Professional English

Lecture 7
Mineral and anthropogenic particles in aerosols. Part 2

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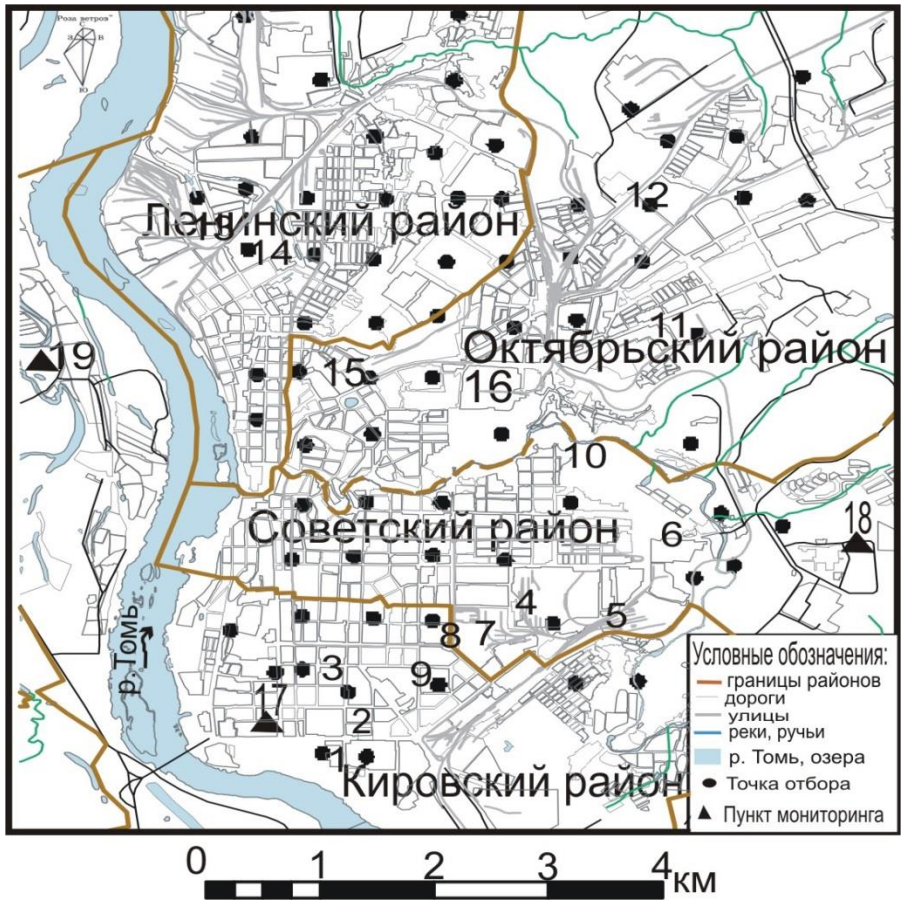
Outline

1. Studying methods.
2. Anthropogenic particles in solid particles of aerosols.

1. Studying methods

Map of sampling sites in Tomsk city



1-16: some enterprises
1, 5, 11, 12 - construction industries;
2, 6, 7, 8, 9, 16 - different engineering plants;
3 - electric bulb factory,
4 - heat-power plant,
10 - ash disposal area,
13- sleeper impregnation factory,
14 - plant of rubber footwear

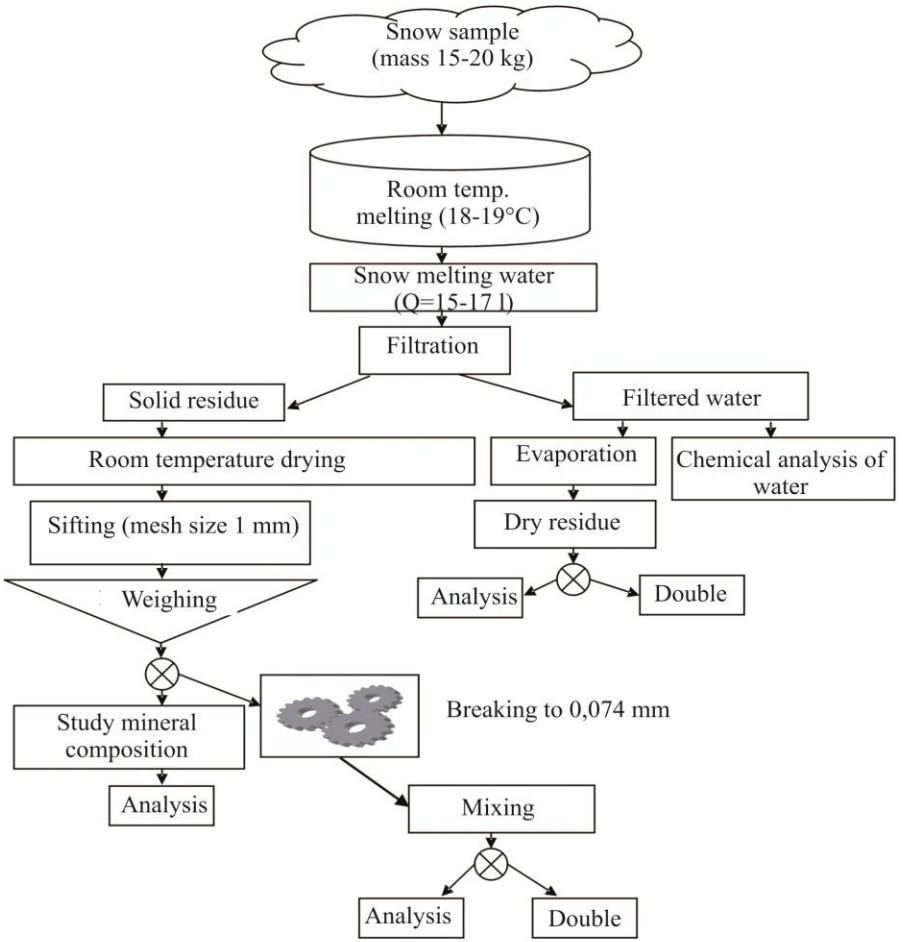
1-16 - plants
17-19 – monitoring points: 17 – campus TPU,
18 – Academgorodok, 19 – Timiryazevo.

The scheme of processing and analysis of the snow samples

After sampling the snow is melted, snow water is filtrated to get the solid residue of snow and filtrate.

The solid residue of snow is dried and weighted.

The object of our investigation is ***snow solid residue*** or ***insoluble fraction of aerosols in snow***.



Laboratories

- Institute of Mineralogy and Geochemistry (University of Karlsruhe, Karlsruhe, Germany)
- Innovation Scientific-Education Centre “Uranium Geology” (TPU, Department of geoecology and geochemistry)
- Кафедра световой и лазерной техники

Innovation Scientific-Education Centre “Uranium Geology” (TPU, Department of geoecology and geochemistry)

laboratories:

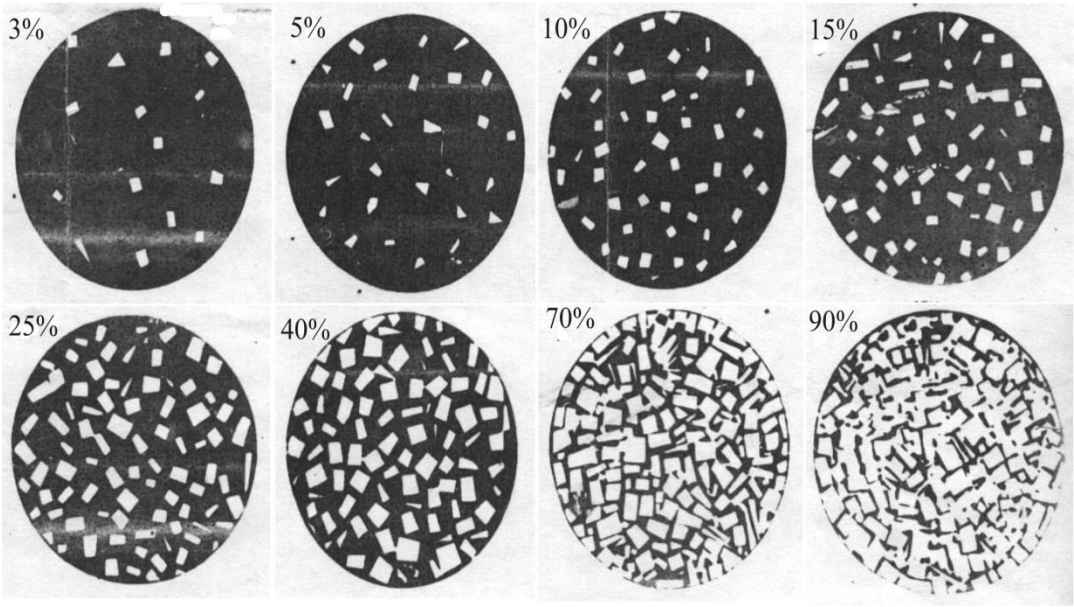
- Nuclear-geochemical laboratory
- Electron-optic laboratory
- Isotope spectrometry laboratory
- Microelement Analysis Laboratory
- Geotechnology

