74-44

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PROJECT EGMA SEISMIC SURVEY– TIMMINS, ONTARIO TO VAL d'OR, QUEBEC

P. G. KILLEEN
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ABSTRACT

A shallow seismic study of overburden was conducted in the Timmins – Val d'Or area as an aid to mineral exploration. The survey was funded under the Emergency Gold Mining Assistance Act program.

Nearly 1400 hammer seismic refraction profiles, covering approximately 350 line-miles in the Abitibi Clay Belt region, were completed during the winter of 1971-1972. Special problems involved with winter seismic operations were overcome. The results of the seismic depth determinations are presented in the form of 53 cross-sections showing sub-surface apparent velocity structure. The bedrock topography was found to have relatively high relief and overburden thickness of 200 feet was not uncommon. Detailed seismic studies in the area of the Kam Kotia Mine and Jameland Mine in Ontario indicate that the depth to bedrock is highly variable over short horizontal distances.

RÉSUMÉ

Les auteurs ont entrepris des études sismiques à faible profondeur de morts-terrains situés dans la région de Timmins – Val d'Or dans le but d'aider à l'exploration minière. Cette étude était financée par le programme établi en vertu de la Loi d'urgence sur l'aide à l'exploitation des mines d'or.

Près de 1400 profils de sismique réfraction par percussion, s'étendant sur une distance d'environ 350 milles dans la zone d'argile de la région de l'Abitibi, ont été complétés au cours de l'hiver 1971-72. Les auteurs ont surmonté les problèmes particuliers qu'entraînent les travaux de sismologie pendant l'hiver. Les résultats des déterminations sismiques en profondeur sont représentés sous forme de 53 coupes transversales décrivant une structure de profondeur à vélocité apparente. La topographie des roches de fond montre un relief relativement prononcé et une profondeur de couverture de 200 pieds n'est pas rare. Des études sismiques détaillées de la région des mines Kam Kotia et Jameland en Ontario indiquent que la profondeur de la roche de fond est très variable sur de courtes distances horizontales.

PROJECT EGMA SEISMIC SURVEY – TIMMINS, ONTARIO TO VAL d'OR, QUEBEC

INTRODUCTION

A refraction seismic survey was carried out in the following areas of Ontario and Quebec during the winter of 1971-72:

1) Timmins – Kirkland Lake area, Ontario
2) Rouyn – Noranda area, Quebec
3) Val d'Or area, Quebec

The purpose of the seismic aspect of the project was to examine overburden as to nature and thickness and to define bedrock topography in the Timmins-Val d'Or areas in conjunction with an overburden drilling program, Skinner (1972). It was also intended to test the application of hammer seismic instruments under winter conditions.

Acknowledgments

The assistance of R. McGorman and B. Carnovale in the Timmins and La Sarre field offices respectively, is gratefully acknowledged.

METHOD

The Huntec model FS-3 portable seismograph was used with a 16-lb. sledge hammer struck upon a steel plate for an energy source. The refraction seismic technique was employed; about one half the refraction profiles were reversed to obtain increased accuracy of velocity and depth information, Hobson and Grant (1964), Hobson et al. (1964), Hobson and Carr (1967). Seismic stations were generally at quarter mile intervals, along existing east-west trending roads and trails. Due to the additional difficulties of winter operation, each seismic crew consisted of three men rather than the usual two.

Four crews worked out of a field office set up in Timmins, Ontario, and four crews worked out of La Sarre, Quebec. Each office was staffed with one man for computation and plotting of field results. The geophysics project supervisor (Killeen) planned and co-ordinated the work being carried out by the seismic crews from the two field offices.

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Approved for publication: April, 1974

WINTER OPERATION

The entire project was carried out in areas normally subjected to below-zero temperatures for most of the winter. This led to several problems of winter operation, which are discussed below.

a) Cold temperature: Cable breaks became such a common occurrence that operations were severely affected. This was solved by changing to a rubber type cable which was guaranteed by the manufacturer (Beldon) to remain flexible to -22°F. Even with this cable, the most often-flexed parts of the cable broke, that is, at the connectors. The normal Cannon- or Bendix-type plugs were replaced with twin-lead trailer light system connectors. These were easily replaced in the field using only a mechanical connection, twisting the bared wires together and taping. No solder was needed. The cost of the connecting plug was also less by at least a factor of 10.

The wooden sledge hammer handles broke more often than during summer operations; for this reason a spare hammer was carried by each group of two crews working together in a given area.

b) The snow: When working on unplowed trails initially, each hammer location was prepared by digging a hole to the ground surface. To remove the necessity of digging such a hole to set the plate on ground, a special steel "impact plate" was used, consisting of a pipe three feet long with both ends welded shut. A handle was welded on the side for carrying and for holding the plate-post in an upright position while hammering on it. The saving in snow shovelling time was considerable. The delay time introduced by the pipe was less than $\frac{1}{4}$ millisecond and was considered a negligible error in computations.

c) Frozen ground: To provide good geophone-to-ground coupling, flat geophone bases were used on the frozen ground rather than the spike bases normally used in soft terrain. The seismic velocity of the frozen surface was observed on many of the records as the first arrivals of seismic energy. These arrivals were usually attenuated at short geophone-source distances and the arrival times through unfrozen overburden were obtained as first events even in areas of thick seasonal frost.

d) Transportation: On roads, the normal procedure was to operate from the rear of a truck, but off roads in deep snow, the instruments were placed on toboggans and towed behind snowmobiles. This caused

an increase in the rough handling of the instruments, but in general no serious problem resulted. It was found that the heavy NICAD batteries were often loosened from their clips; this was remedied by inserting foam pads to maintain pressure on the batteries and thus keep them in place. The inertia switches on the hammers were protected from snow with a metal shield taped on the handle. In the project area the snow was dry and only very wide track or twin-track snowmobiles were able to travel through the deep snows by February. Some areas could only be covered when the ground was frozen because they are too swampy for summer operations. It might be mentioned that record snowfall accumulations were present in the area in the winter of the survey.

e) Other Problems: Along roads, an exceptionally great amount of 60Hz noise was encountered due to the proximity of telephone and other electrical lines. All efforts to properly ground the instruments failed in some areas and the station locations were moved away from the road at a later date using the snowmobiles. No solution to this problem was found.

RESULTS

The results are shown in the form of a series of cross-sections. Results from all areas indicate fairly high relief of the bedrock topography. This is not surprising when one observes the relief on the bedrock outcrops to the south of the claybelt. It is probably valid to assume the same relief continues northward into the project area. Thus individual depth determinations are not as important as an overall average for any given cross-section. The steep dips of the overburden-bedrock interface in some areas are beyond the limitations of the unreversed refraction seismic method, which assumes relatively flat or gently dipping interfaces, Hunter and Hobson (1974). When the quality of the seismic records suffered for any reason, the calculated depth and bedrock velocity are marked "questionable" and denoted with a Q on the cross-sections. The letter M denotes a "minimum-depth calculation, with an assumed bedrock velocity". The letter R near the station number refers to a "reversed profile". On some cross-sections nearly all stations are reversed, and the letter U is used to denote the "unreversed" stations. Velocities are given in kilo-feet per second on the cross-sections.

Timmins, Ontario Area

The seismic refraction survey was carried out in this area from November 15, 1971 to March 30, 1972. Approximately 800 profiles were completed for bedrock depth determinations along primarily east-west trending lines. Since locations were mainly at quarter mile intervals, a distance of about 200 line-miles was covered. Some areas of special interest were detailed at closer intervals. Seismic station locations are shown in Figure 54.

The following is an alphabetical list of townships in which some seismic results have been obtained:

The Timmins, Ontario area (Sheet 42A, Timmins, National Topographic Series Map; 1:250,000)

Township	Figure No.
Beatty	25
Bond	22, 23
Bowman	24
Bristol	18
Calvert	30, 31
Carscallen	17
Carnegie	1
Carr	30
Clergue	30
Currie	23, 24
Denton	17
Dundonald	29, 30
Evelyn	5, 9
German	21, 22, 29
Gowan	4, 6, 7, 8, 9
Guibord	25, 26
Hoyle	8, 9, 21
Jamieson	9, 11, 12, 13, 14
Jessop	9, 14
Keefer	17
Little	3, 4, 5
Matheson	9, 21, 28, 29
McCool	26, 27
Michaud	27
Mountjoy	15, 19
Munro	26
Murphy	8, 16
Ogden	19
Prosser	1
Robb	10, 11
Stock	22, 23
Taylor	23, 24
Tisdale	15, 16, 20
Tully	1, 2, 4
Wark	4, 6, 8
Whitney	16, 20, 21

Area of the Kam Kotia and Jameland Mines

Detailed seismic studies were made in an area of approximately one square mile northeast of Kamiskotia Lake near the Robb-Jamieson township line. A total of 60 depth determinations were computed and are presented in Figures 11, 12 and 13. The seismic station locations are shown in Figure 58.

The bedrock topography is extremely irregular with rapid changes in depth from 25 feet to over 150 feet occurring over horizontal distances as short as 1,000 feet. Individual seismic cross-sections must be considered to obtain depth information at any given location since no general trends are apparent. The rapidly varying bedrock topography and irregular distribution of seismic station locations would make a contoured map of depth determinations of questionable value in this particular situation.

La Sarre, Quebec Area

The seismic refraction survey was carried out in the La Sarre area of Quebec, north of Rouyn-Noranda, during the period December 1, 1971 to March 30, 1972. Approximately 445 seismic refraction profiles were completed along east-west trending lines at quarter mile intervals covering a total of 110 line-miles. Seismic station locations are shown in Figure 55.

The following is an alphabetical list of townships in which seismic results have been obtained:

The La Sarre, Quebec area (Sheet 32D, Noranda-Rouyn, National Topographic Series; Map 1:250, 000)

Township	Figure No.
Clermont	37, 38, 40
Chazel	38, 39, 40, 41
Desmeloizes	35, 36, 37
Du Parquet	46, 47
Hebecourt	46, 47
Hepburn, Ont.	33, 34
La Sarre	40
Palmarolle	43, 44
Roquemaure	42, 43, 44, 45
Royal-Roussillon	40, 41
Sargeant, Ont.	34, 35
Scapa, Ont.	33
Steele, Ont.	32, 33

Val d'Or, Quebec Area

A seismic survey carried out in the Val d'Or area covered about 30 line-miles with approximately 130 seismic refraction profiles at quarter mile intervals. The results given in six cross-sections are referenced by township name in the following list, using the same format as that for the La Sarre area. Seismic station locations are shown in Figures 56 and 57.

The Val d'Or area, Quebec (Sheet 32C, National Topographic Series; Map 1: 250, 000)

Township	Figure No.
Carpentier	52, 53
Courville	53
Rochebaucourt	52
Senneville	49, 50, 51
Vassan	48

SUMMARY

A total of 1, 375 seismic refraction profiles were completed, covering approximately 340 line-miles in the Timmins-Val d'Or region. The work was accomplished utilizing eight FS-3 portable refraction seismic instruments in a working time of 82 crew weeks (3-man crews). Difficulties of winter operation were successfully overcome, and it was possible to meet the objectives of the survey.

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Figures 1 to 58

Figures 1 to 53. Seismic section showing subsurface apparent velocities (kilo-feet per second) and interfaces.

Figure 54. Seismic station locations in the Timmins, Ontario area.

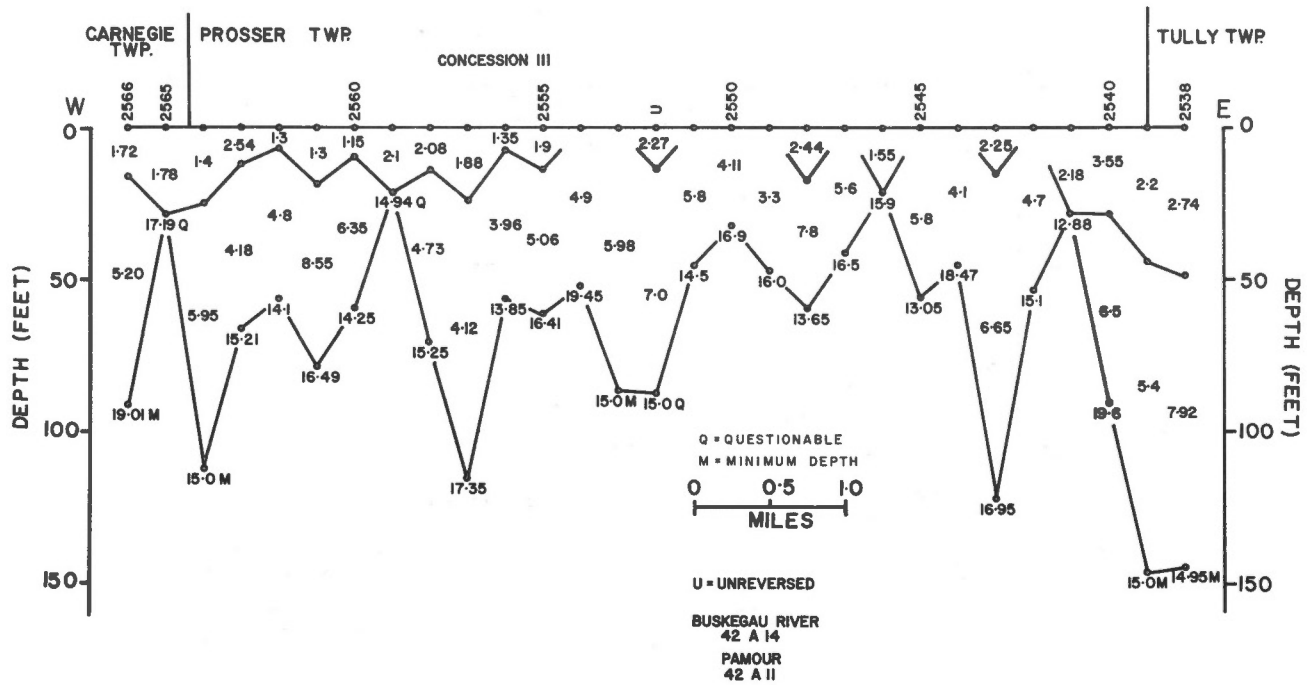
55. Seismic station locations in the La Sarre, Quebec area.

56. Seismic station locations in the area of the Kam Kotia Mine and Jameland Mine, Ontario.

57. Seismic station locations in part of the Val d'Or, Quebec area.

58. Seismic station locations, northeast part of the Val d'Or, Quebec area.

Figure 1



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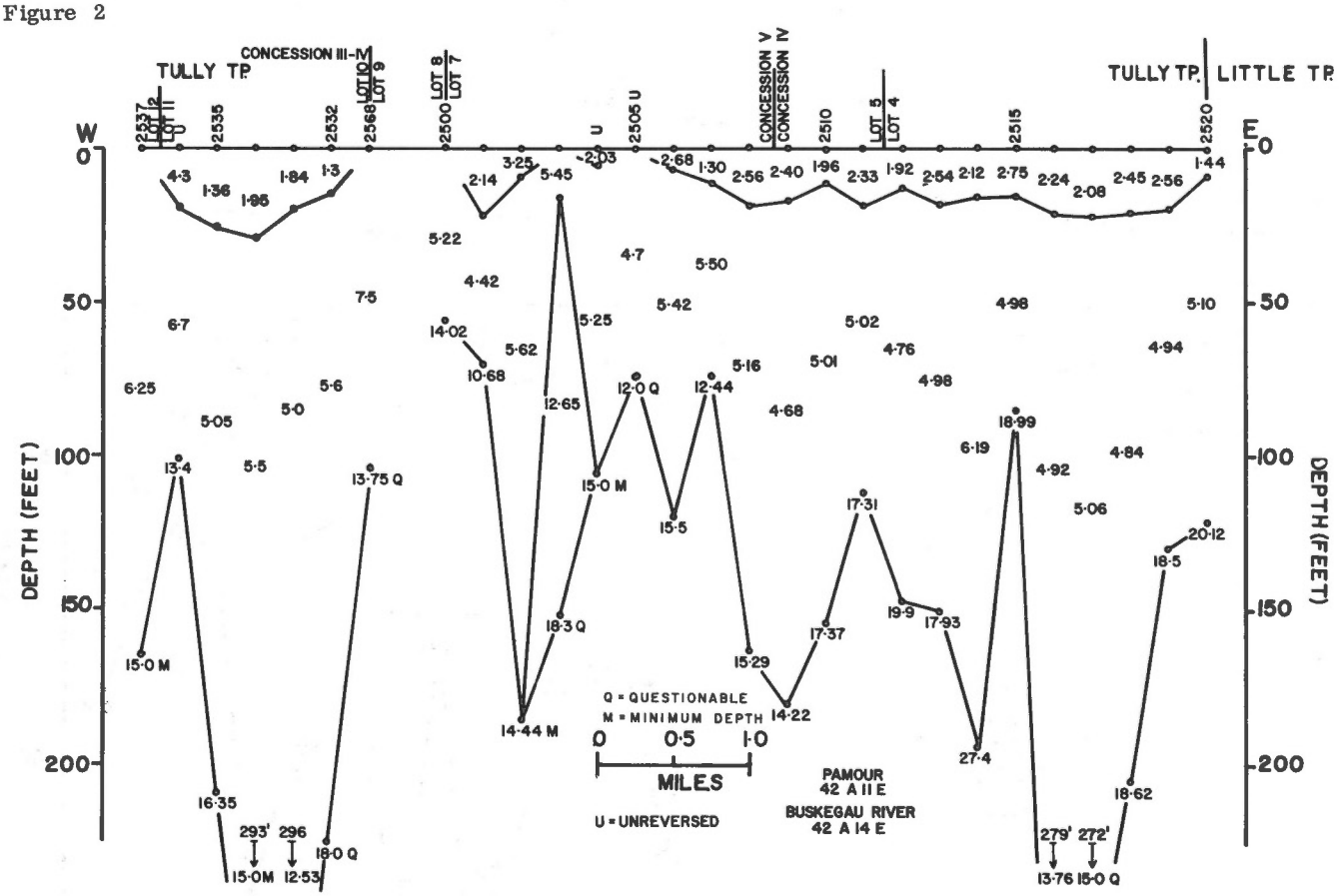

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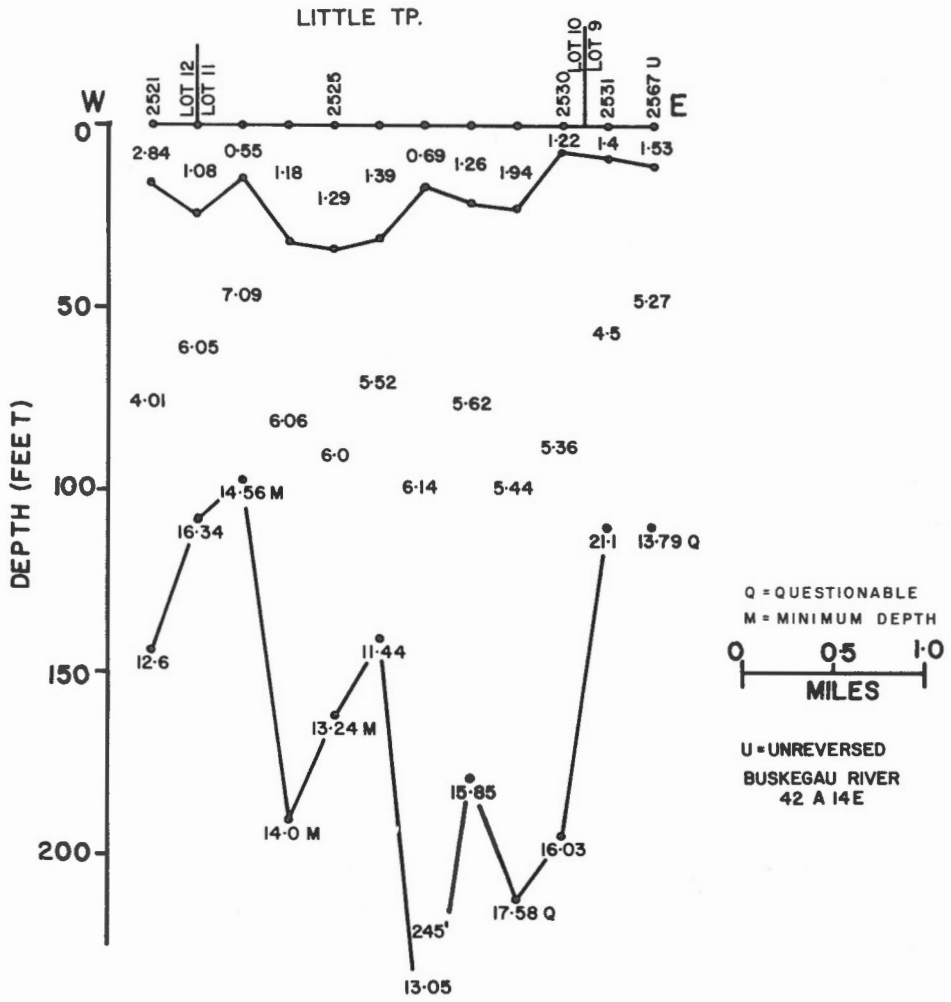

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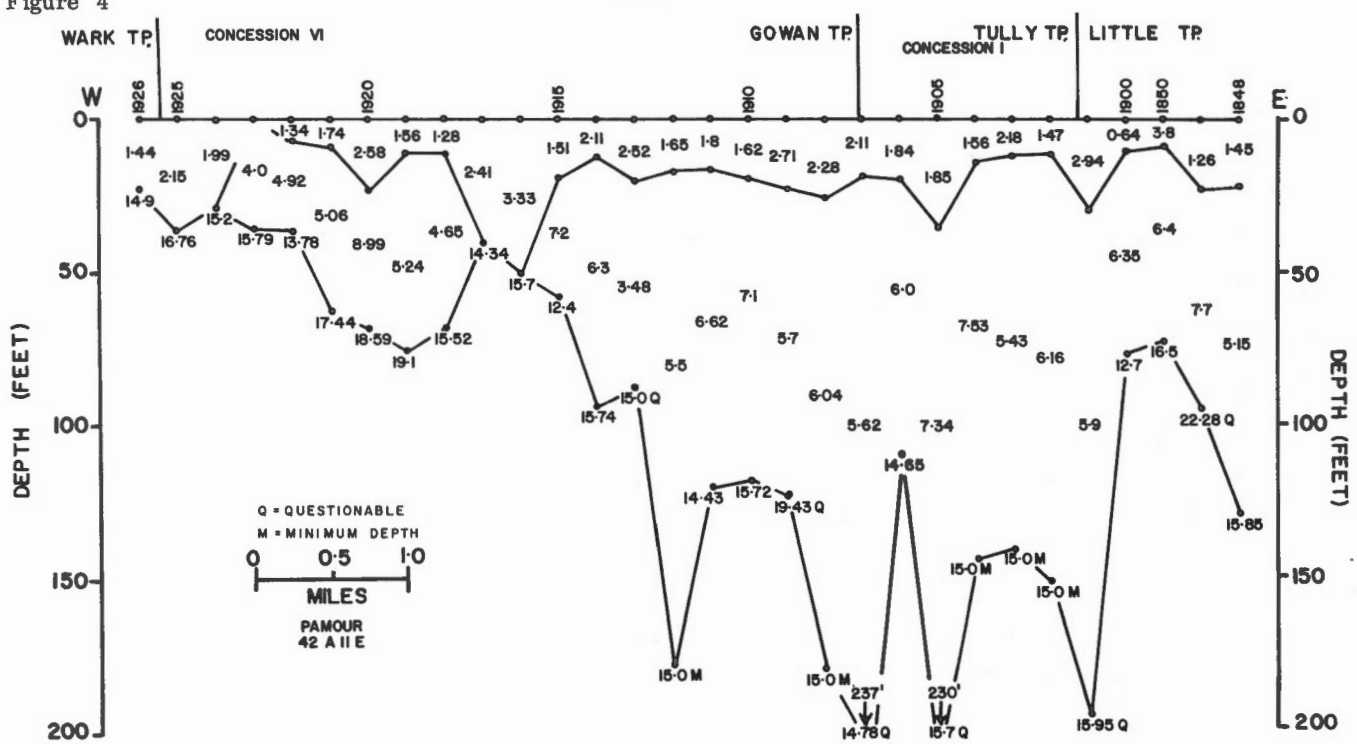

