ACCUMULATION OF TECHNETIUM-99 IN THE IRISH SEA?

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Objective

To assess the impact of continued discharges from Sellafield upon the levels in waters and sediments in the Irish Sea.

Background

^{99}Tc authorised releases (from Sellafield) increased in 1994 as a consequence of the operation of the Enhanced Actinide Removal Plant (EARP), a facility designed to reduce α and β activity from previously stored effluents prior to discharging to sea.

The behaviour of ^{99}Tc in marine UK waters, up to and including 1996 is reported elsewhere [1-3]. Rapid transport has been observed following discharge and the ^{99}Tc seawater concentrations within the Irish Sea have continued to increase over the period of investigation.

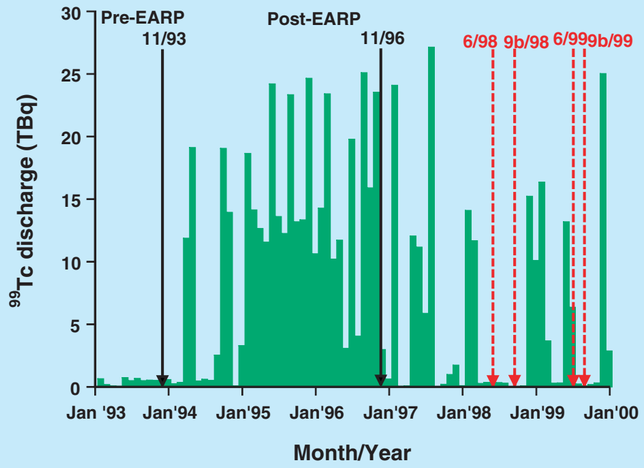

Figure 1: Chronology of ^{99}Tc discharges and surveys.

Results

(1) What is the effect of the recent continued discharges upon seawater concentrations in the Irish Sea?

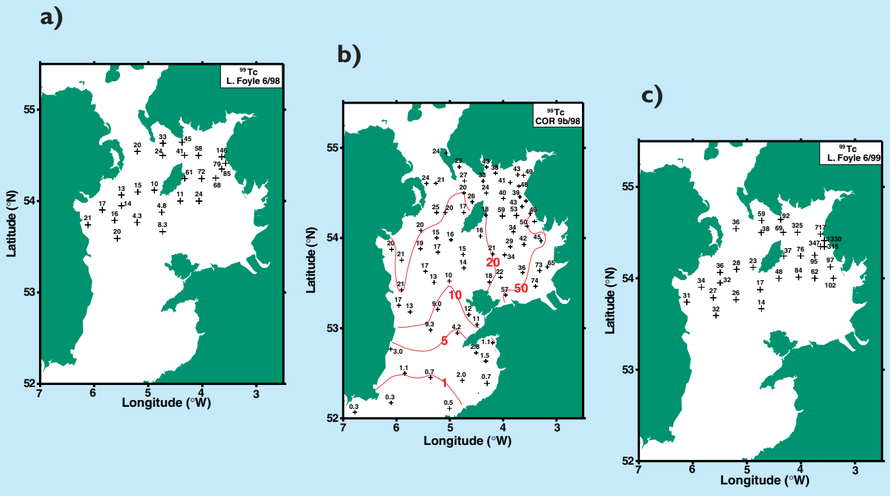

Figure 2: Dissolved ^{99}Tc surface seawater distributions in the Irish Sea (mBq l^{-1}); a) L. Foyle 6/98, b) COR 9b 98, c) L. Foyle 6/99.

(2) Is ^{99}Tc retained for long periods in the water column during summer stratification?

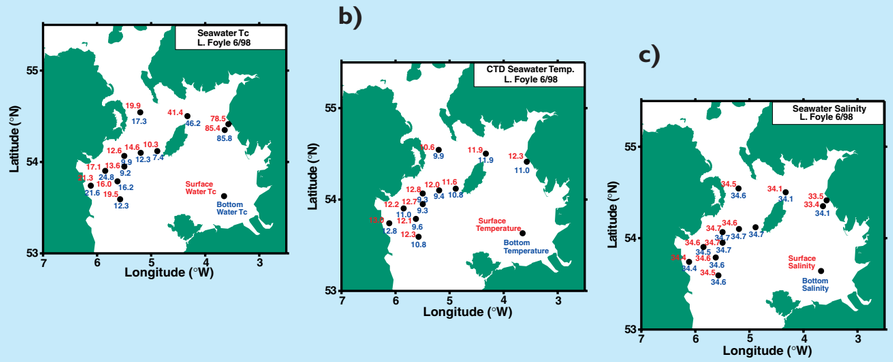

Figure 3: An example of a) dissolved ^{99}Tc concentrations (mBq l^{-1}), b) seawater temperatures (°C) and c) seawater salinity in surface and bottom waters observed in Irish Sea surveys; these data are from L. Foyle 6/98.

