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# BRIEF REPORT ON AN INVESTIGATION OF MINES IN THE HARTS RANGE AND PLENTY RIVER MICA FIELDS, N.T.

by

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## SUMMARY.

The mica mines in the Harts Range and Plenty River fields are small and isolated. Workings are irregular and shallow, seldom reaching 100 feet in depth. Most of those in the Harts Range are very difficult of access.

None of the mines have any ore reserves to speak of. Hand picking of mica from crude ore is required either in the mine or at the mine portal. Miners do their own mica splitting, which, to be done efficiently, requires considerable skill.

Mining of the many erratic deposits has been hampered due to a complete lack of survey plans. The work has usually been done by small syndicates of Italians. More efficient mining methods could be employed by a company, but very few companies could be persuaded to undertake operations owing in large measure to uncertainties arising from the smallness and irregularity of minable concentrations of valuable mica.

Owing to alleged low prices for the poorer classes of mica, miners are steadily leaving the area. Those that are left do not seem imbued with any desire to explore their holdings at depth. Depth exploration, though, is warranted, but equipment and incentive are lacking.

## INTRODUCTION

An examination was made of many of the mines in the Harts Range and Plenty River mica fields during the latter portion of 1951, in the company of Messrs. G.F. Joklik and W. Roberts. The work involved mine surveying and mapping.

A great deal of information of a general nature was obtained from Mr. Joklik, who has spent much time studying the regional geology of the area and the mica deposits. The observations here recorded in regard to mining are the writer's responsibility.

## LOCATION AND ACCESS

The region is characterised by general inaccessibility, poor roads and paucity of water and timber. The nearest mine is over 100 miles from the railhead at Alice Springs.

In the Harts Range the terrain is rugged. Most of the deposits are found in remote, inaccessible regions. At the adjacent Plenty River field the deposits occur in soil covered, fairly flat country with sparse outcrops. The workings in both fields are small and scattered. Very few of the mines occur in close proximity to each other.

## GEOLOGY OF THE DEPOSITS.

### A. Geological Environment and Mineralogy.

Mica is found in pegmatites occurring in country rock composed of highly metamorphic, crystalline schists and gneisses. G.F. Joklik considers that there is a general relationship between the variety of mica found in a pegmatite and the type of host rock. For example, the Mount Riddock amphibolite contains no muscovite deposits, but many of biotite, whereas the greatest number of mica mines occur in the quartz-garnet-mica gneiss formation. It has also been suggested by Mr. C.J. Sullivan that bulges in some pegmatites may be due to alteration of favourable beds, but this, in the opinion of the writer, is far from a proven fact.

Commercial muscovite mica is obtained from very coarse-grained pegmatite bodies which mostly cut across the foliation of the host rock. Parts of these bodies, though, may locally conform to foliation. However, not all discordant pegmatites, by any means, yield economic mica. Those which do not are fairly homogeneous in texture and not very coarse-grained. Moreover, there are bodies of pegmatitic material conformable with schistosity. What little mica they contain is not of sufficient size to be of any value. These latter pegmatitic bodies represent altered country rock, while the formation of mica-bearing deposits has involved the introduction or intrusion of foreign material.

Discordant pegmatites differ markedly in width and persistence. In the mica-bearing bodies widths of 40 feet are not uncommon, while the unproductive ones seldom attain 10 feet in width. Where the two types are in juxtaposition there are manifest certain other striking differences between them. The non-mica-bearing variety is characterised by comparatively uniform width, persistent strike and steep dip. The minable pegmatites, on the other hand, are variable in orientation and irregular in form. Other notable differences are the coarse grain and irregularity of mineral composition of the latter type and the presence in it of large masses of quartz. These points of dissimilarity reflect probable differences in mode of origin.

