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PROFESSIONAL ENGLISH
ATMOSPHERIC AEROSOLS IN ENVIRONMENT

Practicum
in
“Professional English”
for master students teaching according to master program
“Ecology and nature management”, “Ecological environmental problems”

2014

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PRACTICAL WORK 1
TERMINOLOGY RELATING TO ATMOSPHERIC AEROSOLS

1. Guess the meaning of key words

Key word	**the meaning of key words**
atmospheric aerosol	
arise from	
Smoke	
Dust	
Hazes	
Mists	
Suspension	
Particulate matter	

2. Read the text and answer the questions below.

The atmospheric aerosol is defined as an assembly of liquid and solid particles suspended in a gaseous medium, usually air, long enough to enable observation and measurement. These particles are very tiny objects with sizes typically around 100 nm. Therefore, usually they are not visible to the naked eye.

They play very important roles in atmospheric processes, environmental quality, and biochemical cycles of trace elements and compounds.

Particles in the atmosphere arise from natural sources, such as windborne dust, sea spray, and volcanoes. Anthropogenic aerosols category includes aerosols from transportation (e.g. tire and brake detritus, road dust etc.), coal combustion (fly ash etc.), cement manufacturing, metallurgical industries, and waste incineration.

Aerosols, aerocolloids, aerodisperse systems are suspension of fine solid or liquid particles in a gas.

Dust - Suspensions of solid particles produced by mechanical disintegration of material such as crashing, grinding, and blasting.

Hazes - An aerosol that impedes vision and may consist of a combination of water droplets, pollutants, and dust.

Smoke - Small gas-borne particles resulting from incomplete combustion.

Fume - The solid particles generated by condensation from the vapor state.

Mists - Liquid, usually water in the form of particles suspended in the atmosphere at or near the surface of the Earth.

Particulate matter pollution is nowadays one of the problems of most concern in great cities not only because of the adverse health effects but also for the reduced visibility; on a global scale effects on the radiative balance are also of great importance. That is why, air quality standards for PM10 and PM2,5 mass concentration was added in the European Directive (Directive 1999/30/EC).

Smog - A term derived from smoke and fog, applied to extensive contamination by aerosols. Now sometimes used loosely for any contamination of the air.

Fog - A loose term applied to visible aerosols in which the dispersed phase is liquid. Usually, a dispersion of water or ice, close to the ground.

Soot also called elemental carbon, black carbon or graphic carbon usually refer to small carbon particles generated in fuel combustion but is now frequently used to describe very fine solid particles of silica and other inorganic oxides generated intentionally in industrial processes.

Particles are eventually removed from the atmosphere by two mechanisms: deposition at the Earth's surface and incorporation into cloud droplets during the formation of precipitation.

3. Make-up abstract.

4. Answer the questions.

1. What is the atmospheric aerosol?
2. How is dust defined?
3. What is deference between fog and mists?
4. What is particulate matter?
5. What are convertible terms of “soot”?
6. What are the natural sources of aerosols?
7. What are the anthropogenic sources of aerosols?
8. How aerosols are removed from the atmosphere?

References

1. Kondratyev K.Ya., Ivlev L.S., Krapivin V.F., Vatotsos C.A. Atmospheric aerosol properties: formation, processes and impacts – Springer, 2006.
2. Levin Z., Cotton W.R. et. All. Aerosol pollution: impacts on precipitation – Springer, 2009.

PRACTICAL WORK 2
AEROSOL CLASSIFICATION

1. Guess the meaning of key words

Key word	**the meaning of key words**
Sea-salt aerosol	
Dust aerosol	
Biological aerosols	
Anthropogenic aerosol	
primary aerosol sources	
secondary aerosol sources	
eject from	
persistent	

2. Read the text and answer the questions below.

Aerosols are tiny particles suspended in the air (mostly in the troposphere). Atmospheric aerosols are usually classified in terms of their origin and chemical composition. Anthropogenic sources are those determined by human activity.

The atmospheric aerosols, depending on their composition or sources, are classified into the following types of natural aerosols: Products of sea spray evaporation; Mineral dust wind-driven to the atmosphere; Volcanic aerosol; Particles of biogenic origin; Smokes from biota burning on land; Products of natural gas-to-particle.

About 11 percent of the total emitted aerosols in our atmosphere come from human activities, such as the burning of vegetation and fossil fuels and changing the natural land surface cover, which again leads to windblown dust. For example, anthropogenic aerosols are presented by black carbon, volatile organic compounds (VOC), aromatic VOC.

Sea-salt aerosol originates from the oceanic surface due to wave breaking phenomena. The largest droplets fall close to their area of origin. Only the smallest aerosol particles with sizes from approximately 0.1 to 1 micrometers (e.g., those formed by the bursting of bubbles at the ocean surface) are of a primary importance to the large-scale atmospheric aerosol properties. These particles can exist in the atmosphere for a long time. They have been identified over continents as well.

Dust aerosol originates from the land surface. It is composed of solid particles. Most of particles (e.g., composed of Si) are not soluble in water. It is represented by a mixture of different minerals as often seen in the grains of road dust.

Biological aerosols (BA) are characterized by the extreme particle size range and enormous heterogeneity. Biological material is present in the atmosphere in the form of pollens (пыльца), fungal spores, bacteria, viruses, insects, fragments of plants and animals, etc.

Volcanic aerosols originate due to emissions of primary particles and gases (e.g., gaseous sulfur) by volcanic activity. Most of the particles ejected from volcanoes (dust and ash) are water-insoluble mineral particles, silicates, and metallic oxides such as SiO_2, Al_2O_3 and Fe_2O_3, which remain mostly in the troposphere.

The main source of *stratospheric aerosol* is volcanic emissions. As volcanoes erupt, they blast huge clouds into the atmosphere. These clouds are made up of particles and gases, including sulfur dioxide (SO_2). Millions of tons of sulfur dioxide gas from a major volcanic eruption can reach the stratosphere. There, with the help of water vapor (H_2O), the sulfur dioxide converts to tiny persistent sulfuric acid (H_2SO_4) aerosols. These aerosols reflect energy coming from the sun, thereby preventing the sun's rays from heating Earth's surface.

A significant fraction of the *tropospheric* aerosol is anthropogenic in origin. Tropospheric aerosols contain sulfate, ammonium, nitrate, sodium, chloride, trace metals, carbonaceous material, crustal elements, and water.

Aerosol sources are classified into primary and secondary types. Primary aerosols are those that are emitted into the atmosphere directly as condensed solids or liquids. Sea salt, mineral dust and soot particles are clearly primary particles.

Particles can be generated in the atmosphere by gas-to-particle conversions - secondary aerosols. This aerosol is composed of mostly sulfates and nitrates. Also various organic substances (originating, for example, from gases emitted by plants) can make a large contribution in the total aerosol mass (Seinfeld and Pandis, 1998). In particular, SO_2 is oxidized to H_2SO_4 and the rate of conversion is influenced by the presence of heavy metal ions (e.g., Fe, Mn, V).

3. Make-up abstract.

4. Answer the questions.

1. What types of natural aerosols are indicated?
2. What types of anthropogenic aerosols are indicated?
3. What is the main source of stratospheric aerosol?
4. What are the main sources of tropospheric aerosol?
5. How is Sea-salt aerosol originated?
6. What primary aerosol sources are indicated?
7. What secondary aerosols are composed of?

References

1. Kondratyev K.Ya., Ivlev L.S., Krapivin V.F., Vatotsos C.A. Atmospheric aerosol properties: formation, processes and impacts – Springer, 2006.
2. Levin Z., Cotton W.R. et. All. Aerosol pollution: impacts on precipitation – Springer, 2009.

PRACTICAL WORK 3
SIZE OF ATMOSPHERIC PARTICLES
HEALTH EFFECTS OF ATMOSPHERIC PARTICLES

3.1. SIZE OF ATMOSPHERIC PARTICLES

1. Guess the meaning of key words

Key word	**the meaning of key words**
ultra fine	
fine	
coarse	
nuclei mode	
accumulation mode	
refer to	
residence time	
sedimentation velocities	

2. Read the text and answer the questions below.

An aerosol is technically defined as a suspension of fine solid or liquid particles in a gas, common usage refers to the aerosol as the particulate component only. Atmospheric aerosols consist of particles ranging in size from a few tens of angstroms (A) to several hundred micrometers.

Particles smaller than 0.1 micrometers are called “ultra fine”. Particles less than 2.5 micrometers in diameter are generally referred to as and "fine" and those greater than 2.5 micrometers diameter as "coarse".

The fine and coarse particle modes, in general, originate separately, are transformed separately, are removed from the atmosphere by different mechanisms, require different techniques for their removal from sources, have different chemical composition, have different optical properties, and differ significantly in their deposition patterns in the respiratory tract.

Fine particles can often be divided roughly into two modes: the nuclei mode and the accumulation mode. The nuclei mode, extending from about 0.005 to 0.1 micrometers diameter; because of their small size, these particles rarely account for more than a few percent of the total mass of airborne particles. Particles in the nuclei mode are formed from condensation of hot vapors during combustion processes and from the nucleation of atmospheric species to form fresh particles. They are lost principally by coagulation with larger particles.

