IN DEPTH ANALYSIS OF A SEDIMENT CORE FROM NORTH AEGEAN SEA

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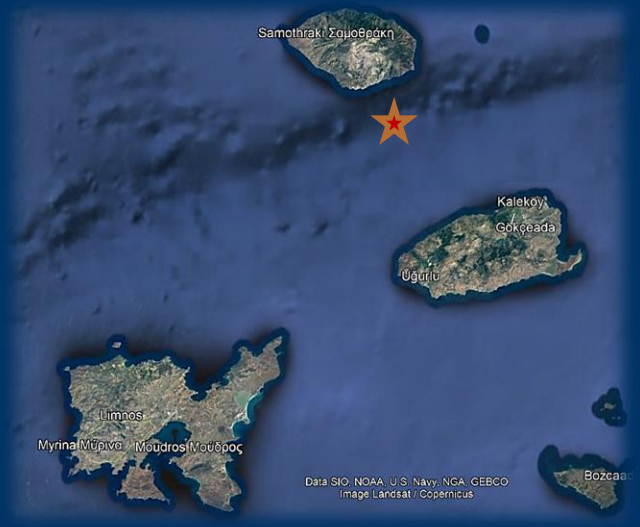
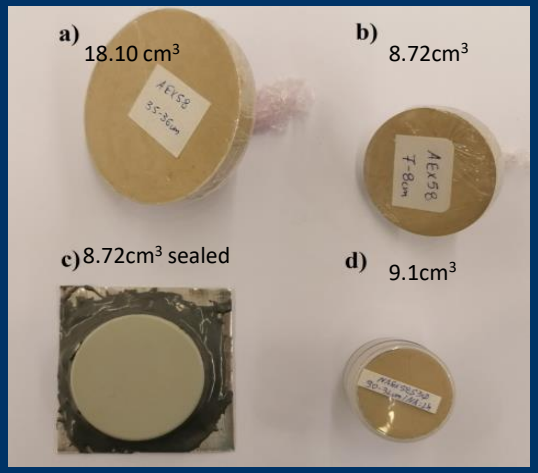
Introduction and Scope

The vertical distribution of radionuclides and trace elements in marine sediment cores provides information regarding the sediment composition, sedimentation rate as well as, deposition and transfer processes.

A sediment core of 39 cm length was grabbed from the deep-sea trench (1540 m depth) southern of Samothrace Island, Aegean Sea.





The core was divided into 39 sediment samples in accordance to the depth of the core.

Each sample was dried to remove humidity and pulverized to obtain density comparable with that of calibration source.

Each sediment sample was analyzed at NED-NTUA by means of γ-spectrometry and Neutron Activation Analysis to determine the vertical distribution of radionuclides and trace elements.

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γ-spectrometry & neutron activation

γ-spectrometry analysis

All samples were analyzed using an XtRa detector (104.5% rel. eff.) coupled with a Compton Suppression System (CSS).

Selected samples, were sealed for radon in order to establish equilibrium between ^{226}Ra and its progenies.

For γ-spectrometry analysis, all sample geometries were calibrated via Monte-Carlo simulation and were experimentally validated.

XtRa-XtCSS


Neutron Activation Tank

Neutron activation

Selected core specimens underwent Neutron Activation Analysis using an ^{241}Am-Be source of ~10Ci.

Two irradiation scenarios were applied:

1st: irradiation for 15d → 1d+5d γ-spectrometry analysis

2nd: irradiation for 1h → 15min γ-spectrometry analysis

Standard Reference Material NIST 2702 "*Inorganics in Marine Sediment*" was used for the quantitative analysis (comparative method).

