DEVELOPMENT OF SRXRF METHOD WITH THE HARD X-RAY RANGE FOR PALEOCLIMATE RECONSTRUCTION (REGION OF LAKE BAIKAL) ON THE STORAGE RING VEPP- 4M

Valentina Trunova[1], Aleksandr Legkodymov[2], Olga Stepanova[3], Andrey Fedotov[3]

[1] *Nikolaev Institute of Inorganic Chemistry SB RAS, Novosibirsk, Russia*

[2] *Budker Institude of Nuclear Physics SB RAS, Novosibirsk, Russia*

[3] *Limnological Institute SB RAS, Novosibirsk, Russia*

The analysis of bottom sediments by the scanning X-ray fluorescence spectrometry method (SRXRF scan) is carried out in the context of paleoclimate research. Comparison of these reconstructed Siberian records with the annual record of air temperature for the Northern Hemisphere shows similar trends in climatic variability over the past 800 year. Estimated harmonic oscillations of temperature and precipitation values for both historical and reconstructed periods reveal sub-decadal cyclicity. Selenga is a large river flowing on the territory of Mongolia and Russia. The largest river inflowing to Lake Baikal and providing up to half of the annual inflow of water into the lake, including about 70% of the entire terrigenous inflow. The average multiyear water flow of the river to Baikal is about 29 km³ of water and about 3600000 tons of terrigenous inflow, most of which settles in a vast delta. In this reason, the studying of geochemical pattern of bottom sediments of Lake Baikal in this part we can reconstruct paleoclimate of the south part of East Siberia and the Northern Mongolia.

The methodology of reconstruction of the paleoclimate includes the use of 5 methods

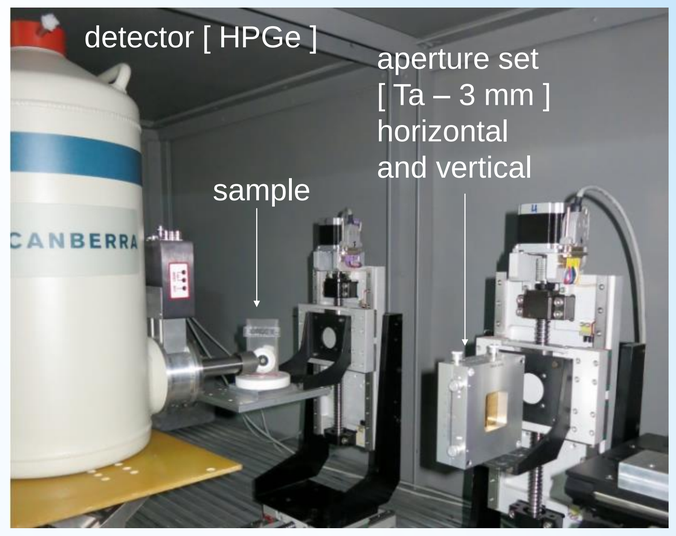
1. **Color processing**

2. **Depth-age model (dating). Analysis of the distribution of activity of isotopes 210-Pb, 137-Cs, 238-U and 226-Ra**

3. **Determination of the content of biogenic silica (BSi), total organic matter, quartz and feldspar was carried out by infrared spectroscopy.**

4. **Scanning method SRXRF**

5. **Statistical processing**
   (PCA -- principal components analysis)
   (CA -- cluster analysis)
   (FA -- factor analysis)

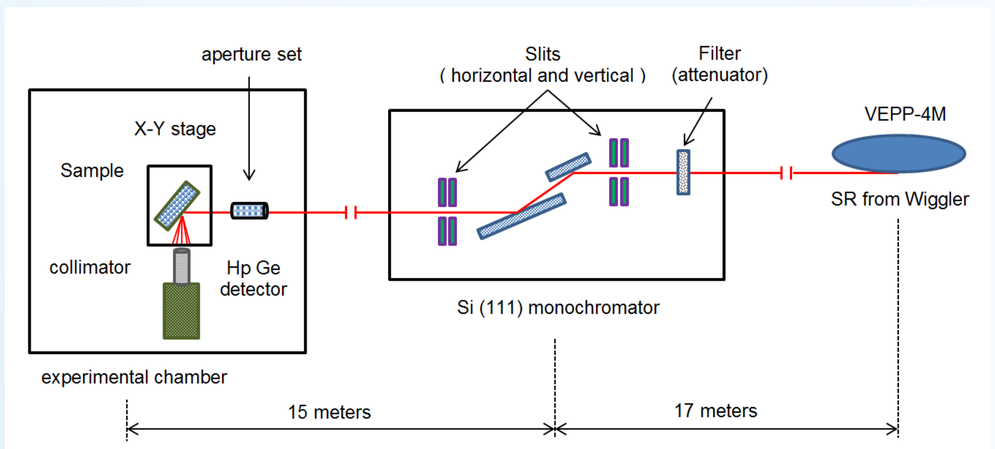


detector parameters

Energy [keV]	5.9	122
Resolution (FWHM) [eV]	125	460

Active diameter – 13.5 mm
Active area - 100 mm²
Thickness (Ge) – 10.5 mm
Thickness windows (Be) – 25.4 mkm

