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A comparison of PERALS® to alpha spectrometry and beta counting: a measure of the sedimentation rate in a coastal basin

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Abstract

PERALS method (Photon/Electron-Rejecting Alpha Liquid Scintillation) is given by its constructor as a quick and accurate method for alpha nuclide counting. With an adapted sample preparation, the separation and alpha counting efficiency would be close to 100%. In this study, we intend to assess its potential applied to recent geochronology. Using the ^{210}Po/^{210}Pb method, we carried out the dating of two cores sampled in the Thau basin (southern France). In the aim to test the reproducibility and the accuracy, several types of standardized materials (artificial tracers and natural soil samples) were previously analyzed. The chemical preparation of solid samples, already described by Case and McDowell [1], has been slightly adapted for our sediments. An intercomparison with the standard techniques currently used (spontaneous deposition of ^{210}Po onto silver disks measured by alpha spectrometry and beta counting of ^{210}Bi) has allowed to confirm the potentialities of the method and the equipment. The precision of the analyses was ±5%. Results obtained on two cores from the Thau basin allow us to measure sedimentation rates of 0.166 and 0.238 cm yr^{-1}.

1. Introduction

The ^{210}Pb method has been widely used for dating lacustrine and coastal sediments deposited in the last 100 years [2–5]. These sedimentation rates, based on the ^{210}Pb method can be used in order to determine the recent pollution history or to understand the sedimentation processes [6–9]. This radioactive Pb isotope has a 22.3 years half-life and belongs to the ^{238}U decay series.

Sedimentation rate measurements using this method are based on the assumption that the ^{210}Pb present in sediments has two distinct sources. The first one is the "in situ" production (^{210}Pb$_{\text{insitu}}$) so called "supported" lead, which is produced by successive decay of its parent isotopes naturally present in rock or soil (^{226}Ra, ^{222}Rn). The second source is atmospheric; a part of ^{210}Pb being also created by ^{222}Rn decay ($t^{1/2}$=3.8 days), a gas released in the atmosphere from the earth crust. This "unsupported" lead is quickly assimilated by the

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sediments through rain, snow and dry deposition, it is called "excess" lead ($^{210}Pb_{exc}$).

To measure ^{210}Pb activity in sediments, three main radiochemical methods are currently used: (1) direct ^{210}Pb γ spectrometry measurement, (2) indirect measurement of ^{210}Pb by α spectrometry of ^{210}Po, or (3) indirect measurement of ^{210}Pb by β counting of ^{210}Bi. All these isotopes possess very short half-lives and their abundance is too low to be measured by the standard techniques of mass spectrometry such as ICP/MS (Inductively coupled plasma mass spectrometry) or TIMS (Thermal ionisation mass spectrometry).

The aim of this study is to examine the potentiality of the PERALS (Photon/Electron-Rejecting Alpha Liquid Scintillation) technique to determine sedimentation rate in a lagoon ecosystem. PERALS technique was developed in the early 70's by the Oak Ridge National Laboratory, first by improving the liquid scintillation counting techniques [10–14] and later by developing a new α-counting technique, thanks to progress in electronics and optics [15–21]. Basically, the α-emitting nuclide (in our case ^{210}Po) is extracted into a solution made by a solvent combined with a lipophilic complexing agent and an appropriate scintillator. This solution is counted in a liquid scintillation spectrometer with high resolution and by discriminating β and γ pulses from α pulses.

In our study, we have also tested the reliability of this method, comparing it with independent α spectrometry and β counting measurements. The results obtained by these three techniques will be discussed.

2. Study area and sampling

The Thau basin is located at 43°20′ North and 3°35′ East, in the Languedoc region (SE France), 30 km from Montpellier (Fig. 1). It is 19.5 km large with a maximum width of 4.5 km and develops an area of 70 km^2 for a volume of 265×10^6 m^3. Its average depth is 5 m with a few deeper sites, which can reach 10–11 m. Its watershed covers 280 km^2. Several rivers feed the pond on its northern border, while a narrow off-shore bar, crossed by three channels, separates it from the Mediterranean Sea.

