

Dynamics of heavy metal (Ni, Cu) and sulfur (S) content in tree-ring of larch affected by industrial pollution from the Norilsk smelters

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The study area

Norilsk industrial region located in the north of the Krasnoyarsk Territory in the south-west of the Taimyr Peninsula. This is a unique industrial complex for the extraction and production of nonferrous and precious metals.

- **airborne dust emissions**
- the objects for waste disposal (sedimentation tanks, slag deposits)

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Airborne dust emissions

The amount of emissions of more than 2 million tones per year

- gaseous emissions
 - sulfur dioxide 96-98%
 - nitrogen oxides, carbon monoxide, chlorides, phenols 2-4 %
 - copper 14%
- inorganic dust
 - nickel 11%, etc.

Area sampling

first site



Area sampling

second site



Area sampling

third site



Area sampling

fourth site



Area sampling

fifth site



Location sites of sampling



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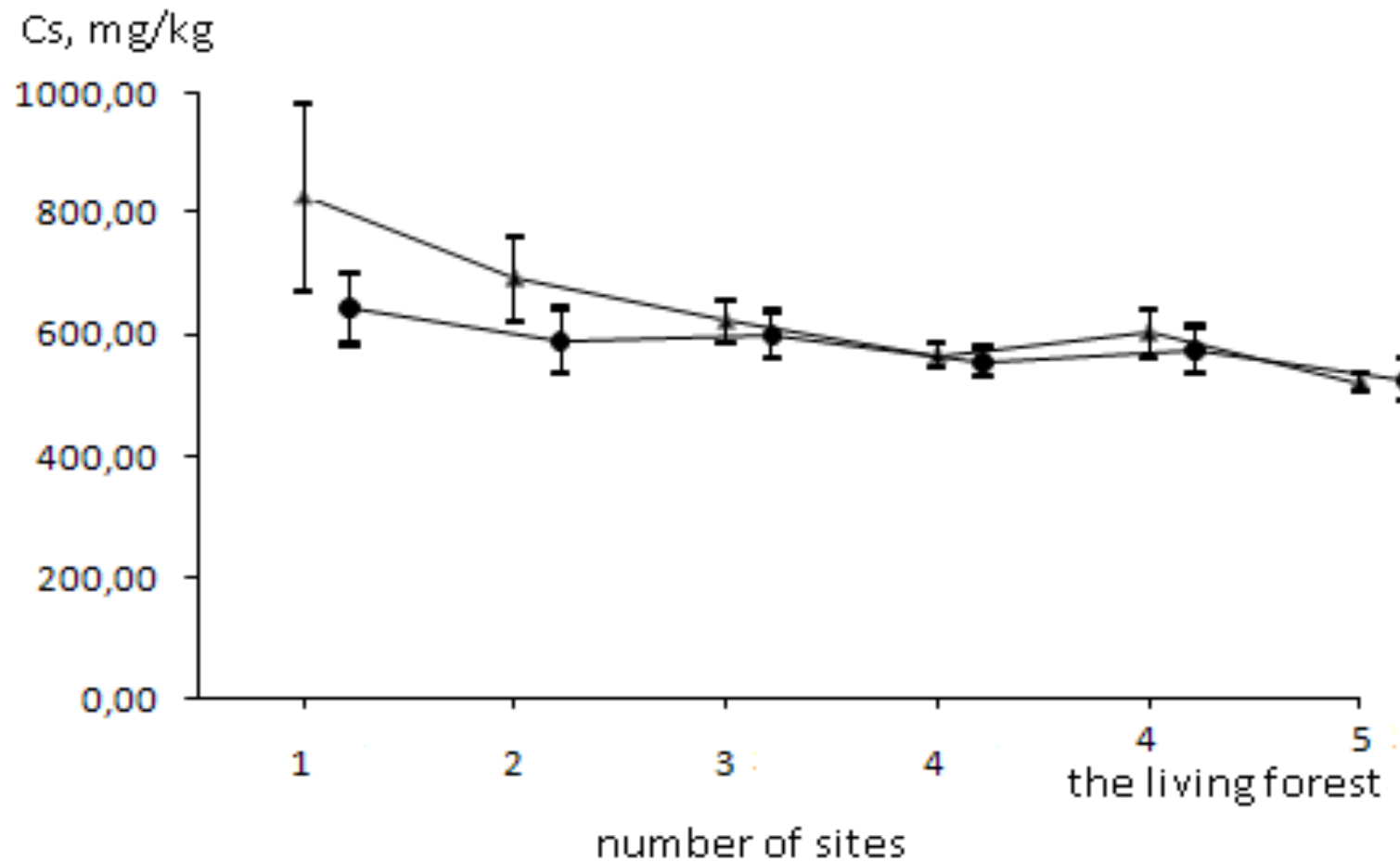
objects and methods

