



# Isolation of new methylotrophic species *Bacillus baksanea* from deep underground hot spring of Baksan Neutrino Observatory



Tarasov Kirill<sup>1</sup>, Zarubin Mikhail<sup>1</sup>, Yakhnenko Alena<sup>1</sup>, Gangapshev Albert<sup>2</sup>, Kravchenko Elena<sup>1</sup>

1. Sektor of Molecular Genetics of the Cell, DLNP JINR, Dubna

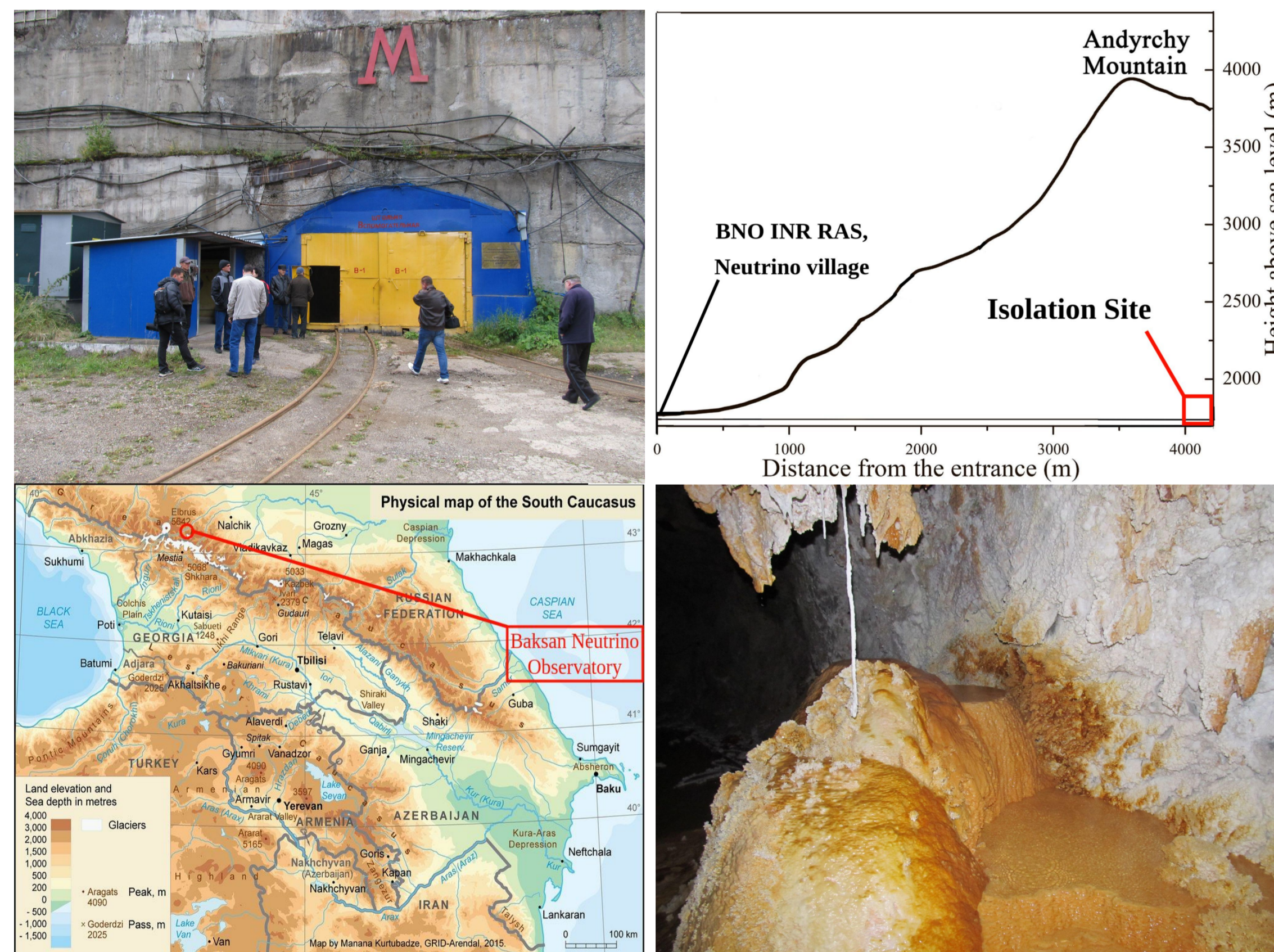
2. Baksan Neutrino Observatory, INR RAS, Moscow

