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Geothermal Service of Canada

Service géothermique du Canada

REPORT ON STUDY OF THE FEASIBILITY OF GEOTHERMAL RESERVOIR MAPPING IN DEEP SEDIMENTARY BASINS USING EXISTING DATA

Sproule Associates Limited
Geological and Engineering Consultants
Calgary, Alberta

Earth Physics Branch Open File Number 83-27
Dossier public de la Direction de la Physique du Globe No. 83-27
Ottawa, Canada

Department of Energy, Mines &
Resources Canada
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Division of Gravity, Geothermics
and Geodynamics

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Mines et des Ressources du Canada
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Abstract

A study of the problems involved in using existing data from wells drilled by the oil and gas industry for mapping potential geothermal reservoirs has been carried out. The purpose of the study was to develop techniques that would permit initial mapping of potential geothermal reservoirs and resources in the most practical and economic manner.

An experimental mapping program has been carried out using these techniques. As a test of the method and as an example of the approach recommended, the Innisfail-Red Deer area of south central Alberta was selected for test mapping of potential geothermal reservoirs.

Initially, it might appear that locating and mapping large geothermal reservoirs at depth in the subsurface would be a very simple matter in view of the very large number of wells already drilled in western Canada. This study has demonstrated that this is not the case because of limitations of the available data and geological complexities.

For the Western Canadian Sedimentary Basin, data are available on over 100,000 wells. Because the available data were collected to meet the needs of the oil and gas industry, they do not usually provide the information on water-bearing reservoirs that would be most valuable in mapping geothermal resources. They do, however, form an extremely valuable data base for the study of geothermal potential.

Established subsurface mapping techniques, using all available data, would produce the most complete information on geothermal reservoirs but would be a very time-consuming and expensive approach which would be impractical at an early stage of assessment of potential.

Résumé

Les problèmes qui surviennent lors de l'utilisation des données provenant des forages de l'industrie pétrolière pour l'établissement des cartes de potentiel géothermique ont été étudiés. Cette étude a été menée afin d'établir les méthodes les plus pratiques et les plus économiques de tracer une carte préliminaire des ressources et des réservoirs de potentiel géothermique.

Un programme expérimental de cartographie par ces méthodes a été effectué. La région d'Innisfail-Red Deer au centre de l'Alberta du sud a été choisie afin d'évaluer la technique et de démontrer la mode opératoire conseillée.

Le très grand nombre de forages effectués dans l'ouest du Canada suggérerait au premier abord que le repérage et la cartographie des grands réservoirs souterrains seraient choses simples. La présente étude indique le contraire à cause des limites des données disponibles et des complexités géologiques.

Les données de plus de 100,000 puits sont disponibles pour le bassin sédimentaire de l'ouest. Puisque ces données ont été recueillies pour satisfaire aux besoins de l'industrie pétrolière, elles ne fournissent pas en général l'information sur les réservoirs d'eau qui serait la plus utile pour la cartographie des ressources géothermiques. Par ailleurs, elles forment une très bonne base de données pour l'étude du potentiel géothermique.

Les techniques bien établies de la cartographie du sous-sol, en utilisant toutes les données disponibles, produiraient le plus d'information sur les réservoirs géothermiques. Cette approche serait très dispendieuse et très longue, et ne serait donc pas pratique aux premiers stages de l'évaluation de potentiel.

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REPORT ON STUDY OF THE FEASIBILITY OF GEOTHERMAL RESERVOIR MAPPING IN DEEP SEDIMENTARY BASINS USING EXISTING DATA

Prepared For
Department of Supply and Services, Canada
September, 1983

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REPORT ON STUDY OF THE FEASIBILITY OF GEOTHERMAL RESERVOIR MAPPING IN DEEP SEDIMENTARY BASINS USING EXISTING DATA

INTRODUCTION

The study upon which this report is based has been carried out under Contract Serial Number OSO82-00273 with the Department of Supply and Services, Canada, extended by letter from Supply and Services, dated July 8, 1983.

The objects of the study were: to determine the problems involved in using existing data, mainly from wells drilled for oil and gas exploration and development, for mapping of potential geothermal resources in deep sedimentary basins; to develop techniques for mapping information pertaining to geothermal resources in sedimentary basins using existing data; and to carry out an experimental mapping program in an area in Western Canada where there are indications that a geothermal potential may be present and where practical uses of geothermal resources may exist.

The work has been carried out with the benefit of meetings and discussions with the Scientific Authority, Dr. A. Jessop, of the Earth Physics Branch of the Department of Energy, Mines and Resources.

In most cases, the data used in this study was originally recorded in the Imperial system. Wherever practical, data have been converted to the S.I. system for inclusion in this report.

OBJECTIVES

The study has been concerned with those potential geothermal resources which occur naturally in the form of hot water at depth in normal sedimentary basins. The Western Canadian Sedimentary Basins are known to contain porous beds at depths which could produce large quantities of water.

The oil and gas industry have explored the western basins for many years, and have drilled well over 100,000 wells in the search for, and development of, hydrocarbons. Information on practically all of these wells is available. This information provides a vast file of data pertinent to the study of potential geothermal resources. It should be stressed that the information collected and preserved has been associated with hydrocarbon exploration and development, with the water not being considered of economic interest. Nonetheless, the data files do provide a vast amount of useful information and effectively form the only source of existing pertinent data.

Well-established techniques of regional and local subsurface mapping could, with appropriate modification, produce the most complete information available on the subsurface beds and their contained water. Such techniques, using all pertinent well data, would require many man-years of intensive work.

The prime objective of the study has been to develop techniques which could be applied relatively quickly and which would give reasonable assessments of the geothermal potential of specific areas within economic limits of time and cost. We have considered it better to present pertinent material on maps for easy interpretation rather than in detailed report form.

Our objective has been to develop techniques for rapid selection and interpretation of the most significant data and presentation in summary form.

Actual economic development of site-specific operations would, of course, require more detailed geological and/or geophysical studies.

STUDY METHOD

General

The study was divided into two phases.

The objective of the first phase was to carry out a broad reconnaisance of the entire prospective portion of the Western Canadian Sedimentary Basin and to use this reconnaisance to select an area for more detailed research and experimental mapping.

The objective of the second phase was to develop techniques for mapping information pertaining to potential geothermal resources in sedimentary basins, and to carry out an experimental mapping program in an area where geothermal resources may reasonably be expected to exist and where there is some realistic expectation of commercial use.

Phase One

For the first phase of the study, a preliminary data review was carried out for some 225 selected wells across the Western Canadian Sedimentary Basin.

The wells were selected on the basis of an eight township grid (approximately 80 kilometres by 80 kilometres or 50 miles by 50 miles). The wells selected were, in general, the deepest wells in the vicinity of the grid corners for which adequate data were available. They were not usually the nearest wells to the grid corners. In most cases, the selected wells are those for which Energy, Mines and Resources has already carried out net rock analyses.

The grid and the wells chosen are shown in Figure 1. Each well was assigned a number by provinces so that Manitoba well numbers are prefixed by 'M', Saskatchewan well numbers by 'S', Alberta well numbers by 'A', British

Columbia well numbers by 'BC' and Northwest Territories well numbers by 'NWT'.

It was agreed with representatives of Energy, Mines and Resources that a sedimentary sequence less than 1,500 metres thick was not likely to provide subsurface temperatures of economic interest.

Areas for which data indicated a sedimentary sequence less than 1,500 metres thick were eliminated from further study.

The study area is, therefore, limited to the south by the International Border (49° North) to the east, northeast and north by the 1,500 metre isopach of sedimentary rock thickness, and to the west and southwest by the edge of the Disturbed Belt.

Complete printouts of data for each of the selected wells within the limited study area were purchased from the files of International Petrodata Limited.

The information purchased for each well includes, but is not limited to, the following:

Well Location

Well Name

Operator

Status

Date Drilled

Elevation

Depth

Productive Zones

Logs Run

Formation Tops

Perforated Intervals

Interpreted Porous Intervals

Drill Stem Test Data

including pressures and recoveries

Water Analyses

Oil and Gas Analyses

Core Analyses

The data for each of the wells in the study area were reviewed in a reconnaisance manner. Microfiche copies of well logs were also examined.

Drill stem test data for tests below 1,500 metres which recovered significant fluids were tabulated. For purposes of the study, recoveries of less than 150 metres of fluid were not considered significant. Tabulations of drill stem test data are appended to this report (Appendix A). Available water analyses for those tests which recovered significant quantities of water are also appended (Appendix B).

Bottom hole, or the deepest available temperatures, were determined from log headings.

A preliminary interpretation of the best porous zones was made from logs and other data. Of necessity, this is a first approximation only, because of the great variety of different logs run and the detailed calculations required for porosity determinations.

Maps were prepared showing the most significant data from this phase of the study for the purpose of selecting an area for more detailed study and experimental mapping.

Figure 1 shows the total depth of the wells and the deepest stratigraphic unit reached. Figure 1 also shows the highest reported subsurface temperature and the depth at which that temperature was recorded. Great care should be taken in interpreting maximum recorded temperatures since they are usually lower than actual temperatures. The temperatures shown do, however, provide a reasonable indication of the comparative temperatures for different depths and areas.

Figure 2 shows those formations which are reported to have recovered significant quantities of fluids on drill stem test. Also shown is the salinity of recovered water in grams per kilogram total solids where available. These data are only given where significant quantities of water were recovered.

