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Deltaic Parasequences on Gamma Logs, Ultra-high Resolution Seismic Images and Outcrops of Lake Pannon Deposits

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The Late Miocene Lake Pannon got finally filled up by large deltaic systems (Bérczi & Phillips 1985), shaping wide morphological "shelves" in the lake. These developed mainly by accumulations of inner-shelf deltas passing repeatedly due to recurring floodings of former delta plains. In boreholes where only wireline logs and small cores are available delta front to delta plain deposits are assigned to Újfalu Formation (Juhász 1994). They also crop out in cliffs as Tihany Fm. along Lake Balaton (Müller & Szónoky 1990). In addition, their sedimentary architecture can be revealed by ultra-high resolution seismic images acquired on the recent lake.

The delta plain deposits are built up of 2–8 m thick coarsening upwards units, made up of cyclic repetition of marls, silts, sands and organic-rich clays, palaeosoils or thin lignite seams. The marls contain shell lag or shell-rich beds above the cycle boundary consisting of typical "caspi-brackish" fauna indicating a connection towards the open lake, but also showing the influence of freshwater input (i. e., *Congeria balatonica*, *C. triangularis*, *Dreissena auricularis*, *Lymnocardium decorum*, *L. apertum*, *L.* cf. *penslii*, *L.* cf. *secans*, *Prosodacnomya* sp., *Prososthenia* sp., *Melanopsis fuchsi*, *M. cylindrica*, and *Unio mihanovici*). The overlying cross-laminated, silty, fine-grained sand beds reveal combined effect of currents and waves, but wave-formed foreshore deposits are very rare. The organic-rich clays at the top of the cycles contain exclusively freshwater forms (i. e., *Anodonta*, *Planorbarius*, *Gyraulus*, helicids, sphaerids, and other planorbids). In outcrops where the cycles are smaller (2–3 m only), intercalations of medium to fine-grained cross-stratified sands with erosional base up to a thickness of 0.5–2 m are common.

As pilot studies, gamma-ray measurements were carried out along the walls of two large outcrops. The obtained gamma-ray logs reflect the cyclic lithological character of the successions and despite the differences in scale they can be used to compare our data to "traditional" well log data.

High resolution and ultra-high resolution single-channel seismic sections acquisited on Lake Balaton show 0–3 m Holocene mud and the sequence architecture of Lake Pannon deposits. The 100–150 m thick progradational character of the Tihany Fm. over prodelta clays/marls to sands was recognized, as well as minor units, which were interpereted as „local occurrence of small coarse-grained prograding deltas" (Sacchi et al. 1998).

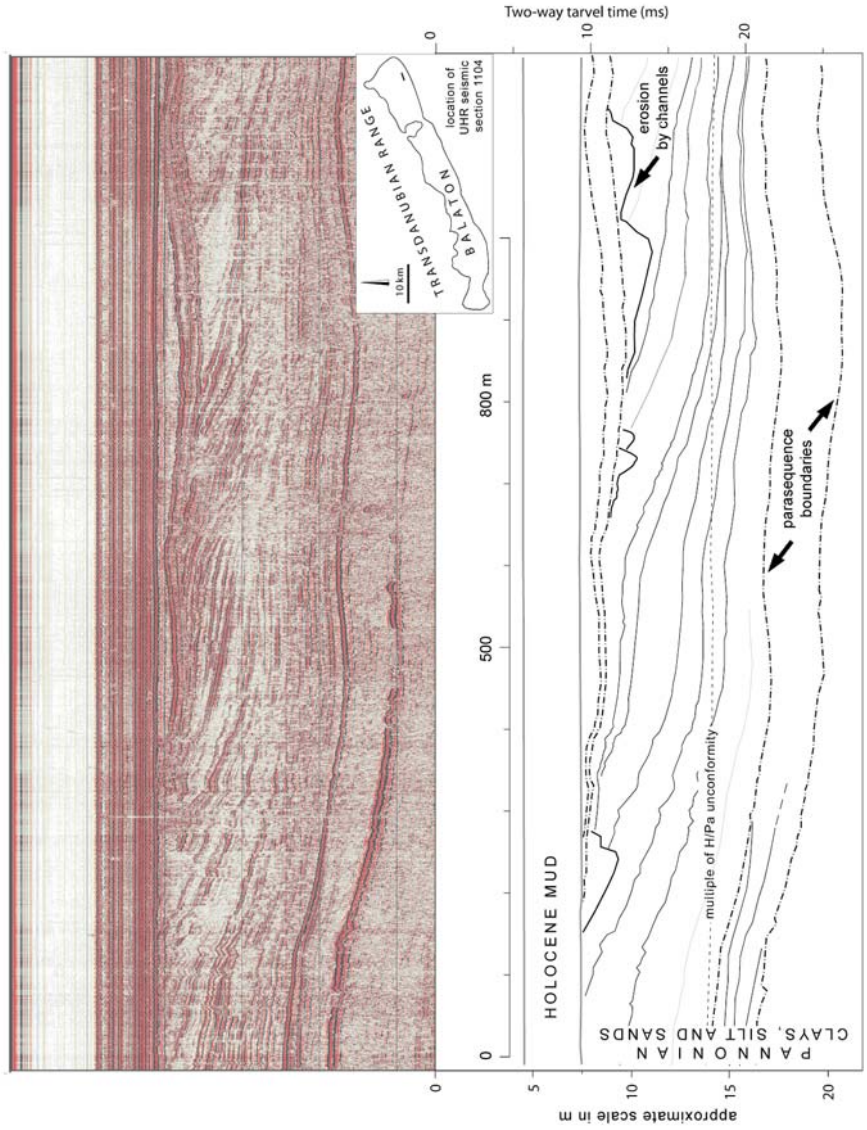

Fig. 1: Gently folded Lake Pannon deposits comprise deltaic parasequences on ultra-high resolution seismic section. Parasequence boundaries are high-amplitude reflections characterized by downlaps and/or offlaps of weaker sigmoidal reflections. Below parasequence boundaries seismically chaotic units with erosional base are common.

During the last few years more than 230 km seismic sections were measured in a semi-three dimensional net of 100–200 m. Small unconformity-bounded progradational units of about 2–10 m thickness can be mapped. The unconformities are mostly shown as high amplitude, good continuity reflection with offlaping or downlapping terminations. The slope of progradational beds has very low angle (0.2–0.8°). Below the top of the units weak, poorly? bedded reflections above 1–3 m deep, 50–200 m wide erosional truncations appear (Fig. 1). The size and geometry of the progradational units and the erosional features are in good agreement with close field observations and can be interpreted consistently.

The few metre thick sedimentary cycles seen in outcrops, on gamma logs and on seismic images are interpreted as parasequences developed on the plains of 50–100 m thick "shelf-delta" bodies. The starting member of each cycle was deposited in shallow non-agitated waters close or below wave base, in partly restricted areas, like interdistributary bays. These are overlain by deposits of progressively shallower, slightly agitated water. The filling up occurred in a progradational pattern directed by crevassing on the higher delta plain. As the bays were filled up, vegetated marshes were formed with several minor channels networking on the plain. Parasequence formation was mainly controlled by autocyclic switching of distributaries and relative lake-level variations of a few metres amplitude.

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