



Coal mining and radioactivity in the coastal area of Ha long Bay, North of Vietnam

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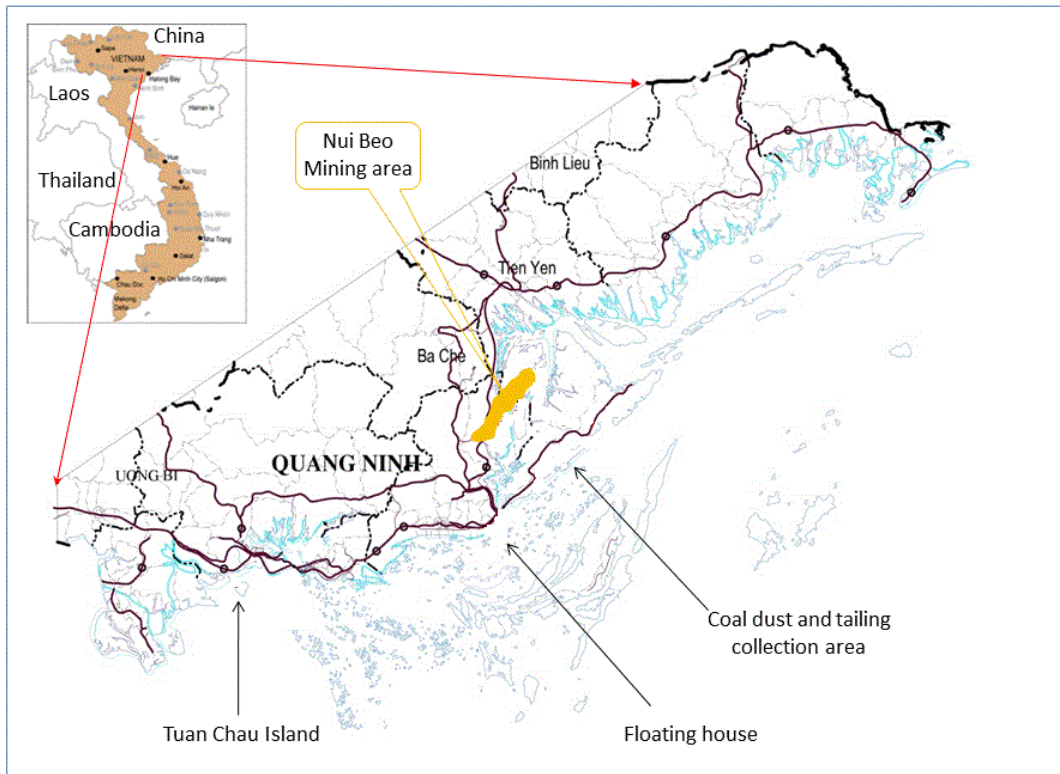


Outline

- ❑ **Study area: Quang Ninh province coastal area**

- ❑ **Environmental impact:**
 - **Radioactivity enhancement (naturally-occurring radionuclides) ?**
 - **Food chain and public health threat ?**
 - **Sustainability of industry, fisheries, aquaculture, and tourism in this region?**

Introduction to Quang Ninh region



Activities in the region:

- Coal mining near the coast and coal export by sea,
- Limestone milling for cement production and export by sea
- Sea food: high yield fisheries, aquaculture, re collection of bivalves and worms
- Halong Bay: World Heritage nature site, developing tourism
- Fast growing population

Coal mining in Nui Beo, near the coast of Quang Ninh province.



Coal mining, coal piles and mine tailings



Cement factory and cement export by sea



Fisheries in the area



Aquaculture and Tourism activities intensively developed along the coastal region



Material and Methods

Sampling :

Sediments along the coast during low tide and in the Bay using a sediment corer

Sediment worms, molluscs and fish from local communities and from the fish market.

