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Late Pleistocene and Holocene Climatic Variability in the Carpathian-Balkan Region

ABSTRACTS VOLUME

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Environmental conditions on the corridor of human migration between 40,000 and 14,000 a BP in the Balkan region. A multi-proxy approach on loess-paleosol profiles

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Project and research questions

This contribution focuses on two PhD projects, which are integrated within the collaborative research centre 806 “Our way to Europe” at the University of Cologne and the RWTH Aachen University (Germany). The main research focus is the migration of anatomical modern human (AMH) to Europe. We concentrate on the paleoenvironmental conditions on the route through southeastern Europe. This links the region with the earliest fossils of Homo sapiens sapiens (so far known) in the Middle East, Anatolia, the Northwestern Black Sea, the Balkans and the Pannonian Basin. One PhD topic deals with the sedimentological and geochemical approach mainly from loess and loess-like sediments to reconstruct the paleoenvironmental conditions; the other PhD topic places an emphasis on the exact timing of those sedimentary records via luminescence dating. In particular the investigation of loess-paleosol sequences plays a central role. Geoarchives in Hungary, Serbia and Romania are of main interest for the project. The investigations will focus mainly on the loess and loess like sediments. However, data will be compared to further geoarchives, such as lacustrine sediments, speleothemes and marine records, to get a complete insight into the climatic evolution. First analyses include the loess-paleosol sequences at Bodrogkereztúr (Hungary, east of Miskolz), Orlovat (Serbia, north of Belgrade), Ságvár (Hungary, southeast of Lake Balaton), and Stalać (Serbia, confluence of South and West Morava).

Regional setting

In this phase of the project, the focus will be on the Carpathian Basin, and the Dobruja region. Widespread loess plateaus are present in these regions, representing at least partly complete and semi-continuous paleoclimatic and paleoenviromental geoarchives. In spite of the extensive distribution of loess and loess-like deposits in southeastern Europe, information about anatomically modern human occupation of these landscapes is rare. However, information about the Paleolithic sites from nearby caves, such as the Peştera cu Oase (dated to 34.000 - 36.000 14C

years B.P.), confirms the presence of modern humans in this region. Fig. **1** shows the investigated area and the location of sampled sections.

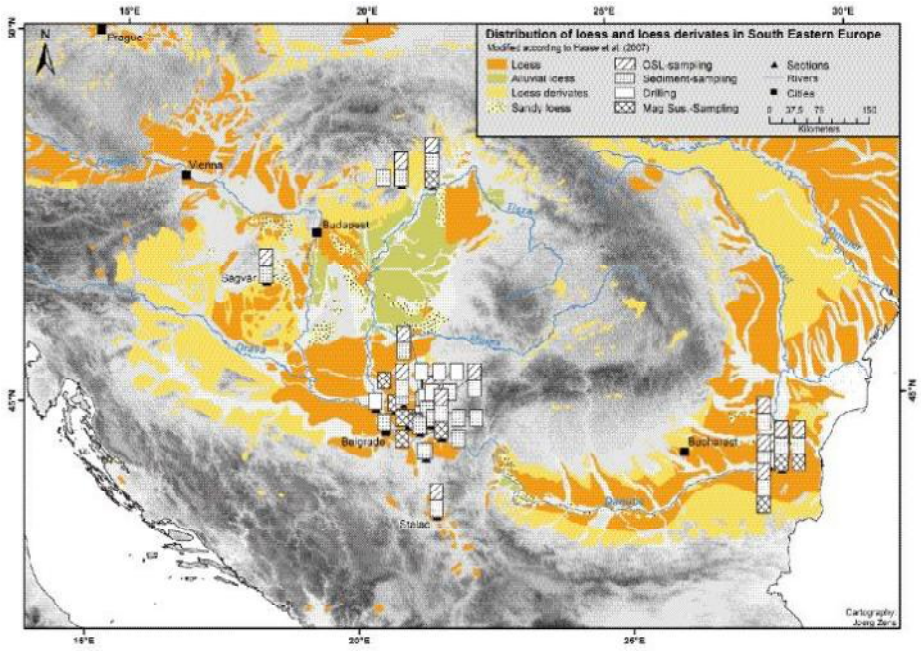

Fig. 1 Map of the investigated profiles and type of investigation showing the distribution of loess and loess derivates in South Eastern Europe (after Haase et al., 2007).

