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MnO_2 Resin
A new approach for Radium separation

UGM05 - 09/12/05 - Manchester

Outline

- Radium
- pH study
- Reaction time
- Amount of resin
- Salt concentration effect
- Flow-rate study
- Conclusion

Radium

- ^{226}Ra (1620 y), ^{228}Ra (5,28 y)
- ^{223}Ra (11,4 d), ^{224}Ra (3,6 d)
  - Water analysis for radioprotection and geological tracing
- Same metabolic behaviour as Ca

Ra separations used

- Separation with TRU or LN resin:
  - Isolation of ^{228}Ra daughter ^{228}Ac.
  - ^{228}Ac measured by γ-spectrometry (338 and 911 keV)

Use of MnO2

- Resin MnO2 80-160 µm particle size
- Use of de-ionised , ground and sea waters
- Study with variation of
  - pH
  - Kinetics
  - Ratio mass of resin vs volume of solution
  - Salinity
  - Flow rates
- Use of ^{133}Ba to monitor Ra behaviour

pH variation

- 10 mL de-ionized water spiked with ^{133}Ba
- 25 mg MnO_2 resin
- Magnetic stirrer
- pH adjusted with HCl or NaOH
- 60 minutes contact
- 20°C
- Measure of filtered MnO_2 in NaI well-type gamma counter

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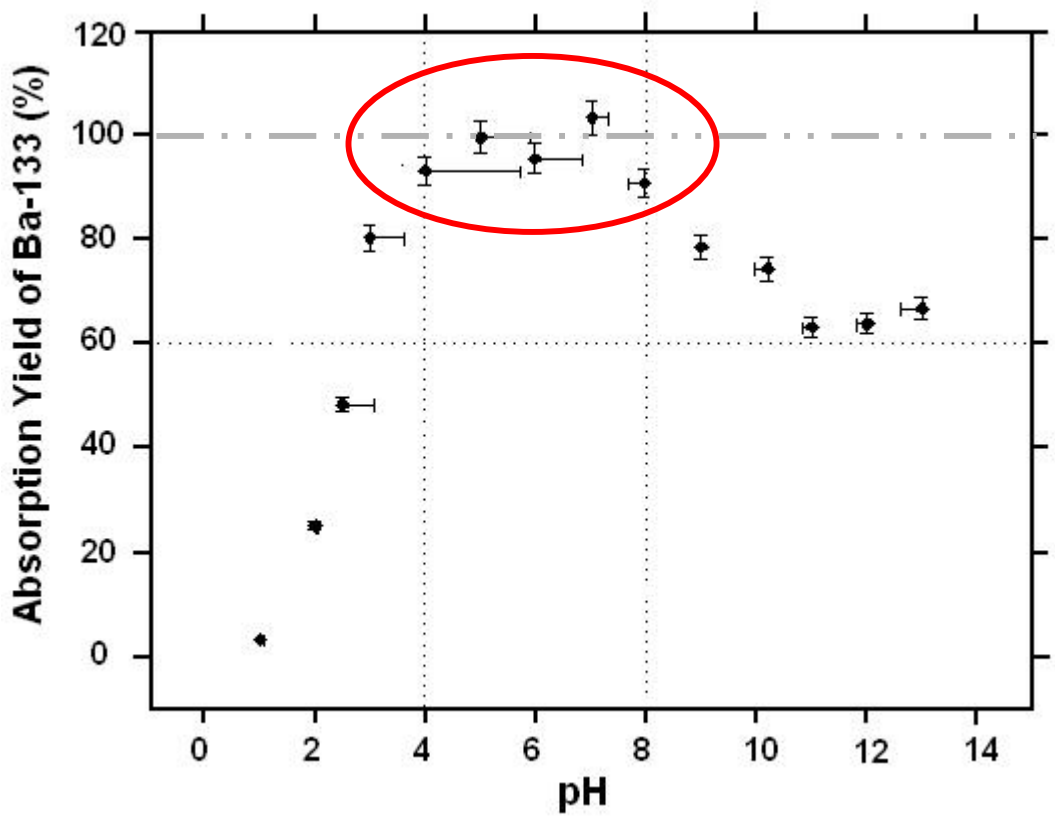
pH variation