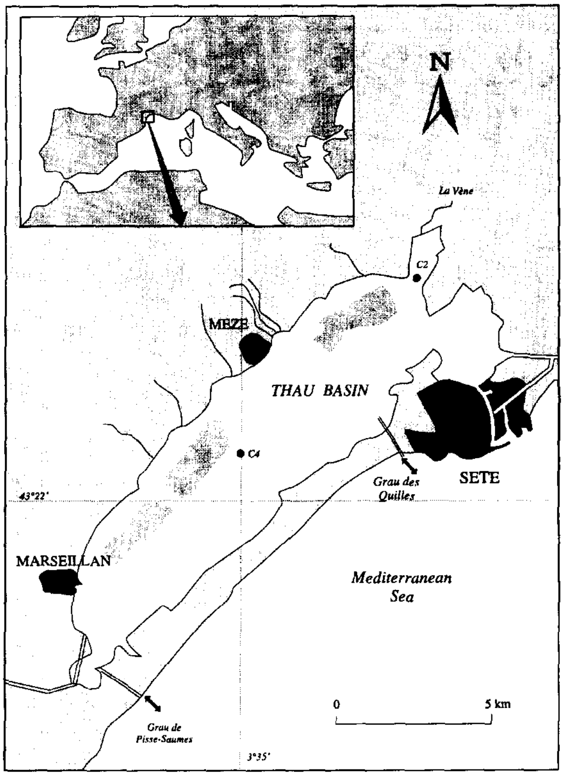

Fig. 1. Location of sampling.

Sampling was carried out in November 1993, with a corer of "Mackereth" model, at depths ranging from 4 to 6 m. Special care was taken during sampling in order to keep the upper layer of sediments undisturbed. The cores (40–80 cm in length) were kept vertical and, as soon as possible, refrigerated at 4°C. For this study, cores 2 and 4 were analyzed. Sediments were collected at 1 cm intervals during the first 10 cm, then at 2 cm intervals until 20 cm and finally every 5 cm. They were dried at 80°C until a constant weight was reached and sieved at 60 µm to reduce the grain size effect (dilution with the fragments of shells or other debris).

3. Sedimentation model

In the simplest case, without bioturbation or diffusion of lead in the sediments, the decrease of $^{210}Pb_{exc}$ activity with depth is governed by the decay equation:

$$^{210}\mathrm{Pb}_{\mathrm{exc}}(x) = ^{210}\mathrm{Pb}_{\mathrm{exc}}(0)\mathrm{e}^{-\lambda t} \quad (1)$$

Where, $^{210}\mathrm{Pb}_{\mathrm{exc}}$ (x) is the activity of lead in excess at the depth x, $^{210}\mathrm{Pb}_{\mathrm{exc}}(0)$ is the excess activity at the surface, λ the $^{210}\mathrm{Pb}$ decay constant and t the time elapsed since the sedimentation at the depth x. This implies that the flux of $^{210}\mathrm{Pb}_{\mathrm{exc}}$ at the interface remained constant during the last 100 years.

This relation can be expressed under a logarithmic form and becomes:

$$\ln {}^{210}\mathrm{Pb}_{\mathrm{exc}}(x) = -\lambda t + \ln {}^{210}\mathrm{Pb}_{\mathrm{exc}}(0) \quad (2)$$

Sedimentation rate, m, is defined by:

$$m = \frac{x}{t}$$

From the later equations, we get the last relation:

$$\ln {}^{210}\mathrm{Pb}_{\mathrm{exc}}(x) = \frac{-\lambda x}{m} + \ln {}^{210}\mathrm{Pb}_{\mathrm{exc}}(0) \quad (3)$$

In a semi-log diagram, sedimentation rate is defined from the slope $\alpha=-\lambda/\mathrm{m}$. To obtain $^{210}\mathrm{Pb}_{\mathrm{exc}}$, we subtract the $^{210}\mathrm{Pb}_{\mathrm{insitu}}$ activity from the $^{210}\mathrm{Pb}_{\mathrm{total}}$ activity. In a first approximation we consider that at the bottom of the core, 80 cm in depth, only the $^{210}\mathrm{Pb}_{\mathrm{insitu}}$ is present ($^{210}\mathrm{Pb}_{\mathrm{exc}}$ has disappeared) and that it has the same value from the bottom to the top of the core. Error is re-estimated by $\pm 0.2\,\mathrm{dpm\,g}^{-1}$.