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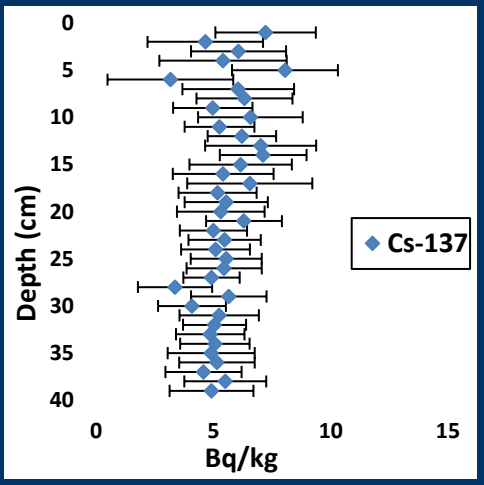
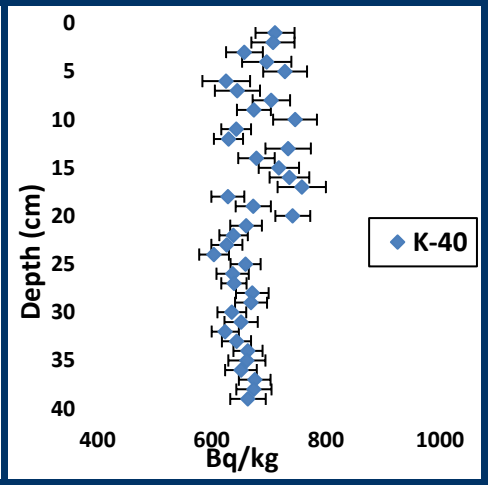
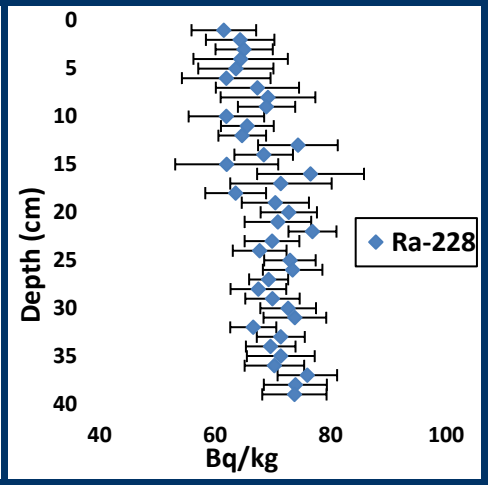
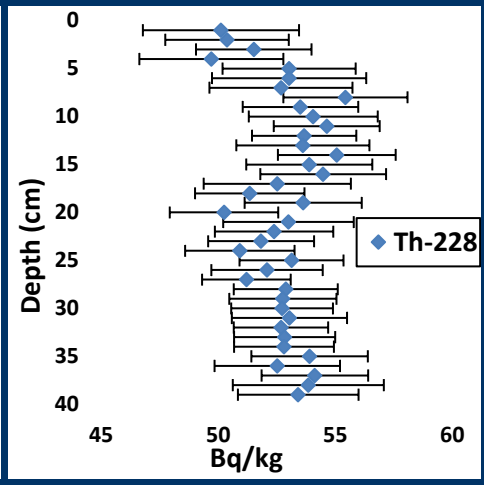
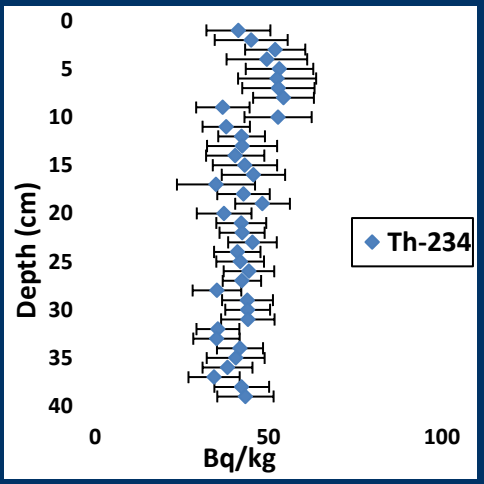
γ-spectrometry results