The accumulation mode, extending from 0.1 to about 2.5 micrometers diameter, usually accounts for most of the aerosol surface area and a substantial part of the aerosol mass. The source of particles in the accumulation mode is the coagulation of particles in the nuclei mode and from condensation of vapors onto existing particles, causing them to grow into this size range. The accumulation mode is so named because particle removal mechanisms are least efficient in this regime, causing particles to accumulate there.

The coarse mode, from >2.5 micrometers diameter, is formed by mechchanical processes and usually consists of man-made and natural dust particles. Coarse particles have sufficiently large sedimentation velocities that they settle out of the atmosphere in a reasonably short time. Because removal mechanisms that are efficient at the small and large particle extremes of the size spectrum are inefficient in the accumulation range, particles in the accumulation mode tend to have considerably longer atmospheric residence times than those in either the nuclei or coarse mode.

3. Make-up abstract.

4. Answer the questions.

8. What classes of aerosol particles on their size are indicated?
9. What types of particles are referred to "fine"?
10. What types of particles are referred to "coarse "?
11. What types of modes are fine particles divided?
12. What are the features of nuclei mode?
13. What types of modes have long atmospheric residence times?
14. What are the sources of coarse particles?

3.2. HEALTH EFFECTS OF ATMOSPHERIC PARTICLES

1. Guess the meaning of key words

2.

Key word	**the meaning of key words**
adverse	
mucous linings	
cough	
nasopharyngeal tract	
lungs	
inflammatory	
respiratory	
health effects	

3. Read the text and answer the questions below.

Airborne aerosols affect many aspects of human health and the environment. Although you may not realize its presence, the aerosol plays an important role in your health!!! Health effects of airborne particles have been studied extensively.

The inhalation route has long been recognized to be a major pathway for disease transmission (e.g. flu, allergy). In recent years, administration of medicine and diagnosis of health condition through aerosol delivery has also become an increasingly important field. The deposition of the aerosol agents in the respiratory system depends on particle size. More recent studies indicate that fine particles (PM 2.5 μm in diameter) are more likely associated with adverse health effects than other fractions. The largest inhaled particles (5 micron m to somewhat greater than 10 micron m) are deposited in the mucous linings of the nasopharyngeal tract. Progressively smaller particle sizes are deposited in successively deeper portions of the respiratory tract by entrapment in a layer of mucous lining the airways. The particle-laden mucous is cleared from the trachea and bronchi in part by coughing. Particles less than ~2 micron m in size reach the alveoli, the deepest portions of the lungs, where the most active exchange of oxygen and carbon dioxide occurs. These particles can promote pathogen development and absorption into the blood stream.

There has been increasing attention in recent years to the potential health effects of ultrafine particles less than 100 nm in diameter due to their large surface area-to-volume ratio and ability to penetrate deeper into the respiratory tract. *In vivo* experiments with fine and ultrafine compounds of the same particles, such as metallic nickel, have shown that the ultrafine particles, for a given dose by mass, result in a greater inflammatory response than fine particles.

Thus, aerosol mass and its toxicity are known to have links to chronic respiratory and acute cardio-vascular problems.

3. Make-up abstract.

4. Answer the questions.

1. What is airborne particles size associated with adverse health effects than other one?
2. What respiratory diseases can aerosols cause?
3. What are inhaled particles deposited in the nasopharyngeal region?
4. What are inhaled particles deposited in the alveolar region?

References

1. Kondratyev K.Ya., Ivlev L.S., Krapivin V.F., Vatotsos C.A. Atmospheric aerosol properties: formation, processes and impacts – Springer, 2006.
2. Levin Z., Cotton W.R. et. All. Aerosol pollution: impacts on precipitation – Springer, 2009.

PRACTICAL WORK 4

Video task *Watch the video "Aerosols and climate change" about aerosol study in Space Agency of France*

I. Before watching discuss the meaning of the words and phrases:

- effect
- predict climate change
- originate from
- occur
- reflect sun light back into space
- solar radiation
- scatter light
- observe
- vary
- probe the atmosphere

II. While watching make notes to answer the following questions:

1. What is CNES?
2. What is CALIPSO and what for is it used?
3. What are aerosols?
4. How are aerosols originating?
5. What can you say about the relationship between clouds and aerosols?
6. How aerosols effect on climate change?

III. Discuss in the group: Why do we care about aerosols?

PRACTICAL WORK 5

STUDY OF SUBSTANTIAL COMPOSITION OF INSOLUBLE PARTICLES OF SNOW BY SCHLICH ANALYSIS

Purpose and tasks.

The purpose of the work is to improve theoretical knowledge obtained in the course of «Aerosols in environment» and develop practical skills in determination of anthropogenic and mineral formations in samples of snow solid residue.

The tasks of research include examination of theoretical material; investigation of substantial composition of snow residue samples.

The investigation material is real samples collected in different urban regions in the course of research work on the given territories. Besides, the material can serve concrete samples selected by the students.

The variant of the problem is shown in Table 5.1.

Table 5.1

The sample number for students

Sample number	Sample characteristics
1	impact area of Power Station-2
2	impact area of reinforced concrete plants
3	impact area of brickworks
4	campus of TPU

The scheme of sample study

1. Calculation of dust load.
2. Microscopic examination of snow solid residue samples.
3. Determination of percentage for natural mineral particles, biogenic constituents and anthropogenic formations in the bulk sample of snow solid residue.
4. Prepare the report or presentation on the practicum.

The dust load is calculated (in mg/m^2*daily) and substantial composition of snow solid residue samples is investigated.

Dust load is calculated by the formula (5.1):

$$P_n = P_o \ / S \times t \tag{5.1}$$

where:

P_n – dust load, mg/m^2 per day (kg/km^2 per day);

P_o – weight of the snow solid residue, mg (kg);

S – square of the pit, m^2 (km^2);

t – number of days from snow-up day (the day when snow falls out and does not melt) to sampling day.

The obtained dust burden values are mapped on the scheme and isolines are drawn in terms of the contamination levels:

less than 250 mg/m^2 per day – low contamination level;

250-450 mg/m^2 per day – middle one;

450-850 mg/m^2 per day – high one;

more than 850 mg/m^2 per day – very high one.

The contamination levels are taken from reference (Методические…, 1982).

Table 5.2

Data on snow formation

Snow-up day: 15.11.2011

Number of samples	Sample characteristics	Sampling day	Size of pit, m^2	Weight of solid residue, g	P_n, mg/m^2 per day
1	impact area of Power Station-2	19.03.2011	0,128	1,6	
2			0,18	0,7	
3			0,14	1,6	
4			0,16	1,3	
5			0,132	0,8	
Average P_n					
1	impact area of bri-kworks	19.03.2011	0,152	4,1	
2			0,16	9,1	
3			0,172	5,5	
4			0,14	2,3	
5			0,148	3,0	
Average P_n					
1	impact area of reinforced concrete plants	21.03.2011	0,06	1,0	
2			0,05	0,9	
3			0,08	0,9	
4			0,08	0,9	
5			0,08	0,8	
Average P_n					
6	campus of TPU	19.03.2011	0,132	0,9	

To calculate the dust load the data from Table 5.2 are used. Table 5.2 should be filled in completely. The background value is 7 mg/m^2 per day.

Then the microscopic examination of snow solid residue samples is performed in details. The study of substantial composition of snow cover solid residue is made on the basis of invention patent № 2229737 on October, 17, 2002. (Язиков Е.Г., Шатилов А.Ю., Таловская А.В. Способ определения загрязненности снегового покрова техногенными компонентами).

Microscopic examination of samples is carries out by the binocular stereoscopic microscope (LEICA, MBS-9).

In the samples of snow solid residue there can be mineral (quartz, feldspar, mica, carbonate, organic particles) and anthropogenic (soot, coal particles, slag, metallic spherules etc.) formations. One should be identified, taken photo and characterized each type of particles. Detailed study of microparticles makes possible to characterize particles with determination of color, luster, hardness, transparency, form, and size of particles, characteristic of surface, degree of roundness and oxidization. There are collection of the particles and guideline in form of the presentation about the particles types. It makes possible to identify types of mineral and anthropogenic particles in the samples.

Report or presentation content.

Having done the laboratory work there should be prepared a report or presentation.

The work includes the following parts:

1. Research methods.
2. Results of research in substantial composition.

Conclusion

References.

In the introduction one should state the purpose of work, initial material, and main research tasks.

The first part includes characteristics of the research methods.

The second part presents the results of dust load calculation in the form of table or diagrams and with determination of contamination level for the researched site. The main types of natural mineral and biogenic particles and those of anthropogenic particles with their characteristic (color, transparency, size, roundness, source etc.) are enumerated. Photos or pictures of all types of particles are given. Sources of mineral and anthropogenic components on the researched sites are pointed out.

In the final part there should be conclusion and references.