4. Experimental

4.1. Chemical preparation for PERALS

The chemical procedure used mainly follows that of Case and McDowell [1]. However, these authors describe a general method for solid samples which cannot be easily applied for lagoon sediments because of their high organic matter content which induces quenching (absorption of light emission during the scintillation). It results in a reduction of the pulse height response for a given energy or a decrease of energy resolution ability or both [10]. Calcination of this organic matter is not possible because Po, despite its high-boiling point, can be volatilized at temperatures as low as 100–150°C, particularly as halide form. To solve this problem the organic matter was oxidized by hydrogen peroxide.

Thus, 300–500 mg of sediment, oven dried during 12 h at 80°C, was placed in an open 100–200 ml FEP beaker with 5 ml of 30% H_2O_2 on a hot plate under controlled temperature at 70°C, until complete evaporation. This operation was repeated two or three times until a whitish precipitate was obtained. Two ml each of concentrated HNO_3, HF and HCl was added to the beaker and then was transferred in ultrasonic tank during 15 mn to ensure that Po does not remain adsorbed against inner sides. The sample was transferred in a 10 ml PTFE bomb and heated at 70°C during 12–24 h until complete dissolution (better than 90%); this dissolution step should not be repeated because Po losses can occur during evaporation. Nevertheless, if a small residue remains, it must be eliminated by centrifugation. The supernate is transferred in 200 ml FEP beaker. Sometimes, Fe(III) induced a yellow coloration, which led to a quenching. To avoid this problem, Fe(III) was complexed with 5 ml of H_3PO_4 15 N and 5 ml of deionised water. Acids and water were removed by heating at 70–80°C but H_3PO_4 still remained because of its high-boiling point. Water was added again and evaporated until the solution is the most translucent and colourless. We have noticed that little addition of H_2O_2 can also help to reduce the colour. At the end, 5 ml of deionised water and 1 ml of HCl 0.1 N was added to the phosphoric acid solution so that the solution is H_3PO_4 7.5 N, HCl 0.01 N.

4.2. Liquid–liquid extraction of polonium

The solution was transferred in a separatory funnel and a precise 1.5 ml of combined extractive and scintillating solution (ETRAX® POLEX®) was added. The mixture was shaken with a magnetic agitator during 45 min, then the two phases were allowed to separate. One ml of water-immiscible organic phase was transferred in a Pyrex culture tube (10×75 mm). This solution was deoxygenated by bubbling argon saturated with toluene, during 2 min, to avoid the chemical quenching caused by oxygen, and the culture tube was put into the spectrometer.

4.3. Counting

Energy of radioactive decay produces a light emission in the scintillator solution, which is detected by a multiplier phototube. There is no problem of self-absorption or of detector geometry because the α-emitting nuclide is homogeneously dispersed in the scintillating solution. The efficiency is 99,6±1% (every decay is detected); for practical terms it is 100%. A pulse-height multichannel analyzer records the α pulses and electronic Pulse Shape Discrimination (PSD) allows the separation and the rejection of γ and β radiations with negligible loss of α emissions. This is done because there is a slight difference in the electronic signal given by the light pulses by α radiations and γ/β ones. Energy resolution is about 200–250 keV, with an upper background count of 0.01 dpm. Even if this resolution is rather good, it does not allow the use of isotopic dilution with a ^{208}Po tracer (Decay energy ^{208}Po=5.115 MeV and ^{210}Po=5.304 MeV). This point is important since it implies that the chemical and counting yield are 100%. Counting was achieved when the number of counts yields a statistical error around 3%. An example of counting spectrum for a ^{208}Po solution is given in Fig. 2. β and γ radiations are efficiently rejected and the Po peak can be easily fitted and integrated by a gaussian distribution.

4.4. Other methods used

In order to examine the reliability of the PERALS technique, two others "classic" methods of measurement of ^{210}Pb activity were used.

The first one was the spontaneous deposition of Po on a silver disc and counting the radiation in an α-spectrometer with a surface barrier detector [22]. Approximately 1 g of dry sample, precisely weighed, was dissolved, following the same procedure as below except that 100 µl of ^{208}Po artificial tracer at 77.5 dpm g^{-1} is added before the dissolution. After 12/24 h on the hot plate, the solution was evaporated almost until dryness and 10 ml of HCl 2N was added. Spontaneous deposition of Po was achieved on silver discs at 80°C during 2 h after addition of ascorbic acid.

