The aim of the project will be to assess the stability of the illite structure (fine-crystalline mica) substituted with radioactive cesium cations. Al-bearing clay minerals will be used for synthesis of the illite structure. The available literature data and the experience of the research team allowed the following research hypotheses to be formulated:

1. Radiocesium decay within (or in vicinity to) Cs-substituted illite particles likely affects the illite structure due to formation of structure defects by the interaction with high-energy beta particles and gamma radiation.
2. The stability of radiocesium-substituted illite may also be affected by interlayer-cations charge imbalance due to formation of Ba^{2+} at the expense of radio-Cs^{+}.
3. Both processes may potentially affect Cs-retention of illite structure.

The verification of the underlying hypotheses will reached by performing of a series of laboratory experiments using mineralogical and radiochemical methods. Swelling Al-bearing clay minerals will be used as starting materials for planned laboratory experiments. The experiments will include the synthesis of the illite-like phases, containing in its structure (between the layers) stable (^{133}Cs) and radioactive (^{134}Cs) cesium ions and assessing the effect of radiocesium decay (ie ^{137}Cs and ^{134}Cs) on the total radiocesium retention in the structure under study. In addition, the proposed studies should answer the question whether the swelling clay minerals can be utilized for decontamination (purification) of natural waters, polluted with radiocesium (^{134}Cs and ^{137}Cs). The measurements will involve the use of radiometric techniques (gamma and beta radiation spectrometry), mineralogical techniques (X-ray diffractometry, IR absorption spectroscopy and inductively coupled plasma mass spectrometry). Dynamic sorption will be applied to saturate the structure with stable cesium ions and containing radioactive cesium tracer. The possible desorption of cesium from the structure of the cesium illite will be tested under static conditions, in different time intervals (mainly half-yearly). Possible cesium desorption from the cesium-illite structure will be tested under static conditions at different intervals of time (mainly half an annual interval). The time schedule is related to the long half-life of ^{134}Cs ($T_{1/2}$ = 2.01 years). At the end of the project, the analysis will continue until the total decay of ^{134}Cs (approximately 20 years) and the findings of the project will be enriched with knowledge from subsequent long-term studies. The static sorption will also be used in an application study of swelling Al-clays to the sustainable decontamination of natural waters.

The presented research is innovative, since no experimental study on the influence of radiocesium decay on the Cs-substituted illite structure is available. It is worth noting that illite structure is the one controlling cesium retention properties of soils and sediments. As is known as a result of nuclear weapon tests or nuclear accidents (Chernobyl 1986, Fukushima 2011), the environment has been contaminated with the long-life radionuclide ^{137}Cs (half-time of ~ 30 years). As a consequence, it is necessary to look for sustainable sorbents for decontamination, i.a., of natural waters. The presented study should answer the questions of whether the cesium-illite structure permanently retains Cs radioisotopes and whether its synthesis due to adsorbtion of radiocesium by Al-swelling clays can be applied to purifying the environment contaminated with radioactive cesium.