REFERENCES

1. Some aspects of ecological problems: textbook/ N.V. Baranovskaya, I.A. Matveenko, R.M. Danilenko, A.V. Talovskaya. – Tomsk: TPU pub.eddition, 2009. – 110p.

2. Yazikov E.G., Talovskaya A.V., Nadeina L.V. Geoecological environmental monitoring: coursebook. − Tomsk: TPU publishing house, 2013. – 135 p.

PRACTICAL WORK 6

STUDY OF SUBSTANTIAL COMPOSITION OF INSOLUBLE PARTICLES OF SNOW BY SCANNING ELECTRON MICROSCOPY METHOD

Purpose and tasks.

The purpose of the work is to improve theoretical knowledge obtained in the course of «Atmospheric aerosols in environment» and develop practical skills in determination of anthropogenic and mineral formations in samples of snow solid residue.

The tasks of research include examination of theoretical material; snow sampling; investigation of substantial composition of snow residue samples.

The investigation material is real samples selected in different urban regions in the course of research work on the given territories. Besides, the material can serve concrete samples selected by the students.

The scheme of sample study

I stage

1. Snow sampling.
2. Preparation of snow samples for analysis.

II stage

1. Preparation of samples for research at scanning electron microscope.
2. Work at electron-scan microscope Hitachi S 3400N.
3. Work at the energy dispersion spectrometer (Bruker) with use of system of energy dispersion microanalysis QUANTAX.
4. Analysis of the result obtained and report design.

At the first stage one should take samples on the territory of a definite object and prepare it for analysis or use the material suggested by a lecturer.

At the second stage one should work at electron-scan microscope to investigate substantial composition of snow solid residue samples.

The most types of geological samples require pretreatment before placing of SEM samples in chamber. It is often required to clean material of sample from extraneous contaminants. It is necessary to dry sediment and soil samples. When picking out many samples contain extraneous components which can prevent further studying and it is necessary to remove them.

At normal state some materials absorb moisture and they must be dried before placing of SEM samples in chamber.

Samples for SEM usually are fastened on “special holder of sample” in aluminium disk with a short “leg” 1 cm in diameter to fasten it on the table in chamber of microscope.

To fasten samples it is often used double-faced adhesive tape (double-faced sticky tape). Quick-drying glue can be used instead of it. It is very important all used ancillary materials will have low steam pressure not to break vacuum in the device. Whatever the material is used to fasten sample, the investigated surface of sample must be grounded in order to provide charge sink. Using stable wax in vacuum gives advantages for fixation of small pieces of samples.

Polish isn't always required for SEM analysis. In a number of cases grains can be dispersed upon the surface of sticky tape or upon the dried surface of graphitic plate and also as suspension or drop in which sample consisting of small particles is placed and then it is evaporated.

The most geological samples are dielectrics and they don't conduct current but in order to remove from the surface electric charge forming when electron bombed it is necessary to spray an electroconductive layer on them and use low operating voltage or rough vacuum electron microscope.

Carbon is the most appropriate element for spraying because of it has got minimal X-ray spectrum with low energy.

In an effort to be identified samples must be marked.

Aluminium "beads" for SEM can be signed with a metallic needle or a pen. In case of epoxy blocks ("checkers") in which samples are placed before polish, paper with marking can be put straight in epoxy resin on back side.

It can be very difficult to find analyzed zones in SEM because of increase and small field of vision on the surface of sample.

To save time it is necessary to prepare a map of surface of sample. This map should be obtained with the help of the measuring optical microscope, having a coordinate grid. It is necessary to take a photograph of the required parts under various increases.

Work at electron-scan microscope Hitachi S 3400N.

The stage of the electron microscope preparation to work and performance the measurement is carried out by staff especially taught in electron microscopy.

In operation the student has to familiarize with basic stages of investigations. And also the student has to carry out studying of sample under various increases and various accelerating voltage, to familiarize with working of vacuum system.

With the help of reflected electron and secondary electron detectors the student has to obtain a qualitative picture and has to retain pictures to illustrate the lab work.

Work at the energy dispersion spectrometer (Bruker) with use of system of energy dispersion microanalysis QUANTAX.

QUANTAX system is generic system of energy dispersion microanalysis to determine chemical composition of solid samples, thin layers or particles by electron microscopes. Using X-rays system of energy dispersion microanalysis (EDS) it can determine all elements from beryllium (4) to americium (95) at the same time and it can obtain the information of elemental composition with spatial expansion in 1 micron and detection limit of tenth proportions of mass percent.

At the given stage of the laboratory work a student has to master the basic principles of obtaining and spectrum processing of studied sample.

The basic stages of spectrum global analysis:

1. Accumulation of spectrum
2. Correction of detector's effects
3. Identification of elements and selection of series of spectrum lines for each element

4. Calculation of background bremsstrahlung radiation (i.e. bremsstrahlung radiation)
5. Separation of superposing peaks and calculation of clean intensities.
6. Calculation of concentrations with using etalons and with the help of without etalon methods
7. Formatting and presentation of results

Analysis of the result obtained and report design.

At the stage the analysis of information obtained is carried out.

It is necessary to carry out diagnostics of substance with specification of chemical formula, impurities with invoking X-ray microanalysis. It is necessary to design the report.

Report content and preparation.

The lab work report is to be made on white paper sheets of A4 size in printed form. The text volume is 5–7 pages. The work is to consist of the following parts:

1. Title page.
2. Purpose of the lab work
3. Theoretical bases of the method and device operation Hitachi S 3400N.
4. Theoretical bases of X-rays microanalysis and system performance QUANTAX.
5. Preparation of samples for research.
6. Experiment procedure with sample chemical characteristic presented in the form of pictures, spectra and tables.
7. Conclusions with recommendation on possibility of application for the studied substance.
8. The list of references.

References

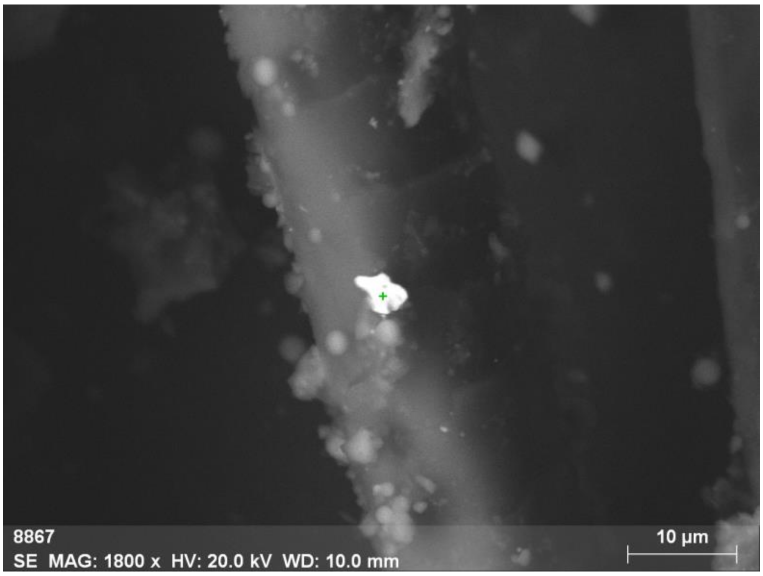
1. Reed, S.J.B., 2005. Electron microprobe analysis and scanning electron microscopy in Geology. Cambridge University Press, 206 pp.
2. Yazikov E.G., Talovskaya A.V., Nadeina L.V. Geoecological environmental monitoring: coursebook. − Tomsk: TPU publishing house, 2013. – 135 p.

