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Structural evolution of the Kopet Dagh fold-and-thrust belt (North-East Iran) and interactions with the South Caspian Sea Basin and Amu Darya Basin

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We present a detailed stratigraphic and structural study of the Kopet Dagh fold-and-thrust belt in NE Iran, which is an investigation of the complex polyphased tectonic history of this belt and its links with the adjacent South Caspian Sea and Amu Darya basins. Based on numerous field surveys, a large amount of 2D and 3D seismic data, borehole data and more than 150 new biostratigaphic datings, a new detailed biostratigraphic chart and 4 main regional cross-sections illustrate the importance of lateral facies variations and structural inheritance in the present-day structure of the belt.

After the Cimmerian orogeny corresponding to the closure of the Paleotethys Ocean in Late Triassic-Early Jurassic times, a post-collisional rifting event was associated with the deposition of one of the main source rocks of the Kopet Dagh and the Amu Darya Basin (Kashafrud Formation). Following this rifting event, over 7 km of sediments were accumulated until the Tertiary above a regional post-Triassic unconformity. The occurrence of local uplifts during the Late Cretaceous-Early Paleocene is interpreted as a consequence of regional-scale modification of plate-slab coupling in the Neotethys subduction zone. The structures associated with the Late Eocene/Oligocene folding phase are sealed in the western part of the belt by a major Eocene-Oligocene unconformity at the base of the thick sedimentary series belonging to the South Caspian Sea Basin. The rapid subsidence of the South Caspian Sea Basin is probably related to syn-compressional downward flexure of the resistant basement basin at the onset of the Alpine phase. In the eastern part of the Kopet Dagh, this deformation is characterized by Middle Jurassic graben inversion with evidences of forced-folding, short-cuts and present-day slip partitioning, and as well by larger scale basement uplift. In contrast, the northwestern part of the belt shows thrust faults involving basement and fault-propagation folds within the sedimentary sequence. The Kopet Dagh presents an arcuate shape that follows the Paleotethys suture zone, which emphasizes the importance of the structural inheritance and inversion processes in the present-day structures. Finally, a change from a mostly dip-slip to a mostly strike-slip tectonics occurred during the Pliocene within the Kopet Dagh as a consequence of a major tectonic reorganization in NE Iran.