



## Geomorphology and Geometry of the Khanuga Anticline, Northern Iraq

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### Abstract

The Khanuga anticline is significant for understanding geological processes in northern Iraq's Low Folded Zone, about 90 km east of Salah Al-Din Governorate. The Khanuga anticline is characterized by its double-plunging form, with its axis aligned with the Zagros trend. This study aims to conduct a geomorphological and geometric analysis of the Khanuga anticline using field data and a stereonet diagram for each traverse. In addition to prepare a geological map and stratigraphic section for the study area. Three selected traverses perpendicular to the fold axis and nineteen stations were selected based on the availability of outcrops because most of the rocks are covered by recent deposits. Field and office measurements proved that the southwestern limb dips more than the northeastern limb; this fact may be attributed to the effect of the Khanuga anticline by the foreland listric fault, which plays an active role in the determination of the fold location and its form. The study presented that the Khanuga anticline exhibits a parallel style and is formed by a combined neutral surface and flexural-slip mechanism. The region is categorized by numerous geomorphological features of structural, denudation, and fluvial origin, which have been observed in the field. This study came to conclude that the Khanuga anticline formed as a result of regional horizontal stress in the northeast-southwest direction in the Late Miocene-Pliocene and is related to the second stage of the Alpine Orogeny. The fold geometry was described as asymmetrical, gentle, linear, horizontal, and upright, based on the structure parameters: limbs, fold axis, axial plane, hinge line, and interlimb angle.

**Keywords:** Khanuga anticline; Listric fault; Flexural slip surface; Neutral slip surface; Fold geometry; Geomorphological features

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### 1. Introduction

The Zagros Fold-Thrust Belt is recognized as one of the most significant continental collision zones, resulting from the convergence of the Arabian and Iranian plates since the Eocene epoch (Jassim and Goff, 2006). In Iraq, this belt is characterized by a series of elongated synclines and anticlines that form the Low Folded Zone. Deformation in this area is primarily controlled by thin-skinned tectonics, with localized influences from the underlying basement (Garzic et al., 2019).

The Zagros Fold-Thrust Belt's Low Folded Zone includes the Khanuga anticline. With softer slopes on one side and steeper limbs on the other, the anticline is asymmetrical (Sissakian et al., 2022).

As is typical in the area, the anticline is also likely a detachment fold. Detachment folds form when a layer of rock separates from the underlying strata, producing folds with a specific shape. Studies of the Korek and Pirat anticlines, which are also part of the Zagros Belt, have demonstrated the presence of detachment folds in the area (Sissakian et al., 2022). GIS has been used as an additional tool in