

# Université d'état de Bachkirie



Башкирский государственный  
УНИВЕРСИТЕТ



**Les facteurs géologiques et la  
prévalence du diabète de type 2  
en République du Bachkortostan**

Medical geology is a new interdisciplinary scientific field studying the relationship between natural geological factors and their effects on human and animal health.

Medicine

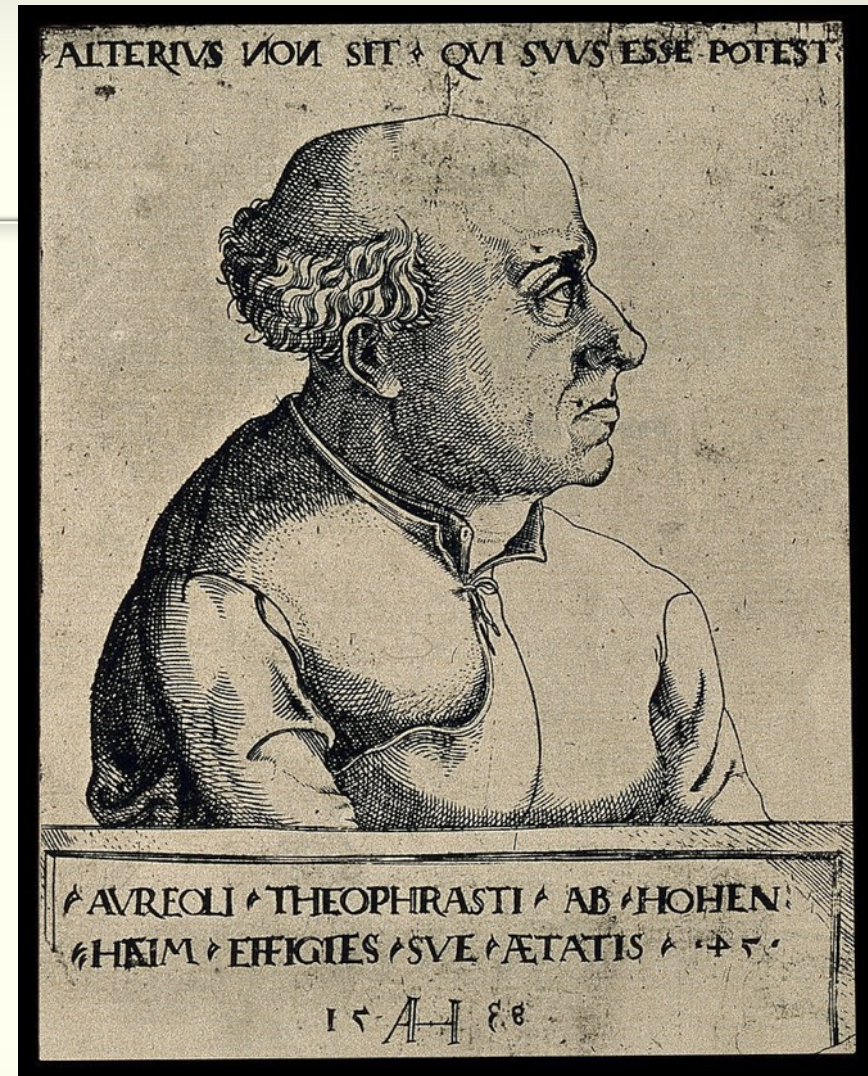


Geology



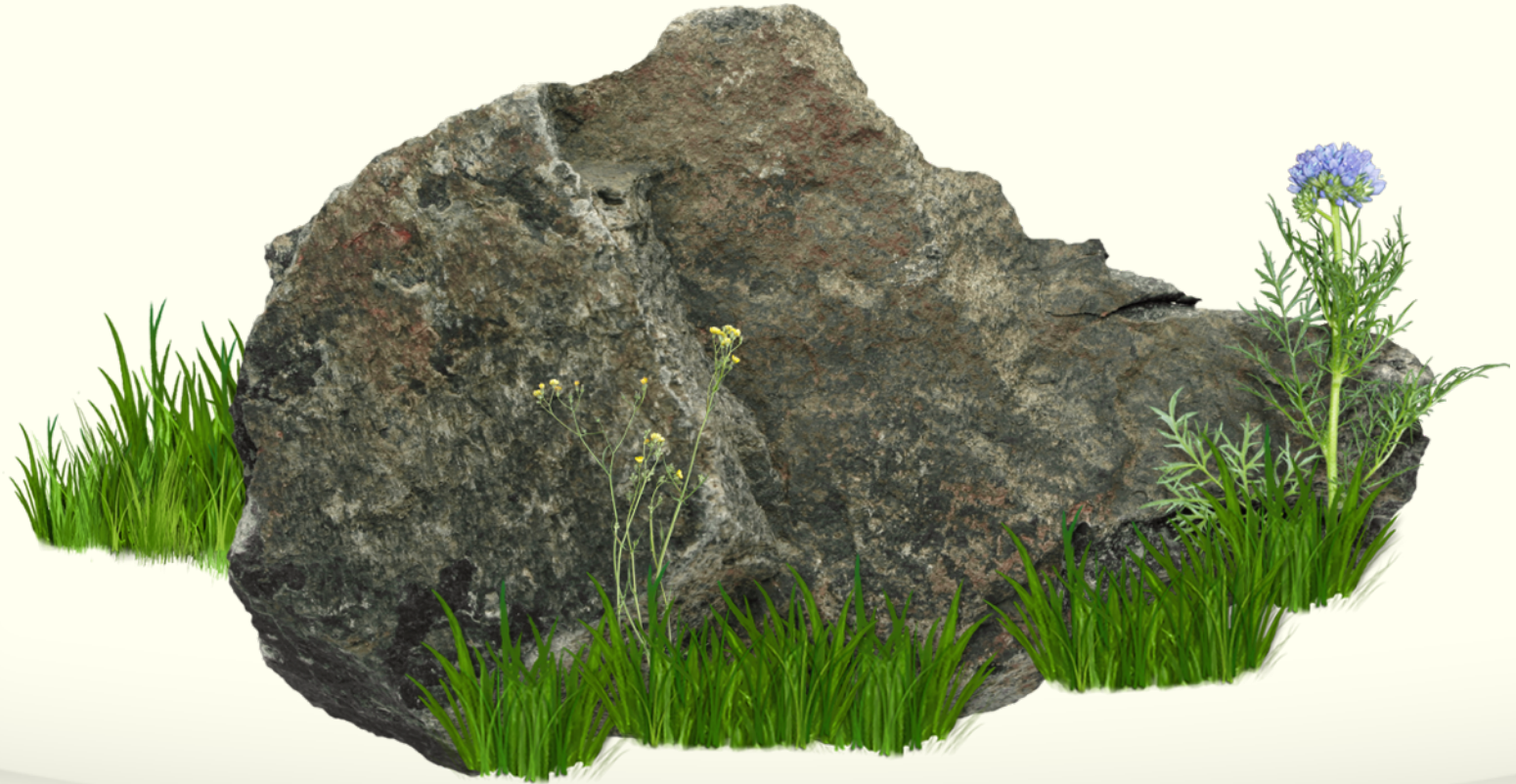
# Paracelsus, the father of pharmacology (1493-1541)

