COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

RECORDS.

1956/27

RADIOACTIVE PROSPECTS IN NEW SOUTH WALES

by

L. C. Noakes

RADIOACTIVE PROSPECTS IN NEW SOUTH WALES

L. C. Noakes

Record No. 1956/27

Table of Contents.

SUMMARY

The principal radioactive deposits in the New England, Broken Hill, Condobolin and Carcoar districts in N.S.W. were inspected in company with officers of the Geological Survey of N.S.W.

Prospects in the New England district are typical of those found with pegmatitic tin and wolfram deposits in or near granite and show no promise.

Prospects known at Broken Hill show no immediate promise although veinlets containing davidite at the surface could make into more promising deposits at depth.

The Condobolin Prospect warrants more investigation although there is no uranium ore in sight and only very high-grade ore could be marketed from a small deposit in this area.

The environment of the Carcoar deposit is promising although the known prospects are not. Radioactive prospecting by testing stream waters should be carried out to search for additional uranium prospects to the north and south of Carcoar.

INTRODUCTION

Inspection of radioactive prospects in N.S.W., to further the Bureau's knowledge of uranium deposits, was arranged with the Geological Survey of N.S.W. and the writer accompanied survey officers on their inspection tours between 14th September and 7th October, 1955.

The principal radioactive deposits in the New England district were inspected with Mr. A. C. Lloyd and occurrences at Broken Hill, Condobolin and Carcoar were examined with Mr. E. O. Rayner Much interesting and useful information was gathered from these inspections and the writer is indebted to the N.S.W. Geological officers for the trouble taken to make the tour as interesting and instructive as possible. Geological notes or reports were available in the field for most of the deposits visited and all information was kindly made available. The purpose of this report is to make available to Bureau officers this information gathered in N.S.W.

The principal radioactive prospects in N.S.W. are grouped in the New England district - in the triangle between Armidale, Inverell and Tenterfield - and in the Broken Hill District. Isolated prospects are situated near Condobolin in central N.S.W. and at Carcoar in the Bathurst district.

The geological environment of each group of deposits is different. New England prospects are typical of the pegmatitic tin and wolfram deposits in or near granite - an environment in which significant uranium ore deposits have not yet been found. The Archaeozoic metamorphic rocks at Broken Hill provide a number of environments, some of which provide commercial ore elsewhere. The occurrence near Condobolin is in granite, but in a definite lode in a late fracture or shear which holds more promise than the typical pegmatitic tin deposits.

Uranium at Carcoar accompanies copper and cobalt in shears near granite and this environment seems to offer definite promise of epigenetic concentration although those known at Carcoar are apparently too small to be significant.

RADIOACTIVE PROSPECTS IN NEW ENGLAND.

EMMAVILLE DISTRICT.

Principal radioactive prospects in the Emmaville

District are situated in am area called the Gulf, about 20 miles along a rough track north-west of Emmaville township.

In this area the rocks consist of the tin granite - a biotite granite, porphyritic in feldspar, quartz and biotite- and the north-eastern portion of a pendent of metamorphosed sediments of Permian age. The Gulf contains a number of tin and wolfram deposits. In general, tin deposits are found in the granite, and wolfram deposits favour the metamorphic contact aurole.

Radioactive minerals have been found in both tin and wolfram deposits although they are apparently more commonly associated with the tin lodes. Radioactivity appears to accompany pegmatitic mineral assemblages associated with the tin and wolfram mineralisation, with no intimate association with the tin and wolfram minerals themselves. The tin granite is noticeably radioactive and gives counts from two to five times the background of sediments of the pendent.

Considerable search for radioactive minerals has been carried out in the Gulf but there is no evidence to suggest that any commercial ore exists.

Deposits visited were: Highland Home Lease, Heisers Lode and Garth's Lode.

Highland Home Lease

Radioactivity occurs in hornfelsic sediments of the pendent close to the margin of the tin granite. Two small dykes of granite and small quartz veins occur within the hornfels. Radioactivity up to 7 times background was observed at several spots, most of which showed no outcrop, and where a soil section has been exposed activity in the soil mantle decreased notably in the first 6 to 12 inches in depth.