Zoning of mineral constituents is characteristic of minable pegmatites. Zones may be predominantly of orthoclase felspar, plagioclase felspar, or quartz, or various proportions of these minerals. Border zones invariably are fine-grained and graphic in texture. Massive quartz, which is often developed, comprises the innermost zone or core. Enclosing the core are successive zones of varying composition, with or without commercial book mica. Mr. Joklik's studies in the field have led him to the conclusion "that clear mica (the best variety) is more generally associated with quartz and plagioclase felspar than with potash felspar".

Economic mica is often found between the core and hanging wall border zone of pegmatites, although its exact position with respect to individual zones varies in different bodies; however, the general distribution is clearly governed by zonal structures. Entire zones in some pegmatites seem to have been mined for mica, but other commercial deposits are confined to certain portions of zones. Mica has occasionally been mined from the footwall side of cores; that it is not found there more often may be due to insufficient exploration in the footwall.

Some irregular deposits have multiple cores. In the Plenty River field most of the worked deposits are associated with outcropping quartz cores. Quartz rubble in that area indicates the presence of underlying pegmatite.

One peculiar feature, that still requires satisfactory explanation, is the presence of considerable quartz as an integral part of pegmatites and its scarcity, even absence, in ordinary vein form cutting either pegmatite or country rock. Wherever quartz occupies a core its boundary with the surrounding zone is very uneven, suggesting irregular replacement. These characteristics, which differ from those of quartz veins in metalliferous districts, may be related not only to mode of origin but also to differences in the nature of fractures in which emplacement occurs.

B. Structure.

Some of the deposits examined show clear evidence of shear or fracture controls, at least in part. These appear to be mainly instrumental in the localization of pegmatites, although bedding exercises some influence. There may also be other factors, not yet recognized.

In some instances, as in the Blackfellows Bones mine, the orientation of pegmatites can be correlated with the orientation of minor structures in the adjacent country rock, but this rule does not seem to be universal application.

Fissure veins with fairly regular strike and dip are characteristic of the biggest mica mines, viz. the Spotted Tiger and the Last Change. But the deposit with the best developed shear control, on both Hangingwall and Footwall, is the Dinkum mine in the Plenty River field. Even the irregular pegmatites, such as at the Oolgarinna and Caruso mines, have regular controls in certain sections. There occur a few gently dipping veins of the "coal-seam" type, of which the outstanding example is the Rex mine.

There is some regularity in orientation of the mica-bearing pegmatites but it is doubtful if one could formulate a fracture pattern, or patterns, to embrace all of those in the region. A statistical study indicates that there are several predominant directions of orientation. Thus the strike line on which the greatest number of deposits occur is roughly east and west (actually an average bearing of 102°). The dip of these is usually steep south, but gentle dips to the south are also known. Other productive trends are 150°, 180°, and another ranging from 55° to 75°. Their dips are seldom less than 45°. However, there are pegmatites with these same alignments that have not been mined for mica.

Commercial pegmatites with two or more of the above strikes occur in several mines, e.g. the Dinkum and Delma.

In addition, there are a very few pipe-like deposits, such as the Benstead mine, which have only been worked to very shallow depths.

## EXTENSIONS OF DEPOSITS.

Some uncertainty exists in regard to extensions of known mica shoots. This is perhaps due to lack of knowledge of the real nature of the fractures and flexures in which pegmatites have been emplaced. This knowledge is far greater in the case of normal igneous dykes and metalliferous deposits of vein- or lode-type, and hence has proved of greater aid in the exploitation of such deposits.

In the case of the pegmatites of the Harts Range and Plenty River insufficient work has been done on most mines to establish definitely the directions in which the deposits extend to depth. It has been contended that the plunge, particularly in fissure veins, seldom exceeds 35° and is controlled by bedding and foliation pitching across the fissures - but this has not been established to the satisfaction of the writer.

