A TIN PROSPECTING PROGRAM

FOR

SOUTHWESTERN NEW MEXICO

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ABSTRACT

A tin prospecting program is described; this is proposed for the general vicinity of the known, non-commercial tin deposits in the Black Range, Catron and Sierra Counties, New Mexico.

This program is planned in three steps, (1) reconnaissance of several townships by a geochemical method (the analysis of near-surface soils for significant constituents), (2) the detail of thereby identified significant anomalies by a geophysical method (radore), and (3) test hole drilling of the more favorable detailed anomalies. Although such a program of reconnaissance and detail prior to test drilling is novel in mineral prospecting, it has been successful, standard operating procedure in petroleum prospecting.

Thumbnail biographies describe the educational backgrounds and professional experience of the individuals who propose, and expect to participate in, this recommended tin prospecting program. Among them is one individual who has played an important part in demonstrating the usefulness of the radore method for outlining ore bodies prior to drilling; other individuals pioneered the successful application of soil analysis to petroleum prospecting and have conducted significant experimental work in its application to mineral prospecting. Pertinent experimental data are available for inspection. The equipment required for this program is available either directly or through rental.

BACKGROUND MATERIAL

Group Qualifications and Experience

The proposed tin prospecting program is to be a joint venture sponsored, and to be undertaken, by the following:

Morton H. Marr, Gulf States Utilities Building, Dallas 1, Texas
James B. Forgotson, 208 Ricou-Brewster Building, Shreveport, Louisiana
Geochemical Surveys (a partnership), 3806 Cedar Springs Road, Dallas 4, Texas, composed of W. R. Ransone, C. V. A. Pittman, E. C. Reagor, Eugene McDermott, and E. E. Rosaire

Brief biographies of these sponsors follow.

Marr, M. H., An independent oil operator. Educational background

in mining engineering. While Marr has engaged to a minor extent in mining operations, his primary activities are in various phases of the petroleum industry, particularly prospecting. In the latter, he has found occasion to make use of various geological, geophysical, and geochemical methods, and, in so doing, he has become well acquainted with their principles, applications, and usefulness.

Forgotson, J. M., Educational background in mining and petroleum geology. For several years was engaged in evaluating mineral resources in Southwestern United States, and now a consulting geologist and geophysicist in both petroleum and mining prospecting. Directed most of the field work which has demonstrated the usefulness of the electromagnetic method known as "radore" in mining, and "radoil" in petroleum, prospecting; this technique recently has been shown to have marked usefulness in outlining ore bodies prior to their evaluation by drilling.

Geochemical Surveys is a partnership founded circa 1941 to exploit geochemical (soil analysis) methods (in petroleum prospecting) invented somewhat earlier by two of the partners, Rosaire and McDermott (both of whom, incidentally, are Past-Presidents of the Society of Exploration Geophysicists). At present, Geochemical Surveys is engaged primarily in the exploration for and production of petroleum; those activities have resulted in and contributed to the discovery of several oilfields. The greater part of the income received by the partnership is from the production of petroleum so discovered. The partnership introduced a combination new to petroleum prospecting, reconnaissance by soil analysis followed by detail by means of core drilling; as a result, the Success Ratio (discoveries/test wells drilled) for this partnership is higher than the average for the petroleum industry as a whole. Brief biographies of the partners follow.

Ransone, W. R., Educational background in geology and physics. Experience in geophysical prospecting (refraction and reflection methods) dates back to 1926.

Pittman, C. V. A., Educational background in physics and engineering. Experience in geophysical prospecting (refraction and reflection methods) dates back to 1927.

Reagor, E. C., Educational background in chemistry and physics. Experience in geophysical prospecting (reflection method) dates back to 1934.

McDermott, Eugene, Educational background in physics and engineering. Experience in geophysical prospecting (refraction and reflection methods, geo-electrical methods) dates back to 1925, in geochemical prospecting, to 1938.

Rosaire, E. E., Educational background in chemistry and physics.

Experience in geophysical prospecting (refraction and reflection methods) dates back to 1925, in geochemical and geo-electrical methods, to 1936.

