

## **Tectonostratigraphic Evolution of the Upper Cretaceous-Eocene of Jordan (Southern Neotethys Margin)**

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### **Abstract**

Combining for the first time extensive outcrop and subsurface stratigraphic data a revised tectonostratigraphic model of the Ajlun and Belqa Groups (Upper Cretaceous-Eocene) in Jordan is proposed. The results of this revision allow precise dating of the initiation and evolution of the NW-SE trending Hamza Graben as Santonian- early Campanian, which makes it time equivalent to the Euphrates Graben in Syria and the Anah Graben in Iraq, as well as to the tectonic obduction phase recorded along the Arabian Plate margins in W. Iran and Oman at that time.

The Ajlun (Cenomanian – Early Coniacian) and Belqa (Late Coniacian – Eocene) groups of Jordan contain a remarkable succession of sedimentary lithofacies, including shallow water limestone, chalk, sandstone, chert, phosphorite and organic-rich marls deposited along the passive southern margin of the Neo-Tethys Ocean. In western Jordan, the Ajlun and Belqa groups outcrop in spectacular wadis along the Aqaba-Dead Sea Transform where they can be studied in detail. Using sequence stratigraphic principles combined with new nannofossil age dating, C/O and Sr isotope stratigraphy, the stratigraphic interpretation of this succession has been refined. Due to the strong variations in lithology and sedimentation pattern, the formations defined at outcrop can be correlated with confidence to well logs and seismic lines in the subsurface. The established stratigraphic framework allowed for the construction of isopach maps, at the group and formation scale.

In southern Jordan, the Ajlun and Belqa groups are characterized by a progressive northward thickening and deepening trend. This suggests a tectonically relatively stable area along the southern Tethyan margin. North- eastern Jordan shows a similar progressive northward thickening trend for the Ajlun Group, testifying of the continuity of this tectonically stable area at that time. This pattern changes dramatically in the Late Coniacian- Early Campanian (lower part of the Belqa Group), when the northwest-trending Hamza Graben in central Jordan, created extra accommodation space in the order of 1800m across a half graben width of 35 km. This half graben extends south-eastwards to the Wadi Sirhan Graben in northeastern Saudi Arabia, and in a northwest direction to the Syrian Arc. Based on thickness trends and growth-strata depicted in seismic imagery, the main extension phase of the graben occurred during the Lower Campanian (Amman Silicified Limestone Fm.), mainly characterized by 1300m of chert-rich dolomites and limestones. The overlying phosphate-dominated Upper Campanian sequence (Al Hissa Phosphorite Fm.) is relatively uniform in thickness all over Jordan, marking a return to a regionally stable tectonic regime. The overlying organic-matter rich sequence (Muwaqqar Chalk-Marl Fm.) shows, again, a slight thickening trend across the Hamza Graben, indicating renewed subsidence within the Hamza Graben.

The improved age dating of the evolution of the Hamza Graben in Jordan, has enabled its orientation and timing to be placed in the broader context of the change from passive to active margins along the eastern and southern margins of the Arabian Plate at that time, and provides new insights in the local, intra-plate behavior during this major tectonic event. This synthesis also demonstrates the contemporaneous creation of the petroleum plays in these graben structures.