The second procedure was the β counting of ^{210}Bi ($E_{\max}$=1.2 Mev) generated from ^{210}Pb after its chemical separation. As a tracer, a known amount of $PbCl_2$ was added to the sample and the dissolution was done as mentioned above. This common lead was used as a tracer but also as a scavenger of ^{210}Pb.

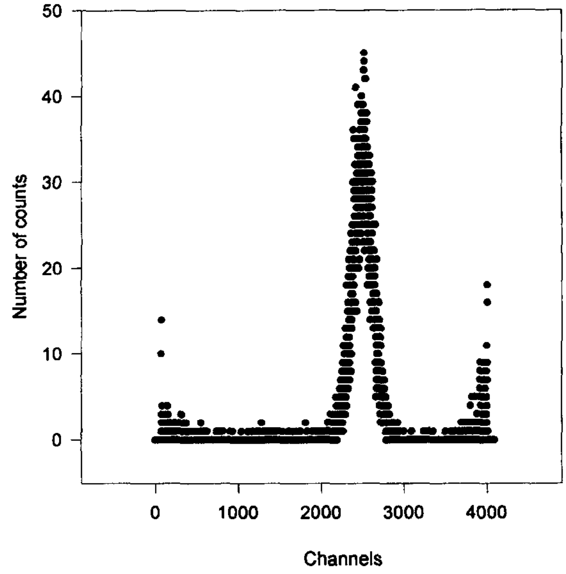

Fig. 2. Example of ^{208}Po spectrum.

Separation and purification of Pb was achieved on an anion exchange resin AG1-X8. Efficiency of the separation was measured by gravimetric technique and ranged from 75% to 97%. Counting must be realized until the ^{210}Bi reaches the equilibrium with ^{210}Pb which is obtained after one month (half-life of ^{210}Bi=5 days).

5. Results and discussion

5.1. Reproducibility and accuracy

To estimate these parameters many replicates have been analyzed on different types of materials:

First, two solutions of artificial tracers SW8 et SW9 (^{208}Po and ^{209}Po) were used. In this case, the preparation is simplified since the digestion step is avoided. Potential problems will only be linked to the Po separation by POLEX® and counting in the spectrometer.

Secondly, natural sediment samples from the Thau basin and one sediment drilled from a core in Mediterranean sea (PRP) were analysed. This latter was kindly supplied by Radakovitcz, O. (Univ.

Perpignan, France) and was calibrated by γ and α spectrometry.

Analytical data and statistical informations as the number of analyses, range, mean, standard error for ^{208}Po, ^{209}Po tracers and the calibrated sediment are summarized, respectively, in Table 1, Table 2 and Table 3. Results from core Nos. 2 and 4 obtained by the different analytical methods are presented in Tables 4 and 5. For the PERALS data, only counting statistics are taken into account in the calculation of the error (1σ). The real analytical error comprising chemical preparation and extraction will be discussed latter.

Table 1
PERALS reproducibility for SW8 liquid artificial tracer (^{208}Po)

No of replicate	^{208}Po activity (dpm g^{-1})
1	77.09±1.54
2	75.37±0.90
3	72.42±1.55
4	76.84±0.64
5	77.84±1.27
6	76.69±0.80
7	78.03±1.37
8	74.96±0.64
9	77.54±1.27
10	76.09±0.90
11	81.12±0.76
12	75.75±0.75
Number of analyses	12
Range	72.42–81.12
Mean	76.65
Std Err	0.60

The error (1σ) is calculated from the number of counts of the ^{208}Po peak.
Certified value: 77.5±0.5 dpm g^{-1}.

Table 2
PERALS reproducibility for SW9 liquid artificial tracer (^{209}Po)

No of replicate	^{209}Po activity (dpm g^{-1})
1	14.17±0.14
2	15.08±0.33
3	15.43±0.14
4	13.40±0.28
Number of analyse	4
Range	13.40–15.43
Mean	14.52
Std Err	0.45

The error (1σ) is calculated from the number of counts of the ^{209}Po peak.
Certified value: 13.90±0.26 dpm g^{-1}.

