8th CJK IMBeR Symposium

Comparative study on the chronology in the sediment of estuary/coast by multi-radionuclides

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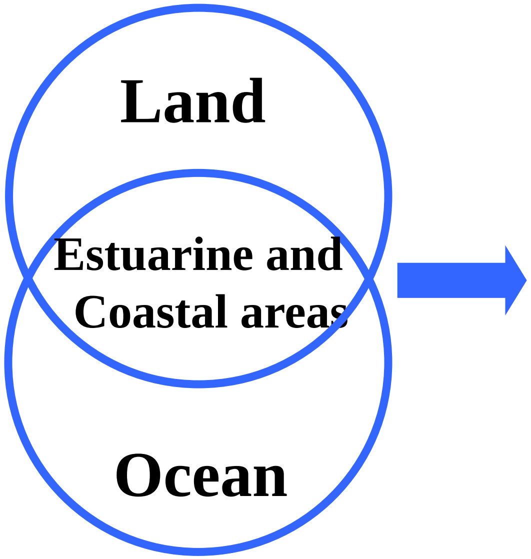
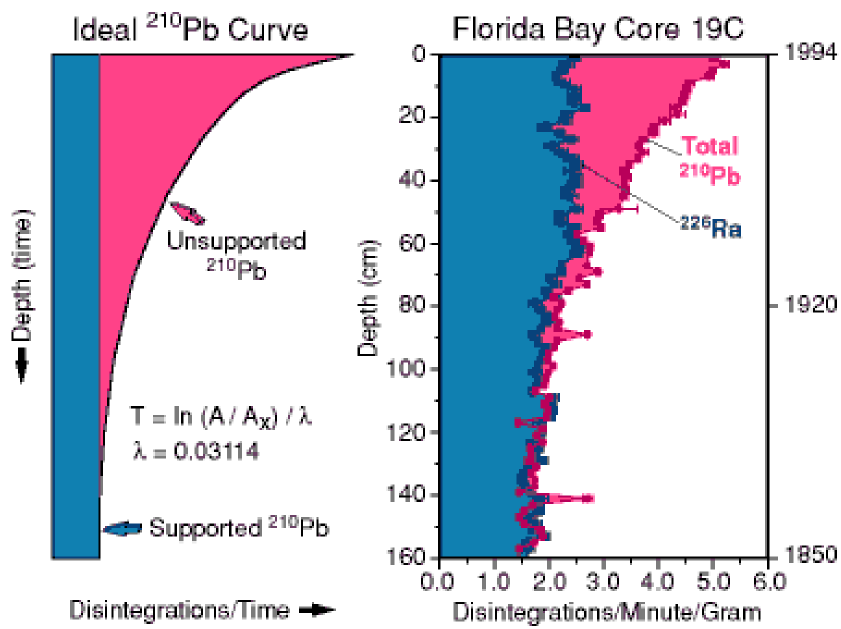
Why sediment rate? Why radionuclides?

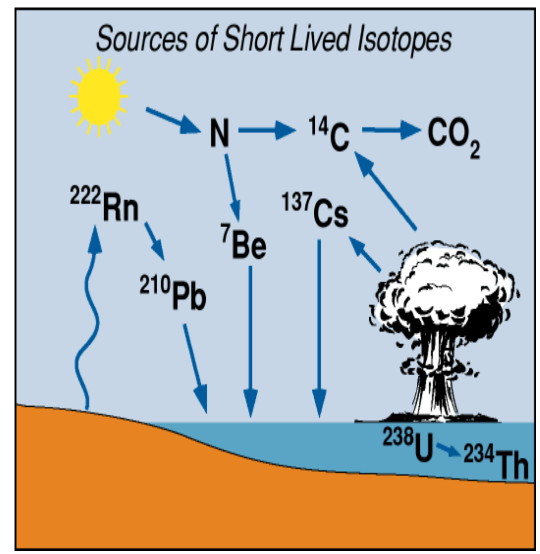


- The Estuarine and Coastal areas are the end of rivers, but also the start of the ocean.
- It is estimated that around 90% of riverine input sediment can be deposited in estuaries and adjacent shelves (Milliman and Meade, 1983; Corbett et al., 2006).
- The modern sedimentation rate is very important for understanding the fates of particle－active substances （i.e. pollutants) and for the eco-environment recording.
- Among all the methods to estimate the sedimentation rate, radionuclides chronology think to be more efficency.