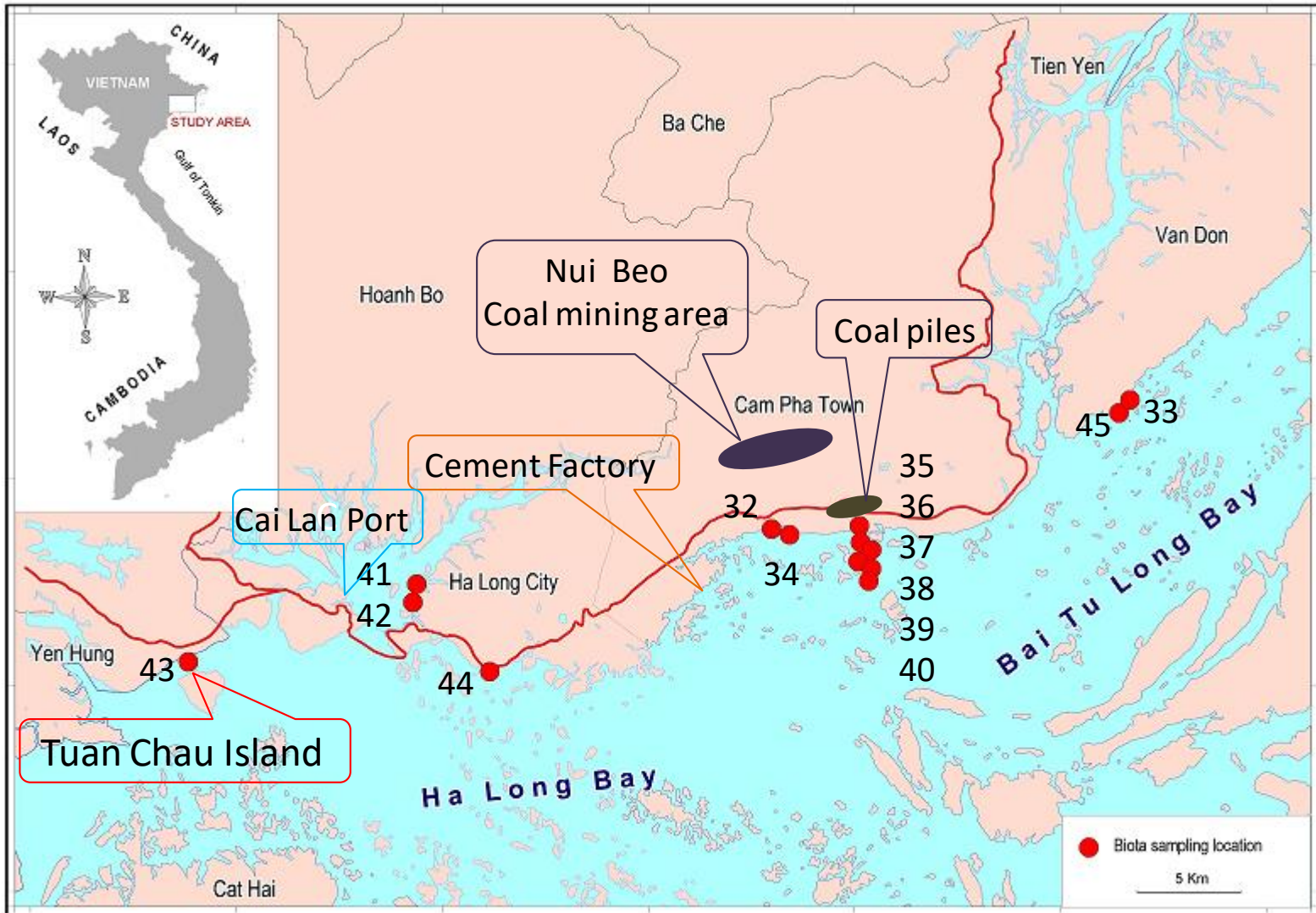
Analysis:

By radiochemistry and alpha spectrometry for main naturally-occurring radioisotopes.

Aspects of sample collection

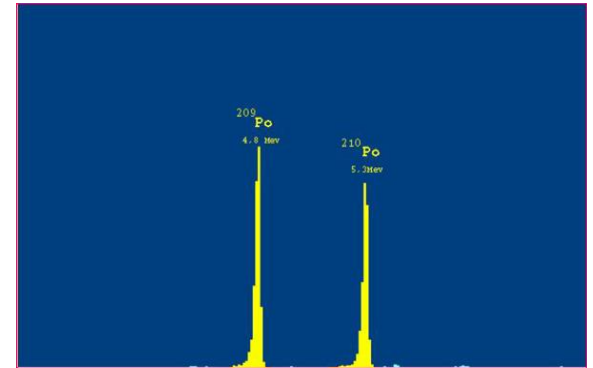


Sampling sites

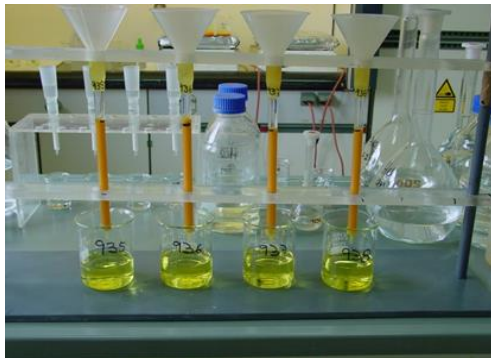


Analytical methods

- Analyses of radionuclides following radiochemical separation
- Target radionuclides: alpha emitters from natural radioactive series (uranium and thorium)