Schlich analysis

on Binocular microscope (Leica EZ4D)

Characteristics of the particles

1. Color.
2. Lustre.
3. Hardness.
4. Transparency.
5. Shape and size.
6. Character of surface.
7. Level of oxidation.



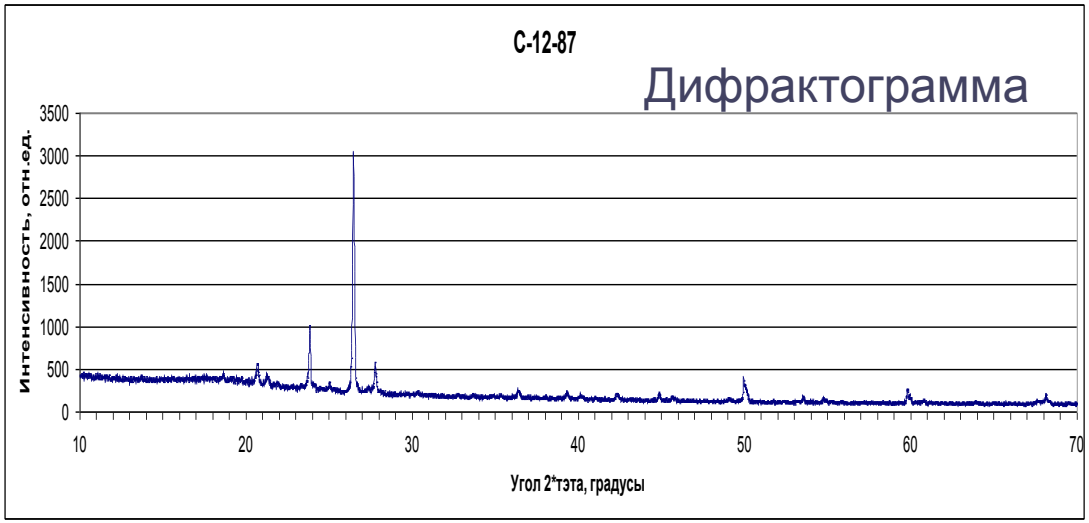
Comparative method of determination content of mineral and anthropogenic particles in samples. Total content – 100 %

Scanning Electron Microscope

"LEO 1530 Gemini“ (Working distance 5 mm), **University of Karlsruhe**

Hitachi S-3400N with X-ray spectral microanalyser – Bruker (Working distance 3 nm), TPU

X – ray diffraction analyses



Это анализ структуры вещества, с помощью рентгеновских лучей. Достоинством метода является низкая погрешность сходимости (1-3%), малая зависимость результатов от матричного эффекта (от изначальной пробы), низкий предел обнаружения – 10-4%.

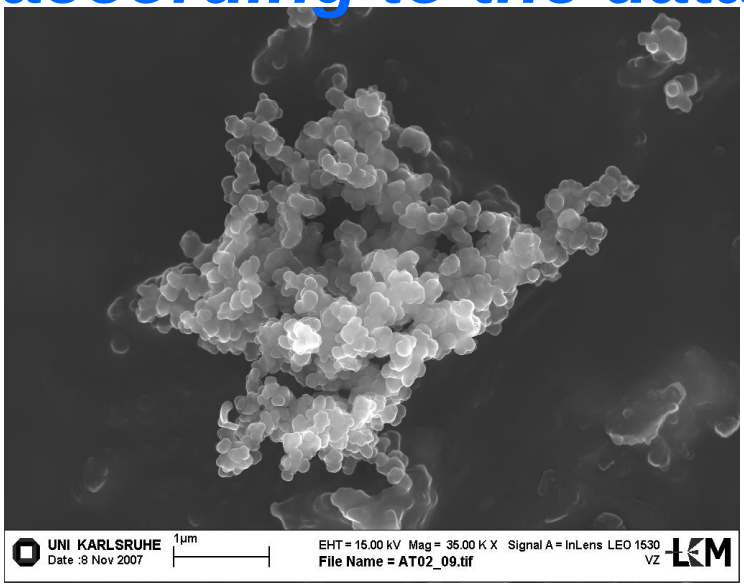
Quartz cuvette with samples inside

2. Anthropogenic components

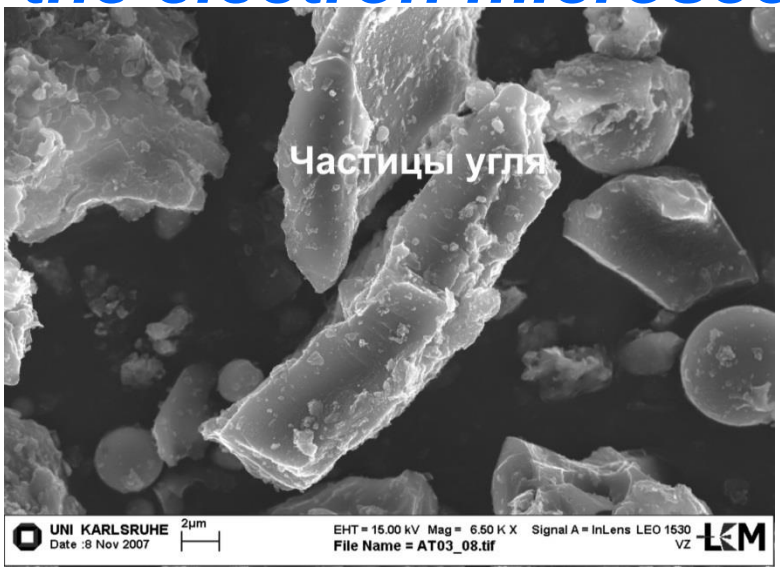
Anthropogenic components are formed from anthropogenic emissions.

Anthropogenic components are related to the emissions from transport, coal combustion, cement manufacturing, metallurgical industries, waste incineration and etc.

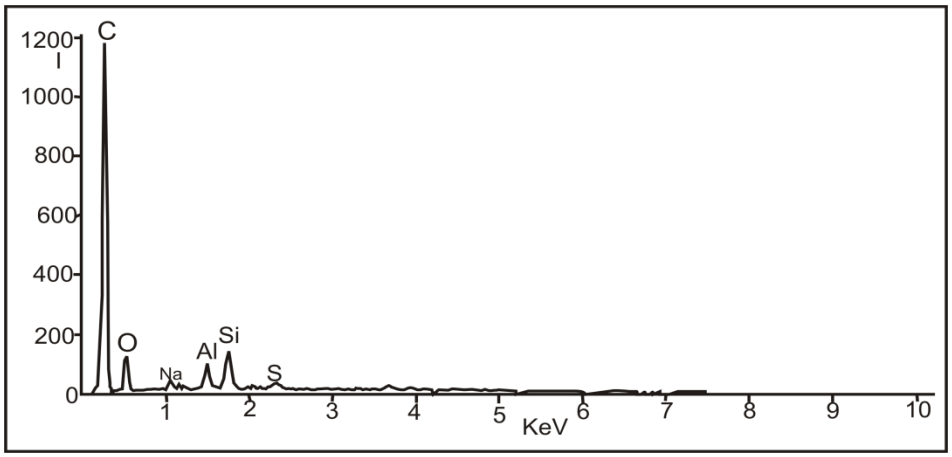
Anthropogenic components (according to the data of the electron microscopy)



