PROJECT DESCRIPTION FOR THE GENERAL PUBLIC

Water means life. Nowadays, we are using approximately half of the renewable resources of water available on our Planet. Latest demographic predictions envisage continuous growth of the global population in the course of 21st century. This means that in several decades from now we may face another global problem: global shortage of water. Even now, in number of regions water is already a strategic resource. Moreover, major water reserves (surface water and shallow groundwater systems) are under growing stress, mainly due anthropogenic pollutants of various nature threatening quality of these reserves. From this perspective, proper management of water resources, in particular groundwater resources, is becoming more and more important, both from local as well as global perspective.

Water which is flowing from our taps everywhere looks the same. Asked for its color we would answer that water is transparent. However, if we would be able to watch each individual water molecule under strong "microscope" we would notice subtle differences stemming the fact that elements from which water molecules are build (hydrogen and oxygen), have their varieties which differ slightly in mass (isotopes). Therefore, in ordinary water which flows from a tap one may find several isotopically different water molecules, several “colors”. Most popular are those molecules which contain ordinary hydrogen (^1H) and ordinary oxygen (^{16}O) - this is $^1H_2{}^{16}O$ molecule. However, there are also other isotope water molecules, such as $^1H^2H^{16}O$, $^1H_2{}^{18}O$, and $^1H_2{}^{17}O$. The first two were subject of interest since several decades. It appeared that if we measure concentrations of those molecules in water, we may learn a good deal about its origin and history.

Stable isotopes of water, ^2H and ^{18}O, are widely used in hydrology since the 1960s. In groundwater hydrology stable isotopes of water serve as powerful tools for identification of the origin of water (e.g. meteoric vs non-meteoric, recent infiltration vs infiltration under different climatic regime), they help to quantify mixing patterns of various water types, they serve as indicators of the elevation of groundwater recharge areas in mountainous regions and they help to identify and quantify the interaction between groundwater and dependent ecosystems, just to name few. In the domain of surface water hydrology they have been successfully used for solving water balances of surface water bodies such as lakes, particularly with respect to underground components of those balances. Also, they were and are used to quantify components of river discharge under different hydrological regimes. Over the past decade, the third isotope molecule of water mentioned above, $^1H_2{}^{17}O$, is receiving growing attention.

The project is aimed at thorough assessment of the potential of full isotope analyses of water (^2H, ^{18}O and, in particular ^{17}O) in groundwater and surface water hydrology. In the framework of this project comprehensive analyses will be made, focusing on assessing the variability of $^1H_2{}^{17}O$ and so-called ^{17}O-excess in groundwaters of various origin such as meteoric waters recharged in other climatic regimes, relicts of ancient seawater, or diagenetic waters. Also, triple isotope balance of surface water body (lake near Krakow) will be made with the main aim of assessing the potential of ^{17}O as an additional isotope tracer in this type of studies. Moreover, so-called kinetic fractionation factors for $^1H^2H^{16}O$, $^1H_2{}^{18}O$ and $^1H_2{}^{17}O$ in the process of water evaporation will be determined in dedicated laboratory experiments. The obtained numbers will be used in solving water balance of the studied lake. Finally, regular measurements of full isotope composition (δ^2H, $\delta^{18}O$ and $\delta^{17}O$) of daily precipitation in Krakow and at the Kasprowy Wierch station in the Tatra Mountains will be conducted. Isotopic composition of daily precipitation will be related to meteorological parameters (air temperature, amount of rainfall, relative humidity), thus enlarging our current understanding of the mechanisms controlling isotopic composition of precipitation in space and time.

Water samples gathered in the framework of the project will be analysed using advanced technology based on differentiated absorption of laser light by isotope molecules of water. Laser spectrometers allow full isotope analyses of water (^2H, ^{18}O, ^{17}O) with the precision and accuracy exceeding those achievable nowadays by classical mass spectrometry technique.

To the best of our knowledge, the scope and extend of the proposed project is without precedence as far as groundwater and surface water hydrology is concerned. It is expected that its implementation will provide valuable, new knowledge and new impetus for applications of isotope-aided methodologies in water resource development and management.