Experiment layout for X-ray fluorescence



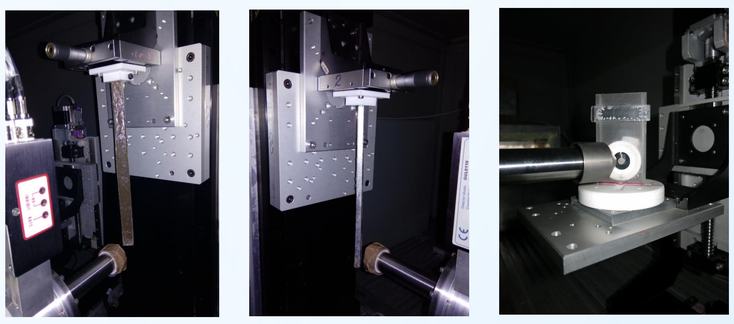
VEPP - 4M «BEAMLINE № 8 »

Source – wiggler; B = 1.9 T (9-pole);
E_{el} = 4.5 GeV; I_{el} = 20 mA

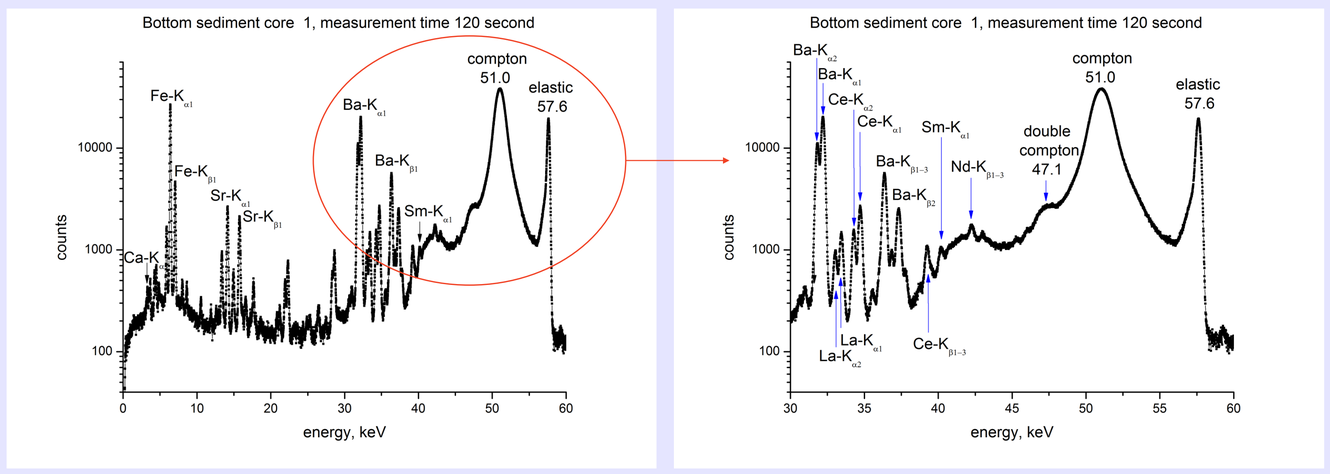
monochromator parameters

length of the first crystal	40 mm
length of the second crystal	110 mm
distance between crystals	4 mm
period 2d for Si (111)	6.271 A
energy range	120 keV (1.13 ^{0}) 40 keV (2.83 ^{0})
energy resolution	3 · 10 $^{-3}$

The application of the hard SRXRF method for scanning of the wet core samples of bottom sediments