Soot

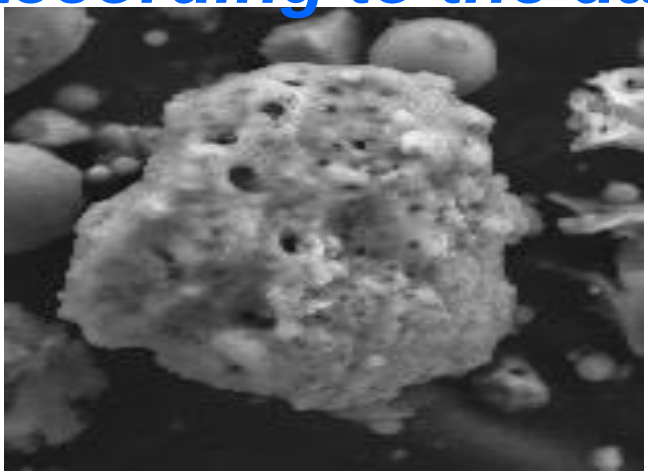


Coal particles

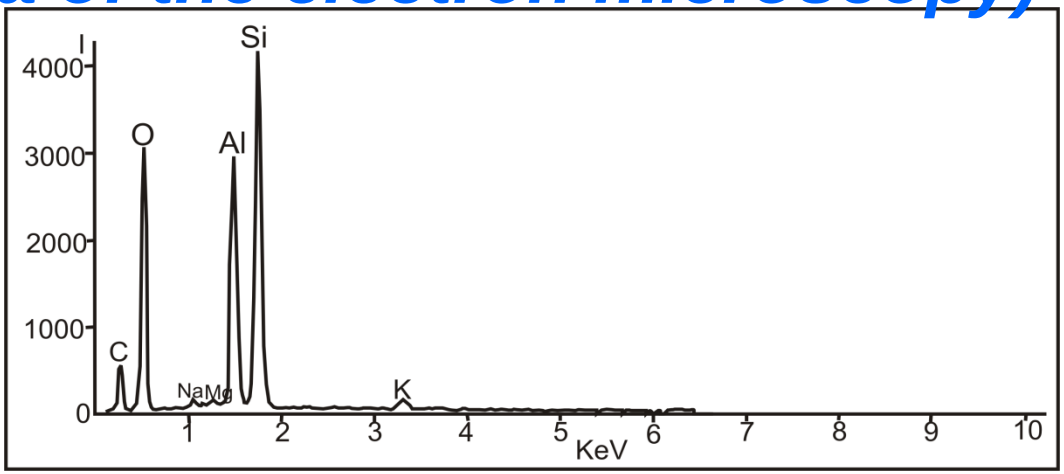


ED spectrum of soot and coal particles

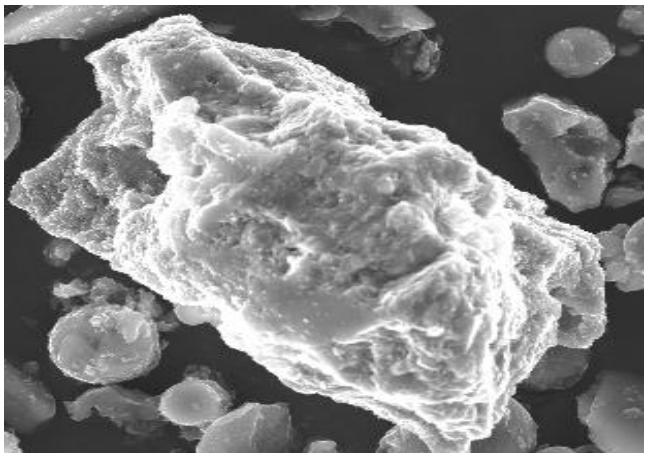
Anthropogenic components (according to the data of the electron microscopy)



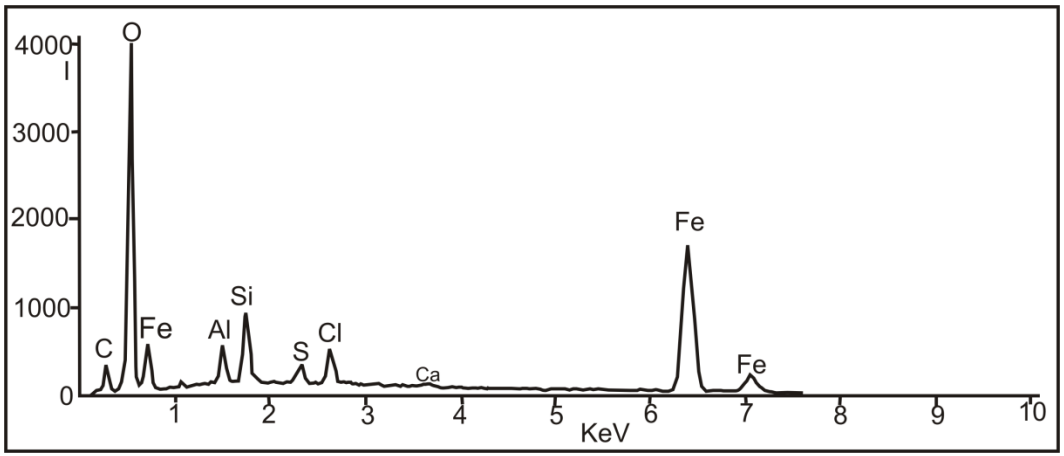
Slag has **porous structure.**



ED spectrum spectrum of slag

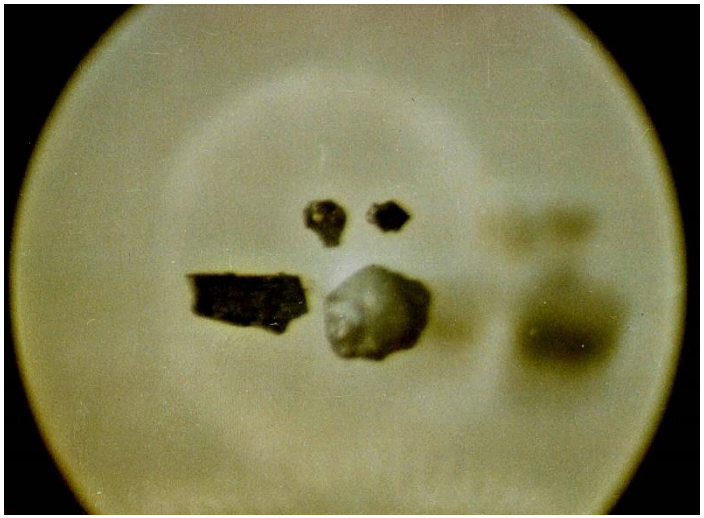


Slag containing Fe oxides

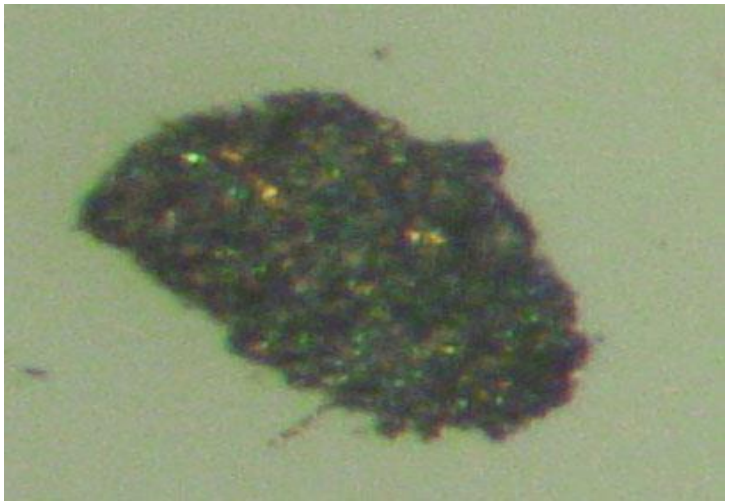


ED spectrum of slag containing Fe oxides

Anthropogenic components (under the binocular microscope)



Coal particles are presented with black **opaque** particles.

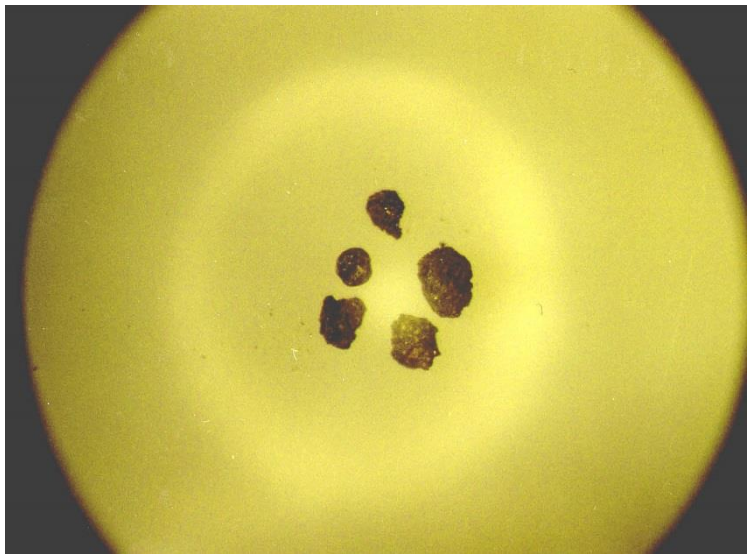


Slag is **presented with black or brown, shapeless particles with semi-metallic lustre.**

Soot, coal particles and slag are emitted with the coal-powered thermoelectric power stations.

