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The Study Internal Structure of the Annual Layers in Lake Sediments Using Synchrotron Radiation with X-ray Focusing Optics

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1 Introduction

Annually laminated (varve) sedimentary deposits are considered as one of the most important archives, since they offer precise temporal information (years) in combination with high time resolutions. Bottom sediments of the lakes contain detailed geochemical information on climate changes in the region over thousands of years.

In recent decades, synchrotron radiation has become widely applicable for analytical investigations. In contrast to microprobes with excitation by electron or proton beams, the use of X-ray radiation does not require complex vacuum systems, making sample preparation and analytical measurements much easier. Microcapillary and focusing

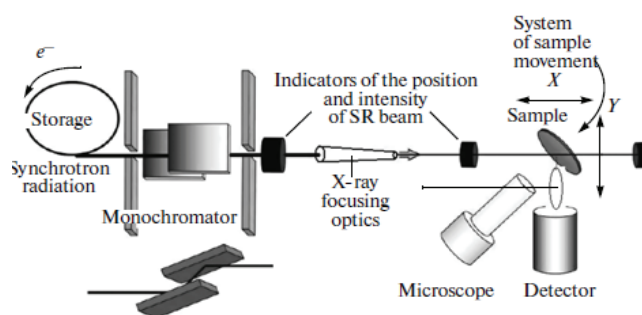


Fig. 1. Scheme of the scanning X-ray fluorescent microanalysis station.

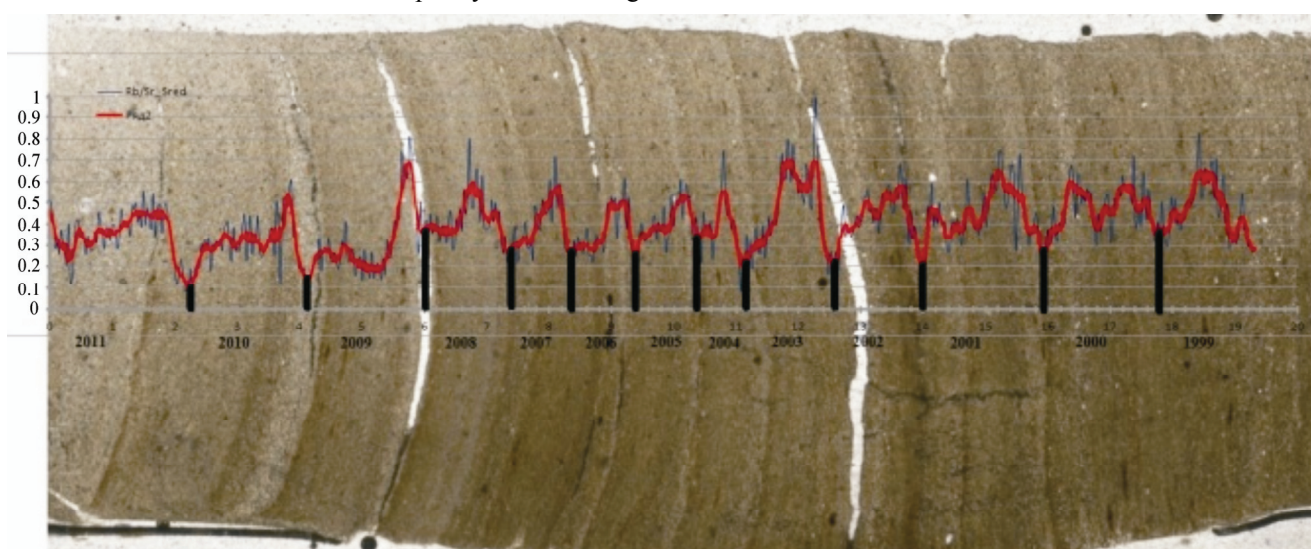


Fig. 2. Variations in the Rb/Sr ratio in the investigated profile of the sample of Lake Donguz-Orun bottom sediment.

X-ray optics allow us to obtain beams with diameters of $<1 \mu\text{m}$.

Scanning X-ray fluorescence microanalysis station

includes the following basic bloc: (1) monochromator; (2) X-ray focusing polycapillary optics; (3) scanning device.

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2 Sample Preparation and Measuring

A specimen of wet sediment was freeze dried in vacuum to preserve its original structure. It was then impregnated with epoxy resin. The prepared samples are suitable for prolonged storage and preparing thin sections. The solid samples were glued to a cover glass and polished to a thickness of 30 μm for viewing under an optical microscope.

Scanning with step of 30 μm was performed on the Element Analysis station at energies of 19 keV, using the apparatus and procedures described in two references. Measuring time for one point was 20 s. The relative contents of more than 15 elements, including rock-forming K, Ca, Ti, Mn, and Fe, and microelements V, Cr, Ni, Cu, Zn, As, Rb, Sr, Y, Zr were determined.

3 Results and Discussion

The content of elements measured in the scanned area of the sample allows us to identify the geochemical indicators marking the annual layers of sediments and differentiating the fast (spring–summer) and slow (winter) conditions of sediment accumulation. The figure shows a plot of the

changes of the Rb/Sr ratio in the investigated area. The maximum Rb/Sr ratio corresponds to the rapid accumulation of sediment during spring and summer floods.

Key words: varve, synchrotron radiation, scanning X-ray fluorescence microanalysis, focusing X-ray optics.

Acknowledgements

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