Title

CARRIER-FREE RADIOISOTOPES FROM CYCLOTRON TARGETS XIV. PREPARATION AND ISOLATION OF Bi204,206 FROM LEAD

Authors

Gile, J.D.
Garrison, W.M.
Hamilton, J.G.

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Jeanne D. Gile, Warren M. Garrison and Joseph G. Hamilton

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Berkeley, California

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CARRIER-FREE RADIOISOTOPES FROM CYCLOTRON TARGETS XIV. PREPARATION AND ISOLATION OF $Bi^{204,206}$ FROM LEAD*

Jeanne D. Gile, Warren M. Garrison and Joseph G. Hamilton
November 21, 1950
Crocker Laboratory, Radiation Laboratory, and Divisions of Medical Physics, Experimental Medicine, and Radiology; University of California, Berkeley and San Francisco, California.

The present paper reports a carrier-free procedure used in isolating radiobismuth from a lead target which had been bombarded with 19 Mev deuterons in the 60-inch cyclotron at Crocker Laboratory. Deuteron bombardment of lead produces $Bi^{204,206}$ by the nuclear reactions[1,2]: $Pb^{204}(d,2n)Bi^{204}$, $Pb^{206}(d,2n)Bi^{206}$. Other possible concurrent reactions include; formation of radio-lead isotopes by (d,p) reaction, radioisotopes of Tl by (n,p) reaction, and radioisotopes of Hg by (n,α) reaction. The short-lived thallium activities, $Tl^{206,207,208}$, had decayed out prior to the chemical separation reported here. The long-lived Tl^{204} and Hg^{203} were not detected. The target was spectrographically-pure[3] lead foil (1/8 inch thick) clamped to a water-cooled aluminum target plate. It was bombarded with 19 Mev deuterons for a total of 20 μa-hr at a maximum beam intensity of 5 μa. Higher bombardment intensities would have melted the target. After bombardment, the foil (approximately 1 gm) was dissolved in a minimum volume of 16N nitric acid and the resultant solution was evaporated to dryness. The lead nitrate containing the carrier-free $Bi^{204,206}$ was dissolved in excess 10 percent sodium hydroxide to give a clear "solution" of sodium plumbate and radiocolloidal[4] $Bi^{204,206}$. This solution, after dilution with an equal volume of water, was drawn through two consecutive Whatman No. 50 filter papers which retained over 98 percent of the

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*This document is based on work performed under Contract No. W-7405-eng-48-A for the Atomic Energy Commission.

[1] G. T. Seaborg and I. Perlman, Rev. Mod. Phys., 20, 185 (1948)

[2] D. H. Templeton, J. J. Howland and I. Perlman, Phys. Rev., 72, 766 (1947)

[3] Bismuth was not detected by spectrographic analysis.

[4] O. Hahn, Applied Radiochemistry, Cornell University Press, Ithaca, New York, 1936.

carrier-free $Bi^{204,206}$ as absorbed radiocolloid. The filters were washed with 5 percent sodium hydroxide until lead could not be detected in the filtrate, followed by distilled water to remove sodium hydroxide. Less than one percent of bismuth activity was removed from the filter paper during the washing. The $Bi^{204,206}$ was removed from the filter paper with a minimum amount of 6N hydrochloric acid which, after a reduction in volume by evaporation, was neutralized with sodium hydroxide to give an isotonic saline solution for biological investigation.

The decay curve was followed for 30 days and showed two periods: 12-hour Bi^{204} and 6.4-day Bi^{206}. Forty hours after bombardment, the activity contained only 6.4-day Bi^{206}. The lead absorption curve showed the 1.1 Mev gamma ray and the softer component (approximately 0.4 Mev) previously reported[2]. The aluminum absorption curve had an end-point of approximately 300 mg, a somewhat lower value than that given in reference (2). The activity was further identified by chemical separation using bismuth, lead, thallium and mercury carriers. Over 99 percent of the added tracer activity was recovered in the bismuth fraction.

We are grateful to Professor G. T. Seaborg for helpful suggestions and Mr. T. Putnam, Mr. G. B. Rossi and the crew of the 60-inch cyclotron for bombardments.