Figure 3 is a map showing the stratigraphic unit at the 1,500 metre depth level. This map is, of course, based only on data from the wells shown and is therefore very much generalized. When combined with a general knowledge of which stratigraphic units are likely to have significant porosity and permeability, this map is useful in determining the general prospectiveness of an area. A brief discussion of the results of the study is presented later in this report under the heading "Regional Interpretation from Phase One Study".

Using the data provided by Phase One, the next step was to select an area for more detailed experimental study. This selection was carried out with the assistance and approval of Dr. A. Jessop of Energy, Mines and Resources.

A number of factors were considered in selecting the area for more detailed study. These included:

1. Potential aquifer quality.
2. Temperature indicated for potential aquifers.
3. Availability of adequate amounts of data.
4. Geography in terms of population distribution and potential industrial uses for geothermal energy.
5. Avoidance of areas which have already been studied in some detail.

6. Selection of an area which would be reasonably representative in terms of potential problems and which would provide a reasonable test case for experimental mapping.
7. Regional and local geological knowledge.

Phase Two

The Innisfail-Red Deer area of south-central Alberta was chosen as best meeting the criteria for selection.

The area chosen is somewhat irregular in shape, the outline being controlled by the factors mentioned above. The area is shown in Figures 5 to 9. Figure 4 illustrates the general stratigraphy of the area from a depth of 1,500 metres to approximately 3,000 metres.

In all, the area selected covers approximately 21 townships (about 2,000 square kilometres or 750 square miles).

A printout of available data for all wells deeper than 1,500 metres within the area was purchased from International Petrodata Limited. The printout only included one well per section (approximately 2.5 square kilometres) in field areas where there may be as many as 16 wells per section. The printout provided data on some 525 wells deeper than 1,500 metres within the area. The large number of wells proved to be required to permit selection of those wells providing the most useful data.

Originally it had been planned to select an area with perhaps 25 to 50 wells penetrating zones of possible geothermal interest. A great many of the 525 wells included in the printout did not prove to provide data which would make an important contribution to the study. Therefore, the data on all wells were reviewed with a view to selecting the wells which would provide the most important information. The factors considered included the following:

1. Depth of wells and deepest stratigraphic units penetrated.
2. Drill stem tests producing significant quantities of fluid, especially from stratigraphic units known or thought to have geothermal potential.
3. Availability of core analyses for formations known or thought to have geothermal potential.
4. A reasonable distribution of data over the map area.

It might be anticipated that there would be considerable problems in reducing the number of wells selected for detailed study out of such a large number. Actually, the reverse proved to be the case, and one of the main problems was in selecting enough wells providing the type and quality of information which was most desirable for the study.

In discussions with Energy, Mines and Resources staff, it was agreed that an attempt would be made to use approximately two wells per township.

Ultimately, a total of 68 wells, or a little over three wells per township, were selected. For these 68 wells, all pertinent data were reviewed and important information extracted and plotted on maps at a scale of 1:50,000.

The following maps were prepared:

Figure 5 Map showing Total Depth, Deepest Stratigraphic Unit Penetrated, Depth at which Highest Temperature was Recorded, Highest Temperature Recorded and Time Since Circulation Ceased.

Figure 6 Map showing Sigificant Recoveries of Fluid on Drill Stem Test with Formation, Depth to Bottom of Tested Interval, Fluid Recovery and Type, Theoretical Water Rise Interpreted from Pressures, Depth from Surface to Theoretical Piezometric Surface and Assessment of Quality of Data and Potential Producing Quality.

Figure 7 Map showing Major Porous Zones Interpreted from Logs with Thickness and Nature of Fluid Recovery Where Tested.

Figure 8 Map showing Weighted Average Values of Permeability and Porosity from Core Analyses.

Figure 9 Map showing Total Solids in Grams/Kilogram for Water Recovered on Drill Stem Test.

Using these maps plus general geological knowledge of the area and of geothermal requirements, a short discussion of the geology and potential of the Innisfail-Red Deer area was prepared. This is included as a later section of this report.

PROBLEMS IN MAPPING GEOTHERMAL POTENTIAL

The two main problems in interpreting geothermal prospects from available subsurface data are:

1. Selecting the limited amount of useful data from the vast amount of subsurface data available.
2. Ensuring that apparently negative data are not misinterpreted.

These problems are discussed below.

Data Selection for Study

There is a vast amount of subsurface data available for most of the Western Canadian Sedimentary Basin. This information comes from exploratory and development wells drilled by the oil and gas industry. By provincial regulations, almost all of the information becomes available to the public within one year of the drilling of the wells.

Unfortunately, a great deal of information which would be of assistance in geothermal studies is not collected during the drilling of hydrocarbon tests. This is quite natural since, until recently, this information has not been of particular interest and additional cores or drill stem tests over water-bearing formations would add very large amounts to drilling costs.

Oil and gas operators normally only test or core those intervals which they have some reason to expect may be oil or gas-bearing.

Very often oil and gas are trapped in formations that have strong variations in porosity and permeability. Such formations do not offer the best geothermal prospects

The most porous and permeable beds, and particularly those with the best vertical and lateral continuity of porosity and permeability, which would form the best sources of geothermal water seldom contain oil or gas throughout their entire thickness. In those cases where they do contain hydrocarbons, these are usually trapped in the upper part of the formations. Drill stem tests and cores, and in particular core analyses, are usually limited to these uppermost intervals. It is therefore not possible to select some specific number of wells per unit geographic area in some sort of geometric pattern, since many of the wells selected might prove to provide very limited useful data.

It is necessary to examine the availability of data for at least most of the wells in a given area to select those which will prove useful. Of course, some limitations, such as minimal depths, can be placed prior to initial well selection. In some areas, it would probably be possible to place other restrictions, but these will vary from area to area and will have to be based on general geological knowledge or initial investigations.

Some idea of the amount of data which must be considered may be gained from the fact that the oil and gas industry has drilled over 50,000 exploratory and 70,000 development wells in western Canada. Of course, not all of these fall within the area of possible geothermal interest, but a great many are located in this area.

Geographic distribution of exploration wells is irregular. Areas known to contain important amounts of oil and gas have been densely drilled, especially in the more accessible areas. Less prospective areas, or those with difficult and expensive access, have generally been less densely drilled.

This usually acts in favour of the geothermal interpreter since, at this time, the highest interest in geothermal development is in areas of fairly dense population and easy access, where economic and practical uses may be reasonably visualized.

There is also an unequal stratigraphic distribution of oil and gas tests.

The Cretaceous and Mississippian sequences are among the most prolific oil and gas producing zones, although locally the Upper Devonian is also a prolific producer. Many of the test wells drilled by the oil and gas industry did not drill past the most prospective zones for specific areas.

The deepest zone usually tested will depend on the area and its known prospects. This means that there is extremely little information available for the deepest beds except in a few areas, such as northern Alberta and northeastern British Columbia, where the "Granite Wash", which overlies basement, and parts of the Middle and Lower Devonian, are productive of oil and gas.

Some of these deep and relatively unknown beds may have very good geothermal potential because of the possible presence of water-bearing basal sands and because of the relatively high temperatures which may be anticipated.

Overall, data are usually not of the quality which gives the best interpretation of geothermal potential, and data distribution varies greatly, both geographically and stratigraphically.

From a more local point of view, it would be desirable to use all of the available pertinent data when mapping geothermal potential in a given area. This is frequently impractical because of the very large amount of data available in many areas. Time and economic constraints make such an approach impractical.

For example, we may take the Innisfail-Red Deer area which was used in our experimental program. This area contains approximately 525 wells when all exploratory wells and approximately one development well per section are considered. Consideration of all development wells could involve something in the order of 250 additional wells.

In the Innisfail-Red Deer area, almost all of the wells penetrated past the 1,500 metre level set as the probable upper limit of geothermal prospects. It therefore became necessary to review available data on all 525 wells to select those wells which would provide the most useful data for the study. The criteria for selection of wells are discussed under the heading of 'Study Method'.

Problems of Negative Data

Because most of the data available were collected for interpretation of hydrocarbon occurrence, these data must be handled very carefully when attempting interpretations of potential for hot water production to avoid incorrect interpretations.

The problem lies largely in avoiding interpreting the lack of complete data as negative evidence. This may be most easily explained by example.

In the most simple case, the lack of a drill stem test of a stratigraphic unit does not mean that the unit lacks potential as a water producer. It usually merely means that the operator saw no indications of the presence of hydrocarbons from logs, cuttings, cores, the mud stream or other sources, and therefore had no reason to carry out a drill stem test or that it was felt that the zone could be adequately evaluated from logs.

In many other cases where a drill stem test has been carried out, the test has only covered a small part of the prospective stratigraphic sequence and this may not have been the most promising part from the point of view of water production. Drill stem tests are usually only run over those intervals for which there is some evidence of the possible presence of hydrocarbons. In the case of a thick porous bed, such as the Leduc Formation of Devonian age in the Innisfail-Red Deer area, this can mean that only a small part of the porous interval is covered by a drill stem test and the operator will usually have attempted to avoid testing the water-bearing interval.

There are also many other reasons for inadequate tests of potential water-bearing zones, including tests which are mechanically defective but which are not reported as "misruns". Where the information becomes critical, as in the case of very detailed mapping of site-specific prospects, it would be desirable to attempt to obtain original drill stem records including pressure charts and improve the interpretation.