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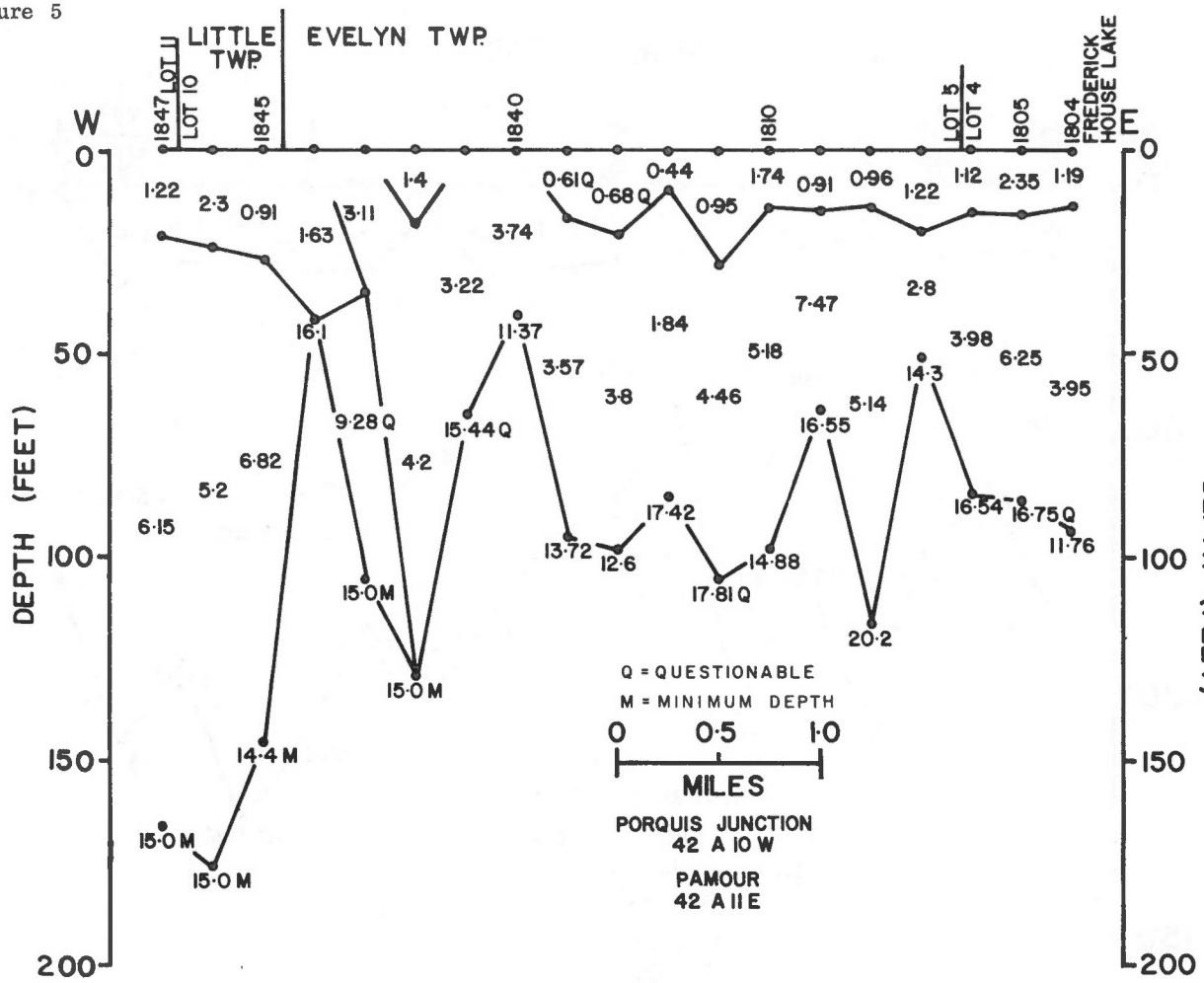

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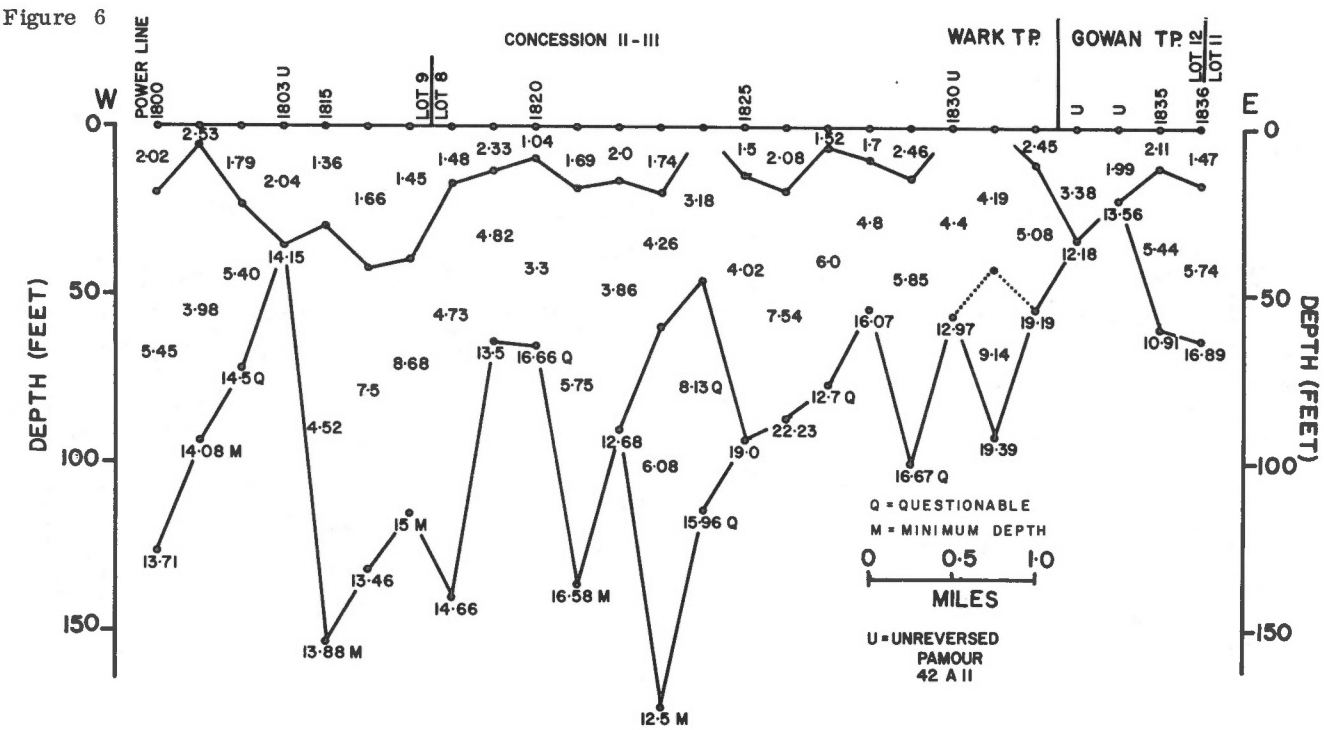

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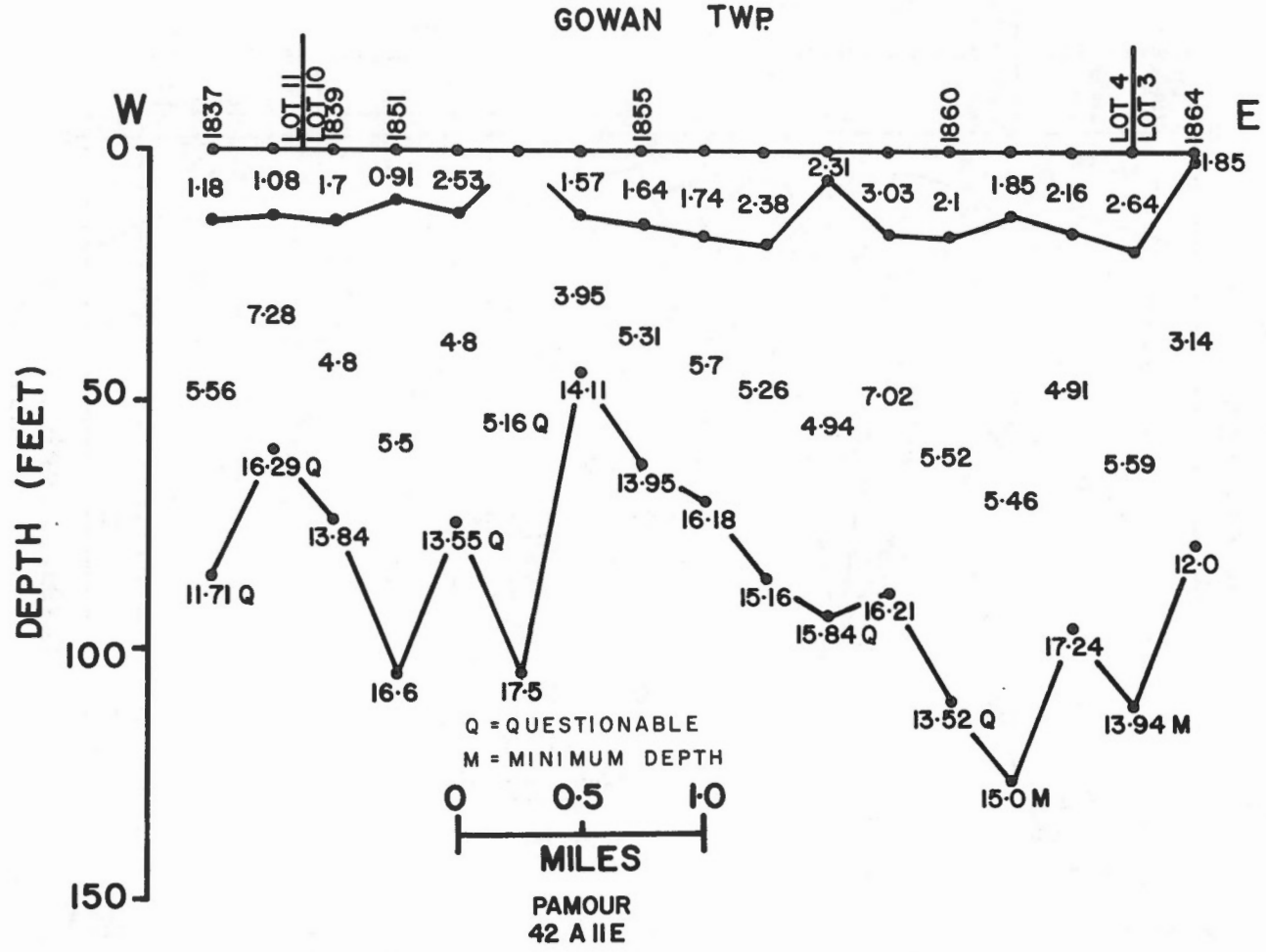

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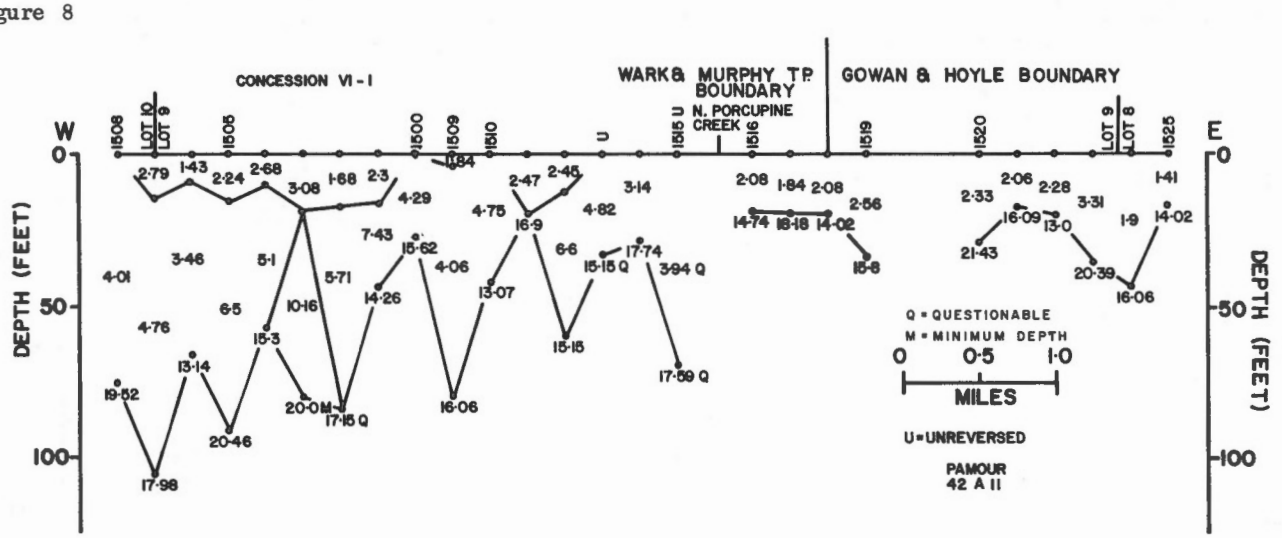

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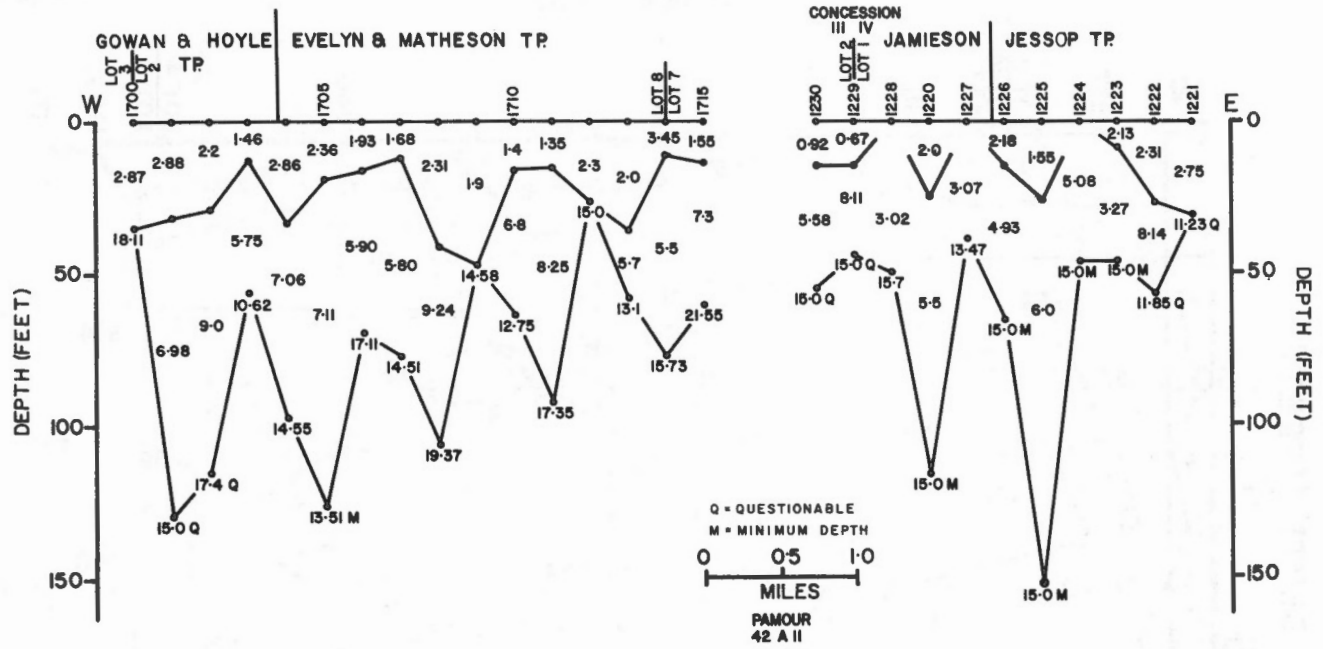

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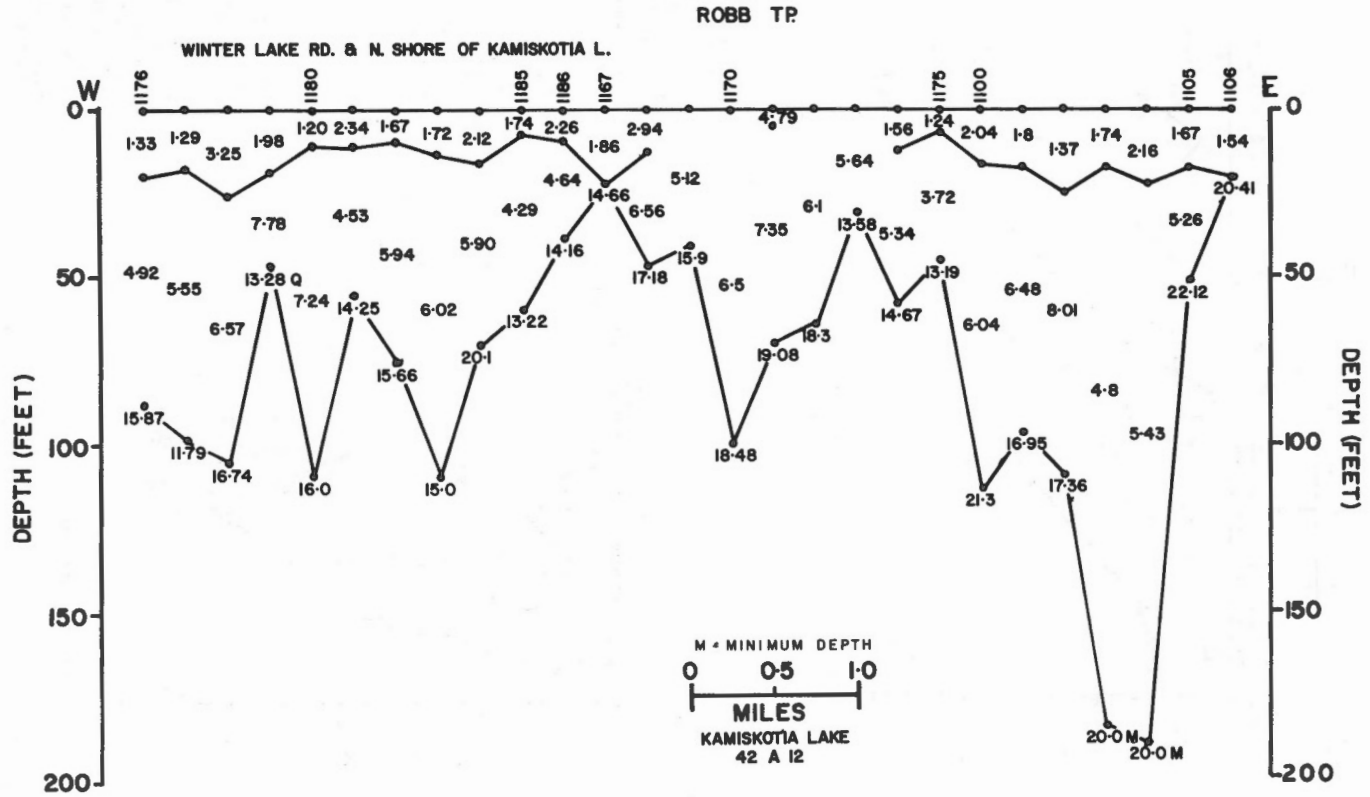

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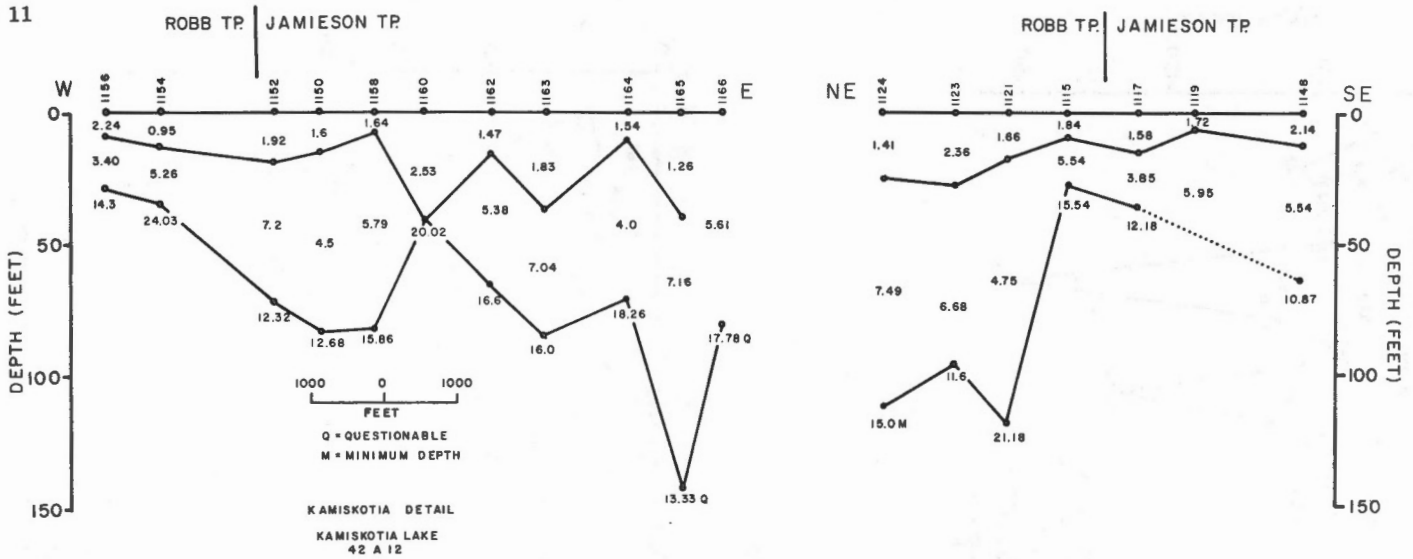