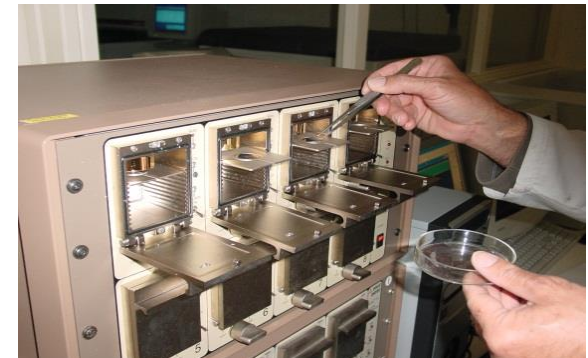
Polonium spectrogram.



Chemical separation by ion-exchange chromatography



Electrodeposition of radionuclides on discs



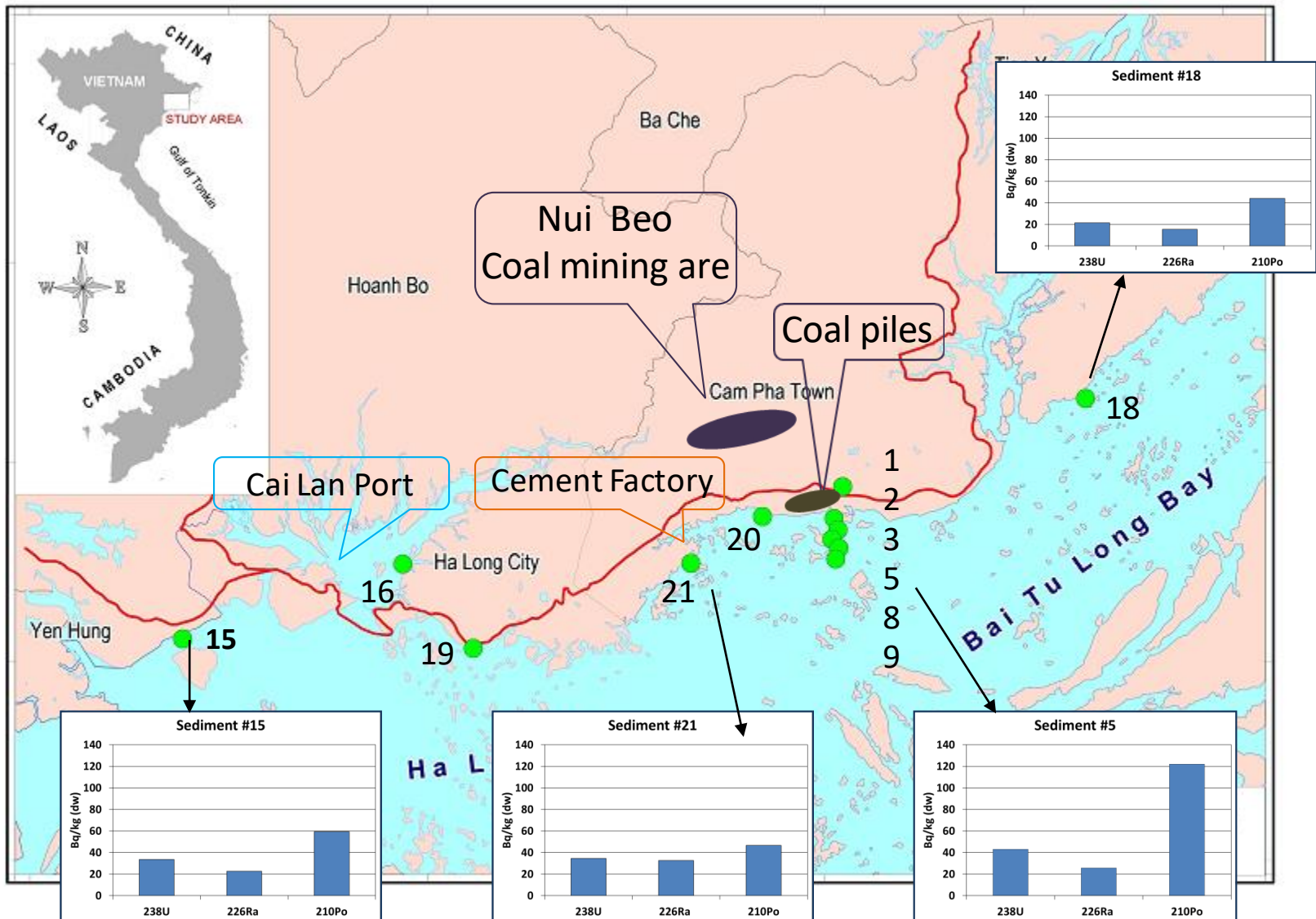
Alpha spectrometry

Results

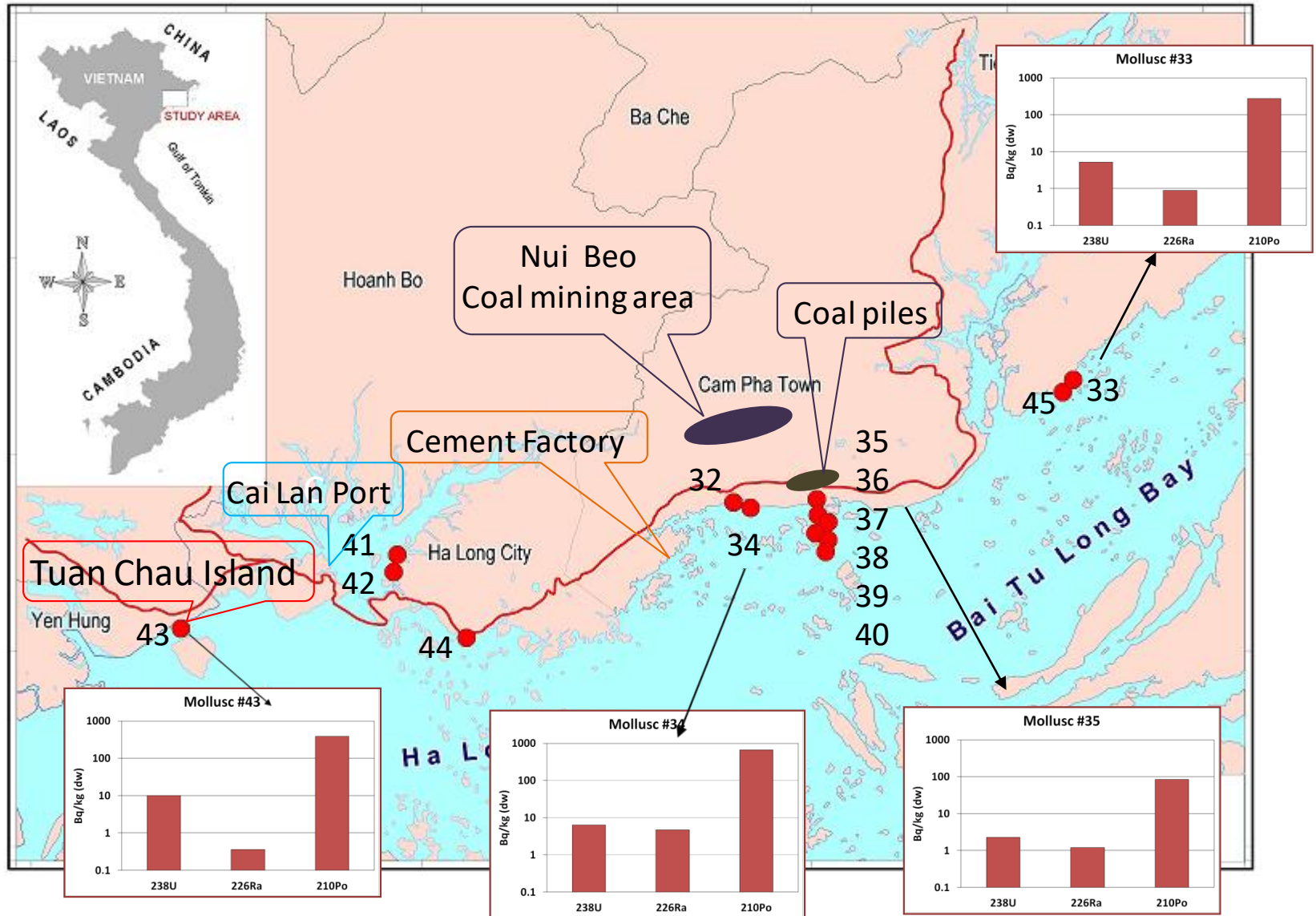
Sediments and biota (Bq/kg dw)