tarasovk49@gmail.com

## Introduction

Life in farthest corners of the Earth with extreme conditions poses many interesting questions concerning principles of evolution. Investigation of extremophilic organisms provide insights on driving forces of nature and can be of great use for biotechnology due to existence of unique pathways and enzymes, far-divergent from what we observe in surface organisms, and for **astrobiology** because organisation of possibly existing underground live organisms on other planets may in some way resemble the organization of Earth-dwelling extremophiles.

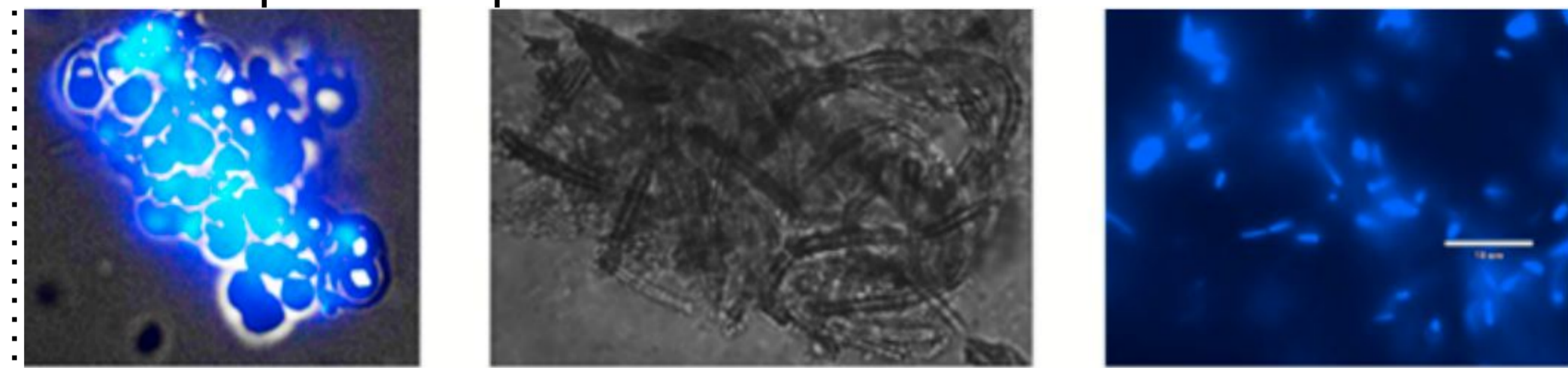