From these thumbnail biographies, it is obvious that the sponsors of this tin prospecting program are professionals in the field of prospecting for petroleum, and are qualified to attempt analysis and solution of prospecting problems. As later paragraphs show, justification exists for their conclusion that their background in petroleum prospecting can be translated advantageously, into prospecting for other minerals.

GROUP EQUIPMENT

Geochemical Surveys maintains a modern laboratory at its place of business in Dallas. Currently, this laboratory analyzes some 75-100 soil samples daily, a rate which can be at least doubled. This laboratory was the first in this part of the United States to acquire certain specialized analytical appartus; these include a flame spectrophotometer, a recording polarograph, specialized microscopes, and automatically controlled, recording apparatus for the simultaneous analysis of soil samples. At present, Geochemical Surveys operates three sample collecting parties and one core drill crew, and has operated in Texas, Oklahoma, Louisiana, Arkansas, Illinois, Missouri, New Mexico, California, and Canada. At such time as prospects have been outlined by geochemical soil analysis, the detail required for the choice of a test hole location will be made by the use of radore. Such equipment will be rented from the inventor, W. M. Barrett, Inc., Shreveport, Louisiana, with whom, for years, one of us, Forgotson, has maintained a close relationship.

INTRODUCTION

In view of its obviousness, it appears superfluous to expound upon the great significance which would be attached to the discovery of of a commercial deposit of tin bearing ore within the continental United States. It should be said, however, that that consideration played an important part in the conception and recommendation of this program.

The Tin Prospecting Problem

This particular prospecting problem is as follows:

Since before 1940, several localized areas of tin bearing ore have been known to exist in Catron and Sierra Counties, New Mexico.

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Tin Deposits of the Black Range, Catron and Sierra Counties, New Mexico, U. S. Geological Survey Bulletin 922-M, 1940

These occurrences have been investigated by mineral prospectors of varying degrees of competence; at present, however, no commercial discoveries have resulted from those investigations.

A Similar Problem in Petroleum Prospecting and Its Solution

This type of problem is one which is quite familiar to those of us with wide experience in petroleum prospecting. Our conclusion is that in such a situation, the competence of the prospector often is less important than the finding effectiveness of the method employed. Thus, in 1924, a competent Gulf Coast prospector wrote as follows:-

"Since the discovery in 1917 of the Hager-Martin dome in Section 28, T 9 S, R 7 E, St. Martin Parish, Louisiana, approximately 675 wildcat wells have been drilled in search of new domes on the coast, involving an expense estimated at $20,000,000, exclusive of leases and overhead expenses. Yet only one new dome has been found during this period, and it has not yet proved profitable commercially as a source of oil."

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Henniger, W. F., Occurrence of Sulphur Waters in The Gulf Coast of Texas and Louisiana, and Their Significance in Locating New Domes, Geology of Salt Dome Oil Fields, DeGolyer and Others, Amer. Assoc. Petrol. Geol., 1926, pp. 774-776.

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Yet in 1927, only three years after this was written, nine salt domes were found in eleven crew months of operation by two refraction seismograph parties; these were staffed by men who, in 1924, were wholly without experience in petroleum prospecting. The use of an effective method, new to the area, in the hands of relatively inexperienced men, readily solved a prospecting problem which, only three years earlier, the most competent prospectors had found to be (for all practical purposes) insoluble.

Comparative Positions of Mineral and Petroleum Prospecting

On the basis of our experience in petroleum and mineral prospecting, we (the individuals who recommend, and expect to participate in, this tin prospecting program) consider that mineral prospecting today is quite similar in status to petroleum prospecting in 1924; i.d., just when geophysical methods were being successfully introduced. Further, on the basis of our experience with geochemical and geophysical methods in mineral prospecting, we are convinced that the stage is set for a revolution in mineral prospecting which will be comparable to that which took place in petroleum prospecting with the successful introduction and widespread use of geophysical methods.

