Diatomededelingen 33

2009

The joint

40th Meeting of the Dutch-Flemish Society of Diatomists (NVKD)
and
3rd Central European Diatom Meeting (CE-DiatoM)

26-29 March 2009

Utrecht, The Netherlands

Nederlands-Vlaamse Kring van Diatomisten

Late Glacial and Holocene diatoms from glacial Lake Taul dintre Brazi, Retezat Mts, Romania

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INTRODUCTION

The rich biotic evidence preserved in lake sediments of remote alpine lakes has special value in the reconstruction of past ecosystem reactions to rapid climate changes. Siliceous algae (diatoms and crysophycean statospores) are one of the most often studied biotic proxy, but the evenness of diatom-based studies is low, some lake-districts are studied more in detail and repeatedly, while others remain completely unknown (Claire et al. 2005). One of such poorly investigated lake-rich areas is the Retezat Mountains (South Carpathian Mountains).

The Retezat is the wettest massif in the Romanian Carpathians due to Mediterranean and oceanic influences. As a result, the effects of the last glaciation have been more significant here than elsewhere in the South Carpathians. Numerous glacial lakes appear in the subalpine and alpine belts that were formed following the retreat of the ice, mainly during the Late Glacial. One of these glacial lakes is Lake Taul dintre Brazi (N 45o23'47" E22o54'06" 1740 m a.s.l) from the subalpine belt. It is located below the upper tree limit, in a Norway spruce (*Picea abies*) forest. So far, only a single radiocarbon dated pollen diagram provides information on the Late Glacial and Holocene vegetation history of the subalpine belt (Fărcaş et al. 1999). Diatom assemblages from palaeoecological respect were studied at first time by Péterfy (1974) in Mts Retezat. Recently diatoms of pre-industrial times and the present day were compared in order to show biological and limnological changes, from five lakes of the district (Claire et al. 2005).

MATERIAL AND METHODS

Five meters long sediment core was taken in 2007 with Livingston piston corer from the deepest part of the shallow lake (1 meter average depth). For sub-sampling the plastic tubes containing the sediment were cut into halves and sub-samples were taken at 1-4 cm intervals for multi-proxy analyses, including pollen, macrofossils, cladocera, chironomids, geochemical and siliceous algae. For siliceous algae analyses samples were prepared using standard digestion procedures (Batterbee 1986). Aliquot-evaporated suspensions were embedded in Zrax (refractive index 1.7). At least 300 valves were counted in 52 samples using a light microscope (LEICA DM LB2 with 100 HCX PLAN APO). The percentage ratio of diatoms to chrysophycean cysts follows Smol (1985). For the modelling sediment deposition time, nine plant macrofossil samples were analysed in the AMS Laboratory in Poznan, Poland. CalPal-2007Online program (Danzeglocke et al. 2007) was used to obtain calibrated age ranges (Table 1). Diatom stratigraphies were zoned with optimal splitting by information content as implemented in the program psimpoll 3.00 (Bennett, 1992).

Table 1. Results of the AMS ^{14}C measurements of core Taul Dintre Brazi. All dates were converted into calendar years BP using the CalPal-2007Online program.

Laboratory code	Dated material	Method	Depth below water surface (cm)	^{14}C ages BP	Calibrated BP age ranges (1 sigma)	Mid-point of 1 sigma calibrated age range
Poz-26103	needle leaves	AMS	119	725±30	668 – 691	680
Poz-26104	cone scale	AMS	160	1735±30	1604 – 1692	1648
Poz-26106	*Pinus mugo* cone	AMS	238	3045±30	3230 – 3324	3277
Poz-26107	*Pinus* twig	AMS	315	5040±40	5739 – 5873	5806
Poz-26108	needle leaves	AMS	355	6320±40	7196 – 7293	7245
Poz-26110	*Picea abies* seed and 2 *Picea* needle leaves	AMS	450	8240±50	9135 – 9301	9218
Poz-26111	*Picea* needle leaves	AMS	505	8810±50	9753 – 10054	9904
Poz-26112	*Picea abies* cone	AMS	545	9610±50	10,833 – 11,100	10,967
Poz-27305	*Pinus* sp. needle leaves (2)	AMS	578	11590 ± 60	13,353 – 13,586	13,470