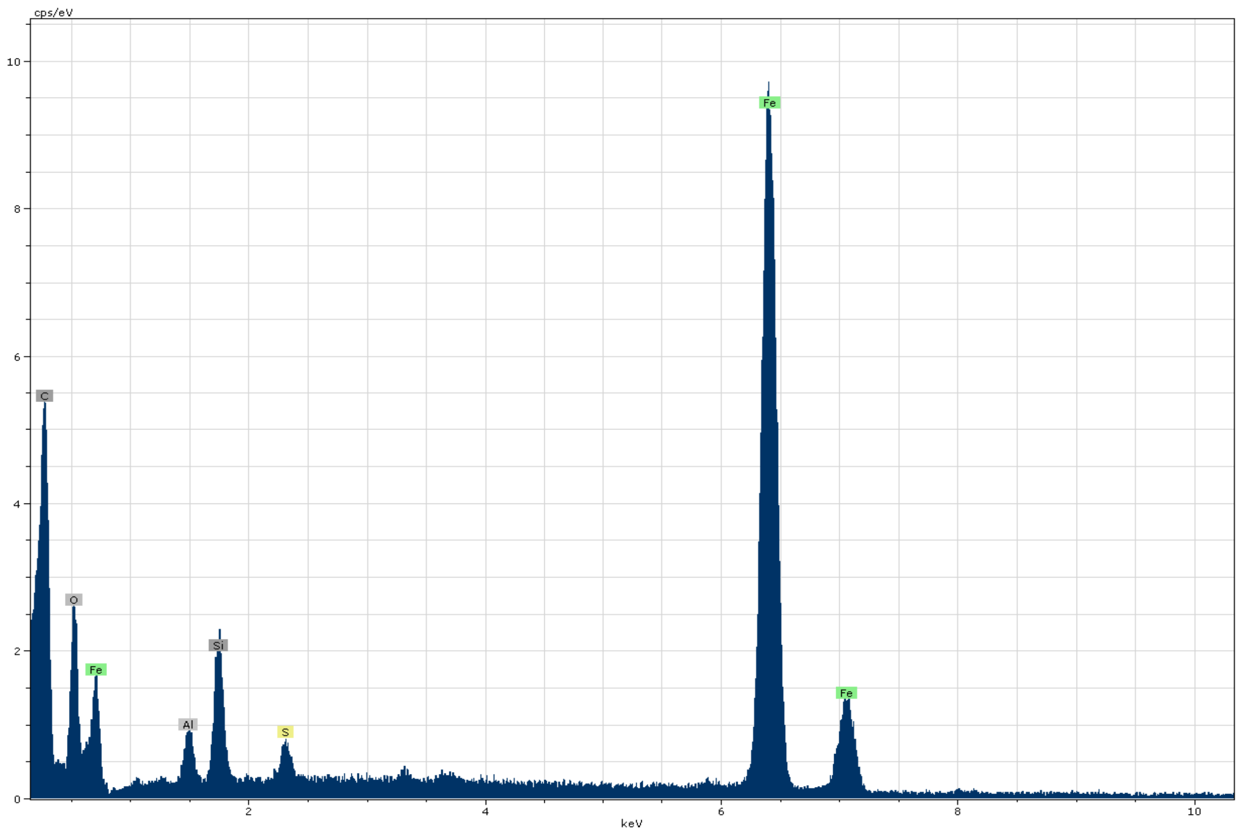
Task: Sample from impact area of power station

1. Characterize particles with determination of form, and size of particles, characteristic of surface and etc.

2. Determine of types of particle and mineral using ED spectrum.

№ 1





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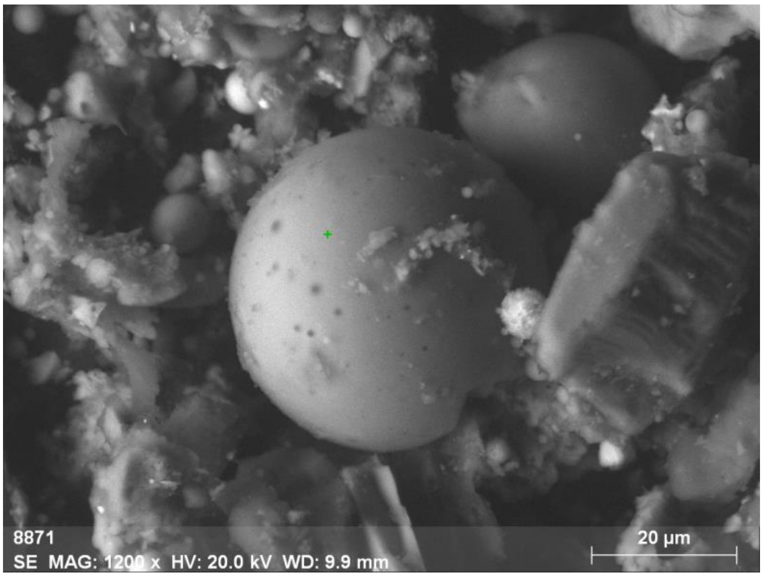
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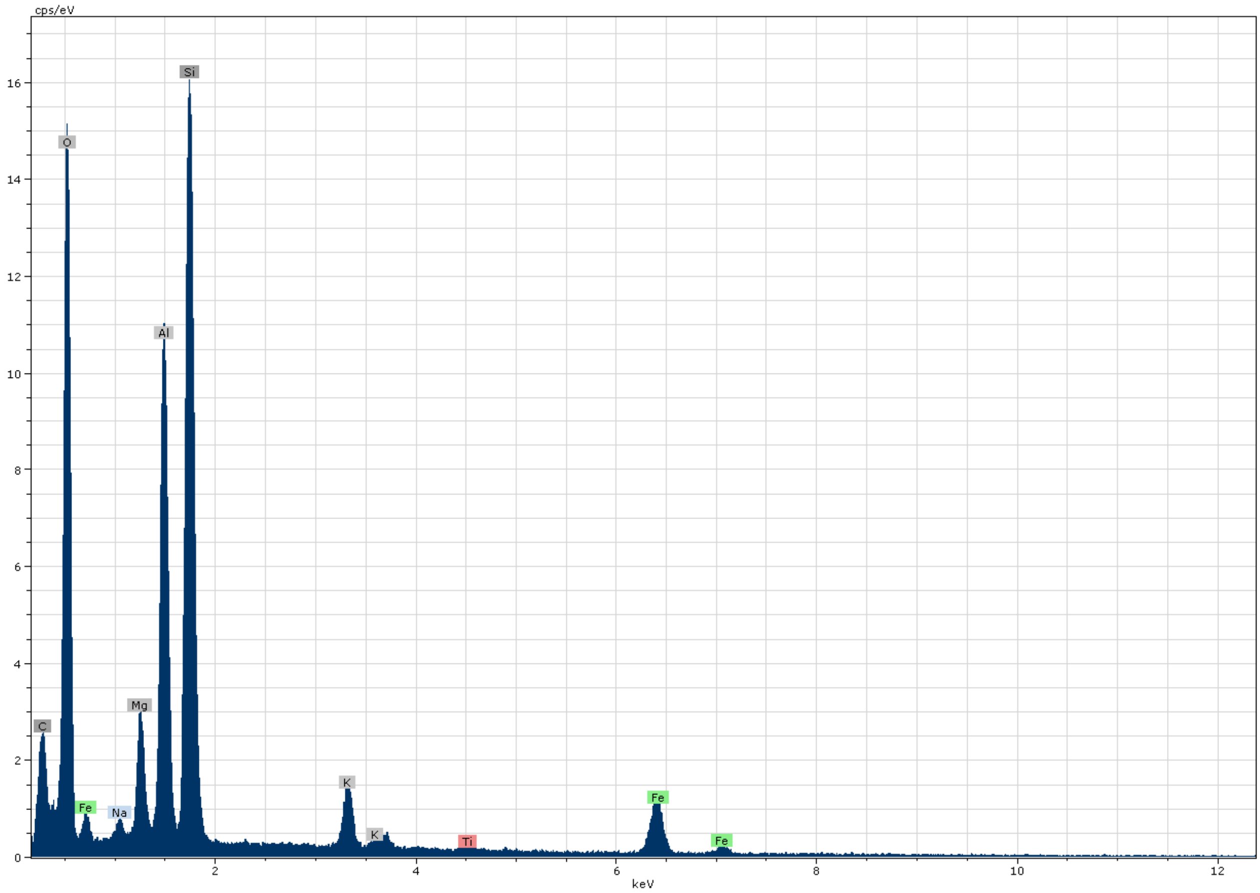
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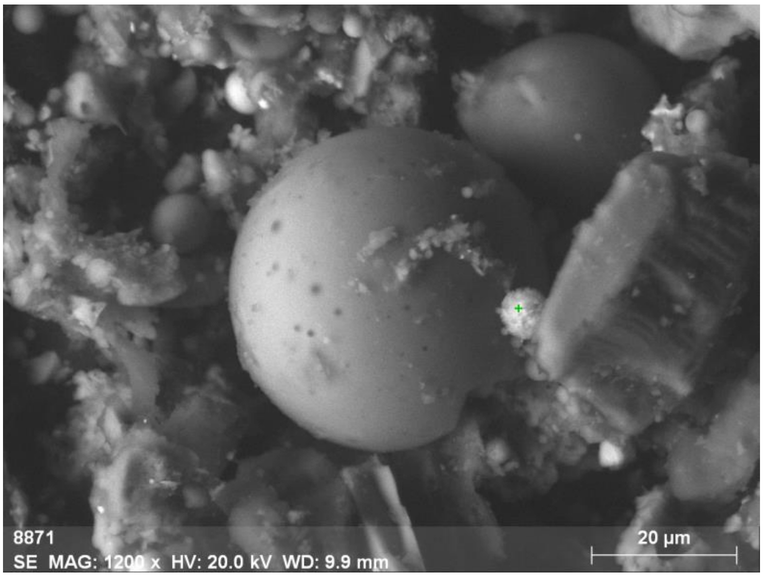

