Application of Environmental Tracers for assessing groundwater discharge into Galway Bay, Ireland

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Introduction

As a result of the gradually increasing anthropogenic impact on the environment significant detrimental changes in groundwater quality have been observed in many aquatic systems, particularly in highly vulnerable karst systems. In respect to the flow characteristic of karst systems intensive agricultural activities may cause increased nutrient and contaminant input into coastal oceans. Eutrophication, harmful algae blooms, and degradation of estuarine water quality have been reported for many coastal areas in North and South America as well as Asia. However, there are no or only a few data available for European coastlines focusing on freshwater fluxes and nutrient transport coupled to submarine groundwater discharge (SGD). As part of the presented project we have located SGD in a small coastal bay in the west of Ireland using naturally occurring tracers such as stable isotopes ($\delta^{18}O$ and $\delta^{2}H$), radon-222, water chemistry data and physico-chemical parameters.

Study Site and Hydrogeology

Kinvarra Bay, investigated in the presented study, is located in western Ireland close to the city of Galway (Fig. 1). The bay is hydraulically connected to a well developed karstic aquifer composed of Carboniferous limestone. The aquifer has a thickness of approximately 450 m and consists of a fracture network and a conduit system, both representing preferential flow paths in the aquifer.

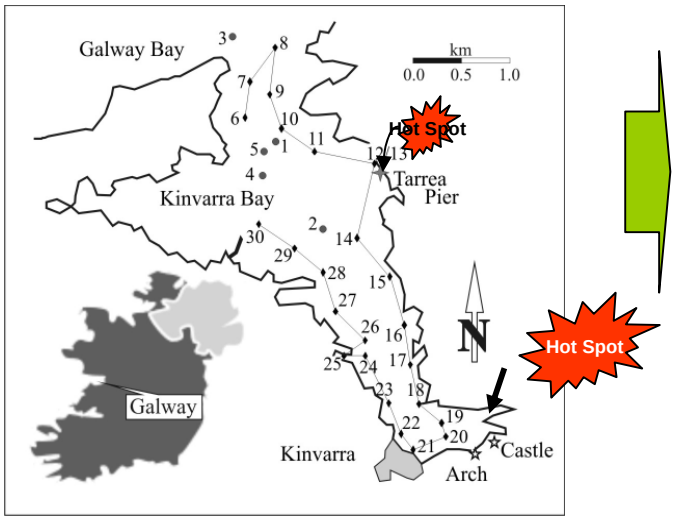

Fig. 1: Site map of the Kinvarra Area located in the west of Ireland including sampling points chosen for the 2007 field campaign

^{222}Rn Measurements

Preliminary results confirm ^{222}Rn to be the preferred groundwater tracer in the investigated system for the quantitative assessment of SGD to the bay (Fig. 3). The results of the first field campaign will be evaluated by applying a mathematical model in order to quantitatively describe SGD into Kinvarra Bay. In a second field survey radium isotopes will be used as additional environmental tracer to improve our knowledge in the understanding of SGD.

Stable Isotopes

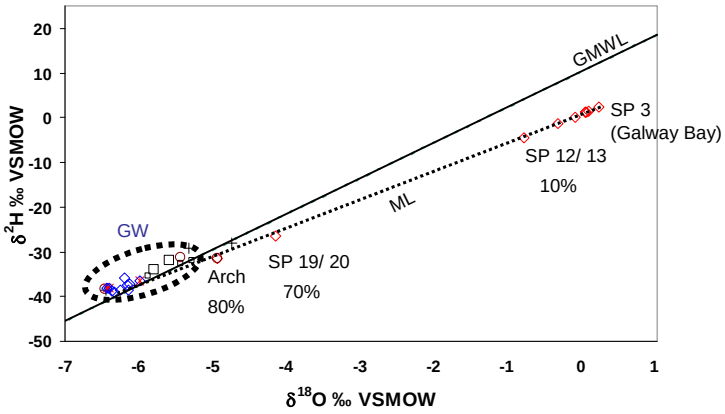

Fig. 2: $\delta^{2}H$ / $\delta^{18}O$ plot illustrating sea water (SP 12/13, SP19/20, SP3, Arch) and groundwater (**GW**) signatures; contribution of groundwater to sea water at several sampling points is shown in [%]; the dashed line represents the groundwater/ sea water mixing line (ML), the full line represents the Global meteoric water line (GMWL)

The results which are shown in Fig. 2 confirm that stable isotope signatures of groundwater and sea water can be used as a tool for a qualitative assessment of groundwater discharge to Kinvarra Bay.

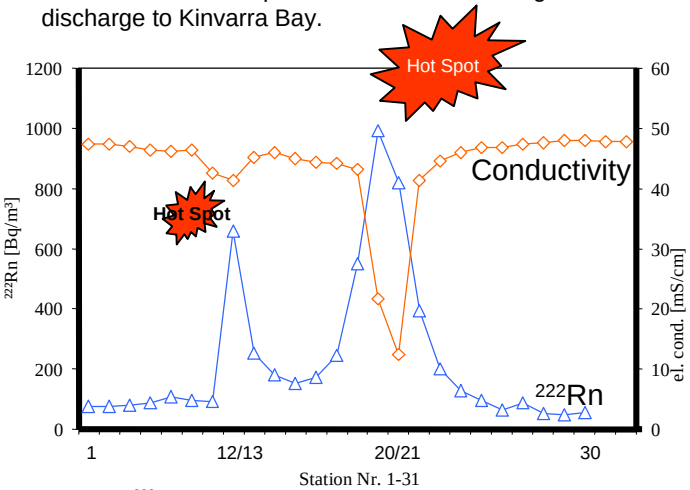

Fig. 3: ^{222}Rn concentrations and conductivity measurements in the bay

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