Table 3
PERALS reproducibility for PRP calibrated sediment (^{210}Pb)

No of replicate	^{210}Pb$_{tot}$ activity (dpm g^{-1})
1	7.21±0.21
2	6.87±0.10
3	7.09±0.37
4	6.85±0.18
5	6.82±0.09
6	7.21±0.21
No of analyse	6
Range	6.82–7.21
Mean	7.01
Std Err	0.07

The error (1σ) is calculated from the number of counts of the ^{210}Po peak.
Calibration by α spectrometry: 6.80±0.15 dpm g^{-1} and γ counting: 7.30±0.35 dpm g^{-1} (Radakovitz O., personnal communication).

Table 4
^{210}Pb$_{tot}$ activity in core No. 2 (dpm g^{-1})

Sample (cm)	^{210}Po by PERALS[a]		^{210}Bi[b]
	First measurement	Second measurerement	
0–1	7.09±0.22	—	9.07±0.55
1–2.2	7.83±0.24	7.45±0.17	—
2–3.4	5.29±0.11	—	5.23±0.39
3.4–4.6	6.21±0.16	6.50±0.21	7.32±0.44
4.6–6	5.11±0.22	4.54±0.14	3.79±0.27
6–7.2	3.70±0.11	—	—
7.2–8.4	2.67±0.09	—	3.38±0.25
8.4–9.6	2.57±0.09	2.26±0.30	—
9.6–10.8	2.15±. 0.09	1.77±0.10	1.54±0.14
10.8–11.8	2.78±0.10	—	—
16–17	2.11±0.08	—	1.85±0.16
21.5–22.5	1.87±0.06	2.25±0.08	—
26.5–27.5	1.97±0.08	—	—
32.5—33.5	1.72±0.06	—	—
40–41	1.58±0.05	—	—
49.5–50.5	1.50±0.05	—	—
68–69	1.45±0.05	—	—

The ^{210}Pb$_{tot}$ activity indirectly obtained by the [a]PERALS measurement of ^{210}Po; [b]beta counting of ^{210}Bi.
The PEARLS error (1σ) takes into account the counting statistics of the ^{210}Po peak whereas for the ^{210}Bi, the error (1σ) also integrates the uncertainty linked to the background correction.
^{210}Pb$_{insitu}$ is estimated at around 1.47±0.2 dpm g^{-1}.

Table 5
$^{210}Pb_{tot}$ activity in core No. 4 (dpm g^{-1})

Sample (cm)	^{210}Po by PERALS (i)		^{210}Bi (ii)	^{210}Po (iii)
	First measurement	Second measurement		
0–1	11.35±0.35	10.43±0.31	8.23±0.50	8.37±0.30
1–2	8.71±0.29	8.72±0.33	9.06±0.50	9.00±0.41
2–4	6.79±0.21	7.05±0.21	8.02±0.47	7.02±0.66
4–5	5.76±0.11	—	—	—
5–7	5.11±0.15	4.92±0.10	4.69±0.28	4.44±0.26
7–8.5	4.63±0.14	4.86±0.11	—	—
8.5–10	4.49±0.12	4.46±0.10	4.28±0.25	3.81±0.33
10–11.5	4.36±0.12	—	—	—
11.5–12.5	3.89±0.09	3.66±0.13	3.42±0.24	—
13–14	3.18±0.08	—	2.17±0.15	3.44±0.12
16–17	2.42±0.09	—	—	—
23–24	2.07±0.07	—	—	—
24–25	3.31±0.08		2.84±0.17	—
29–30	1.77±0.06	—	—	—
60–61	1.73±0.07	—	—	—

The $^{210}Pb_{tot}$ activity is indirectly obtained by the [a]PERALS measurement of ^{210}Po; [b]beta counting of ^{210}Bi; [c]isotopic dilution and "classic" alpha spectrometry.

The error of this later (1σ) is calculated from the counting statistics of the ^{210}Po and ^{208}Po peaks and from the uncertainty linked to the background correction.

$^{210}Pb_{insitu}$ is estimated at around 1.75±0.2 dpm g^{-1}.

The mean of the ^{208}Po countings by PERALS is 76.65 dpm g^{-1} (Table 1). The range of the values is rather narrow (from 72.42 to 81.12 dpm g^{-1}). Discrepancies between mean and the extreme value does not exceed 5.7%. The ^{208}Po counting errors are often lower than 3% because it has been possible to record a great number of decays due to the high activity. In the case of ^{209}Po tracer (Table 2), the mean is slightly higher than the certified value and the range of data is, in proportion, greater than previously reported. On these liquid tracers, where it was not necessary to perform a dissolution procedure, the measured average activities are very comparable or sometimes higher than the certified values indicating that no Po loss occurs during the chemical preparation. Overall recoveries range from 93% to 106% as it was indicated by the constructor.