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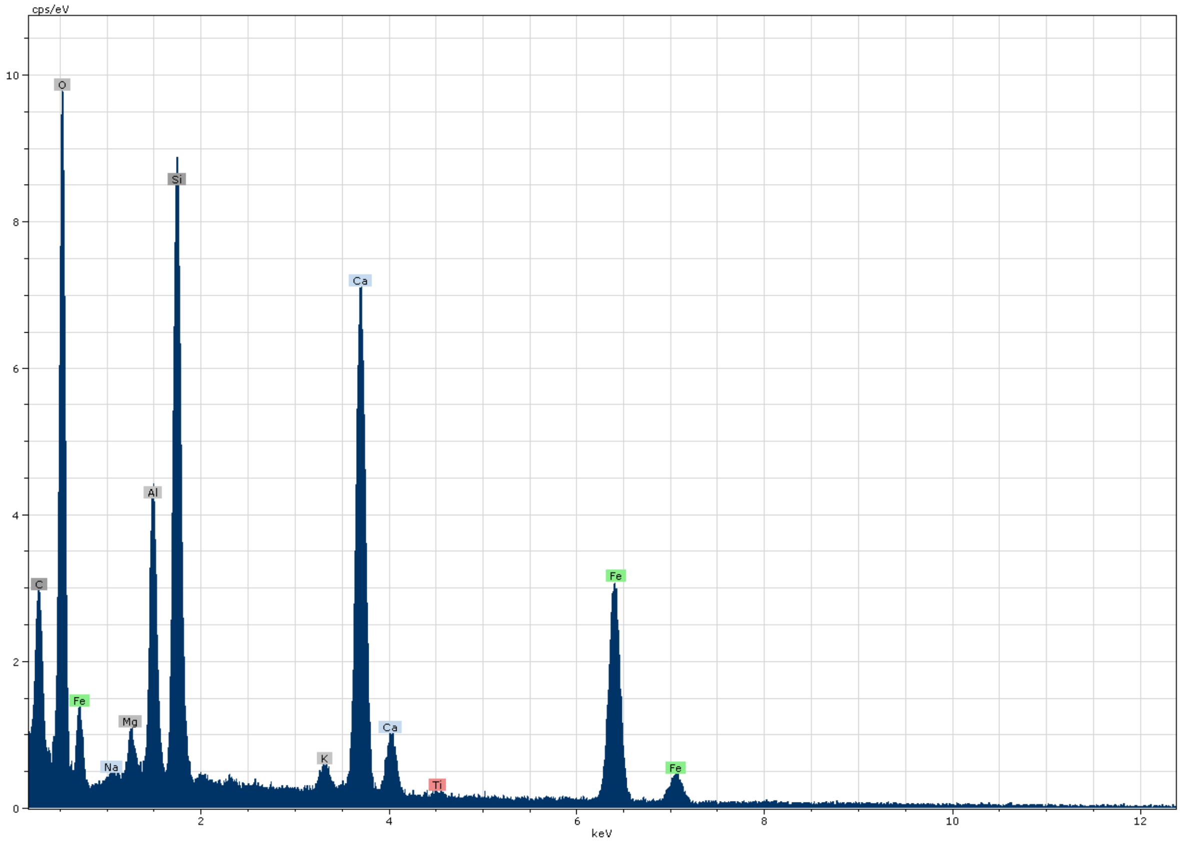

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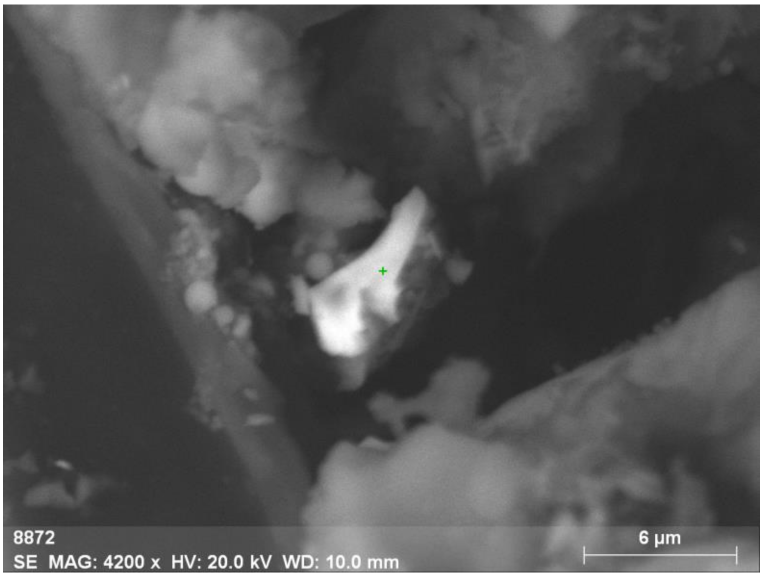
№ 4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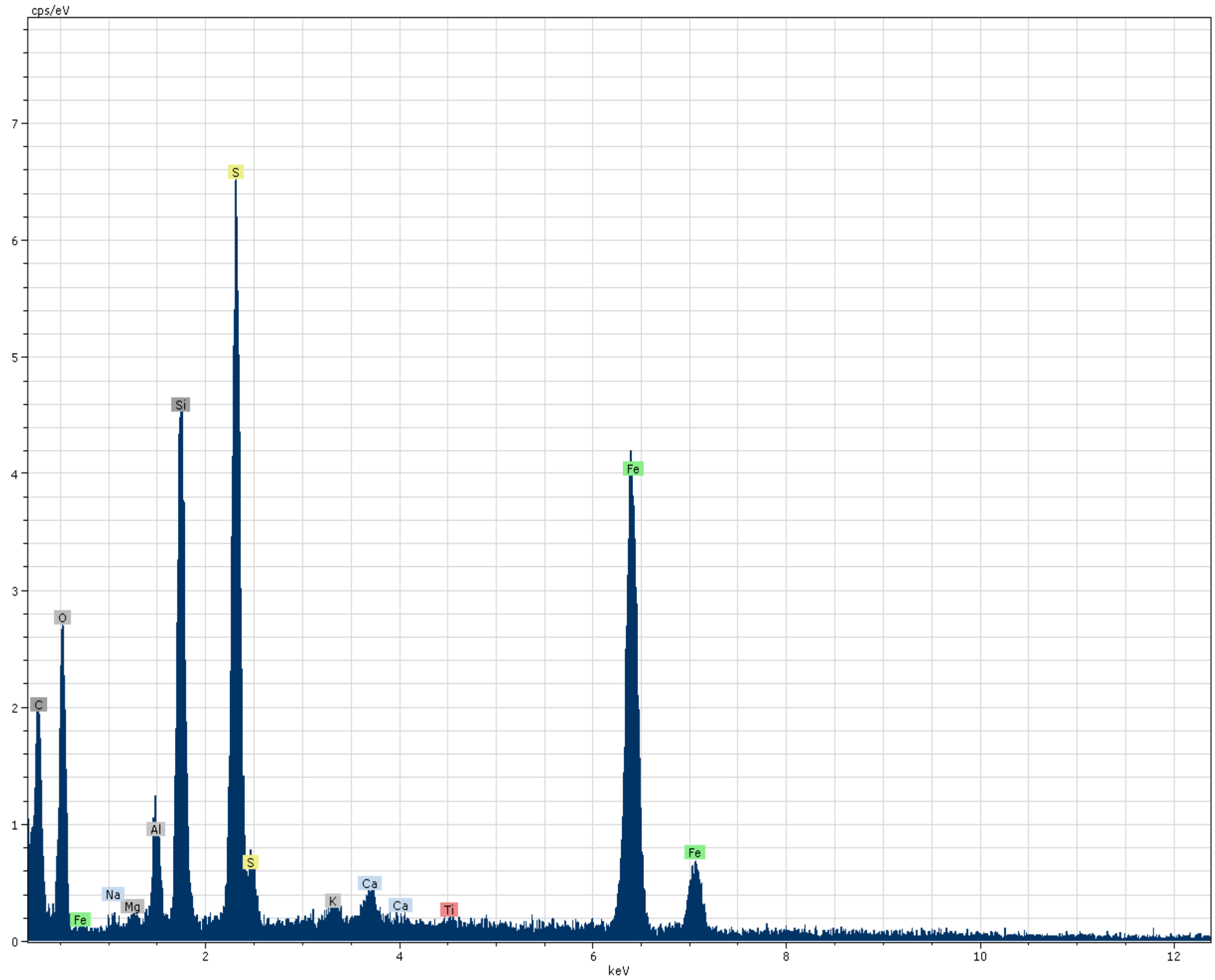
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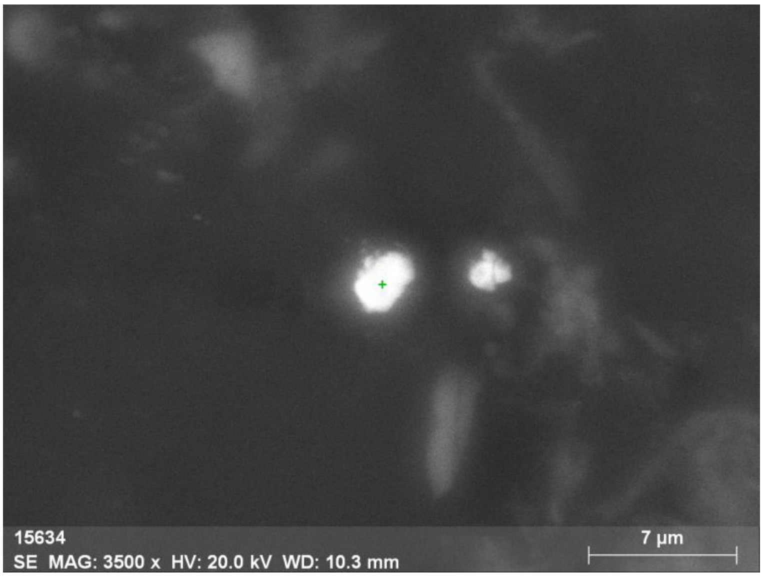
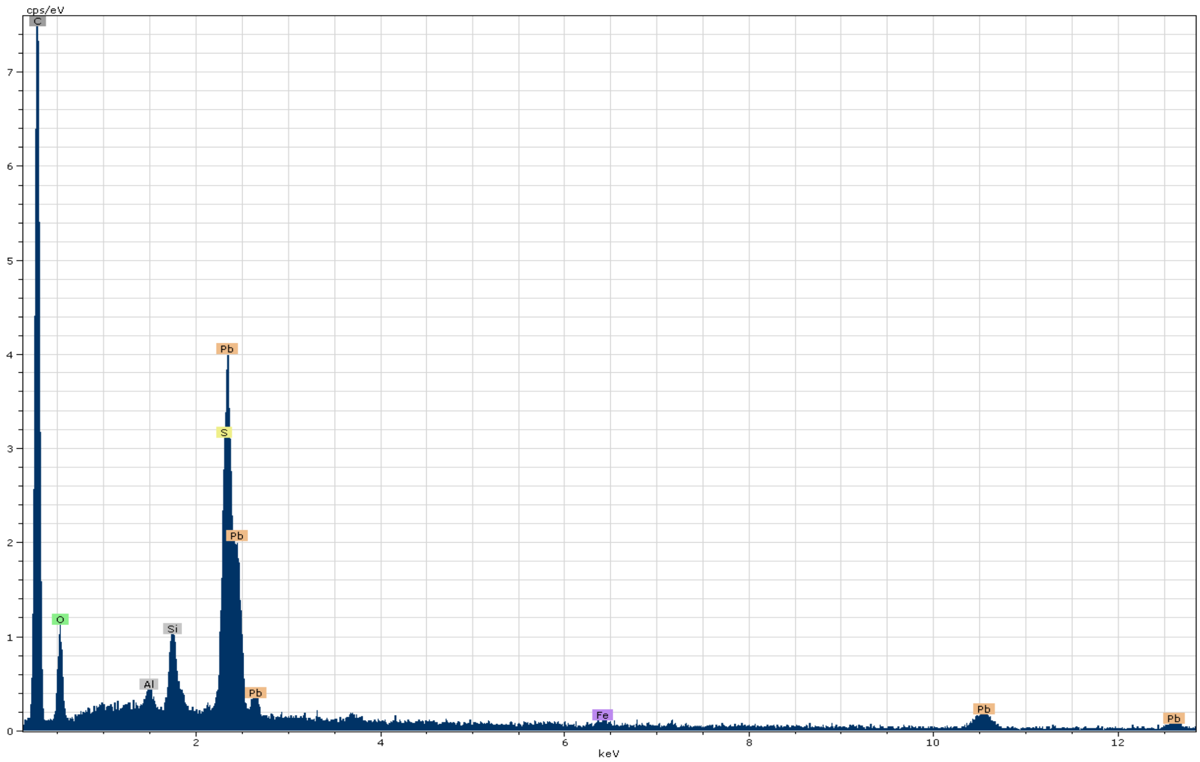
№ 5


