Response of a Fluvial Depositional System to Unequal Compaction of Underlying Peat (Neogene, Most Basin, Czech Republic)

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In coal-bearing basins, compaction of peat can play a significant, but as yet not fully explored, role in the behaviour of depositional systems. The Most Basin in the northwestern part of the Czech Republic, one of several sub-basins of the Ohře Rift (Eger Graben) of Central Europe, is characterized by the occurrence of an extensive coal seam near the base of the basin fill, overlain by tens to hundres of metres of clastic strata, with a wide range of resulting compactional phenomena.

Our study focuses on a fluvial system in the eastern part part of the so- called "Žatec Delta", the largest clastic depositional system of the Most Basin. Fluvial deposits exposed in the open-cast mine Hrabák (owned by MUS, a.s.) represent a relatively narrow, elongate body of clastics, lenticular in cross-section, enclosed within the main coal seam of the Most Basin.

Three main facies associations (architectural elements) occur in the studied part of this fluvial body and are interpreted as (i) channels and channel belts, (ii) lobes of splay deposits, (iii) sheets of floodplain deposits. Typically, the geometry of the architectural elements is dominated by syndepositional rotation of originally horizontal strata. This is interpreted as caused by localized differential subsidence induced by unequal compaction of underlying peat. With increasing compaction of peat loaded by fluvial clastics, the rate of subsidence at a particular location decreased and the locus of deposition migrated laterally toward the peripheries of the clastic system, where a potential of forming accommodation by compaction still existed. This gradual, outward shift of compaction-driven accommodation zones caused gradual lateral accretion of the whole depositional system, well-documented by the highwalls in the Hrabák mine, orientated oblique to almost perpendicular to palaeoflow.

At the scale of individual architectural elements, a typical effect of syndepositional tilting is the divergence of strata towards zones of higher rates of compactional subsidence, well-exemplified by sheet-like bodies of flood-plain fines and some packages of crevasse splay deposits. The patterns of migration of fluvial channels in time are a very sensitive indicator of spatial and temporal changes in local accommodation due to differential compaction. Three basic channel migration patterns were distinguished which differ in the ratio between the rates of deposition (Vd) and subsidence (Vs):

1) simple lateral migration - formation of a channel belt approximately parallel to surrounding strata, (Vd >> Vs);
2) simple aggradation of channels, exposed as thick and narrow sandstone bodies in cross-section, (Vd = Vs);
3) oblique aggradation, a combination of lateral migration and aggradation during the channel activity, (Vd > Vs). Resulting channel-belts are oblique to general stratification.

During the lifetime of an individual channel system, its migration pattern could have changed several times as the channel migrated across places with different rates of compactional subsidence or in response to subsidence evolution of one place. Although geologically instantaneous avulsions of channels, interpreted as caused by floods, are also documented in the Hrabák mine, peat compaction was the main control of the channel migration patterns, as well as on the overall geometry of the whole depositional system.

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Effects of Tectonic- and Compaction-driven, Syndepositional Tilting in the Architecture of a Rift-margin Deltaic Complex: the Bílina Delta (Neogene), Most Basin, Czech Republic

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Although the changes in architecture of clastic strata are generally attributed to the interplay of sea/lake-level changes, subsidence, and sediment supply, there are many other factors which can exert a profound influence on stratigraphic geometries. The aim of our contribution is to highlight the roles of fault--propagation folding and compaction in tilting the basin floor at the margin of an extensional basin and generating a wide range of responses in stratigraphic geometries of a lacustrine delta depositional system.

The Early Miocene Bílina Delta is a package of fluvio--deltaic clastics deposited at the southeastern margin of the Most Basin, one of the sub-basins of the Ohře Rift (Eger Graben) basin system in Northern Bohemia. The delta formed at the mouth of a river that drained into a shallow lake and its deposits overlie the main coal seam in this part of the basin and a package of lacustrine clays. Close to the Bílina Fault, which is one of the major basin-bounding extensional faults, the internal architecture of the deltaic system reflects a significant influence of syndepositional tilting, recorded as basinward divergence of originally horizontal strata, thickening of stratal units in the same direction, and tilt-induced growth faulting.

The divergence of strata is pronounced in the architecture of individual Gilbert-type and shoal-water mouth bars, as well as in the overall architecture of the deltaic strata in the cross-section normal to the fault strike. Within the Gilbert-type mouth bars, originally horizontal topsets show a significant basinward divergence over a distance of tens of metres, with the dip angle increasing towards older strata (up to 30 degrees), attesting to deposition of the mouth bar during gradual tilting. These individual mouth bars show increasing amalgamation towards the fault.