Unfavorable and Favorable Factors Should Compensate

Granted that there will be a major difference in the size of the target

(i.e., the typical mineral deposit can be expected to be very much smaller than the typical petroleum accumulation). However, there should be an important compensating factor in that, once we can "read" through the surface mantle (which so effectively limits the finding effectiveness of the otherwise competent mineral prospector who relies wholly upon visual inspection) a number of mineral prospects reasonably can be expected at depths which are very shallow as compared with those encountered, and successfully handled, in petroleum prospecting. That is, while in mineral prospecting, our possible targets will be much smaller (than in petroleum prospecting), on the other hand, the range also will be much smaller. Thus, we can expect that the unfavorable factor of very small target size will be compensated, to an appreciable degree, by the favorable factor of shallower depth.

New Methods Available in Mineral Prospecting

Two potentially important methods recently have become available to the mineral prospector; one of these is geochemical (soil analysis) and the other is geophysical (radore). Either method, alone, would have marked a significant advance in the art; however, in proper combination, they bid well to effect an advance so great as to justify the term "revolution".

Reconnaissance and Detail Methods

The location of an ore body (or petroleum accumulation) is a problem in three dimensions, latitude, longitude, and depth. Obviously, any method which operates in the third dimension (depth) could be used, unaided, in prospecting. That is, all the mineral deposits (and petroleum accumulations) could be discovered simply by drilling enough wells. However, the resulting discovery cost would be unduly high, in view of the following considerations. By far the greater part of any area to be prospected (an area which is large when compared with the area of the typical target) can be expected to be barren (of ore or petroleum); consequently, an important factor in any organized prospecting campaign is the cost of eliminating barren areas incidental to the recognition of localized, potentially significant anomalies. This, the "not finding" cost, makes up unduly percentage of the discovery cost when an exploration campaign is based upon reconnaissance by a method which operates in the third dimension; on the other hand, the "not finding" cost makes up a much smaller percentage of the discovery cost when an exploration campaign is based upon reconnaissance by an appropriate method operating only in two dimensions.

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Rosaire, E. E., On the Strategy and Tactics of Exploration for Petroleum, III, Geophysics, Vol. 4, No. 3, July, 1939, pp. 155-166.

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Thus, when appropriate methods are available, a two step approach has distinct advantages in prospecting. The first step is reconnaissance

by an appropriate "stratigraphic" method (i.e., operating only in two dimensions, latitude and longitude), this should result in the recognition of localized, potentially significant anomalies with a low "not finding" cost (i.e., the cost of eliminating barren areas). The second step is the detail of those localized anomalies by an appropriate "structural" method (i.e., operating in the third dimension, depth) so as to determine their areal extents and depths; thereby the most favorable locations are chosen for that "supreme arbiter", the drill.

Characteristics of Radore and Soil Analysis

The geophysical method known as radore has been used successfully (in the Ozark area) to pin point ore bodies; i.e., by using radore to determine their probable outlines and depths, favorable locations have been made for test holes. However, by virtue of that very pin point finding effectiveness, the radore method is a "structural" method (since it operates in the third dimension), and is a very high cost "not finding" method if used on reconnaissance.

On the other hand, an unusual characteristic of the soil analysis method is that it operates only in two dimensions, and appears to have little, if any, depth perception. However, its two dimensional finding effectiveness appears to be reasonably high and its cost per unit area reasonably low. Thus, soil analysis emerges as peculiarly suited to the reconnaissance phase in an organized prospecting campaign, whereby the "not finding" cost should be a relatively low percentage of the discovery cost.

Thus, in our opinion, the combination of soil analysis (for reconnaissance) and radore (for detail to choose the most favorable locations for test holes) appears to be a promising approach to the problem of locating commercial tin deposits in the Black Range area of New Mexico.

Outline of the Proposed Tin Prospecting Program

The following paragraphs describe various phases of the proposed tin prospecting program; i.e., the working hypothesis upon which it is projected, the reconnaissance, the detail, and the test hole drilling phases. Where applicable, there are included estimates of the cost and time required for completion.

Working Hypothesis

In the past, prospecting for tin in this area has proceeded upon the working hypothesis that, if commercial deposits of tin bearing ore do exist in this area, they will be found in close juxtaposition to the known non-commercial deposits. This working hypothesis may or may not be valid. If it is valid, then the inferences from past prospecting are unfavorable, for, as yet, no commercial deposits have been found in spite of reasonably intensive investigations inspired by a favorable demand situation.