All substances are poisons, there is none which is not a poison. The right dose is the difference between a poison and a remedy.





**Microelements contained in rocks are the main factor of the geological environment, because organisms do not synthesize them**



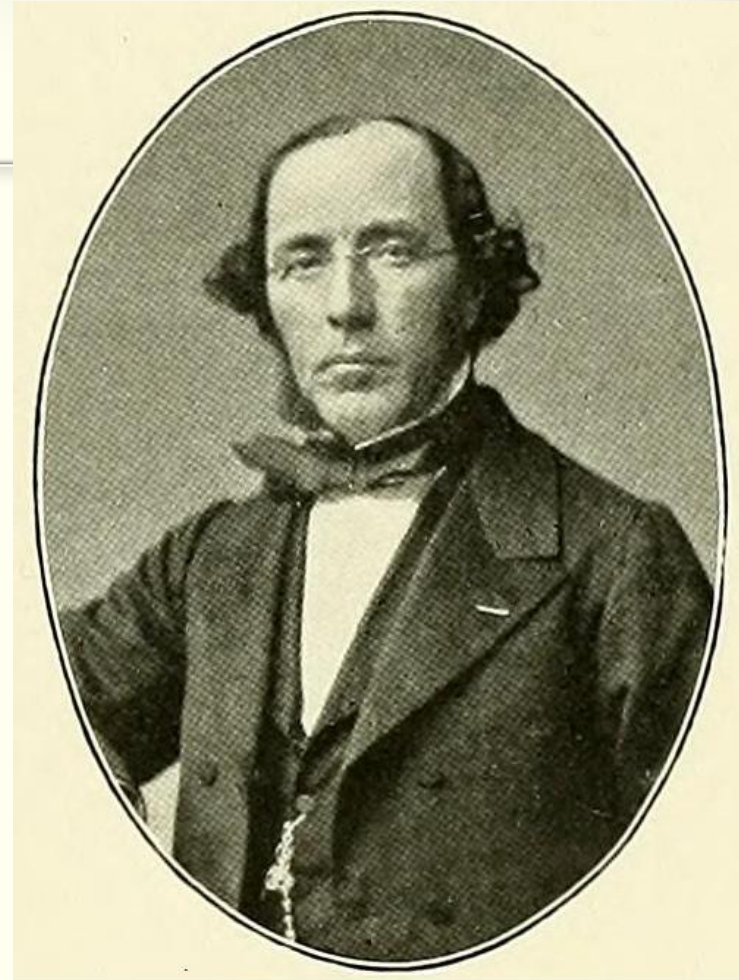
**One of the biggest geochemical diseases is iodine deficiency. It may result in goiter.**

**The sea is a major source of iodine and those who are further from it are at a disadvantage.**

**Another source of it is in soil rich in iodine.**



In 1849 the French chemist **Gaspard Chatin** was the first scientist, who discovered the relationship between endemic goiter and lack of iodine in the environment

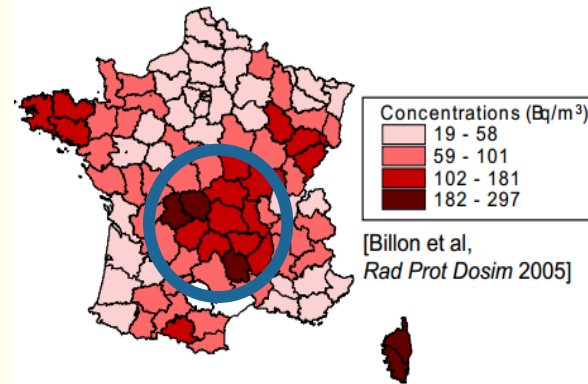


# Geographical distribution of health problems

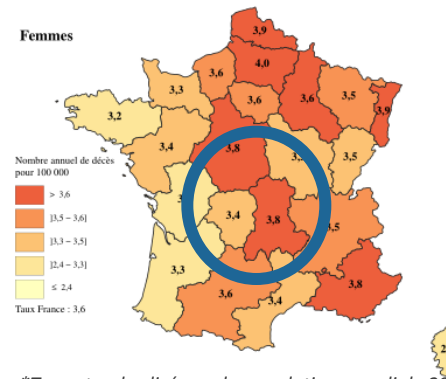
When the prevalence of these diseases was mapped, differences between areas were established, and that facts could not be explained only by genetic, social factors or nutrition

- central nervous system diseases,
- cardiovascular diseases,
- chromosomal and genetic changes,
- birth defects,
- leukemia,
- lung cancer (Rn-220, Rn-222),
- bone sarcoma (Ra-226),
- nasopharyngeal carcinoma,
- multiple sclerosis (Rn-220, Rn-222),
- cataracta