A shaft had been sunk to about 30 feet following down a steeply dipping quartz vein, 12 inches to 18 inches wide, but radioactivity was found at depth. No radioactive minerals have been discovered and the most likely source of the present high counts in surface soil and rubble is the presence of radon near the surface derived from unknown granitic sources. The occurrence is of mineralogical interest only.

Heiser's Lode

Heiser's Lode consists of siliceous tin-bearing ore filling a fracture in the granite. It was mined many years ago for tin and is of some interest because it yielded the first specks of torbernite identified in the New England area.

A uranium mineral was reported by Card in 1910 from this area but the recent discovery was by M. J. Lawrence of the University of Technology, Sydney, who was collecting samples of tin ore in the district. The subsequent publicity and reward initiated wide-spread prospecting in which many other radioactive occurrences were found in the tin districts of New England. The level of radioactivity in Heiser's Lode is no greater than that in the surrounding tin granite and the occurrence is purely of mineralogical and historical interest.

Garth's Lode.

Garth's Lode is another pegmatitic fracture-filling which has been traced for some 800 feet along or close to the contact of the main tin granite with a fine-grained granitic phase. The lode, consisting of quartz and pegmatitic material, is up to 3 feet in width and has been mined for tin to a depth of 40 feet in places. Lenses or bunches of black biotite associated with felspar and a variety of pegmatitic minerals are

miles north-east of Torrington.

prominent and give noticably high counts. The biotite shows many zircon inclusions and is associated with some monazite. Field assay of black biotite gave .02 to .04%eU$_3$O$_8$ and the activity is probably due to thorium.

Tin, wolfram, molybdenite, stilbite, purple and green fluorite and barite comprise the pegmatitic assembly and some copper pyrites and arsenopyrite have been found. Specks and flakes of torbernite are found in places and one picked specimen assayed .2%eU$_3$O$_8$. Radioactivity along the line of lode. is commonly about 2½ times that of the surrounding tin granite Apart from monazite, no primary radioactive mineral has been identified.

Radioactivity in the old tin workings was found by the Geological Survey of N.S.W. and subsequently explored by a company- Uranium Prospecting and Development - who cleared out old workings and sank six drill holes to hit the lode at about 150 feet. No radioactive ore was discovered but widths of up to 3 feet of 2% tin ore was reported. However, more attractive tin prospects are known in the district and further development is not expected.

As a matter of interest, Uranium Holdings sank a shaft to 80 feet on a siliceous fracture-filling in granite in the vicinity of Garths Lode because flakes of torbernite were seen on the surface but found nothing of interest.

TORRINGTON DISTRICT.

Another group of radioactive occurrences is situated in the Torrington District, about 18 miles north-east of Emmaville, mainly in the pendent of sediments close to the tin granite. Occurrences were inspected at Bollinger's Lode, at a lease under option to Torrington Uranium and at Fielder's Hill.

Bollinger's Lode.

Bollinger's Lode, 4 miles north-east of Torrington consists of a number of lensing quartz veins with maximum widths of about 3 feet which occur within a fine-grained phase of the tin granite similar to that seen at Garth's Lode. As at Garth's Lode, these veins contain masses of black biotite with which some monazite is associated.

Beryl occurs in pockets or "bungs" within the veins but mainly within the main lenses. The veins were mined for wolfram early in this century and some attempt has been made to produce beryl.

Gummite was found on the dumps and the veins show up to 4½ times the background of the tin granite. This activity is almost certainly due to both thorium and the presence of secondary uranium minerals.

The veins have been developed by a shaft to 50 feet and two cross-cuts which were flooded at the time of the inspection. Radioactive prospects at the lodes was investigated by a company - Red Terror - who deepened the shaft and explored the deposits by four drill holes which intersected 6 veins to a maximum depth of 150 feet below the surface with no indication of radioactive ore.

Some of the small lenses containing beryl, in pockets the size of a fist, would assay about 5%BeO and this ore could be beneficiated to produce the minimum saleable ore of 10% BeO for which about £15 a unit would be paid, but the quantity of the concentrates available would scarcely exceed 10 tons. Billingers Lode is not a radioactive deposit.

Torrington Uranium.

Torrington Uranium are investigating a lease about 6 or 7 miles north-east of Torrington. The lease is situated in hornfels

close to the contact of the tin granite and the deposit consists of intrusive aplite and quartz-topaz rock which contains disseminated wolfram in places assaying about .5% WO3.

