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Architecture of Deltaic Bodies Affected by Growth Faulting: Examples from the Bílina Delta (Neogene, Most Basin, Czech Republic)

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Growth faults are the most common deformation structures found in the sedimentary record of deltaic depositional systems. The knowledge of their geometry and architecture of delta bodies affected by growth faulting has implications for the studies of oil reservoir geometry and heterogeneity, as well as of the general controls on stratigraphic architecture.

The Early Miocene Bílina Delta is package of a fluvio-deltaic clastics deposited at the southeastern margin of the Most Basin, one of the sub-basins of the Ohře Rift basin system in North Bohemia. The Bílina Delta is interpreted as a lacustrine, fluvial-dominated, mouth-bar – type delta, with distributaries terminated by friction-dominated mouth bars, mostly with a Gilbert-type profile and a fan-like plan-view shape, characterized by steep, sandy foresets.

Growth faulting was the most important deformation process which affected the Bílina Delta depositional system. The resulting structures are faults characterized by listric fault planes and systematic stacking of a number of mouth bars on the hangingwall side. The delta bodies affected by growth faulting are characterized by large thickness and pot-like shape in cross sections oriented perpendicular to the direction of mouth bar progradation. The growth faults occur in delta bodies which are affected by synsedimentary tilting of the basin floor, or in delta bodies underlain by thick accumulation of lacustrine clays and/or a coal seam. Therefore, two main triggering processes are considered for the onset of growth faulting: (i) gravity sliding induced by basin-floor tilting, (ii) loading of thick units of mobile material. Combination of both processes is common. Generally, the fault slip magnitude and the number of vertically stacked mouth bars depended on the thickness of underlying mobile material. Because of the strong curvature of the listric fault planes, the marginal parts of growth faults are commonly aligned oblique to parallel to mouth bar progradation. Local accommodation was created due to the rotation of the subsiding hangingwall and resulted either in strong aggradation of topset strata, thickening (diverging) towards the growth fault plane, and in the formation of new mouth bars which show a basinward decrease in thickness. Whether topsets aggraded or a new mouth bar formed, depended on the ratio between the rate of deformation (subsidence) and rate of sedimentation. During progradation of an individual mouth bar, subsidence was compensated by aggradation of the topsets. The space for a new mouth bar was created during episodes of nonsedimentation which resulted from fluctuations of sediment supply. Rotation of the hangingwall side caused backtilting of the older mouth bars towards the fault plane and thus a decrease in slope of the foresets of the older mouth bar. This resulted in downlap of foresets of younger mouth bars on the backtilted fronts of older mouth bars.

Localized subsidence induced by growth faulting was an episodic process. Individual subsidence events began as a consequence of loading by deposits of a new mouth bar. The general architecture of the sedimentary packages affected by growth faulting is characterized by a decrease of mouth-bars thickness from older to younger strata, in response to a slowing subsidence, caused, in turn, by the decrease in growth fault displacement. Generally, the main phase of growth faulting is dominated by vertical stacking of new mouth bars, whereas the later faulting episodes are characterized by low displacement magnitude and the rate of creation of accommodation sufficient only for topset aggradation.