- Objects
 - wood disk or wood core
 - soil
 - water extraction
 - ammonium acetate buffer-extraction
- Methods
 - X-ray fluorescence method
 - atomic-emission method

The concentration of elements in different soil horizons

№ site	Depth, cm	Total contents, mg/kg			Exctraction from soil, mg/kg			
					Water		AAB	
		Cu	Ni	S	Cu	Ni	Cu	Ni
1	0-6	830	716	2660	1,13	0,68	72,14	48,33
	7-14	110	175	751				
	14-24	120	210	570				
2	2-8	100	140	1800	0,27	0,15	31,27	24,78
	8-18	99	110	1351				
3	0-10	935	525	1240	1,98	1,27	95,62	69,69
	10-20	90	97	1359				
	20-60	120	130	972				
4	0-4	522	200	1018	0,73	0,55	53,62	39,83
	4-40	67	58	380				
5	0-10	28	38	345	0,06	0,07	1,21	1,03
	10-20	32	37	290				
	20-40	33	37	310				
	40-50	48	52	450				

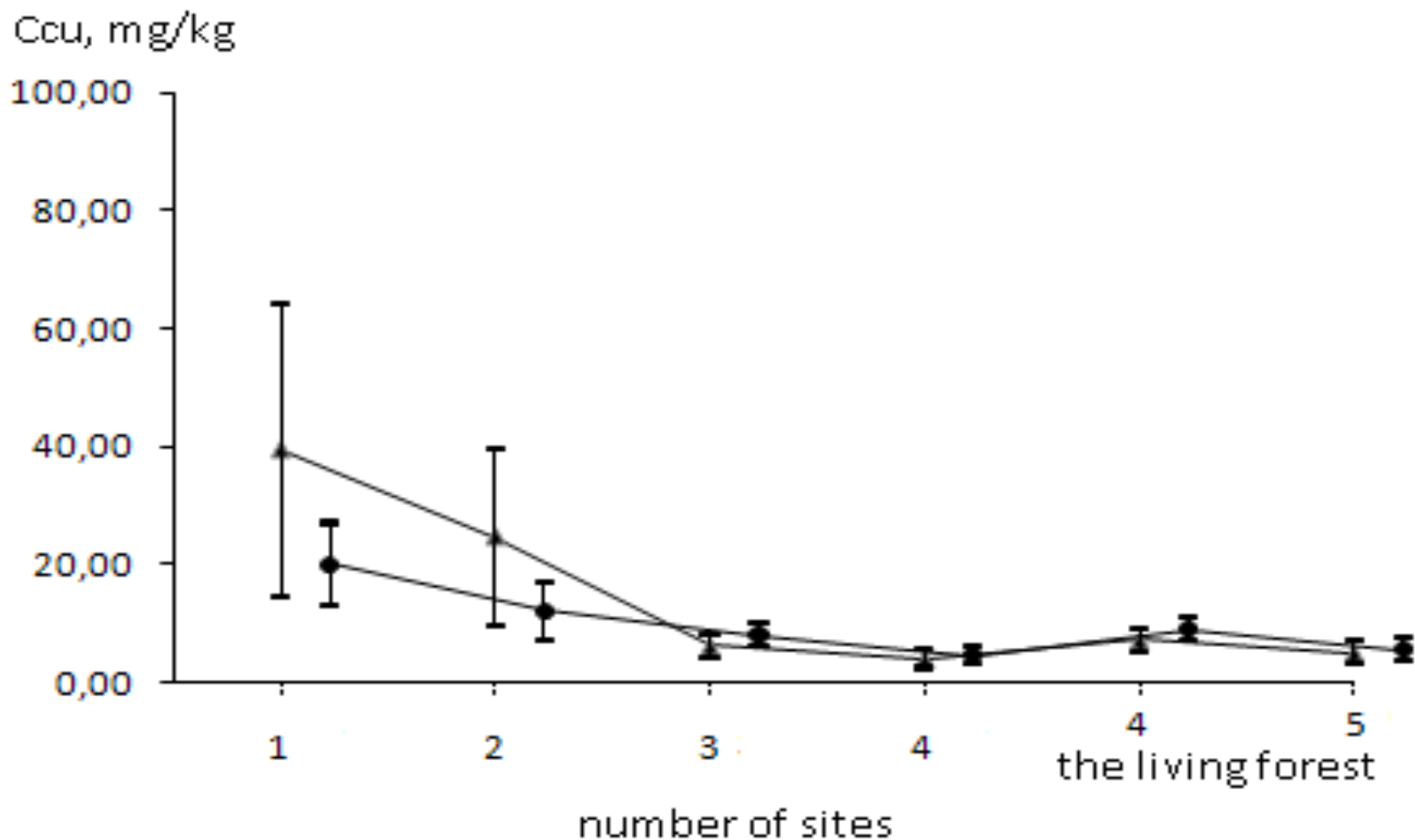
The sulfur content



● - heartwood, ▲ – sapwood

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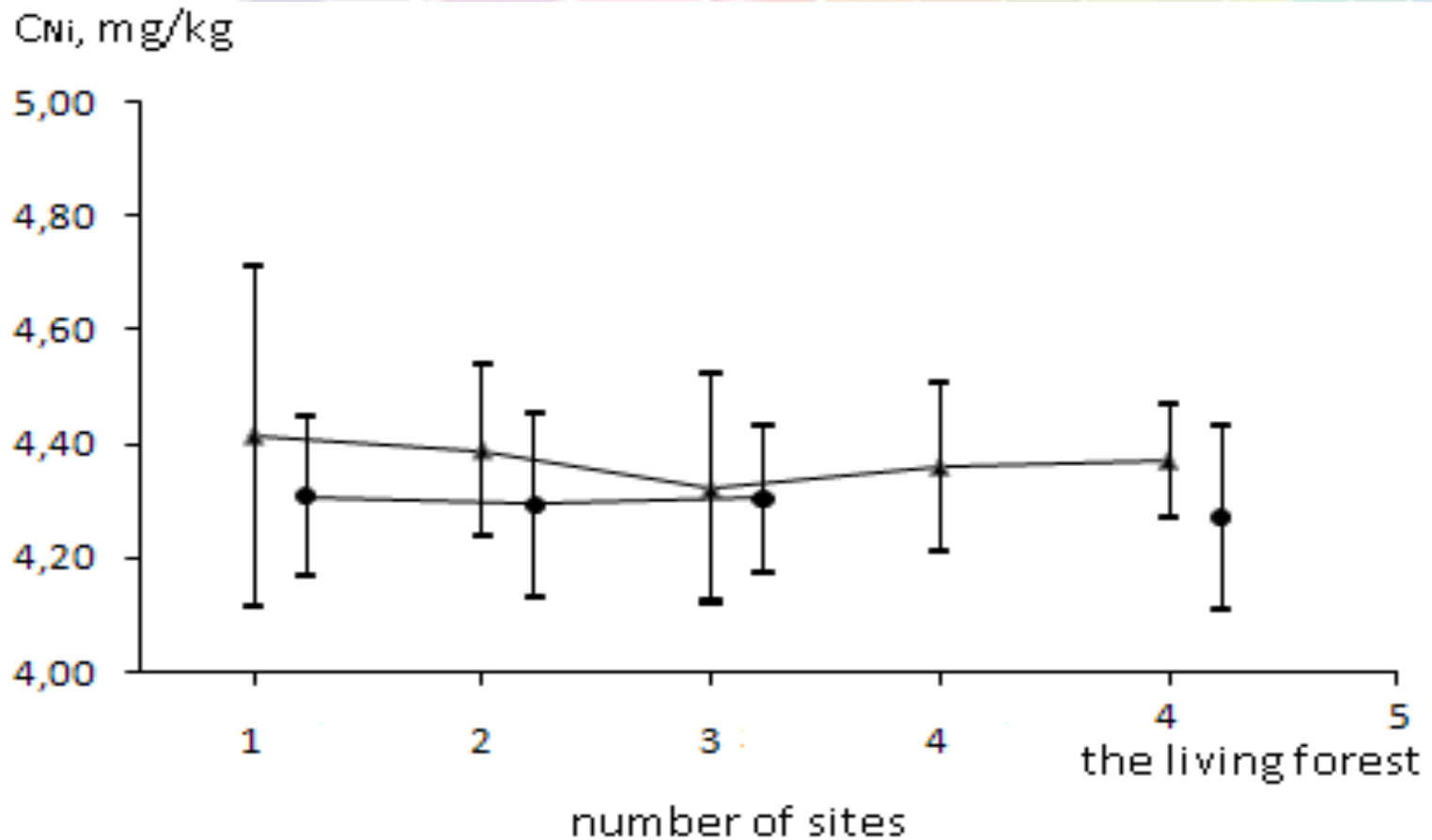
The copper content