Prior to the discovery of petroleum there, the Tampico Region of Mexico was notable for its visible seepages of asphalt, oil and gas. Many of these visible indications of petroleum were tested by wildcat wells located in close juxtaposition. Some of these test wells resulted in discovery; many were abandoned as failures. In the light of the extensive development which has taken place there, it appears that some of these visible indications of petroleum did indicate underlying, or nearby, petroleum accumulations, others definitely were not associated with petroleum accumulations (i.e., were associated with igneous instrusions), and still others remain today with as yet undetermined significance.

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Muir, John M., Geology of the Tampico Region, Mexico, Amer. Assoc. Petrol. Geol., 1936, pp. 152-157.

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A quite competent prospector, who was active during the early development there, has expressed his considered judgement that the overall significance of the visible evidences of petroleum in the Tampico Region was general rather than specific; i.e., indicated that the general area, rather than specific localities, was favorable to the accumulation of petroleum.

Our working hypothesis for this proposed tin prospecting program is quite similar; i.e., we have proceeded on the basis of the working hypothesis that the known non-commercial tin deposits in the Black Range are not themselves necessarily associated with, or even close to, commercial tin deposits, but rather that their significance is the favorability of the general region to localized occurrence of tin bearing ore deposits, some of which may be commercial. We propose, therefore, not to restrict our exploration to the immediate vicinity of the known, non-commercial tin deposits, but rather to explore the broad area blanketed by rhyolite flows for local mineralized areas which reasonably can be expected there, and which may well include commercial deposits of tin bearing ores.

Thus, the proposed tin prospecting program envisages a regional reconnaissance, by soil analysis, of about 6 townships; most of this area, of course, will be barren of significant mineralization. However, that large area reasonably can be expected to include one, or even more than one, mineralized locality more favorable (from the standpoint of a commercial tin deposit) than those now known. When such a favorable mineralized locality is indicated, it will be detailed by radore; i.e., a detailed radore survey will be made of the geochemical anomaly, with the objective of choosing the most favorable location for a test well. This last, of course, will be properly sampled so that the resulting data can be fully evaluated in terms of commercial value of the mineralized deposit.

Reconnaissance (by Soil Analysis)

As stated earlier, the reconnaissance is to be conducted by the analysis of soil samples taken at shallow depths along a predetermined grid. That analysis will not be restricted to tin alone, but will include analyses for other constituents.

This follows because our experience in geochemical prospecting by soil analysis has demonstrated that a soil constituent which is significant in one area may not be significant in another area. Local conditions may act to suppress the anomalous occurrence of what was expected to be the most significant soil constituent, and another may assume the position of indicator. Thus, in recent exploration in the Ozark lead-zinc area, the lead content of the soil was not markedly interesting from a prospecting standpoint, while zinc, manganese, and barium did yield significant anomalies in the vicinity of known ore bodies (as well as in areas not yet investigated by test drilling).

Therefore, while we as yet have no reason to anticipate that the concentration of tin in the near-surface soil will fail to be a significant indicator, we plan to carry analyses for a suite of soil constituents, and to give consideration to them, singly and in combination, in our resolution of the resulting geochemical data.

Our first exploration will be the collection, and subsequent analysis, of soil samples collected at a spacing of 0.1 mile along a profile 18 miles long. Since by far the greater part of that profile should be barren of significant mineralization, those "long profile" data will furnish the adequate background so necessary in the recognition and evaluation of local anomalies.

With that background material at hand, the reconnaissance will be initiated on a grid of similar profiles spaced one half mile apart. Closer spacing will be relied upon, locally, whenever the analyses indicate the possible existence of a mineralized area. Further, that "detailed reconnaissance" will be initiated promptly, without waiting for the basic reconnaissance grid to be completed.

If six townships (three long, two wide) are sampled by a grid of 20 samples to the mile, along profiles one half mile apart, approximately 4300 reconnaissance samples would be required. At a sample collection rate of 20 per day or 440 per month (working 22 days/month), 10 crew months would be required. An additional 5 months or 2200 samples may be necessary for detailing anomalies indicated by the reconnaissance sampling. Presumably, such a complete sample grid would not be required except in the event that no anomalies of potential significance were found. However, about that number of samples probably will be required if potentially significant anomalies are discovered during the reconnaissance survey. Thus, the 15 months of sampling would cost, at $8,000 per crew month (for the cost of analysis as well as collection) an estimated $120,000. nearly $28.00 per sample!!!