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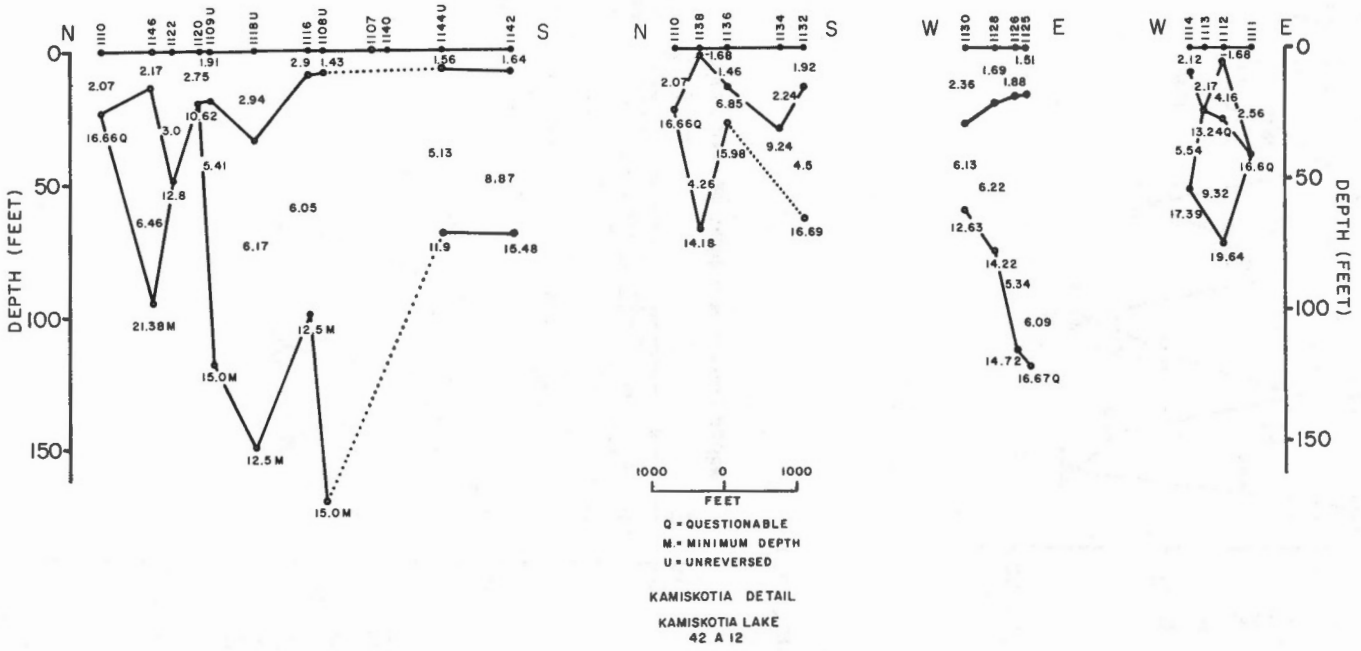

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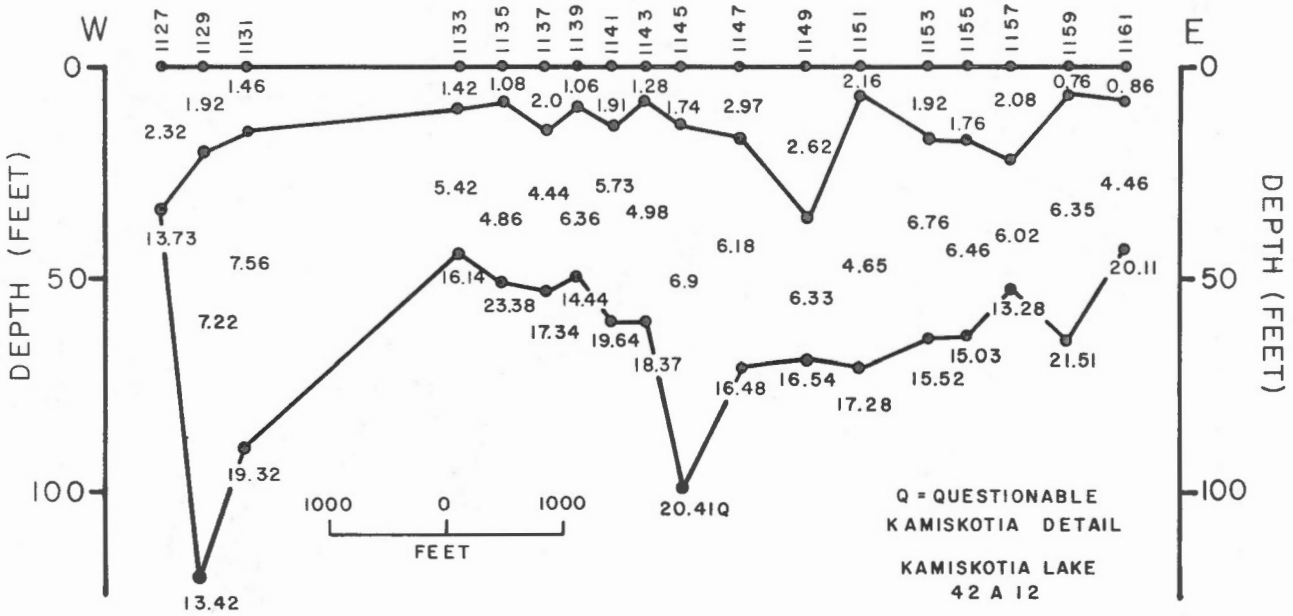

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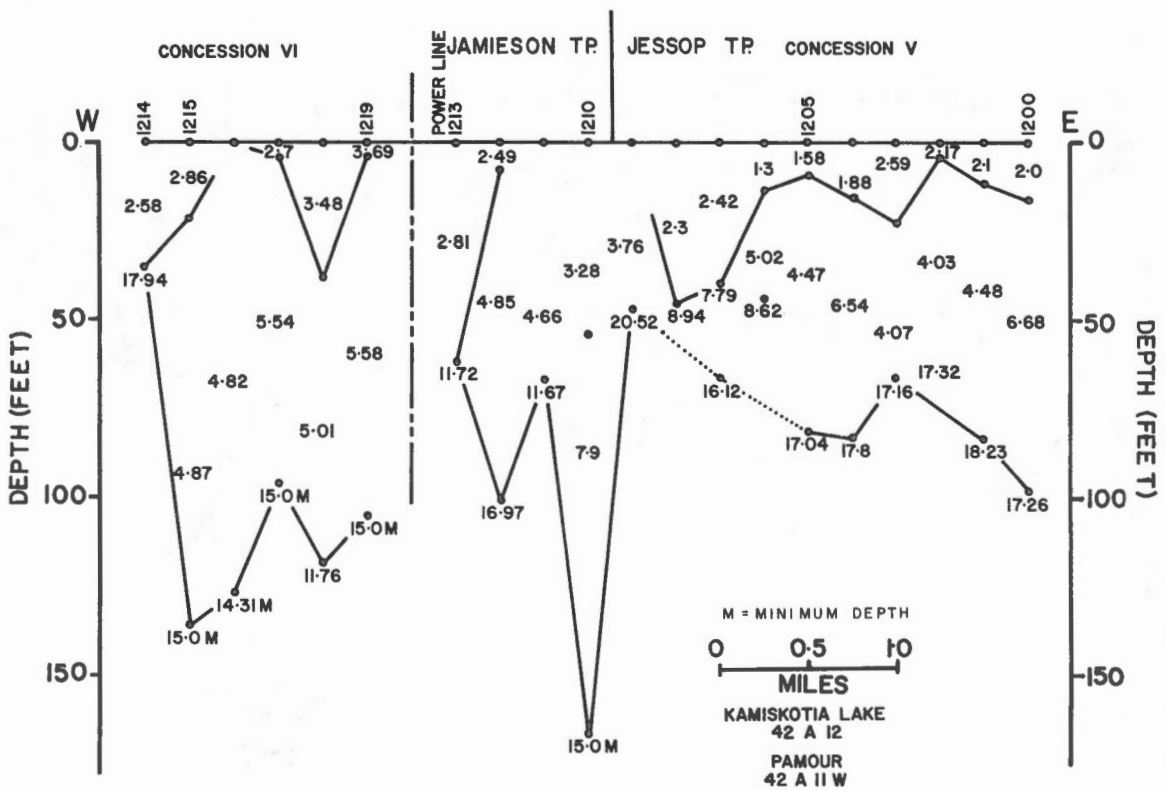

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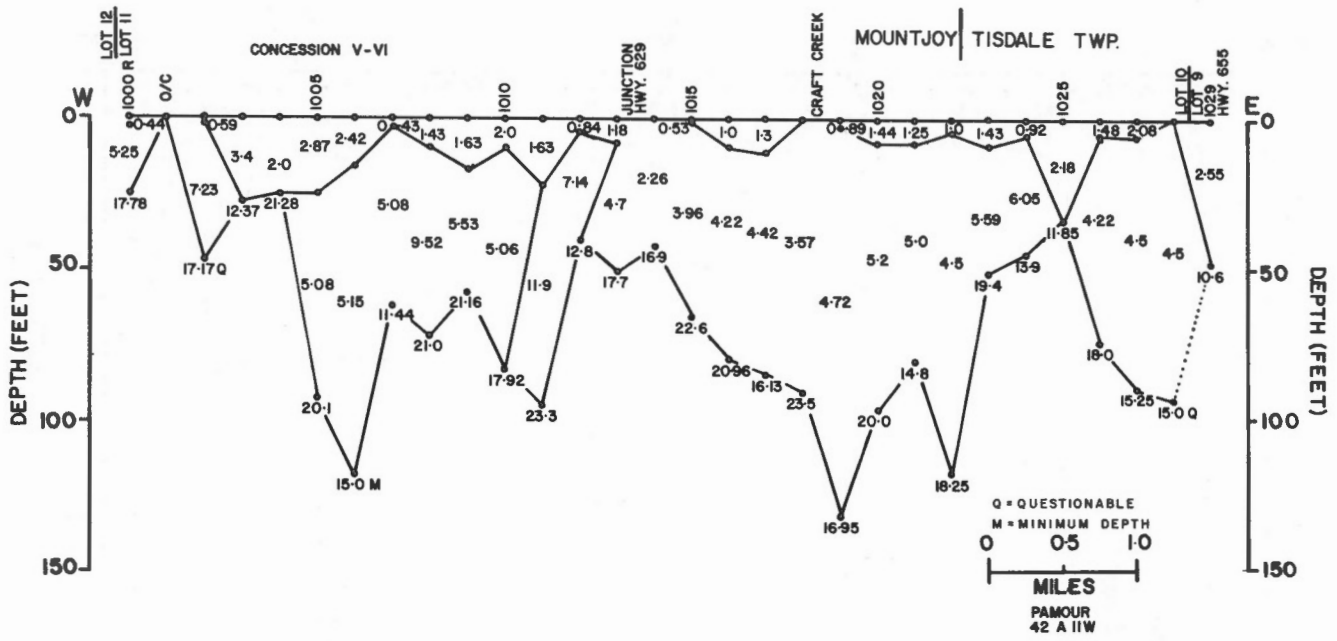

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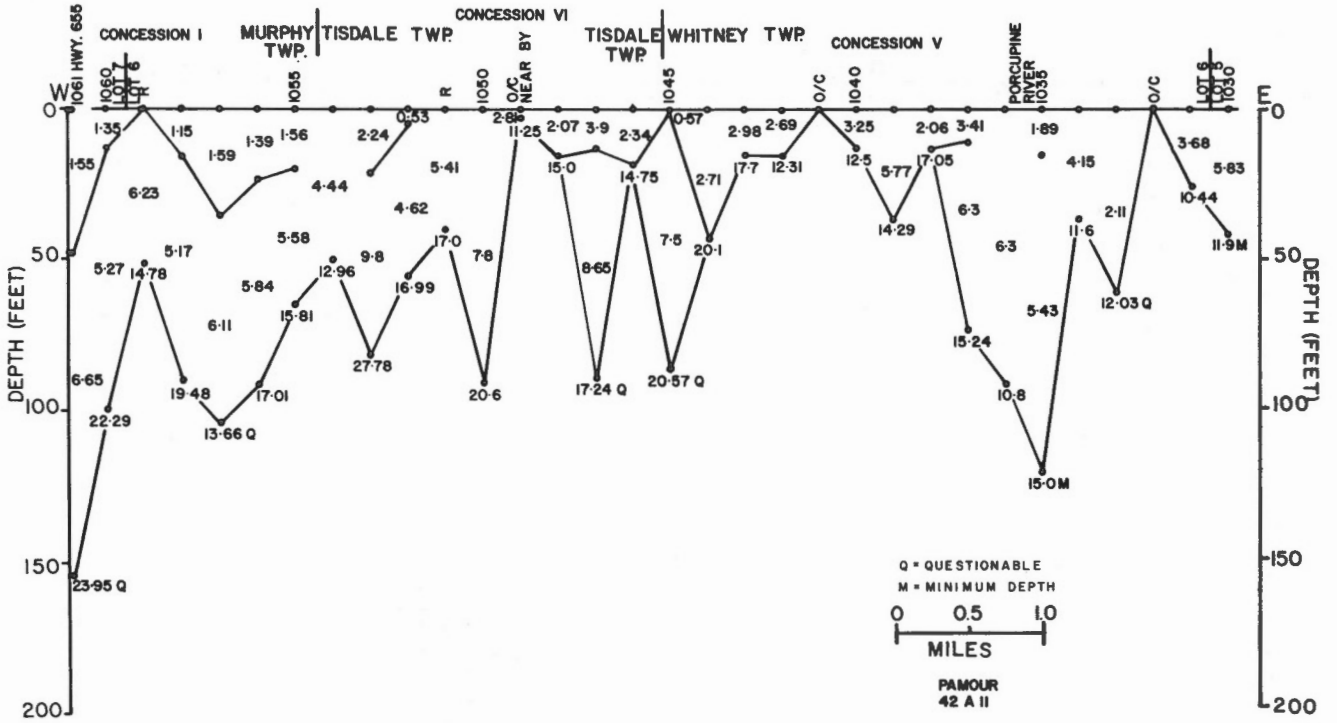

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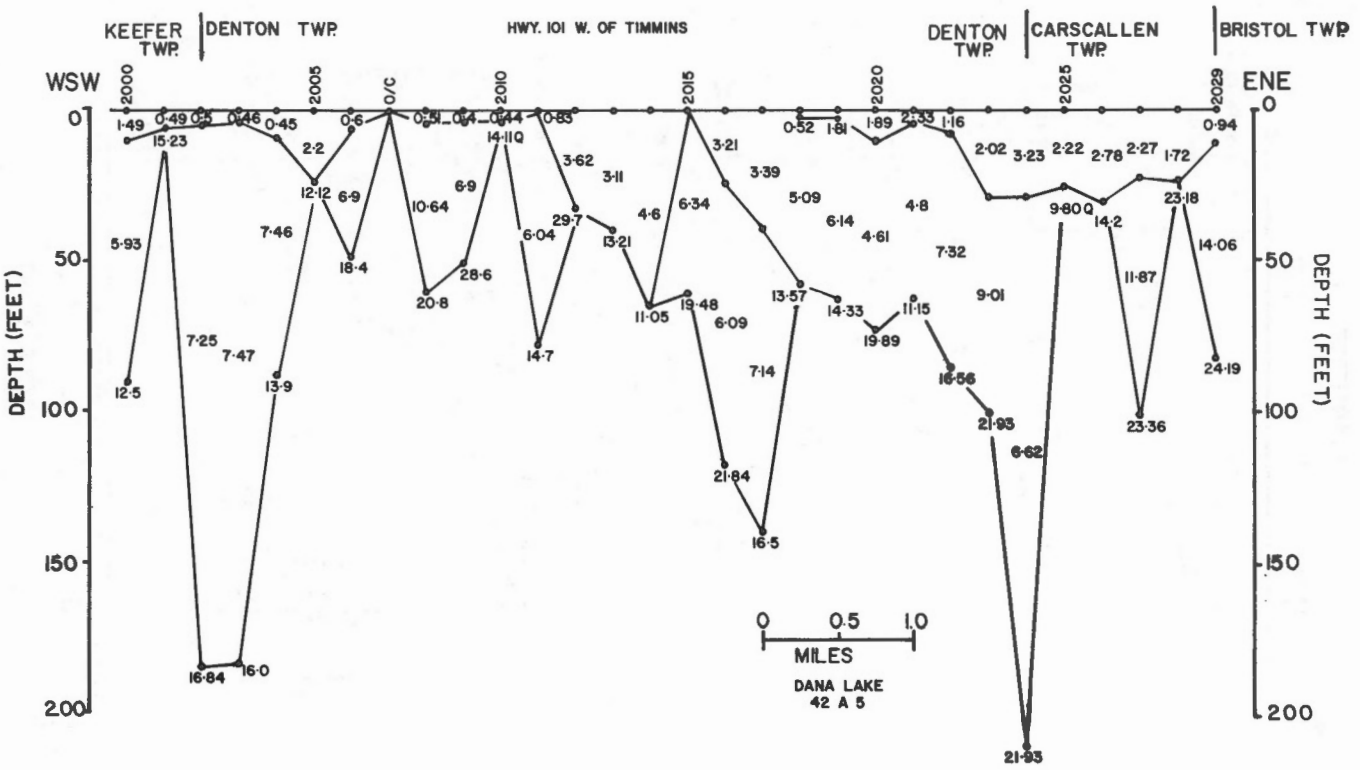

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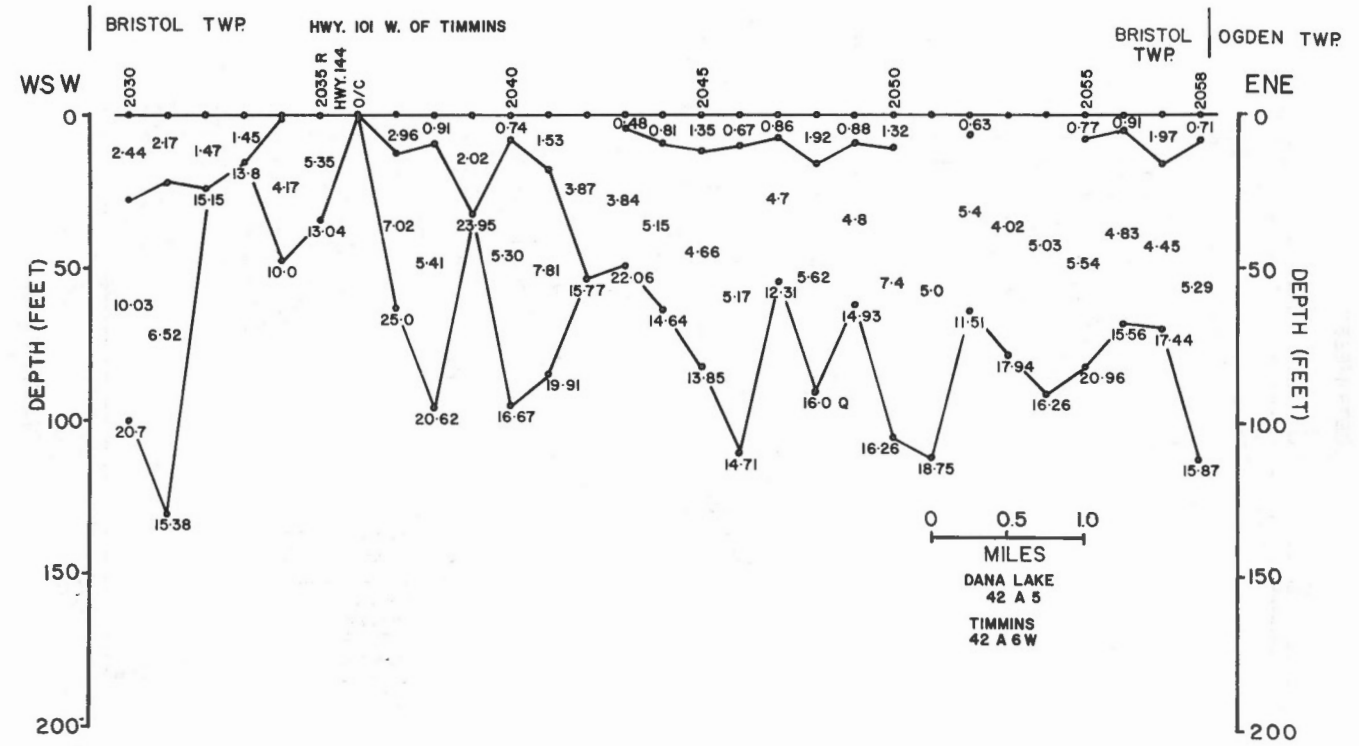

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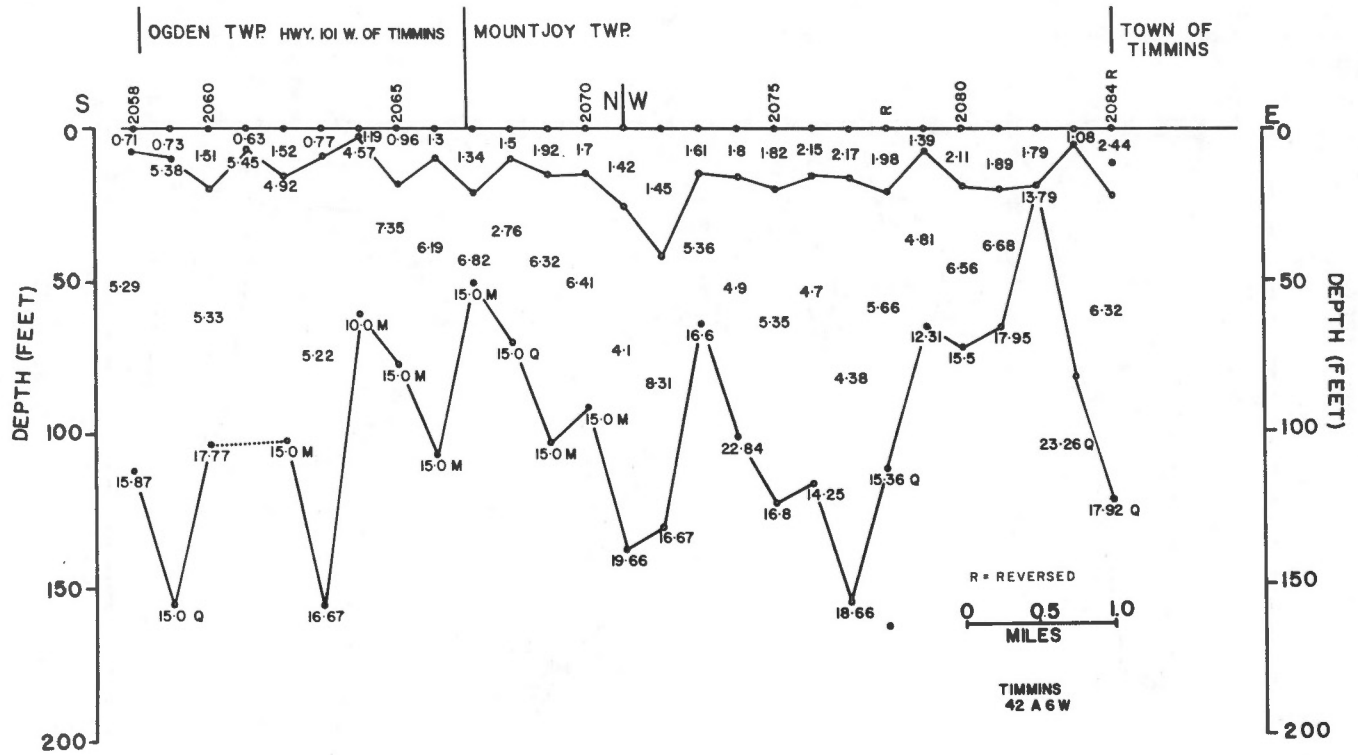