The Geological Survey of N.S.W. found specks of torbernite within this deposit but these are of little significance because similar traces of uranium have been found in all of the wolfram deposits in the district which have been carefully searched. The level of radioactivity at the deposit is slightly higher than that in the tin granite itself.

The deposit has been explored by costeans and a shaft to 50 feet and Torrington Uranium have installed a small treatment plant consisting of a stamp battery, Wilfley table and Vanner in an attempt to produce wolfram and uranium. There is no uranium in sight and since the gross value of the wolfram ore is likely to be about 80/- per ton the prospect for wolfram production is not very bright.

Fielder's Hill

Fielder's Hill is an interesting wolfram deposit, in hornfels close to the tin granite, situated about 10 miles north-west of Torrington. Here the hornfels of the pendent has been intruded by a sill-like body of quartz-topaz tock which carries disseminated wolfram and, in places, tracesof secondary uranium minerals.

The level of radioactivity within the quartz-topaz rock is about twice that found in the surrounding sediments and specks or torbernite are visible in places within the quartz-topaz rock itself. However, maximum activity was found at the edge of a small mass of rock containing quartz, felspar, biotite, and fluorite which appears to intrude the quartz-topaz rock as a pipe. The margins of this pipe are very weathered and give high connts. Minute specks of a yellow mineral could represent secondary uranium but this could not be confirmed.

There is no suggestion of commercial radioactive ore at the deposit but there seems to be possibilities for additional production of wolfram. The sub-horizontal sill of quartz-topaz rock intrudes the sediments towards the top of a hill and previous mining has been carried out by removing the 30 - 40 feet of sedimentary overburden and open-cutting the quartz-topaz rock in a deep pit, about 400 feet in diameter and about 200 feet deep which is now half filled with water.

Approximately 500,000 tons of ore with an average assay of .54%WO3 has been removed from this pit in the past. Stone remaining in the walls of the pit is reported to be of the same general grade, in which case large-scale working of the deposit could probably continue. The ground is held but no development is going on at present.

Radio-active occurrences in the Torrington and Emmaville Districts are therefore typical of those found with pegmatitic tin and wolfram deposits. No commercial ore is likely to result from these districts and the money spent in sinking shafts and drill holes to no result should caution prospectors against spending time and money chasing uranium in this environment.

OTHER RADIOACTIVE PROSPECTS

Apart from the major uranium occurrences in the Emmaville and Torrington Districts, Woodford's uranium prospect at Gilgai near Inverell was inspected and small lead mines at which some trace of radioactivity had been observed were examined at Webb's Consol near Emmaville and at Silver Valley near Tingha.

At Woodford's Prospect 2 miles north-east of Gilgai sporadic, small outcrops of griesen, occurring within the tin granite, are radioactive and some secondary uranium minerals

have been found. These bodies are very irregular and consist mainly of hard grey rock with phenocrysts of quartz feldspar and biotite. The mineral assemblage includes lead, copper pyrities, pyrite peacock wolfram, torbernite, and other secondary uranium minerals not identified. Many of the small greisen bodies show radio-activity up to 3 or 4 times that found in the surrounding tin granite. The best dumps containing secondary uranium minerals produced assays of up to .1%U_3O_8 and a selected specimen from one of these dumps assayed .2%U_3O_8. In all, 16 of the small greisen bodies have been opened up to some extent by small pits or shafts but the prospects of finding commercial ore seem most remote. These silicified greisens are very similar to the rocks examined at Hughes Prospect on Storey's Creek in north-eastern Tasmania, where, by coincidence, the best radio-active specimen also returned an assay of .2%E_3O_8.

At Webb's Consul Mine a lens of siliceous ore containing lead-zinc-silver, chalcopyrite, and pyrite occurs within a whitish granite porphyry which is a phase of the main tin granite. However, there is no evidence of noticable radioactivity on the line of load, in fact, as one would expect, the lead-zinc ore shows less radioactivity than does the tin granite. Most of the mullock and ore dumps show radioactivity similar to that shown by the tin granite and this is probably due to the granite content of the dumps.

