Abstract

Our understanding of the Earth's climate system has significantly improved from studying past climatic and environmental conditions and their respective drivers. Within this context, lakes display valuable terrestrial archives recording regional climate signals in their sediment record. The main objective of this thesis is the reconstruction of past climatic and environmental conditions of the Eurasian Arctic and the Balkan Peninsula. For this purpose hydro-acoustic, sedimentological and geochemical analyses of selected lakes have been conducted. Additionally, cosmogenic nuclide surface exposure dating of moraines was performed in order to constrain Late Pleistocene glaciation events in the mountain ranges of the Central Balkans.

Within the scope of the Russian-German project Paleolimnological Transect (PLOT) lakes Ladoga (NW-Russia) and Levinson-Lessing (Taymyr Peninsula) were investigated. Hydro-acoustic data from Lake Ladoga provide important information on the sediment architecture of the basin and were substantial in order to identify sediments, which were not completely eroded by the last inundation of the Scandinavian Ice Sheet (SIS) peaking at around 21 ka. A 22.7 m long sediment core (Co1309) from the north-western part of the lake was retrieved and a multi-proxy approach including (bio-)geochemical, biological, and sedimentological analyses as well as radiographic imaging was applied. Pollen and non-pollen palynomorphs from the lower part of the core (ca. 22.7 - 13.3 m composite depth (mcd) ≙ 118 – 80 ka) indicate brackish-water conditions, likely as a gulf of the pre-Baltic Sea, gradually rising water levels and a gradual cooling towards marine isotope stage (MIS) 5a. The chrono-stratigraphical framework and seismic data indicate a hiatus in the sediment record spanning from ca. 80 – 14 ka. The upper part of the core (13.3 – 2 mcd) consists of ca. 2.500 glaciolacustrine clastic varves, with first and last varve occurrence at ca. 13.9 and 11.4 cal. ka BP, respectively. Varve-thickness, -geochemical and -granulometric characteristics display key parameters in order to reconstruct the regional retreat pattern of the SIS, as well as North Atlantic driven climate fluctuations. The uppermost part (2 – 0 mcd) of core Co1309 reflects Holocene sedimentation and reveals a sensitive reaction of the regional vegetation on North Atlantic driven climatic shifts. However, vegetation response to climatic shifts seems to react delayed, likely due to community inertia or local factors promoting only a moderate initial effect of North Atlantic climatic fluctuations.

Hydro-acoustic data from Lake Levinson-Lessing reveal important insights into the sediment architecture and depositional history of the lake, which likely formed ca. 90 ka ago in the course of the independently reconstructed last deglaciation in the region and presumably exists continuously since then. Five seismic units could be identified, with the lowermost Unit V presumably reflecting a basal till. Units IV and III likely reflect a proglacial lake stage and marine inundation, respectively, whereas Units II and I display hemipelagic sedimentation. Submerged terraces indicate lake-level fluctuations, which might be coupled to the regional climate- and paleogeographical history. However, an unambiguous interpretation in a temporal context is difficult as the hydro-acoustic data as yet lack an independent chronology.

In order to investigate the environmental and climatic history of the Balkan Peninsula and the Central Mediterranean, the sediment record of Lake Ohrid was drilled within the scope of the ICDP project ´Scientific Collaboration of Past Speciation Conditions in Lake Ohrid` (SCOPSCO). The sedimentation processes of the upper 250 m of the DEEP site record were investigated in order to infer the climate and environmental conditions of the last 637 ka. Based on a robust chronology it was shown that Lake Ohrid is an excellent recorder of glacial-interglacial variability and millenial scale climate changes.

Moraines in the close vicinity of Lake Ohrid (Galicica Mountains and Mount Pelister, FYROM) were chronologically constrained applying surface exposure dating by cosmogenic nuclides. Mid-latitude mountain glaciers react particularly sensitive to shifts in climate conditions, thereby complementing past climatic information obtained by lacustrine archives. At Pelister Mountain, cosmogenic ^{10}Be ages indicate a most recent moraine formation at ca. 15.2 ± 0.9 ka, largely synchronous with the Oldest Dryas chronozone. ^{36}Cl measurements on boulders from the Galicica moraine resulted in ages centred around 12.0 ± 0.6 ka, implying a glacial advance and retreat in the course of the Younger Dryas chronozone. Careful evaluation of effects of erosion and snow cover revealed only a minor influence on the resulting ages, whereas the selection of production rates significantly affects exposure ages. Although being proximal to Lake Ohrid, the glaciation in the Galicica Mountains did not leave an imprint in Lake Ohrid's sediment record, likely due to low production of debris and sediment retention and dissolution of the karstified limestone. Although the respective last glacier advance is asynchronous in the two mountain ranges, the studies imply that glacier advances on the Balkan Peninsula were triggered- or at last are highly influenced by North Atlantic driven climate signals.

Conclusively, the studies presented in this thesis reveal that all investigated archives obtained valuable information on past climatic and environmental conditions on different temporal scales, ranging from annual to orbital. In consideration of advantages and limitations of all methods and archives used, a multi-proxy and multi-site approach is recommended in order to increase the reliability of the obtained information.