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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

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REPORT ON LABORATORY TESTS OF MOLYBDENITE SAMPLES

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INTRODUCTION

In the course of the Bureau's investigations in the search for uranium, the presence of radioactivity has been noted in molybdenite samples from several Australian deposits. Samples of radioactive material carrying molybdenite were collected from several sources (see Plate 1) and a programme of preliminary testing on the samples was carried out in the geophysical laboratory.

The information so far obtained is by no means complete. The results indicate the need for improvement in some of the techniques used, and the desirability of further tests using improved equipment. Owing to shortage of staff, the research work associated with these improvements cannot be put in hand at present.

It is considered, however, that the results so far obtained will be of assistance in estimating the possibilities of molybdenite deposits as sources of uranium.

TECHNICAL DETAILS.

The following samples were examined:-

Sample No. 1. Sample W1 from Whipstick mines, submitted by Department of Mines, Sydney.

Sample No. 2. Sample W2 from Whipstick mines, submitted by Department of Mines, Sydney.

Sample No. 3. Small sample showing molybdenite collected from the dump of the Attunga copper mine.

Sample No. 4. Ore from Kingsgate.

Sample No. 5. Wall rock from Kingsgate.

Sample No. 6. Material from dumps at Baker's Creek mine.

Sample No. 7. Material from dumps at Glen Eden mine.

Sample No. 8. Material from dumps at Allies mine.

Sample No. 9. Material from various dumps at Wunglebung.

Of these samples, Nos. 1 and 2 are the only ones with geological significance, and Nos. 1, 2 and 4 the only ones representative of material which could be classed as ore. Sample No. 3 was collected during a brief visit to the copper mine at Attunga. It was learned subsequently that the molybdenite occurrence at Attunga is situated in extremely rough country some miles from the copper mine, so that this sample cannot be considered in any way representative of Attunga molybdenite. Samples 6, 7 and 8 were included as typical of mines showing no evidence of radioactivity when tested with a portable Geiger counter.

The samples were crushed, and assayed radiometrically. A molybdenite concentrate was then prepared by C.S.I.R.O. from portion of each, and concentrate and tail

were assayed radiometrically and fluorimetrically. The tails consisted mainly of silica, and were insoluble in ordinary acids. In order to prepare them for fluorimetric assay, they were fused with sodium peroxide, and then taken up with acid. To preserve uniformity of treatment, the same process was applied to the concentrates. The effect of this on the results is discussed below.

RESULTS

Results as recorded are shown in the following table.

Sample No.	Amount of Concentrate (per cent)	Equivalent U_3O_8 by Radiometric Assay. (per cent)	U_3O_8 by Fluorimetric Assay. (per cent)
1. Bulk		.029	
Concentrate	9.4	.015	.012
Tail		.028	.017
2. Bulk		.033	
Concentrate	25.1	.049	.019
Tail		.026	.019
3. Bulk		.005	
Concentrate	12.3	.010	.0056
Tail		.004	.0019
4. Bulk		.048	
Concentrate	52.3	.033	.013
Tail		.046	.019
5. Bulk		.001	
Concentrate	7.9	.008	.0011
Tail		.004	.001
6. Bulk		Nil	
Concentrate	19.9	.001	.0001
Tail		Nil	.0003
7. Bulk		Nil	
Concentrate	16.0	.0005	.0005
Tail		Nil	.0002
8. Bulk		.0015	
Concentrate	43.8	.0015	.0009
Tail		.002	.0011
9. Bulk		.010	
Concentrate	24.5	.011	.0051
Tail		.010	.0032

The second column shows the percentage of concentrate by weight, and may be taken as a measure of the molybdenite content of the bulk sample.

In each case, absorption tests were performed as part of the radiometric assay, and results were consistent with most or all radioactivity being due to uranium. However, due to the very low activity observed in samples 5, 6, 7 and 8, absorption tests on these samples have very little significance.

DISCUSSION OF RESULTS.

This was the first systematic investigation of a set of samples undertaken in the geophysical laboratory, and the results have proved useful mainly as indicating the need for improvements in technique.

The accuracy of the radiometric assay results may be affected by the following causes:-

(1) Errors in sampling.

(2) Statistical errors, which may be reduced to any required limit by counting for a long enough period.

(3) Possible disturbances of radioactive equilibrium. This is inherent in any radiometric assay. However, the effect particularly referred to here is the possibility of radioactive equilibrium being disturbed by the flotation process for the concentration of the molybdenite.