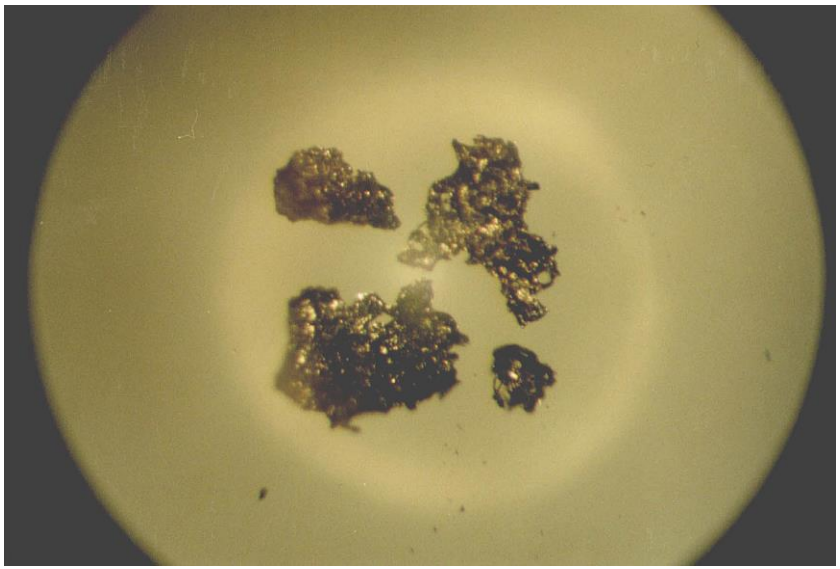
Mag. 50x
Язиков, 2006

Anthropogenic components (under the binocular microscope)



Black and brown shapeless metallic particles.

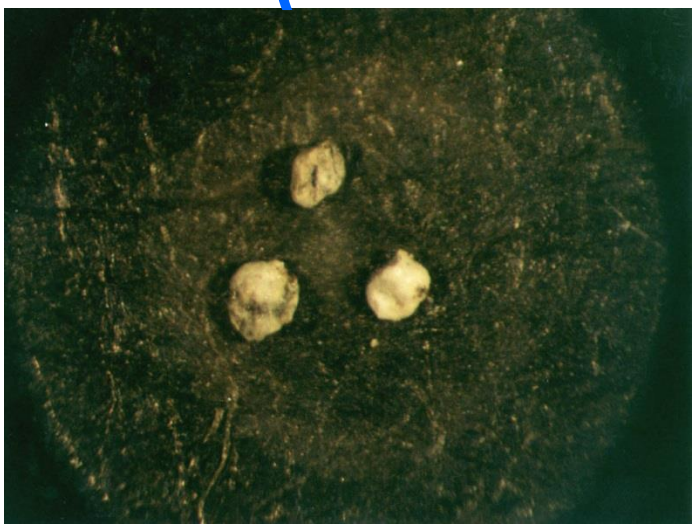
It is emitted with the metallurgical and machine building plants.



Coal dust is black flat particles. It looks like a shell.

Mag. 50x
Язиков, 2006

Anthropogenic components (under the binocular microscope)

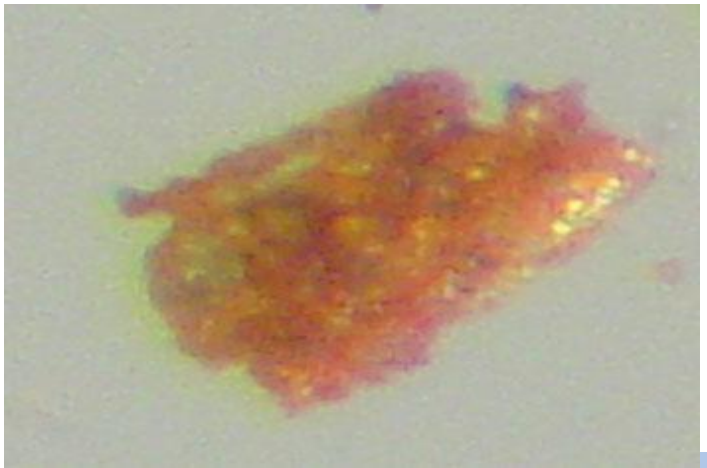


Semi-angularity grey spherules.

It is emitted with the metallurgical plants.

Sawdust

It is wastes of the woodworking enterprise.



Particles of broken bricks

Mag. 150x

Язиков, 2006

Anthropogenic components (under the binocular microscope)

Al-Si spherical particles are light-grey and white hollow spherules with glass lustre.

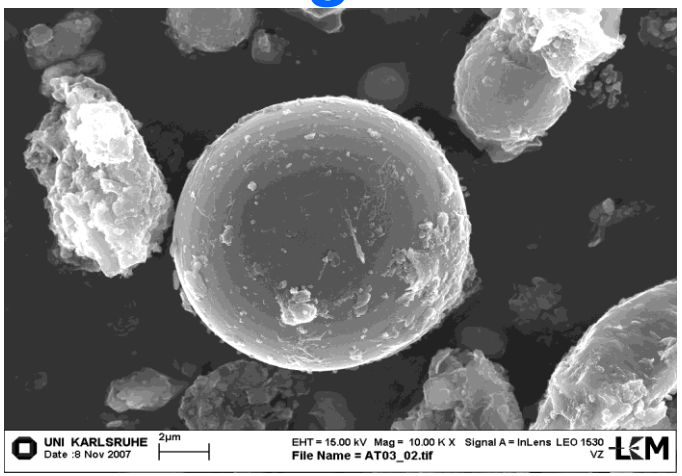
It contains mullite and sillimanite.

It is emitted with the coal-powered thermoelectric power stations.

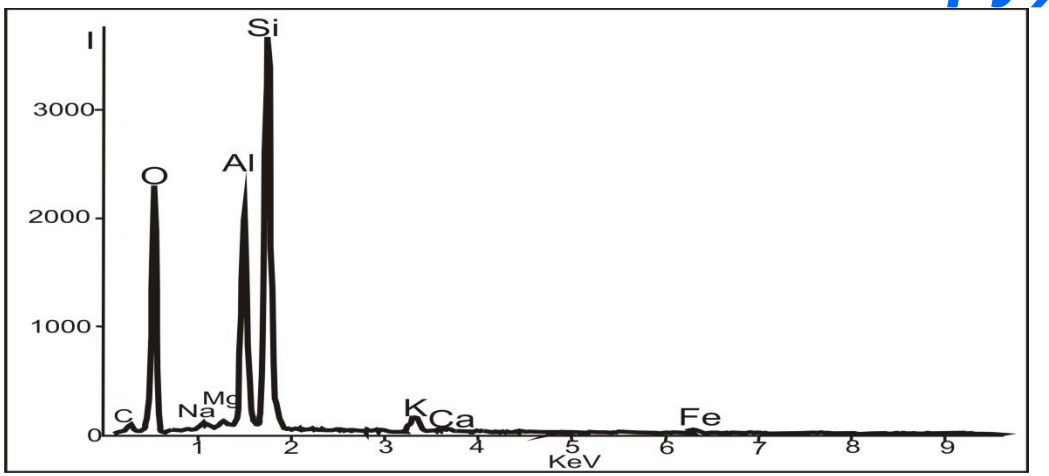
Al-Si fly ash = Combustion spherules

Mag. 50x
Язиков, 2006

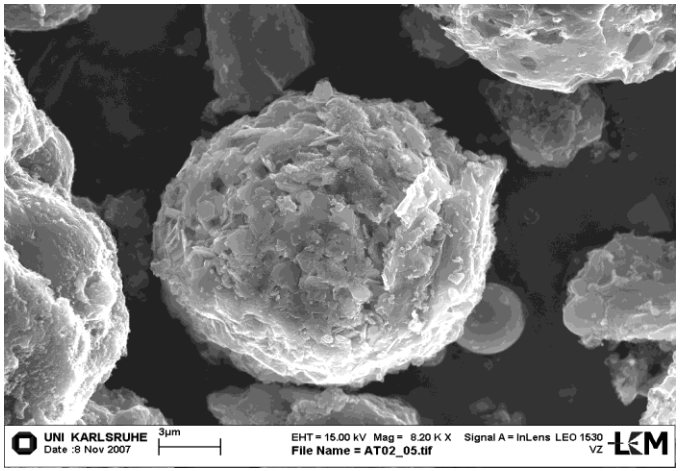
Anthropogenic components (according to the data of the electron microscopy)