## Isolation source



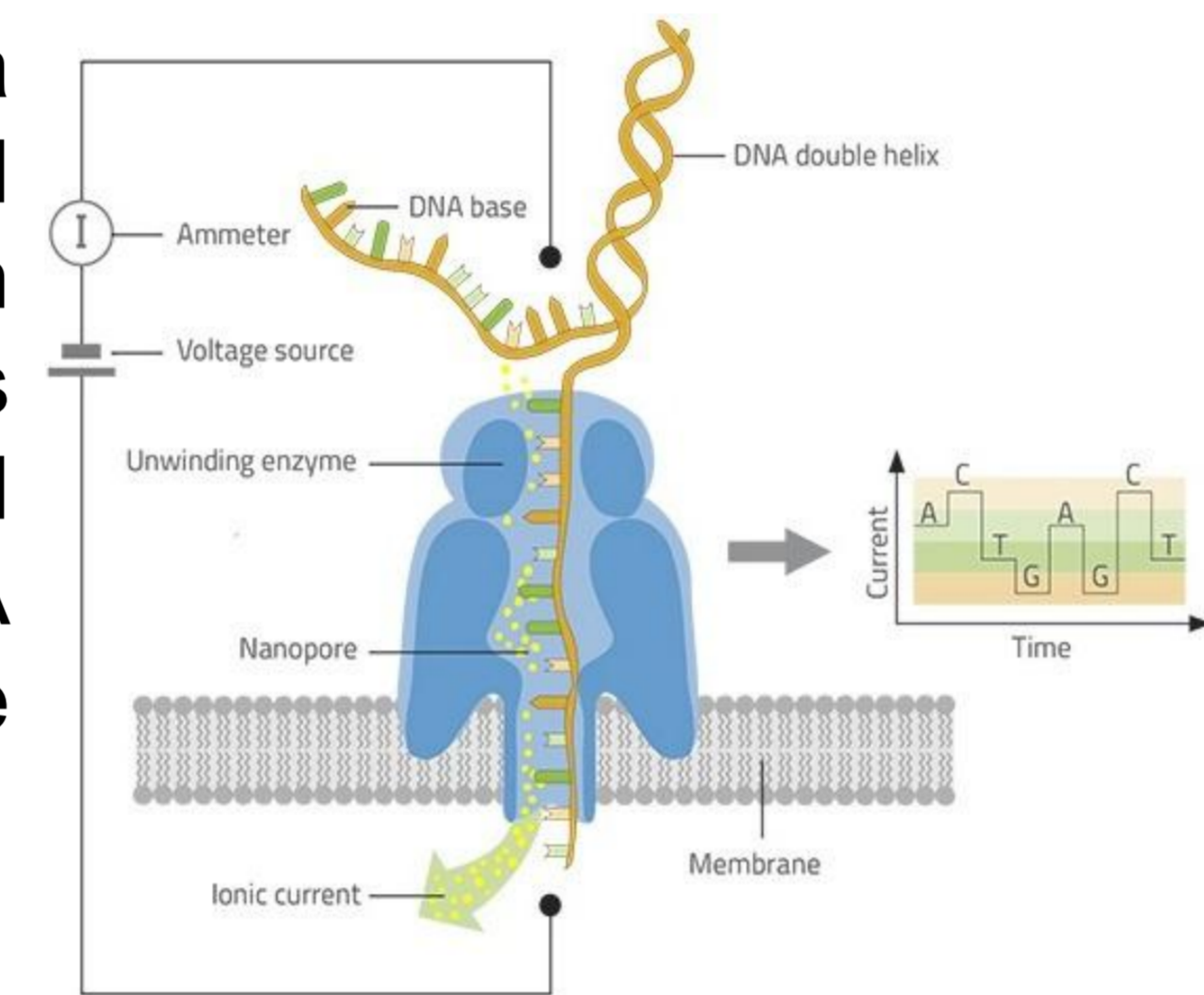
Hot-water springs are ubiquitous in Caucasus, region of high tectonic activity. One of such is the spring located at the end of underground tunnel of Baksan Neutrino Observatory 2 km under mountain rock. Its waters are hot and highly-mineralized, and organisms inhabiting it possess unique features to resist such severe conditions. A new species from it *Bacillus baksanea* has been isolated and characterized in this work.

## Sequencing and annotation workflow

Axenic culture of microorganism is a culture in which no cells of other species is present.