Growth faults observed in the deltaic strata adjacent to the Bílina Fault are interpreted as caused by gravity sliding induced by basin-floor tilting, because their heave to throw ratios (Morley and Guerin 1996) are relatively high. The growth fault planes are strongly listric, flattening in shallow depths where they pass into prodelta heteroliths which functioned as the zone of detachment. Local accommodation space formed due to rotation of the subsiding hangingwall and resulted either in strong aggradation of topset strata, thickening (diverging) towards the growth fault plane, or in the formation of complete new mouth bars showing a basinward decrease in thickness.

With respect to the position of the observed phenomena relative to the Bílina Fault, two causes of syndepositional tilting are possible. The first possibility is growth folding related to the propagation of the Bílina Fault (cf. Gupta et al. 1999). Formation of a growth monocline above the tip of the propagating fault was caused by deformation of ductile material above the fault before the fault plane breached the surface. In this case, the ductile layer important for the formation of the monocline was represented by a thick bed of peat, clays and heterolithic strata underlying the proximal deltaic deposits.

The second possibility is syndepositional tilting caused by differential compaction of the peat underlying the deltaic clastics. In the study area, the peat accummulated on a pre-depositional topographic slope inclined basinwards (Dvořák and Mach 1999), which caused the thickness of peat to increase downslope. From this resulted a basinward increase in the potential compaction-induced subsidence that could induce basinward tilting of overlying strata. The resulting tilt of stratal units of dimension comparable to the slope itself would not exceed the topographic slope angle (max. 20 degrees).

The majority of observed tilt-induced phenomena – basinward divergence of topsets, growth faulting induced by gravity sliding – occur only in close vicinity (less than 250 m) of the Bílina Fault, although the area potentially affected by compactional tilting is larger (400–500 m). The amalgamation of the topsets takes place always basinward of the Bílina Fault and the tilt of these topsets and other originally horizontal strata in this narrow zone often exceeds 20 degrees determined by the topographical slope. Therefore, we interpret growth folding induced by fault propagation as the main cause of the **small-scale** tilt-induced phenomena (of mouth-bar scale) in the deltaic deposits. This is also supported by the occurrence of syndepositional compressional and extensional fractures, characteristic of forced folding (Withjack et al. 1990; Withjack and Callaway 2000), near the Bílina Fault, and on the other hand, by the absence of similar phenomena in areas in greater distance from the Bílina Fault that were affected only by compaction. The compactional tilting is interpreted as the cause of the overall, **large-scale**, basinward divergence of stratal units observed over the whole area of the pre-depositional topographic slope. The rate of compactional tilting was not fast enough to cause the tilting at the mouth bar scale, because the fastest compaction had already taken place during deposition of lacustrine and prodelta sediments on the main seam.

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References

DVOŘÁK Z. and MACH K., 1999. Deltaic deposits in the Nort-Bohemian Brown Coal Basin and their documentation in the Bílina opencast mine. *Acta Universitatis Carolinae – – Geologica*, 43 (4): 633-641.

GUPTA S., UNDERHILL J.R., SHARP I.R. and GAWTHORPE R.L., 1999. Rolo of Fault Interactions in controlling synrift sediment dispersal patterns: Miocene, Abu Alaqa Group, Suez Rift, Sinai, Egypt. *Basin Research*, 11: 167-189.

WITHJACK M.O., OLSON J. and PETERSON E., 1990. Experimental Models of Extensional Forced Folds. *AAPG Bulletin*, 74 (3):1038-1054.

WITHJACK M.O., and CALLAWAY S., 2000. Active Normal Faultig Beneath a Salt Layer: An Experimental Study of Deformation Patterns in the Cover Sequence. *AAPG Bulletin*, 84 (5): 627-651.

Moravian Jurassic Geodes and their Geological Significance

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Moravian silica geodes occur “in situ” only in small relics of Jurassic platform silicified limestones near the village of Olomučany (the central part of the Moravian Karst). We know a few next localities of Jurassic limestones in the area of Brno but they do not contain geodes. Besides, the above mentioned primary occurrence, the largest geodes are already found in secondary position in younger sediments. The most attractive geodes come from the Rudice Formation – claystones with lenses of limonitic iron ores, quartz sandstones and chert gravels that originated by weathering especially of the Jurassic sediments under tropical conditions in the Lower Cretaceous. The Rudice Formation is situated just in the Jurassic limestones in the Moravian Karst. In addition to it, new finds of geodes have been ascertained in Neogene (Eggenburgian–Ottnangian) gravels of