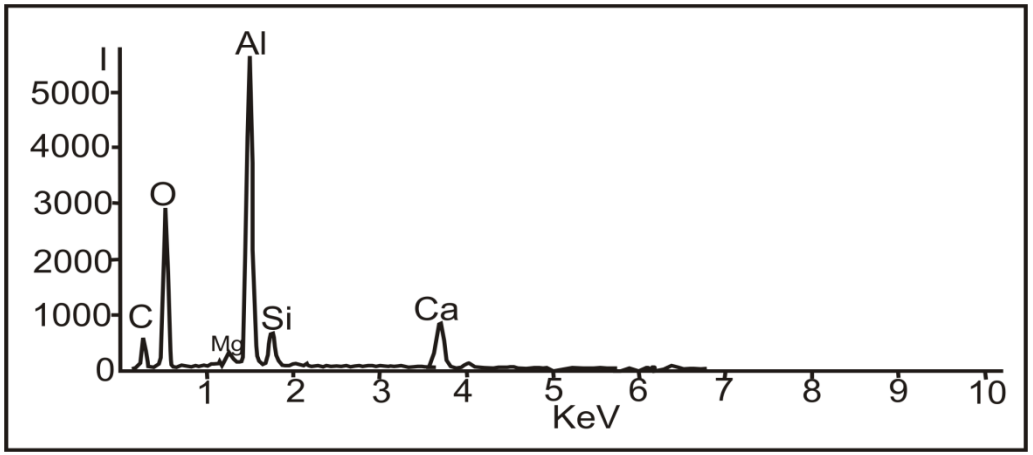
Combustion spherules



ED spectrum of combustion spherules

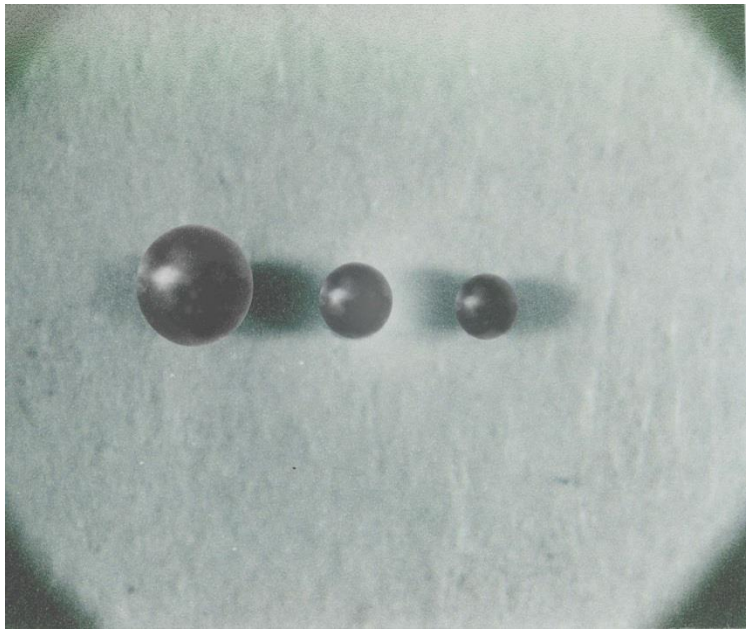


Spherules with mullite



ED spectrum of spherules with mullite

Anthropogenic components (under the binocular microscope)



Metallic spherules is black spherules with metallic lustre.

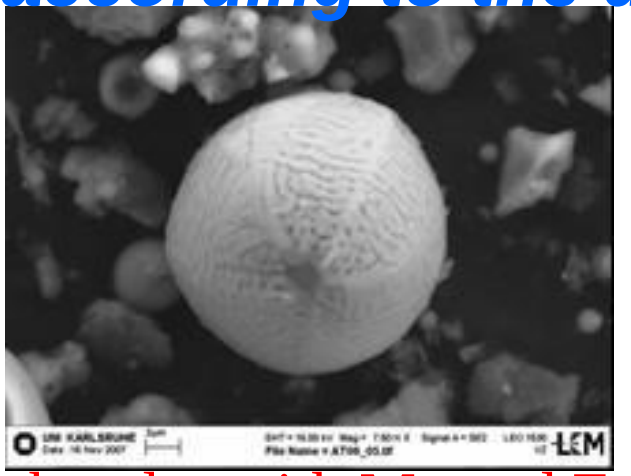
It contains magnetite, magnesioferrite, hematite.

It is emitted with both the coal-powered thermoelectric power stations and machine-building plants with foundry.

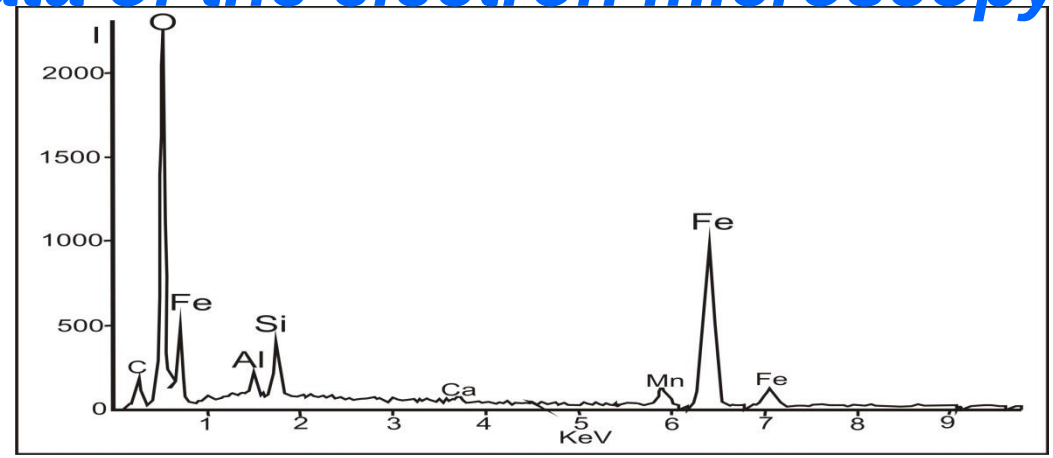
Mag. 50x

Язиков, 2006

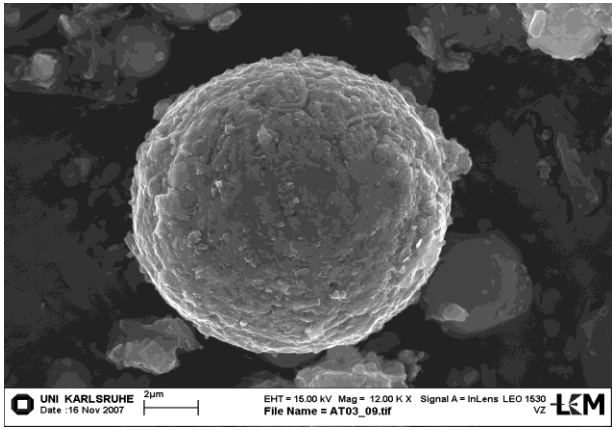
Anthropogenic components (according to the data of the electron microscopy)