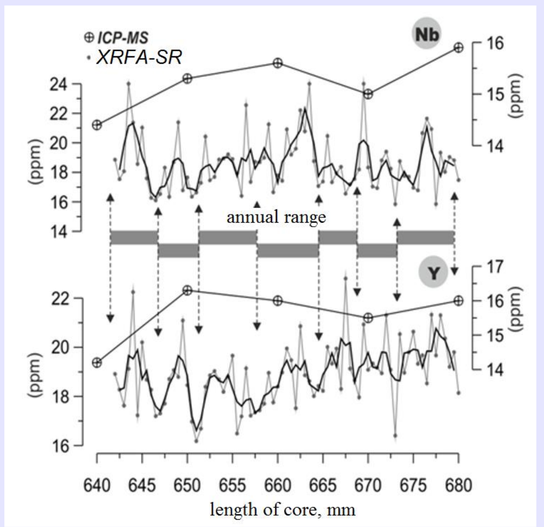


A typical SRXRF spectrum of bottom sediments measured on the storage ring VEPP-4M

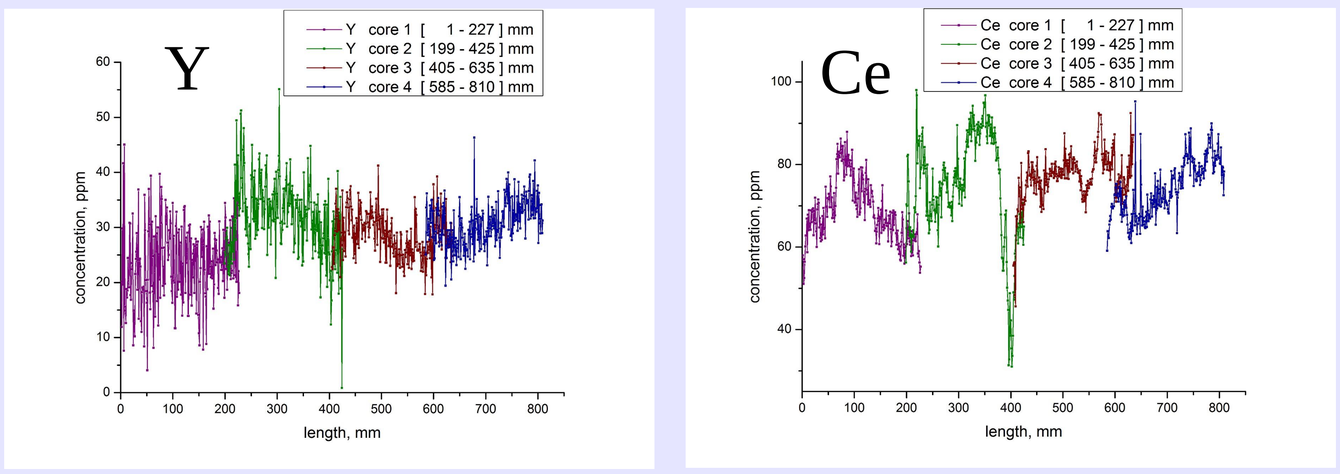


Comparison of data obtained by SRXRF method in scanning with step of 0.5 mm and ICP-MS method with step of 10 mm

At the same time, the use of SRXRF method proved to be much more effective, in comparison with the more traditional ICP-MS analysis

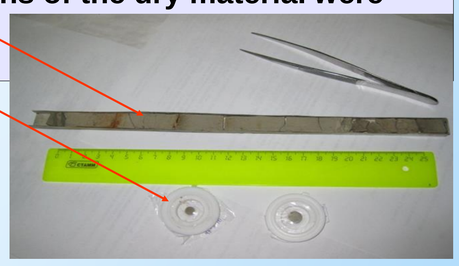


The lacing of the core sample of bottom sediments



The analysis of the scanning SRXRF gives information over 30 chemical elements. The following elements were defined: rockforming and rare earth elements: K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, As, Se, Br, Rb, Sr, Y, Zr, Nb, Mo, In, Sn, Sb, Cs, Ba, La, Ce, Pr, Nd, Sm, Th and U.

1. **The scanning of core on vertical (Intensity)**
2. **The dry material from the data of the intensities of the elements of the wet core profile was obtained.**
   The dry material analysis by the external standard method (standard sample BIL-1 (Baikal silt)) was performed.
   The values of the concentrations of the chemical elements of the wet core by recalculating the concentrations of the dry material were obtained.



Conclusion:

The determination of the heavy and rare earth elements (I, Cs, Ba, La, Ce, Pr, Nd, Sm) at the new station of SRXRF on the storage ring VEPP-4M extend of possibilities for paleoclimate reconstruction of Baikal region. Scanning analysis with a spatial resolution of 1 - 0.1 mm made it possible to reconstruct the dynamics of bottom sediments of the Baikal region with a time resolution "year-season" in the range from 100 to 1000 years.

Contact person: Aleksandr Legkodymov, e-mail: a_legkodymov@mail.ru