● - heartwood, ▲ – sapwood

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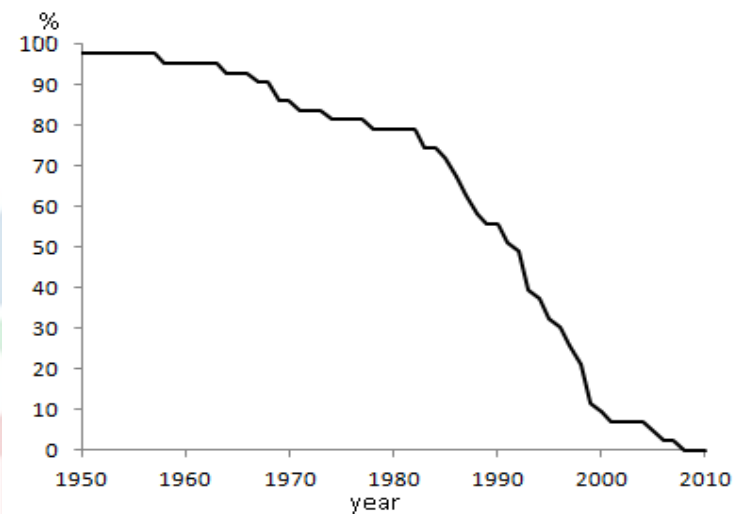
