Unconventional Deposits:
New Source for Extraction of Critical Metals

Ulanova Olga, Zelinskaia Elena

National Research State Technical University of Irkutsk, Russia

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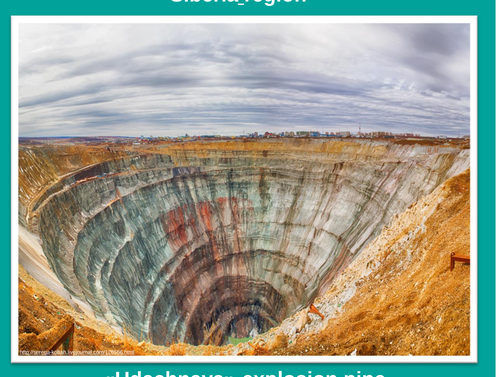
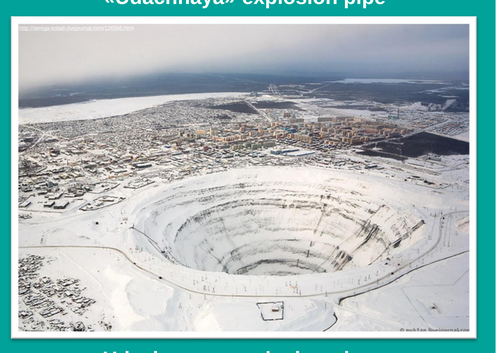
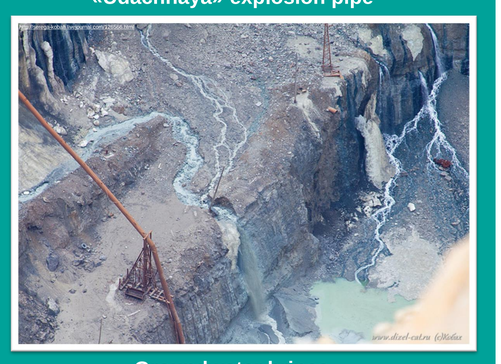
Siberia_region



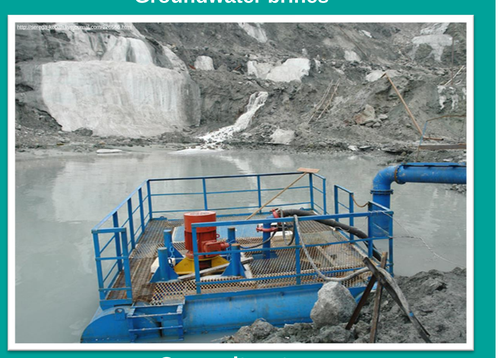
«Udachnaya» explosion pipe



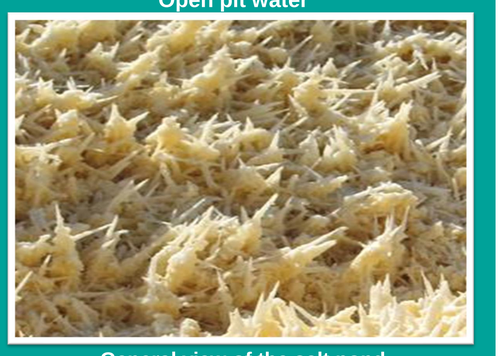
«Udachnaya» explosion pipe



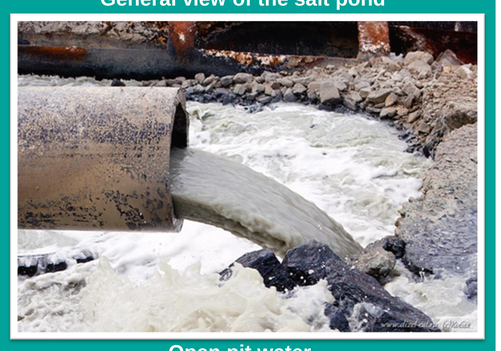
Groundwater brines



Open pit water



General view of the salt pond



Open pit water

Introduction

- The industrial value of brines from Siberia (Russia), of the Aral region lakes of Kazakhstan and brines in Karabogazgol of Turkmenistan is caused by the high contents of rare elements (lithium, rubidium, cesium, strontium etc.).
- The absolute concentrations of these elements in brines exceed the lower limits of the mining cut-off tens of times. Today, rare earth metals are a part of the strategic reserve of many countries.
- Rare earth metals are also called “industrial vitamins” because even small amounts of them in alloys and other compounds improve their properties.

Materials & Methods

- The methods used in the research projects are as follows:
- the atomic absorption analysis; the flame photometry;
- the flame mass spectroscopy;
- analytical-experimental, static, and dynamic methods for the ion exchange process;
- the mathematical modeling of the ion exchange kinetics;
- planning and processing of experiment results using the static methods and the Microsoft Excel software.

Results & Discussion

- The environmental and economic efficiency was proved for the processing of complex brines and the integrated selective extraction of rare earth metals from sodium chloride brines of the and calcium chloride brines based on the ion exchange sorption, eluent chromatography, flotation, crystallization, and freezing techniques. The basic technological schemes were developed for the metal extraction from pit water and brines.

1. The dependence of the degree of extraction of metal ions (Sr, Li, Rb, Ca, Mg, Na) on the concentration of hydrochloric acid in the range of 0.1 to 8 N HCl was established. It was shown that the efficient separation and extraction of metals is reached by the gradient elution, which allows to obtain products with the lowest content of impurities, particularly, to provide 92% extraction of strontium and 97.9% extraction of rubidium.
2. Based on the height equivalent to a theoretical plate (HETP), the possibility of the chromatographic separation of Sr, Li, and Rb ions was shown using a KU-2x8 and a Dawex-50x8 cation exchangers on the brines at the 2 N HCL eluting.
3. The technological scheme for the lithium, strontium and rubidium sorption extraction from the brines was proposed.

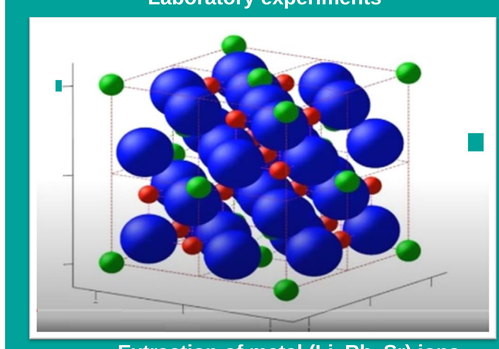
Conclusions

- The issues of the integrated production of critical metals from unconventional resources (pit water and brines in Siberia and Central Asia) are not explored enough yet, despite the great prospects of this area.
- Apparently, the main phase in the integrated processing of groundwater brines is the technology for the extraction of industrially valuable rare and alkali earth elements. In each individual case, the environmental and economic feasibility of the groundwater brine recycling should be studied.

Kazakhstan

Salt dunes of Karabogazgol in Turkmenistan

Laboratory experiments



Extraction of metal (Li, Rb, Sr) ions

Rubidium

Lithium

Strontium

Kontaktperson

Olga Ulanova
Dr.- Ing., Department of Mineral Processing & Environmental Protection
National Research State Technical University of Irkutsk
Lermontov Str, 83, Irkutsk, 664074, Russia
Kontakt: Schweiz, Zürich
E-Mail: olga.ulanova@gmx.de

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