Measurements carried out on the PRP calibrated sediment by PERALS (Table 3) fall exactly into the domain of calibration defined by α and γ spectrometry (6.80 and 7.30 dpm g^{-1}, respectively). They display a maximum discrepancy between average and extreme value of 3%, comparable to the counting error.

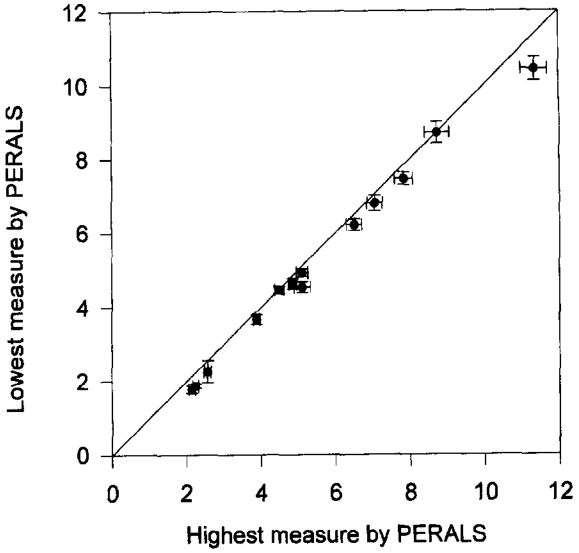

Fig. 3. PERALS reproducibil ity. Line x=y presents the ideal case.

Replicates by PERALS on the samples from core Nos. 2 and 4 are presented in Fig. 3. For most of them, the reproducibility is very good, considering the counting error bars alone. However, at less than 3 dpm g^{-1}, the difference between upper and lower values measured can reach 15–20%. It is possible that a small part of ^{210}Po generated by the $^{210}Pb_{insitu}$, located in the crystalline lattice of minerals, is not well extracted during digestion. Thus, it results a weak reproducibility when the $^{210}Pb_{insitu}$ contribution for the $^{210}Pb_{total}$ is important.

In the case of the PRP calibrated sediment, reproducibility is better because the whole dissolution was easily achieved. These restrictions are not linked with the PERALS method which allows to measure the low activities with a good precision, but with the chemical preparation of the samples.

5.2. Application to the geological problem

Results obtained by the three methods on samples from core No. 4 are summarized in Table 5 and plotted on Fig. 4. Most of activities are similar whatever the method, except for the surficial layer