The Main Workings in the Whistle Duck mine give probably the only conclusive evidence of plunge in all the region. There the quartz core, and with it the commercial mica zones, rakes at 45° to the east. In the Last Chance mine the miners have followed down the mica shoots in such a way as to suggest a uniformly flat plunge; likewise with the Billy Hughes mine. But generally it is difficult at present to determine the direction of downward extension of the mica shoots, except by more work underground. It is even more difficult to predict in the irregular pegmatites with multiple controls. Workings are comparatively shallow, and practically no winzing has anywhere been attempted below present bottom levels.

The productive pegmatites are known to lens out laterally. Without doubt they do so in depth as well. But there is no reason to believe that the deposits will not live down, with en echelon repetitions. Lateral extensions may exist in some instances, as is the case with non-producing pegmatites, with which certain sections of the Harts Range are well ribbed.

## MINING.

Most mines have advanced little beyond the prospecting stage and merely represent enlargements of surface workings such as cuts, trenches, etc. Very little systematic mining has been done, due mostly to the irregular nature of the pegmatite bodies and to the absence of survey plans. If miners were provided with up-to-date plans and sections, particularly of the irregular deposits, mining would be greatly aided and much wasteful work eliminated. The advantages of such maps in systematising future operations are evident.

The Dinkum mine in the Plenty River field, represents about the only worth-while attempt to carry out mining properly. The work was done by a company and was facilitated by the regular dimensions of the pegmatite. Systematic work has been attempted at the Central mine, evidently without much knowledge of the form of the deposit and without enough ore to warrant the expenditure on dead work.

## EXPLORATION

Some exploration at depth could be done with present equipment, but the mines are nowhere near well enough equipped for mining below the water table. To work the mountain mines efficiently it is necessary to tackle them from adits at lower horizons in view of the acute transport and other difficulties involved in the present set-ups. To do this a knowledge of the plunge of the mica shoots is essential. Some winzing and intermediate work from bottom levels should supply the necessary information. A desirable substitute, or adjunct, would be diamond drilling.

In no mine so far examined has any apparent endeavour been made to find another mica shoot beyond the confines of known shoots. A more enterprising policy would reveal, as in metal mining, that the shoots so far worked are not the only ones that exist. Repetitions should be found down dip. Likewise the hitherto little-heeded surface indications in the immediate vicinity of some mines could well prove worth investigating.

## CONCLUSIONS.

To ensure future production of mica, prospecting for new deposits, for which there is scope, should be encouraged. Also, present and past producing mines should be explored at depth, and along the strike where feasible. It is considered that exploration at depth would yield the best results in the shortest time. In this connection diamond drilling would be advantageous, except perhaps in the case of very irregular deposits with indeterminable plunge. The use of the diamond drill as a means of preliminary exploration is recommended in such mines as the Rex, Eastern Chief, Eldorado and other fairly regular deposits. The core would be no criterion of grade, of course, but, if a sufficient thickness of pegmatite were encountered and zoning indicated there would be warrant for further work.

In mountain mines adits closer to floors of valleys could be put in, say, by companies with the resources to undertake the preparatory work required to facilitate mining and transport of ore and supplies. But it seems that with mica deposits it is not possible to plan very far ahead, and, generally speaking the uncertainties of mica mining and the working conditions are not such as to attract any company to attempt to establish an efficient mining industry. Therefore, the only alternative is to encourage small groups or syndicates, such as those operating at present, with aid for mining at depth and for installation of better haulage facilities. Reasonably up-to-date survey plans should be provided to guide development and general planning.

The miners on the fields appear to be lacking in conviction about the deposits continuing to depth. Whether this is due entirely to fears about the expenses involved, or to lack of equipment, or to expectation of Government assistance, cannot be decided for certain. The absence of enterprise in any miners is hard to understand, and in this case is put down as due primarily to lack of equipment.

Exploration of any sort will certainly languish without the impetus of higher mica prices. If the situation should arise in the future where mica is urgently needed, then the implementation of the above proposals will ensure that supplies are forthcoming.

S R Tomich

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