Likewise, the absence of cores or core analyses does not necessarily mean that there were no indications from samples of the presence of porosity. It may only mean that there was no reason to suspect the presence of hydrocarbons. It may also mean that the operator did not feel that the extra cost of coring was justified because the area was well enough known that adequate interpretation of porosity and hydrocarbon saturation could be made from logs.

To review each well in detail and attempt to explain the absence of positive geothermal data would be a very large task indeed.

For these reasons, we have shown on our maps only those drill stem tests which recovered significant quantities of fluid. To show tests, especially tests of prospective formations, which did not recover such quantities of fluid without adequate explanation could in our opinion be very confusing to those not familiar with oil and gas exploration and development approaches and techniques.

Our philosophy, in the initial phases of mapping of geothermal potential, has been to attempt to place the positive information on maps without cumbersome details in a reasonable time at reasonable cost. It is hoped that these maps will provide the necessary leads for interested parties. Where the maps offer encouragement, and where there are potential commercial uses, more detailed studies should be carried out.

RECOMMENDATIONS FOR MAPPING GEOTHERMAL POTENTIAL

The area in the undisturbed portion of the Western Canadian Sedimentary Basin which is considered to have some potential for geothermal water resources by virtue of a sedimentary sequence exceeding 1,500 metres thickness is in the order of 750,000 square kilometres and contains many tens of thousands of exploratory and development wells which provide data pertinent to the study of geothermal prospects. Even a small area, such as might be considered for commercial geothermal production, may contain many hundreds of wells.

The example of the Innisfail-Red Deer area used in Phase Two of the present study contains over 500 wells when only one field or development well per section is considered. There are probably in the order of an additional 250 field and development wells in the Innisfail-Red Deer area. It is clearly uneconomic to attempt detailed studies or mapping of all the wells in a given area in anything but advanced stages of prospect study.

It is assumed that interested parties would take one of two different basic approaches to investigating geothermal potential in the Western Canadian Sedimentary Basin.

The first approach might be referred to as the regional approach and would consist of an overall review of the prospective portion of the basin in a search for areas where temperatures are high enough and where there are some indications of the presence of porous beds containing significant quantities of water. An operator might then attempt to select a geographic area where some commercial use could be developed.

The second approach might be referred to as the local approach. In this case, an operator might wish to consider whether geothermal heat might be used in a specific area and perhaps for a specific application.

Government agencies might use either approach in studies of geothermal potential as a public service.

In either case, reference to Figure 1, the map showing total depths and maximum recorded temperatures, which accompanies this report, will give an indication of the maximum temperature of water which could be reasonably anticipated for the general area. The errors in recorded bottom hole temperatures have been discussed in other reports and certainly the best that can be expected is an approximation of possible temperatures.

Figure 2, which shows formations which recovered significant quantities of water for selected wells together with published geological studies, will give some indication of whether porous beds may be anticipated in a given area. A great deal of caution is required in this approach since the approximately 200 wells used in the preparation of Figure 2 will certainly not have tested all potentially productive zones in each area.

Having established a possible interest and potential in a given area, an operator or a government agency will have to begin a more detailed study. We recommend that this be a study of the type carried out in Phase Two of the present work.

The size of area to be selected for study will depend on a number of factors. Some of these are related to geographic and demographic factors and depend largely on the intended use. Other factors are dependent on geology and well density.

An initial review of all wells in the selected area is recommended to permit selection of pertinent wells for more detailed study. The factors to be considered have been outlined in the section of this report headed 'Study Method'. No hard and fast criteria for selecting wells for study can be established except for depth. There is too much variation in data and in geology. A review should, however, clearly indicate the best wells.

There are a number of commercial sources available which provide summaries of well data, including depths, logs available, cored intervals, drill stem test intervals, formation tops and other information. Such summaries are also usually available in provincial government files. Summaries may be in the form of cards, data sheets, microfiche or computer printouts. The amount of data in the summaries provided by the various commercial services varies. For example, summary cards and data sheets do not usually provide details of core analyses or water analyses. These are available from some services providing computer printouts, and other services can also provide core analyses and water analyses separately from the summary cards or sheets.

Unfortunately, to our knowledge, none of the services regularly provide data on bottom hole or other temperatures. To obtain temperature data, it is usually necessary to go to the headings on electrical and mechanical logs. Such logs are available from various services either as hard copies or on microfiche.

Detailed drill stem test reports may contain drill stem test temperatures, pressure charts and other data. These are available from specialist services and from government files.

The services of a subsurface geologist experienced in the area under consideration and with knowledge of the various sources of information are considered essential at this stage of the study.

As a first approach, it will be necessary to review summary data on all wells in the selected area. If computer printouts are used, it would be possible to restrict the printout based on a number of factors. Perhaps most important is depth. There is no need to review other data on wells which are not deep enough to provide information on stratigraphic units which may be hot enough to be of interest from a temperature point of view.

It would also be possible to restrict printouts to those wells which, for example, recovered water on drill stem test or on which drill stem tests were run below selected depths or for which core analyses are available.

From our experience in the Innisfail-Red Deer area, we do not believe that this is a good plan. If too many restrictions are placed on well selection, the ultimate printout may contain very few wells. We have found it necessary to use for our study a number of wells for which there is less information than would be desirable. If these wells had been eliminated from the original printout, it would have been necessary to repeat the process.

A review of all wells of sufficient depth in an area should, when combined with a reasonable regional geological knowledge of the area, permit a selection of the most promising wells for more detailed study, and should give a very good indication of those formations which may prove to have geothermal potential in the area.

These selected wells should then be studied in more detail.

All drill stem tests should be studied with intervals tested, testing times, recorded pressures and recoveries and salinities of recovered waters.

Where adequate pressure data are available, the theoretical rise of water in the well due to natural pressure can be calculated. This can be compared with the actual rise in the time the valves were open and a preliminary qualitative assessment of producibility can be made. The calculated data can also be expressed in other terms such as the piezometric surface or elevation to which water would rise under natural pressure, the depth of the piezometric surface, or the pressure at any selected datum. These methods have been used on the included maps in the belief that they provide the most useful information for those not fully familiar with hydrodynamics.

At least an initial interpretation of porous sections in formations of possible interest should be made. Because of the great variation in the types of logs run in various wells, and the very detailed calculations involved in detailed porosity analyses, it appears that only a general interpretation should be attempted at this stage in the interests of economy. Attempts to compare porosity interpretations using the many different log suites available are not considered practical at this stage.

Available core analyses should be examined and summarized and weighted average porosities and permeabilities calculated. In most cases, this will only give an indication of the porosity and permeability ranges that can be anticipated. Cores are usually only cut over only small portions of the intervals that could be of geothermal interest. Also, cores may not be analyzed throughout, obvious water-bearing sections being omitted.

If the data resulting from the foregoing exercises are plotted on maps to an appropriate scale, it should usually be possible to make reasonable assessments of the geothermal potential of the area. The accuracy of such assessments will of course depend largely on the well distribution and the distribution of testing and coring programs in individual wells. The geology of the area will, of course, be most important in controlling the accuracy of assessments.

There will be cases where few if any wells actually reach potential warm water-productive zones or very limited testing may have been carried out in potentially water-productive zones.

In some cases, it will probably prove possible and useful to contour certain data. This does not appear to be the case in the Innisfail-Red Deer area.

We believe that maps of the type presented with this report offer the best way to present data. In other areas with different geology, there may well be better methods. For example, it appears likely that in an area in Saskatchewan where the Lower Paleozoic sands of the Winnipeg and Deadwood are present, and where there is adequate well control, it might prove possible to prepare isopach maps of the porous beds.

It should be stressed that the lateral extent of a potential geothermal water reservoir and connection with a source of mobile water is extremely important to provide the capacity for the large daily production which will be required.

There may be cases in which individual wells show good porosity over considerable vertical intervals and give indications of reasonable production capacity but where the lateral extent of the reservoir is not sufficient to provide the extended production and/or to maintain reservoir pressure.

It is therefore essential that both the lateral and the vertical extent of potential reserves be considered.

The work outlined above should take a study of geothermal potential to a stage equating with that reached by the present study for the Innisfail-Red Deer area, allowing for the fact that particular maps produced for any given area may well differ depending on the type and amount of well control, the geology of the area and other factors. At this stage, it should be possible to make a reasonable assessment of the geothermal potential so far as available data permit.

A short report outlining the geothermal potential should be prepared. This report, with accompanying maps, should permit a reader to make an initial assessment of the geothermal potential of the area.

Additional work will, however, usually be required before economic studies can be carried out or before exploratory or development drilling can be considered.

If the initial work indicates a potential geothermal source bed, all wells penetrating that source should be checked in detail. This would include the best detailed analyses of porosity permitted by the log suites available. Available core analyses should be plotted to the same scale as the logs and compared to assist in establishing parameters for log interpretation. Where drill stem test data permit, Horner plots of pressure increments with time should be made to determine productivity.

REGIONAL INTERPRETATION FROM PHASE ONE STUDY

The regional survey conducted as Phase One provided a general interpretation of geothermal prospects in the Western Canadian Sedimentary Basin. The reconnaisance nature of the survey and the fact that it was based on a very small sampling of the total number of wells means that it would not necessarily show all prospective zones, but the fact that the wells selected were among the deepest for each area means that most of the regionally prospective stratigraphic units should be indicated, especially when the results are combined with a general knowledge of the stratigraphy of the area.