## Radiation situation and leukemias in France



Radiation situation in a residential area on the territory of France



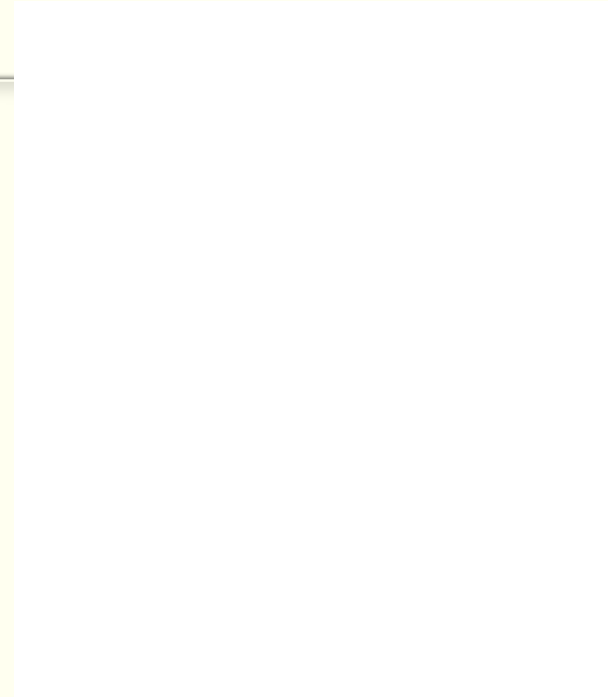
Standardized rates of mortality for all leukemias in the regions of France

\*Taux standardisés sur la population mondiale 2000-2025 (OMS) exprimés en nombre de décès pour 100 000 personnes. Sources: Inserm-CépiDc





# Bush sickness (Morton's neuroma) and Cobalt deficiency

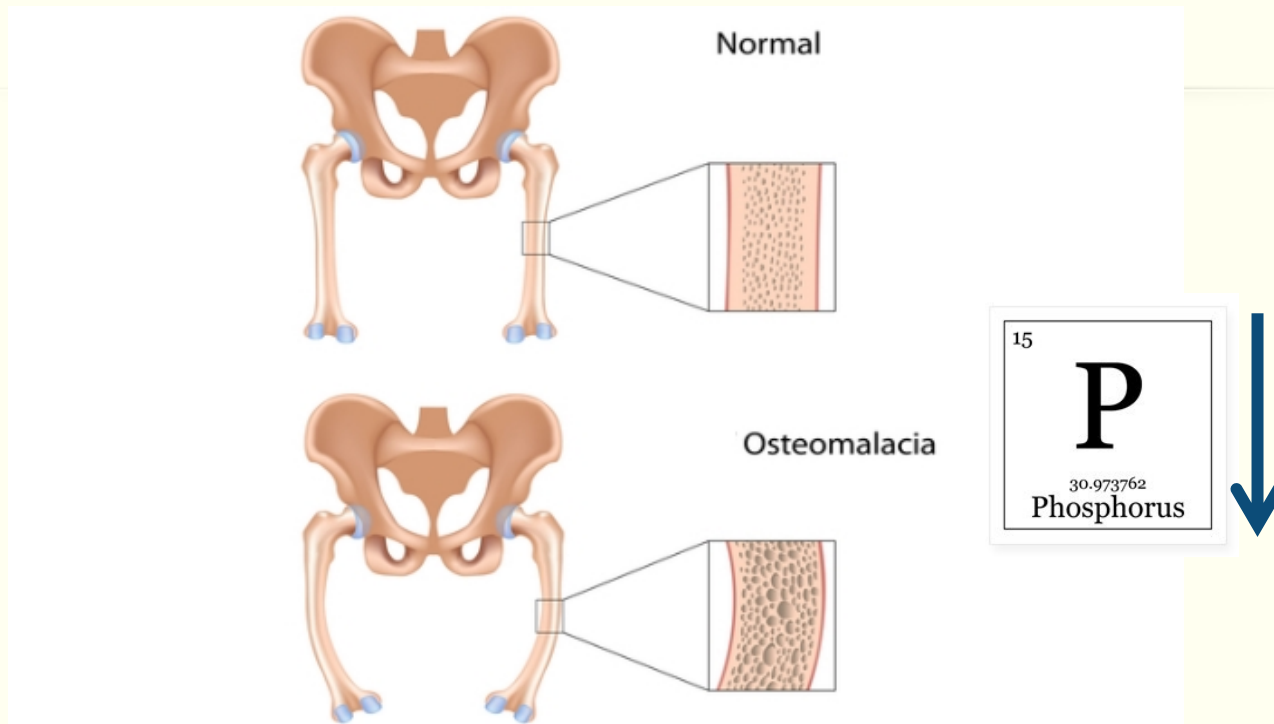


**Cobalt deficiency is a good example of the relationship between animals health and geological factors.  
Dr. Eric Underwood in 1935 discovered the importance of cobalt to health**





# Osteomalacia and Phosphorus deficiency



**Geologist John Vogt experimented by adding crushed bones in food for animals on farms in Norway, where was developed osteomalacia. He came to conclusion that the cause of osteomalacia was phosphorus deficiency**



# Several common problems in Medical Geology



Black shales



The expected pattern should be predictable. If the regularity is established in one region, it should be observed in other geologically similar areas.



Serpentine rocks



High concentrations of vital and toxic elements can be found in the same soils and rocks. This creates difficulties in statistically determining which element is harmful to health and which plays a protective role.

There are more than **400 million** people suffering from diabetes in the world, in Russia – more than **4 million**. The amount of ill people increases 2 times every 15 years.

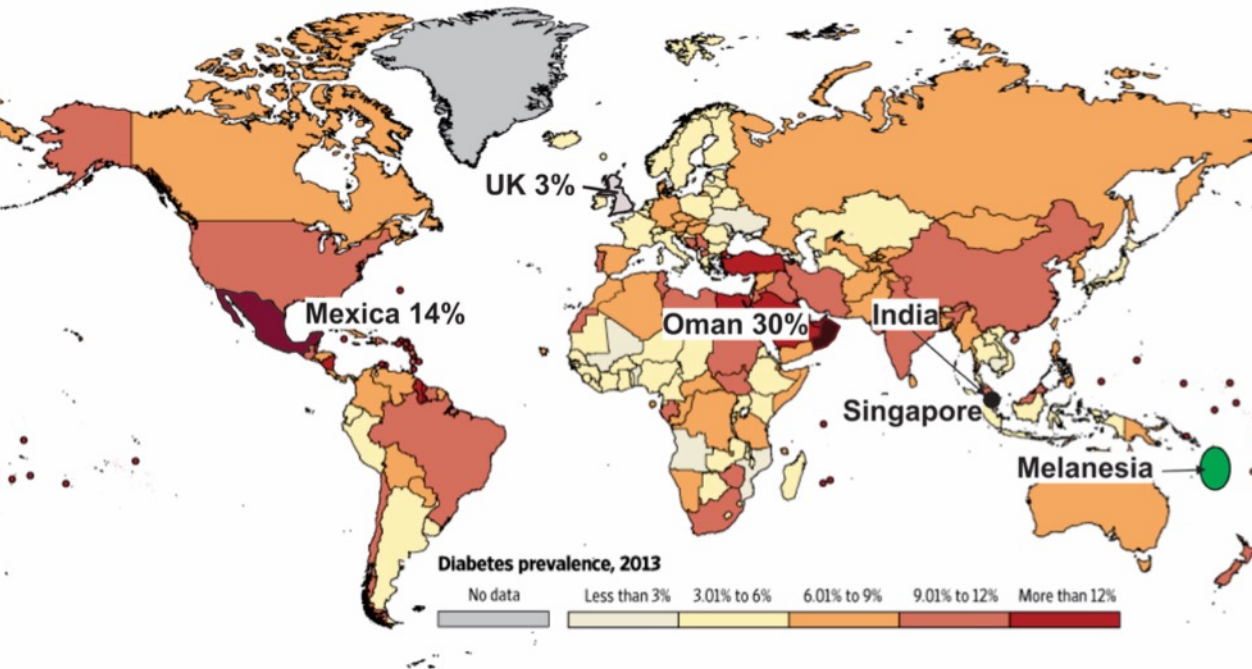
Progression of diabetes is connected with:

- **Obesity**
- **Genetics**
- **Environmental factors which need to be studied**



Diabetes prevalence varies considerably. Changes in the diabetes prevalence during migration. Among the Indians who migrated to Singapore, diabetes is 5 times more frequent in comparison with residents in their homeland.

Diabetes doesn't seem to affect some populations of Melanesia, located on the coral islands (limestone massifs)





The numerous data on the role of different chemical elements in the regulation of carbohydrate metabolism was the precondition for studying the possible connection of microelements in the environment in the progression of diabetes .

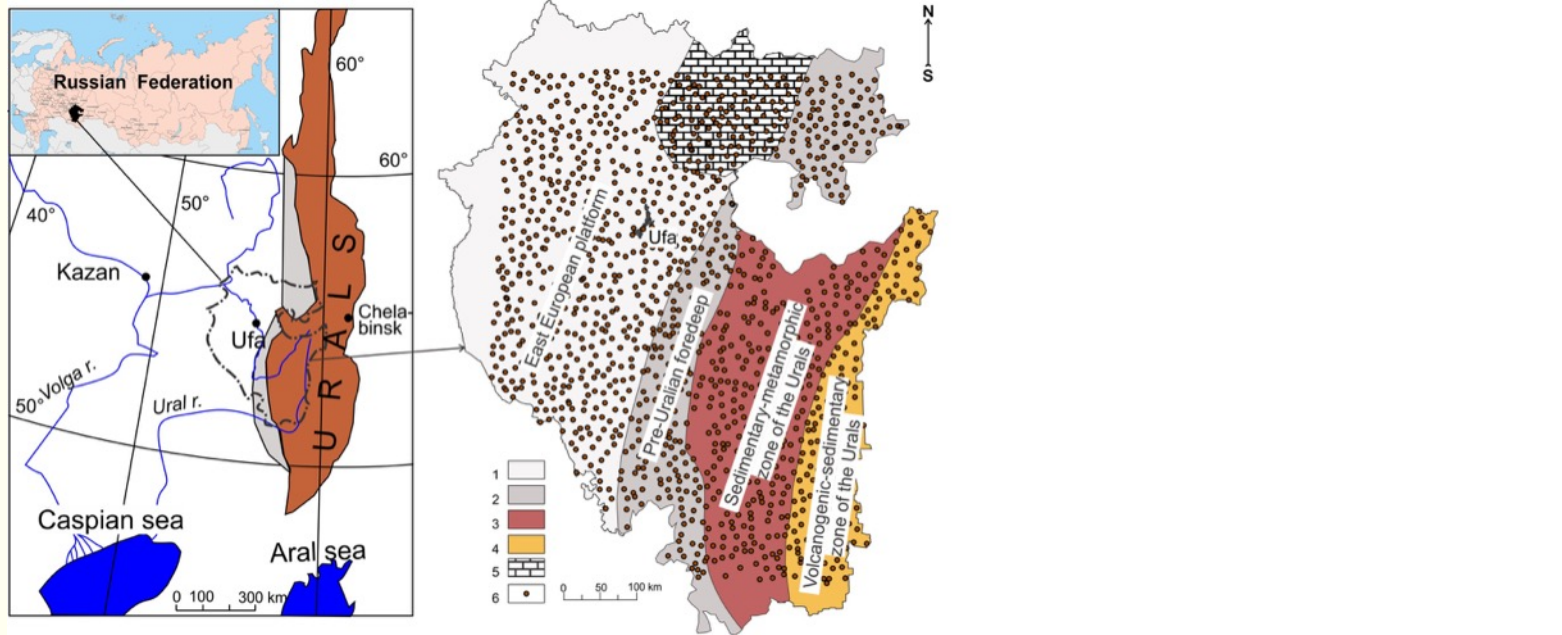
**Calcium** affects activity of the enzymes converting proinsulin into insulin.