Principle of chronology by radionuclides

^{210}Pb Chronology- decay of ^{210}Pb$_{ex}$



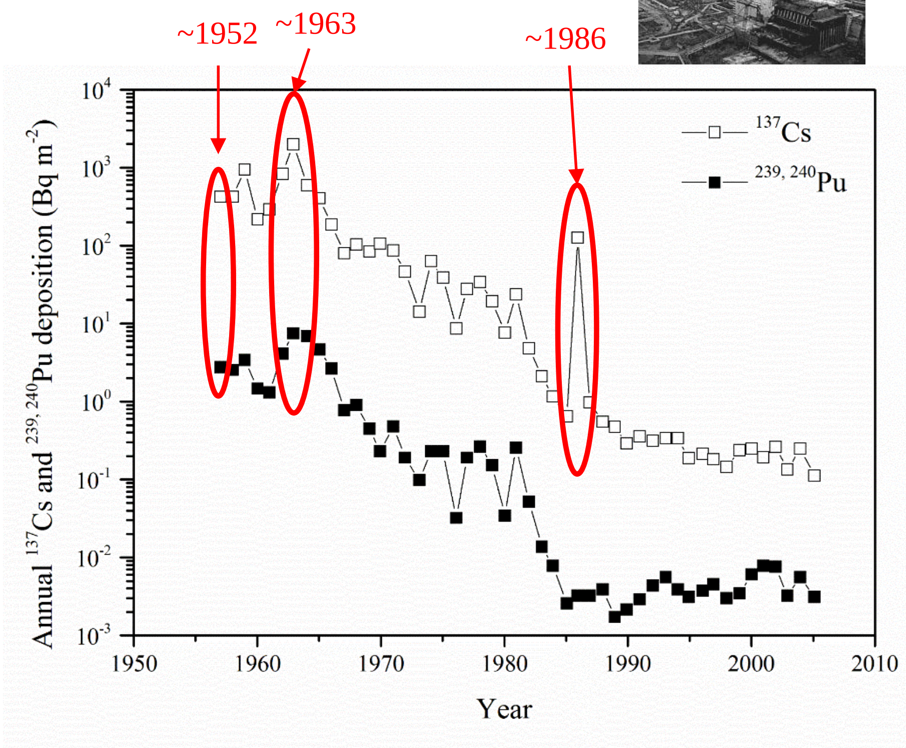


$$\ln A = \ln A_0 - \frac{\lambda}{S} Z$$

Sedimentation rate

Principle of chronology by radionuclides

^{137}Cs and ^{239,240}Pu Chronology- time horizon

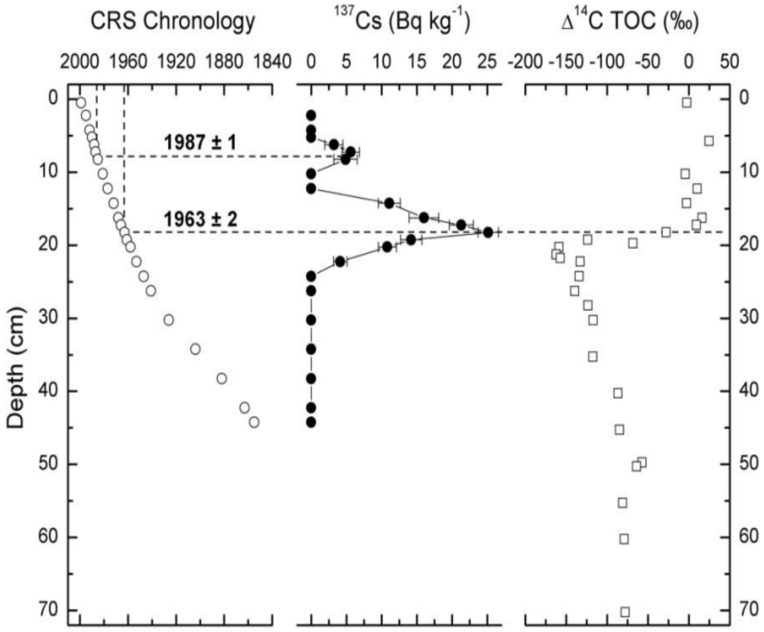


Annual ^{137}Cs and ^{239,240}Pu deposition (Bq m^{-2}) observed at Tsukuba during 1957–2005 (Hirose et al., 2008).