It is evident from the discrepancies in the results of radiometric assay of the various fractions that the errors mentioned under (1) and (2) have affected the results, so that the third decimal place in the results shown is unreliable. This error could be reduced by a longer counting period, and by several repetitions of the sampling. The possibility of errors due to (3) has not been directly checked. Checking could be performed using alpha counting and a gamma ray spectrometer, but it has not yet been possible to put such equipment into operation. The general nature of the results suggests that the effect is not serious.

The fluorimeter technique used by the Bureau has been based on overseas practice as detailed in various publications.

Some difficulty has been found, however, in reconciling the information given by various authorities consulted, and much experimental work has been necessary to establish a suitable procedure. A detailed report on the Bureau's experience in fluorimetric assay work is being prepared. Briefly, the process involves taking the sample into solution in nitric acid and extracting the uranium with ethyl acetate to avoid possible quenching of the fluorescence by other metals in the solution. If the material is insoluble in acids it must be decomposed by a more severe chemical treatment before solution. As stated above, the process used in the present instance was to fuse the samples with sodium peroxide.

The accuracy of the fluorimeter assays has been

affected by the following factors:-

(1) It was discovered during the course of the tests that the preliminary fusion with sodium peroxide seriously affected the efficiency of the extraction process. Several check tests were made using the same process on samples of known uranium content, and errors of the order of 50 per cent were observed.

(2) The fluorescence of the concentrate samples may have been affected by quenching. The extraction process has been thoroughly tested, and found reliable in extracting uranium from samples containing quenching elements in amounts normally encountered in minerals. It is considered, however, that the extraction of very small amounts of uranium from samples consisting almost entirely of molybdenite imposes a very severe demand on the process. Techniques for checking this have been developed, but have not been used in the present instance.

(3) The behaviour of the solutions was somewhat irregular, in that unexpected colour changes occurred at various stages. It is considered that these may have been due to the presence of traces of the flotation reagents. The possible effect of such impurities on the fluorescence has not been checked.

For the above reasons, it is considered that all fluorimeter results are minimum figures, and are certainly too low by considerable amounts, which may be of the order of 50 per cent.

CONCLUSIONS.

It is obviously desirable that the tests be repeated, making use of later improved methods, and certain special equipment which is at present being constructed. It would also be desirable to have better samples in some cases, and to include material from other sources, notably Wolfram Camp. It is considered, however, that the following conclusions may be drawn at the present stage.

(1) The activity of the samples is due essentially to uranium. The radiometric assay results on bulk samples represent figures for actual U_3O_8 content, accurate to two decimal places.

(2) The uranium appears to be associated with the molybdenite, to the extent that, from any one locality, the samples containing most molybdenite are the most radioactive.

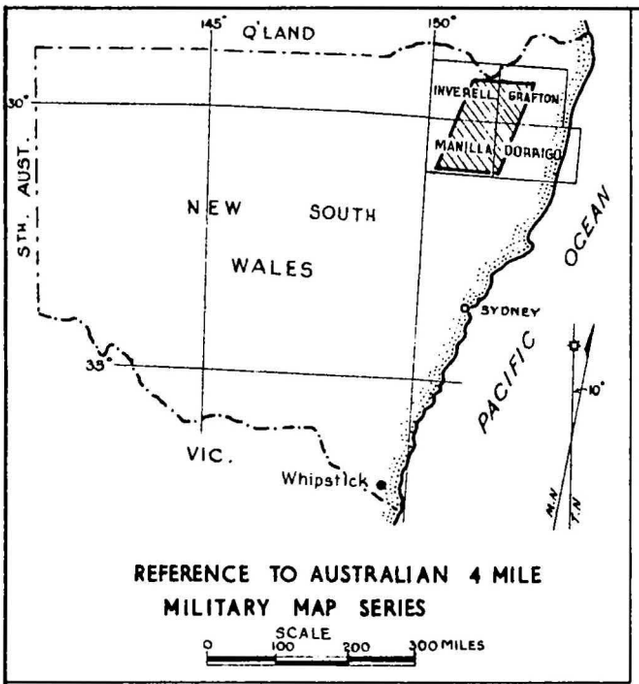
(3) The flotation process for concentrating molybdenite does not concentrate the uranium efficiently.

(4) Considering the uranium content of bulk sample and the percentage of molybdenite, it appears that molybdenite from Whipstick is richer in uranium than that from Kingsgate and Wunglebung.