The first sections to be investigated in the laboratory are located at Stalac and Orlovat in Serbia. Stalac is located in the Central Balkan region, which marks a transition zone between Atlantic, continental and Mediterranean climatic regions. Therefore it is potentially extraordinary sensitive to past and present climate change and of high importance for our research goal. The Orlovat loess section is located on the right side of Tamiš river in the Serbian part of the Banat region (Southeast Carpathian Basin). This section is part of the small Tamiš Loess Plateau. The plateau was probably much larger in the past, but is now highly affected by erosion. Its difference to surrounding profiles makes it very interesting for our investigation.

Methodology

The project includes a considerable amount of field investigations to understand the regional setting and the collection of samples. The field work will mainly focus on the first year and the first half of the 2nd year of this three year project.

The first field campaigns of the second phase of the CRC 806 took place in October 2013 and in April and May 2014. Time was spent in the regions around Tokaj, Miskolz and the Balaton in Hungary, Vrsac and Nis in Serbia, and the Dobruja in Romania. All visited sites included detailed sampling for geochemistry, sedimentology, and luminescence dating. At some spots also oriented samples were taken for paleo- and rockmagnetism, and a reconstruction of paleo wind directions is in progress. Additionally, two depressions near Vrsac in Serbia, as well as one within the dune field of the Deliblato sands (Banat, Serbia) were drilled to enhance our understanding of the landscape evolution.

After the field campaign a considerable amount of time will be spent in the laboratories in Cologne and Aachen. In the sedimentological laboratory (RWTH Aachen University) a multi-proxy approach (grain size measurements, multi element analysis, CNS and CaCO3 content) is applied, and combined with rock- and paleomagnetic measurements at the University of Bayreuth. Geomorphological investigations are always logged to investigate differences between geomorphological and sedimentological processes, and paleoclimatical effects on the sediment.

In the Cologne luminescence laboratory (CLL) loess samples are extracted under subdued red light conditions, and treated with 10% hydrochloric acid, 30% hydrochloric peroxide, and 0.01 N sodium oxalate to remove carbonates and organic matter, and dissolve aggregates. After removing the chemicals thoroughly the samples are separated into a 4-11 µm fraction and a 63-100 µm fraction. Part of the samples undergo etching in order to remove the feldspar component. Both polymineral and pure quartz aliquots will be analyzed for fine grains and purely quartz aliquots for the coarser fraction according to the single aliquot regenerative dose protocol (SAR) by Murray and Wintle, 2003. For the investigation of the quartz signal, pre-heat and dose recovery tests need to be fulfilled in order to allow an adequate dating approach. In case of feldspar investigations (polymineral) the post-IR-IRSL protocol will be used (Thiel et al., 2011). Here, a proper test for the first stimulation temperature is of importance for the measurement and needs to be assessed (Buylaert et al., 2012). Results of luminescence dating will be later on used for age depth modelling. Moreover, it will be tried to investigate geomorphological processes, such as mass accumulation rates of loess, paleo wind directions and others, but these attempts might be quite difficult and have to be evaluated at a later stage of the PhD project.

The gained knowledge needs to be applied to the archeological findings. Among others it will be tested if the settlements of the first modern hunters and gatherers are concentrated on the foothills of the mountains such as the Banat hills or Bükk Mountains. As the archeological findings are usually connected with short sections with a low resolution concerning paleoclimate/environmental changes (e.g. Kels et al. 2014), also nearby long sections will be investigated aiming at getting a better insight into the paleoclimatic evolution of this particular region.

In the final phases of the PhD projects all parameters of interests will be combined to get a complete understanding of the variability in paleo climate and paleo landscape dynamics. This will help understand its effects on AMH migration and populations dynamics.

Results

Sedimentology and geochemistry

In the sedimentological laboratory (RWTH Aachen University) a first focus was put on the Orlovat loess section located on the right side of Tamiš River in the Serbian part of the Banat region (Southeast Carpathian Basin). This section is part of the small Tamiš Loess Plateau. This plateau was probably much larger in the past, but highly affected by erosion. In previous investigations on this section it was concluded that it is different from the surrounding profiles (Marković et al., 2014). This could indicate differences in the climatic evolution within the Banat region. Comparing magnetic susceptibility, grain size and geochemical results combined with luminescence dating, it was established that specific geomorphological conditions together with different dominating wind systems may provide a new insight into different paleoclimate proxies (Figure 2).