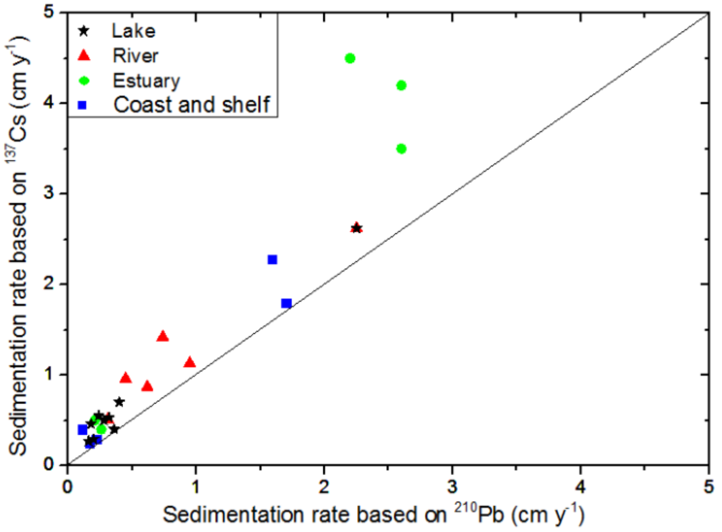
$$R=H/(T_c-T_m)$$

H： Time maker depth（cm）
T_c： Sampling time（y）
T_m： Time horizon for the peak（y）

Match well or not well by radionuclides

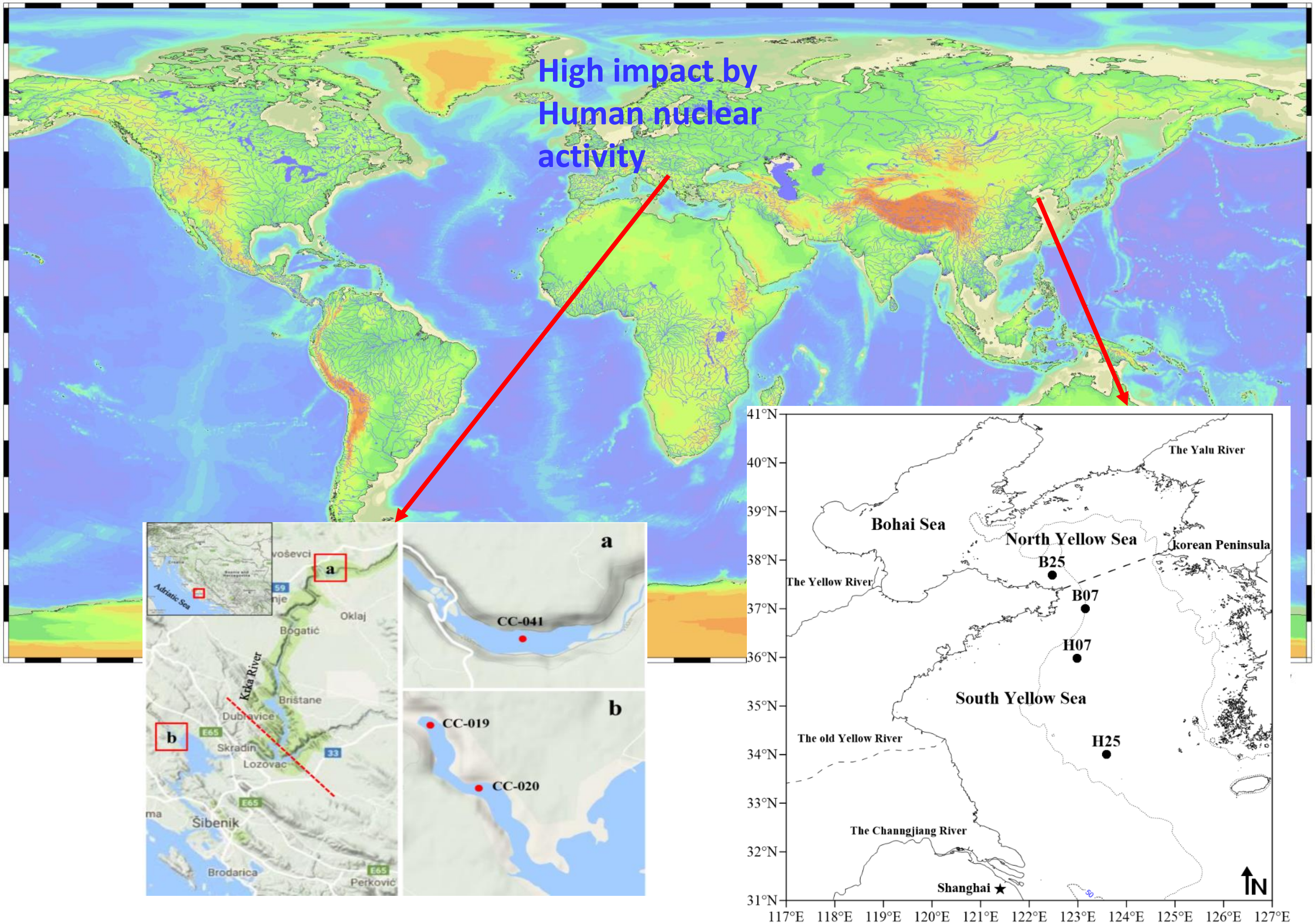


Lima et al., 2005