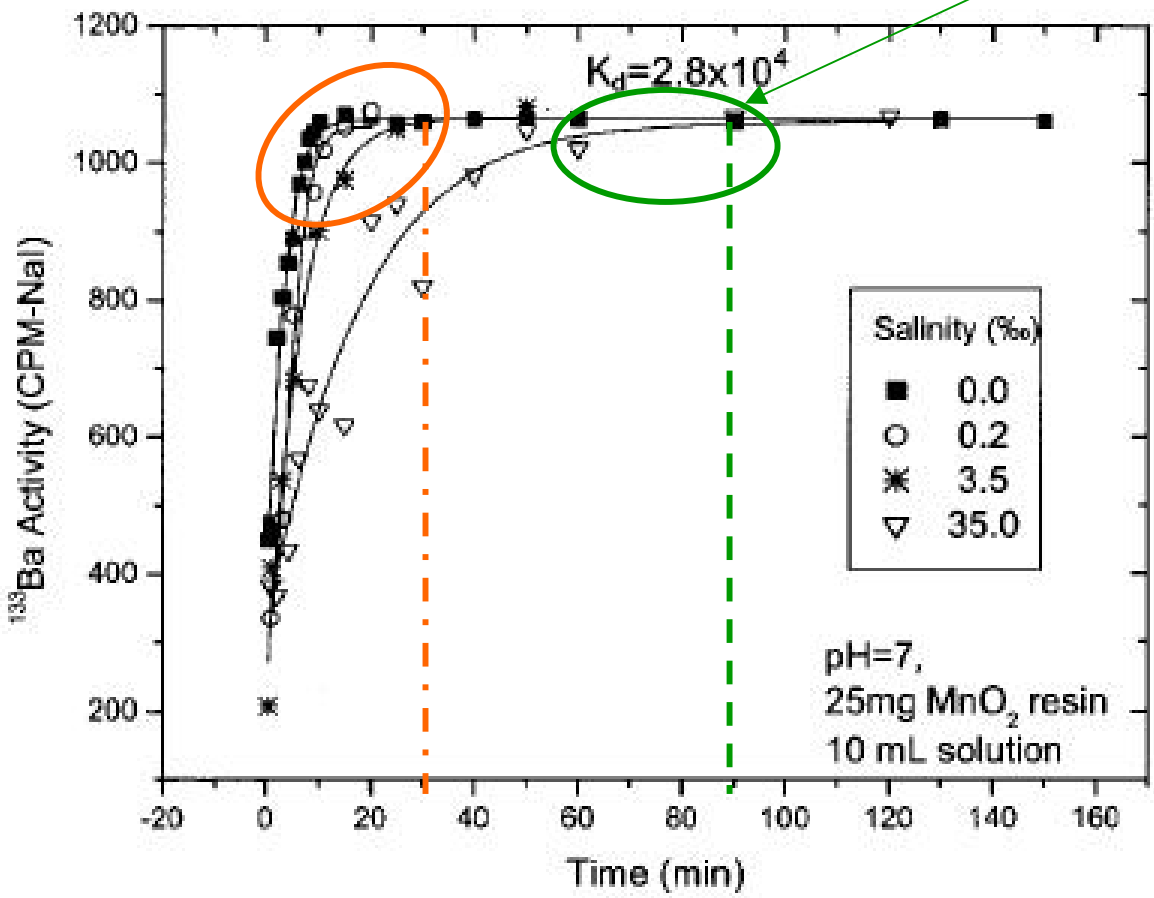


Kinetics

- 10 mL water samples spiked with ^{133}Ba (de-ionized, 0.2, 3.5 and 35‰ salinities)
- 25 mg MnO_2 resin
- Magnetic stirrer
- pH = 7.0
- 1.0 to 90 minutes contact
- Measure of filtered MnO_2 in NaI well-type gamma counter