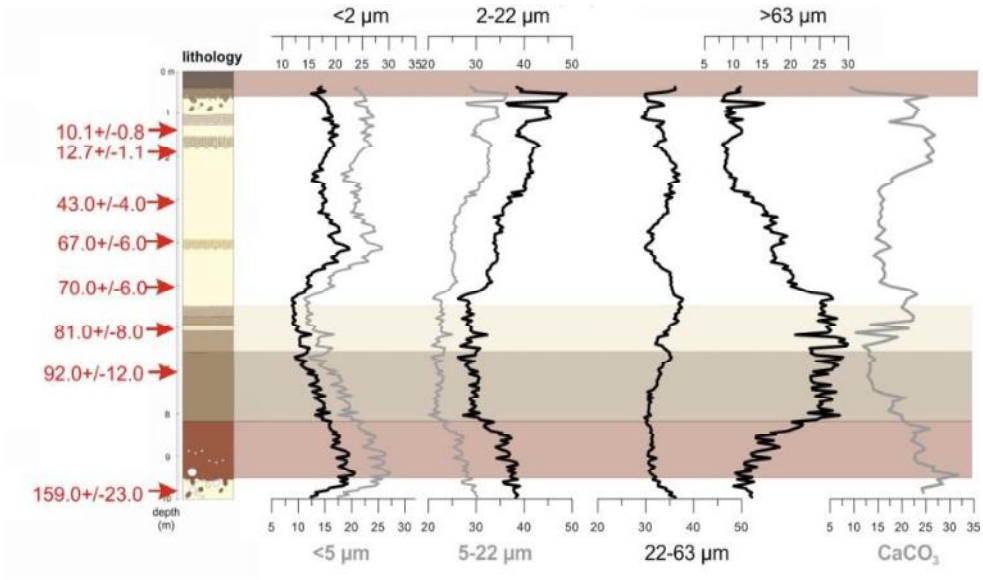

Fig. 2 Grain size results from the Orlovat section

Luminiscence dating

In the CLL several samples of Stalac (Serbia), Ságvár and Bodrogkereztúr (Hungary) underwent sample preparation. For Stalac and Ságvár polymineral and pure quartz fine silt grains (4-11 µm) are prepared and for Bodrogkereztúr polymineral fine silt grains and the etched medium silt grains (63-100 µm) are obtained.

Stalac is located in the Central Balkan region, which marks a transition zone between Atlantic, continental and Mediterranean climatic regions. Therefore it is potentially extraordinary sensitive to past and present climate change. In contrast to the Carpathian Basin, the loess accumulation during the Quaternary was spatially limited. Therefore, any section in this region may be important for the understanding of the regional paleoclimatic differences. Thus first investigations within the luminescence project focus on the Stalac section. Placed near the confluence of South and West Morava, the loess deposits accumulated dating several glacial cycles. The Last Glacial Cycle is present with a thickness of 3 m to almost 20 m in a northern position within a paleo depression. Different grain sizes and minerals will be investigated to enhance the overall understanding of the luminescence characteristics of material from the Balkans. A preheat test was conducted on the quartz grains of one Stalac sample. Unfortunately, no plateau was present, which makes the investigation undesirable. Therefore, an analysis of the feldspar samples appears more suitable and further luminescence measurements will focus on this mineral.

Future perspective

Our geochemical and sedimentological study shows that Lake Stiucii preserves a detailed archive of late glacial-Holocene climate change responses. It provides an unprecedented view on the past regional climate dynamics in the Transylvanian Lowlands that controlled variations in catchment stability, lake internal dynamics and productivity. Given the sensitivity of this lake to hydrological

forcing, our data provide a robust framework for interpreting past climate changes in this region with respect to both natural climate variations and also to the marked human impacts during Late Holocene. Moreover, our data show that such hydrologically sensitive water bodies reacted closely to threshold changes, including climate boundary conditions such as prolonged droughts, cold spells or episodes of intensive runoff. These attributes suggest that other shallow water basins in Transylvania and the surrounding Carpathian Lowlands may provide sensitive archives for assessing the characteristics of past environments in a region where such data remain very sparse.

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