Wang et al. 2016

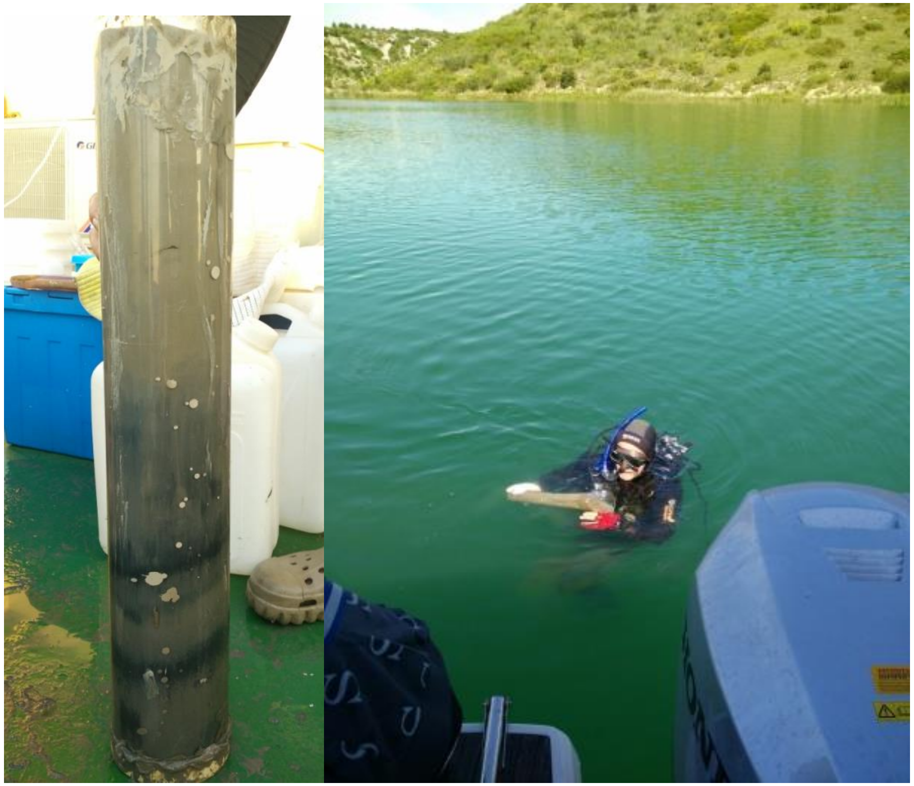
Sampling sites



Krka River, Croatia

The Yellow Sea

Sampling and radionuclides analysis



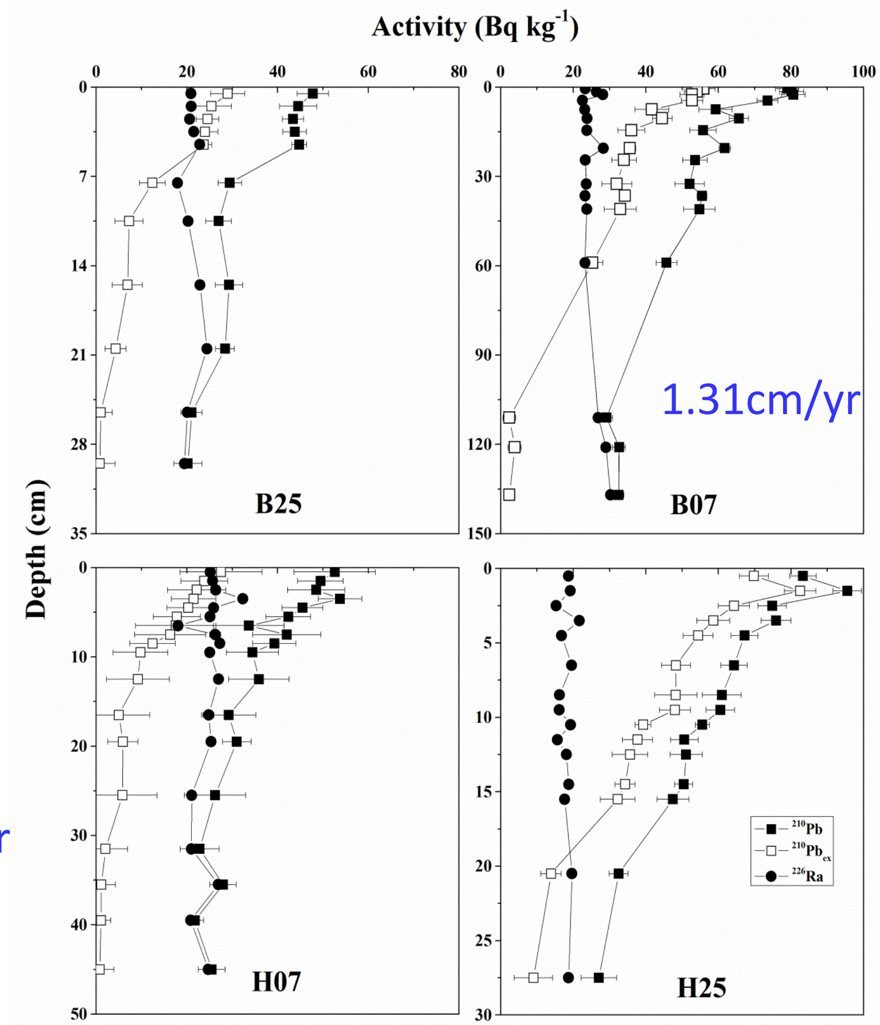
Diving to the bottom of the Krka River to collect sediment cores