The Silver Valley Lead and Uranium Mine is situated in the Tingha area and was floated during the uranium boom. At the mine, sporadic mineralisation including lead, zinc, silver, pyrite, chalcopyrite and a little tin occurs along a fissure in granite, close to a contact with the sediments of a pendent. Radioactivity along the lode is of the same order as that in the surrounding granite although some oxidised ore gave 1½ times the granite background. Sporadic high counts along the lode channel were reported in the company's prospectus and considerable development was done.

At the time of the inspection, however, this unjustifiable development had ceased and most underground exposures were not accessable. The three most promising exposures of the lode, given in the prospectus, showed 7", 18" and 17" of lode material respectively.

The mine has no radioactive prospects whatever and shows no promise of producing economic lead ore. The geological prospectus was cleverly written. The geological facts and figures were there but no analyses was given. The mining geologist could analyse the figures for himself and realise how poor were the chances of success, but the laymen was blinded with science.

RADIOACTIVE PROSPECTS IN THE BROKEN HILL DISTRICT.

A number of radioactive prospects are known in the Broken Hill District and those seen may be classified into five types:-

1. Veins containing davidite in a shear zone
2. Faint radioactivity associated with lead-silver mineralisation.
3. Radioactivity associated with copper in shears
4. Secondary uranium minerals occurring in shear zones
5. Thorium occurrences.

Except for one example of type 4 all prospects occurred in Archaeozoic rocks. At present, only prospects in the davidite

belt seem worthy of attention. The association of uranium with copper in shear zones are generally a hopeful sign but the only prospect of this type inspected - the Copper Blow - showed only sporadic uranium mineralisation.

1. Veins Containing Davitide.

A syndicate of prospectors has discovered small quartz veinlets containing davidite in a persistent shear zone traversing gneisses about 12 miles west of Broken Hill. Detailed outcrop mapping by the Geological Survey of N.S.W. has shown the existence of a shear zone through the gneisses, about 100 to 200 feet wide, which may be traced for miles by the outcrop of quartz veinlets or by the outcrop of heavy quartz scree. Some of these veinlets show a typical assemblage of blue quartz, rutile, some ilmenite, davidite, and black biotite. They have been found in a number of places along some four miles of the shear but the main development was being carried out at two places where veins have been exposed by bull-dozing and by costeans. No sub-surface development has yet been attempted.

The level of radioactivity in the shear zones in the vicinity of davidite veins was at least twice the backgrouns on the surrounding gneisses but readings of more than 20 times background were obtained on the veinlets themselves. However, where exposed by bull-dozing these veins were discontinuous of the order of 6 feet long and only about 4 inches in width. At one prospect a pocket of quartz and davidite was reported to have produced about a ton of ore.

The prospects will not be promising until greater width and more continuity is found. Davidite commonly carries only 4-7%U_3O_8, hence quartz veins need to carry something like 10% davidite to provide attractive ore. The occurrence of davidite at Broken Hill is, in general, similar to that at Radium Hill which is only 50 miles distant and if commercial ore ~~was~~ were found it could presumably be marketed at Radium Hill.

Prospectors in the davidite belt at Broken Hill have little to show to date, and their best chance of development is to interest a company in exploration under option. The Atlas Company was to inspect the davidite belt late last year but the outcome is not yet known.

2. Radioactivity Associated with Lead-Zinc Mineralisation.

Faint radioactivity associated with lead-zinc ore was observed at the Hen and Chicken and Daydream Lodes about 12 miles north-west of Broken Hill. These mines provided the first ore to be smelted in the Broken Hill district. Old workings are for the most part inaccessible and little of the original lode can be seen except on dumps where the siderite gang from the Daydream Lode is prominent.

In the workings which were accessable readings of twice the background provided by the surrounding pegmatite and gneisses were recorded but no secondary uranium minerals have been found. The occurrence is of mineralogical interest only.

3. Uranium associated with copper in shears

Uranium is associated with copper at the Copper Blow - a north-easterly trending shear about 12 miles north-north-west of Broken Hill. There is little radioactivity at the northern end of the shear but significant counts are found over about 100 feet towards the southern end where the shear is about 5-6 feet wide. The shear has been sporadically mined for copper by small shafts and cuts and lode material exposed is largely oxidised. Specks of torbernite and probably other secondary uranium minerals were seen and a beta probe picked up a number

of high spots in the ore channel where secondary minerals were subsequently found. The count rates suggest low values - perhaps .1%eU$_3O_8$ at high spots in the ore channel and lower values on the dumps.