This monthly rate for the soil sampling crew is not our normal contract rate; this is much higher. A charge of $8,000 per month for such a soil crew is expected to approximate, very closely, the expense of sample collection, transportation to the laboratory, analysis, and usual tabulation and display of the resulting data.

If as the reconnaissance progresses a possible soil analysis anomaly is indicated, the sampling crew at once will be directed to complete a closer sampling of that area, probably to a uniform grid 1/20th of a mile on a side. Once such a "reconnaissance detail" is completed, the soil sample collecting crew will return to the wider reconnaissance grid spacing.

Detail by Radore

If that "reconnaissance detail" confirms and generally outlines a likely looking anomaly, a radore crew will be moved in to initiate the geophysical detail.

A radore crew utilizes a transmitter of electromagnetic waves and a calibrated field strength receiver. The transmitter is set up at a chosen location, and the portable receiver then occupies surveyed positions along a profile across the anomalous area. The measured field strengths are then plotted and the curves examined for typical, significant anomalies; if these exist, they are interpreted in terms of the outline of the ore body, its depth, and its electromagnetic characteristics. (These last have been found to bear a relationship to the richness of the ore body.) From these conclusions, the decision is reached as to whether or not this anomaly should be subjected to test drilling; if the decision is favorable, these data permit the choice of a favorable test well location.

The rental of such a radore crew is about $7,500 per month. The time required for the evaluation of prospects such as these will vary quite a lot; much depends upon the size and depth of the anomaly, the terrain, and the magnitude of the radore anomaly. Our present estimate is one radore crew month to each likely soil analysis anomaly, with a possibility that 8 prospects will be found which are worthy of such a detail.

Test Hole Drilling

Test holes will be located in accordance with the findings of the radore detail; however, we expect to move in a rig for an immediate test of any suitably detailed, worthy, radore anomaly.

Our estimate of the test drilling cost is $2.50-$3.00 per foot of hole drilled; with an estimated depth of 1,000 feet, perhaps two such test holes can be drilled in one month of continuous operation. While a projection of the anticipated drilling costs can be little more than a guess, for the purposes of rounding out an estimate, 18 such test holes (9 drilling crew months) are included.

CONCLUSION

Recapitulation of Program

Thus, it is apparent that a flexible prospecting program is contemplated. If the reconnaissance is unfavorable, the estimated costs for radore and test drilling will not ensue. On the other hand, if favorable results do ensue from the reconnaissance, then it may be that soil sampling, radore, and drilling crew activities all may be in operation at the same time (but not, of course, in the same locality).

The following table then indicates what may take place if the reconnaissance and detail surveys yield favorable results. The times are figures from I-day (initiation day).

