Potential risk from radioactive waste stored at Risø, Denmark

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HELCOM MORS EG 5-2015
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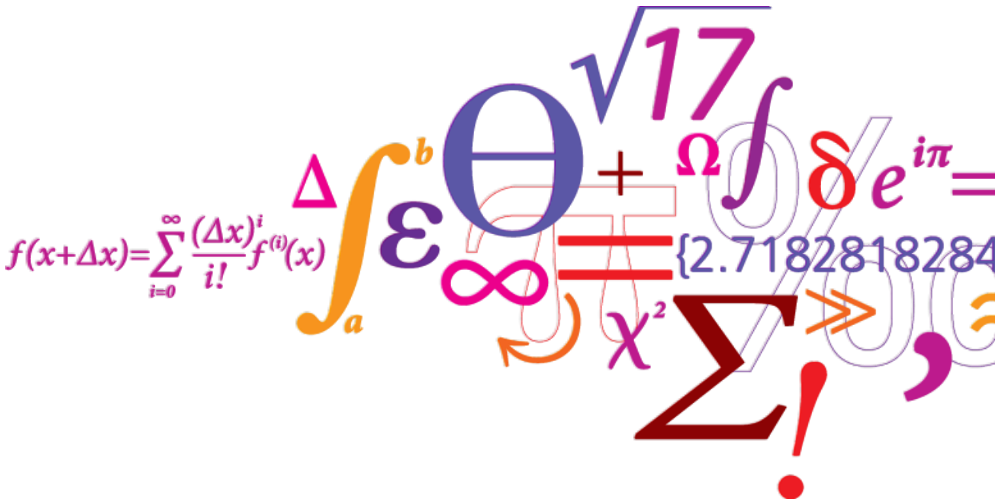

