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DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY

GEOPHYSICAL SECTION

SEISMIC REFRACTION TESTS
WILLIAMSTOWN AREA

by

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Geophysicist.

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SEISMIC REFRACTION TESTS

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SUMMARY

Two seismic refraction tests were carried out near Williamstown to determine whether the method could be used to trace buried river channels in the search for deep lead gold deposits.

The bedrock surface could not be detected as the velocity of the alluvium is greater than that of the surface velocity of the bedrock. However, higher velocity layers were detected in the weathered bedrock whose surface configurations might reflect those of the bedrock surface above.

In view of the poor velocity contrasts it was decided not to use the refraction method.

INTRODUCTION

Seismic refraction tests were carried out in the Williamstown area during December 1962 by the Exploration Geophysics Section at the suggestion of Australian Development N.L. to determine whether the method could be used to trace buried river channels in the search for deep lead gold deposits.

Two sites were selected about 3 miles west of Williamstown by the side of the road running along the ridge between the Barossa Reservoir and the South Para River. This ridge runs approximately N.W. - S.E. with the old Barossa alluvial gold field lying at the northern end. (See Plate)

GEOLOGY

The above-mentioned ridge is capped by a remnant of Tertiary alluvium (See Plate) overlying a bedrock of Archean schists and gneisses striking slightly east of north and having an average dip of approximately 65°E.

During the Tertiary the drainage appears to have been to the north and may have been controlled by the strike of the bedrock. The alluvial gold of the old Barossa field probably came from quartz reefs to the south and it was thought that other remnants of buried channels containing payable gold might be found along the ridge.

FIELD METHODS AND RESULTS

The recording equipment used was a twelve channel S.I.E. P 19 portable seismograph with bi-level recording.

At Site A (See Plate) an attempt was made to use a sledge hammer for the source of energy. A spread with a 5 ft. geophone spacing was laid out along the side of the road and a metal plate struck with the hammer at distances of 5 ft., 55 ft., and 110 ft. from both ends of the spread. This indicated a surface layer approximately 2.5 ft. thick with a horizontal velocity of 955 ft./sec. overlying a layer with a horizontal velocity of 3860 ft./sec. The first arrivals of energy were too poor to be detected beyond a distance of 110 ft. A second spread with a 10 ft. geophone spacing and with the plate hammered at a distance of 110 ft. from each end of the spread indicated a deeper layer with a horizontal velocity of 9230 ft./sec. from the troughs and peaks following the first arrivals of energy, but the velocity is unreliable. The results were poor but as a very rough approximation this layer might be dipping 13° N.W. and have an average depth of 40 ft. In view of the poor results it seemed that explosives were necessary to reach the bedrock.

At Site B two spreads with a 10 ft. geophone spacing were laid out along the side of the road and charges ranging from 3 - 24 ozs. of gelignite were fired at depths of 1-2 ft. and at distances of 200, 300, and 500 ft. from the ends of the spreads. A layer with a horizontal velocity of approximately 4370 ft./sec. was detected with a slightly higher velocity layer beneath. To determine the velocity of the material above the 4370 ft./sec. layer a spread with a 3 ft. geophone spacing was laid out with the sledge hammer used as a source of energy at distances of 3 ft. and 20 ft. from the ends of the spread. This indicated a single horizontal velocity of 3120 ft./sec. It was hoped that the depth to the 4370 ft./sec. layer could be calculated beneath each geophone using a reciprocal method, but it became apparent that the measured reciprocal times came from energy travelling through a deeper layer of higher velocity and could not be used. Also the reciprocal times could not be calculated from the combined travel times of only two spreads. An average depth of 85 ft. was calculated for the two spreads. This indicated an offset distance of approximately 70 ft. which was too great to show the surface configuration of the 4370 ft./sec. layer with only two spreads.

INITIAL CONCLUSIONS

The horizontal velocities of 9230 ft./sec. at Site A and 4370 ft./sec. at Site B possibly indicate weathered Archean bedrock which is overlain by Tertiary alluvium having horizontal velocities of 3860 ft./sec. and 3120 ft./sec. respectively. Although it might have been possible to obtain a reasonable picture of the bedrock configuration from continuous profiling it was decided not to use the method because of the poor velocity contrasts and the resulting large offset distances.

The tests showed that a sledge hammer could be used as a source of energy to provide a rapid method of obtaining near surface information even though it failed to detect the deeper layers. They also revealed the possibility of error in the reciprocal methods of depth determination when a recorded reciprocal time is used, as the energy may be travelling through a deeper layer of higher velocity due to the greater shot to geophone distance. The reciprocal time can be calculated from the travel times in continuous profiling without the inconvenience of requiring an extra geophone and recording channel.

SUBSEQUENT DRILLING

Following this seismic work, Australian Development drilled a line of holes along the ridge. These indicated the bedrock to be far more weathered than anticipated and closer to the surface than indicated by the seismic results.