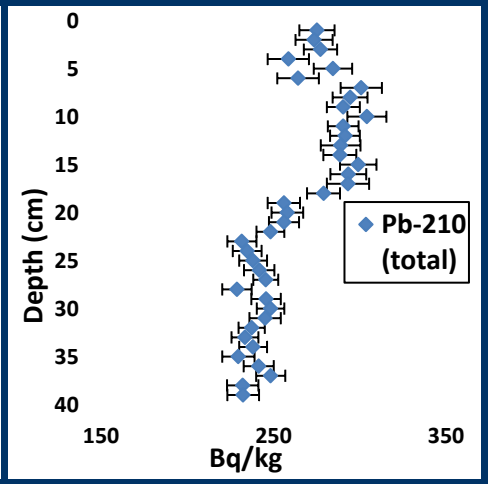


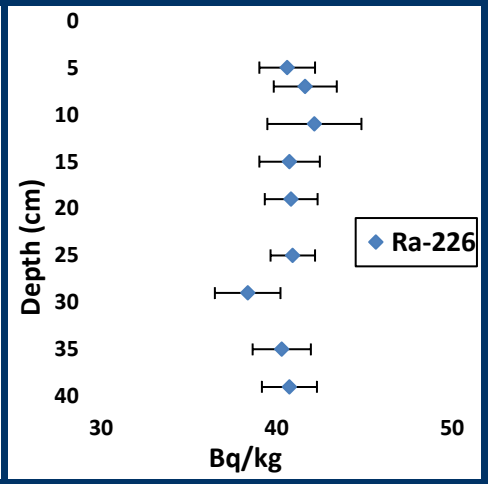


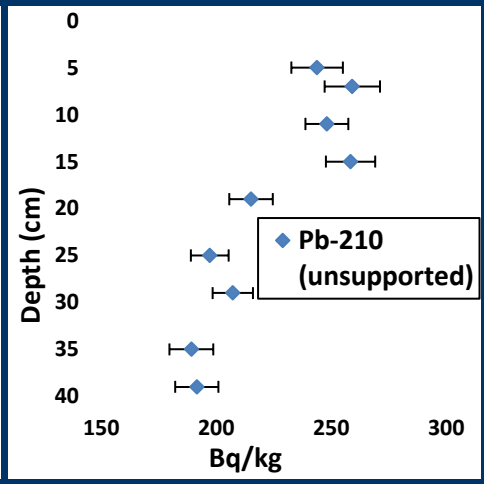












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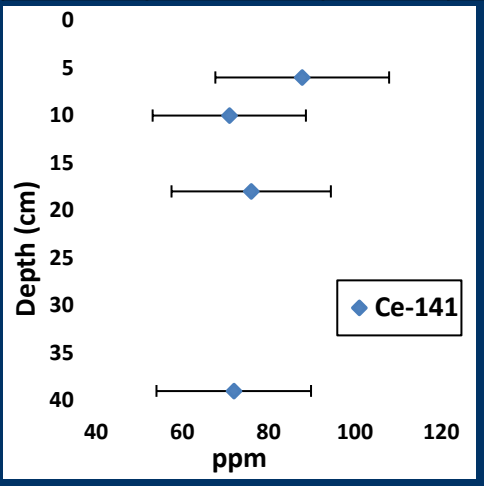
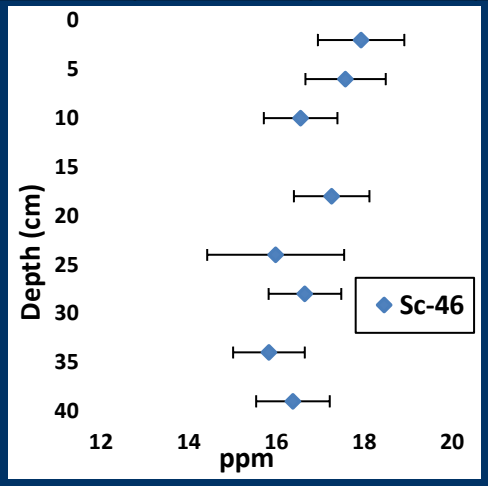
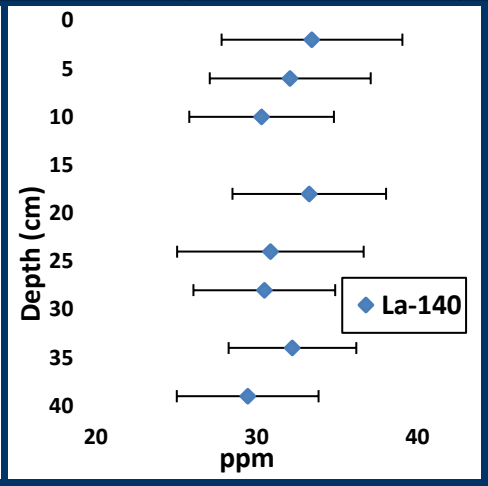
Neutron activation analysis results

1st irradiation scenario results:

Sample Depth (cm)	Mn (ppm)	As (ppm)	Cr (ppm)	Zn (ppm)	Co (ppm)	Rb (ppm)	Fe (ppm)	K (ppm)	Na (ppm)
1-2	3013 ± 83	24 ± 6	164 ± 48	428 ± 316	28 ± 13	150 ± 90	39086 ± 3295	23073 ± 971	17809 ± 283
5-6	3447 ± 93	23 ± 5	139 ± 46	ND	31 ± 13	129 ± 77	43697 ± 3080	24062 ± 954	18138 ± 284
9-10	3504 ± 94	20 ± 5	156 ± 45	387 ± 258	22 ± 10	104 ± 68	44355 ± 2901	23378 ± 909	19040 ± 300
17-18	3509 ± 95	19 ± 5	120 ± 37	ND	23 ± 11	104 ± 68	44222 ± 2914	22968 ± 911	17259 ± 274
23-24	3051 ± 83	21 ± 6	114 ± 63	702 ± 424	ND	ND	39832 ± 4769	22757 ± 877	16910 ± 267
27-28	2968 ± 80	18 ± 5	96 ± 43	502 ± 292	17 ± 9	105 ± 66	42722 ± 2794	22695 ± 883	17366 ± 276
33-34	2981 ± 81	14 ± 4	126 ± 40	ND	22 ± 10	102 ± 66	41378 ± 2789	23327 ± 890	17872 ± 290
38-39	2461 ± 67	22 ± 5	129 ± 40	ND	23 ± 10	101 ± 66	40666 ± 2845	21776 ± 847	18151 ± 284







*Strong indication of **Sm** in the samples, however, quantification was not possible due to strong Uranium interference.

2nd irradiation scenario results: **Al** → 64500-73000ppm & **V** → 107-183ppm

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Conclusions

- The vertical distribution of most natural radionuclides showed no significant variation. The mean activity ratios of $^{226}Ra/^{234}Th$ was 0.94 ± 0.03 (radioactivity equilibrium) and $^{228}Ra/^{234}Th$ was 1.60 ± 0.05 (typical range 0.8 – 1.4). For the area, both findings indicate steady and calm sedimentation processes.
- The vertical distribution of anthropogenic ^{137}Cs was very low and almost constant. No peak related to nuclear incidents was observed indicating very low sedimentation rate (expected for deep sea). After deposition at the seafloor, ^{137}Cs diffuses through the sediment pores obtaining almost uniform vertical distribution.
- Unsupported ^{210}Pb activity was about six times higher than ^{226}Ra, indicating high radon fluxes.
- Most major and trace elements detected are within the expected range - based on literature – with the exception of K and Na that show an increased concentration.

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