THE ACTIVATION ANALYSIS OF GOLD IN SMALL REFRACTORY PEBBLES

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THIS CONTRIBUTION IS AN EXTENDED ABSTRACT OF A PAPER PRESENTED AT THE 4TH SYMPOSIUM ON THE RECENT DEVELOPMENTS IN NEUTRON ACTIVATION ANALYSIS, HELD AT CHURCHILL COLLEGE CAMBRIDGE, 4-7 AUGUST 1975

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1. SYNOPSIS

The gold content of a suite of small pebbles, residual to the milling and leach of a gold bearing ore, has been investigated by means of neutron activation analysis (NAA).

An NAA technique presenting a sensitivity of 0.02 µgm gold, was used as being appropriate to the samples under investigation. An alternative NAA technique developed with the same sample suite showed a sensitivity of the order of 10^{-4} to 10^{-5} µgm gold.

The NAA techniques developed, are appropriate to the determination of gold in small samples of ore not normally amenable to milling and/or dissolution.

2. LIST OF CONTENTS.

3. INTRODUCTION.

Instrumental Neutron Activation Analysis has proved an extremely sensitive method for the determination of gold [1,2,3,4] and is an excellent method for the assay of trace levels of gold in small samples.

The Chamber of Mines Research Laboratory (CMRL), provided the Activation Analysis Research Group (AARG) with a suite of twelve samples of small pebbles residual to the milling and leach of a normal gold mine ore process. The gold bearing pebbles supplied, varied in weight from a fraction of a mg to a few hundred mg each.

4. EXPERIMENTAL METHODS.

Two preliminary experiments were undertaken, in order to determine the appropriate parameters for the assay of the CMRL ore pebbles.

4.1. Trial in 'Poolside' Irradiation Facility

Three samples of assorted pebbles were sealed into quartz vials and irradiated in cadmium cans for 24 hours in the poolside rack of the SAFARI reactor at the Atomic Energy Board Research Station at Pelindaba. At periods ranging from three to six days post irradiation, the samples were radiometrically analysed with a Ge(Li) detector. A sensitivity of 10^{-10} to 10^{-11} gm gold was determined after a decay time of six days.

4.2 Trial in 'Pneumatic' Irradiation Facility.

Five samples of assorted pebbles were packed into polyethylene containers and irradiated for ten minutes in the pneumatic facility of SAFARI. Radiometric analyses four days post irradiation, showed a sensitivity of about 10^{-6} gm. gold.

4.3 Comment on Trial Experiments.

The irradiation at the SAFARI pneumatic station gave quite adequate sensitivity for the analysis required on the CMRL pebbles. Since the pneumatic method involved a much easier handling technique than the pool irradiations, the main pebble investigation was undertaken taken using the pneumatic irradiation system only.

4.4. The Main Experiment.

The main experiment was carried out as follows, the suite of twelve samples was analysed in duplicate, one analysis being on a single pebble where possible and the other being on a number of pebbles. The duplicate procedure was undertaken in order to obtain some idea of sample homogeneity. The standards used for the irradiations were prepared from a 0.2 mg per ml solution of gold in aqua regia.

The samples and standards were packed in the polyethylene irradiation rabbits used with the SAFARI pneumatic irradiation facility, six to a rabbit, and irradiated for ten minutes. After the irradiation the samples activity was allowed to decay for four days. This decay interval was sufficient for the main interference isotope, arsenic-76, $t_{\frac{1}{2}}$ = 1.1 days, to decay and improve the visibility of the

gold-198, $t_{\frac{1}{2}}$=2.7 days radioisotope emissions used for the gold assay. The samples and standards were counted on a Ge(Li) detector for between 50 and 1000 seconds dependent on the activity of the gold radioisotope.

5. EXPERIMENTAL RESULTS.

The calibration graph obtained with the standards is shown in Appendix 1 and the gold assays determined are shown in Appendix 2.

6, CONCLUSIONS.

6.1 The methods used in the PEGAN project proved adequate for the assays of the levels of gold found in the small refractory samples provided by the Chamber of Mines Research Laboratory.

6.2 The gold is dispersed most inhomogenously in the majority of the samples tested.

6.3 A modification of the neutron activation method would assay to much lower gold values or could be used with even smaller samples.

6.4 The major problem in dealing with small samples for gold assay, lies in determining accurate weights at the submilligram levels.

7. ACKNOWLEDGEMENTS.

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(4) Neutron-Activation Analysis of Routine Mineral-Processing Samples. NIM Report No. 1670, 30th August 1974.

Appendix 2.

PEGAN Gold Assay Results

Sample (description)	Gold Assay ~ ppm	Number of Pebbles
83+18, (round)	35 ± 5 60 ± 5	1 10
84, (round)	7 ± 2 7 ± 2	1 10
97/8, (round)	3 ± 1 0.4 ± 0.1	1 10
100, (clean crystal)	3.5 ± 1 4 ± 1	1 10
127, (radial)	5.5 ± 0.5 26 ± 3	1 10
127, (mud marks)	11 ± 2 920 ± 30	1 10
127, (smooth faction)	3.5 ± 0.5 13 ± 2	1 10
133, (round)	21 ± 2 10 ± 2	1 10
134, (round)	6.0 ± 1 5.5 ± 1	1 10
175(1), (round)	14 ± 2 14 ± 2	1 20
175(2), (thin crystal)	11 ± 2 100 ± 10	5 30
175(3), (crystal)	110 ± 10 360 ± 5	1 10

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