Results and Discussion

More than one hundred taxa were distinguished in the 52 samples. The "fragilaroid" taxa (including *Fragilaria, Pseudostaurosira, Stauroforma, Staurosira*) were abundant in the older, Late Glacial and Early Holocene layers. Beside the common fragilaroid species, *Stauroforma exiguiformis* was dominant in several samples. In the last 10,000 cal yr BP *Aulacoseira* species gradually replaced fragilaroid taxa. At least eight different *Aulacoseira* taxa alternated in the Holocene. *A. alpigera* was dominant, but *A. nygaardii, A. subarctica, A. ambigua, A. nivalis, A. pfaffiana, A.* cf. *lirata* were also abundant. *A. valida* was present having lower but permanent relative frequency throughout the Holocene. Small-celled, fine structured diatoms were abundant in the sedimentary sequence, causing difficulties in the species level identification. The SEM studies provided evidence for the presence of *Achnanthidium, Eolimna, Kobayasiella, Microcostatus, Nupela, Psammothidium* and *Sellaphora* species.

Three zones were differentiated with 2-5 sub-zones (Fig. 1.) on the basis of the generic level diatom analyses. The most characteristic changes were found at *ca.* 10,150 and 5800 cal yr BP. Below 588 cm (14,266 cal yr BP) diatoms were not found.

DAZ TDB-1 (584 - 514 cm; 14,000 – 10,150 cal yr BP)

Small fragilaroid taxa are dominant, with the definite peak of *Sellaphora* species pointing to cold, shallow pond condition. The increasing abundance of different small araphnid species explains the division into sub-zones at 12,350 and 10,800 cal yr BP.

DAZ TDB-2 (514 – 310 cm, 10,150 – 5700 cal yr BP)

The frequency of fragilaroid taxa fluctuates but they are gradually replaced by *Aulacosiera* species in this zone. A first, wetter period can be inferred between 9800 and 9700 cal yr BP (sub-zone 2B) when the increasing relative frequency of the planktonic/tychoplanktonic *Aulacoseira* taxa suggest an increase in water-depth. After these one hundred years long period fragilaroid taxa gain domainance again, suggesting decreasing lake level and/or colder water temperature (sub-zone 2C). The most remarkable changes in the profile can be detected in the fourth sub-zone (TDB-2D), when several diatoms (e.g. *Brachysira brebisonnii* with other *Brachysira* species, *Tabellaria flocculosa, Cymbella gracilis, Eunotia meisteri*) show marked relative frequency peaks. The ratio of chrysophyceaen statospores is high pointing to oligotrophic lake water. The interpretation of the paleoenvironmental changes in this period, between 8900 and 8400 cal yr BP, require further analysis esp. connecting changes with the 8.2 ka event. The fifth sub-zone can be characterised by the gradual decrease of fragilaroid species that probably refers to increasing lake level.

DAZ TDB-3 (310 – 0 cm; 5800 – 0 cal yr BP)

Aulacoseira species dominate in this zone, accompanied by several small-celled achnanthoid diatoms. Increased relative frequency of *Nitzschia* species is also characteristic that can probably be connected with higher nutrient concentration. The border of the two sub-zones is at 3000 cal yr BP.

CONCLUSIONS

The aim of the multi-proxy analyses on the sediment of Taul dintre Brazi is to provide high-resolution environmental reconstruction for periods that show rapid climate change. On the basis of earlier published paleolimnological studies in this region, rapid climate changes are expected around 12,900; 11,500, 8,600-8,200 and 3,300-2,800 cal yr BP. The preliminary, genus-level diatom analyses verified the evidences of these boundaries. Species-level identification is fundamental for fine diatom-based environmental reconstruction (pH, trophy). The higher resolution analyses with species level identification promise high quality data set for the palaeoecological reconstruction of the s southeast European region. Our results about the diatom flora and succession fit well with the data of ~ 17,000 yr old Zănoguţa *Sphagnum* bog 1840 m asl in Retezat Mts (Péterfi 1974). The analogous changes can help in the better understanding of climate-driven events in the Retezat Mts.

