In-situ radionuclide quantitative characterization in aquatic ecosystems using the KATERINA detector

C. Tsabaris[1], D.L. Patiris[1], G. Eleftheriou[1,2], M. Kokkoris[2], R. Vlastou[2]

[1] Hellenic Centre for Marine Research, Institute of Oceanography, Attica, Greece
[2] National Technical University of Athens, Faculty of Applied Mathematics and Physics, Athens, Greece

Abstract
A new detection system named "KATERINA" [1] based on NaI(Tl) crystal has been developed and applied for measuring radioactivity in aquatic ecosystems. The detection system is designed for qualitative and quantitative radionuclide detection (gamma ray emitters) in the aquatic ecosystems with maximum depth of deployment 400m. The system offers volumetric activities in absolute units (Bq/m^3 or Bq/l) for all gamma ray emitters in the energy range (from threshold energy 50 keV to 3000 keV). The efficiency calibration for aquatic environment was first measured by dilution of three reference sources (^{99m}Tc, ^{137}Cs, and ^{40}K) in a special tank and then simulated using the GEANT4 code [2]. "KATERINA" detector has been immersed for acquiring radon daughters (^{214}Pb and ^{214}Bi) in several regions where submarine groundwater is discharged [3] into the coastal zone as well as natural radioactivity measurements in magmatic regions of Adriatic sea [4]. The detection system incorporates special memory and microcontroller for stand alone operations in order to acquire data in situ and autonomously up to three months without any maintenance. Also, it can be installed in floating stations (buoys) for long term measurements at specific sites that exhibit contamination of artificial and/or natural occurring radioactive materials (i.e. in regions with enhanced industrial fertilizer activities or other hot-spot areas).

References
[1] C. Tsabaris, C. Bagatelas, Th. Dakladas, C.T. Papadopoulos, R. Vlastou, G.T Chronis, "An autonomous in situ detection system for radioactivity measurements in the marine environment", Applied Radiation and Isotopes 66, 1419-1426 (2008).
[2] C. Bagatelas, C. Tsabaris, M. Kokkoris, C.T. Papadopoulos and R. Vlastou 2009. Determination of marine gamma activity and study of the minimum detectable activity (MDA) in 4pi geometry based on Monte Carlo simulation. Environmental Monitoring and Assessment, pp 1-10 article in press.
[3] C. Tsabaris, D. Patiris , K. Ioannides , A. P. Karageorgis , K. Stamoulis , G. Eleftheriou , D. Georgopoulos and E. Papathanassiou. Radio Isotopes as Tracers for the study of the Submarine Groundwater Discharge of Kalogria Bay, SW Peloponnissos, Greece, accepted in 39th CIESM Congress, Venice, Italy, 10 - 14 May 2010.
[4] Branko Petrinec, Zdenko Franic, Nenad Leder, Christos Tsabaris, Tomislav Bituh and Gordana Marovic, 2010. Gamma Radiation and dose rate investigations on the Adriatic islands of magmatic origin p.1-9 (2010) article in press.