Tracing submarine groundwater discharge to coastal waters on the Irish Shelf and the North East Atlantic with the Ra quartet

S.L. NICHOLAS[1,2], A. GRASSIE[2], A.M. WIECZOREK[2], M.M. MULLINS[1,2], E. DALY,[1,2] B. O'NEILL,[2] and P.L. CROOT[1,2]

[1] iCRAG (Irish Centre for Research in Applied Geosciences) National University of Ireland Galway (NUI Galway), Galway, Ireland. sarah.nicholas@nuigalway.ie

[2] Earth and Ocean Sciences NUI Galway, Galway, Ireland

The quartet of naturally occurring radium isotopes (^{223}Ra, ^{224}Ra, ^{226}Ra and ^{226}Ra) can be used as tracers for the mixing of coastal and shelf waters (Schmidt et al., 2011) and as tracers of submarine groundwater discharge in coastal margins.

Samples for Ra activity were collected in transects across the Irish shelf and the North East Atlantic over an area of approximately 27,000 km^2. Denser sampling occurred in Galway Bay. Activities of ^{223}Ra and ^{224}Ra were measured using a radium delayed coincidence counter (RaDeCC) (Moore and Arnold 1996). Activity of ^{226}Ra was determined from the initial linear in-growth of ^{222}Rn, and ^{228}Ra was determined from ^{224}Ra counts after a period of ingrowth (3-9 months).

^{228}Ra activity decreased across the shelf as was expected, but was higher in the vicinity of the shelf break along with the short lived Ra isotopes indicating mixing at the slope break.

The highest activities of ^{224}Ra and ^{228}Ra were in Galway Bay, with greater ^{224}Ra activity at the outlet of the Corrib River. Submarine groundwater discharge from the karst landscape on the Clare coast is a likely contributor the greater activity of both ^{224}Ra and ^{228}Ra measured on the south shore of Galway Bay.

The shallow geometry and large tidal of Galway Bay support a tidal prism model with short residence times (Hartnett et al 2011). However, the low ^{224}Ra/^{228}Ra ratios in parts of the bay indicate reserves of older water. This suggests a more complex circulation of water within Galway Bay.

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[1]Schmidt et al. (2011) *Geo-Mar. Lett.* **31**, 259–269. [2]Moore and Arnold (1996) *J. Geophys. Res.* **101**, 1321–1329. [3]Hartnett et al. (2011) *Proc. Inst. of Civ. Eng - Water Management* **164**, 243–256.