ACKNOWLEDGEMENTS

This research was funded by the Marie Curie Reintegration Grant (MERG-CT-2006-041088) held by E. Magyari. We thank the support of the Bolyai János Research Scholarship and the Hungarian Scientific Fund (OTKA PD73234 and 43078). This is Hungarian Academy of Sciences - Hungarian Natural History Museum Paleo Contribution No. 81.

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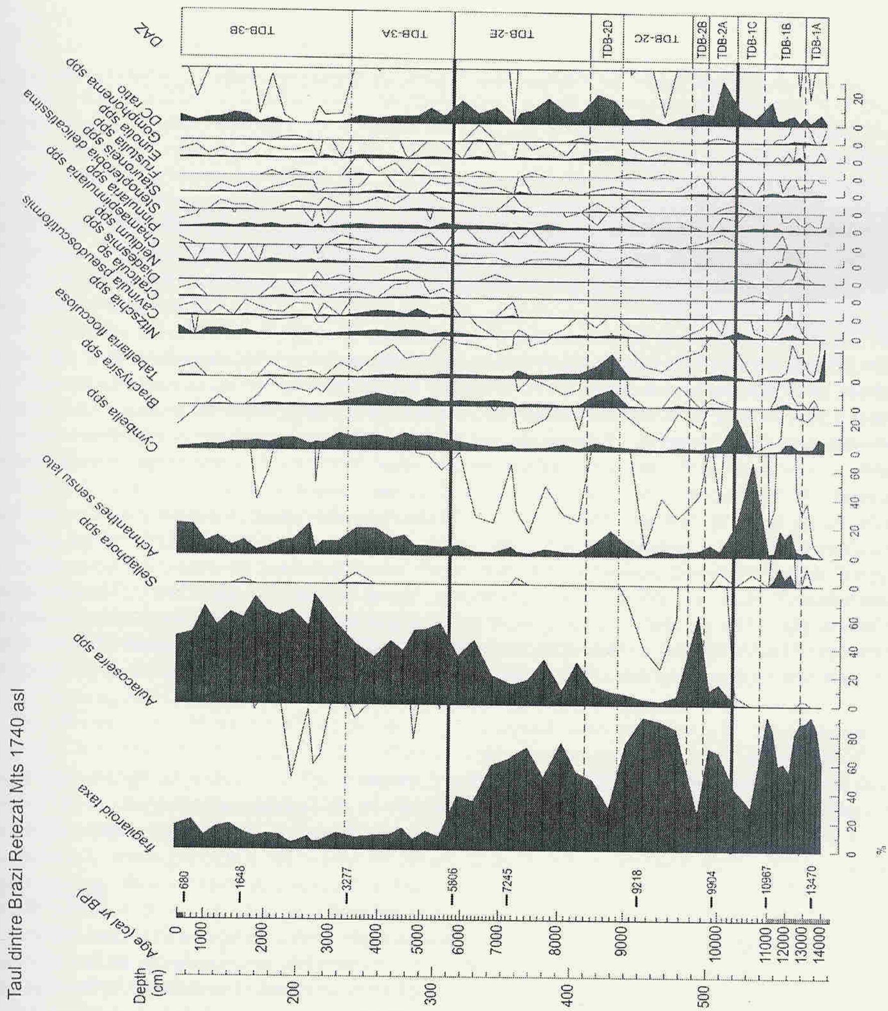

Figure 1. Relative frequency diagram of selected diatom genus in glacial Lake Taul Dintre Brazi, Retezat Mts. Diatom relative frequencies are expressed as percentage of total diatoms. Lines without filling are exaggerated (x10).