For the Williston Basin in southern Saskatchewan, the Cambrian Deadwood Formation, probably in conjunction with the Ordovician Winnipeg Group, certainly appears to offer the best prospects both from the reservoir point of veiw and with regard to temperature.

Other Ordovician units, including the Stoney Mountain and the Yeoman Beds, are also prospective.

The Silurian Interlake Group has good porosity and permeability over much of the southern Saskatchewan area, but bed continuity is uncertain and would have to be investigated. The Interlake is considerably higher in the section and temperatures will not be so high as in the Cambrian Ordovician sequence.

The Devonian has a number of intervals with at least local good porosity. These include the Souris River, the Duperow and the Dawson Bay. The Dawson Bay porosity is often filled with salt in those areas where the Prairie Evaporite salt is present.

The Devonian units are also rather shallow except in the deepest part of the basin.

Overall, there appears to be a much better continuity of porosity and permeability in the Williston Basin of Saskatchewan than in the Alberta Basin to the west.

In southern Alberta, south of about Township 25, the Cambrian beds appear to offer good potential but there are comparatively few wells which test the Cambrian.

In this area, the Devonian Beaverhill Lake and probably to a lesser extent, the Cooking Lake, may also contain important quantities of water.

Over much of this southern area, the Sweet Grass Arch basement high reduces the thickness of the sedimentary sequence and the maximum temperatures which may be expected, except in the westernmost part of the area.

Further north, in the general area of Calgary and Edmonton, there is very little information available on Cambrian prospects. The best prospects appear to be in the Devonian section, particularly the Nisku and Leduc Formations. The Leduc is a reefal facies which has limited geographic development.

Higher in the section, the Mississippian and Cretaceous units may have good porosity and permeability, but such developments are often of limited lateral extent.

Still further north, the Cambrian and the Granite Wash, which overlies basement, appear to offer the best prospects.

From the vicinity of Township 70 northwards, the Devonian Elk Point Group, particularly the Gilwood Sand and the Muskeg Formation, and the overlying Slave Point Formation, are important prospects.

The Slave Point, like the Leduc Formation further south, is a reefal facies of restricted areal development. In many places, it appears to be an excellent potential reservoir.

In northeastern British Columbia, the Slave Point Formation, where developed, and the Muskeg Formation appear to be the best prospects.

The same situation prevails in the limited portion of the southern Northwest Territories where the sedimentary section is thick enough to provide adequate temperatures.

Figure 1 shows the approximate maximum temperatures which can be anticipated. These range up to about 75°C in the deepest portion of the Williston Basin, to over 100°C in the westernmost part of the Alberta Basin and up to 125°C in northeastern British Columbia.

In most cases, the deepest and hottest waters have high salinites, frequently over 200 grams per kilogram total solids. In southernmost Alberta and in northeastern British Columbia, salinites may be lower in some deep formations.

INNISFAIL-RED DEER AREA

Regionally, the Innisfail-Red Deer area is located in the eastern flank of the Alberta Basin, approximately in the area where dips begin to increase rather sharply westward into the deepest portion of the Alberta Basin.

Regional dips are generally to the west, or slightly south of west, in the range of 10 metres per kilometre. Except on erosional surfaces and where reefal growth is involved, dips appear to be reasonably uniform with no evidence of major structural deformation apart from the regional tilting.

Figure 4 provides a very generalized illustration of the stratigraphic sequence from a depth of 1,500 metres to the Beaverhill Lake Formation, the deepest unit for which stratigraphic information is available, at a depth of slightly over 3,000 metres.

The pertinent portion of the sedimentary sequence is briefly discussed below. The thicknesses given are approximate. They are based on wells in the southwestern portion of the map area. To the north and east, many of the formations thin slightly.

The upper part of the sedimentary sequence above 1,500 metres, the shallowest portion considered to be of geothermal interest, consists of Mesozoic and Cenozoic shales and sands and glacial deposits of Quaternary age.

The shale and sand sequence of the Colorado Group extends over about 500 metres from approximately 1,500 metres to approximately 2,000 metres. The section is predominantly dark grey shale, but a number of important sand sequences are included. The Cardium sand is usually quite thin. While it can be an important oil-producing sand, it is generally fine-grained and permeabilities are probably too low to produce important amounts of hot water.

The Second White Specks interval may contain sand locally, but it is not likely to contain significant water.

The Viking sand may have some potential, but there is considerable variation in porosity and permeability. One well in Lsd. 1-6-39-26 W4M produced about 750 metres of oil from about 1,600 metres depth. Overall, the Viking is not considered to be an important geothermal prospect.

Below the Colorado Group is the sand and shale sequence of the Mannville Group, often referred to as the Blairmore. The sands of the Mannville, especially those in the lower part of the unit, vary considerably in thickness and in character.

The Ostracod sand locally has good develoment, but sand developments may be very limited in a lateral sense.

The same comments apply to the Glauconitic sand.

The basal sand of the Mannville Group is usually referred to as the Ellerslie, although it, or part of it, may also be referred to as the Basal Quartz. The Ellerslie generally lies on the irregularly eroded Paleozoic surface where it often tends to be thick over Paleozoic low erosional features and to thin, or even disappear, over Paleozoic erosional highs. Although locally the Ellerslie may be quite thick with good porosity and permeability, its limited lateral extent could reduce its effectiveness as a potential geothermal source. Among the wells selected for study, several produced significant quantities of oil on drill stem test of the Ellerslie. One well in Section 33-38-27 W4M also produced water and gas. Indicated pressures would suggest a piezometric surface less than 200 metres from surface for this well.

Below the Mannville, at a depth of some 2,200 metres in the southwestern portion of the map area, is the irregular Paleozoic erosional surface.

In the westernmost part of the map area, the Shunda Formation forms the Paleozoic surface. The Shunda consists of argillaceous limestone and dolomite with some siltstone and sandstone. Important porosity is rare, and the Shunda is not considered to be an important prospect.

Below the Shunda is the Pekisko Formation, consisting generally of limestone which may be crinoidal and porous but porosity developments are frequently local. The Pekisko is truncated by post-Paleozoic erosion in the general area of the Fifth Meridian. We have shown a very generalized illustration of the Pekisko edge in Figure 6. It is stressed that the Pekisko edge as shown is very generalized and is not based on a study of all pertinent wells. The wells studied do not show large water recoveries from the Pekisko, but locally it might produce significant water.

The Banff Formation, also of Mississippian age, underlies the Pekisko. It consists mainly of calcareous shale and argillaceous limestone and dolomite. It seldom contains porosity and is not regarded as having any geothermal potential.

The thin dark shales of the Exshaw form the Basal Mississippian unit. Thin sands may be present locally, but they are not considered prospective regionally.

The Mississippian is conformably underlain by the Devonian beds.

The Wabamun Group forms the uppermost Devonian unit. It consists of dolomite limestone and calcareous dolomite. Further south, in the area of Calgary and Okotoks, the Wabamun contains the porous Crossfield Member, which produces gas and could produce water. The porous Crossfield Member does not appear to extend as far north as the Innisfail-Red Deer area.

Underlying the Wabamun is the Winterburn Group.

The dolomite siltstone of the Calmar Formation at the top of the Wabamun Group does not appear to contain significant porosity in the map area.

The lower unit of the Winterburn Group is the Nisku Formation. On the basis of present information, the dolomites and dolomitic siltstones of the Nisku Formation would appear to have some promise. Porosity distribution is somewhat irregular, but a number of wells have had very good water recoveries. Available core analyses indicate that permeabilities are not usually as good as those in the underlying Leduc. The formation is, however, more widespread than the Leduc and underlies all of the map area.

The Nisku is underlain by the Ireton Shale. The Ireton varies considerably in thickness, being quite thin where the Leduc Reef is developed and much thicker where the reef is not developed.

Where present, the Leduc Reef is probably the most important potential water source in the map area on the basis of present information. The reef may reach in the order of 100 metres in thickness. It consists of reefal carbonates, usually dolomites. The generalized area of Leduc Reef development is shown on Figure 6. Again it must be stressed that the Leduc edge as shown is very generalized.

The Leduc Reef is underlain by the fragmental limestone and shales of the Cooking Lake Formation. The Cooking Lake has been penetrated by relatively few wells in the map area. Some of them have given up important quantities of water on test and the Cooking Lake could be prospective.

The Cooking Lake Formation is underlain by the Beaverhill Lake Group. Very few wells have reached the Beaverhill Lake in the area, so its potential is difficult to assess. Regionally, the Beaverhill Lake Group consists of argillaceous carbonates, and it is probably not an important prospect.

There is no information available below the Beaverhill Lake Group.

It is anticipated that there is a section belonging to the Elk Point Group below the Beaverhill Lake Group. The Elk Point Group, if present, could contain porous sand sections, especially in the basal portion. Wells in adjacent areas are reported to have obtained large water flows from the Lower Paleozoic sands. Regionally, there is not enough information to determine the extent of such sand developments.

The experimental mapping program has shown that, on the basis of available information, the best prospects for geothermal water production in the Innisfail-Red Deer area are the Devonian Leduc Formation, with the Nisku Formation, also of Devonian age, being the second best prospect.