	238U	234U	230Th	226Ra	210Pb	210Po
Sediments (n=12)	21-43	21-44	33-157	14-57	-	25-122
Worm	90	103	3.7	19	16	21
Bivalve molluscs (n=11)	1.6-10	1.8-11	0.4-1.5	0.2-4.7	1-197	54-670
Shrimp meat (n=1)	0.45	0.48	0.21	1.2	9	422
Fish filet (n=1)	0.04	0.08	1.0	0.84	2	18

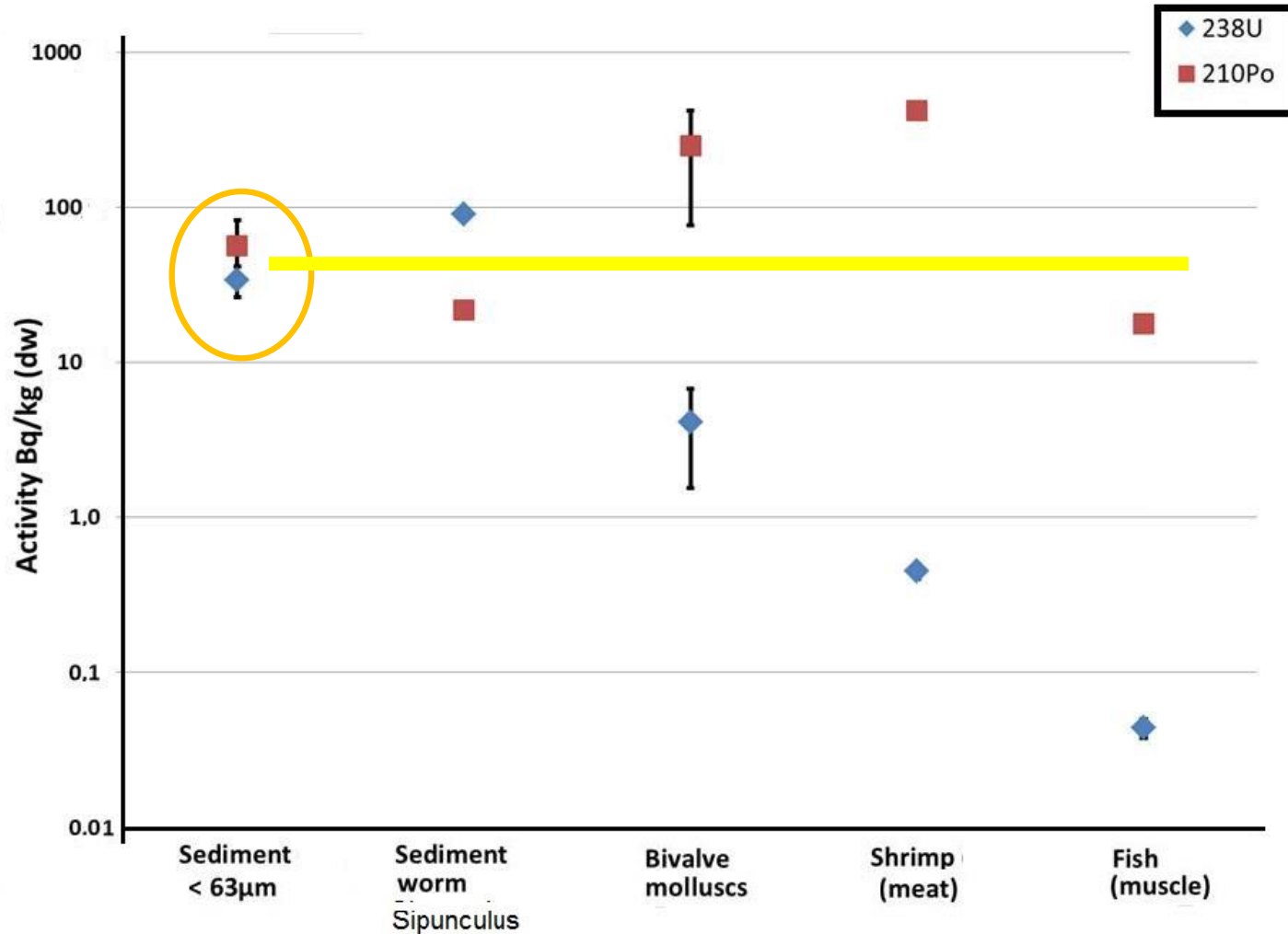
Radionuclides in sediments: ^{238}U , ^{226}Ra , ^{210}Po