**Zinc** is essential for insulin production by pancreatic beta cells.

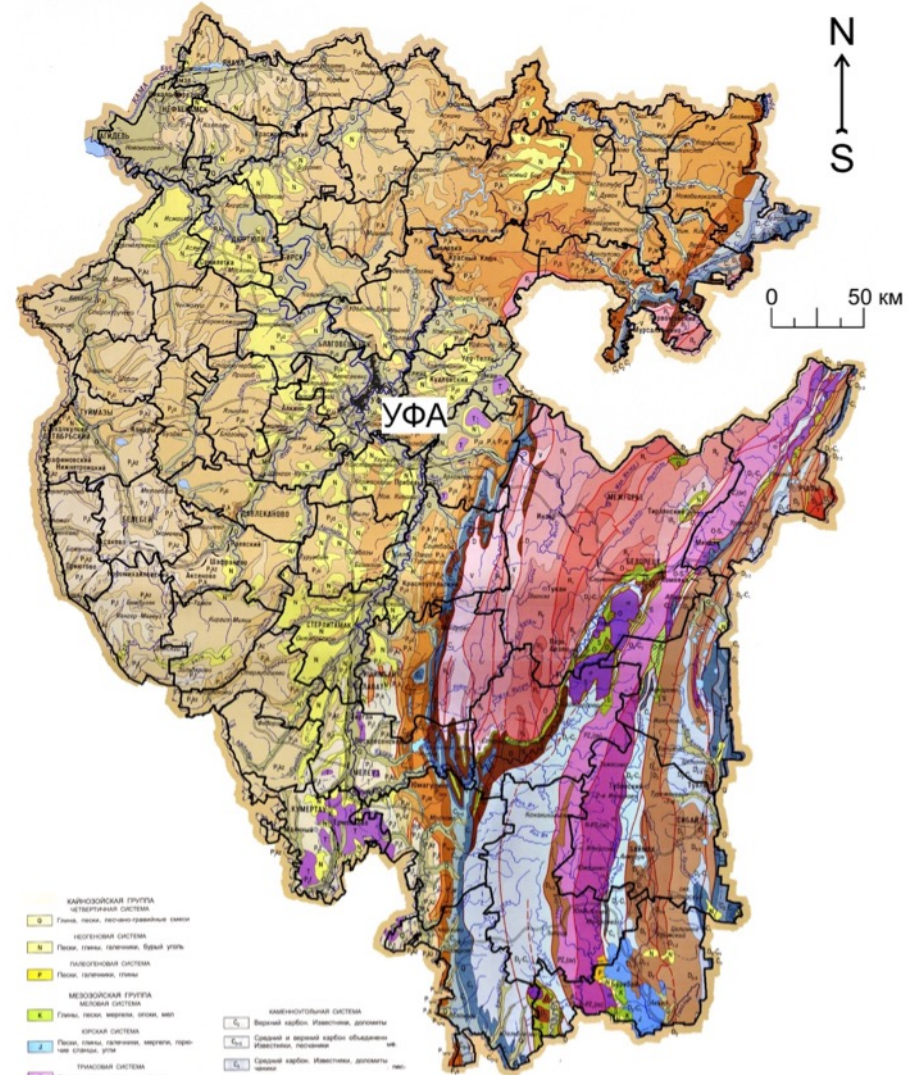
**Iron, copper, magnesium, chromium, vanadium, manganese, nickel and lithium** take part in glucose oxidation, absorption by peripheral tissues and potentiate insulin action.



The research was held in the Republic of Bashkortostan  
Total area 143,600 km<sup>2</sup> Population 4,065,993 people. The western part of RB is situated in the East European Platform and the eastern part is in the Ural mountains



The wide range of geological structures and rocks, causes variety of microelement profile of the biosphere, allowing to use this region as a research ground for studying the biological role of geological factors.





**100 000** diabet suffering people

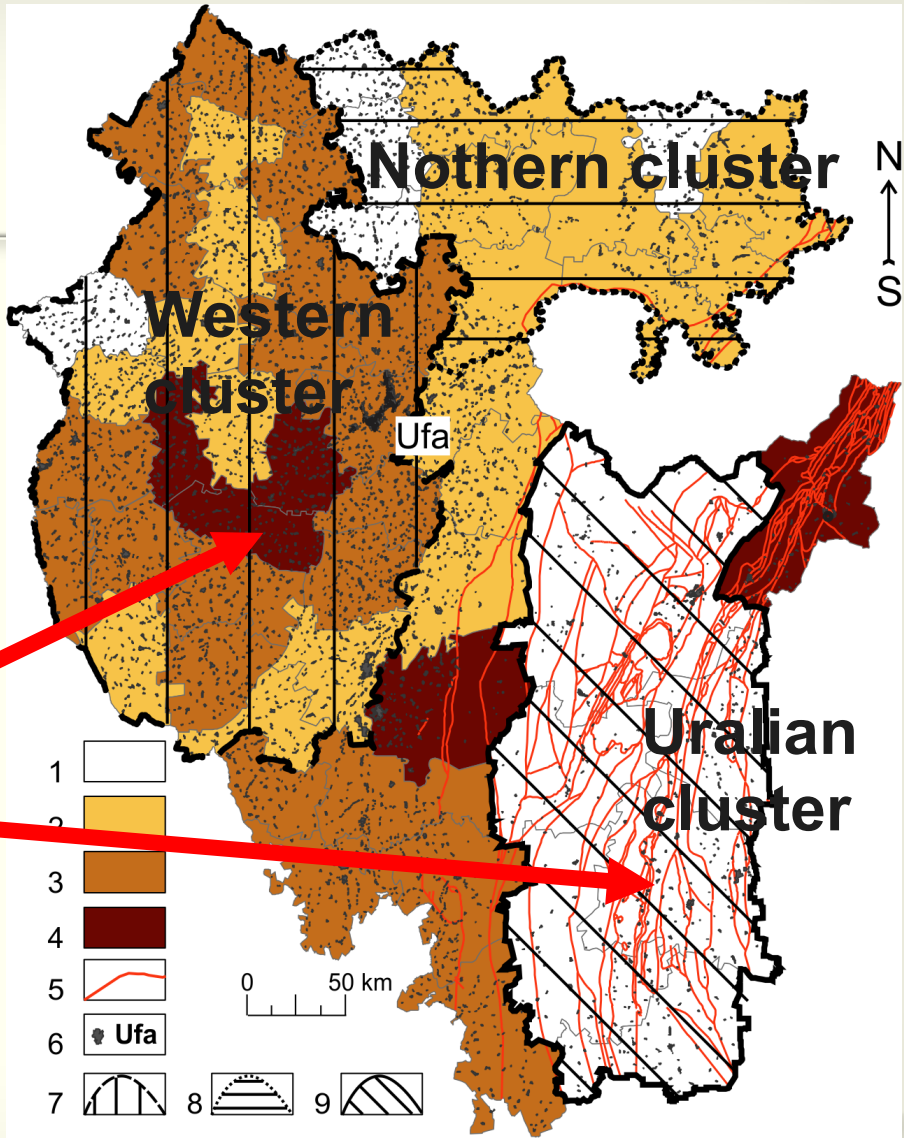
Variation in the prevalence of the disease – **3 times**

