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Structural modeling of the Zagros fold-and-thrust belt (Iraq) combining field work and remote sensing techniques

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The Zagros fold-and-thrust belt is known for its spectacular fold trains, which have formed in detached Phanerozoic sedimentary cover rocks above a shortened crystalline Precambrian basement. Orogeny evolved through the Late Cretaceous to Miocene collision between the Arabian and Eurasian plate, during which the Neotethys oceanic basin was closed. Still active deformation shortening in the order of 2-2.5 cm/yr is partitioned in S-SW directed folding and thrusting of the Zagros fold-and-thrust belt and NW-SE to N-S trending dextral strike slip faults. The sub-cylindrical doubly-plunging fold trains with wavelengths of 5 – 10 km host more than half of the world's hydrocarbon reserves in mostly anticlinal traps.

In this work we investigate the three dimensional structure of the Zagros fold-and-thrust belt in the Kurdistan region of Iraq. The mapped region is situated NE from the city of Erbil and comprises mainly Cretaceous to Cenozoic folded sediments consisting of mainly limestones, dolomites, sandstones, siltstones, claystones and conglomerates. Although the overall security situation in Kurdistan is much better than in the rest of Iraq, structural field mapping was restricted to sections along the main roads perpendicular to the strike of the fold trains, mainly because of the contamination of the area with landmines and unexploded ordnance, a problem that dates back to the end of World War Two. Landmines were also used by the central government in the 1960s and 1970s in order to subdue Kurdish groups. During the 1980-1988 Iran-Iraq War, the north was mined again.

In order to extend the structural measurements statistically over the investigated area resulting in a three-dimensional model of the fold trains, we used the Fault Trace module of the WinGeol software (www.terramath.com). This package allows the interactive mapping and visualization of the spatial orientations (i.e. dip and strike) of geological finite planar structures (e.g. faults, lithological contacts) from digital elevation models. The minimum vegetation cover in the investigated area allows an accurate picking of geological planes from the digital elevation model, which has been draped with LANDSAT and ASTER satellite images in order to enhance the contrast of lithological contacts. Geological planes of finite extent are interpolated in the Fault Trace module by virtual planes, which can be translated and rotated in any spatial direction. Comparison of measured data from the field with interpolated spatial orientations from the remote sensing data demonstrate that the calculated dip and strike values can be reproduced within the measurements error of a geological field compass.