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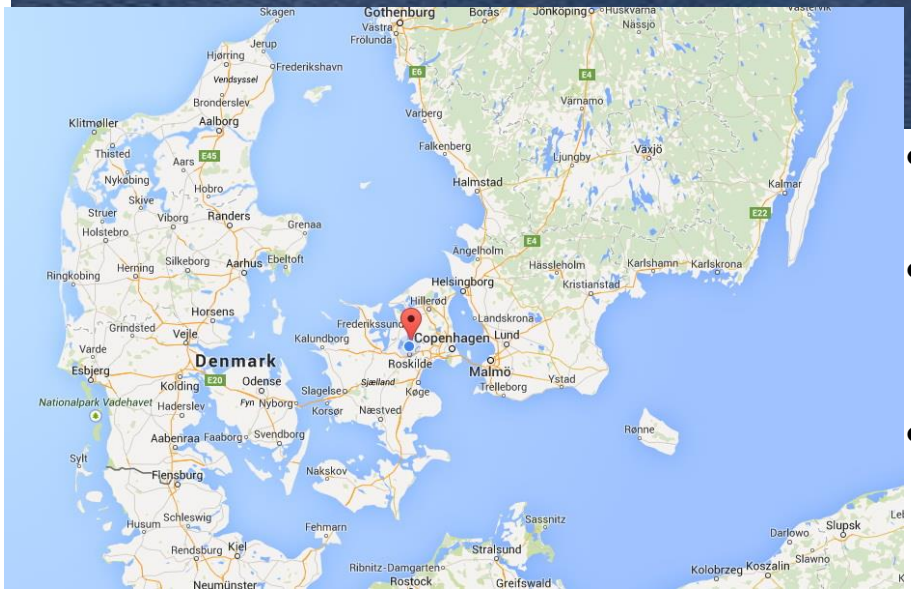
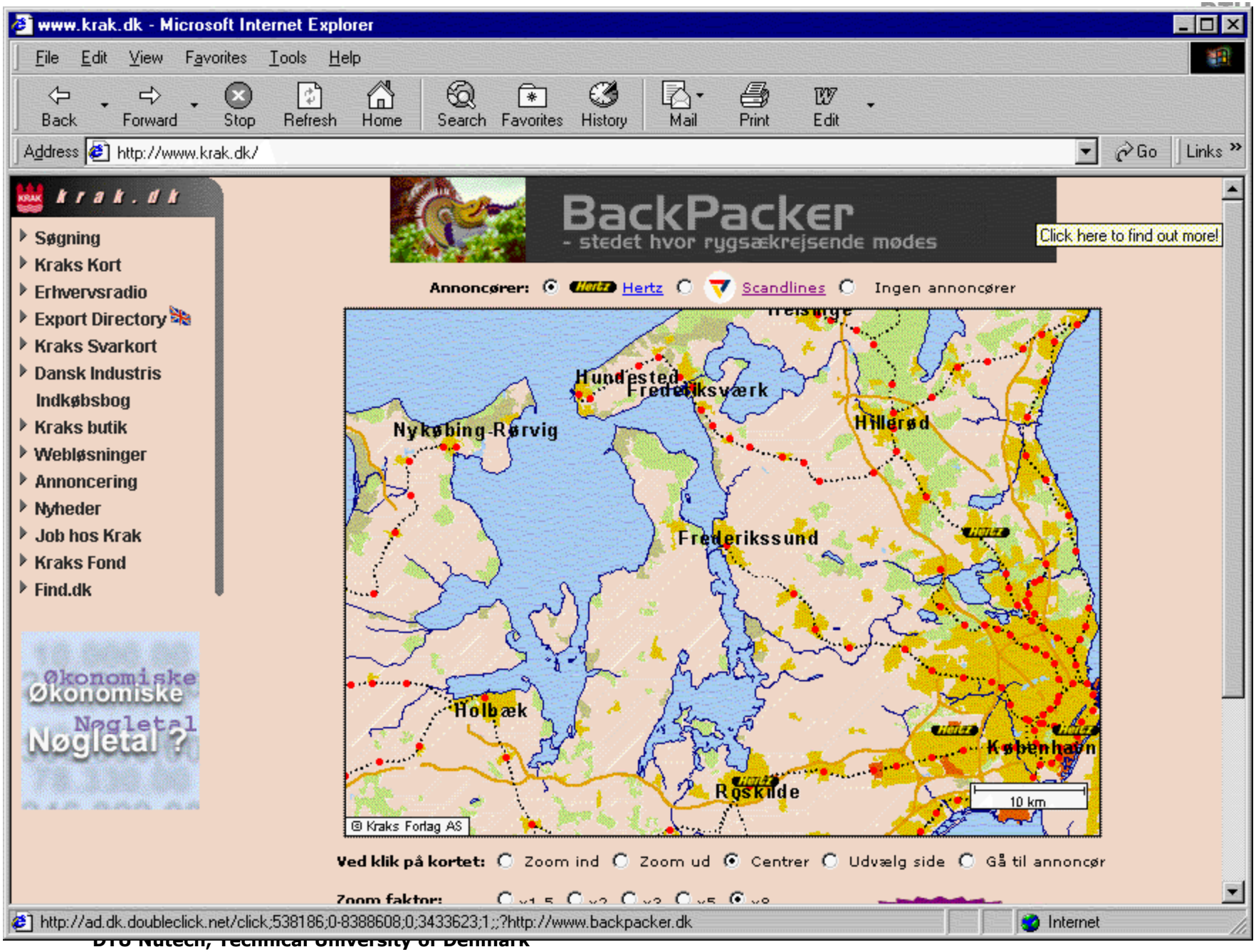


- Radioactive waste stored in barrels at Risø site since 1958
- Heavy storm on 5 December 2013 raised water level in Roskilde Fjord 2.1 m above normal but below waste barrels
- Assessment required of potential radiological consequences of water level 3 m above normal

Potential source term and release

- Low-activity and high-activity waste barrels stored separately. High-activity waste from spent fuel experiments in hotcells and from research reactor.
- 5000 barrels in low-level storage are stacked at 4 levels with about 25% in bottom layer which holds about 560 GBq ^{137}Cs and 42 GBq ^{60}Co.
- Contents in barrels (bottom layer) at high-level storage of ^{90}Sr and ^{239}Pu are estimated at 16 GBq and 11 GBq, respectively. Estimates are based on a nuclide vector determined from analyses of waste samples and normalised to ^{137}Cs. ^{241}Pu is down-scaled to ^{239}Pu by factor 50 (dose factor).
- Flooding of lower level waste barrels is assumed to cause release to water of 0.1% of radionuclide inventory in these barrels
- Release scenario covers fast transfer of radionuclides to water in Roskilde Fjord

