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Mobile underwater in situ gamma-ray spectroscopy to localize groundwater emanation from pockmarks in the Eckernförde bay, Germany

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Abstract: Eckernförde Bay in the Baltic Sea is well-known for the pockmarks areas which are located in the centre and off the southern shore-line of the bay emanating groundwater in a non-continuous but episodic way. Mobile underwater in situ gamma-ray spectroscopy is exploited proving that both ²¹⁴Bi and ⁴⁰K are efficient radiotracers for localization of seepage areas whenever either sediment is in mixture with the emanating fluid or resuspension of surface sediment occurs as a side effect of the fluid emanation.

Keywords: in situ gamma-ray spectroscopy; pockmarks; submarine groundwater discharge; Eckernförde Bay; radon; radiotracers

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1. Introduction

Eckernförde Bay is a narrow bay (Förde in German or Fjord in Danish) 16 km long and 2–6 km wide located on the east coast of Schleswig-Holstein (northern Germany) in the south-western Baltic Sea. At the middle of the mouth of Eckernförde Bay, the “Mittelgrund” (an axially stretched moraine sill) divides the bay into two channels, the northern with depth 26–29 m, and the southern with depth 22–24 m. Most of the water exchange between the Baltic Sea and the bay occurs from the northern channel. Regarding tidal effects, the region is characterized as a micro-tidal one. Wind-induced currents as well as internal and standing waves affect the hydrodynamic conditions of the bay. Resonance of the bay’s internal waves with those of the open Baltic Sea results in currents bearing suspended particulate loads from the open Baltic to the bay on a regular basis even under fair-weather conditions (Friedrichs and Wright 1995). The sedimentation rates in the bay that have been estimated in several mm

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