15634
SE MAG: 3500 x HV: 20.0 kV WD: 10.3 mm
7 µm


cps/eV
C
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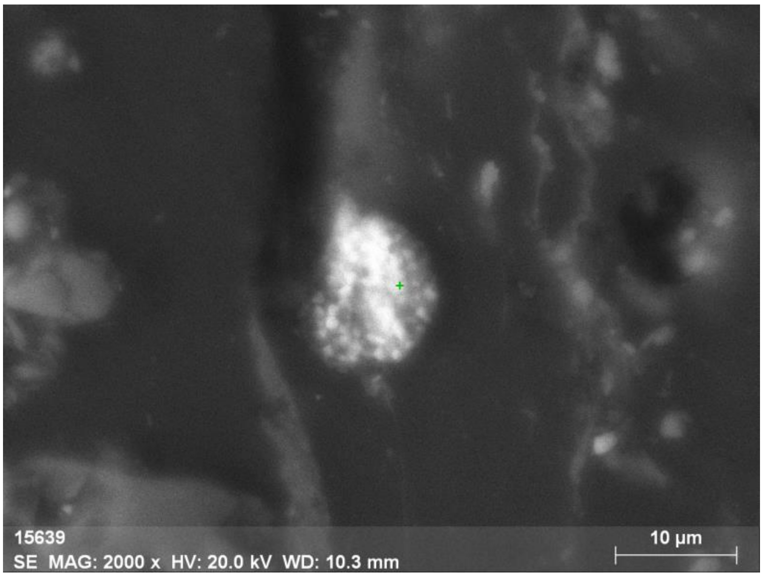
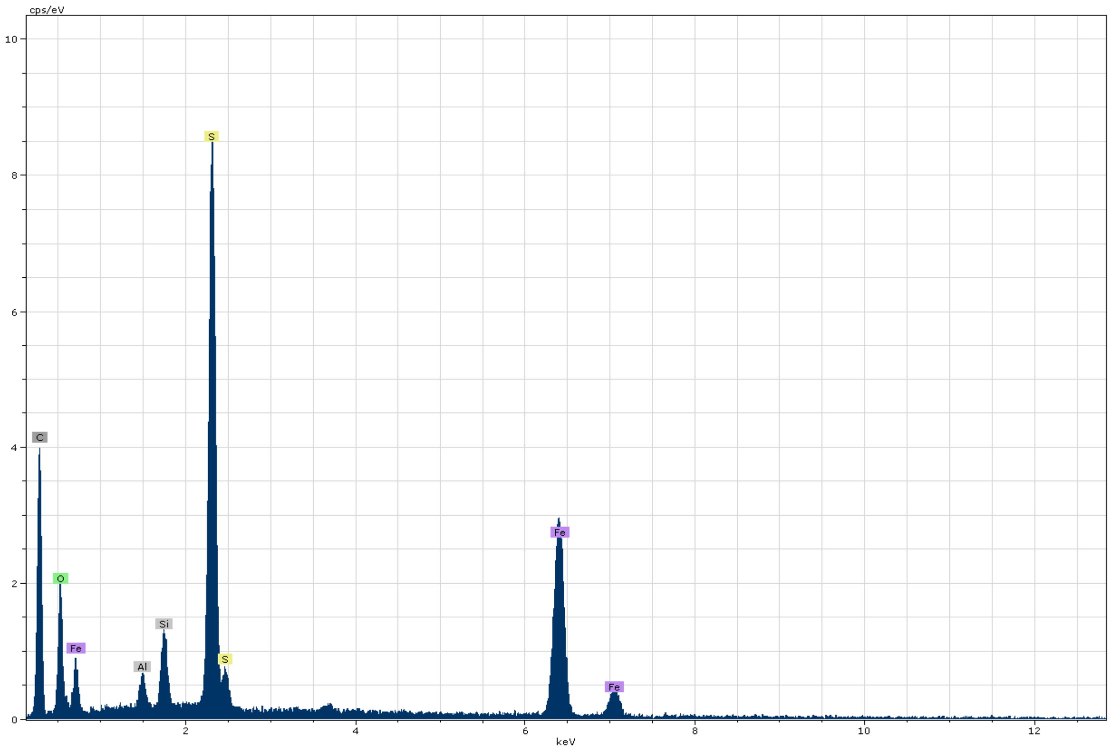
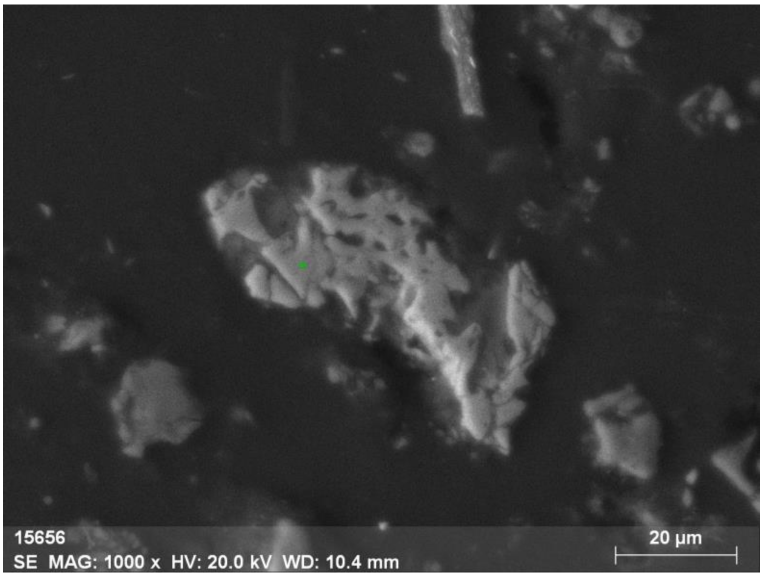
№ 6