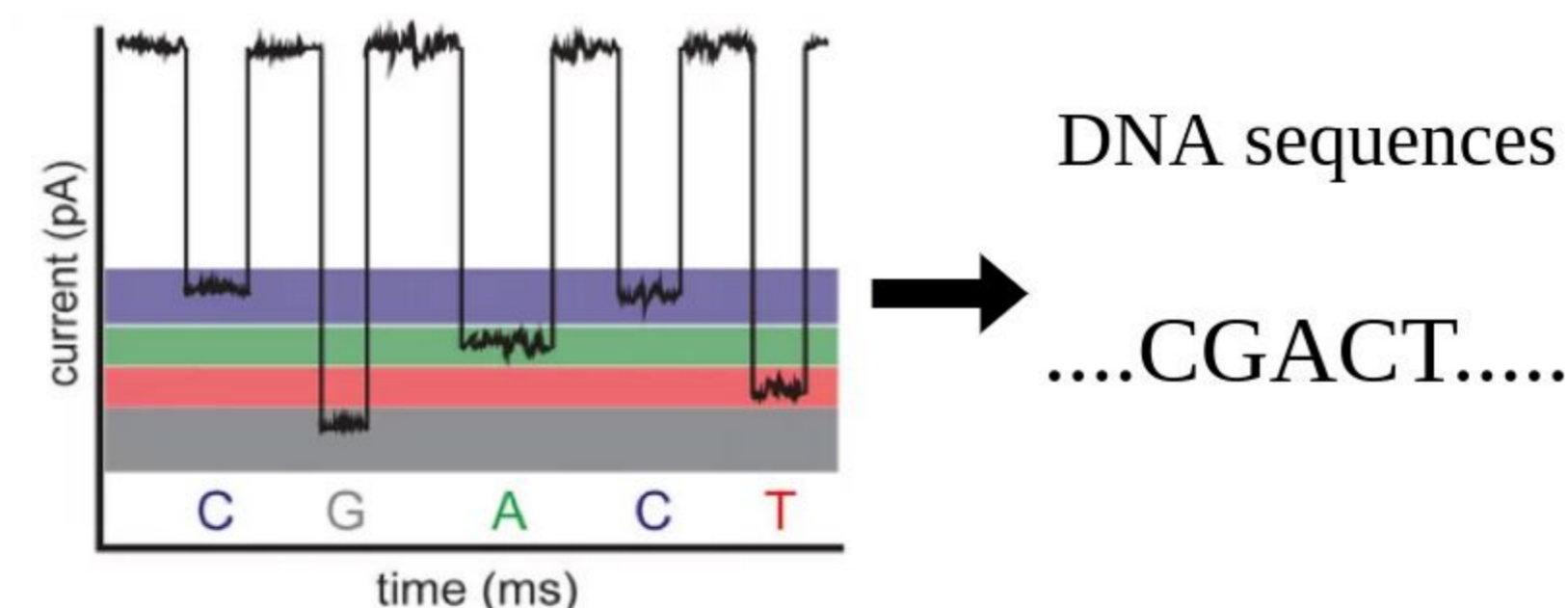


Nanopore sequencing is a sequencing technique based on ion current registration driven by bias voltage across membrane through nanosized protein pore while DNA molecule traverses through the pore at the same time.