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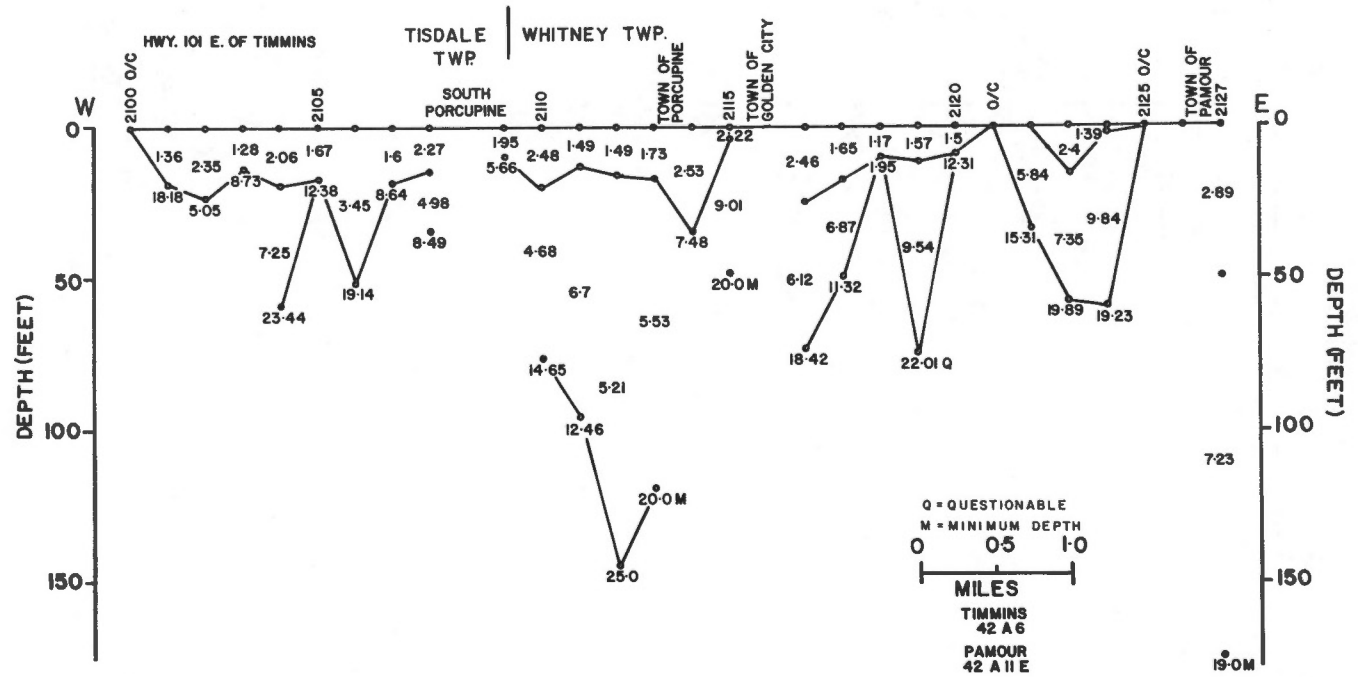

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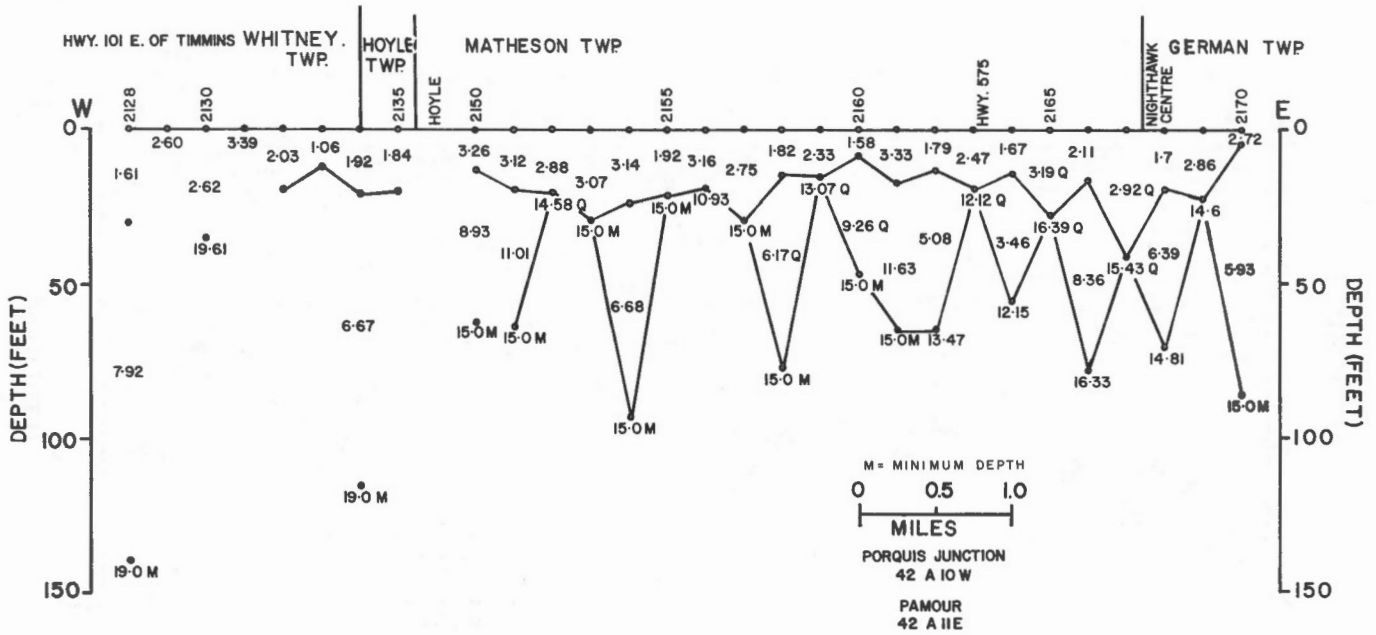

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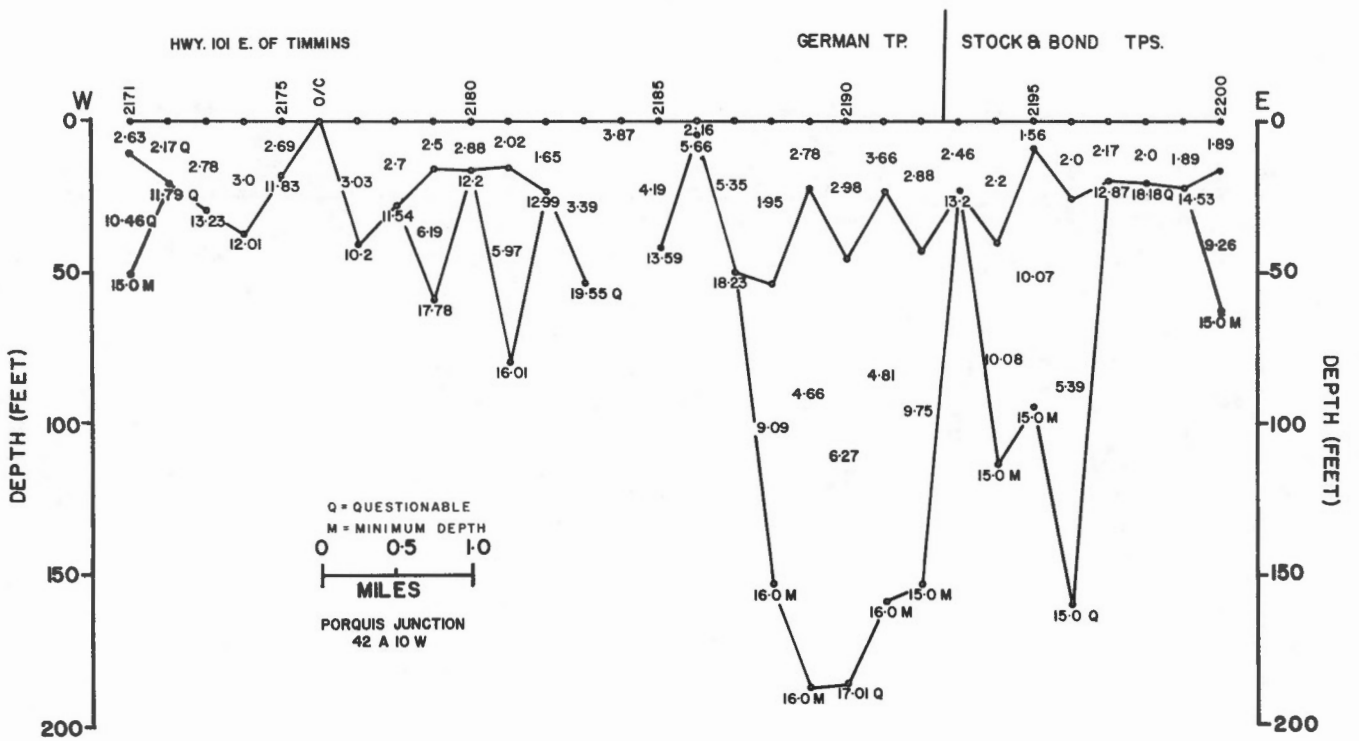

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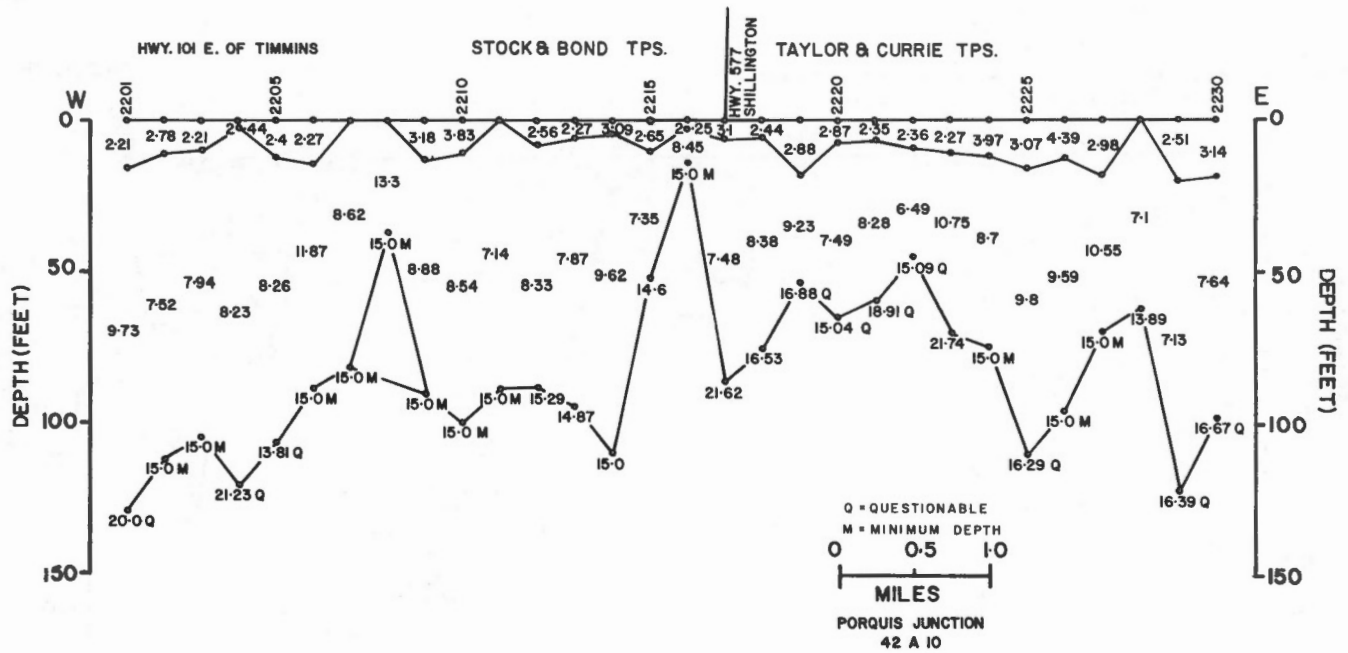

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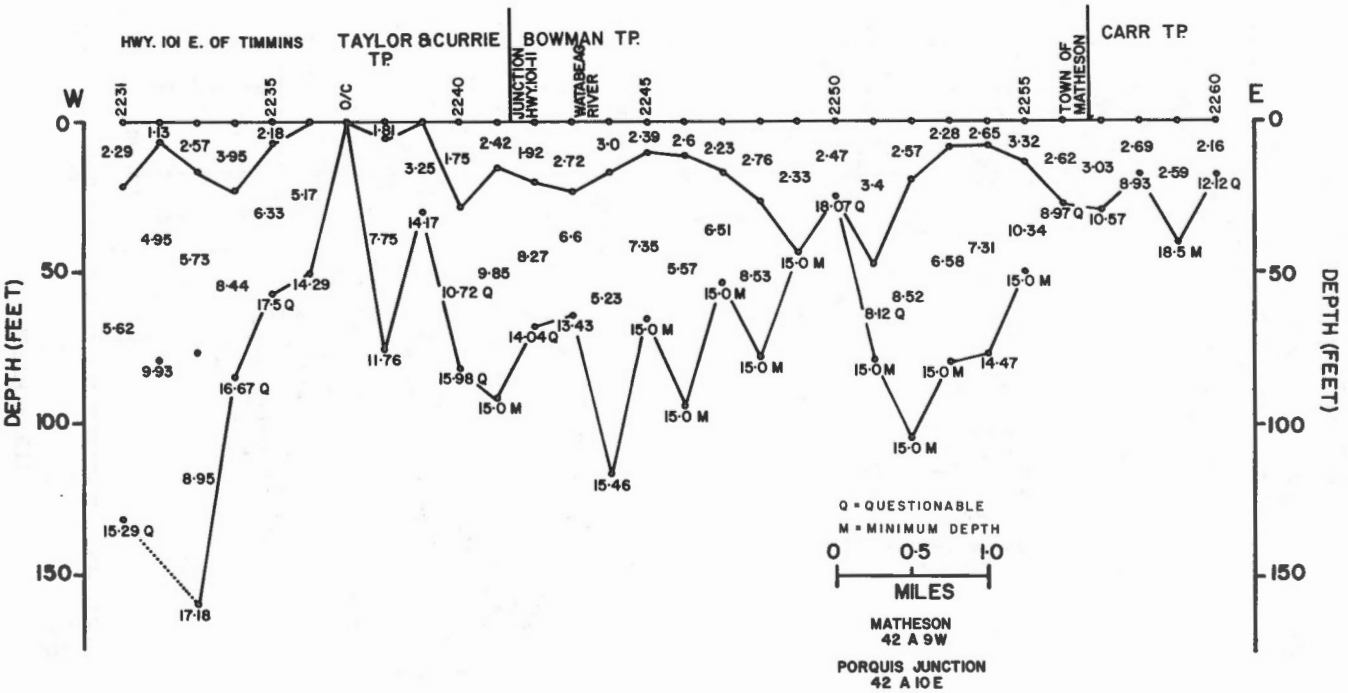

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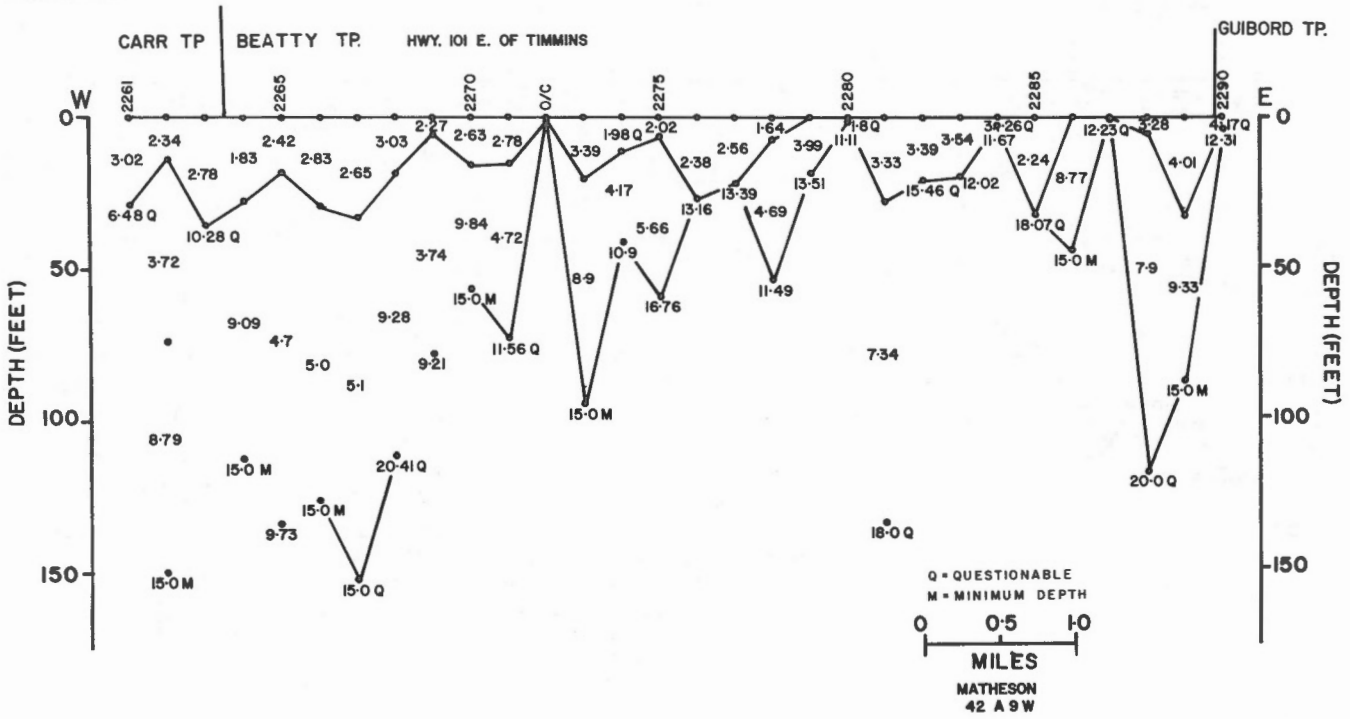

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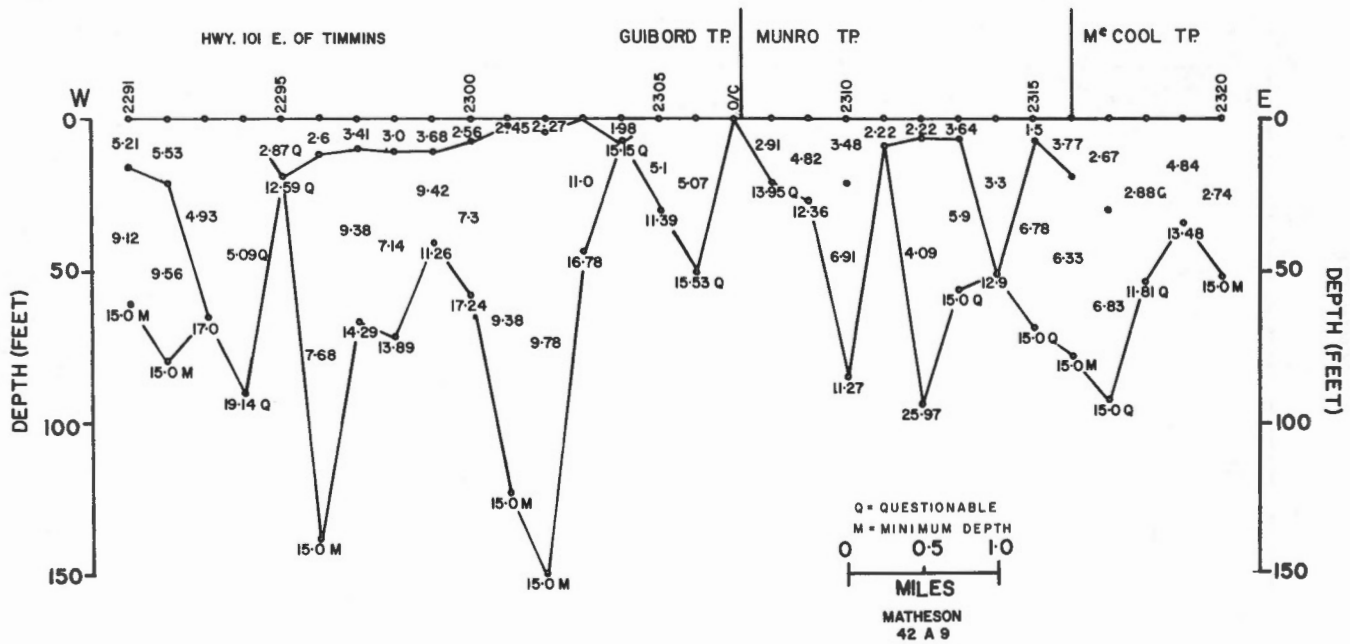