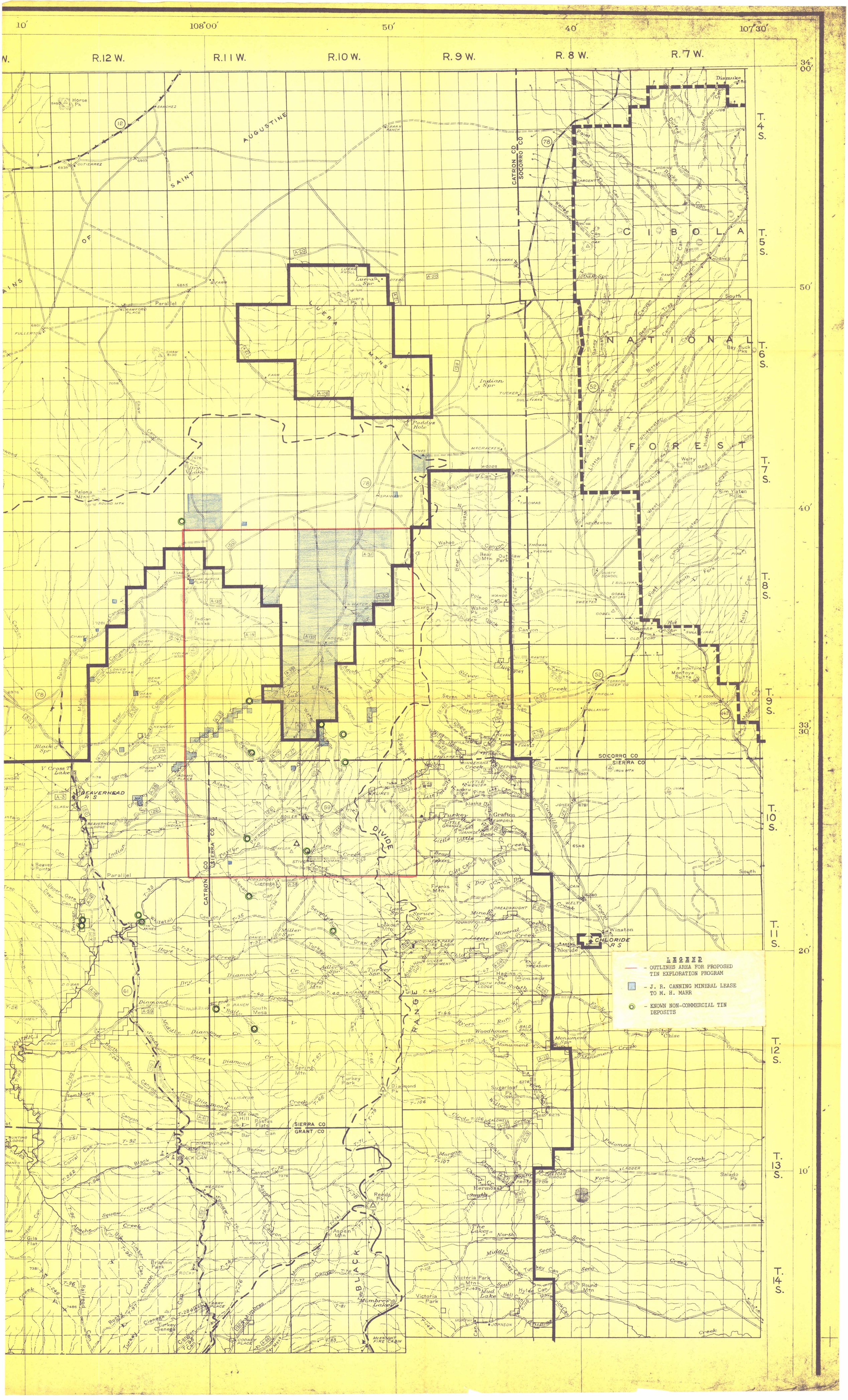
Phase	Start	Finish	Time Required	Est. Cost.
Reconnaissance	I-day	I-day plus 15 months	15 months	$120,000
Detail	I-day plus 4 months	I-day plus 12 months	8 months	60,000
Test Drilling	I-day plus 9 months	I-day plus 18 months	9 months	54,000
Complete Program	I-day	I-day plus 18 months	18 months	$234,000

Respectfully submitted,

E. E. Rosaire

E. E. Rosaire

June 27, 1951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SAINT AUGUSTINE PLAINS
CIBOLA NATIONAL FOREST
LUERA MTNS
CATRON CO
SOCORRO CO
SIERRA CO
GRANT CO
BLACK RANGE
DIVIDE
BEAVERHEAD R S
CHLORIDE R S
Luera Spr
Luera Pk
Indian Spr
Paddys Hole
Dry Lake
Pelona Mtn
Indian Peaks
Tiry Lake
V Cross T Lake
Black Spr
Grafton
Winston
Chloride
Hermosa
Mimbres Lake
Sugarloaf Pk
Salado Pk
Reeds Pk
Aspen Mtn
Diamond Pk
Round Mtn
Victoria Park
Mud Lake
The Lakes
LEGEND
- OUTLINES AREA FOR PROPOSED TIN EXPLORATION PROGRAM
- J. R. CANNING MINERAL LEASE TO M. H. MARR
- KNOWN NON-COMMERCIAL TIN DEPOSITS