Gamma Spectrometry-^{210}Pb, ^{137}Cs

ICP-MS-^{239,240}Pu

Sediment cores in the Yellow Sea

0.25cm/yr

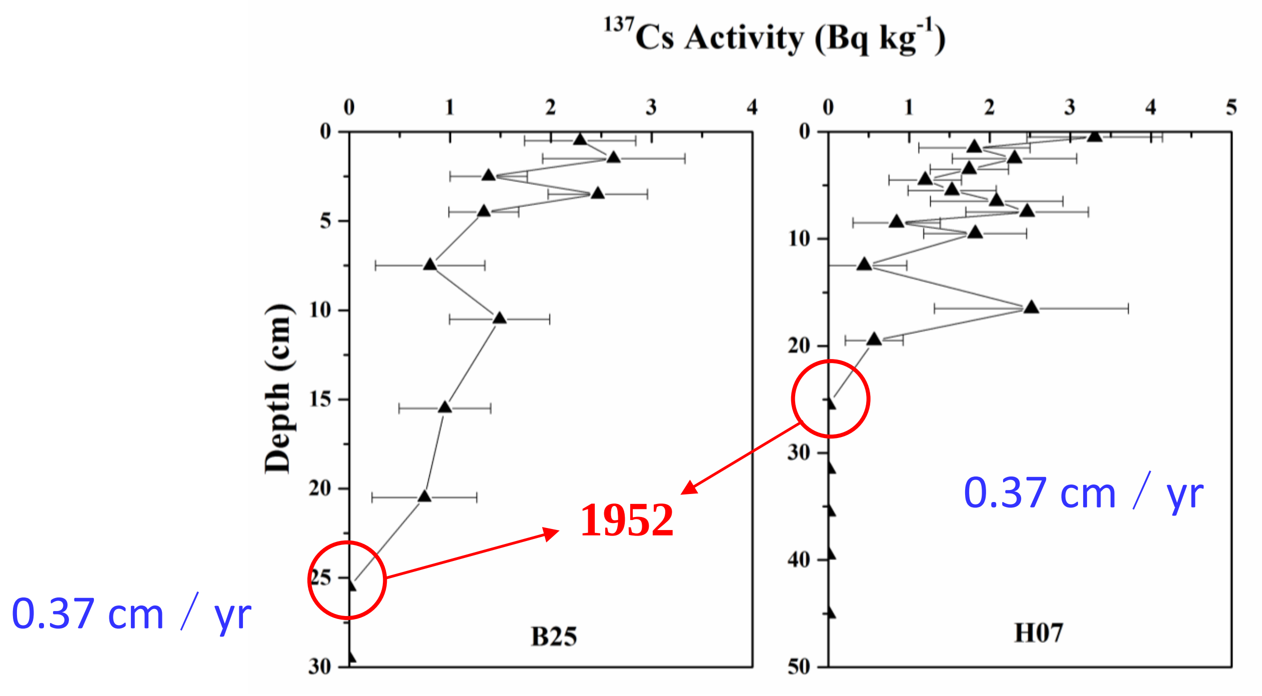


0.37 cm/yr

0.41 cm/yr

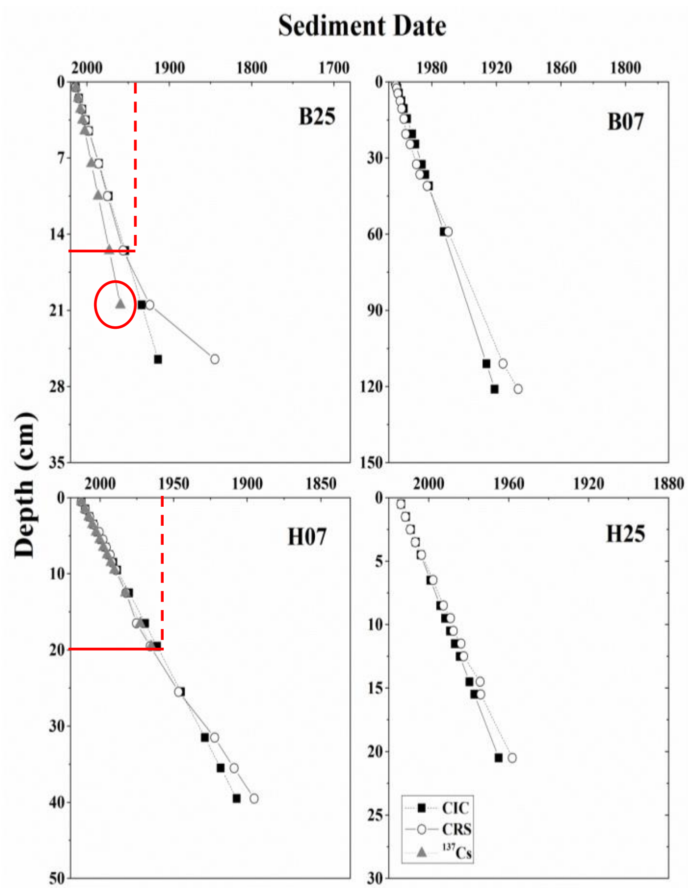
Vertical distribution of ^{210}Pb, ^{226}Ra and ^{210}Pb$_{ex}$ in the sediment cores in the Yellow Sea.

