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# Highlights of Analytical Chemistry in Switzerland

## Division of Analytical Chemistry

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## Polonium – on the Trace of a Powerful Alpha Nuclide in the Environment

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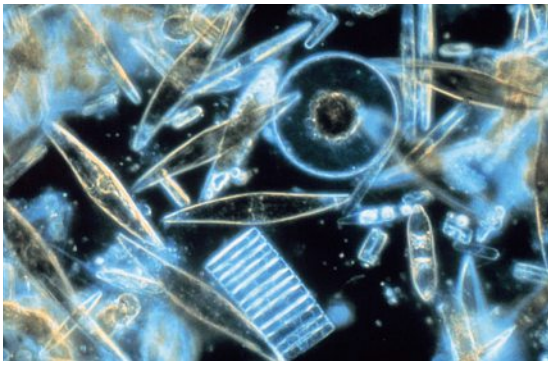
Polonium-210 ($^{210}$Po) belongs to the natural decay series of uranium-238. It is produced at the end of the decay series as a daughter nuclide of the β-emitter lead-210 ($^{210}$Pb). $^{210}$Po decays with a half-life of 140 days. Therefore chemical modifications and transport processes are possible. The main source of $^{210}$Po is the natural fallout of the decay of radon-222 in the atmosphere. The ingestion of dust particles causes 8–10% of the natural internal radiation dose of man. $^{210}$Po can accumulate especially in seafood.

Polonium is a very toxic metal. Irène Joliot-Curie died in 1957 of leukemia probably caused by the inhalation of polonium dust from a broken vial in 1946. A well-known case is the death of the ex-Soviet agent Alexander Litwinenko. He died in London weeks after drinking poisoned tea.

$^{210}$Po is a strong alpha emitter with an energy of 5'400 keV and has only one weak gamma ray emission at 803 keV (0.005% emission probability). Therefore the analytical method of choice is alpha spectrometry. The first two steps in every alpha spectrometry are the destruction of the matrix and the selective enrichment of the analyte. Above temperatures of 250 °C polonium is lost by evaporation. Therefore the methods of choice are wet ashing or microwave digestion. The final sample solution is set to a reducing milieu by the addition of hydroxylamine hydrochloride. The polonium is deposited onto a silver disc, which is then analyzed with alpha spectrometry.


Commercially available healing earth.



Diatoms (@ public domain).

Sediments containing the residues of diatoms are known as siliceous earths, also called diatomaceous earths or mountain flours. They find a wide spread use in industry, in cosmetics and in supplementary diet (healing earths). Our investigations of healing earths with gamma ray detection showed remarkable amounts of nuclides of the radioactive series of $^{238}$U and $^{232}$Th. In one sample we measured 400 Bq/kg of $^{210}$Pb, the precursor of $^{210}$Po. Our focus then switched to $^{210}$Po. Its activity was 42 Bq/kg, so the two nuclides were not in equilibrium. Probably most of the $^{210}$Po was lost during a heating step during the production process. **The yearly intake of two kg of this healing earth would result in a dose of 500 μSv, half of the annual permitted dose for non-professionals in Switzerland. $^{210}$Po activity only causes 10 μSv.**

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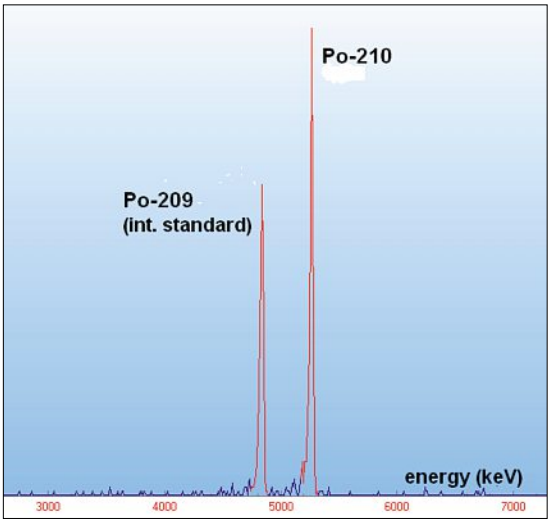
**Reference**

M. Yamamoto, T. Abe, J. Kuwabara, K. Komura, K. Ueno, *et al.*, *J. Radioanal. Nucl. Chem.* **1994**, *178*, 81.




Alpha spectrum of a healing earth extract. For quantification control $^{209}$Po was added (70 mBq). $^{209}$Po has an alpha energy of 4'800 keV. The sample was counted for 24 h in an alpha vacuum chamber (silicon barrier detector).

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