Information on the Devonian Cooking Lake Formation is more limited, but it would also appear to have an important potential.

Higher stratigraphic units of Mississippian and Cretaceous age are indicated to have limited porosity and permeability developments.

Porosity and permeability vary more in the Nisku than in the Leduc, but they are locally good with some water recoveries exceeding 1,000 metres.

Temperatures in the Nisku are expected to be in the order of 60°C to 70°C.

There is some additional regional information for the Nisku Formation in the map area, but the wells selected for study include most of the Nisku tests except for the Innisfail field in the northeastern corner of the map area, where oil production is obtained from the Nisku Formation.

Where present, the reefal Leduc Formation is the most prospective unit. A number of tests have produced over 1,500 metres of water. Calculated piezometric surfaces are frequently within 500 metres of surface. Data quality is generally good.

Water salinites in the Leduc are high, usually over 200 grams per kilogram total solids. Nisku salinites are expected to be similar.

Temperatures in the Leduc Formation are indicated to be in the order of 70°C to 80°C or higher in the southern part of the map area, and somewhat lower in the northern part where the Leduc is not so deep.

In the southern part of the map area, depths to the Leduc porosity are in the order of 2,700 metres. Updip to the northeast, depths are in the order of 2,200 metres.

The data indicate very good potential for the recovery of large quantities of saline water with temperatures of 70°C to 80°C or higher from the Leduc Formation. Unfortunately, the Leduc is present only over a part of the map area.

The Innisfail oil field, in the southern part of the map area, produces oil from the Leduc Reef.

Detailed study of additional data from field wells and the production history of the field could provide additional information if a commercial use of geothermal water were to be considered in this area.

SUMMARY AND CONCLUSIONS

General

A study of the problems involved in using existing data from wells drilled by the oil and gas industry for mapping potential geothermal reservoirs has been carried out. The purpose of the study was to develop techniques which would permit initial mapping of potential geothermal reservoirs and resources in the most practical and economic manner.

An experimental mapping program has been carried out using these techniques.

For the Western Canadian Sedimentary Basin, data are available on over 100,000 wells. Because the available data were collected to meet the needs of the oil and gas industry, they do not usually provide the information on water-bearing reservoirs which would be most valuable in mapping geothermal resources. They do, however, form an extremely valuable data base for the study of geothermal potential.

Established subsurface mapping techniques, using all available data, would produce the most complete information on geothermal reservoirs but would be a very time-consuming and expensive approach which would be impractical at an early stage of assessment of potential.

In most cases, it is, therefore, necessary to attempt to select representative wells for initial studies of specific areas. (In some cases, there will only be a limited number of deep wells, all of which will be selected.) The studies have shown that a large proportion of the wells provide limited data for the interpretation of potential geothermal reservoirs and it is necessary that the wells selected for study be those providing the most useful data and at the same time providing a reasonable geographic distribution within the area of study.

To meet these needs, it was found that it would normally be necessary to briefly review the data on all exploratory wells drilled within an area of study to select representative wells for further study.

Criteria for selection of wells include:

a. Geographic distribution.
b. Depth and lowest stratigraphic units penetrated.
c. Drill stem tests or other tests of stratigraphic units considered or indicated to have potential.
d. Water analyses of recovered waters.
e. Adequate pressure data for such drill stem tests.
f. Core analyses of stratigraphic units considered or indicated to have potential.
g. Adequate logs for interpretation of porosity.

Summaries of such data are readily available on summary cards or computer printouts and these can be reviewed relatively quickly to select the best wells for more detailed study.

Because of the variability of subsurface geology, no individual well can be considered really representative of even a small area, but a reasonable selection of wells should permit a valid initial assessment. The selection should be carried out by someone who has at least a general knowledge of the subsurface geology of the area.

When the wells have been selected for further study, a more detailed consideration of the pertinent data provided by each well is required.

Data on porous and permeable water-bearing zones should be extracted, summarized or interpreted as necessary, and plotted on maps.

These data will include, where available:

a. Depth to important water-bearing zones.

b. Drill stem test results with fluid recoveries.

c. Pressures from drill stem test results interpreted to indicate potential water rise or potenimetric surface.

d. Water chemistry.

e. Summaries of core analyses.

f. Temperature data.

A brief statement of the potential of the area as interpreted from the mapped data and from geological knowledge of the area should be prepared. This statement should summarize the results, but the maps are expected to provide the main source of information.

Providing that sufficient deep well data are available, this approach should give a reasonable initial assessment of the potential geothermal reservoirs of an area in a reasonable time and at a reasonable cost.

In very few cases will the data collected from oil and gas exploration and development permit thorough interpretation and mapping of the geothermal potential and reservoirs, although it will provide a very useful guide to prospective stratigraphic units and geographic locations. More detailed mapping than that carried out in the present study would not appear justified without specific developments in mind. In such cases, all available data will have to be used and studied in detail and it may be necessary to obtain more data by drilling and testing.

It should be stressed that there is always an element of risk in subsurface exploration and development. This applies to water just as to oil and gas. The degree of risk will depend on the complexity of the geology, the amount and quality of data, and the skill and experience of the interpreter among other factors. Careful studies can reduce, but never eliminate, the risk. In order to fully assess potential geothermal reservoirs, wells will have to be tested with the objective of obtaining geothermal data.

Initially, it might appear that locating and mapping large geothermal reservoirs at depth in the subsurface would be a very simple matter in view of the very large number of wells already drilled in western Canada. This study has demonstrated that this is not the case because of limitations of the available data and geological complexities.

Existing data provides considerable useful information, but information on the best water-bearing zones will usually be very limited and this will severely restrict the detail in which potential geothermal reservoirs can be mapped.

Innisfail-Red Deer Area

As a test of the method and as an example of the approach recommended, an area was selected for test mapping of potential geothermal reservoirs. The area selected was the Innisfail-Red Deer area of south central Alberta.

An area of about 21 townships was selected in collaboration with representatives of the Department of Energy, Mines and Resources. The area selected contains approximately 525 wells when only exploration wells and one development well per section are considered. There are perhaps another 250 development wells.

Data on the 525 wells referred to above were briefly reviewed, and the 68 wells which appeared to provide the most useful data were selected.

Data on the selected wells were studied and interpreted in more detail, with particular attention being given to temperatures, drill stem test results, core analyses and indications of porosity from electrical and mechanical logs.

The pertinent data and interpretation were plotted on maps at a scale of 1:50,000, and a short assessment of potential geothermal reservoirs was prepared.

For the area considered in the experimental mapping program, the Leduc Formation of Devonian age clearly emerges as the best geothermal prospect. Secondary prospects are present in the Nisku, Cooking Lake and Beaverhill Lake Formations, also of Devonian age.

Higher stratigraphic units of Mississippian and Cretaceous age appear to have limited prospects, because porosity and permeability developments are restricted both laterally and vertically.

Although the area selected was one which it was anticipated would provide a relatively large amount of valuable information, the actual amount of data on the best water-bearing reservoirs proved to be disappointingly small. This will probably be the case in most areas.

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505 Second Street S.W.
Calgary, Alberta
November 23, 1983
HAG/paob

LIMITED

APPENDIX A

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO		SI		Pressures (kPa) HP		SIP		FP	Recovery (m)
S-1 Neumann No. 12 12-29-002-02 W2M KB. 520.9 m												
S-1-9	2346.4-2353.4	IKGP	-	60	-	15	-	-	-	27407	-	9308	426.7 swtr
S-1-10	2611.5-2623.7	RDRV	-	120	-	21	-	-	-	25166	-	12411	844.3 swtr
S-1-11	2800.5-2806.6	DDWD	-	60	-	20	-	-	-	29992	-	29647	2225.0 swtr
S-2 Imperial Halket 15-07-003-08 W2M KB. 586.1 m												
S-2-5	2069.6-2074.8	BDBR	-	60	30	30	-	-	21684	19478	2103	3516	289.6 brwtr
S-2-9	2193.6-2200.7	DPRW	-	90	-	30	-	-	-	21512	3068	3827	287.1 brwtr
S-2-10	2370.1-2383.8	DSBY	-	60	40	30	-	-	5654	4619	4482	4482	393.2 fwtr 9.1 wtrcmud
S-2-12	2828.2-2835.9	SNMN	-	90	-	30	-	-	-	30751	10204	11376	1039.4 gcwtr
S-2-13	2830.1-2842.3	SNMN	-	150	25	30	-	-	29372	28786	10411	13328	1234.4 gcwtr
S-2-14	3023.0-3036.4	WNPG	-	90	-	30	-	-	-	29165	12100	12100	1097.3 frwtr 9.1 mud
S-3 Fina Radville 13-04-006-18 W2M KB. 663.3 m												
S-3-1	1495.3-1535.0	SPRF	5	90	30	90	16313	15775	15044	14941	1682	3365	274.3 swtr
S-3-3	1538.6-1545.3	MIDL	5	120	30	90	16837	16740	15051	14148	758	3385	3.0 oil 310.9 swtr
S-3-4	1944.6-1956.2	BDBR	5	120	30	90	20877	20553	19133	18319	772	3261	280.4 gcoc swtr 15.2 ocmud
S-3-7	2672.5-2696.6	YOMN	5	180	30	60	31171	30951	27386	26538	1551	7205	579.1 swtr 27.4 mud