Kinetics

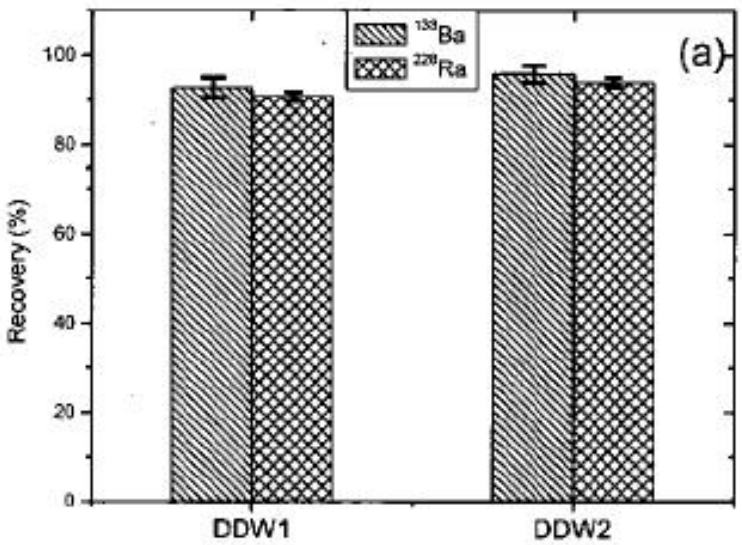
Charged sample



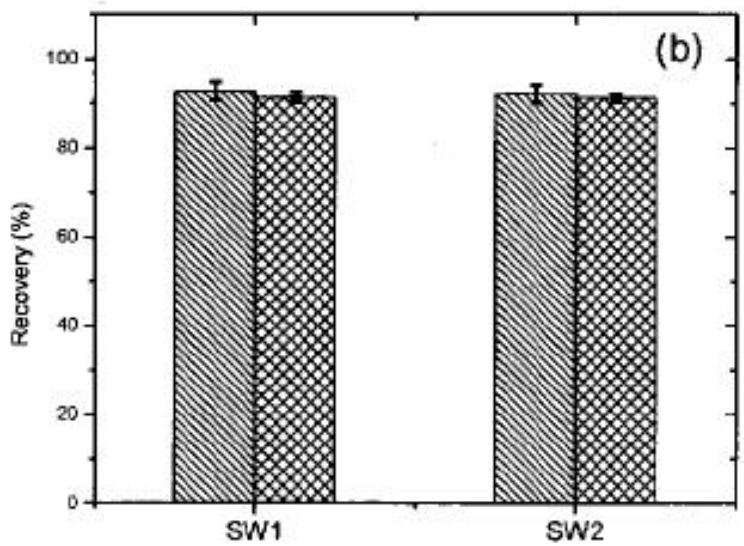
Ratio Vs/Vm

- Batch experiment
  - 25 mg MnO2/10 mL solution (25 g/1.0 L)
  - 10 mg MnO2/10 mL solution (10 g/1.0 L)
- Column
  - 1 g MnO2 resin
  - Geometry: ∅i = 0.9 cm, H = 6,5 cm
  - Water samples: de-ionised and artificial seawater

Ratio Vs/Vm



De-ionized water



Seawater

Flow rate

- 1.0 L sample water spiked with ^{133}Ba and ^{228}Ra
- 1.0 g MnO2 resin cartridge
- pH = 7.0
- Peristaltic pump, flow rate 0 -300 mL/min
- Samples: de-ionized and seawater