The average prevalence - **1773** cases per 100 000 people

Maximum in the western part – **2845**

Minimum within the Urals – **906** per 100 000 people

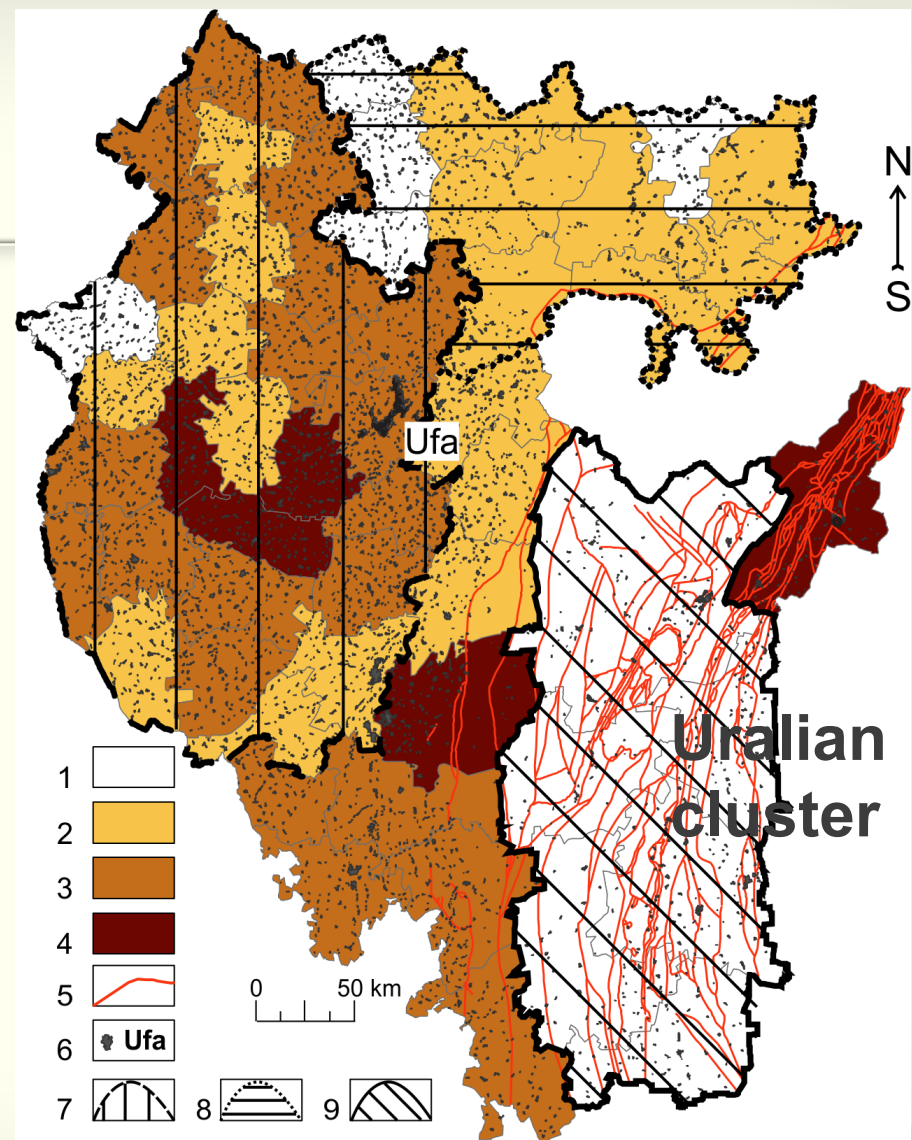
**3 clusters: Uralian, nothern and western**





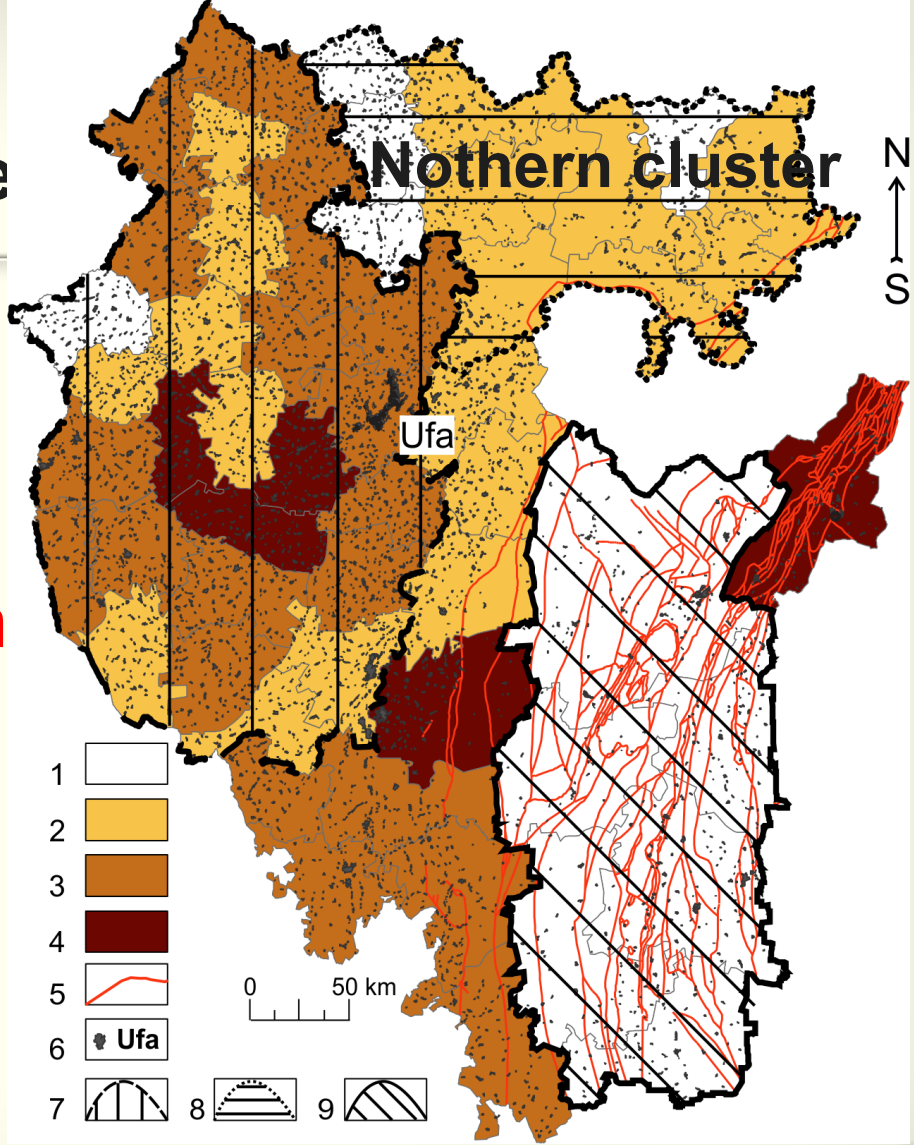
# Uralian cluster:

- High concentration of **tectonic faults**
- **Carbonate rocks**
- Possibility of a favourable effect of geodynamic active zones on health
- Positive influence of limestones on health, because of calcium and high availability of trace elements containing in carbonates



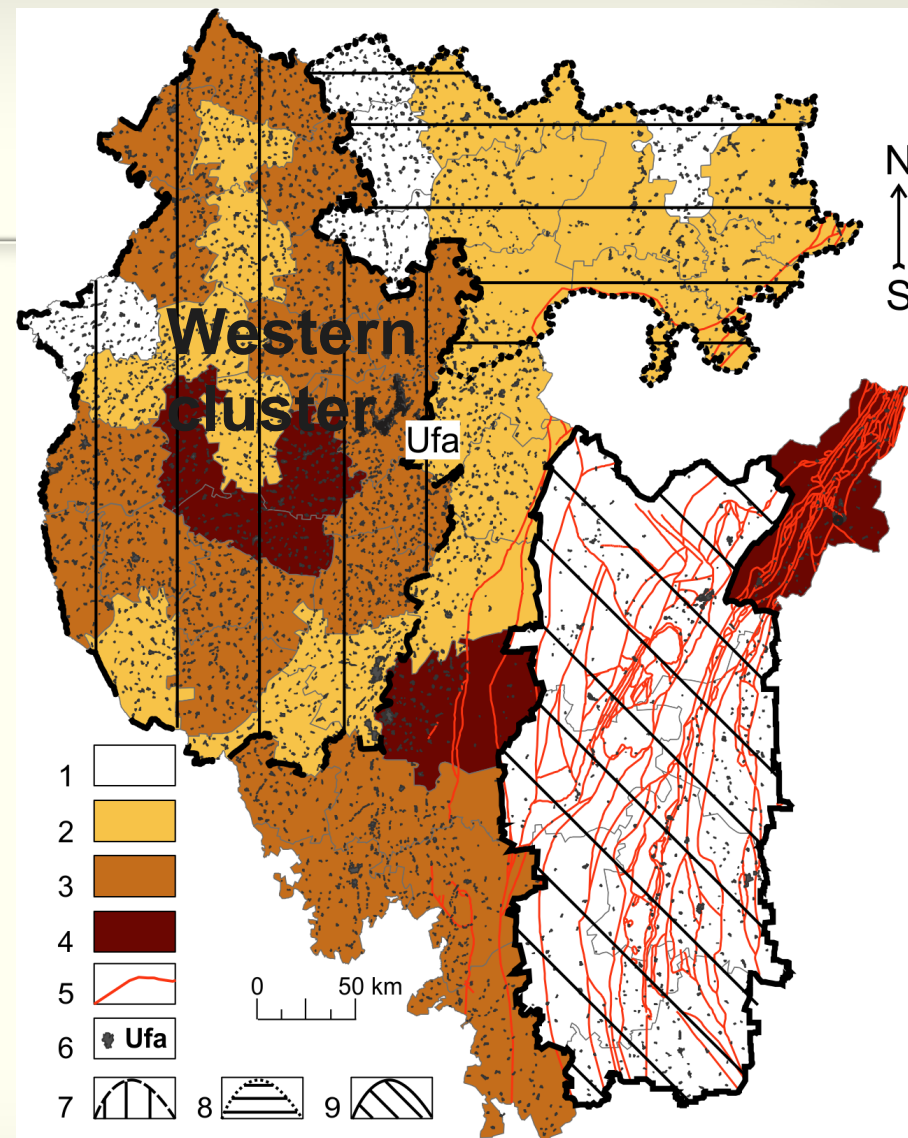
# Nothern cluster:

- Widespread of carbonate rocks
- **Uniform diabetes prevalence** in accordance with **uniform distribution of trace elements** in the area due to the outcrops of rocks of marine origin



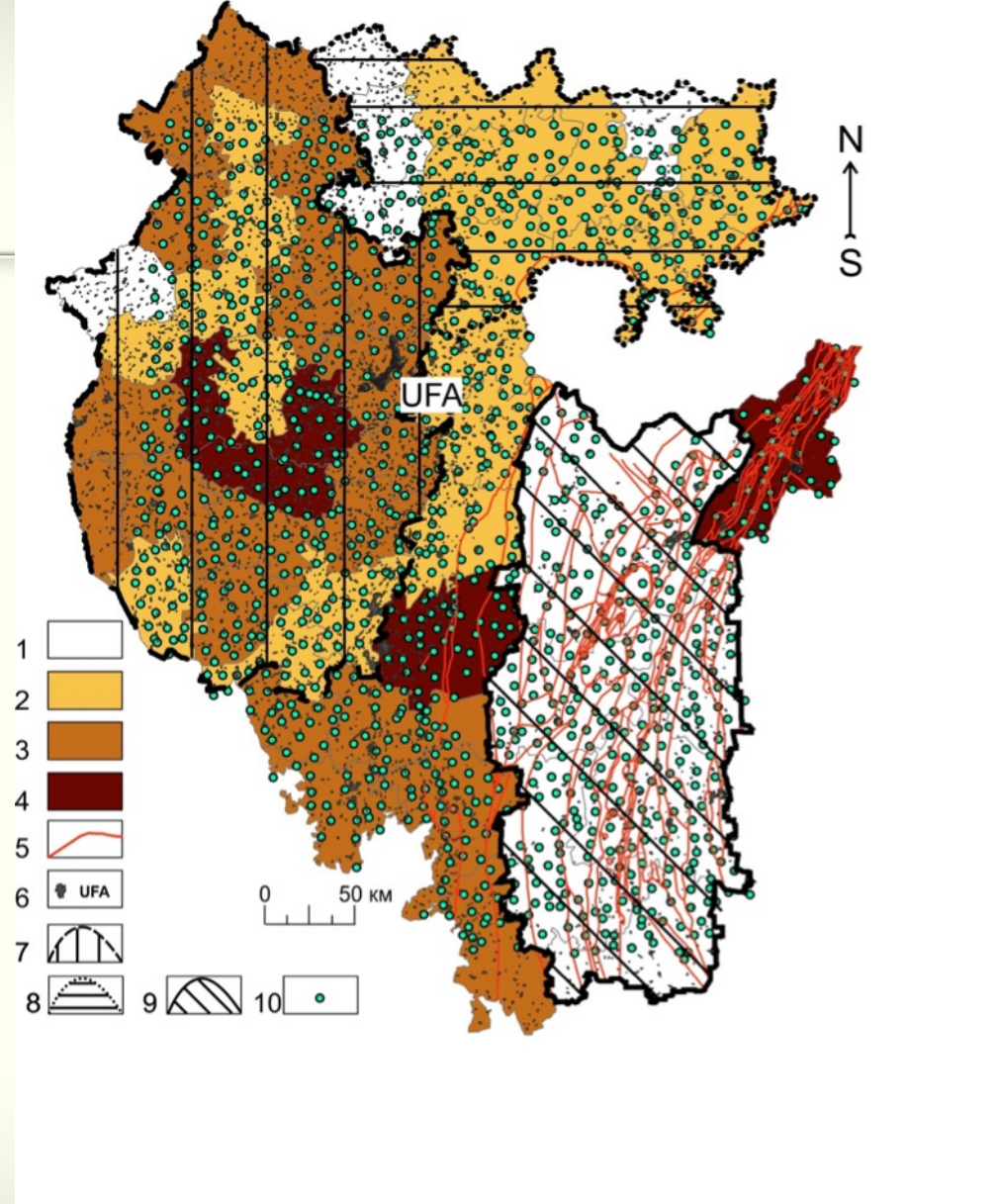
## Western cluster:

- The diabetes prevalence **varies greatly** from low – **1268**, to high – **2845** per 100 000.
- Rocks of **continental genesis**, that causes **mosaic distribution of chemical elements** according to the relief and paleorelief.



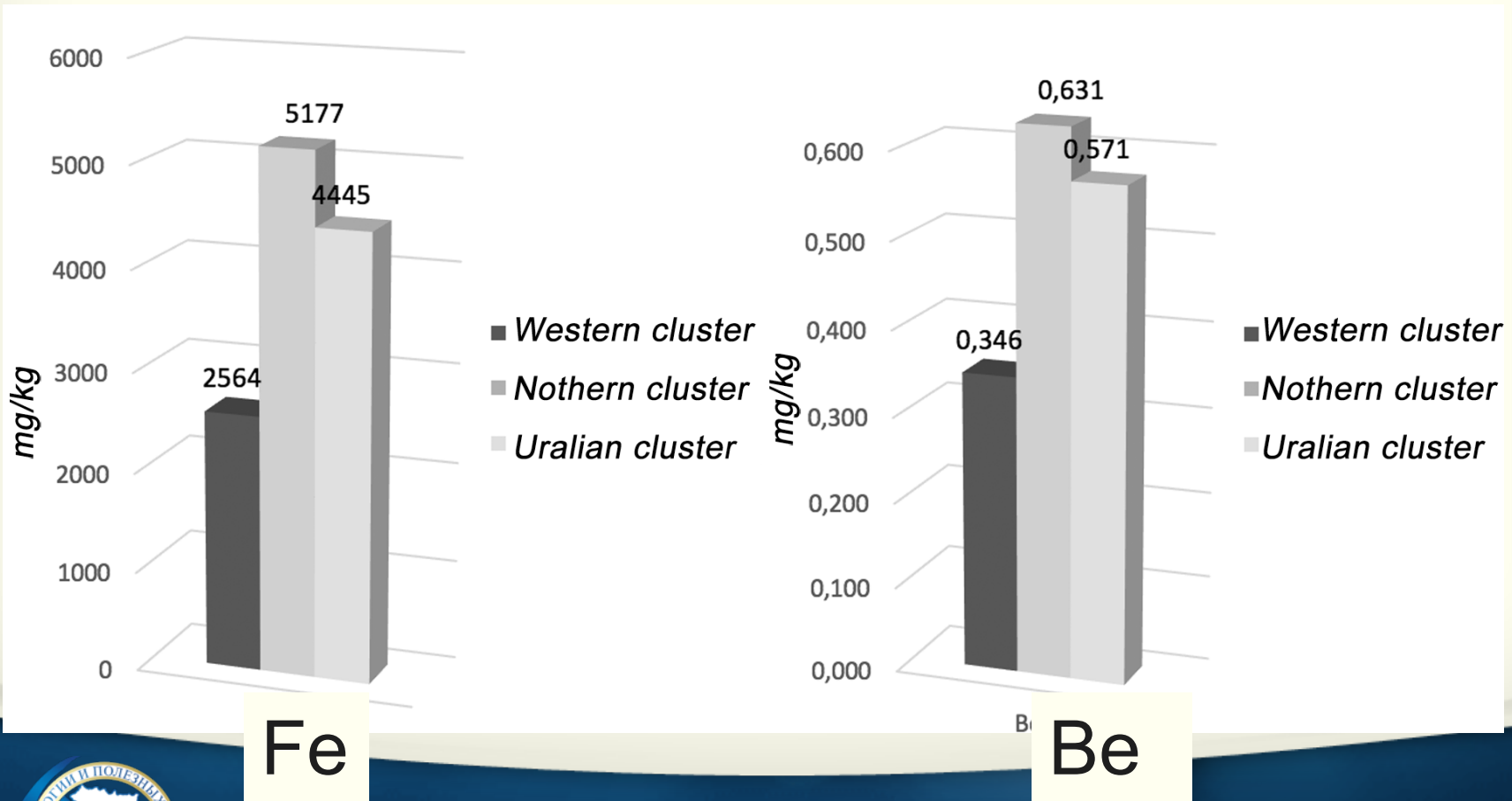


Comparative analysis of **45** chemical elements (**1042** samples, **ICP-MS** method) in soils of **3 clusters** showed higher content of **iron and beryllium** in the territory of the northern and Uralian clusters in comparison with the western ( $p < 0.05$ ).





The revealed association between the higher levels of iron and beryllium and decrease of diabetes prevalence testifies to the possible **beneficial role** of these elements **in the regulation of carbohydrate metabolism**, which **requires further more detailed studies**.







Merci beaucoup!