**Слайд 1**

Dear colleagues, good afternoon. I’m a PhD student at SPbU. Me and my associates from our department – Vadim Abramov, Konstantin Titov, and Andre Revil (Savoy, EDYTEM) prepared a presentation about complex electrical conductivity of Angola kimberlites.

**Слайд 2**

The content is: a brief talk about motivation; secondly, what rocks and by what methods we studied; thirdly, the main results including the behaviour of electrical conductivity and additional parameters with discussion. Finally, we will summarize our observations about electrical properties of the kimberlites.

**Слайд 3**

We all know that kimberlite rocks are the main source of diamonds on the Earth. The base geophysical set for searching kimberlite pipes always includes magnetic prospecting.

However, some pipes exhibit no magnetic response. Moreover, magnetic anomalies of the same shape and magnitude are produced by both kimberlite and non-kimberlite bodies.

This is why, last decades, electrical methods are increasingly applied for kimberlite exploration (Transient Electromagnetic, resistivity tomography and so on). In particular, relatively high DC electrical conductivity values as well as elevated Induced Polarization chargeability values were detected *in situ*. But only scarce factual base concerning electrical properties of kimberlite is available to date.

That’s why we decided to study the complex electrical conductivity behavior of six kimberlite samples.

**Слайд 4**

Our samples of early cretaceous age can be divided into 3 groups.

The first group is autolithic breccias with its typical clastic structure consist of serpentinized olivine, partially weathered to clay minerals (smectite group). We also see some ore minerals such as hematite, magnetite, ilmenite.

The second group is porphyritic kimberlite with a massive texture and smaller olivine peudomorphs, also serpentized and chloritized, which placed in the whole serpentine mass.

The only sample in a third group is tuff sandstone with psephite-psammitic structure. The clastic material located in a clayey matrix.

**Слайд 5**

The samples were saturated with sodium chloride water solutions of concentrations from 0.5 to 12 g/l.

After the first saturation we started SIP measurements. The idea is passing an alternating current of different frequencies through the rock.

If we work with a polarized medium we can observe a phase lag between current and voltage. We also measured the magnitude of the complex impedance.

With the predefined geometrical factor *k*, we obtained the complex resistivity (**conductivity**).

After we calculated the real and imaginary parts of the complex conductivity based on the electrical conductivity magnitude and phase.

In addition, we carried out the cation exchange capacity (CEC), and specific surface area (SSA, BET method) measurements as well as optical microscopy studies to obtain the mineral composition.

Now, **let me to show** results.

**Слайд 6**

The figure shows the real conductivity of the three groups of samples as a function of the pore water conductivity.

The linear fit corresponds to Archie's law considering an effect of the surface conductivity.

We see the highest values of the real part and surface conductivity for autolitic breccias and tuff sandstone.

On the contrary, porphyritic breccias are characterized by lower values.

**Слайд 7**

The figure**s** on the slide illustrate relationships between SSA, surface conductivity and CEC. Except for one point (empty square, **autolithic breccia**), the data can be well approximated by linear fit (Fig. a) and linear fit forced to go through the origin (Fig. b).

**Слайд 8**

What else can we extract from the SIP measurements? Figure a. shows the relationship between the imaginary part of the complex conductivity (at 1.46 Hz, with 𝜎𝑤~1 S/m) and the surface conductivity. This relationship is fairly well approximated by a linear fit forced to go through the origin. Later we will know the importance of this relationship for our study.

Figure b. shows imaginary conductivity spectra for the six studied samples. For the autolitic breccias two types of spectra were detected: the first one with monotonous increased values with frequency increase; and the second with a more or less pronounced maximum in the frequency range 0.01 to 1 Hz. For the porphyritic kimberlite, we detected a monotonous increase of 𝜎′′ with increased frequency. For the tuff-sandstone with kimberlite material, we detected a pronounced maximum.

**Слайд 9**

I have to remind you that all studied samples contain a certain small amount of conductive minerals.

Therefore, we should identify the nature of the IP mechanism: metallic particles or ion-conducting rocks.

For the case of the metallic particles, we should observe a strong relationship between the peak position in the phase spectra and the water salinity (conductivity).-We don’t.

But we found that the strong variations of the surface conductivity are determined by the variations of both the cation exchange capacity and the specific surface.

Furthermore, the surface conductivity and formation factor values are typical of sandstones rather than of igneous rocks.

And, finally, let’s go back to the relationship between s’’ and surface conductivity from the previous slide. It is a theoretical parameter mentioned by Andreas Weller(2013) and Andre Revil (2017) called l-parameter.

We obtained the slope of 1.5\*10 to the power of -2, which is of the same order of magnitude than that obtained with a sandstone collection 4.2\*10 to the power of -2.

Hence, this relationship presents another proof about proximity of kimberlite electrical properties to those of clayey sandstones.

**Слайд 10**

**I summarize** the results: we observed significantly different electrical properties….

We hope this fact can attract practitioners dealing with kimberlite exploration.

Regarding our collection, the nature of IP is not associated with inclusions of conductive ore minerals.

Lastly, the intensity of surface conductivity and polarization are determined by the specific surface area **and the CEC of kimberlites.**