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO	Times (minutes) VO	Times (minutes) SI	Times (minutes) SI	Pressures (kPa) HP	Pressures (kPa) HP	Pressures (kPa) SIP	Pressures (kPa) SIP	Pressures (kPa) FP	Pressures (kPa) FP	Recovery (m)
S-4 Shell Big Muddy Lake No. 1	15-12-003-21 W2M	KB. 768.1 m											
S-4-6	1684.6-1716.0	PPLR	-	60	15	15	-	20340	-	14479	-	14479	1426.5 swtr
S-4-21	2194.0-2205.5	BDBR	-	60	-	45	-	26545	-	21374	-	8963	518.2 gcswtr
S-4-22	2205.5-2254.9	BDBR	-	60	-	30	-	26200	-	21374	-	7584	27.4 gcm
		DPRW											600.0 sulgcocswtr
S-4-23	2254.9-2282.3	DPRW	-	45	-	35	-	27579	-	21718	-	13790	1158.2 swtr
S-4-25	2282.3-2315.9	DPRW	-	60	-	30	-	27579	-	23097	-	22753	2225 sulsbrwtr
S-4-27	2318.3-2325.6	DPRW	-	45	-	30	-	28269	-	21374	-	2758	213 gcocsw 30.5 ocmud
S-4-28	2325.3-2356.1	DPRW	-	45	-	30	-	29647	-	23442	-	8274	704.1 sulswtr 27.4 mud
S-4-30	2360.1-2386.1	DPRW	-	60	-	30	-	28958	-	5171	-	-	457.2 swtr
S-4-31	2386.0-2416.5	SRSR	-	60	-	30	-	28958	-	22063	-	5861	396.2 swtr
S-4-36	2625.2-2655.1	WPGS	-	45	-	30	-	-	-	-	-	-	1944.6 sulswtr
S-4-37	2656.6-2687.4	IKGP	-	60	-	30	-	31716	-	25166	-	16547	356.6 swtr
S-4-38	2687.4-2711.8	IKGP	-	60	-	30	-	32750	-	25855	-	24132	1453.9 sulswtr
S-4-39	2709.4-2740.2	IKGP	-	55	-	30	-	35163	-	26890	-	25511	2042.2 swtr
S-4-40	2739.5-2776.1	IKGP	-	70	-	30	-	34129	-	-	13790	16547	1847.1 sulswtr
S-4-42	2778.3-2810.3	IKGP	-	50	-	30	-	42058	-	30337	-	8963	438.9 swtr
		STNL											
S-4-43	2807.2-2841.3	STNL	-	45	-	30	-	34474	-	35855	-	9653	563.9 swtr
		SNMN											
S-4-44	2841.3-2877.9	SNMN	-	60	-	30	-	36542	-	26545	-	11032	603.5 swtr
		RDRV											
S-4-45	2961.1-2966.6	WNPG	-	33	-	5	-	-	-	-	-	5516	1691.6 swtr
S-4-46	3109.0-3115.1	DDWD	-	60	10	30	-	-	28613	28613	13100	25166	1681 swtr

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO		SI		Pressures (kPa) HP		SIP	FP		Recovery (m)
S-5 Imperial Long Range 04-31-001-27 W2M KB. 833.3												
S-5-1	1804.4-1817.5	RCLF	-	60	30	31	22698	21560	17940	17885	483	4275	384.0 sulwtr
S-5-3	2183.3-2183.9	BDBR	-	56	30	31	26717	26717	21546	21546	18271	21546	2186.9 swtr
S-5-4	2464.3-2476.5	DSBY	-	65	-	30	25304	25062	-	24373	9480	24373	2367.1 sulswtr
S-5-5	2486.3-2496.3	WPGS	-	32	30	30	25462	25373	24545	24635	11066	24532	2365.2 sulswtr
S-5-6	2505.5-2516.1	IKGP	-	32	30	30	25159	24869	-	-	6502	24814	2386.6 swtr
S-5-7	2571.9-2580.1	IKGP	-	30	30	30	26641	26290	25490	25442	414	20857	1947.7 swtr
S-5-10	2605.7-2617.9	IKGP	-	90	30	30	27152	26765	25711	23573	4778	6674	237.7 swtr
		STNL											457.2 wtrcush
S-5-11	2669.1-2682.8	RDRV	-	90	30	30	28255	28220	26255	24270	4813	6929	246.9 swtr
													457.2 wtrcush
S-5-14	2738.6-2743.2	WNPG	-	62	30	32	29227	28896	27090	27000	9032	26393	2139.7 sbrwtr
													457.2 wtrcush
S-6 Amerada Shell Crown SE 10-26-001-13 W3M KB. 820.5													
S-6-2	1495.0-1522.5	BDBR	-	35	-	30	-	19650	-	15858	13100	15168	1522.5 swtr
S-6-3	1863.9-1874.5	IKGP	-	30	-	30	24132	24132	-	19133	-	3792	304.8 swtr
S-6-4	2345.7-2361.0	DDWD	-	60	-	30	-	29785	-	22753	5516	10170	518.2 gcswtr
													442.0 strcmud
S-7 Imperial Tidewater Climax 6-10-3-18 06-10-003-18 W3M KB. 937.6													
S-7-10	1735.8-1743.2	BDBR	-	60	-	-	-	22063	-	-	-	6205	576.1 sulgcswtr
													27.4 gcmud
S-7-13	2009.5-2016.3	SRSR	-	60	-	-	-	26200	-	-	-	5516	521.2 sulgsbrwtr
													32.0 gcmud
S-7-14	2046.7-2054.4	SRSR	-	30	-	-	-	27234	-	-	3447	12066	1127.8 frwtr
													6.1 mud

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO		SI		Pressures (kPa) HP		SIP		FP		Recovery (m)
S-8 Imperial Etal Battle Creek No. 4-31 04-31-003-26 W3M KB. 936.3													
S-8-20	1572.5-1575.8	BDBR	-	45	-	15	-	17375	-	14479	-	2551	228.6 sulgcbrwtr
S-8-21	1689.2-1692.2	DPRW	-	60	-	15	-	19305	-	16203	-	3103	310.9 sulgcwtr
S-8-29	1745.9-1758.1	DPRW	-	45	-	15	-	18616	-	14824	-	9653	1371.6 sulwtr
S-8-39	1902.0-1909.5	SRSR	-	60	-	15	-	22753	-	17926	-	15513	1453.9 gcbrwtr
S-9 Baetal Wilnichenko No. 2-12 02-12-013-27 W3M KB. 755.9													
S-9-5	1647.7-1661.8	SRSR	-	60	30	32	21960	21829	16568	14796	1158	2406	201.2 swtr
S-9-8	1787.0-1794.1	WPGS	-	60	55	30	23670	23270	17775	17685	6047	17106	1444.8 swtr
S-9-9	1797.1-1809.3	ODVC	-	30	21	30	23284	23284	17975	17975	7557	15348	1179.6 swtr
S-10 Mobil Etal Dorrell No. 32-9 09-32-006-22 W3M KB. 1054.0													
S-10-3	1793.7-1802.9	BDBR	-	30	-	45	-	-	-	15513	5171	9584	1023.2 swtr
S-10-4	1886.1-1909.9	DPRW	-	30	-	45	-	-	15858	7652	3447	7653	670.6 sulwtr
S-10-8	2079.0-2083.9	SRSR	-	60	-	60	-	-	15168	3930	2241	3930	400.8 brwtr
S-10-9	2135.1-2148.5	SRSR	-	30	-	45	-	-	18547	18409	15651	18409	1792.2 brwtr
		DSBY											
S-10-10	2189.4-2194.0	IKGP	-	60	-	60	-	-	4068	4068	4068	4068	402.3 brwtr
S-10-11	2199.4-2216.2	IKGP	-	75	-	45	-	-	18443	15444	9101	15444	1453.9 brwtr
S-10-12	2303.1-2306.7	ODVC	-	60	-	83	32681	32681	-	14686	8618	9860	637.9 brwtr
													9.1 mud
S-10-14	2669.4-2673.1	DDWD	-	90	-	100	-	-	22753	22063	11101	22615	2359.5 brwtr
S-10-15	2640.2-2643.8	DDWD	-	30	-	59	32991	32405	-	21925	15700	20340	1470.7 swtr
													563.9 wtrcush
S-10-16	2654.8-2659.4	DDWD	-	75	-	80	-	-	23028	11721	6895	11721	567.8 swtr