VELOCITY TEST

In view of the drilling results a seismic velocity test was made on weathered bedrock dipping approximately 80°E and exposed in a small cut along the side of the road about 800 ft. west of Site B. A spread with a 3 ft. geophone spacing was laid out across the strike and a sledge hammer was used as a source of energy at distances of 3 ft. and 30 ft. from the ends of the spread. This indicated a surface horizontal velocity of 2390 ft./sec. Such a low surface velocity could also be expected at Sites A and B and is probably due to weathering, the steep dip, and the traverse running across the strike.

FINAL CONCLUSIONS

The velocities of 3860 ft./sec. and 3120 ft./sec. at Sites A and B are thought to come from alluvium which overlies weathered bedrock of lower surface velocity giving a velocity inversion and making the calculated depths to the 9230 ft./sec. and 4370 ft./sec. layers too great. These layers are considered to be in weathered bedrock which increases in velocity with depth, and it is possible that their surface configuration could reflect that of the overlying bedrock surface providing an indirect method of locating the buried channels.

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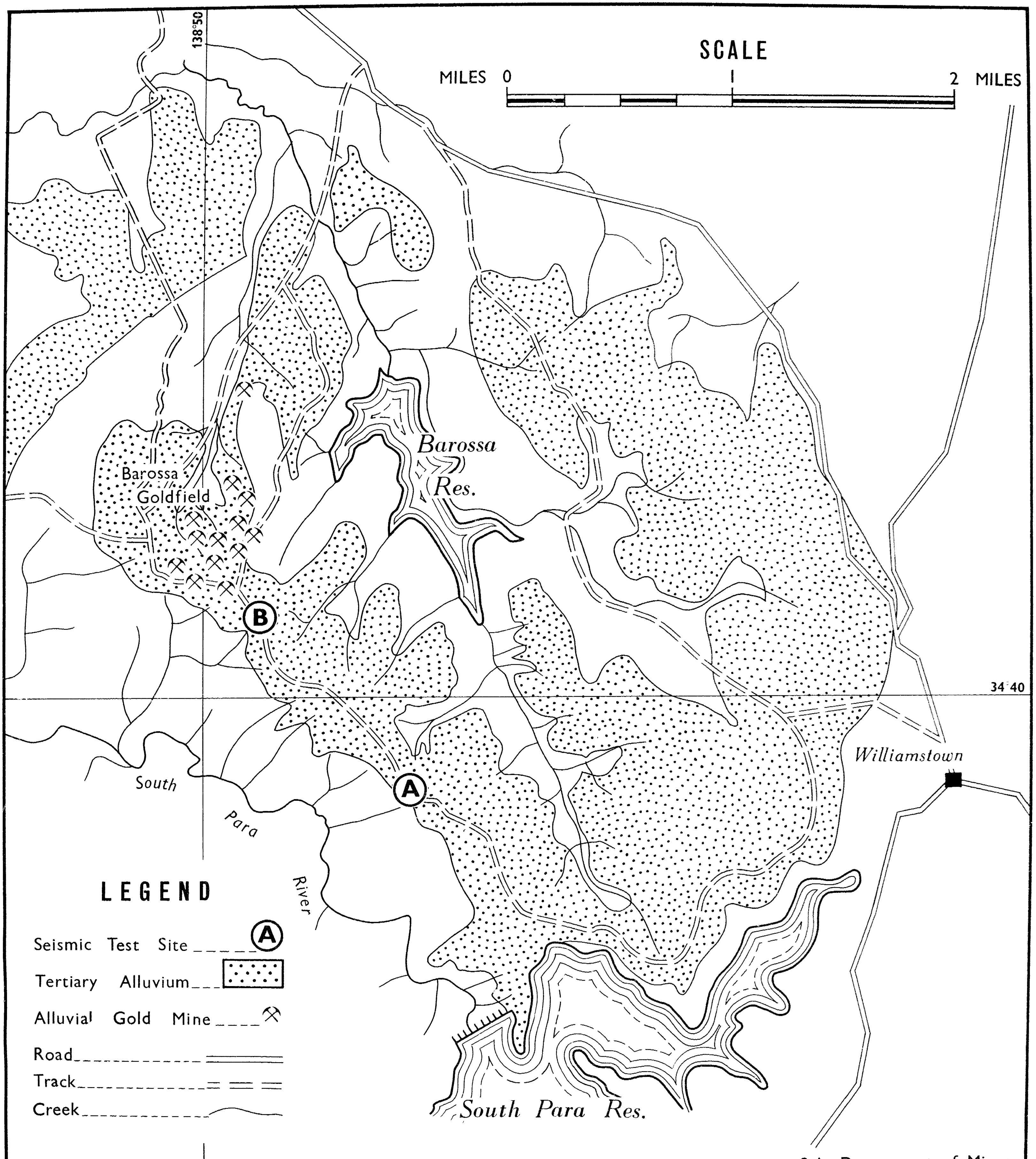

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