

First Workshop of the PAGES Varves Working Group, Palmse, Estonia, 7–9 April 2010

The interest in climatic records has increased markedly due to the concern for global warming. A major aim of natural scientists is to improve the predictive power of climate simulations. The instrumental record of the impact of climate change on the environment is too short to capture the whole range of climatic variability. Therefore geological records are investigated and different proxy data are produced to reliably reconstruct past shifts in the climate beyond the historical record. PAST Global changeS (PAGES), a core project of the International Geosphere and Biosphere Programme (IGBP), has stressed the need to quantify the natural range of climatic variability that has occurred in the recent geological past. Research priority has been given to continuous high-resolution natural records with decadal to annual resolution. Excellent examples that can be achieved include the studies of the Greenland ice cores and the construction of regional dendro-climatological time-series from tree-ring data.

Lake sediment records are potentially one of the most useful sources of palaeoclimatic and palaeoenvironmental proxy data. However, the construction of an accurate geochronology on sediment sequences is often a complicated task. Radiocarbon dating has so far been the most widely used method for dating and correlation of different sediment sequences. However, the technique has a number of limitations, including hard-water errors, reservoir effects and calibration on the ^{14}C plateaux. Annually laminated or varved lake sediments provide independent dating tools that may contain records with calendar year chronology and deliver high-resolution proxy data showing changes in the lake ecosystem and climate at annual to seasonal resolution (Fig. 1). The Swedish word '*varv*', meaning cycle or layer, was originally used by Gerard De Geer, a Swedish geologist and the father of varvochronology, for limnoglacial clays with annual couplets of light-coloured silt and dark-coloured clay. In our days, when annually laminated sediments have been discovered in different sedimentological environments, *varve* has become a common word for a sediment structure representing the deposition during a single year, including several seasonal sublayers of different composition and colour.

Eleven years ago, in 1999, the last specific meeting for the 'varve community' was held in the Lammi Biological

Station in Finland. Since then, different research groups have worked with varved sediment sequences worldwide and developed new advanced tools for studying annual sediment records (e.g. X-ray fluorescence scanning, image analysis), hence numerous publications have appeared on varved sediments. It was time to take a step forward and therefore the Varves Working Group (VWG), a new community of scientists, was established under the frame of the IGBP-PAGES Cross Cutting Theme 1 'Chronology'. The purpose of the VWG is to gather the

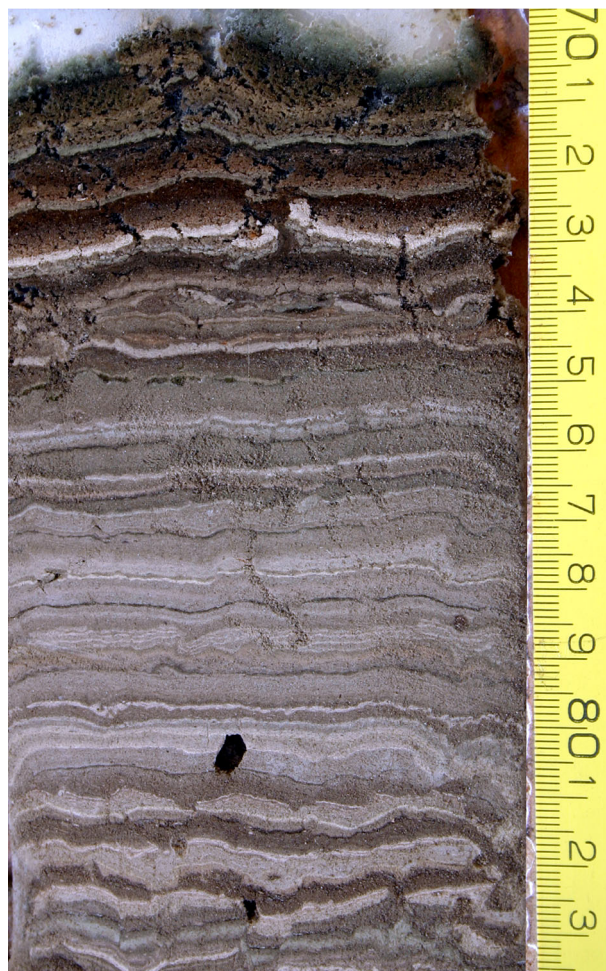


Fig. 1. Freeze core from hypereutrophic Lake Otepää Pikkjärvi, southern Estonia, showing the water–sediment interface and the surface thick varves induced by anthropogenic eutrophication. Photo by Siim Veski.



Fig. 2. Participants in the meeting at Palmse Manor House. Photo by Siim Veski.

varve community together and to bridge the gaps between people working with sedimentary varves and other communities dealing with annually resolved records (tree-rings, ice cores, corals, speleothems).

The workshop in Palmse, northern Estonia, was the first in the series of workshops that has been planned. The workshop was organized by Dr Antti Ojala and MSc. Emilia Kosonen, Geological Survey of Finland, and hosted by the Institute of Geology at Tallinn University of Technology and locally organized by Dr Atko Heinsalu. More than 40 participants attended the workshop, primarily from European countries, including Russia, and from the USA and Canada (Fig. 2). Oral presentations were made in four sessions, grouped according to the themes of varved sites, environments, sedimentology and geochemistry; chronology; analytical and numerical methods and tools; and environmental and climate history case studies. They were complemented by a poster session.

Generally, there were many attractive oral and poster presentations, especially those introducing new analytical and software tools for the varve studies. The first session keynote speaker W. Tylmann talked about the systematic survey to find annually laminated lake sediments and geological, geomorphological and limnological settings that control the varve deposition in lakes of northern Poland. The next session keynote speaker

I. Snowball presented an original talk about validating varve chronologies with independent complementary dating techniques (historically dated marker layers, palaeomagnetic secular variations, tephrochronology, atmospheric lead pollution isochrones and radiocarbon wiggle matching) to reduce chronological uncertainties. The last keynote speaker A. Brauer presented a new approach to studying annually laminated sediments, by combining micro-facies analyses on thin sections with high-resolution micro-XRF element scanning on impregnated sediment blocks, and discussed its potential for improving varve counting and interpreting seasonal palaeoclimatic signals.

The scientific presentations were followed by discussions of the objectives, expectations and the future of the VWG. The group decided to implement a website with information related to the tools and methodologies useful for the study of varves. Moreover, the group agreed that some technical guidelines and quality banners needed to be fixed to facilitate the assessment of varved records for the use of climate modellers and decision-makers. These criteria will be agreed upon after learning from the other scientific communities dealing with annually resolved records during the next VWG workshop to be held in North America in 2011. Further information on the VWG activities is available on the webpage <http://www.pages-igbp.org/science/varves/varves2010.html>

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