ACKNOWLEDGMENTS.

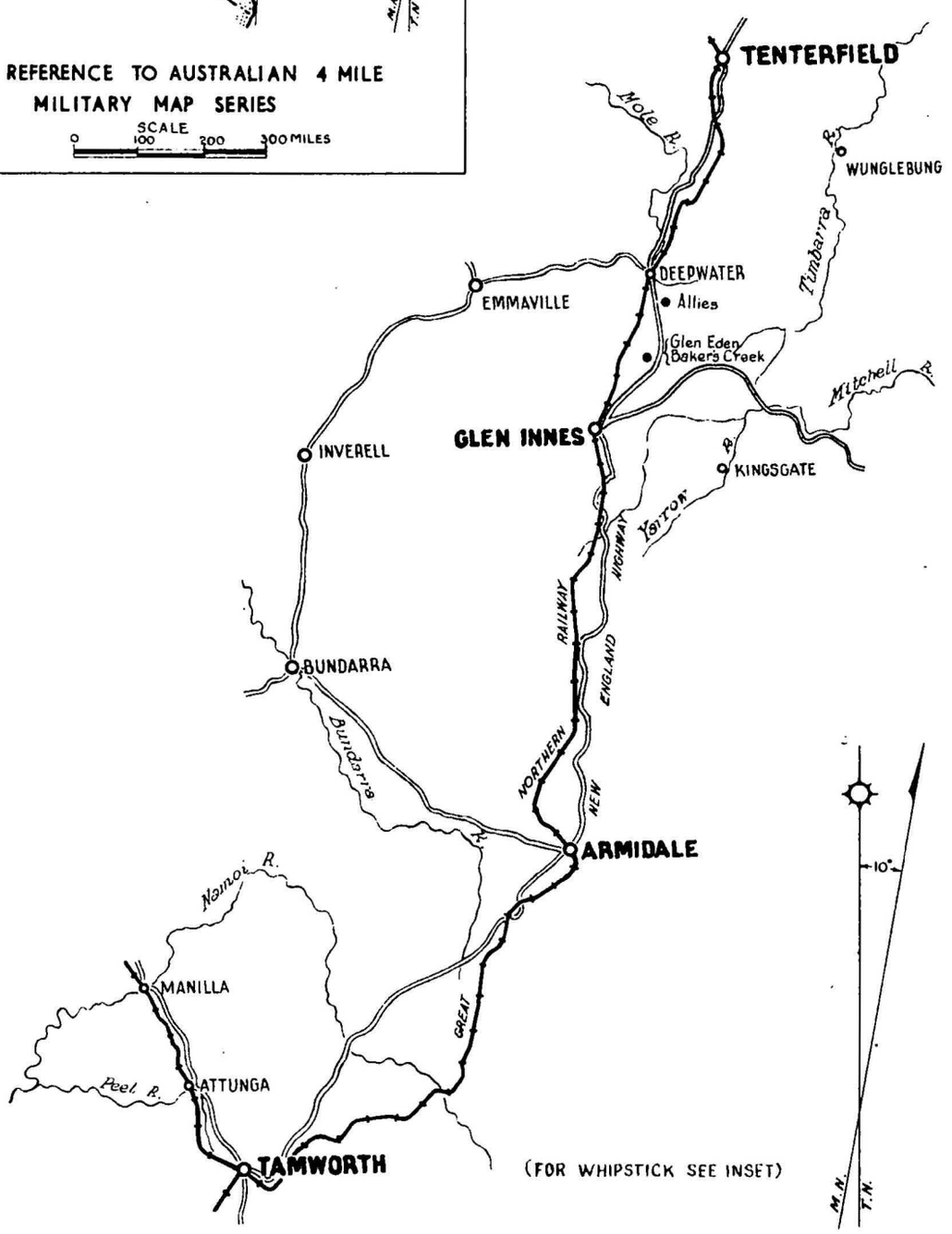
It is desired to acknowledge the assistance of Mr. Blaskett, of the C.S.I.R.O. Ore Dressing Laboratory, at the University of Melbourne, who prepared the molybdenite concentrates.

PLATE I



REFERENCE TO AUSTRALIAN 4 MILE MILITARY MAP SERIES

SCALE 0 100 200 300 MILES



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LOCALITY MAP

SCALE IN MILES

10 0 10 20 30 40 50