Sediment cores in the Yellow Sea



Vertical distribution of ^{137}Cs in sediment cores B25 and H07.

Sediment chronology from ^{210}Pb and ^{137}Cs



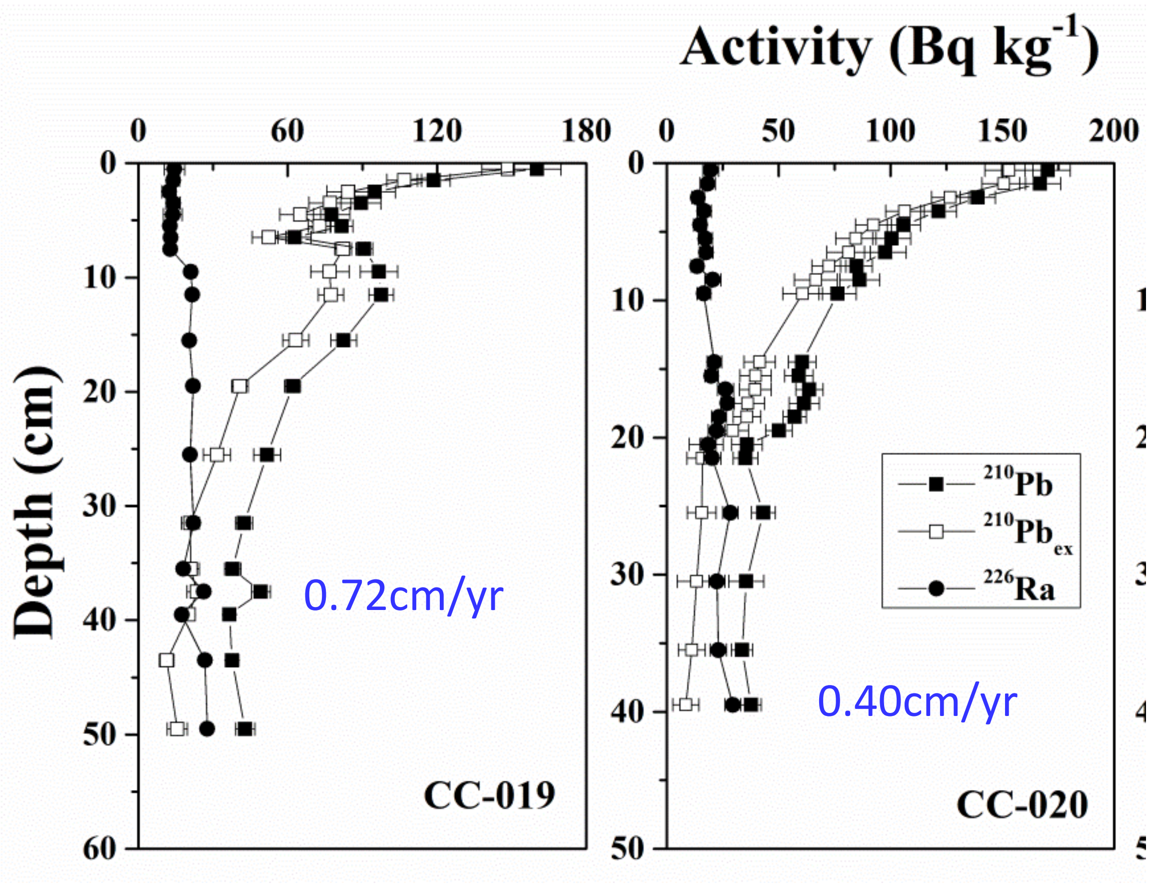
The comparison of ^{210}Pb chronology and ^{137}Cs chronology results

Station	^{210}Pb models	^{210}Pb R (cm y^{-1})	^{210}Pb I (g cm^{-2} y^{-1})	^{137}Cs R* (cm y^{-1})	^{137}Cs I (g cm^{-2} y^{-1})
B25	CIC	0.25	0.19	0.37 (23cm)	0.29
B07	CIC	1.31	0.97	-	-
H07	CIC	0.37	0.19	0.37 (23cm)	0.19
H25	CIC	0.41	0.26	-	-

