

Using environment tracers for investigation of submarine groundwater discharge

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Introduction: The sustainable management of coastal marine environments requires a comprehensive understanding of the processes related to material transport from land to coastal sea. Submarine groundwater discharge (SGD) plays a key role since it provides a major pathway for solute and particulate transport of sediments. Contaminants carried by discharging groundwater have considerable potential to cause deterioration of the overall ecological status of coastal marine environments. Adding to the general difficulties in localizing SGD in order to investigate the related processes is the spatial and temporal variability. The scientific aim of the presented study was to use the multi-tracer application for SGD investigation, at the Black Sea east coast, in the Adjara region of Georgia.

Methods: The environmental tracers are defined as natural or anthropogenic substances that originate from defined sources, due to their geogenic omnipresence, they are most suitable for large-scale and/or long-term studies. In order to assessment of the geological/geographical setting regarding the potential of SGD occurrence were measured complex of parameters: $\delta^{18}\text{O}$, $\delta^2\text{H}$, ^{222}Rn , $\delta^{210}\text{Pb}$, $\delta^{137}\text{Cs}$, chemical parameters and salinity [1-4]. In additional, for determine the sediment mass accumulation and sedimentation rate measured radionuclides: ^{210}Pb , $\delta^{137}\text{Cs}$, ^7Be , ^{40}K etc. In 2012-2013 years, a joint maritime and land expedition was performing together with German, Greek and Georgian scientist, in the coastal zone of adjustment areas. All source of surface and underground waters sampled on the land. It was measured by physical properties and Rn directly on the field, chemical composition and radionuclides in laboratory. Marine profiles were performed along parallel and perpendicular of the coastline. The physical properties of water (conductivity, temperature, salinity, pH, oxygen) and the concentration of radon were measure continuously [5]. During measurement the modern equipment we're using: RAD7, HORIBA, IC chromatograph etc. Therefore, the sea water and core were sampled and analyzed radionuclides by high resolution gamma-ray spectrometry in the Institute of Oceanography, at the Hellenic Centre for Marine Research, Greece.

Results: Two anomalies identified during marin expedition. Along with the high values of radon, low values of conductivity and pH are observed, in the same areas indicating the existence of groundwater in these areas. All sea water samples taken from the perpendicular profile showed a lower isotope signature for both oxygen and hydrogen compared ($\delta^{18}\text{O}$ 11.1-9.5 ‰, and $\delta^2\text{H}$ 7-73.8- 57.4 ‰) to the isotopic composition of the off-shore sample ($\delta^{18}\text{O}$ 3 ‰ ($\delta^{18}\text{O}$) and $\delta^2\text{H}$ -22.2 ‰ ($\delta^2\text{H}$). Using a two-component mixing equation, the decreasing proportions of meteoric water in the seawater were calculated. The freshwater content close to the river mouth was up to 19 %. Farther north, even 4 km away from the river mouth, it decrease till 6 and 11 %. The concentrations of ^{137}Cs in the sediment and seawater ranged between (20 ± 2) to (50 ± 4) Bq/Kg and (8 ± 1) to (25 ± 2) Bq/m³. According vertical distribution of ^{137}Cs concentration in the sediment core, were calculated the sedimentation rate, about 0.3 cm/year.

Discussion: The general conclusion that a combined tracers information allows SGD localization. Variation of Rn, water salinity, pH, stable isotopes indicates the location of the groundwater discharge area along the coastal sea. The accumulation of radionuclides in the sea sediment was tracing SGD zone to the deep sea area. The vertical distribution of ^{137}Cs activit concentration in the core sediment samples was utilized to derive the sedimentation rate. Obtained data will be use in the frame of IAEA-RER7009, project "Enhancing Coastal Management in the Adriatic and the Black Sea by Using Nuclear Analytical Techniques".

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