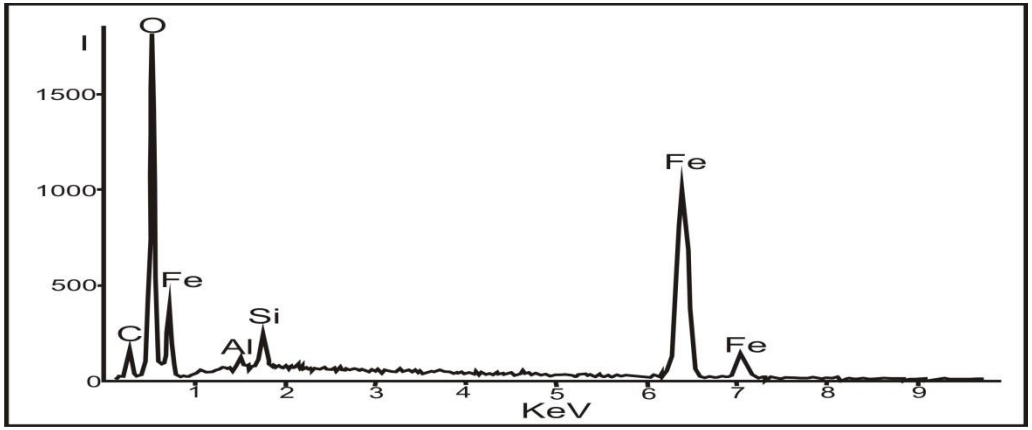
Spherules with Mg and Fe oxides



ED spectrum of spherules with Mg and Fe oxides

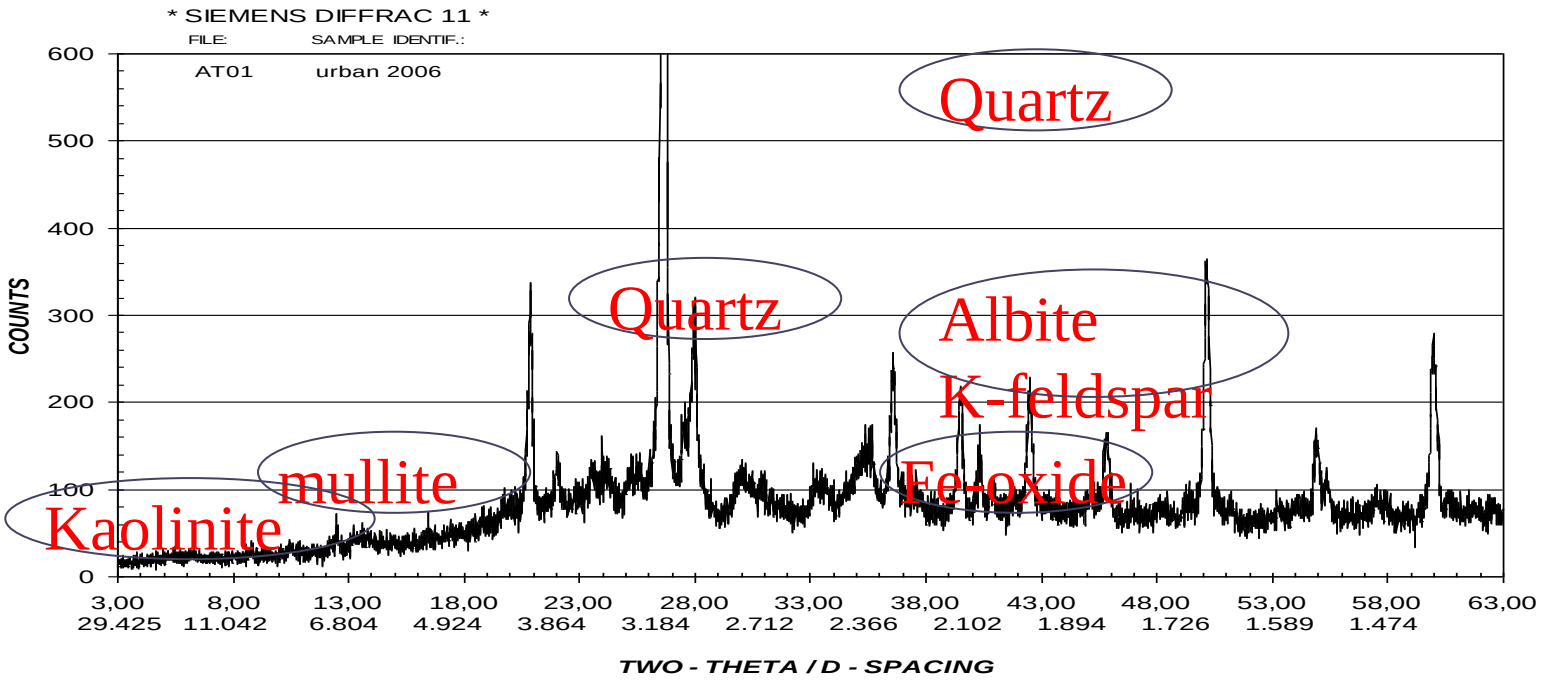


Spherules with Fe oxides



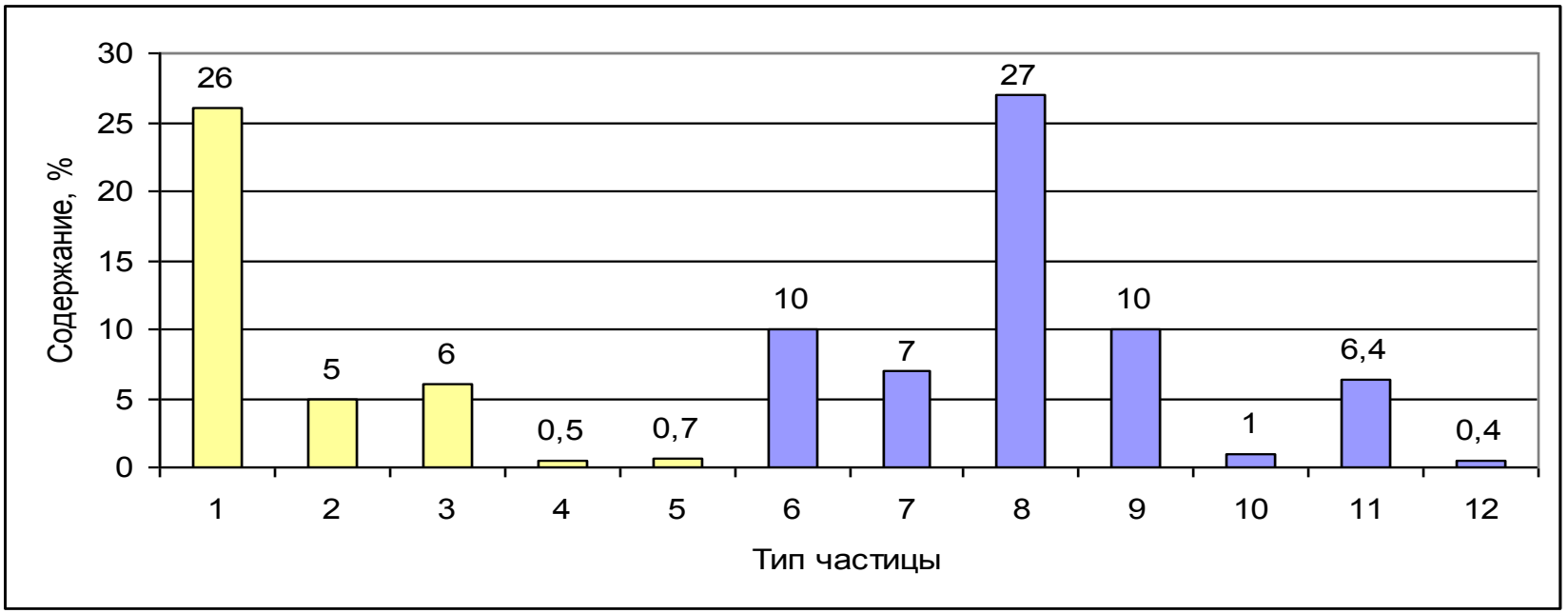
ED spectrum of spherules with Fe oxides

Diffraktogramm of the solid residue of snow (according to the data of X-ray analysis)



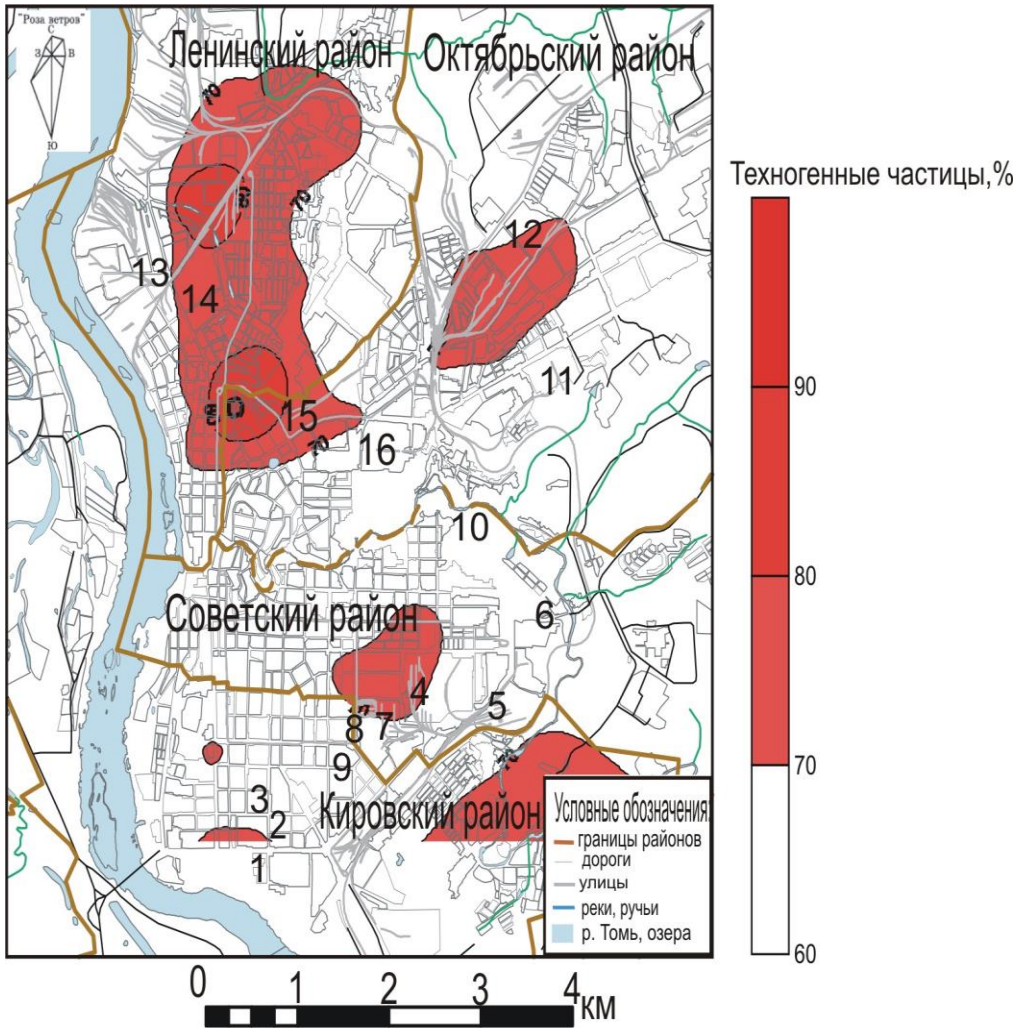
The samples of the solid residue of snow comprise quartz, amorphic quartz, feldspar, dolomite, mica, kaolinite, Fe-oxides (magnetite, magnesioferrite, hematite) and mullite according to the data of X–ray analysis.