Some oxidised copper ore is sporadically mined but little uranium ore is apparent.

4. Secondary uranium minerals in shear zones.

Autunite has been found in biotite schist which occurs either as a raft of sediments or in a shear through pegmatites at Eldee Creek, which is about 22 miles in a direct line north-west of Broken Hill. The band of schist, dipping vertically and about 30-50 feet wide, can be easily followed through the pegmatite. The mechanism by which the schist came into this position is not known.

Radioactivity along the schist is commonly twice the background of the pegmatite and reached 20 times background where autunite was found in one small outcrop along the shear. No primary mineral has been found.

Radioactivity was observed also in a shear in biotite schist close to a granite contact on Mundi Mundi Creek in the same general area. Ferruginous and pegmatitic material appears associated with the radioactivity but the source was not identified. The evidence of a few pits suggests that the shear is small and discontinuous.

These occurrences do not seem to warrant further investigation but the source of radioactivity is not known and any additional occurrences should be carefully examined to aid in appraisal.

The only occurrence of uranium so far known in the Broken Hill District in Upper Proterozoic rocks (Adelaidean System) is the occurrence of rutherfordite in crushed dolomite at the margin of the iron-filled shear zone at Corona, 60 miles north-east of Broken Hill. The ferruginous material, about 30-40 feet thick where seen, can be traced for miles and cuts across the strike of the folded dolomites of the Torrowangee Series. The ferruginous material is not noticeably magnetic at the surface and shows no appreciable radioactivity. At one locality, white dolomite, showing crushing at the margin of the shear zone, gave counts of 3 times local background and contained some greenish rutherfordite in cracks. The occurrence is of mineralogical interest only and it is probable that uranium carbonate was deposited from solutions migrating through the cracks of the dolomite near the shear.

5. Occurrences of thorium

Thorite and monazite are associated with black biotite in veinlets and small lenses in the davidite shear zone, and some creeks have noticably radioactive sand. Field assays of black biotite material from a lens in the davidite belt gave a ratio of .48, indicating thorium, and an assay of about 1.5% thorium oxide. No doubt higher assays could be obtained but there is no suggestion of sufficient material to provide commercial thorium ore in areas examined. Examination of radioactive stream sands shows that monazite is restricted to thin layers of sand which are laid down after floods. Samples were obtained but these have not yet been examined, but under present conditions the sands could not be regarded as likely sources of thorium.

6. Radioactive prospect near Condobolin.

Between Nymagee and Condobolin a biotite granite of uncertain age outcrops over a wide area. The granite is reported to be noticably radioactive although, where examined, radioactivity

was only slightly above the level of that found in surrounding sediments and soils.

The Blackfellow's Tank Prospect is situated about 54 miles north-west of Condobolin where lode material, following north-westerly trending fractures in the granite, carries iron, manganese, sphalerite, some galena, chalcopyrite, fluorite and secondary uranium minerals. In outcrop the lode forms a hard cap of silica, iron and manganese but at depth the ore minerals are contained in a black, chloritic gangue.

Some development was done in search of copper ore some years ago and, more recently, secondary uranium minerals were found on the dump. Torbernite, autunite, ochres, and curite have been identified and pitchblende was suspected at the 28 foot level.

Outcrops of the lode over a total length of about 200 feet gave readings of up to 5 times the background of the granite and the dump gave up to 20 times background. The lode exposed along some 40 feet of drive at the 28 foot level varied from 2-5 feet in width, pitched 45° to the north and dipped 70° to the west.

Radioactivity was highest at the northern end in a clayey seam on the foot-wall of the lode, which was pinching upwards. A cavity in the clay-seam gave a reading of 40,000 counts per minute and black fragments, suspected pitchblende, had been obtained from this seam. Fairly high readings up to 30 times background were also obtained from the southern end and high readings continued down the hanging wall.