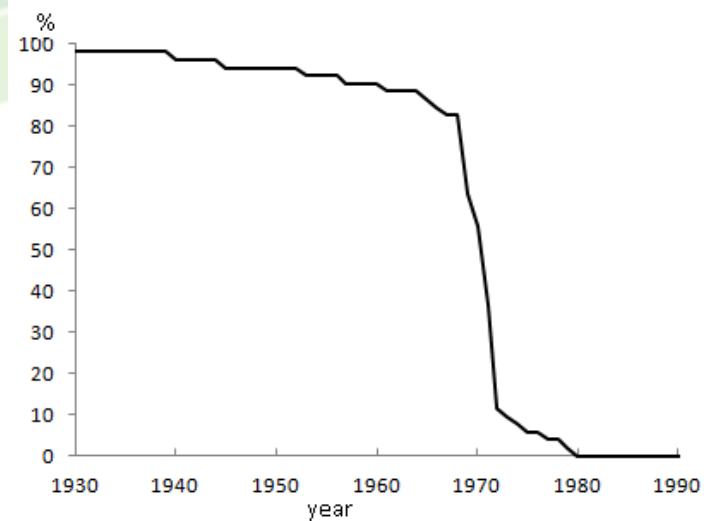
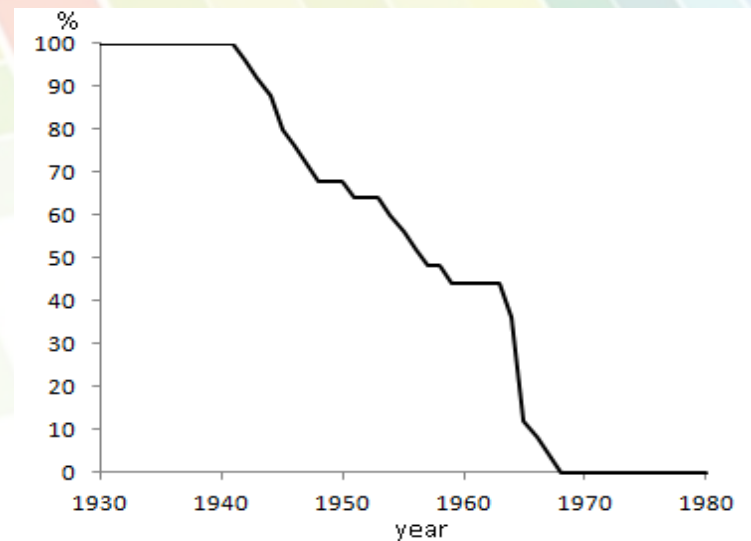
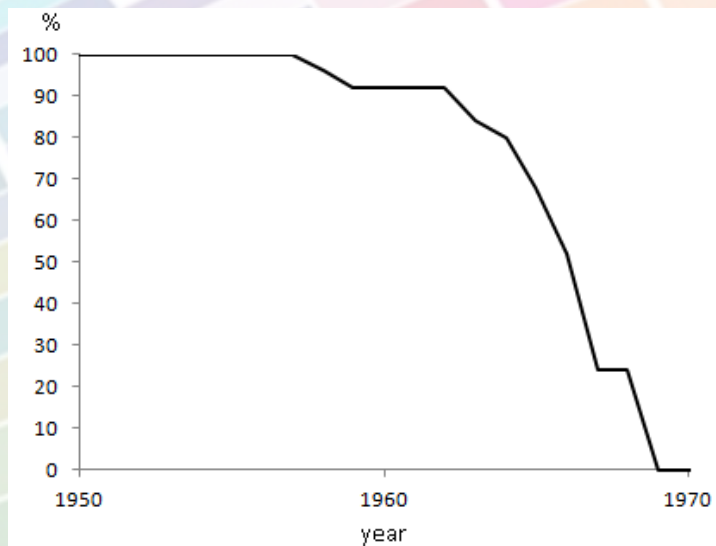
The nickel content