Comparison of the mineral and anthropogenic components in the snow solid residue in Tomsk-city



***Mineral and organic particles (1–5)**: 1 – quartz ; 2 – Quartz covered by iron oxides; 3 – organic particles; 4 – feldspar; 5 – mica. **Anthropogenic components (6–12):** 6 – Al-Si micro spherules; 7 – metallic spherules; 8 – soot and coal particles; 9 – slag; 10 – Fibrous particles ; 11- Particles of broken bricks; 12 – paint particles.*

The scheme of distribution of anthropogenic components in the snow solid residue in Tomsk city



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3 - electric bulb factory,
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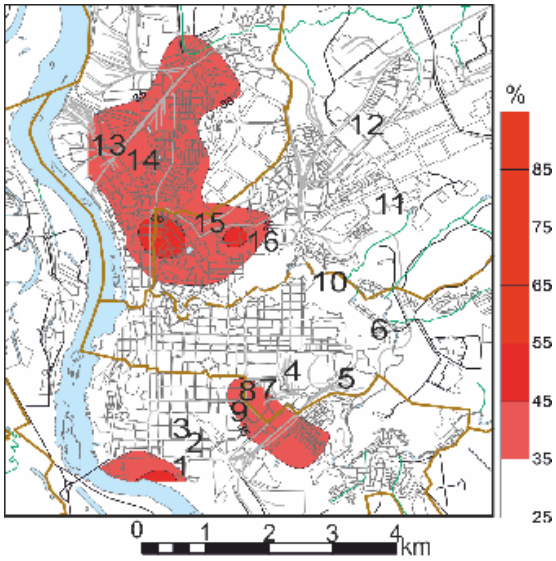
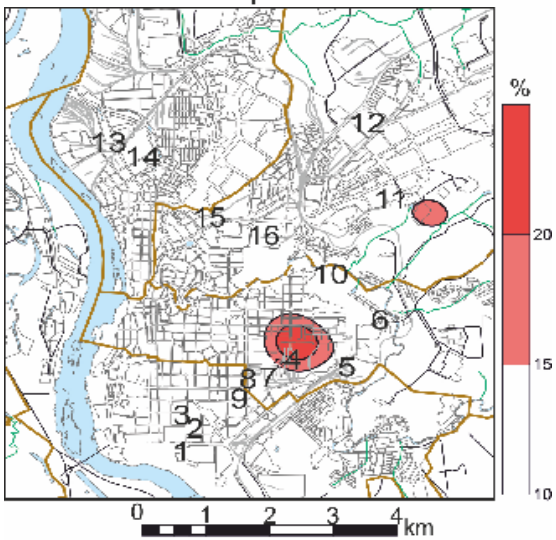
14 - plant of rubber footwear

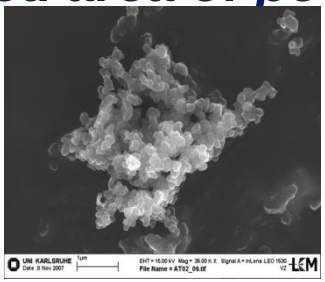
Composition of the insoluble fraction of aerosols in snow in the effected area of power station



Coal particles

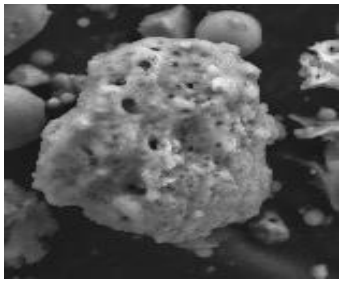


Al-Si spherical particles

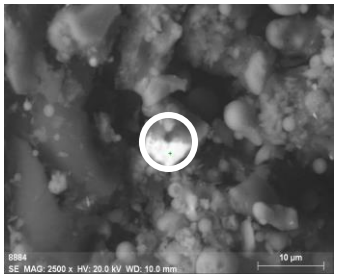


soot

Coal particles

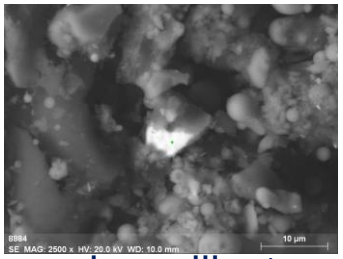


slag

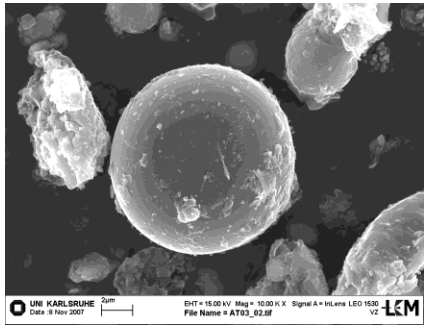


pyrite

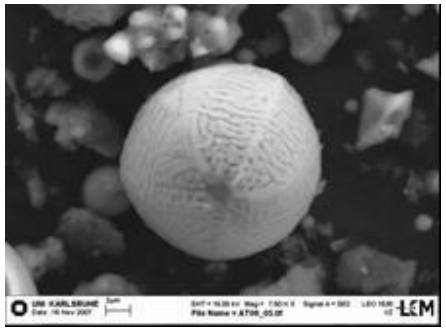
barite



alum silicate and sulfides Cu и Fe



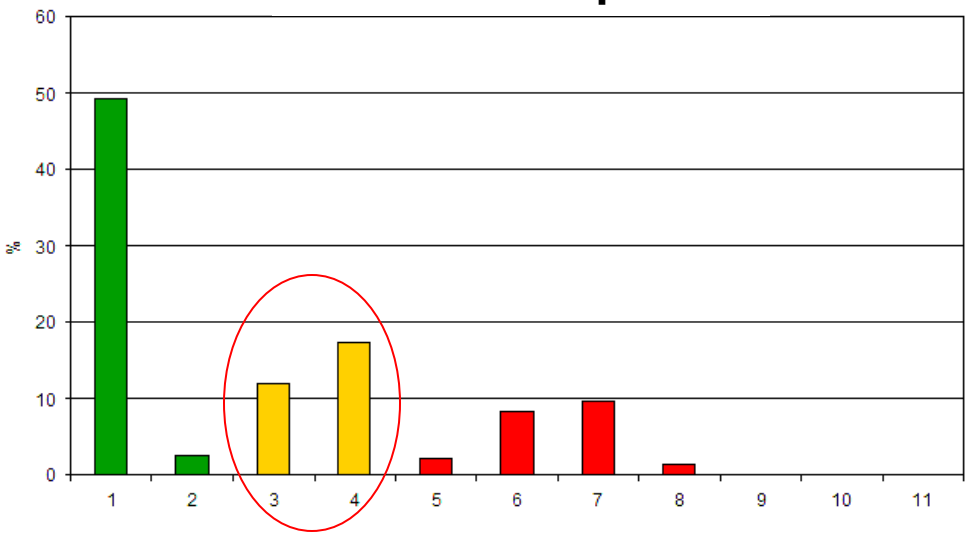
Al-Si spherical particle



metallic spherical particles associated to magnesiofferite

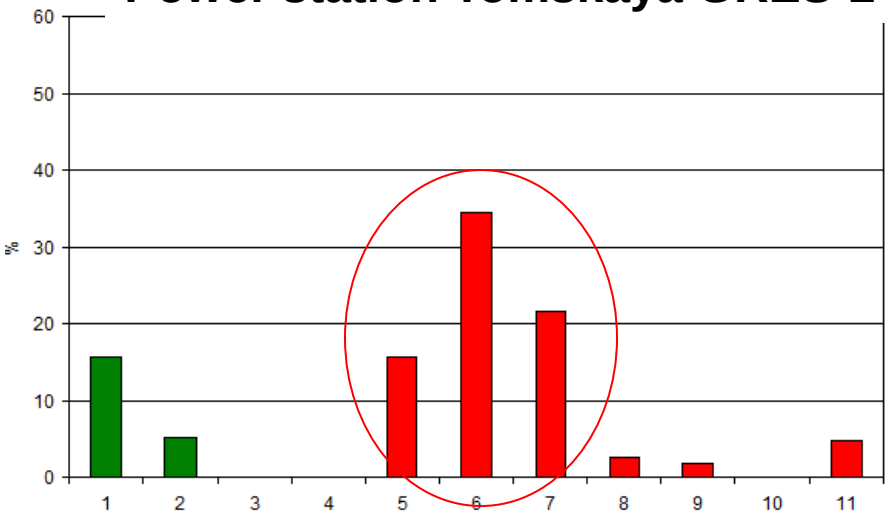
Comparison of the mineral and anthropogenic components in the snow solid residue in Tomsk-city

