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Quantification of fold growth of frontal antiforms in the Zagros fold and thrust belt (Kurdistan, NE Iraq)

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The Zagros fold and thrust belt is a seismically active orogen, where actual kinematic models based on GPS networks suggest a north-south shortening between Arabian and Eurasian in the order of 1.5-2.5 cm/yr. Most of this deformation is partitioned in south-southwest oriented folding and thrusting with northwest-southeast to north-south trending dextral strike slip faults. The Zagros fold and thrust belt is of great economic interest because it has been estimated that this area contains about 15% of the global recoverable hydrocarbons. Whereas the SE parts of the Zagros have been investigated by detailed geological studies, the NW extent being part of the Republic of Iraq have experienced considerably less attention.

In this study we combine field work and remote sensing techniques in order to investigate the interaction of erosion and fold growth in the area NE of Erbil (Kurdistan, Iraq). In particular we focus on the interaction of the transient development of drainage patterns along growing antiforms, which directly reflects the kinematics of progressive fold growth. Detailed geomorphological studies of the Bana Bawi-, Permam- and Safeen fold trains show that these anticlines have not developed from subcylindrical embryonic folds but they have merged from different fold segments that joined laterally during fold amplification. This fold segments with length between 5 and 25 km have been detected by mapping ancient and modern river courses that initially cut the nose of growing folds and eventually got defeated leaving behind a wind gap. Fold segments, propagating in different directions force rivers to join resulting in steep gorges, which dissect the merging fold noses. Along rapidly lateral growing folds (e.g. at the SE end of the Bana Bawi Anticline) we observed “curved wind gaps”, a new type of abandoned river course, where form of the wind gap mimics a formed nose of a growing antiform. The inherited curved segments of uplifted curved river courses strongly influence the development of the drainage system. This new model helps to detect embryonic fold segments of subcylindrical folds, which are otherwise difficult to identify.