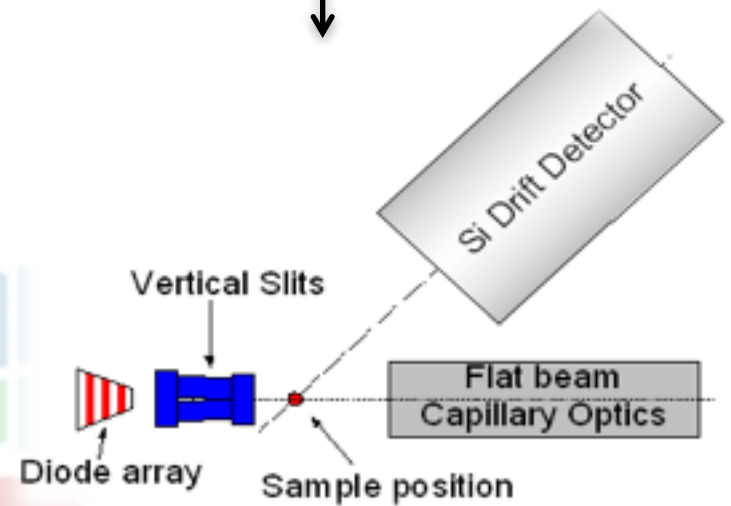
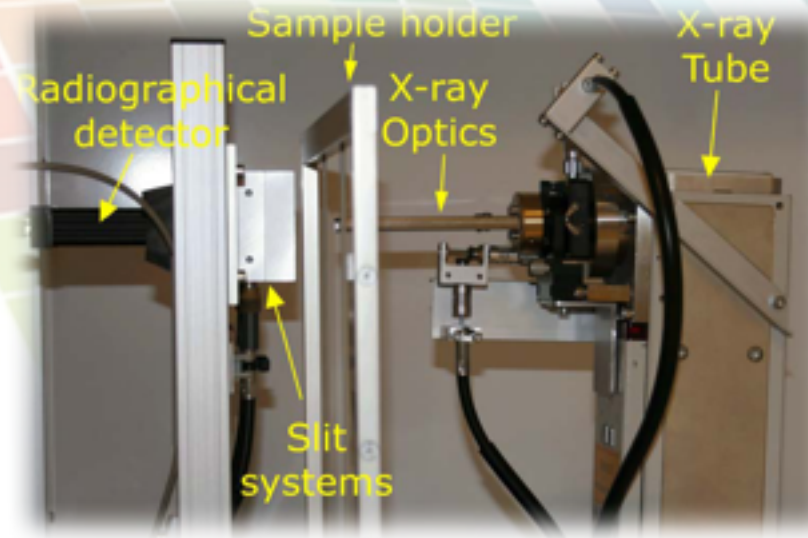
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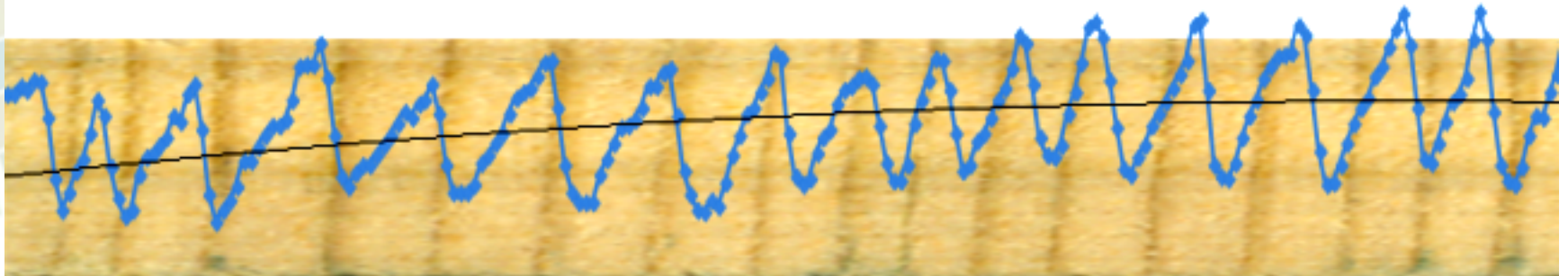
Dynamics of tree death



The ITRAX Multiscanner



Change in the concentration of calcium in the tree-ring



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Conclusions

- Elemental content of the wood samples was combined with the data on elemental content of soils. It was found, that the hydrogeological regime of the area, affects the content of heavy metals in soils, originating from manmade emissions of the enterprises of Norilsk industrial region. The maximum content in the studied elements in larch wood samples was found in the areas which are located on the way of gas and dust emissions in accordance with the wind rose. It is shown that the contamination of the explored areas is due to the air transport of anthropogenic emissions of companies, which is reflected in the accumulation of heavy metals and sulfur in the organic-soil horizons.
- Preliminary results demonstrate a high potential of multi-elemental analysis of tree-rings in detection of the features of changes in wood chemistry at one of the most polluted region of the world.
- Further research suggests to analyze the distribution of heavy metals in samples of wood with annual resolution

Thank you for your attention

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