Quaternary climate reconstruction in the middle Tisza region based on VHR seismic images

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Based on very high-resolution (VHR) waterborn seismic profiles an ancient meandering river (Palaeo-Bodrog) with high discharge was reconstructed under the modern Tisza. The study verified the existence of the third hydrological axis (Gábris, 2002) of the Pannonian Basin during the Middle Pleniglacial. The catchment area of this river was the junction zone of the Western and Eastern Carpathians, thus the climate proxy resulted from the study of the alluvial sediments for the earlier part of MIS3 (Fig. 1) might be applicable for the nearby mountainous areas.

On the VHR profiles sedimentary structures of 20–30 m thick alluvial deposit were observed. Seven frequently occurring seismic units were analysed. The most spectacular, 300–3000 m-long series of inclined reflections appear consequently in the same depth level. This unit was interpreted as laterally accreted point bar complexes of a meandering river. Other seismic units in the same depth level were extended floodplain deposits, abandoned cut-off channel fills and large erosional scours. The Tiszaliget core revealed the medium sand to silty-clayey upward fining succession of the point bar and the overlying floodplain fines correlating well to the seismic interpretation. The OSL ages derived from the ancient point bars show Middle Pleniglacial (MIS3), 46–47 ± 4.6 ky (Cserkész-Nagy et al., 2012). The duration of meander development was about 2–3 ky.

The spatial and temporal variations of the point bar geometry were resurveyed by quasi-3D seismic profiling. The dip directions of series of inclined reflections and geometry of progressive development units helped to reconstruct natural meander migration. Channel-forming discharge (400 to 1800 m^3/s) curve was calculated from the width (350–520 m) and depth (6–7 m) data of the river. A primary trend in discharge variation was detected within the range of millennial-scale climatic fluctuations (Cserkész-Nagy & Sztanó, 2016). The undulation of the river-bed reflects the same trend. Increasing discharge was coupled with stepwise incisions in correspondence with meander migration phases, while continuous decreasing discharge resulted in slight aggradation of the river bed.

The alluvial history of the succession fits well into the glacial–interglacial climate model, and supports the deterioration of the climate described for the Carpathian Basin (Novothny et al. 2011). Sustained meandering of the high-discharge Palaeo-Bodrog proves a mild and wet climate at the beginning of MIS3. Subsequent aggrading storeys with meandering character reflect a decrease of discharge, which implies the aridification of climate.

Incising channels followed by rapid infill suppose a sudden cold period, but the subsequent meandering phase indicates climate re-amelioration. Towards MIS2, the transition of river pattern from meandering to braided may reflect the permanent deterioration of the climate.

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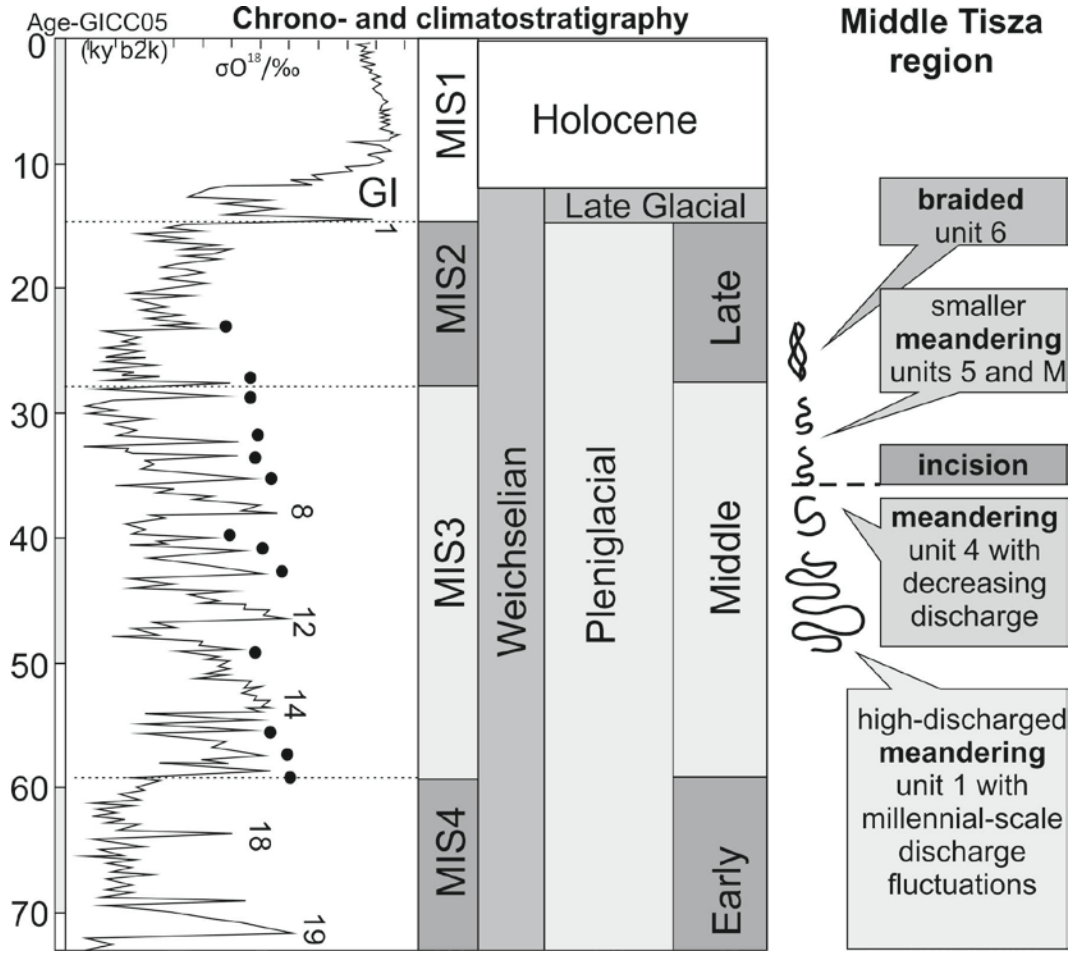

Fig. 1: Reconstructed alluvial history of the middle Tisza region (after GICC05, Svensson et al. 2008).