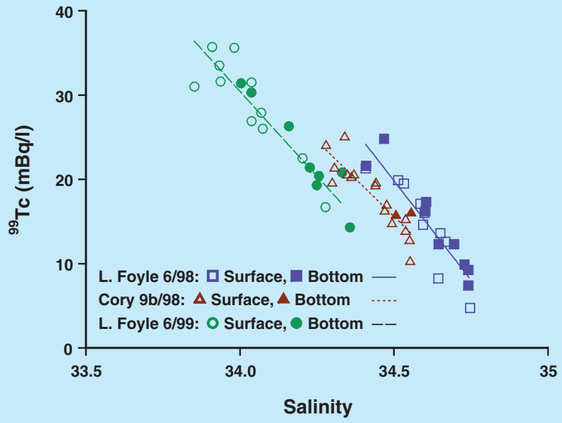

Figure 4: Correlation between salinity and dissolved ^{99}Tc in surface and bottom waters for all data obtained in the western Irish Sea (area bounded by latitudes 53°25'-54°36'N and longitudes 4°44'-6°6'W). Linear regression lines are fitted to combined surface and bottom data from individual surveys.

(3) Are sediments providing a temporary sink of ^{99}Tc, which will prolong the residence time in the Irish Sea?

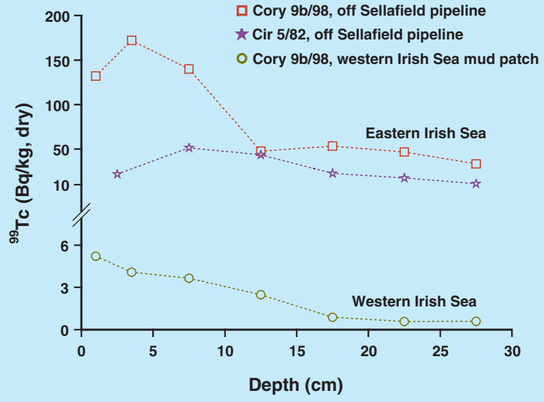

Figure 5: Vertical distribution of ^{99}Tc in sediment cores from the eastern and western Irish Sea. For comparison, data from a Pre EARP core are also shown (collected in May 1982) [4].

Summary of results

(1) Significant variations were observed in the dilution and dispersion of ^{99}Tc in the water column.
- In the vicinity off Sellafield, fluctuations in monthly discharges are reflected in seawater concentrations.
- Away from the Cumbrian coastline, the complex water transport patterns of the Irish Sea result in smoothing the impact of variable monthly discharges.
- Variations in water movements may cause accumulation in certain areas of the Irish Sea, e.g. Liverpool Bay.

(2) Data indicate clear evidence of thermal stratification.
The ^{99}Tc concentrations were larger in the warmer surface layer in comparison with the colder bottom layer (average ^{99}Tc $_{surface}$ /Tc $_{bottom}$ = 1.3).
^{99}Tc concentrations, at the surface and depth, were inversely related to salinity.
Enhanced ^{99}Tc concentrations in bottom waters from stratification were not observed.

(3) Different ^{99}Tc depth core profiles were obtained between east and west Irish Sea.
The ^{99}Tc concentration range was consistent with literature values [4] at depth.
Data show accumulation in surface sediment near the Sellafield out-fall, from elevated ^{99}Tc discharges. This may possibly provide a secondary input to the western Irish Sea.

Acknowledgements

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References

[1] Leonard, K. S., McCubbin, D., Brown, J., Bonfield, R. & Brooks, T. (1997). Distribution of Technetium-99 in UK coastal waters. Marine Pollution Bulletin. 34 (8) 628-636.

[2] Kershaw P.J., McCubbin, D. & Leonard, K. S. (1999). Continuing contamination of North Atlantic and Arctic waters by Sellafield radionuclides. Sci. Total Environ. 237/238 119-132.

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