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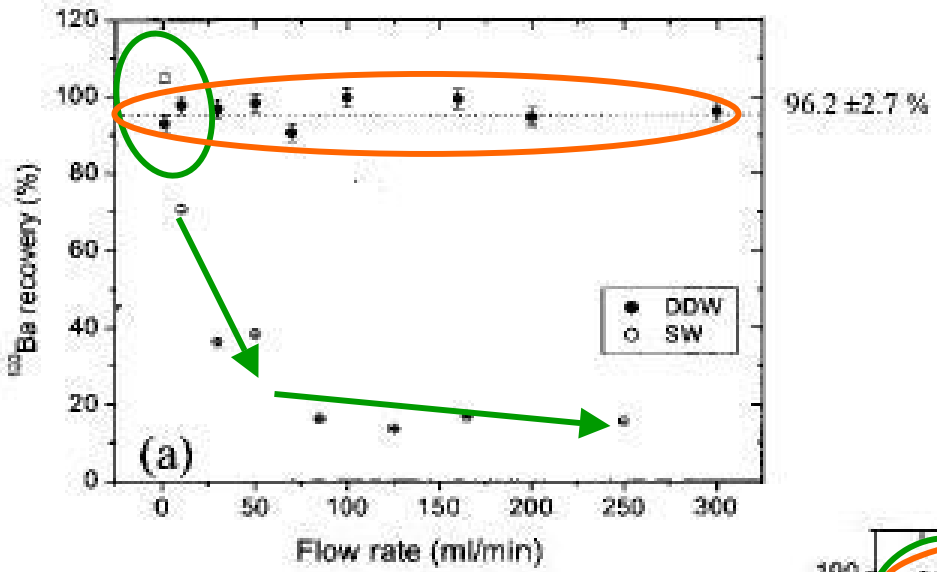
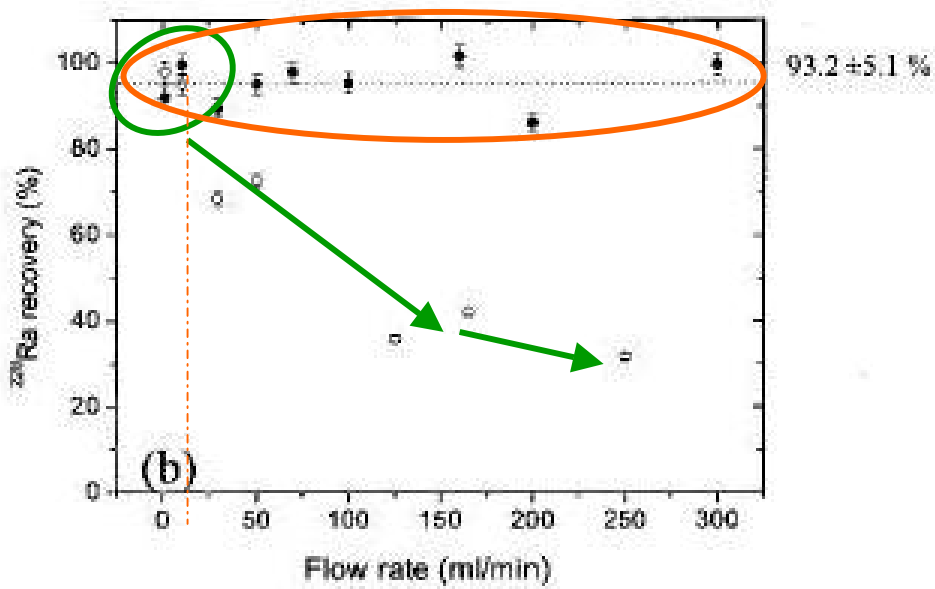
Flow rates - results