A small specimen of the blackish fragment previously obtained from the clay seam was provided by the leasee and examined at Canberra. It gave very high counts but investigation by W.M.Roberts showed that the fragment consisted of pyrolusite with no trace of either uranium or thorium. A copy of his report is attached. The ratio of gamma counts to beta plus gamma counts for this fragment were then compared with the ratios obtained from known uranium and thorium minerals, and it was found that the fragment was emitting approximately 10 times the beta emissions recorded from these known radioactive minerals. The pattern of radioactivity was not, therefore, that of known uranium and thorium minerals and the conclusion was reached that the source of radioactivity was pyrolusite soaked in a radioactive daughter-product obtained from migrating solutions. The presence of pitchblende or uraninite in the lode is therefore very doubtful at present.

No commercial ore is known at the deposit although the existence of a definite lode channel and the presence of uranium induces some further investigation at depth at the northern end of the drive. However, it should be realised that with no immediate prospect of treatment plants in N.S.W., the heavy cost of transporting ore to a treatment centre would make unprofitable any but the highest grade of ore (perhaps 1%U_3O_8). Bulk samples from the ore dumps have assayed 0.2 and .03%U_3O_8 and selected specimens from the same dump have returned .25, 0.1 and 1%U_3O_8.

Radioactive prospect at Carcoar.

No recent development has been done at radioactive prospects at Carcoar and these have already been described by R. S. Matherson, Record 1952/65.

Only a brief inspection was made of the prospects at which radioactivity is pronounced and where specimens of torbernite and autunite together with copper and cobalt minerals can be found. In the small shears, traversing volcanics close to the granite, uranium and cobalt mineralisation appear to be too sporadic to give promise of ore.

The significance of the Carcoar deposits lies in the fact

that they appear to be situated in the meridional belt of epigenetic deposits which stretches from the Goodradigbee River northwards through Yass. Deposits of tin, wolfram, lead, zinc and copper in this belt are addmittedly small, but useful copper-uranium shows might be found. It seems an obvious belt for radioactive prospecting by testing ~~by testing~~ waters from the streams flowing roughly west through the belt. Prospecting might be done north and south of Carcoar to locate any drainage area in which uranium might be shedding. This work is to be carried out by Mr. Taylor of the United Kingdom Atomic Energy Commission, in conjunction with the Geological Survey of N.S.W.

CONCLUSIONS

Prospects in the New England district are typical of those to be expected in areas in which pegmatitic tin and wolfram deposits accompany granite. No uranium and thorium ore is in sight and no production should be expected. Although each occurrence needs to be examined, prospectors might be cautioned against spending time and money ~~and~~ in developing those prospects which are typical for this environment.

In the Broken Hill district there are types of deposits in which the source of mineralisation is not clearly evident and further prospects, found in shears, could prove of importance. The davidite belt has some small promise which should be investigated by some sub-surface prospecting.

The Condobolin Prospect is not encouraging, particularly because any ore found would have to be of very high grade, but such prospects are worthy of investigation.

Uranium mineralisation at Carcoar seems too sporadic to become commercial but the environment is hopeful and prospecting for similar occurrences by testing stream waters to the north and south seems well worth while.

EXAMINATION OF A RADIOACTIVE SPECIMEN FROM CONDOBOLIN N.S.W.

A small specimen of a black sub-metallic material from Condobolin, N.S.W. was submitted by Mr. L. C. Noakes for examination to determine the cause of the radioactivity. The sample measured approximately 3/8" x ¼" x 3/16" and when tested with the Austronic B.G.R.1 counter gave a reading of 4000-5000 C.P.M.

In polished section it is shown to consist of pyrolusite, which forms irregular grains ranging up to 0.35 mm. across, the interstices between which are filled with an apparently isotropic material, but which at very high magnifications is resolved into a mass of extremely fine crystals having similar optical properties to those of pyrolusite.

No separate uranium or thorium mineral could be identified in the section. A crushed portion of the specimen was repeatedly tested with the sodium fluoride bead and the sodium-zinc acetate methods. All tests gave a negative result for uranium.

Spectrographic analysis for uranium and thorium showed no detectable amounts of either element. A Gamma/Beta-Gamma ratio of .01 was obtained from the material, which is too low for uranium or thorium.

In view of these results it appears that the high radioactivity of the specimen is due to a concentration of radioactive daughter products formed from the disintegration of uranium, these have probably been absorbed by the manganese oxide structure during its formation.

(W. M. B. Roberts)