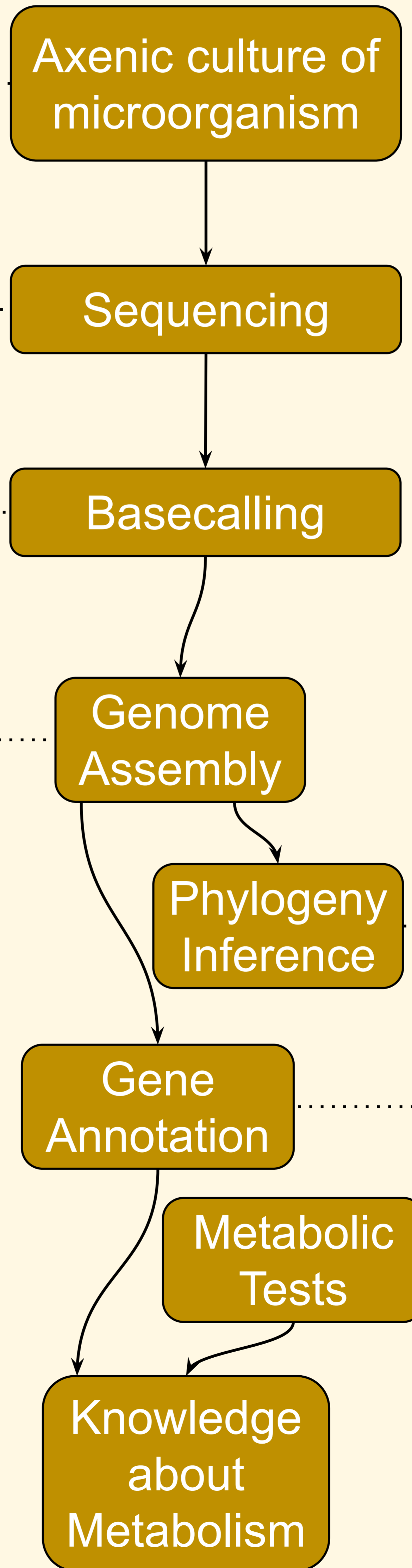
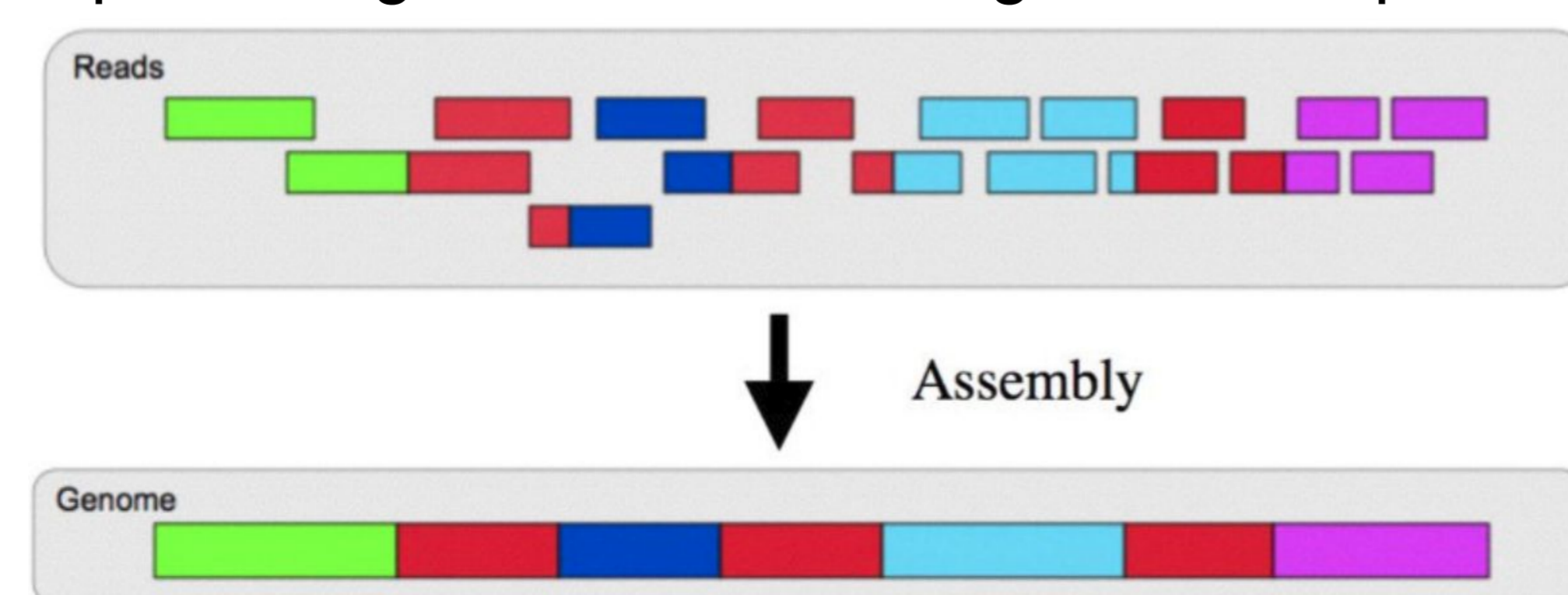


The pattern of ion current versus time indicates which type of nucleotide occupied the pore for that period. That nucleotide could be determined via neural network signal processing.

