

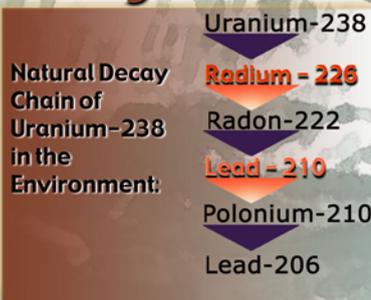
The Potential Use of Pb-210/Ra-226 Disequilibria for Age Determination of Mysticete Whales

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In this study, the disequilibria between Pb-210 and Ra-226 in the tympanic bullae of two mysticete whales, gray and bowhead, were investigated for use as a chronometer. Radiometric ageing depends upon accumulation of the naturally occurring radionuclide, Ra-226, (exclusive of other U-238 decay chain members) in the bullae and subsequent retention of decay product, Pb-210. Ages are determined from the ratio of Pb-210/Ra-226.

Theory:



Through Metabolism

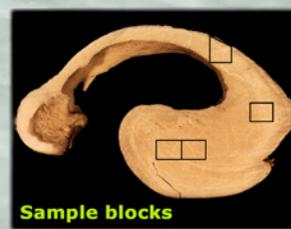
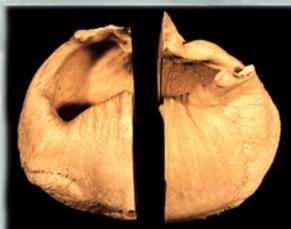
Radium-226 becomes part of the whale's bones

Through Radioactive Decay

Lead-210 increases in the whale's bones

- I. Radium-226 and its progeny, lead-210, found in the whale's tympanic bullae are measured.
- II. The activity ratio of progeny/parent (lead-210/radium-226) is used to estimate the whale age. The activity ratio may not be greater than one to estimate a radiometric age.

Samples:



Sample blocks

Samples are taken from the tympanic bullae by first cutting a transverse cross section approximately one cm. thick. Next, blocks about one cm² square are cut from the cross section. Chemical analysis of the blocks estimates the activity (amount) of Ra-226 and Pb-210 in disintegrations per minute per gram of bone. From this, the activity ratio of Pb-210/Ra-226 is calculated.

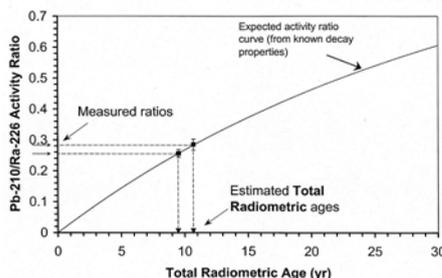
Results:

Successful Samples

Samples where activity ratio was < 1.0. Measured activity ratios are given with ± 1 SD. Total radiometric age includes time between collection and analysis with ± 1 SD. Whale age is given with ± 1 SD and is corrected for time between collection and analysis.

Sample Identification	Measured Pb-210/Ra-226 activity ratio (± 1σ)	Total radiometric age in years (± 1σ low, high)	Time between collection and analysis in years	Whale age in years (± 1σ low, high)
Gray whale, 8.7 m, Female	0.256 (0.013)	9.5 (8.9, 10.1)	3.8	5.7 (5.2, 6.3)
Gray whale, 10 m, Female	0.285 (0.018)	10.8 (9.9, 11.6)	4.0	6.8 (5.9, 7.8)

Estimation of Total Radiometric Ages



Unsuccessful Samples:

Samples where activity ratio was > 1.0. Measured activity ratios are given with ± 1 SD.

Sample Identification	Measured Pb-210/Ra-226 activity ratio (± 1σ)
Gray whale, 4.5 m, Female neonate	2.28 (0.16)
Bowhead whale, 17.4 m, Male	2.88 (0.11)
Bowhead whale, 12.9 m, Male	15.4 (1.4)

Conclusions:

- I. Further consideration of this age determination method for gray whales is suggested by the two samples that gave a reasonable estimation of age-at-length. Therefore, additional samples are planned for gray whales.
- II. The underlying necessary assumptions may not hold sufficiently true for a particular species or specimen, as suggested by the samples where the activity ratio of Pb-210/Ra-226 was greater than one.

