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Seismic study of pull-apart-induced sedimentation and deformation in the Northern Gulf of Aqaba (Elat)

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Abstract

New multichannel seismic and bathymetric data are presented, which clarify the Plio-Quaternary evolution of the northern Gulf of Aqaba (Elat) and the Dead Sea Transform (DST). The seismic data reveal two main seismic sequences, a lower (pretectonic) and an upper (syntectonic) unit, separated by a prominent unconformity. These units are each linked to a distinct tectonic phase in the history of the DST. Parallel horizons and an undisturbed internal structure point to a tectonic quite time or pure strike-slip without extension or compression during the first (pretectonic) phase. The second (syntectonic) phase, which begins in the early Pliocene, is characterized by a major change in the activity of the DST. The pretectonic sedimentary unit subsided and, consequently, dips southward with a supplementary inclination to the east. The coeval sedimentation of the syntectonic unit is recorded by the divergent reflection pattern and onlap terminations on the unconformity. The apparent fault system seems to be rearranged in the second phase. The stepover of the main strand of the DST from the eastern side of the Elat Deep to the western side of the northern Gulf of Aqaba was mapped in detail for the first time. The very smooth shape of the stepover and the apparent lack of extensional tectonics do not fit with the classical pull-apart basin model for the Elat Deep and point to a decoupling of the crystalline basement from the sedimentary overburden. Comparisons of the new geophysical findings with analog models support this assertion.

Keywords: Dead Sea transform; Pull apart; MCS data; Bathymetric data

1. Introduction

The Dead Sea Transform (DST), also called the Dead Sea Rift, is one of the main tectonic features in the Middle East, as part of the Red Sea Rift system. It is a continental plate boundary separating the Arabian Plate from the Sinai Sub-Plate (Fig. 1A), originating at the Red Sea Rift in the south and terminating after approximately 1200 km to the north, at the continental collision zone of the Taurus Zagros orogenic belt. About 105 km of left lateral displacement is documented along the DST (e.g., Quennell, 1959; Freund

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