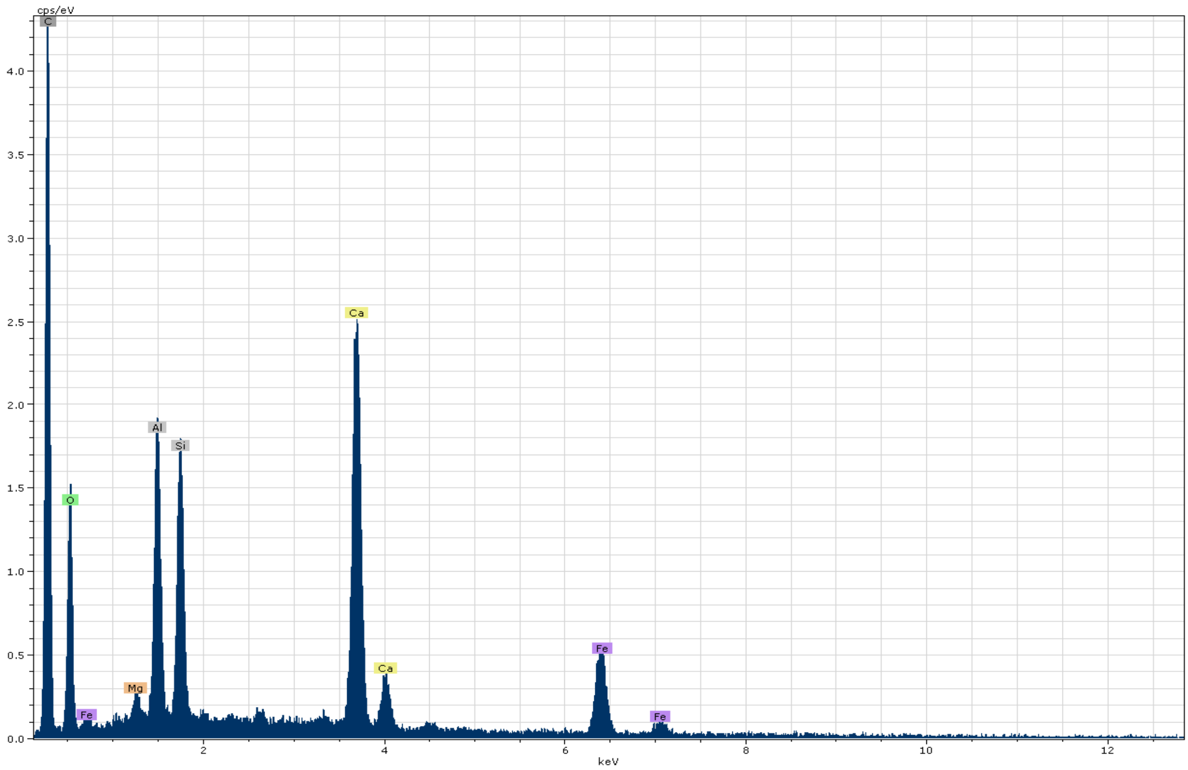

15639
SE MAG: 2000 x HV: 20.0 kV WD: 10.3 mm
10 µm


cps/eV
keV
C
O
Fe
Al
Si
S
S
Fe
Fe

№ 7



15656
SE MAG: 1000 x HV: 20.0 kV WD: 10.4 mm
20 µm



cps/eV
C
O
Fe
Mg
Al
Si
Ca
Ca
Fe
Fe
keV

PRACTICAL WORK 7

GEOCHEMICAL PARTICULARITIES OF INSOLUBLE PHASE OF SNOW

Purpose and tasks.

The purpose of the work is to improve theoretical knowledge introduced in the lecture course "Atmospheric aerosols in environment", to consider some issues concerned with ecological-geochemical assessment of the territory as well as to interpret the results obtained. The task of the research includes application of geochemical methods to predict the disease incidence for city dwellers.

The information on the Ecological-geochemical assessment of the territory in Tomsk city is suggested in the form of a real data.

The concentration of microelements is chosen from the database in Table (attached Excel file).

The order of work

In the course of the lab work the consequent treatment of the material is performed with the subsequent drawing a conclusion. The work consists of three stages of investigation.

I stage:

1). Calculation of mean (C), standard deviation (S) and concentration coefficient, factor of pollutant (element) load on the environment, coefficient of relative increase in total elements load for each element.

2). Construction of geochemical row of element association with concentration coefficients and coefficient of relative increase in total elements in descending order.

3) Calculation of total pollution factor and factor of total element load.

3). Make tables and diagrams of the distribution of element concentration and the calculated factories.

II stage:

1). Analyzing tables and diagrams.

2). Defining the contamination level in terms of dust load, total pollution factor and factor of total element load.

2). Make presentation or report on the practicum.

At the first stage the sampling of the concentration elements is used to calculate the main distribution characteristics of the elements: mean (C), standard deviation (S). The obtained results are presented in the form of table 7.1.

Table 7.1

Element concentration in the samples of Tomsk, mg/kg

Element	*Name of the sample site*	*Background site*
E.g. U	*4.4±1.7*	*0.2*

Notes: ± - standard deviation

Concentration coefficient is shown the anomalous of element concentration relatively the background value. It is calculated by the formula (7.1):

$$KK = C / C_b \tag{7.1}$$

KK –concentration coefficient;

C – element concentration, mg/kg;

C_b – background value of element concentration, mg/kg.

According to concentration coefficient the geochemical row of element association from the highest value to the lowest value are constructed. Example: $Pb_{25} – Zn_{10} – Cu_3 – Ni_2$.

If the concentration coefficient is more than 3 it means the local sources have emitted dust with elements. In contract to that if the concentration coefficient is less than 3 dust with elements is related to diffuse pollution. The concentration coefficient helps to determine the dominant elements for dust aerosols which come from different plants.

That makes it possible to determine the type of pollution sources (Геохимия …, 1990).

Total pollution factor is calculated by the formula (7.2):

$$Z_c = \sum KK - (n-1) \tag{7.2}$$

where:

KK – concentration coefficient

n – a number of elements having the KK values more than 1.

It characterizes the impact of the group of elements.

The obtained results are presented in the form of Table 7.2.

Table 7.2

Example

A number of geochemical elements ranges from the highest value of concentration coefficient to the lowest one and contamination level in terms of total pollution factor

Name of the sample site	concentration coefficient				Total pollution factor (Contamination level)
	More than 10	10..5	5..3	3..1	
E.g. Tomsk	*U13,8–Tb11,5*	*Yb9,5–La9–Ba8,6–*	*Na4,5–Ag4,3–Br4,2–Lu4,1–Hg4,2–Sb3*	*Th2,3–Hf2,1–Sr1,8–*	*93 (middle)*

		Ta8,1– As7,6– Sm7,6– Ce5,2		*Ca1,5– Fe1,4– Co1,3– Sc1,2– Eu1,1–Cs1– Cr0,9– Rb0,8–Au0,3*	

Factor of pollutant (element) load on the environment (or average daily fallout of elements with dust on the city territory) is calculated by the snow sampling results. The factor is defined as a pollutant mass falling on a unit of square in a unit of time. Total pollutant mass (P_n, dust load) and element concentrations (C) in the snow solid residue are used to calculate the factor. Based on that the following factors are calculated.

1. Total load producing by the chemical element emissions in the environment (or average daily fallout of metals on the city territory) is calculated by the formula (7.3):

$P_{total} = C \times P_n$, mg/km^2 per day (7.3)

For Ca, Na, Fe: $P_{total} = C \times P_n \times 10$, g/km^2 per day

The obtained results are presented in the form of Table 7.3.

Table 7.3

Average daily fallout of elements with dust on Tomsk territory, mg/km^2 per day

Element	*Name of the sample site*	*Background site*
E.g. U	*31.9*	*1.4*

2. Coefficient of relative increase in total elements load is calculated by the formula (7.4):

$K_p = P_{total} / P_b$ (7.4)

where:

P_b – background value of total element load. It is calculated by the formula (7.5):

$P_b = C_b \times P_{nb}$ (7.5)

P_{nb} – background value of dust load, it is 7 kg/km^2 per day for the Tomsk region.

As the anthropogenic abnormalities usually comprise many elements, **factor of total element load** (Z_p) is calculated as well. It characterizes the impact of the group of elements. The factor is calculated by the formula (7.6):

$Z_p = \sum K_p - (n-1)$ (7.6)

where: n – a number of elements having K_p values more than 1.

The obtained results are presented in the form of Table 7.4.