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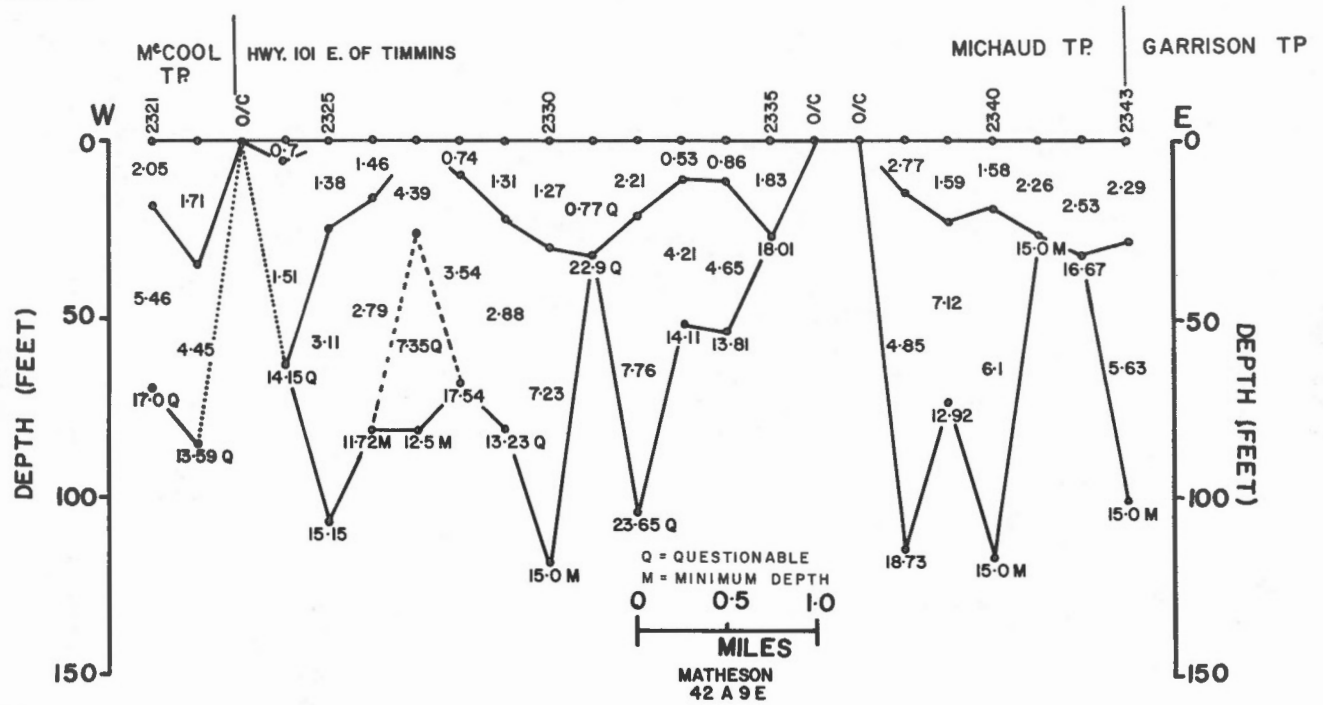

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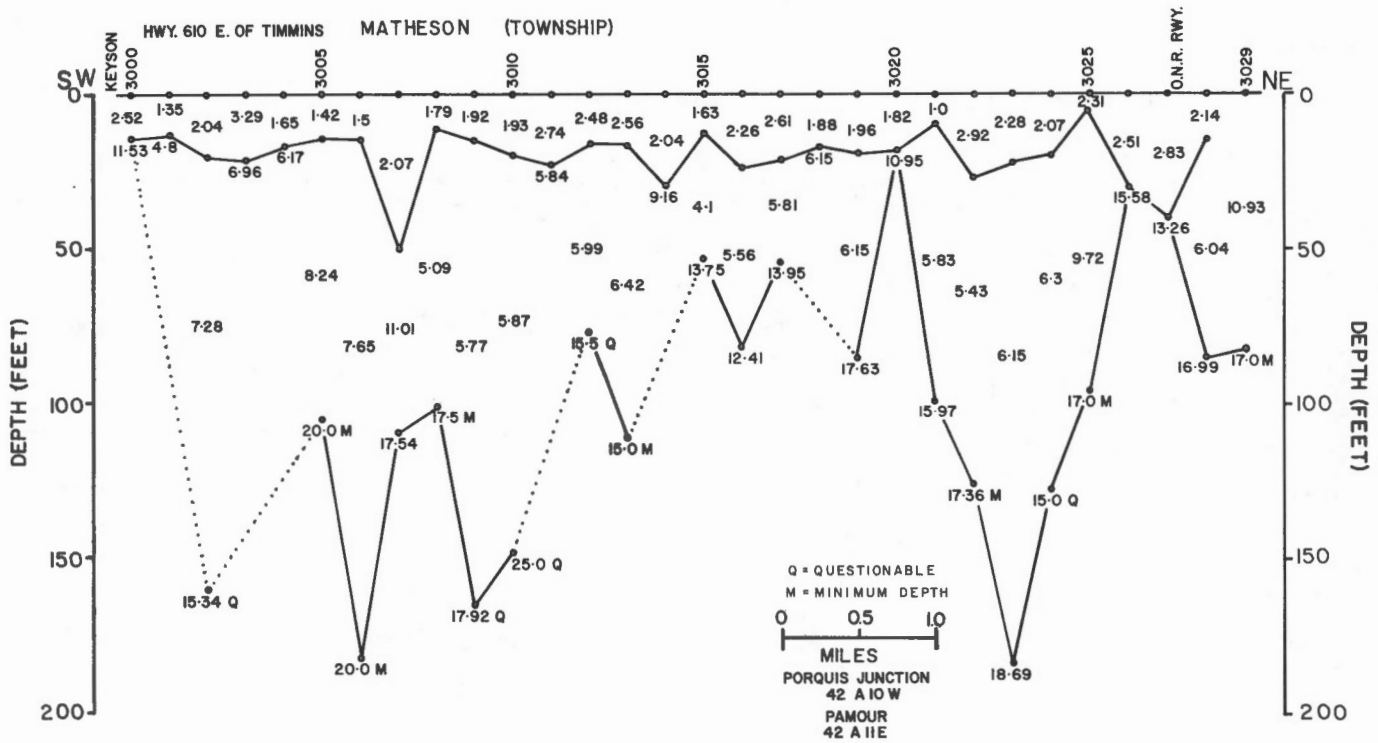

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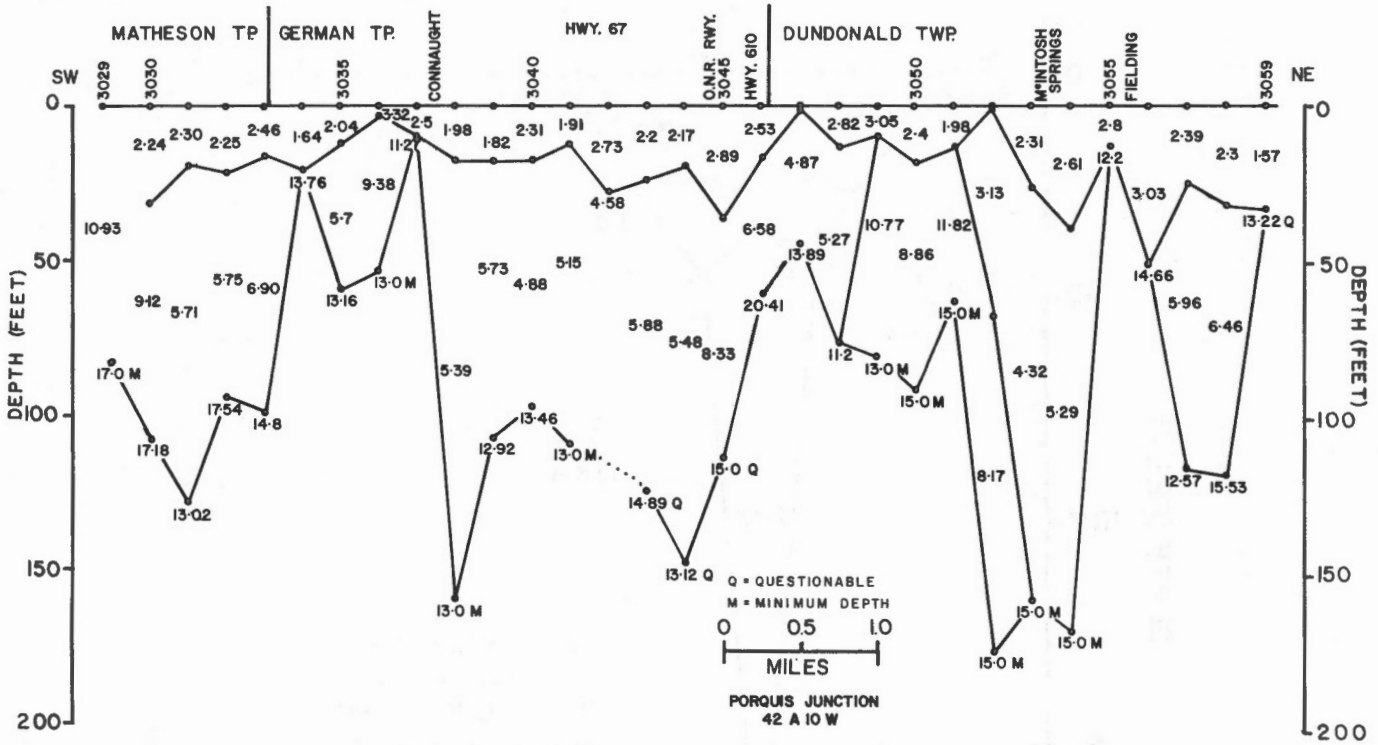

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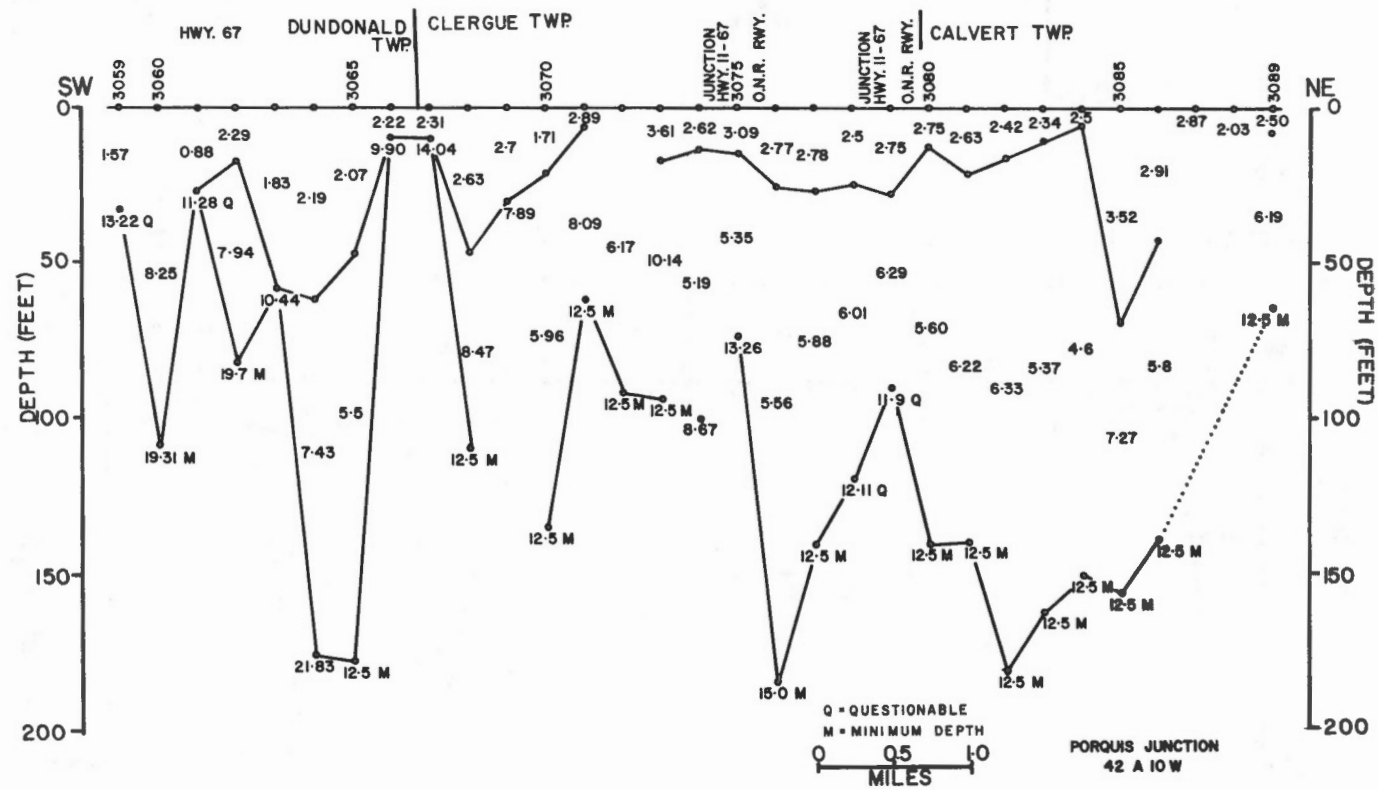

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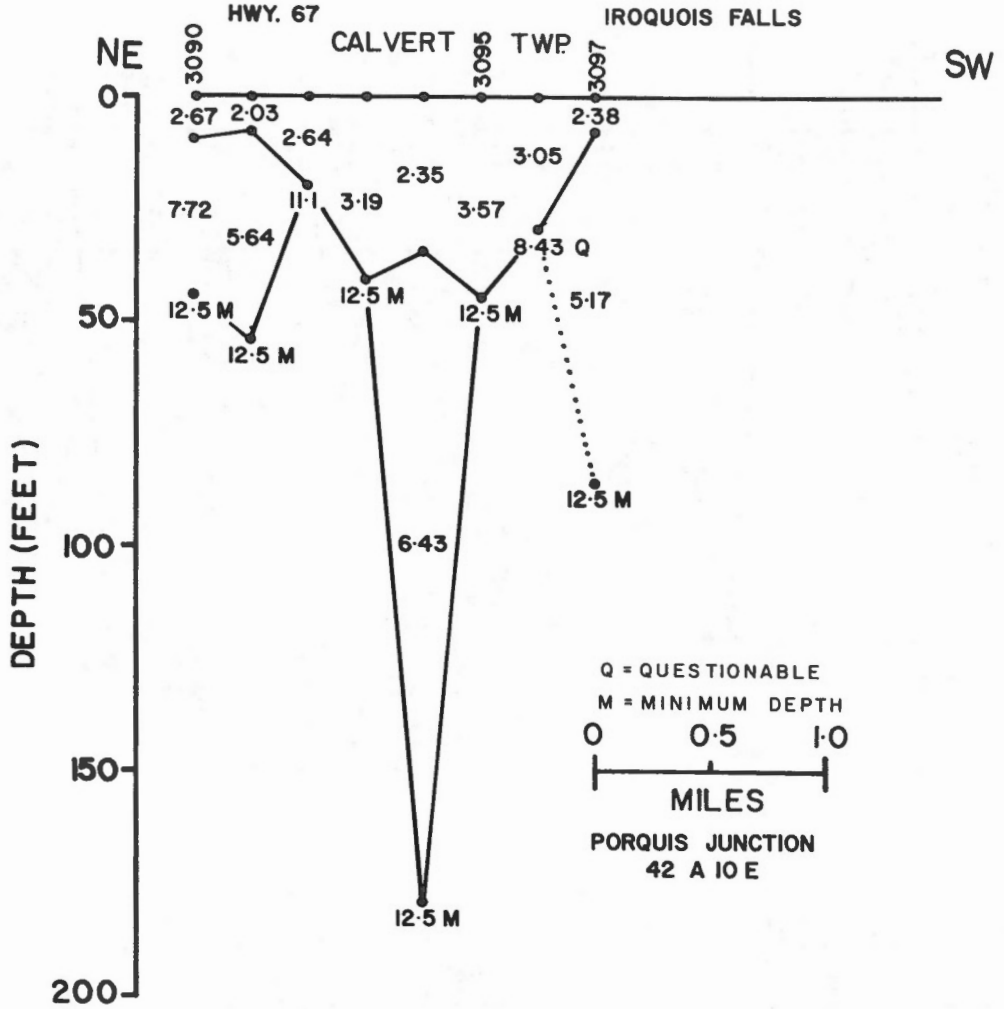

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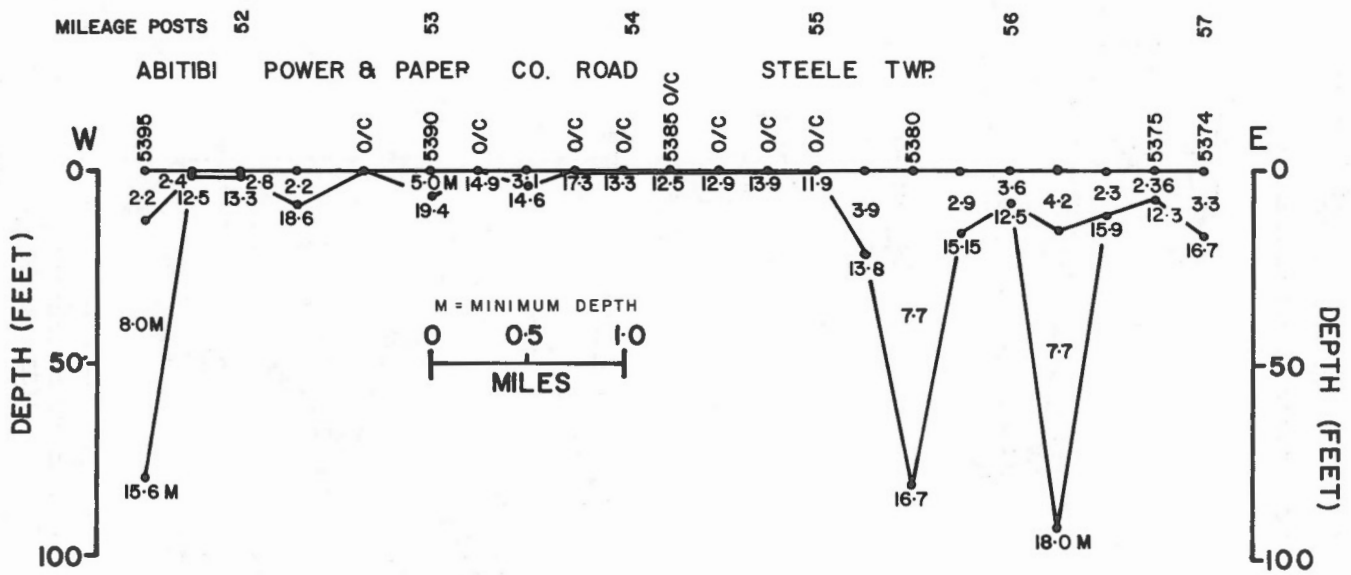


Figure 33

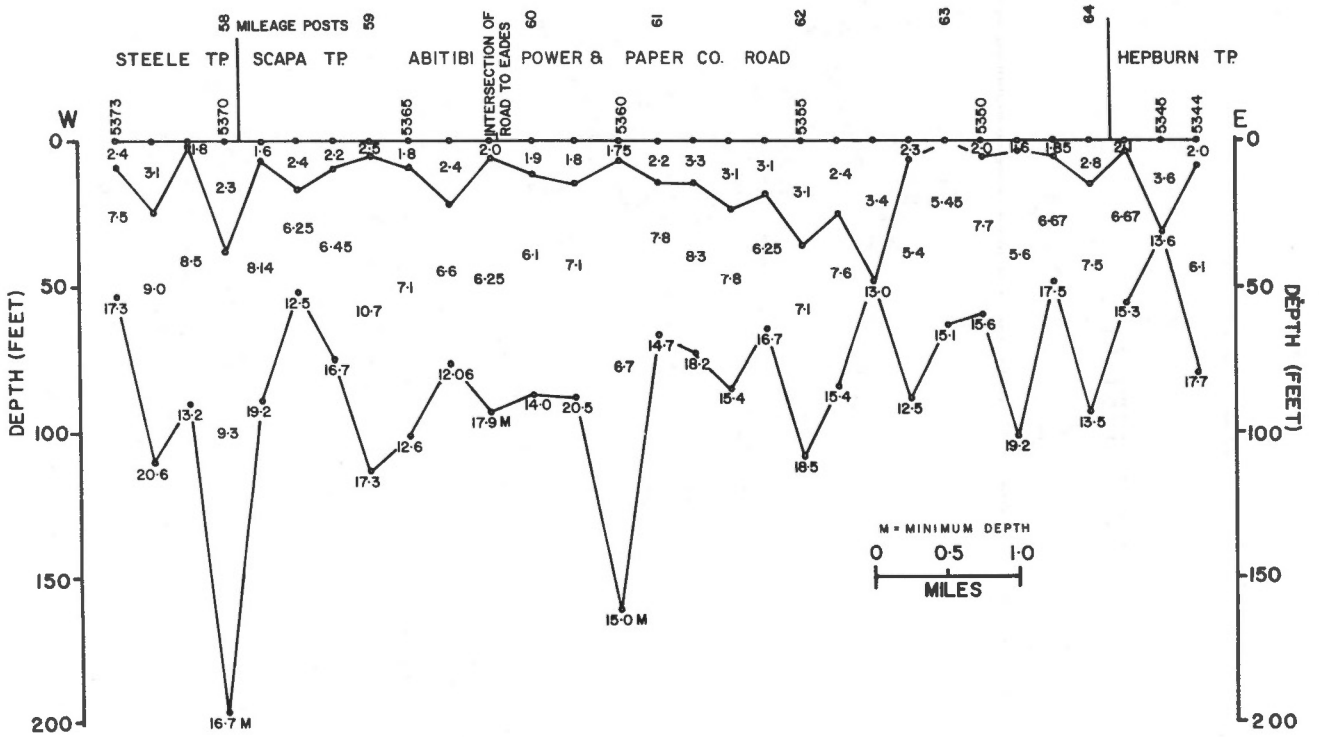
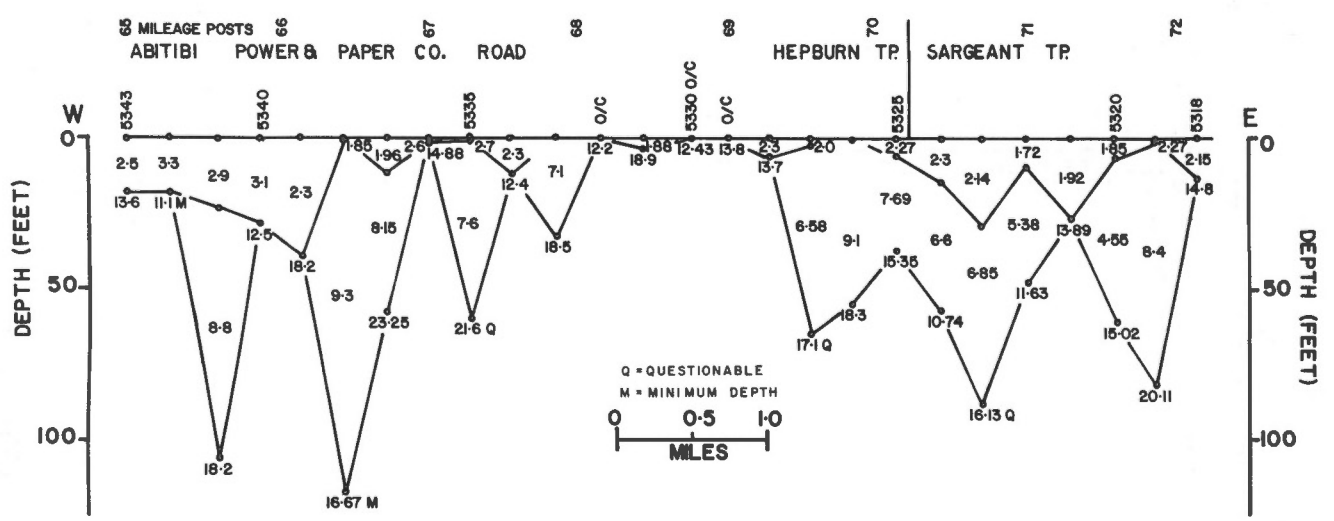