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO		SI		Pressures (kPa) HP		SIP		FP		Recovery (m)
S-11 Delhi Etal Rock Creek 2-4 02-04-010-19 W3M KB. 929.9													
S-11-3	1809.6-1818.1	DPRW	-	30	-	30	22718	22187	-	16161	7091	11466	1101.0 sulgcwtr
S-11-4	1991.9-2001.6	SRSR	-	30	-	50	24842	24752	-	17637	2406	5357	521.2 olswtr
S-11-5	2036.1-2040.6	SRSR	-	30	-	30	25462	25511	-	18988	16547	18450	1766.9 sulwtr
S-11-6	2081.8-2089.4	IKGP	-	30	19	20	26297	26297	19085	19140	6143	18209	1647.4 swtr
S-12 Shell Wood Mountain No. 1 07-34-009-11 W3M KB. 775.4													
S-12-10	1602.9-1640.7	BDBR	-	120	-	15	-	19650	-	-	-	10170	960.1 sulwtr 30.5 gcmud
S-12-12	1750.2-1858.1	DPRW SRSR	-	60	15	20	-	23442	-	-	-	6895	792.5 sulwtr 61.0 wtrcmud
S-12-13	1978.8-2033.9	ODVC	-	60	20	20	-	25511	-	19995	-	18961	1798.3 frwtr
S-13 Fina Crane Valley 14-12-9-28 14-12-009-28 W2M KB. 714.1													
S-13-1	2317.7-2327.5	RDRV	5	120	30	90	25469	25028	23697	23573	414	986	701.0 brwtr
S-13-2	1859.3-1908.0	DPRW	5	120	30	90	20367	20264	19340	19257	2358	4640	1775.5 brwtr
S-14 Norcanols Omega No. 1 04-24-007-23 W2M KB. 737.6													
S-14-3	2802.9-2865.1	DDWD	-	30	-	-	-	-	-	-	-	-	2692.6 swtr
S-14-4	2743.2-2779.5	DDWD	-	24	-	-	-	-	-	-	-	-	2576.2 swtr
S-14-5	2016.3-2026.9	DPRW	-	110	-	-	-	-	-	-	-	-	1984.2 sulwtr
S-14-6	1653.5-1659.9	MSNL	-	230	-	-	-	-	-	-	-	-	1757.8 sulswtr
S-15 BA Richfield Husky Normandin 14-11 14-11-014-16 W2M KB. 596.5													
S-15-3	2122.9-2137.3	YOMN	-	90	20	45	-	-	-	19988	951	5295	457.2 swtr
S-15-8	2215.0-2224.1	WNPG	4	90	33	61	30640	30571	22525	14576	1372	6743	713.2 swtr

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO		SI		Pressures (kPa) HP		SIP		FP		Recovery (m)
S-16 Imperial CND SUP Stoughton 3-27 03-27-008-08 W2M KB. 627.3													
S-16-6	1729.7-1738.9	DPRW	-	-	-	-	-	-	-	16203	-	3347	283.5 swtr
S-16-9	2180.5-2192.7	IKGP	-	60	30	75	27227	26800	22139	22167	2268	5488	285.0 swtr
													219.5 wtrcush
S-16-10	2299.4-2316.2	IKGP	-	45	-	15	29551	28992	-	22201	3385	3785	384.0 swtr
S-16-11	2321.4-2327.5	STNL	-	92	81	32	29937	29558	23525	21450	3716	4799	118.9 ocswtr
													352.7 wtrcush
S-16-12	2348.5-2365.2	SNMN	-	60	20	30	29234	29234	24014	22167	4102	6660	246.9 swtr
													384.0 wtrcush
S-17 Tenn Walpole A4-22-10-33 04-22-010-33 W1M KB. 637.6													
S-17-2	1661.2-1684.0	WPGS	2	60	60	60	19616	19519	16106	15844	1296	1041	274.3 wtr
													18.3 wtrcmud
S-18 Tidewater CDN SUP Imperial 1-4 01-04-020-32 W1M KB. 507.8													
			-	-	-	-	-	-	-	-	-	-	-
S-19 Triton Tidewater Debuc CR No. 15-22 15-22-019-04 W2M KB. 551.1													
			-	-	-	-	-	-	-	-	-	-	-
S-20 Imperial Muscowpetung 192116 01-09-021-16 W2M KB. 608.1													
S-20-8	1508.5-1520.0	WPGS	-	60	30	20	19167	19167	14134	13031	896	4757	396.2 swtr
S-20-9	1590.1-1601.7	IKGP	-	30	6	30	20271	19995	15375	14755	2482	10066	1024.1 swtr
S-20-10	1788.9-1798.3	YOMN	-	60	-	30	22615	22753	-	17720	3654	13583	1188.7 swtr
S-20-11	1859.9-1871.2	WNPG	-	30	-	30	24890	24649	-	18340	8550	16168	1508.8 swtr

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO		SI		Pressures (kPa) HP		SIP		FP		Recovery (m)
S-21 Dillman Tuxford No. 1 01-03-019-26 W2M KB. 595.9													
S-21-1	1969.0-1986.4	WNPG	-	60	-	15	27303	27303	-	20995	15961	20891	1828.8 swtr
S-21-2	2009.9-2024.8	DDWD	-	30	-	10	27993	27786	-	19926	17926	19512	1755.6 swtr
S-21-4	2216.5-2237.8	DDWD	-	20	-	15	31268	31578	-	22477	17754	20960	1722.1 swtr
S-21-5	1752.6-1760.2	IKGP	-	60	-	15	-	-	-	18326	655	6522	470.9 swtr
S-22 Imperial Lake Valley 126191 12-06-019-01 W3M KB. 598.0													
S-22-2	1991.6-2000.7	DDWD	-	60	21	30	21408	21863	20229	20174	17237	20009	1676.4 swtr 164.6 wtrcush
S-23 BA Moore 627 06-27-015-06 W3M KB. 734.9													
S-23-1	1783.1-1794.4	SRSR	-	45	20	32	23677	23387	18409	17264	848	4033	349.9 swtr
S-23-2	1862.3-1871.5	DSBY	-	30	43	30	23649	23428	-	18685	5916	13135	1254.3 swtr
S-23-4	1987.3-1994.9	IKGP	-	30	20	30	25655	25455	19947	19981	9887	18292	1752.6 frwtr
S-23-9	2361.9-2366.5	DDWD	-	45	32	30	29489	29592	22367	22511	8756	17961	1534.4 swtr
S-23-10	2286.6-2298.2	DDWD	-	45	45	30	28765	28655	21705	21257	1613	6460	1150.0 swtr
S-24 Socony Woodley Southern Success 37B 07-03-017-16 W3M KB. 741.9													
			-	-	-	-	-	-	-	-	-	-	-
S-25 Amurex Canada Southern Kieville 14 04-27-015-23 W3M KB. 739.4													
			-	-	-	-	-	-	-	-	-	-	-
S-26 Mobil Oil North Richmond 31-1 01-31-018-28 W3M KB. 768.4													
S-26-15	1766.0-1768.8	ODVC	-	61	-	60	23132	22746	-	17720	1248	14079	1152.1 swtr
S-26-17	2207.7-2222.0	DDWD	-	90	-	60	26724	26676	-	20567	7377	20229	1600.2 gcwtr 396.2 wtrcush
S-26-18	2239.4-2248.8	DDWD	-	90	-	65	27393	26359	-	20891	7681	20891	1664.2 gcfrwtr 411.5 wtrcush

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO		SI		Pressures (kPa) HP		SIP		FP		Recovery (m)
S-27 Husky Phillips Eatonia No. 1 04-32-026-24 W3M KB. 744.9													
			-	-	-	-	-	-	-	-	-	-	-
S-28 Imperial Fortune 13203014 13-20-030-14 W3M KB. 593.1													
S-28-8	1702.3-1709.9	DDWD	-	30	30	60	21884	21808	16575	16168	1593	4164	219.5 swtr
S-29 Birsay Crown No. 1 13-04-025-08 W3M KB. 660.2													
			-	-	-	-	-	-	-	-	-	-	-
S-30 HB Watrous 6-24-30-28 06-24-030-28 W2M KB. 631.9													
S-30-2	1822.7-1863.9	DDWD	5	30	30	60	19671	19753	17189	17189	16609	17175	1333.5 swtr 147.8 mud 85.3 wtrcmud
S-31 Tidewater Stalwart Crown No. 1 14-10-027-25 W2M KB. 515.7													
S-31-5	1609.6-1612.4	WNPG	-	60	-	15	-	-	-	15341	-	11032	987.6 swtr
S-32 BA Beckett 8-11 08-11-025-15 W2M KB. 658.4													
			-	-	-	-	-	-	-	-	-	-	-
S-33 Husky Phillips Fitzmaurice No. 1 16-18-027-08 W2M KB. 624.0													
			-	-	-	-	-	-	-	-	-	-	-
S-37 Cree Candedaphne 7-29 07-29-037-18 W2M KB. 561.4													
			-	-	-	-	-	-	-	-	-	-	-

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO	Times (minutes) SI	Pressures (kPa) HP	Pressures (kPa) SIP	Pressures (kPa) FP	Recovery (m)
S-38	Imperial Gurnsey 13-34-33-23 13-24-033-23 W2M KB. 545.9							
			- -	- -	- -	- -	- -	-
S-39	White Rose Etal St. Denis 4-16-37-1 04-16-037-01 W3M KB. 558.7							
			- -	- -	- -	- -	- -	-
S-40	Banff Etal Langham 12-30-38-7 12-30-038-07 W3M KB. 511.8							
			- -	- -	- -	- -	- -	-
S-41	CPOG Leipzig 2-30-37-19 02-30-037-19 W3M KB. 675.1							
			- -	- -	- -	- -	- -	-
S-42	Ceepee Reward 4-28 04-28-038-24 W3M KB. 695.6							
			- -	- -	- -	- -	- -	-
S-52	Husky DH Turtleford 6-5-51-20 06-05-051-20 W3M KB. 615.4							
			- -	- -	- -	- -	- -	-
S-43								