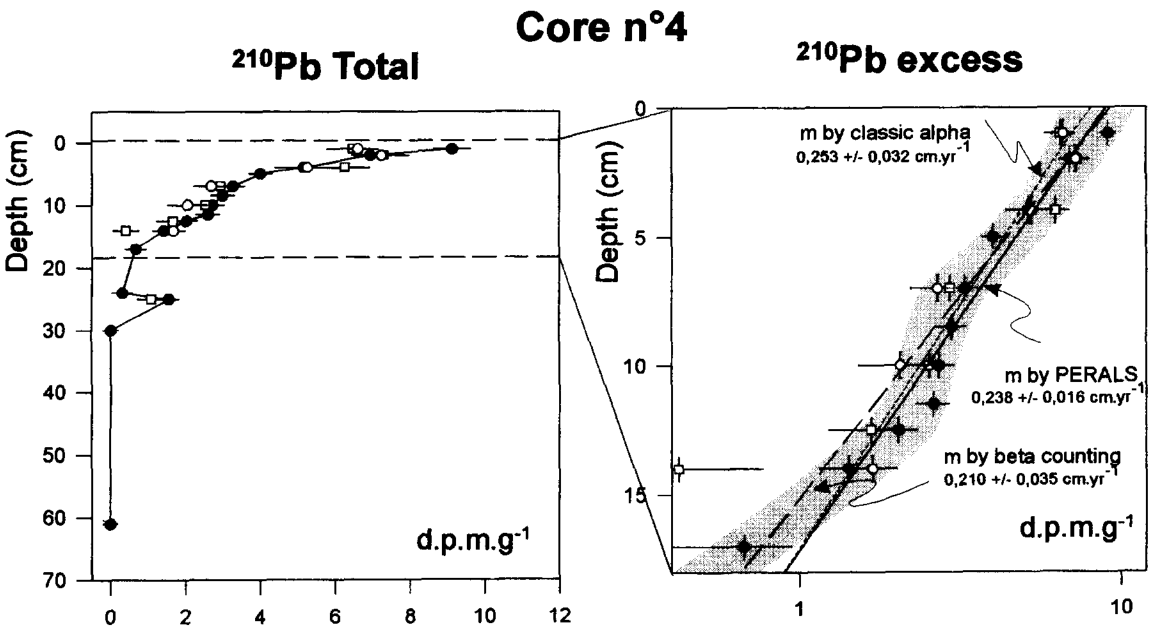

Fig. 4. $^{210}Pb_{tot}$ and $^{210}Pb_{exc}$ vs. depth for core No 4. ^{210}Pb is indirectly measured with ^{210}Bi by β counting (○), with ^{210}Po by PERALS (●) and with ^{210}Po by conventional α spectrometry (□). Sedimentation rates (m) are calculated using linear regression, each point weighted with the inverse of the error percent.

Table 6
Determination of the sedimentation rates and $^{210}Pb_{exc}$ initial activities with the different methods

		Sedimentation rate (cm yr^{-1})	$^{210}Pb_{exc}$ (0) (dpm g^{-1})
Core 2			
	PERALS	0.166±0.032	8.49±0.69
	β counting	0.167±0.052	9.27±1.16
Core 4			
	PERALS	0.238±0.016	9.18±0.30
	α spectrometry	0.253±0.032	8.03±0.38
	β counting	0.210±0.035	9.26±0.69

(0–1 cm) where the PERALS data are higher than the α and β ones and the 13–14 cm layer which presents a lower value by β. Nevertheless, there is no systematic bias linked to one method. Sedimentation rate and initial activity, $^{210}Pb_{exc}$ (0), are calculated using linear regression, each point weighted with the inverse of the error percent (Table 6). With this mathematical calculation, the slope is less influenced by the deepest layers which present a wide analytical error. Initial ^{210}Pb activities are comparable whatever the method used. PERALS, classic α spectrometry and β counting give almost the same sedimentation rates: 0.238±0.016 cm yr^{-1}, 0.253±0.032 cm yr^{-1} and 0.210±0.035 cm yr^{-1}, respectively. The lower precision by β and α measurements is mainly due to the lesser number of analyses. The results by PERALS demonstrate an exceptional regularity which tends to confirm the real potentialities of this method. However, the 24–25 cm layer presents a positive anomaly in $^{210}Pb_{exc}$ which is today unexplained. We can also notice that the envelope shape of the analyses (dotted pattern) suggests a change in the sedimentation rate between 7 and 12 cm by the breakdown of the slope.

With the samples from core No. 2, we observe some local discrepancies between PERALS and β (Fig. 5), the weighted linear regressions define exactly the same sedimentation rate (0.166±0.032 cm yr^{-1} and 0.167±0.052 cm yr^{-1}). The larger uncertainty is mainly related to geological considerations rather than to the analytical indetermination. Indeed, the decrease of ^{210}Pb seems to be less regular than in the case of the core No. 4.