Radionuclides in biota (molluscs' soft tissues): ^{238}U , ^{226}Ra , ^{210}Po



Bioaccumulation: U and Po



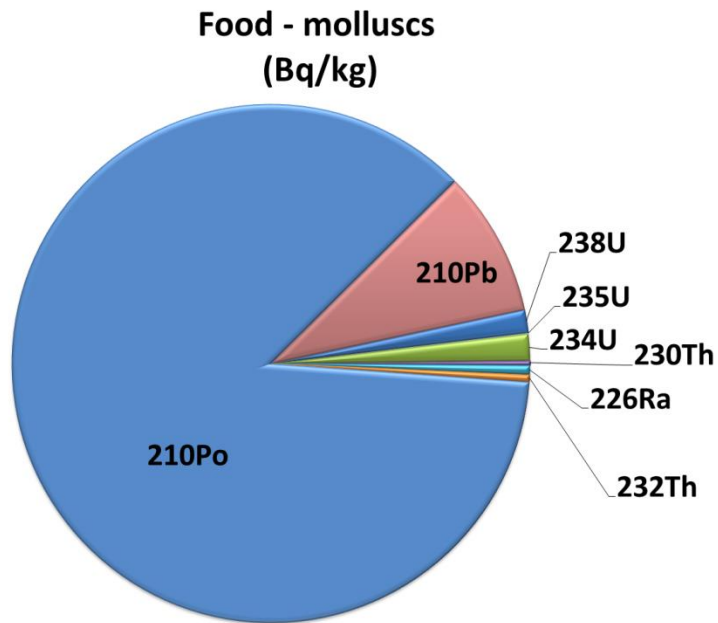
Comparison with other regions

Bq/kg (d.w)	U-238	Ra-226	Po-210
Molluscs:			
Vietnam	4.1±2.6	1.6±1.5	248±171
FASSET (2004)	5	3.5	185
Portugal	2.1±0.15	0.45±0.06	930±50

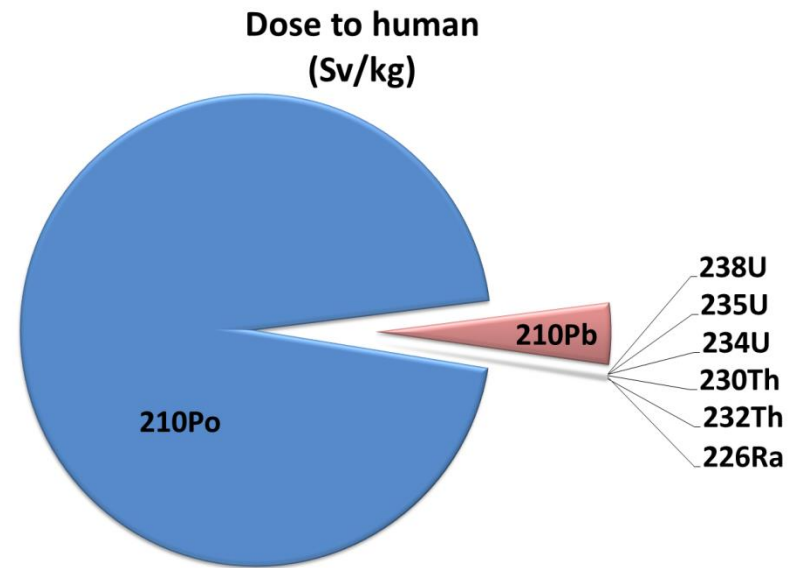
Bq/kg (d.w)	U-238	Ra-226	Po-210
Fish:			
Vietnam	0.044±0.006	0.84±0.08	18±0.8
FASSET(2004)	0.04	1	55
Portugal	0.014	3	25

Contribution to radiation dose to humans

Radionuclides in sea food
(molluscs' soft tissues)



Relative contribution to internal dose in humans



Conclusions

In the coastal areas of Bai Tu Long and Ha Long Bays,

- Radionuclide concentrations were low in coal and limestone
 - No enhancement of natural series radionuclides was detected in bottom sediments of the Bays
 - No significant enhancement of radionuclides was detected in marine organisms
 - Polonium-210 concentrations were higher, as it is generally the case in marine biota
 - Sea food will give a significant contribution, mostly through ^{210}Po , to radiation dose received by humans.
- ➔ No NORM residues with enhanced radioactivity levels and no radiological impact.

Thank you for your kind
attention