Nuclide	Release (GBq)
^{60}Co	1.2
^{90}Sr	16
^{137}Cs	31
^{239}Pu	11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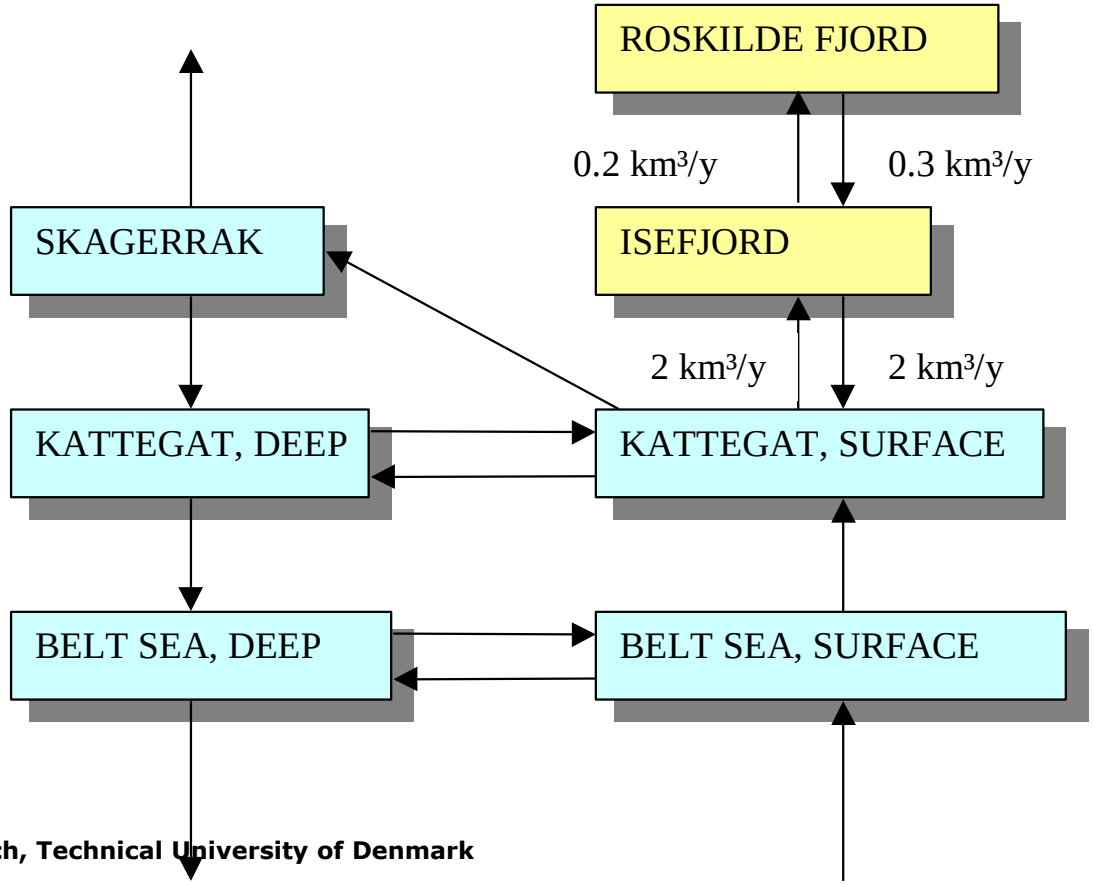
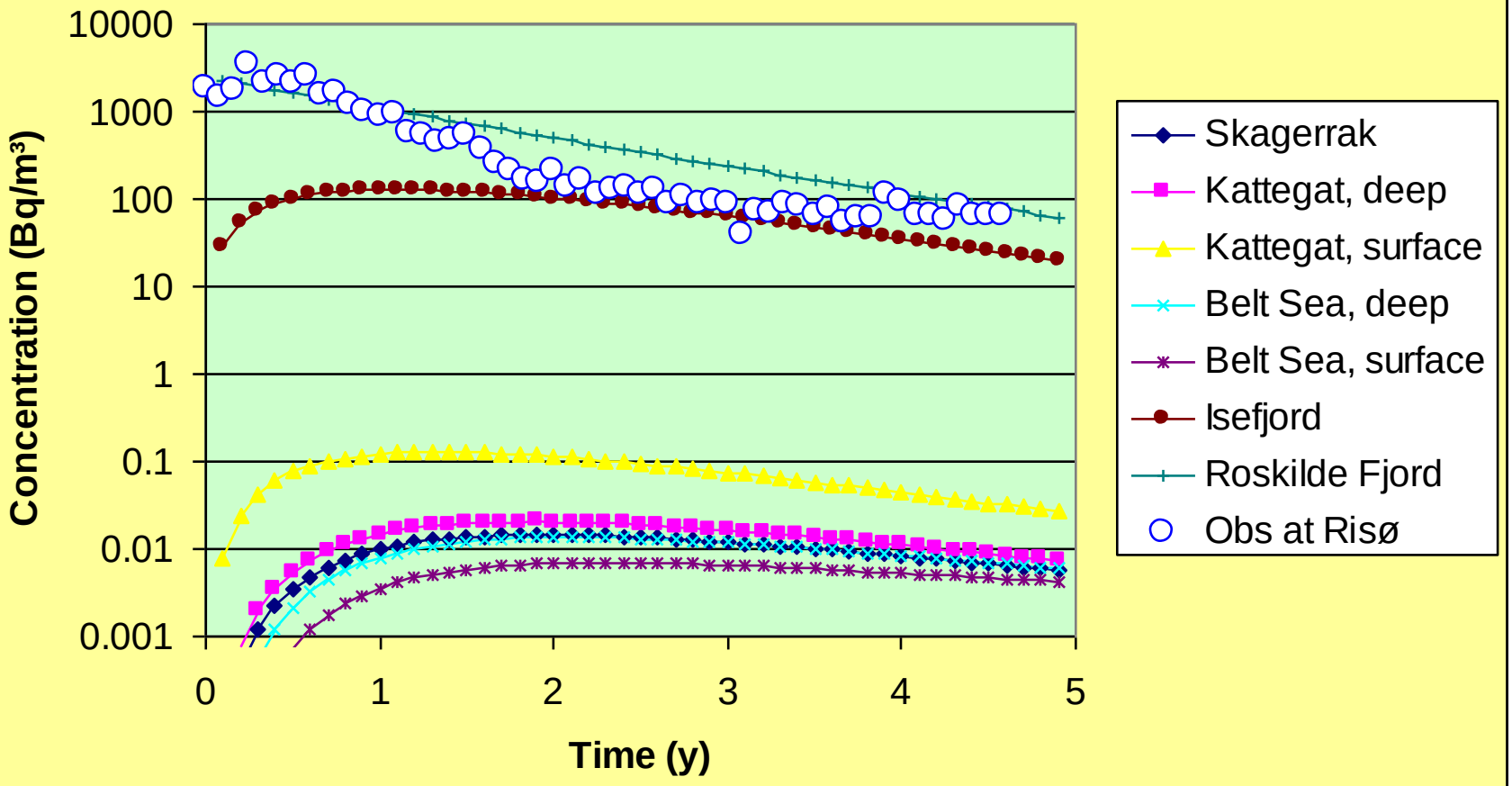
Region	Area (m^2)	Depth (m)	Volume (m^3)
Roskilde Fjord	1.0E+08	4	4.0E+08
Isefjord	2.5E+08	9	2.3E+09
Kattgat, deep	2.0E+09	100	2.0E+11
Kattegat, surface	1.6E+10	20	3.2E+11
Skagerrak	3.2E+10	210	6.8E+12
Belt Sea, deep	4.7E+09	30	1.4E+11
Belt Sea, surface	1.1E+10	14	1.5E+11