Figure 34



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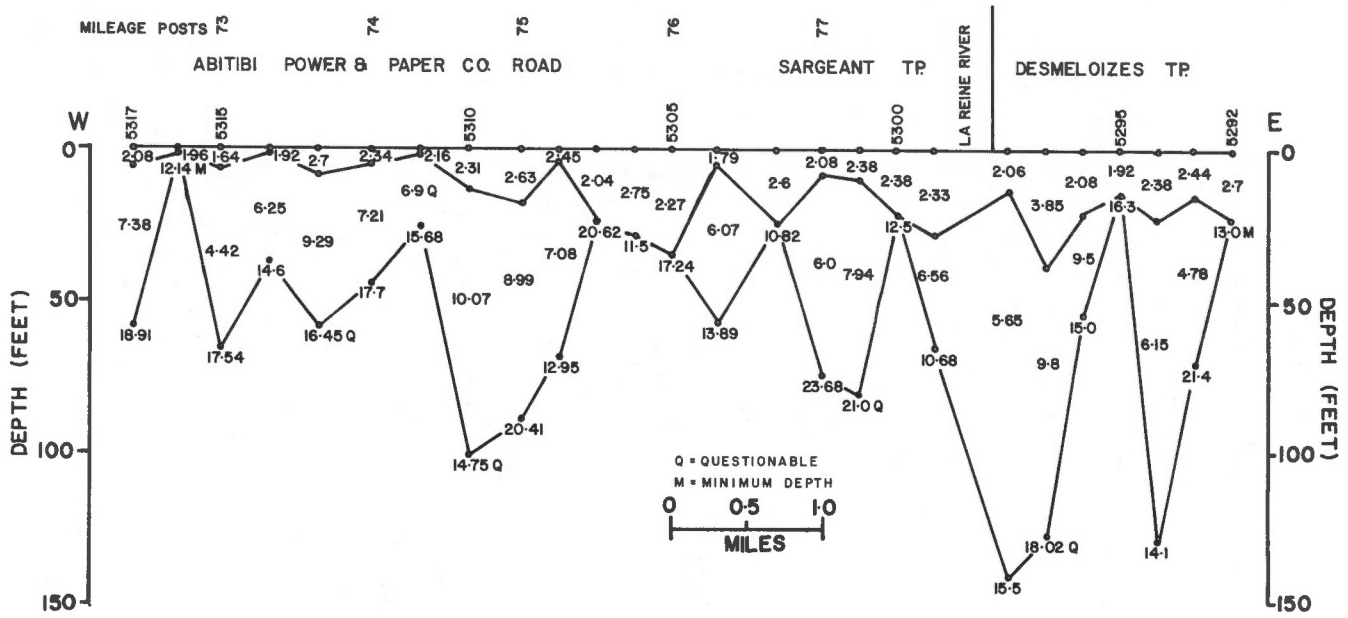

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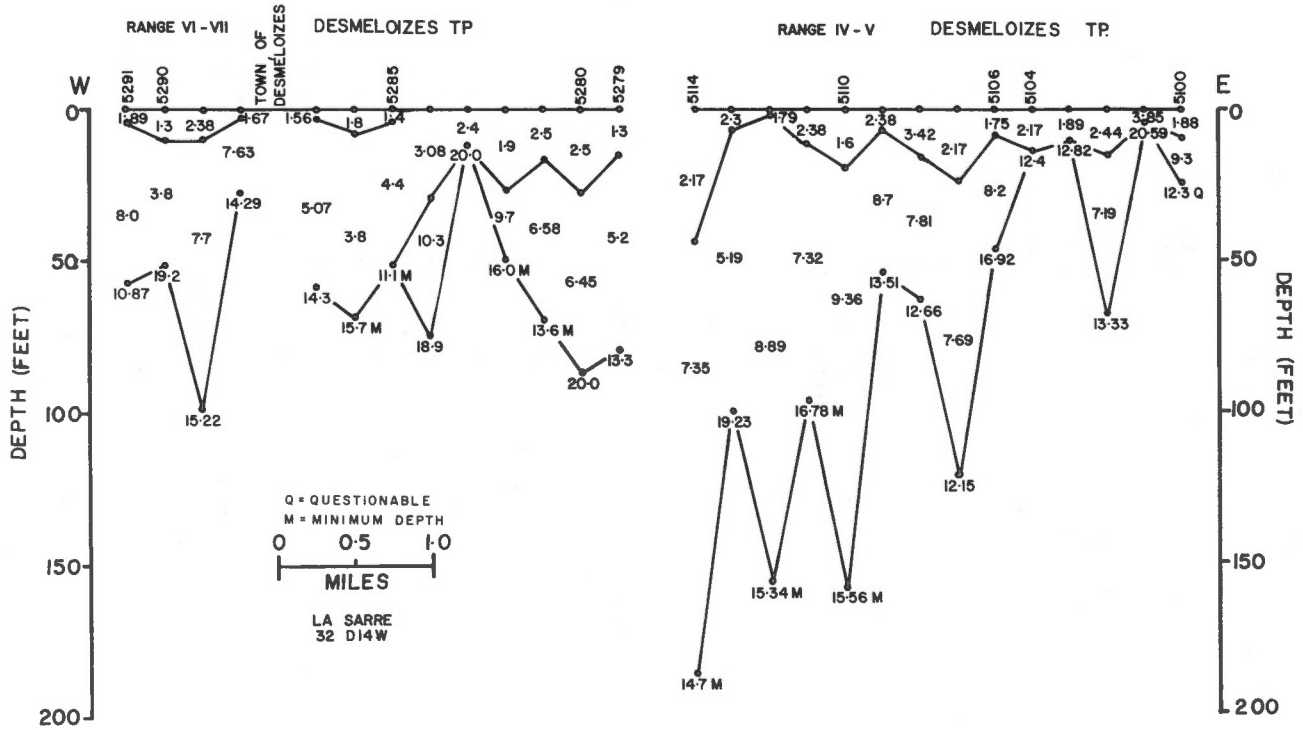

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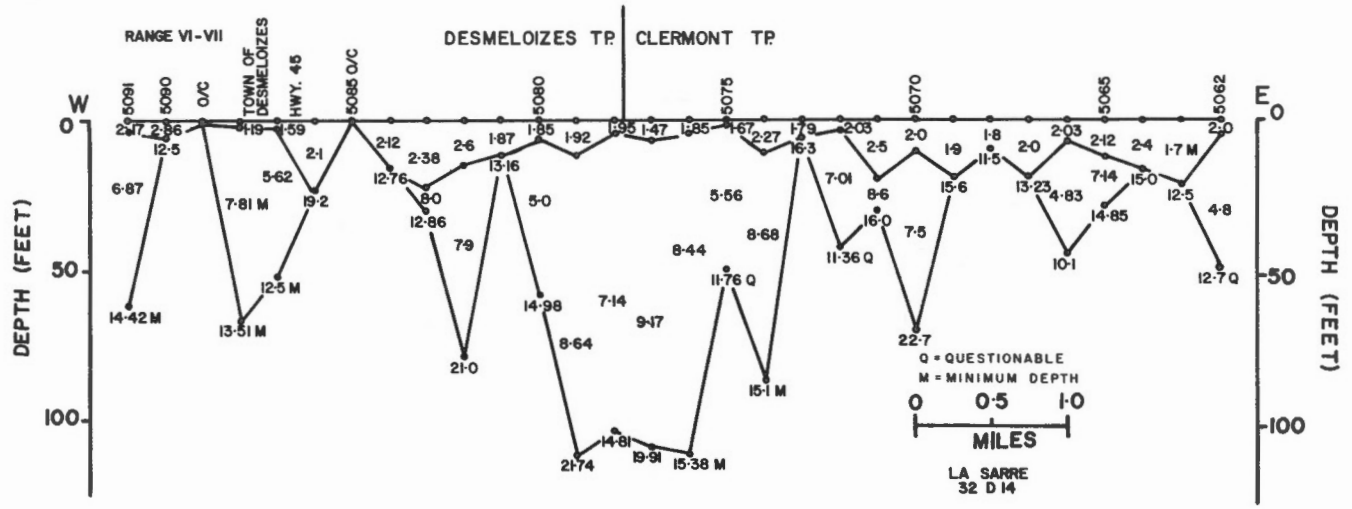

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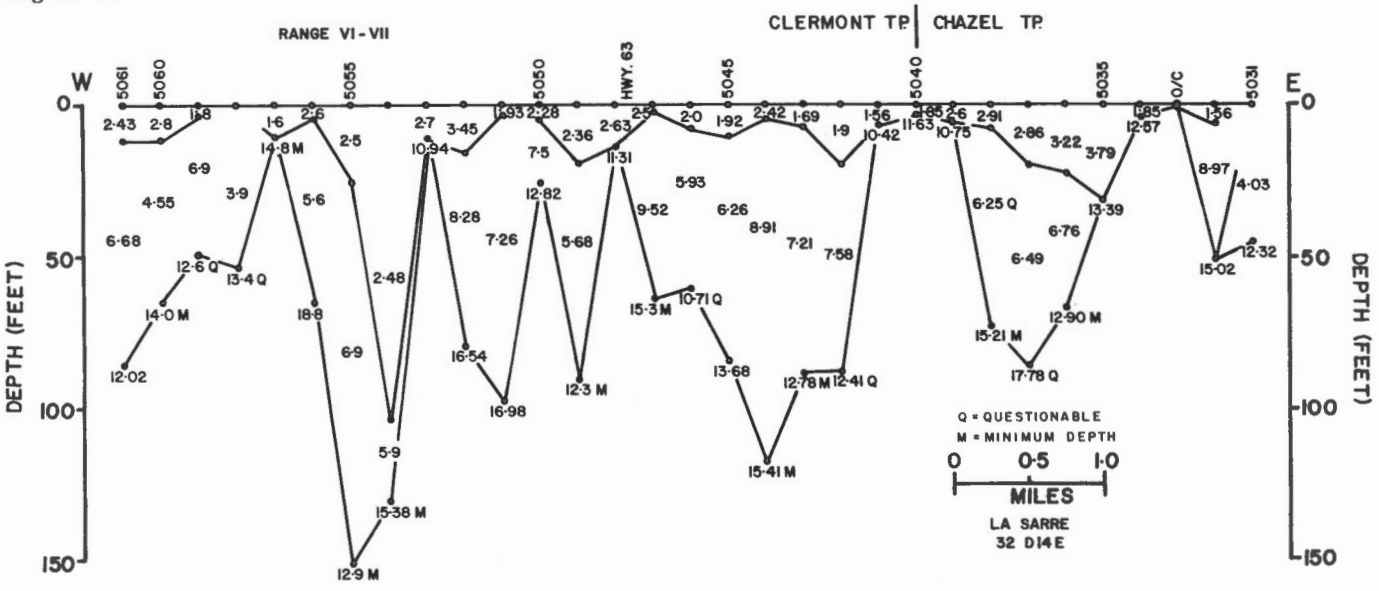

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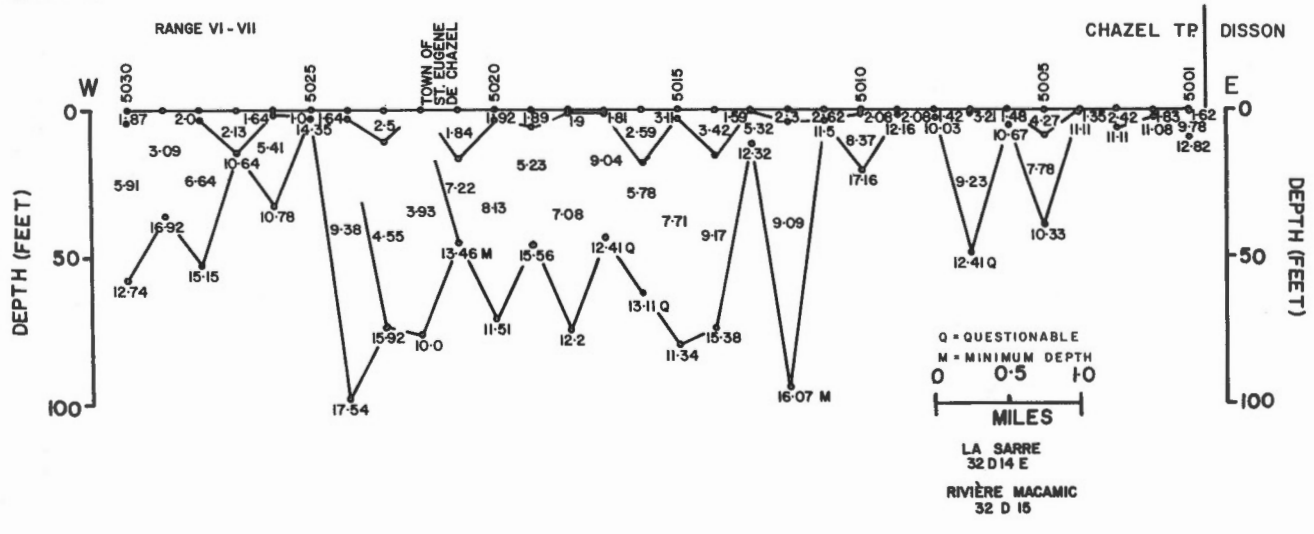

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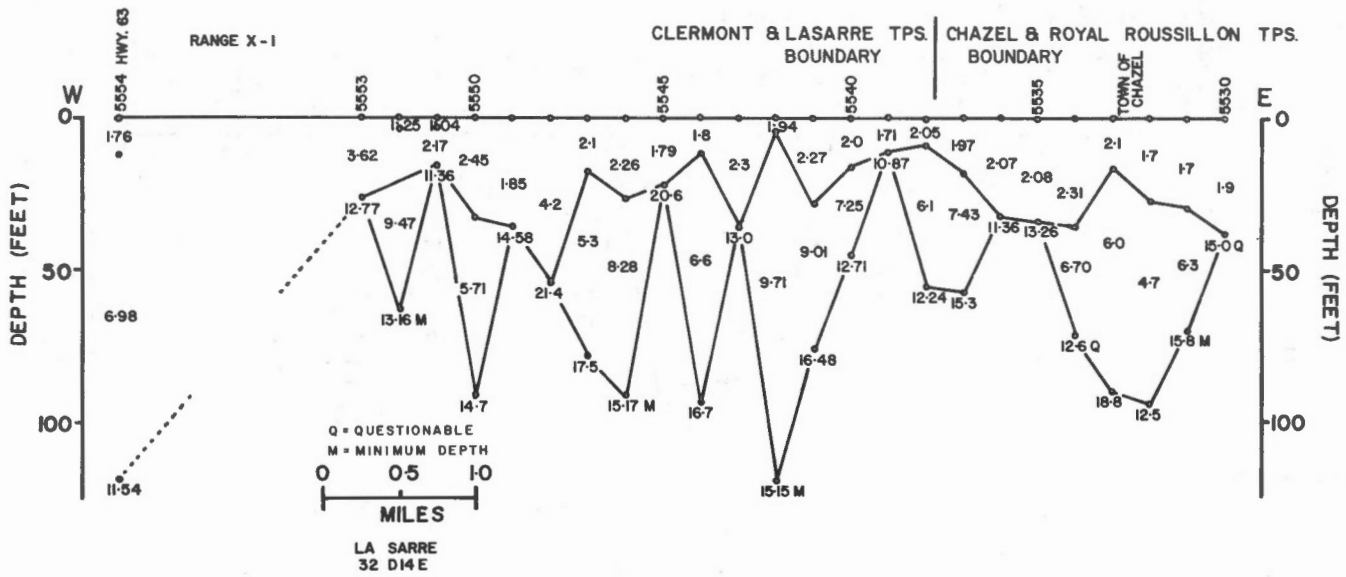

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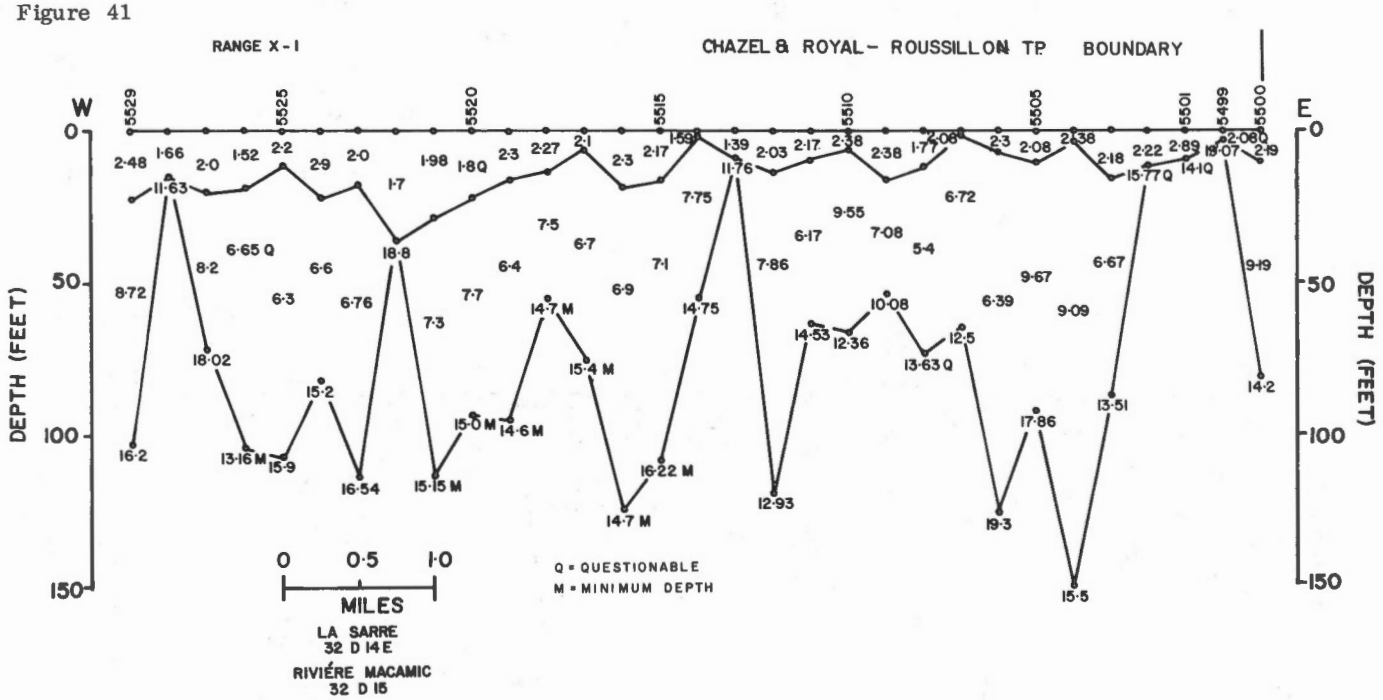

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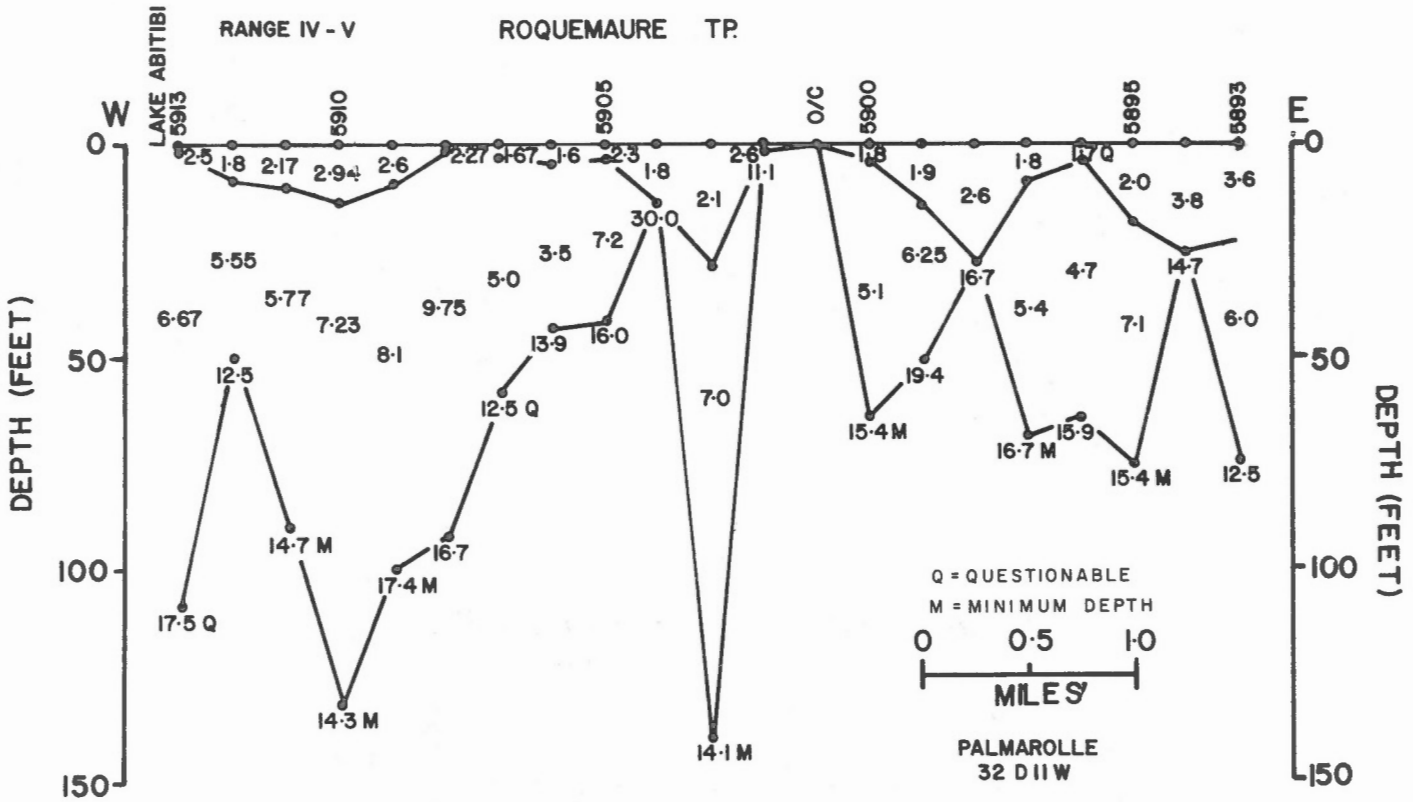
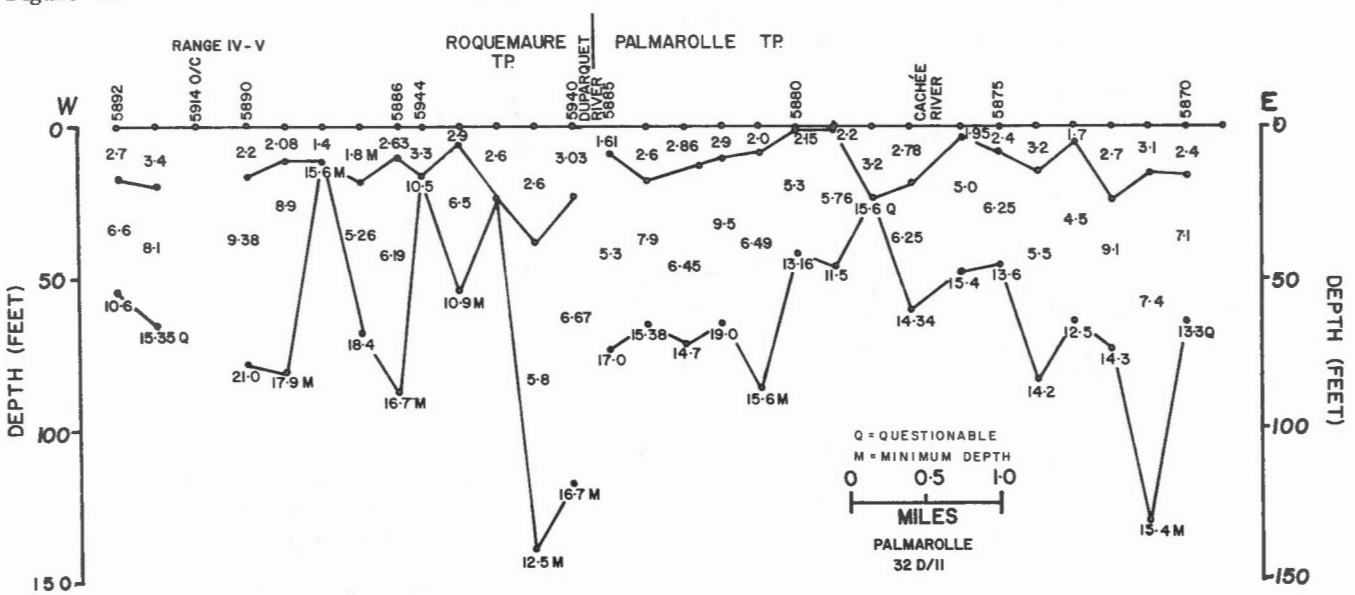