The process is called **basecalling** and pieces of DNA produced are called **reads**.

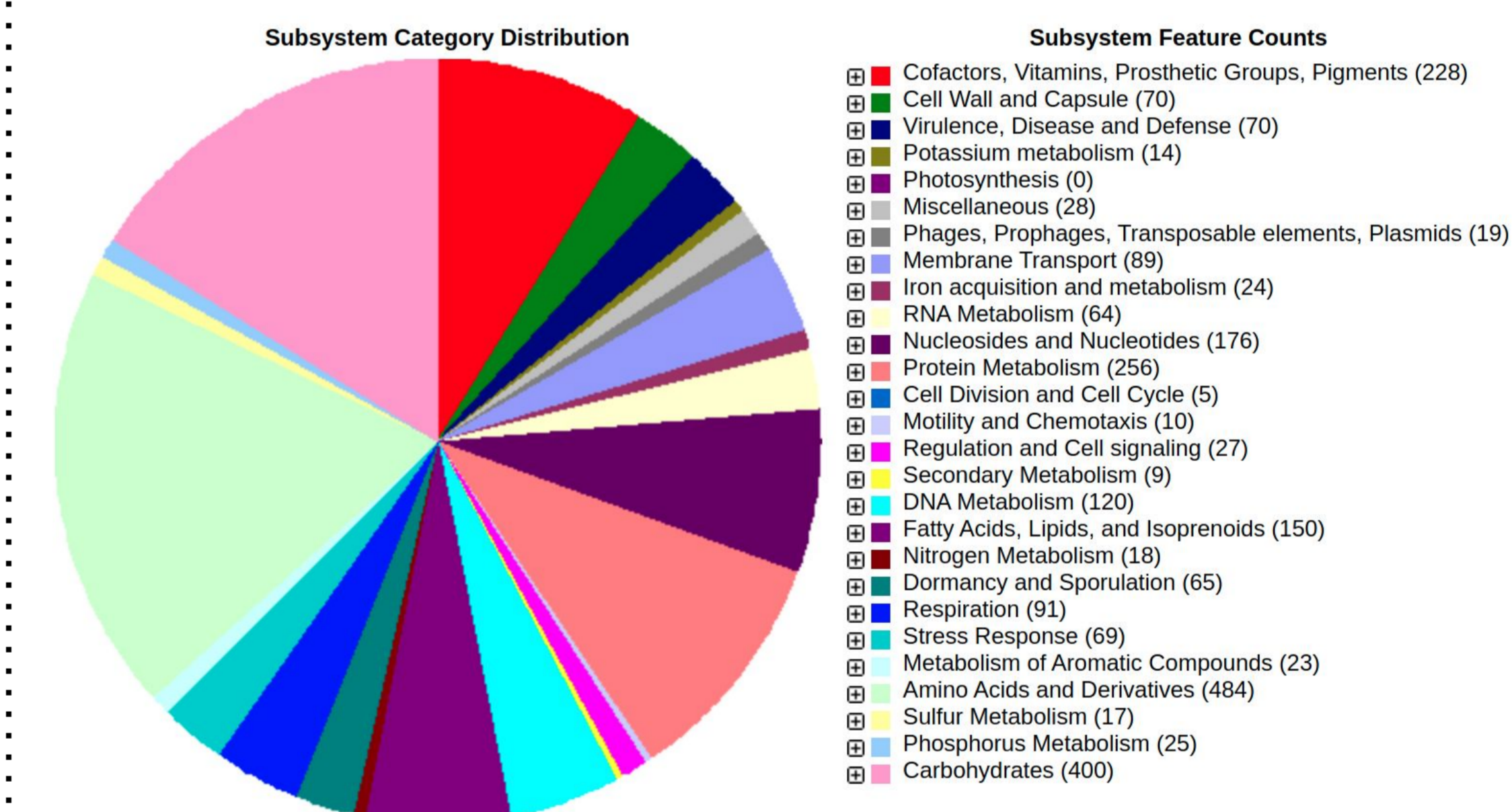
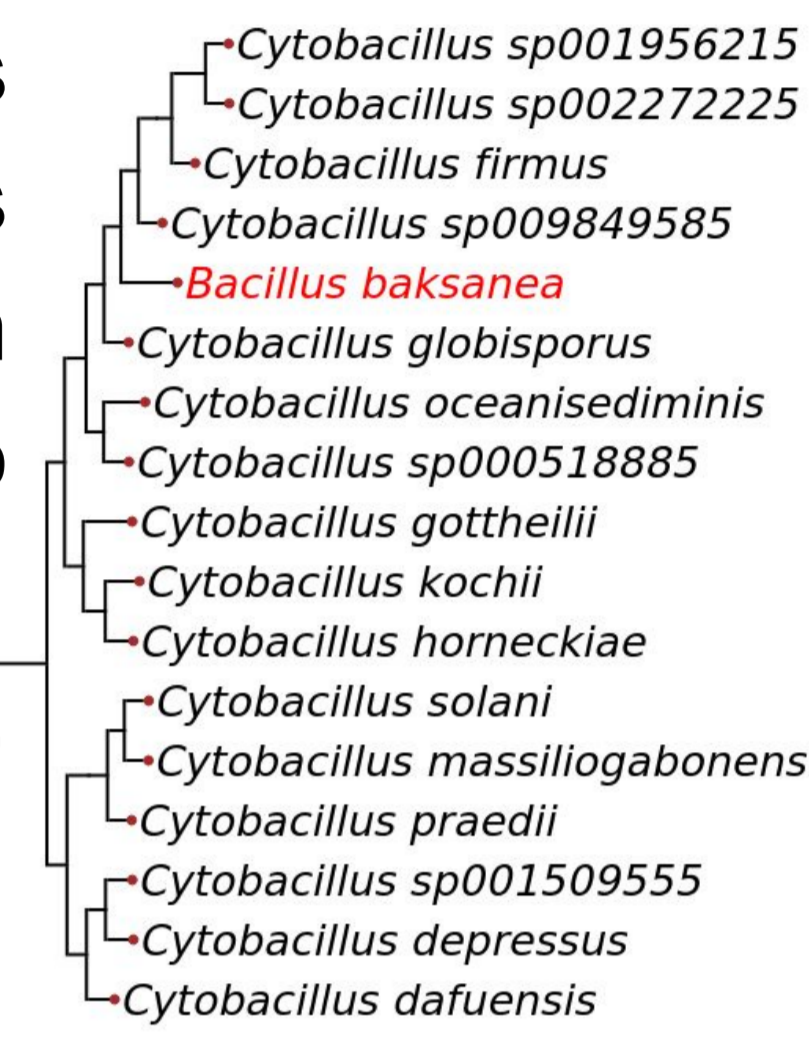


Genome assembly denotes process of constructing of one-piece genomic DNA molecule from reads. Regions of reads overlap allowing reconstruction of genome sequence.



## Results

Phylogeny inference suggests that *B. baksanea* is a new species of extremotolerant microorganism and is most related to *Cytobacillus oceanisediminis*, also extremophilic bacteria, inhabiting marine sediments.



Metabolic features of *B. baksanea*:

1. C<sub>1</sub>-compounds utilization (methanol, formaldehyde, methylamines)
2. Riddance of heavy ions (cobalt, cadmium, zinc, copper)
3. Resistance to thermo- and osmotic stresses.

## Future work

Further metabolic characterization of *B. baksanea* will be performed as well as characterization of the bacteriophage found in the genome. Assessment of biotechnological value of *B. baksanea* for methanol utilization and water treatment from heavy metal ions.