Table 7.4

A number of geochemical elements ranges from the highest value of coefficient of relative increase in total elements to the lowest one and contamination level in terms of factor of total element load

Name of the sample site	Geochemical row of coefficient of relative increase in total elements	Factor of total element load (Contamination level)

The diagrams in terms of calculated factors are made as well.

At the second stage it is necessary to analyze the contamination level and to obtain the prognosis schemes of children's disease incidence according to the data on dust load, total pollution factor and factor of total element load.

There is the following gradation for values of dust load in terms of the recommendations from Сает и др. work (Геохимия …, 1990):

less than 250 mg/m^2 per day – safety morbidity level;

250-450 mg/m^2 per day – mildly unsafe one; increase in bronchial asthma and conjunctivitis;

450-850 mg/m^2 per day – unsafe one; increase in respiratory and sense organs morbidity;

more than 850 mg/m^2 per day – immensely unsafe one; increase in morbidity more than 2 times.

The total pollution factor is characterized by the following contamination levels (Геохимия …, 1990):

less than 64 – low contamination level;

64-128 – middle one;

128-256 – high one;

more than 256 – very high one.

Therefore, obtained information data makes it possible to forecast children morbidity, which is in its turn, is determined in accordance to Russian methodic recommendations (Fig. 7.1).

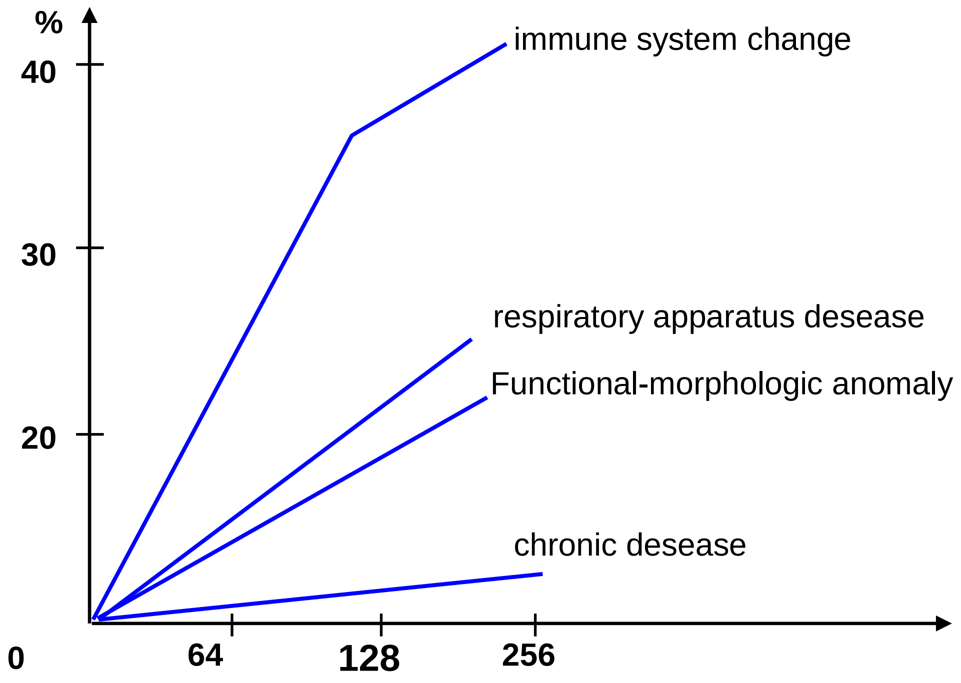


Fig. 7.1 Forecast children morbidity according to the value of total pollution factor

The factor of total element load is characterized by the following contamination levels (Геохимия …, 1990):

- less than 1000 – low contamination level;
- 1000-5000 – middle one;
- 5000-10000 – high one;
- more than 10000 – very high one.

Report content and preparation

Having done the laboratory work there should be prepared a report. Penscript is presented on standard (297x210 mm) or nonstandard pages. The text volume is 10-12 pages.

The work includes the following parts:

Introduction.

3. Characteristic of sampling region.
4. Research methods.
5. Element concentration in snow solid residue.
6. Prognosis for children's disease incidence.

Conclusion.

References.

In the Introduction one should point out the purpose of work, initial material, and the main tasks of research.

In the first paragraph one should analyze general ecological situation in the city as well as in the respect of the site involved.

The second paragraph comprises description of research methods and types of analyses.

The third paragraph consists of literature review on heavy metals that gives the possibility to analyze the obtained material and estimate the effect of the given elements on human health. Results should be presented in tables and diagrams.

In the 4 paragraph on the basis of snow survey and geochemical indicators there should be presented the prognosis for children's disease incidence. In particular, it should be pointed out the impact of definite elements exceeding the standard indexes. It should be presented nature conservative measures enabling the improvement of ecological situation in the city.

Conclusion includes summary of the work and measures of environmental monitoring in the city territory using the other types of investigation. At the end of the work there should be reference.

REFERENCES

1. Some aspects of ecological problems: textbook/ N.V. Baranovskaya, I.A. Matveenko, R.M. Danilenko, A.V. Talovskaya. – Tomsk: TPU pub.eddition, 2009. – 110p.
2. Yazikov E.G., Talovskaya A.V., Nadeina L.V. Geoecological environmental monitoring: coursebook. − Tomsk: TPU publishing house, 2013. – 135 p.

PRACTICAL WORK 8

MODES OF RADIOACTIVE ELEMENTS OCCURRENCE IN INSOLUBLE PHASE OF SNOW BY FISSION RADIOGRAPHY (F-RADIOGRAPHY) METHOD

Purpose and tasks.

The purpose of the work is to consolidate theoretical knowledge presented in the course «Atmospheric aerosols in environment» and to determine content and modes of radioactive elements occurrence in the insoluble particles of snow by fission radiography (f-radiography) method.

It requires to analyze the results of f-radiography method. It makes possible to determine the modes of occurrence and character distribution of radioactive elements in solid residue of snow and soil samples from the impact area of nuclear-fuel combine. The photos show the distribution of radioactive elements in the samples (Fig. 8.1).

One has to determine the modes of occurrence, character distribution, and concentration of radioactive elements in samples. Then the results for solid residue of snow and soil samples from the impact area of nuclear-fuel combine are compared.

The number of tracks allows calculating the density of tracks from the fission of the radioactive elements in the sample. The density of tracks is needed to calculate of the radioactive fissionable elements concentration.

The concentration of the radioactive fission elements can be determined by the formula 8.1:

$$C = Cst*Ds/Dst \qquad (8.1)$$

C – Concentration of the radioactive fission elements, mg/kg

Cst – Concentration of uranium in the standard, C= 7,23 mg/kg

Ds –density of tracks in the specimen, track/mm^2

Dst –density of tracks in the standard, 4527 track/mm^2 for solid residue of snow and 5040 track/mm^2 for soil samples.

The density of tracks (D) is the ratio of average number of tracks and the square of one section (0,026 mm^2).

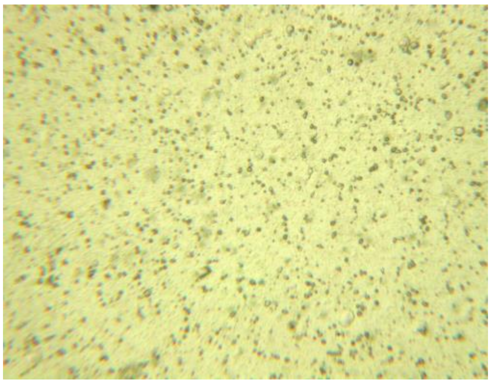
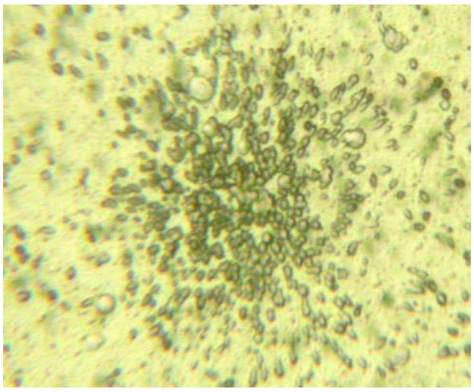



Fig. 8.1. Distribution of radioactive elements in the insoluble particles of snow from the impact area of nuclear-fuel combine (by the results of f-radiography method). Lavsan detector. Mag. 200-500^{X}

Report content or preparation

Having done the practicum there should be prepared a report or presentation.

The report or presentation includes the following parts:

Introduction.

1. Characterization of research method.
2. Results of determination of modes of radioactive elements occurrence.

Conclusion.

References.

In the Introduction one should point out the purpose of work, initial material, and the main tasks of research.

The first paragraph comprises description of research methods and types of analyses.

In the second paragraph on the basis of f-radiography method results the description and comparison of modes of occurrence and character distribution of radioactive elements in the sample from the impact area of nuclear-fuel combine are given.

REFERENCES

1. Yazikov E.G., Talovskaya A.V., Nadeina L.V. Geoecological environmental monitoring: coursebook. − Tomsk: TPU publishing house, 2013. – 135 p.