Figure 43



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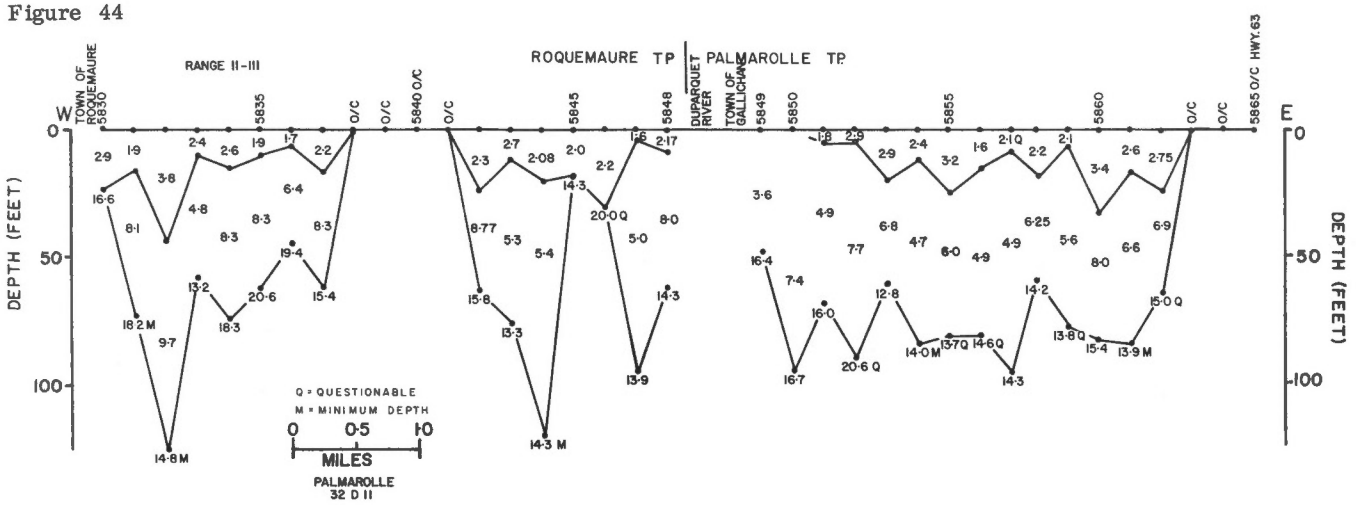

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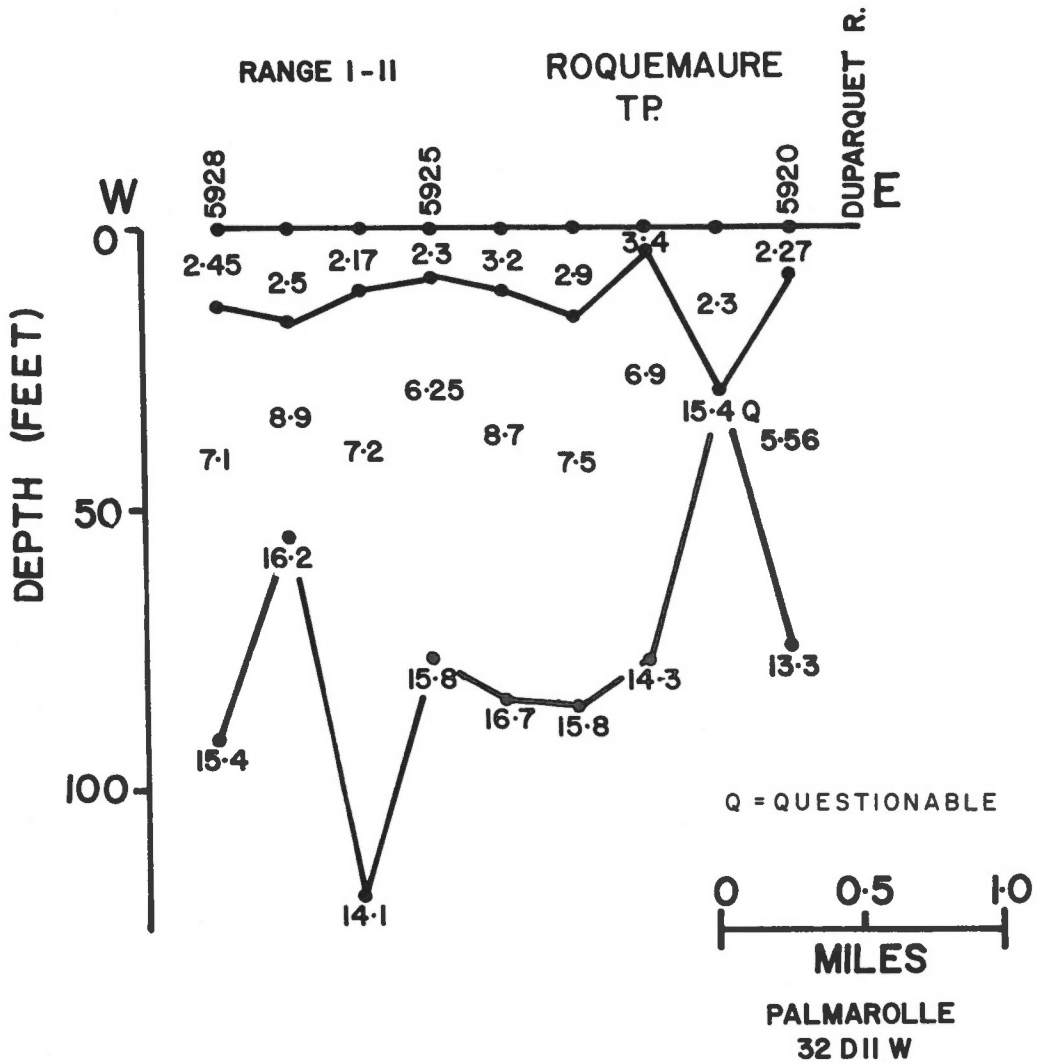


Figure 46

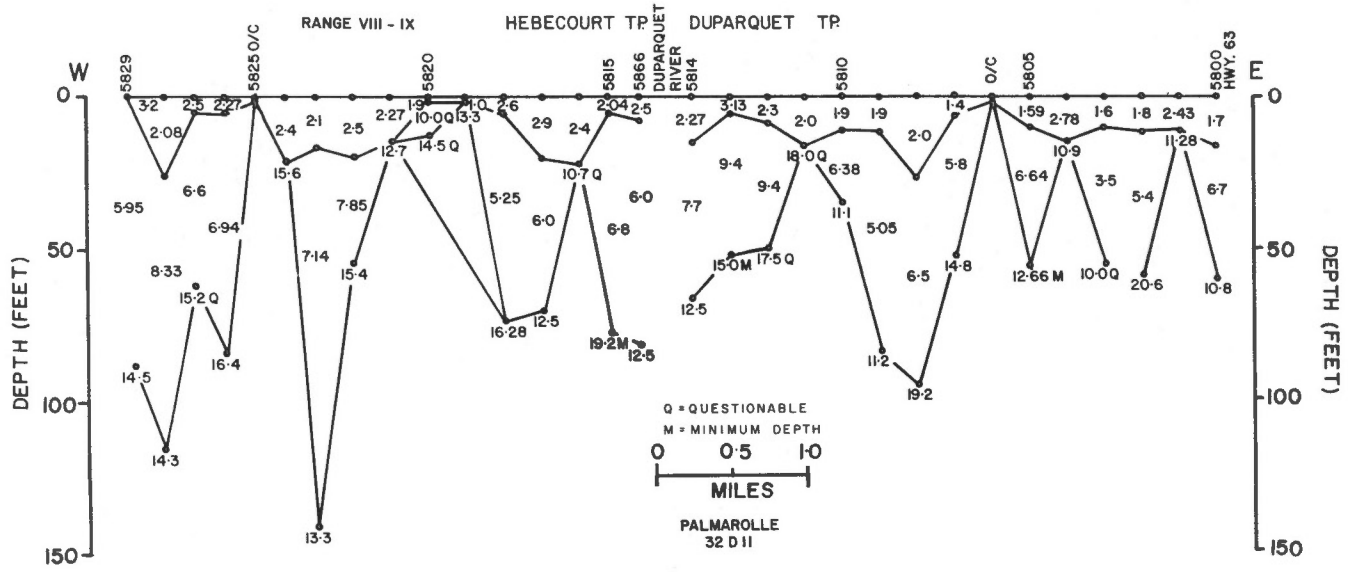
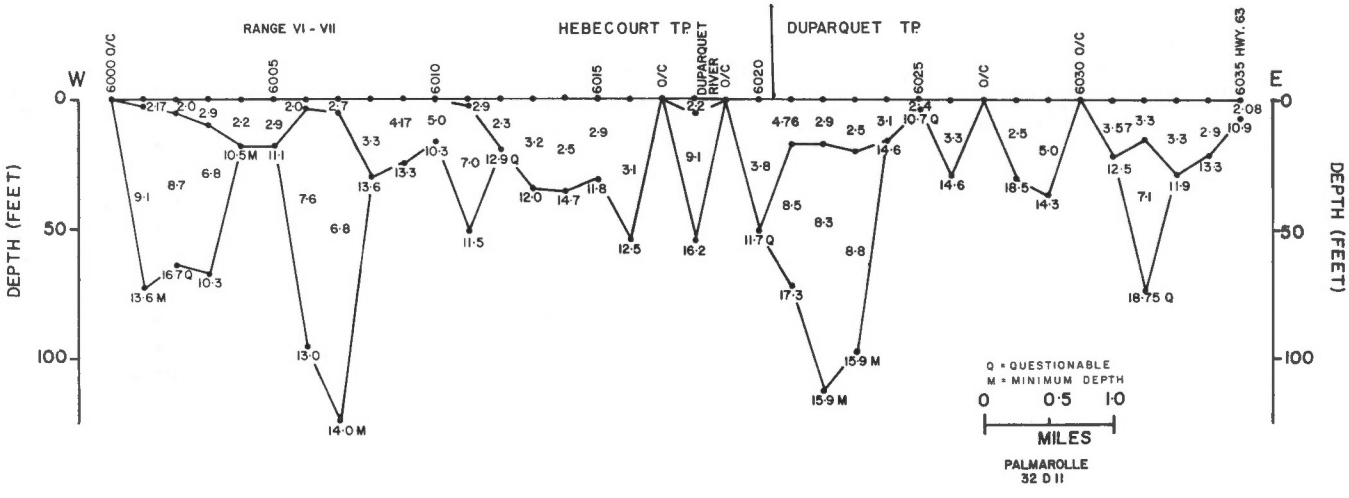


Figure 47



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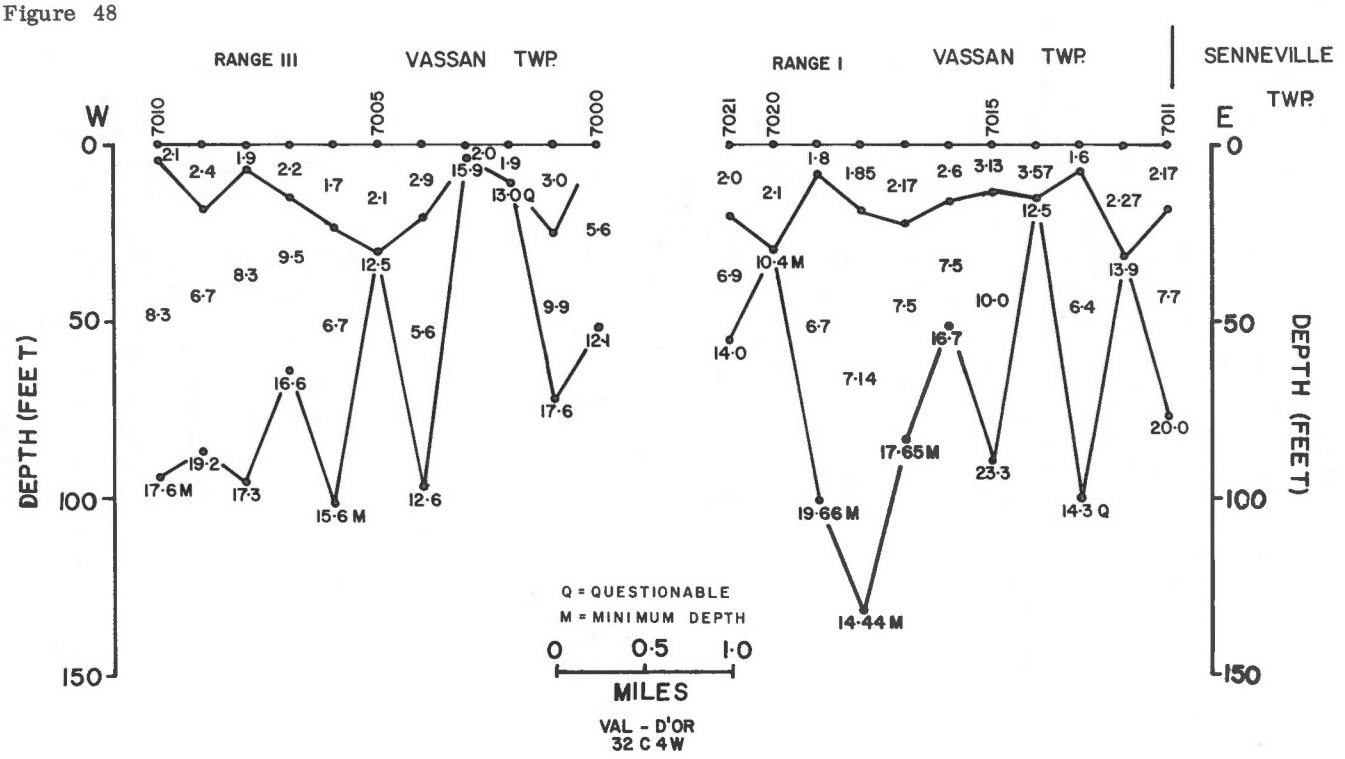

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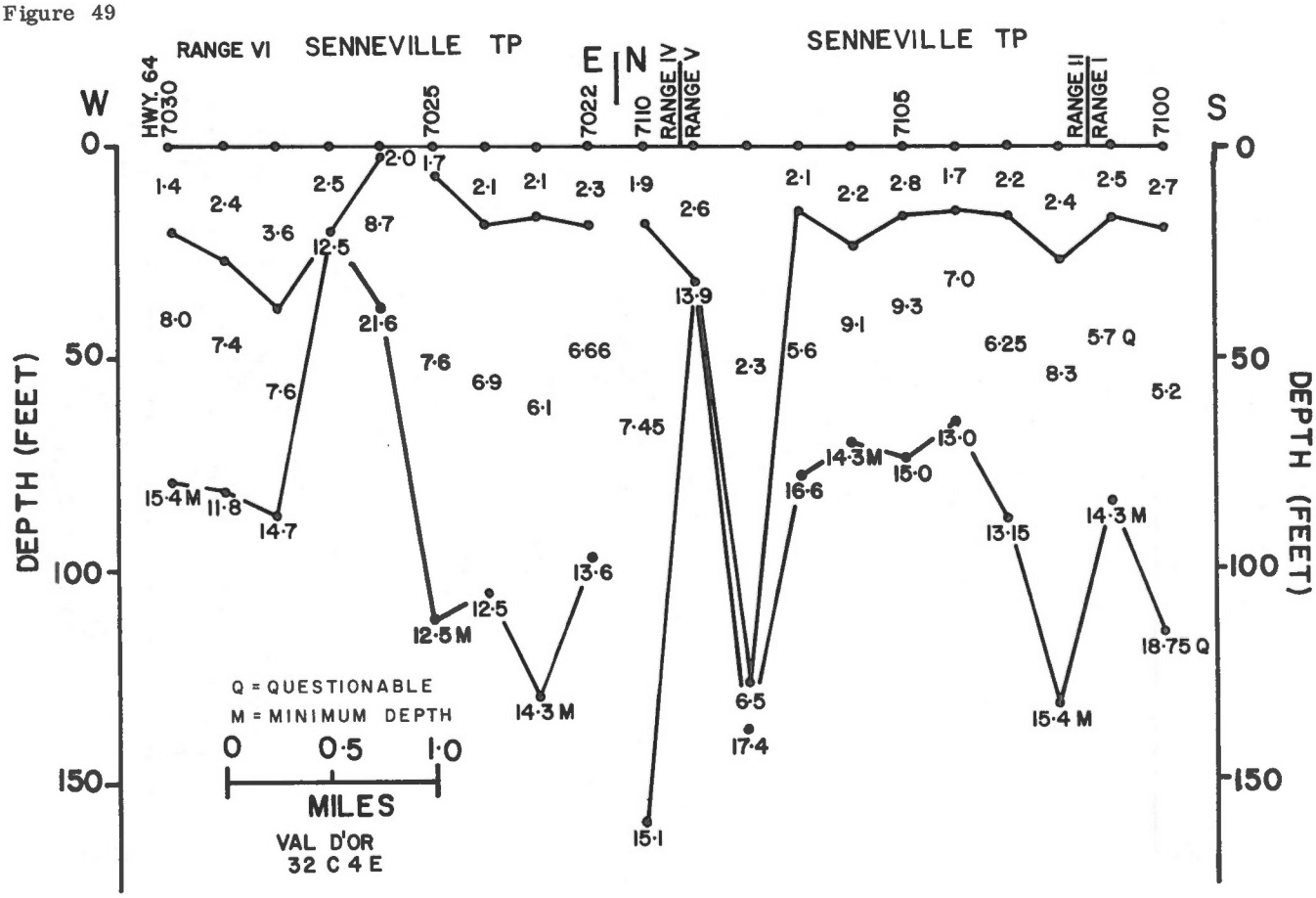
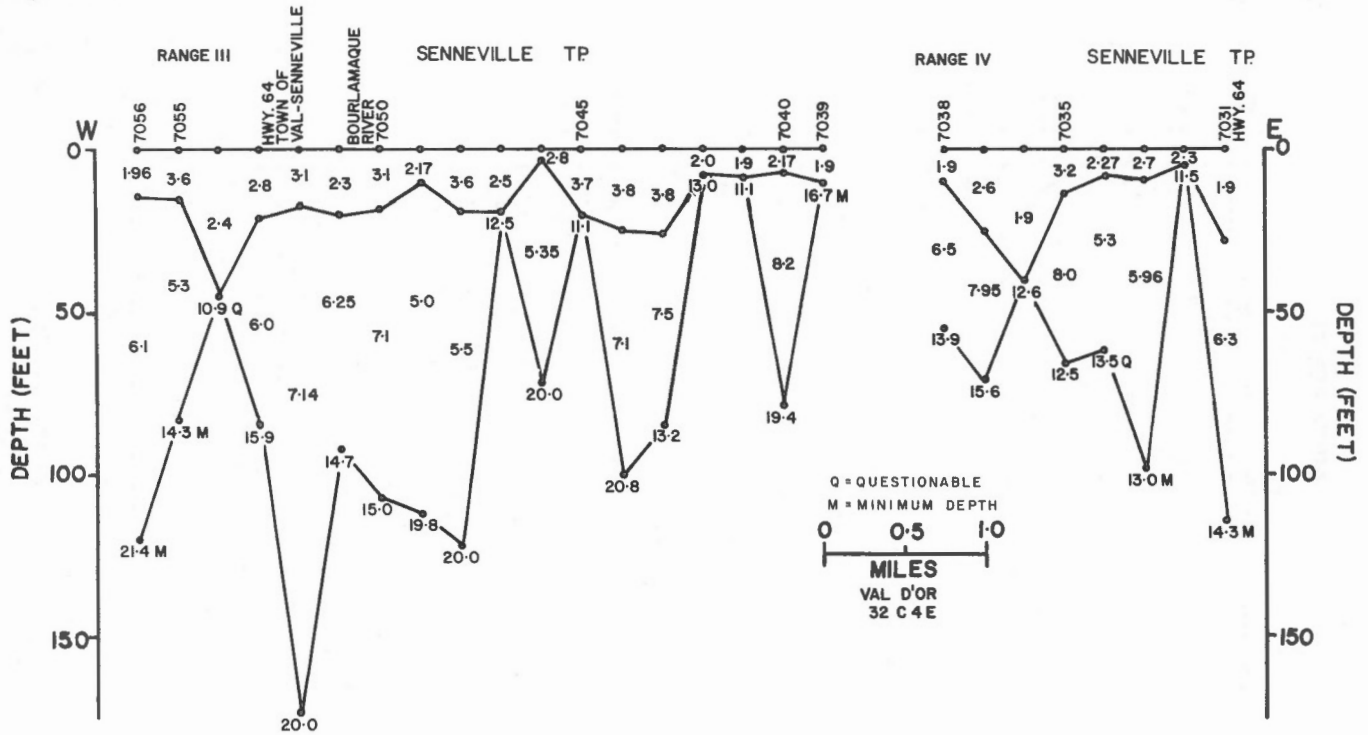