construction plants



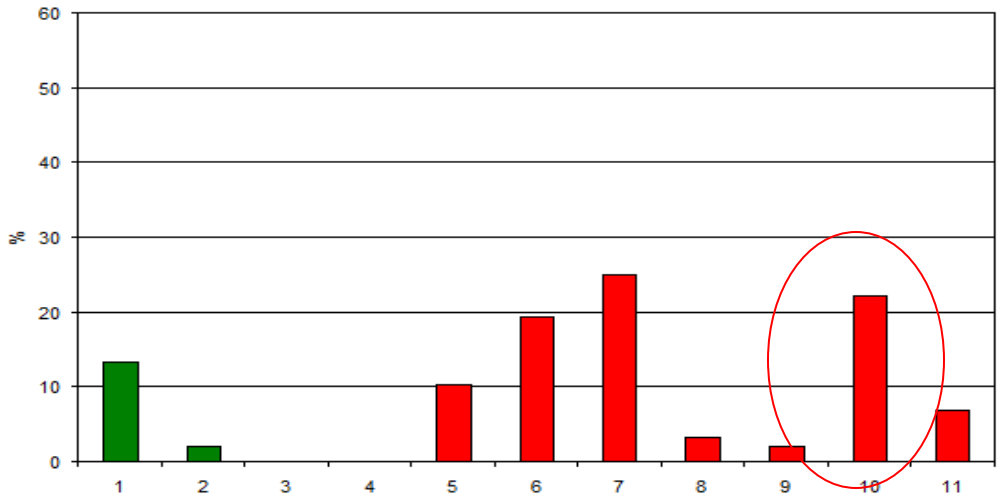
Particles of broken bricks

Power station Tomskaya GRES-2



Al-Si spherules, soot

reinforced concrete plant

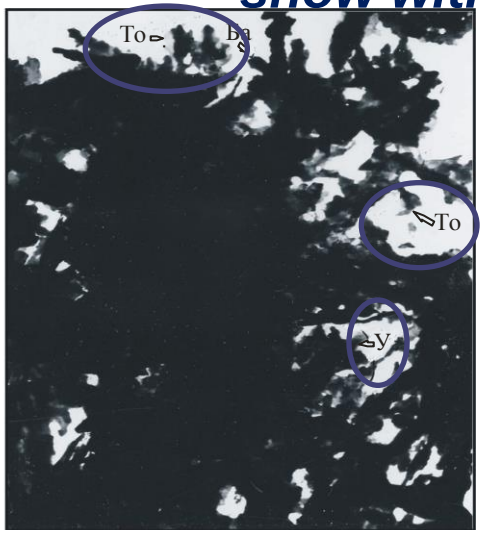


cement kiln dust

Mineral particles(1-2): **1** - *quartz*; **2** - *feldspar*; ***Anthropogenic particles*** (3-11): **3-4** - *Particles of broken bricks*; **5** - Al-Si spherules; **6** - soot; **7** - slag; **8** - *metallic spherules*; **9** - *Fibrous particles* ; **10** - cement kiln dust; **11** – another particles

По материалам Филимоненко Е.А.

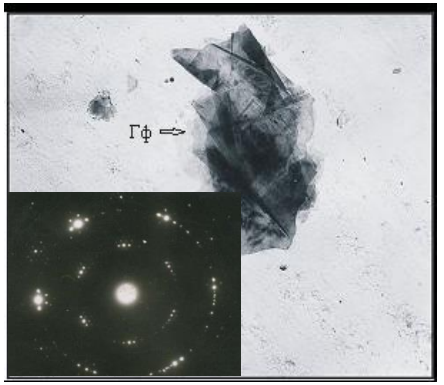
Anthropogenic components in the insoluble fraction of aerosols in snow within impact area of the Toms-Severs k facility



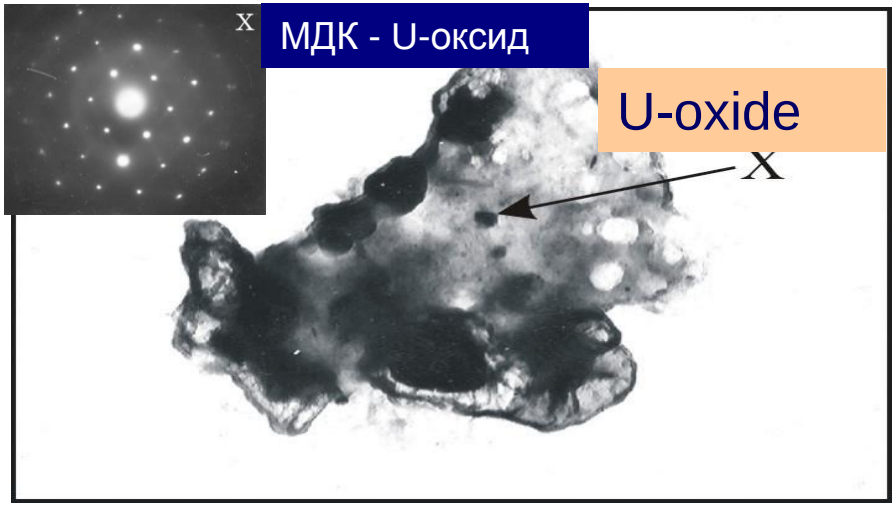
To–todorokite;
Ба–baddeleyite;
U-oxides

Monazite (EDS: mainly Si,Al,P, lower proportion Ca,Ce,Nd,Th)

Baddeleyite (EDS: Zr,Si,Al)

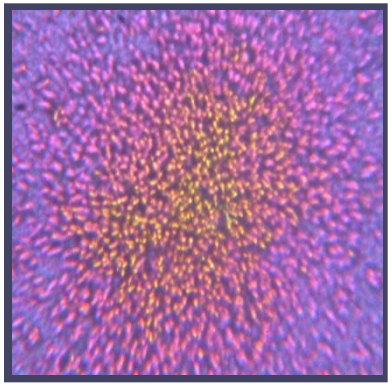


graphite (Гф)

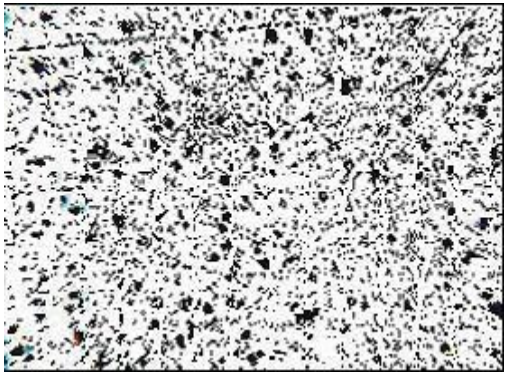


(electron microscopy, увел. 1000x,)

Modes of occurrence of radioactive elements



concentrated («hot particles»)



dispersed

F-radiography method

Conclusion

The composition study of dust aerosols by help of modern mineralogical analyses makes it possible to:

- reveal mineral, organic and anthropogenic particles,
- identify the peculiarity of dust industrial emissions,
- determine origin of atmospheric particles,
- make environmental assessment.

Laboratory works

1. Study of substantial composition of snow solid residue sample by schlich analysis
2. Study of substantial composition of snow solid residue sample by scanning electron microscopy method

References

- Geoecological environmental monitoring: coursebook / E.G. Yazikov, A.V. Talovskaya, L.V. Nadeina; National research Tomsk polytechnic university. − Tomsk: TPU publishing house, 2013. – 136 p.