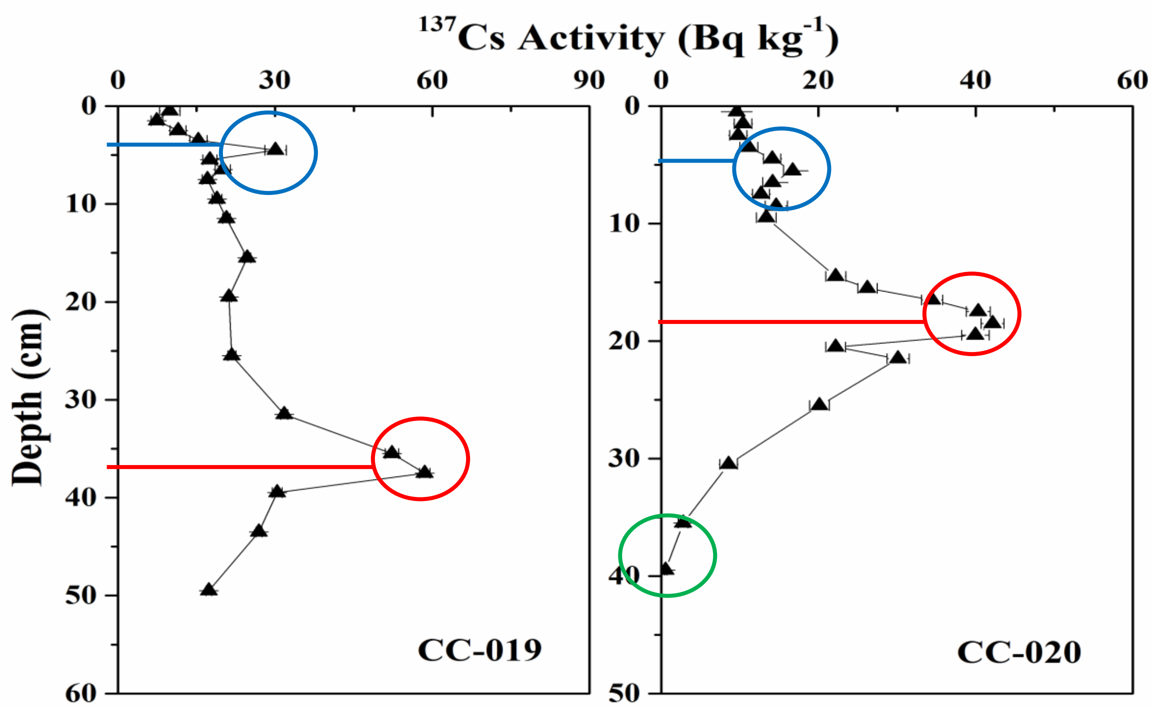
^{137}Cs move to more deep in B25？

The chronology by ^{210}Pb is well agreement with that by ^{137}Cs for H07 (1952 time-poins), but not for B25

Sediment cores in the Krka River, Croatia



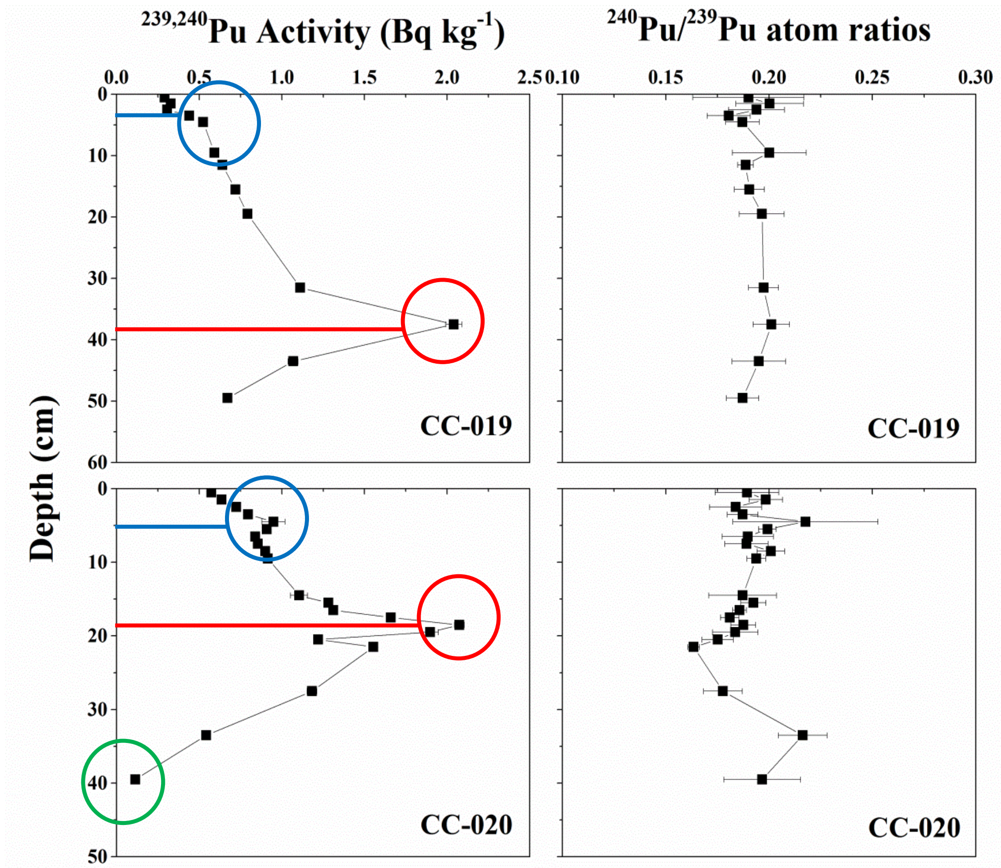
Sediment cores in the Krka River, Croatia



Vertical distribution of and ^{137}Cs in the sediment cores from the Krka River.

