordovician Qasim Formation forms the flanks of the 30-kilometer long, north-south oriented, doubly plunging structure. The Upper Ordovician to Lower Silurian glacial sandstones of the Sarah and Zarqa formations in the northwestern corner of the Al-Kahfah area exhibit complex reverse and strike-slip faulting. The anticline has been interpreted to be the result of a positive tectonic inversion that has resulted in simultaneously brittle and ductile compressional deformation, due to heterogeneity in mechanical properties of the Lower Paleozoic Qasim, Sarah, and Zarqa formations. Potential field data indicate the presence of a gravity high east of the anticline, where the steeper limb of the Al-Kahfah anticline supports the positive inversion model. This study demonstrates that potential field data on the Al-Kahfah anticline can be used to interpret the structural evolution in the study area. In addition, potential field data can be used as a useful exploration tool in basins that are only covered by sparse 2D seismic data. Furthermore, the observed heterogeneous distribution of faults and fractures in the anticline can be related to the overall structural geometry, and can be used by analogy to optimize well locations in fold structures mapped on 3D seismic.