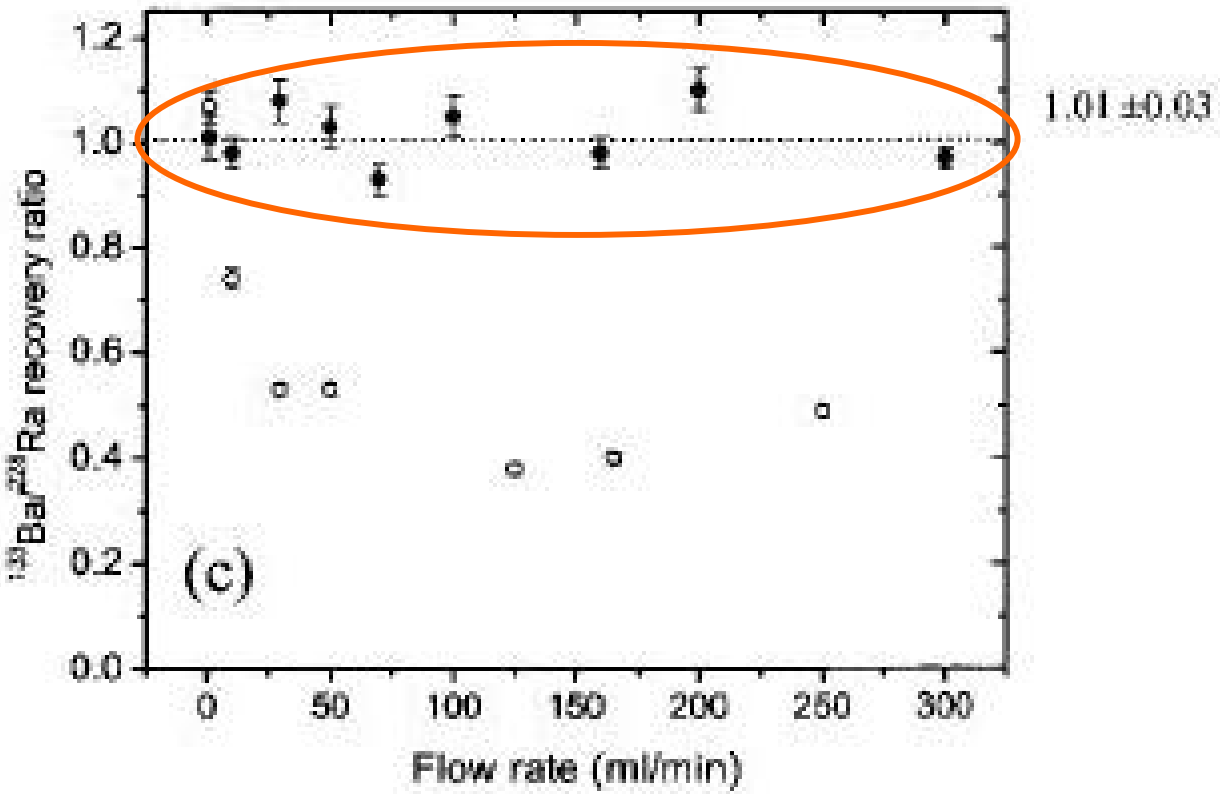
^{133}Ba



^{228}Ra



Flow rates – results: $^{133}Ba/^{228}Ra$



Review

- pH window : 4-8 for 90-100% recovery
- Kinetics dependant of salinity
- Use of columns
- Flow rate dependant of salinity
  - 20 mL/min OK for all types of water samples

Results: ^{226}Ra and ^{228}Ra in water

- 1.25 g MnO2 resin cartridges
- 1.5 L samples spiked with ^{133}Ba
- pH = 6-7
- Flow rate ~20 mL/min

Procedure

- Load of sample on MnO_2
- Strip MnO_2 with 15 mL 4 M HCl-1.5% H_2O_2
- Load 15 mL strip solution from MnO_2 resin on TRU (1 mL)-DGA, Normal (2 mL) stacked
  - TRU (U, Th removal), DGA (^{228}Ac retention)
  - Collect load + 5 mL 4 M HCl rinse for ^{226}Ra
  - Discard TRU resin
  - Strip ^{228}Ac from DGA with 10 mL 0.5 M HCl
  - Micro-precipitate with CeF_3
- α-spectrometry

Summary

- Rapid and efficient method for Ra separation
- Applicable to a variety of water samples
- Use of large initial samples