- ➢High radioactivity
- ➢Clearly show 3 time-points(1952, 1963 and 1986)

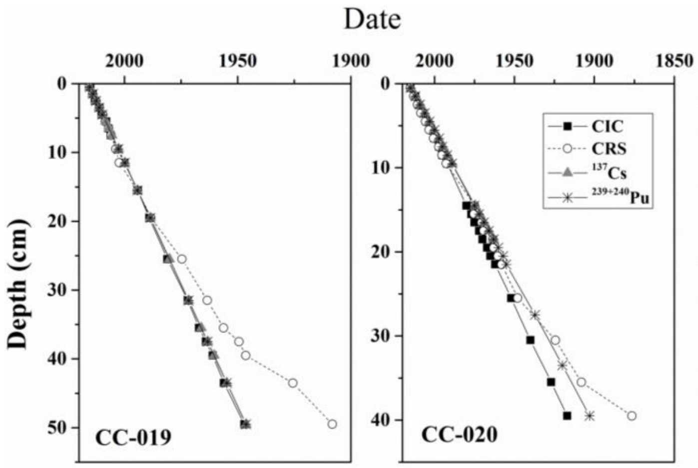
Sediment cores in the Krka River, Croatia



Vertical distribution of $^{239,240}Pu$ and $^{239}Pu/^{240}Pu$ atom ratios in sediment cores from sediment cores from the Krka River.

- **High radioactivity**
- **Clearly show 3 time-points(1952, 1963 and 1986)**
- **The good correspondence between ^{137}Cs peaks and $^{239,240}Pu$ peaks can be observed in both sediment cores.**

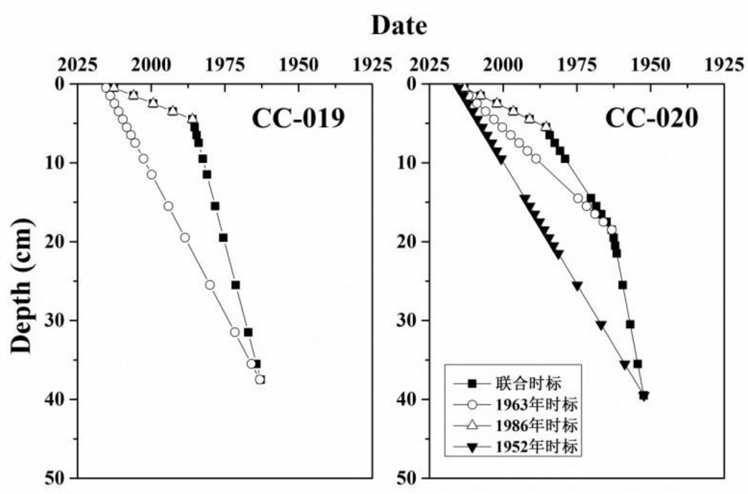
Sediment chronology from ^{210}Pb $^{137}Cs/^{239,240}Pu$ with different time points



核素	定年模型	CC-019		CC-020	
		$R^{\#}$	I	$R^{\#}$	I
^{210}Pb	CIC	0.72	0.45	0.40	0.22
^{137}Cs	1986*	0.15 (4.5cm)	0.09	0.18 (5.5cm)	0.10
	1963*	0.71 (37.5cm)	0.45	0.35 (18.5cm)	0.19
	1952*	-	-	0.62 (39.5cm)	0.34
$^{239+240}Pu$	1986*	0.15 (0-5cm)	0.09	0.15 (4.5cm)	0.08
	1963*	0.71 (0-38cm)	0.45	0.35 (18.5cm)	0.19
	1952*	-	-	0.62 (39.5cm)	0.34

The chronology by ^{210}Pb is well agreement with those both by ^{137}Cs and Pu with 1963 time point， but not for the 1952 and 1986 time points

Sediment chronology from $^{137}Cs/^{239,240}Pu$ with different time points



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- The sediment date calculated by the 1986 peak point are older than those by the 1963 peak point (lower sedimentation rate than those from the 1986 time point), indicating the upward movement of ^{137}Cs / Pu on the top of sediment cores.
- The sediment date calculated by the 1952 time point are much younger than using the 1963 time point (larger sedimentation rate than those from the 1963 time point), indicating the downward movement of ^{137}Cs / Pu on the bottom of sediment cores.

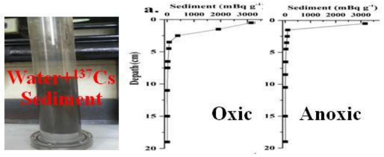
REMARKING SUMMARY

- Even in stable sedimentary condition， the mobility（or diffusion） of ^{137}Cs / Pu would limit the chronology application in the marine environment in some cases， especial for 1950s and 1986 time points .

- More case study need to be identified.

- Lab study is necessary for mobility of ^{137}Cs / Pu / ^{210}Pb in different conditions such as oxidation / reduction， organic components， etc.

Wang etal.2017



Thank for your attention!