H-3 discharge to Roskilde Fjord (1 TBq)



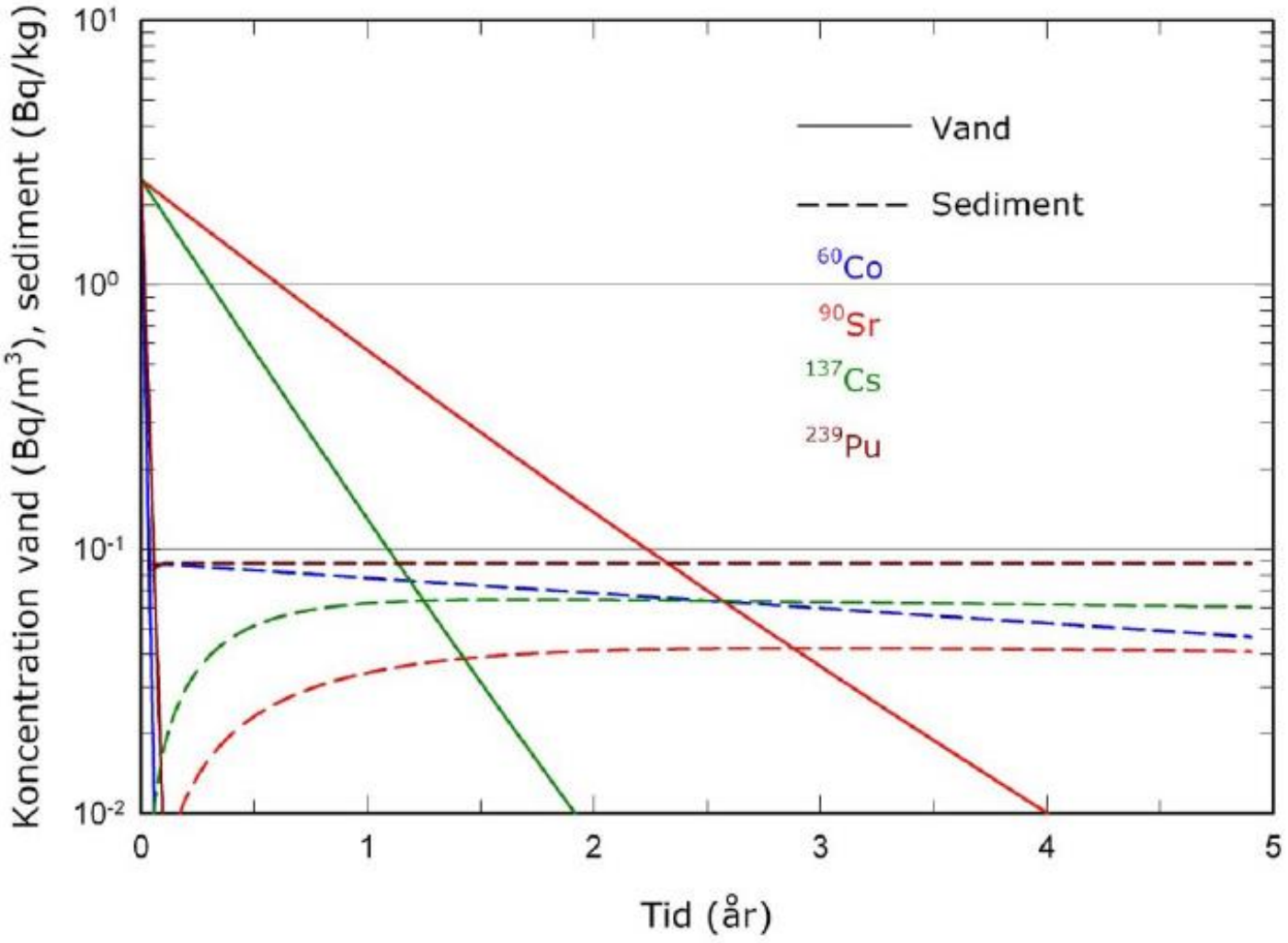
Exposure pathways for representative persons

Pathway	Assumption
Fish consumption	90 kg/a
Crustacean consumption	10 kg/a
Shellfish consumption	10 kg/a
External gamma dose from beach residence	700 h/a
Inhalation of particles and sea spray from beach residence	700 h/a

Nuclide specific parameter values

Nuclide	E_g (MEV)	K_d (L/kg)	CF_{fish}	CF_{crust}	CF_{shell}	E_{ing} (Sv/Bq)	E_{inh} (Sv/Bq)
^{60}Co	2.5 e0	2 e5	1 e3	5 e3	5 e3	3.4 e-9	3.1 e-8
^{90}Sr	2 e-6	1 e3	2 e0	2 e0	1 e0	2.8 e-8	1.6 e-7
^{137}Cs	5.6 e-1	3 e3	2 e2	3 e1	3 e1	1.3 e-8	3.9 e-8
^{239}Pu	8 e-4	1 e5	4 e1	3 e2	3 e3	2.5 e-7	1.2 e-4

Concentrations in water and sediments



Predicted dose to adult - 23 microSv