Figure 50



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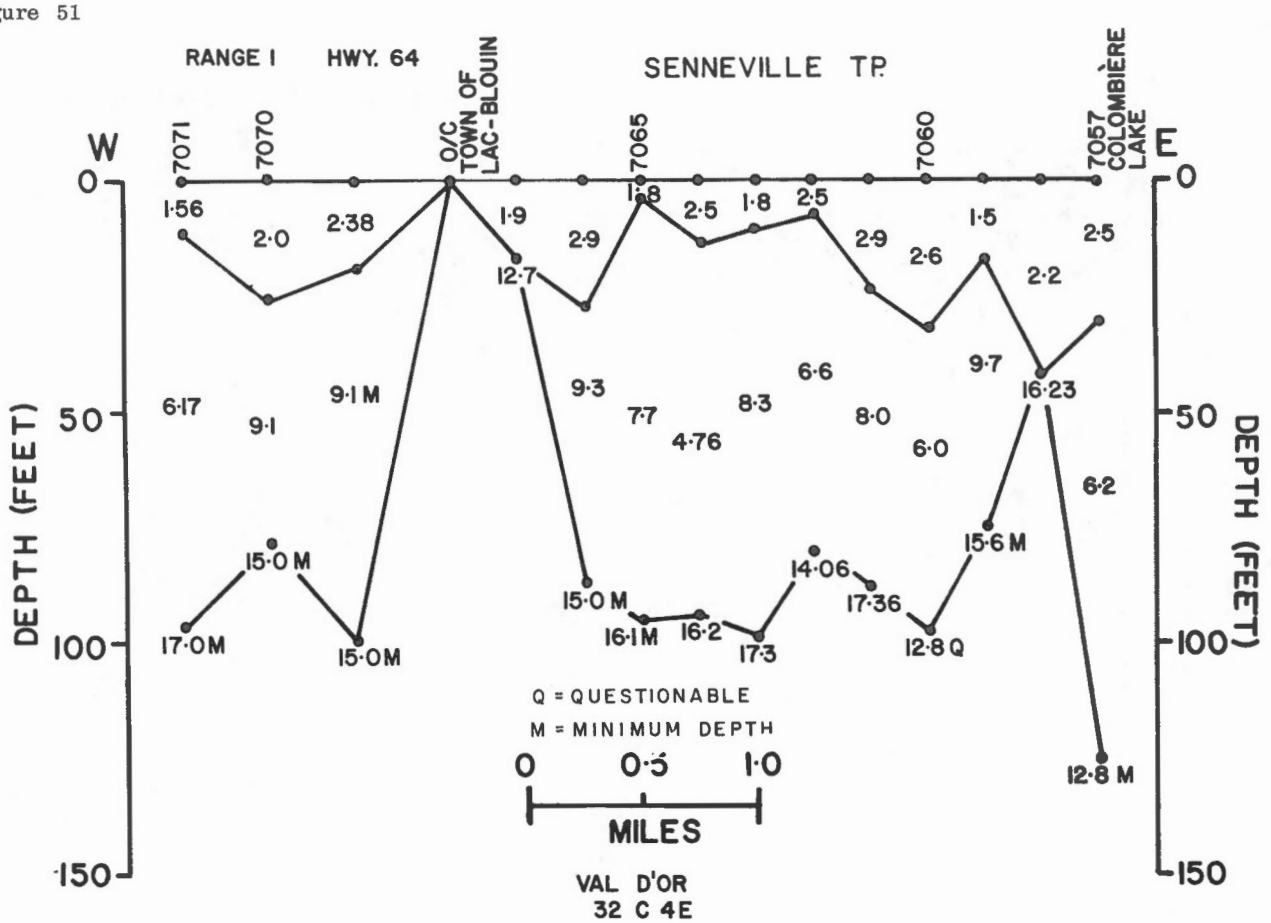


Figure 52

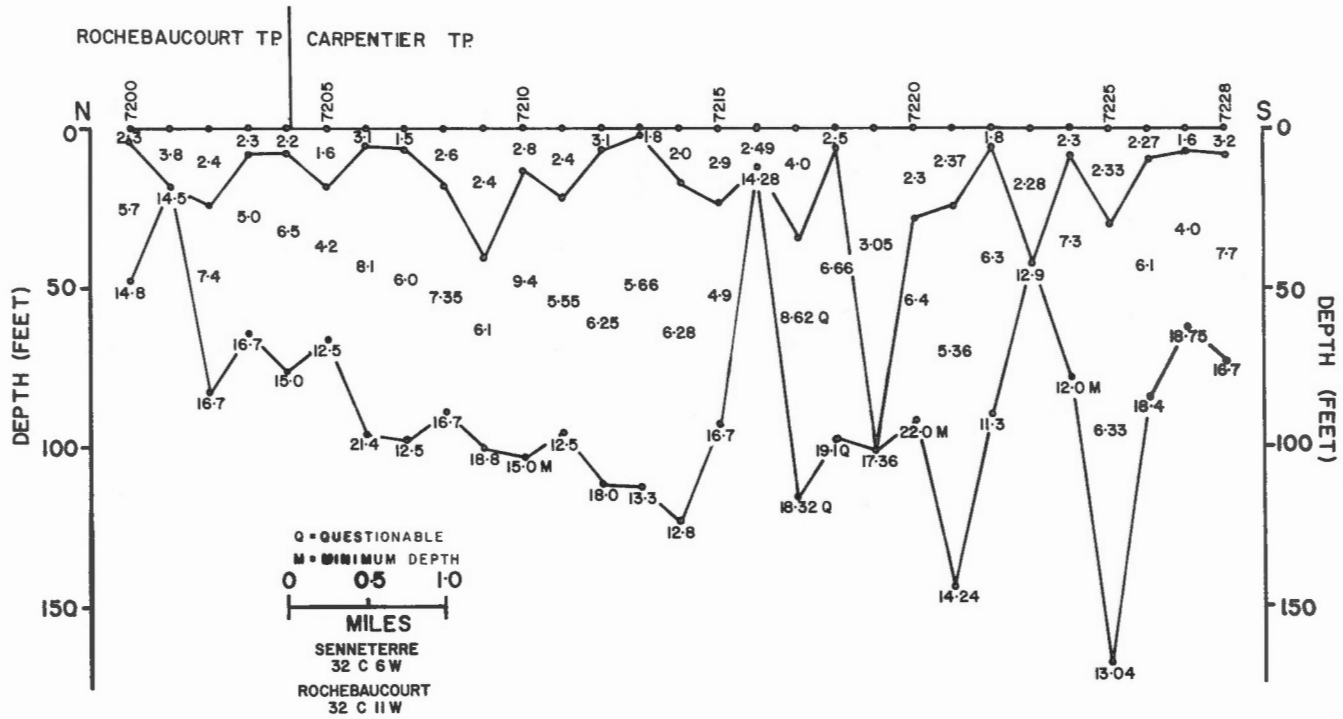
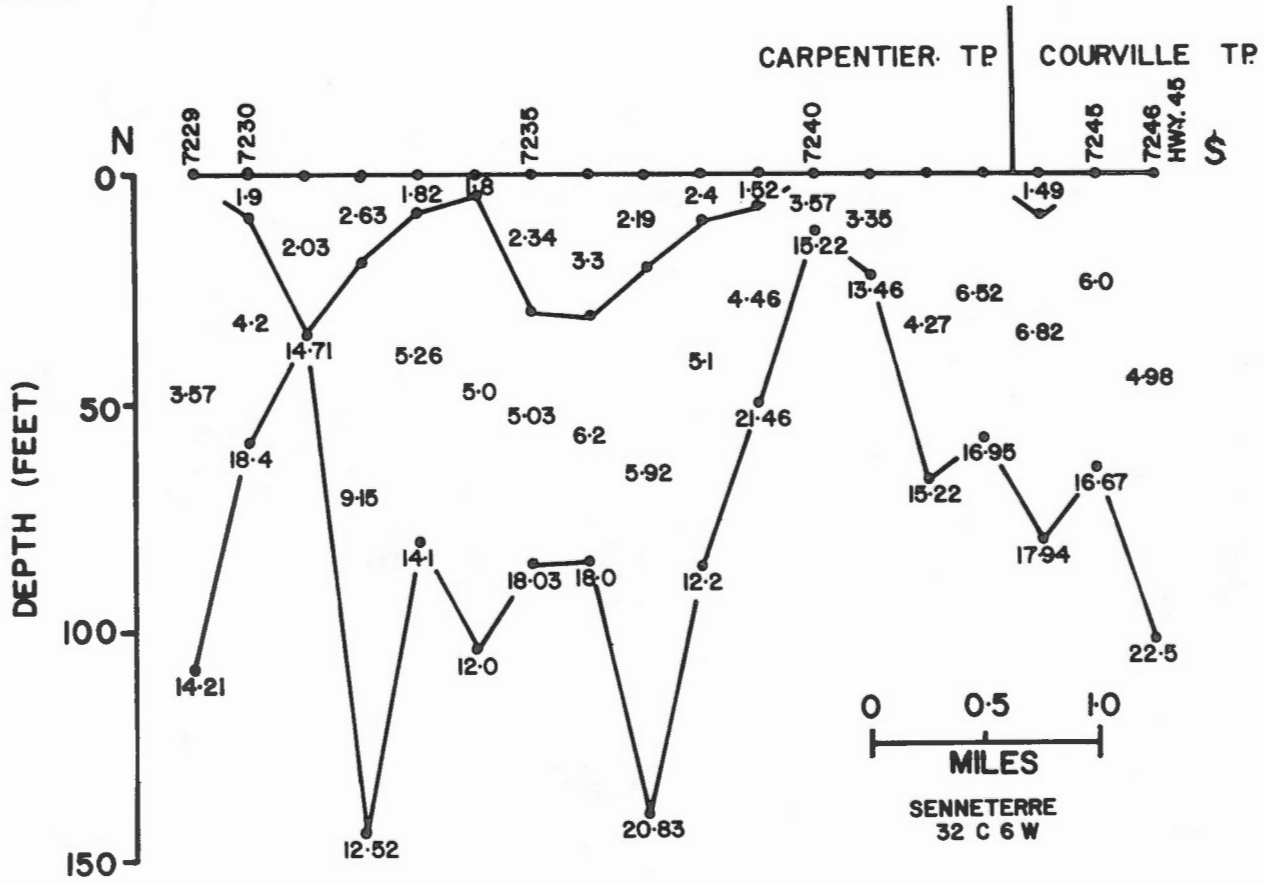


Figure 53



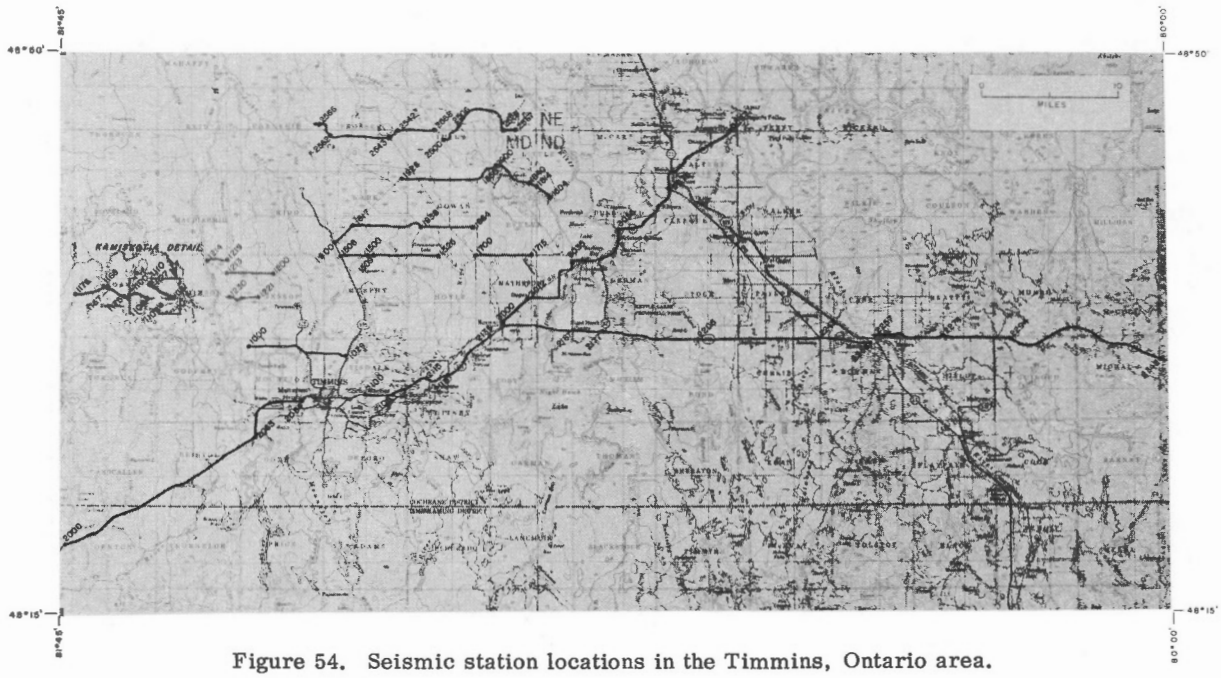


Figure 54. Seismic station locations in the Timmins, Ontario area.

Figure 55. Seismic station locations in the La Sarre, Quebec area.

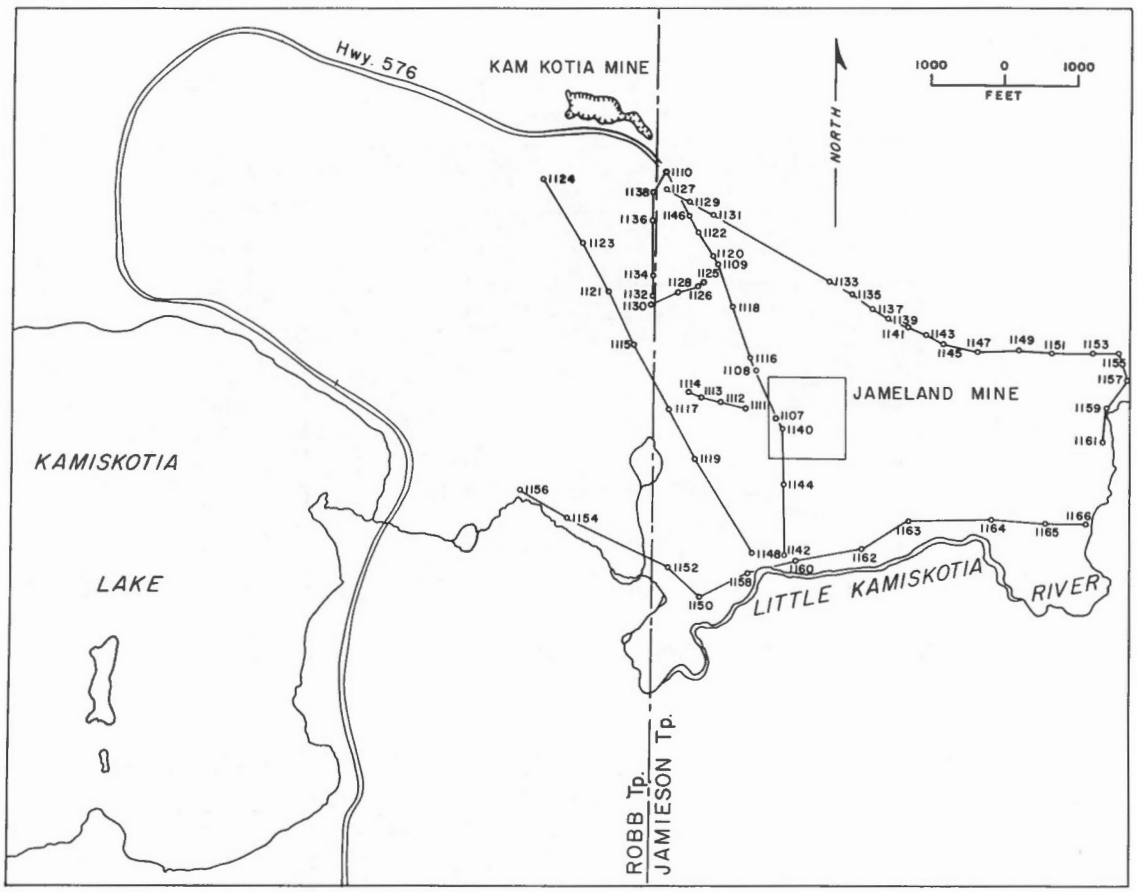


Figure 56. Seismic station locations in the area of the Kam Kotia Mine, (see Figure 54 for location of Kamiskotia detail).

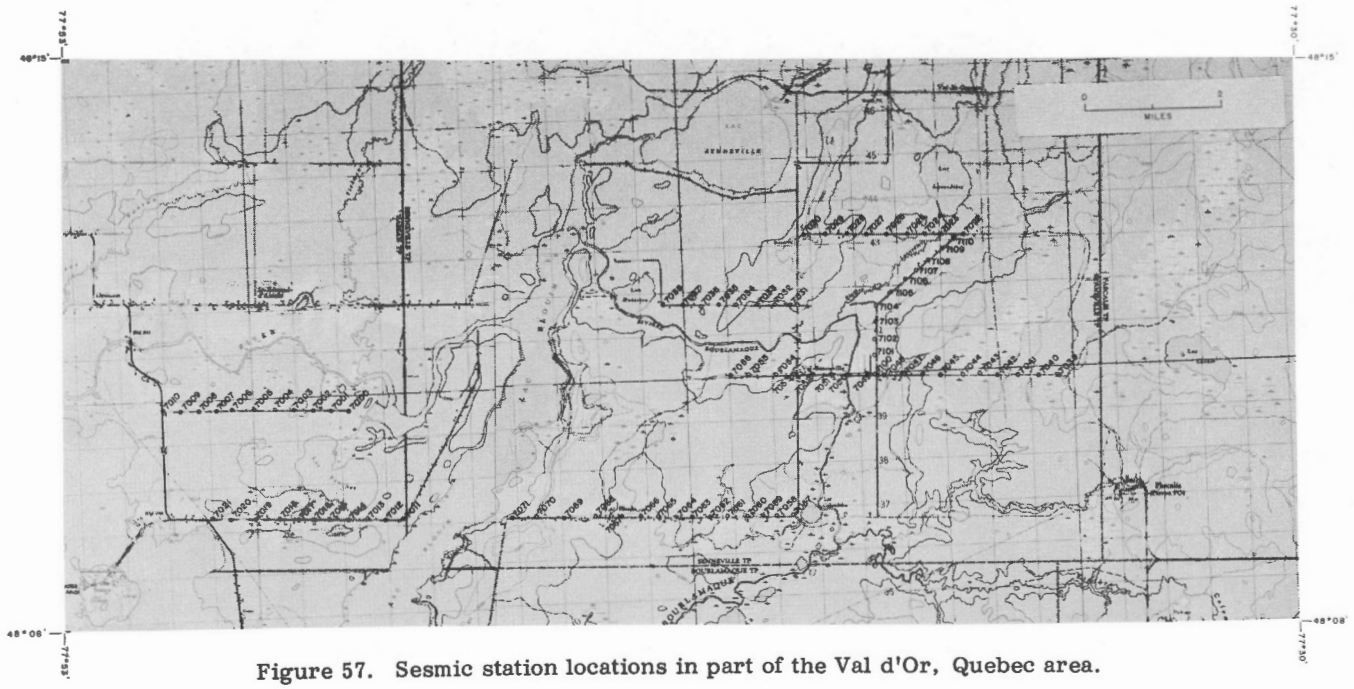


Figure 57. Sesmic station locations in part of the Val d'Or, Quebec area.

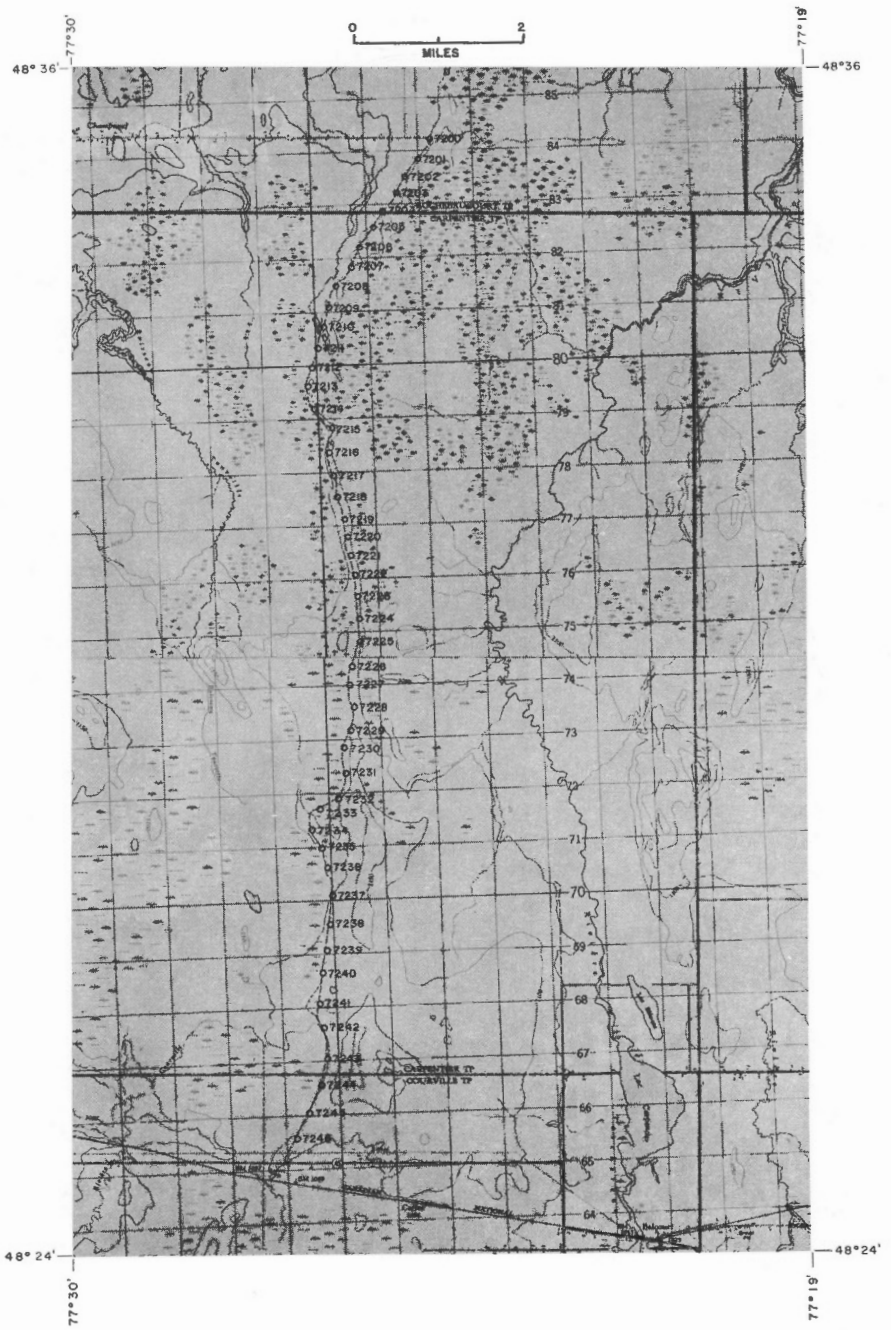


Figure 58. Seismic station locations, northeast part of the Val d'Or, Quebec area.