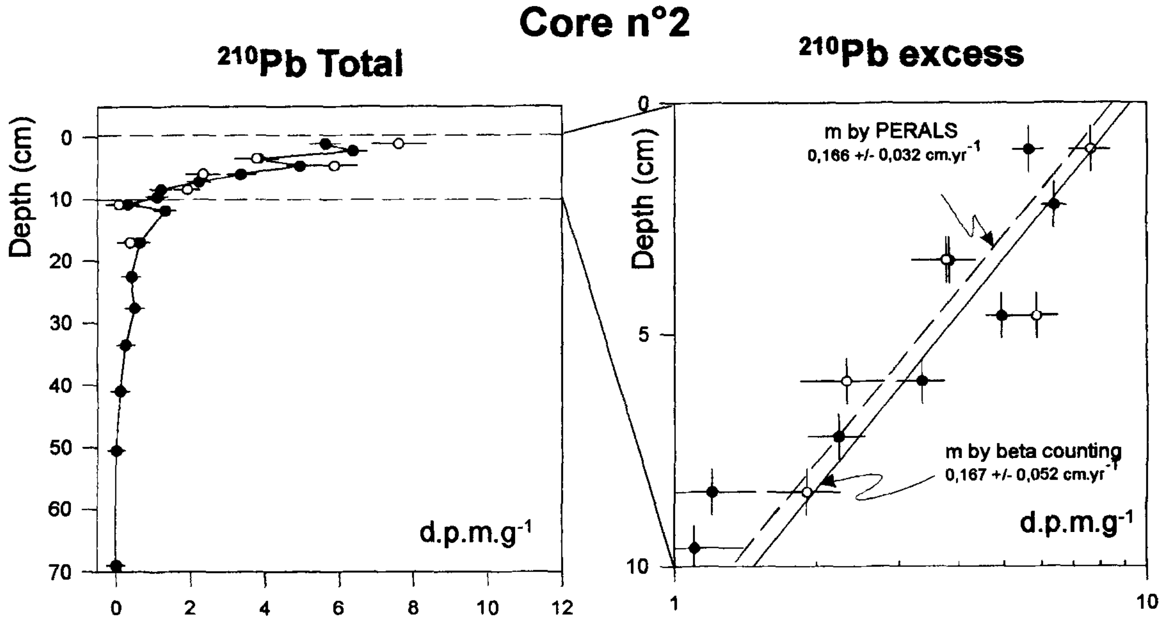

Fig. 5. $^{210}Pb_{tot}$ and $^{210}Pb_{exc}$ vs. depth for core No 2. ^{210}Pb is indirectly measured with ^{210}Bi by β counting (○) and by ^{210}Po by PERALS (●). Sedimentation rates (m) are calculated using linear regression, each point weighted with the inverse of the error percent.

6. Conclusion

The choice of a method depends on different criteria: the quality of the results, the time consumed and the cost of products used. Table 7 summarizes the main characteristics of the methods used. The three methods described gave very comparable results.

Basically the main source of errors is the volatility of ^{210}Po for methods using this isotope. By α counting this problem can be avoided by using isotopic dilution with an artificial tracer but by PERALS the relative poor energy resolution of the instrument does not allow using this technique. For PERALS care must be taken during the extraction

Table 7
Characteristics of PERALS, β counting and α spectrometry applied to the ^{210}Pb measurement

	PERALS	β counting	α spectrometry
Method	No tracer	Use of a common lead tracer	Isotopic dilution (artificial tracer)
Sample preparation	Easy and quick but requiers precautions	Heavy and time consumming.	Easy and quick.
Efficiency	≈100%	60–90%	80–90%
Counting			
Energy resolution	Poor	Medium	High
Efficiency	≈100%	30–40%	<35%
Control of efficienty	Precautions, no control	Poor	High
Statistical error calculation	From one peak	From one peak	From two peaks
Background	0, 01 dpm	0, 14 dpm	0, 05–0, 10 dpm
Precision	4–5%	<10%	6–8%
Correction	No correction needed	Self absortion and background	Variable background

and bubbling to avoid quenching. Using self deposition and α counting, one must be very concerned with the cleaning of ^{210}Po from the silver planchet which is a difficult task. ^{210}Bi method ask for more chemistry; after the loading of samples, ionic resins must be carefully washed-up because Pb could give an impure sulfate precipitatation resulting in a wrong chemical yield.

The ^{210}Bi and β-counting method has a chemical yield from 60% to 90% and a counting yield of around 30–40%. It needs more chemical products, and it requires background and auto-absorption correction, since the diode has a background increasing over time due to recoil contamination, which render the activity measurements less precise. Moreover with the ^{210}Bi method, results cannot be obtained before one month after the beginning of the analysis. Chemical yield of self deposition is 80–90% but α counting is not more than 35%. It necessitates a background correction since the diode has a background increasing with time. The PERALS method has a chemical and counting yield of 100%. That allows to improve the counting statistics or reduce the necessary weight of the sample or to count two time more samples in the same time.

Thus, PERALS is a competitive and rapid method to determine the sedimentation rate in comparison with α spectrometry or β counting. However, as there is no control on the chemical preparation efficiency, it is better to insert some standards in the unknown sample series or to duplicate some samples by another method to control the procedure.

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