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO		SI		Pressures (kPa) HP		SIP		FP		Recovery (m)
A-1 Texaco Cypress Hills No. 4-13-6-3 04-13-006-03 W4M KB. 1109.5													
A-1-8	1726.7-1738.9	LDUC	5	60	125	30	19726	19429	14024	13231	1324	4171	396.2 sulgcswtr 27.4 mud
A-1-11	2496.3-2500.9	MCMB	5	60	30	30	32136	31695	20050	19981	1448	5171	487.7 swtr 9.1 wtrcmud
A-4 Gulf Blood 5-18-7-23 05-18-007-23 W4M KB. 1015.9													
			-	-	-	-	-	-	-	-	-	-	-
A-5 B.A. CPOG Carmangay 8-25-12-24 08-25-012-24 W4M KB. 958.6													
A-5-4	2735.3-2759.7	ELDN	-	65	-	45	30923	30923	-	14844	-	4268	335.3 wtrcush 18.3 mud
A-5-6	1721.2-1733.4	TRVL	5	60	30	45	19229	19105	16320	16127	1007	3785	350.5 sulswtr
A-6 Honolulu Taber 6-25-10-16 06-25-010-16 W4M KB. 790.3													
			-	-	-	-	-	-	-	-	-	-	-
A-7 BA Grand Forks No. 12-14-12-12 12-14-012-12 W4M KB. 757.4													
A-7-19	1603.2-1613.9	BHL	1	60	30	30	19312	19312	1717	16272	2468	6584	1295.4 gcswtr
A-7-20	1684.0-1713.6	EKPP	3	45	28	38	20402	20402	17713	18257	2792	8605	670.6 swtr
A-7-21	2072.6-2086.1	MCMB	2	60	30	30	25662	25662	19423	19402	1082	5247	502.9 swtr
A-8 CPOG Princess No. 10-4-19-11 10-04-019-11 W4M KB. 773.0													
A-8-6	1637.7-1650.5	BHL	2	60	30	30	21456	21346	17389	15665	986	4544	302.4 swtr
A-8-7	2183.9-2199.1	STPN CORL	2	30	30	31	29110	28896	20188	20236	18836	20036	1524.0 swtr

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO		SI		Pressures (kPa) HP		SIP		FP		Recovery (m)
A-9 IMP Calstan Lk Newell 5-1-17-14 05-01-017-14 W4M KB. 751.6													
			-	-	-	-	-	-	-	-	-	-	-
A-10 Cal Std Parkland 4-12 04-12-015-27 W4M KB. 1008.6													
A-10-7	2141.8-2148.2	ELRL	-	60	-	30	-	27234	-	14479	-	3792	304.8 wtrcush 36.6 gcmud
A-10-8	2147.6-2151.3	ELRL	-	70	-	35	-	27579	-	15168	-	4482	304.8 wtrcush 21.3 mud
A-10-16	2267.1-2273.5	TRVL	-	60	-	30	-	27579	-	19305	-	2758	61.0 sulgcswtr 192.0 wtrcush 30.5 ocmud
A-10-17	2356.4-2361.0	ELKS	-	60	-	15	27248	27248	-	19526	3282	3316	304.8 wtrcush 3.0 wtrcmud
A-10-24	2680.1-2692.3	WBMN	-	60	-	30	-	-	-	-	-	-	3.0 o 109.7 ocfrwtr 304.8 wtrcush
A-10-25	2691.1-2698.7	WBMN	-	60	-	30	31730	31302	-	23732	3282	4061	277.4 ocmud 3.0 o 88.4 sulgcwtr 304.8 wtrcush 274.3 ocmud
A-10-26	2814.2-2821.8	NSKU	-	52	-	30	32426	32309	-	12548	4813	4813	457.2 wtrcush 6.1 mud
A-10-27	2907.2-2914.8	LDUC	-	60	-	30	33715	33467	-	14010	5985	5985	348.6 wtrcush 4.6 mud
A-10-28	2940.7-2954.4	LDUC	-	60	-	30	34219	34219	-	11831	6136	6136	548.6 wtrcush 4.6 mud
A-10-30	3584.4-3595.4	GRNW	-	104	-	30	44616	44616	-	24552	15961	16099	1447.8 wtrcush

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO		SI		Pressures (kPa) HP		SIP		FP		Recovery (m)
A-11 Shell Mackid No. 1 01-19-021-28 W4M KB. 1065.0													
A-11-17	2159.5-2175.1	TRVL	-	92	-	-	-	-	-	-	-	-	1524.0 swtr
		ELKS											54.9 gcmud
A-11-22	2667.3-2700.5	WBMN	-	60	-	-	-	-	-	-	-	-	367.3 wtrcush
		CLMR											6.1 wtrcmud
A-11-23	2738.3-2745.6	NSKU	-	60	-	-	-	-	-	-	-	-	367.3 wtrcush
													7.6 wtrcmud
A-11-27	2741.4-2748.7	NSKU	-	30	-	-	-	-	-	-	-	-	365.8 wtrcush
													2.06 mud
A-11-28	2845.9-2865.1	LDUC	-	60	-	-	-	-	-	-	-	-	457.2 wtrcush
													3.0 mud
A-12 Shell Crossfield #1 04-22-027-01 W5M KB. 1139.3													
A-12-29	2529.5-2555.7	PKSK	-	60	-	15	-	-	-	2930	-	2758	219.5 wtrcush
													7.6 mud
A-12-30	2555.1-2586.2	PKSK	-	60	-	15	-	30337	-	6033	-	5516	274.3 wtrcush
		BNFF											233.2 wtrcmud
A-12-31	2586.6-2616.7	BNFF	-	60	-	15	31716	31026	-	6895	-	3620	274 3 wtrcush
													13.7 mud
A-12-33	2751.1-2766.4	WBMN	-	60	-	15	-	32405	-	5516	-	5171	460.2 wtrcush
													4.6 mud
A-13 T.G.T. Nacmine 6-8-28-21 06-08-028-21 W4M KB. 901.0													
A-13-3	1867.2-1879.4	NSKU	-	26	15	20	24690	23739	15341	15375	3889	8860	722.4 gcswtr
A-13-4	1914.1-1929.4	LDUC	-	45	15	30	24725	-	15065	15079	3668	15065	1421.9 sulgcswtr
A-13-5	2258.6-2289.0	BHL	-	60	-	30	29289	28593	-	22098	14134	22091	1658.1 swtr
													192.0 wtrcmud
A-13-7	2849.9-2921.5	GRNW	-	90	-	30	35198	34805	-	26352	14520	25807	1944.6 swtr
													304.8 wtrcush

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO			SI	Pressures (kPa) HP		SIP		FP		Recovery (m)
A-14 Mobil Oil CPR Hutton 11-18-24-15 11-18-024-15 W4M KB. 751.9													
A-14-10	2350.0-2369.8	CDRL SPRN	-	75	15	30	30764	30971	22456	16513	2544	13769	1289.3 swtr
A-15 Chevron East Sunnybrook 412811 04-01-028-11 W4M KB. 803.5													
			-	-	-	-	-	-	-	-	-	-	-
A-16 Pacific Amoco Express 7-12-22-1 07-12-022-01 W4M KB. 666.9													
			-	-	-	-	-	-	-	-	-	-	-
A-17 Imperial Eyehill #1 13-36-035-02 W4M KB. 812.9													
			-	-	-	-	-	-	-	-	-	-	-
A-18 Homestead Calnan Hamilton Lk. 8-15 08-15-035-10 W4M KB. 773.3													
A-18-8	1549.3-1563.9	BHL	-	120	-	10	-	-	-	-	6033	7757	359.7 swtr
A-19 Rio Bravo Ronald #1-6 01-06-038-15 W4M KB. 837.0													
			-	-	-	-	-	-	-	-	-	-	-
A-20 CPOG Oberlin 10-15-38-21 10-15-038-21 W4M KB. 819.6													
			-	-	-	-	-	-	-	-	-	-	-

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO		SI		Pressures (kPa) HP		SIP		FP		Recovery (m)
A-21 INP HB Dickson 1-28-36-3 01-28-036-03 W5M KB. 965.6													
A-21-1	2799.6-2834.9	NSKU	-	60	-	60	-	-	-	-	-	-	120.4 sulswtr 562.4 wtrcush
A-21-2	2996.2-3006.9	IRTN	-	30	-	130	-	-	-	-	-	-	54.9 sulgcswtr 276.1 wtrcush 242.6 ocmud
A-21-3	3084.0-3083.1	CKGK	-	251	-	33	39176	38480	-	26076	8419	9956	193.5 sulswtr 774.8 wtrcush
A-22 Mobil Etal James 8-14-34-7 08-14-034-07 W5M KB. 1226.8													
A-22-1	3606.7-3665.5	WBMN	5	45	45	60	41320	41975	34060	34039	13652	22932	1173.5 gcwtr 847.3 wtrcush
A-22-2	4140.4-4195.3	SHM	6	60	39	60	52200	52200	44519	41438	22691	19540	199.9 sulwtr 1417.3 wtrcush
A-22-6	3851.1-4260.2	CKGK SHM	30	82	30	166	47650	41355	36432	36742	8108	12983	850.7 sulwtr 623.6 wtrcush 1133.9 mud
A-23 Home Etal Sturrock 11-16-41-16 11-16-041-16 W5M KB. 1602.9													
A-23-1	2182.4-2196.1	IRTN	5	120	60	120	22739	22546	17740	17637	3269	5040	1493.5 gcsbrwtr 54.9 mud
A-23-2	1676.4-1690.1	WBMN	15	120	60	120	17471	17271	12928	12893	765	765	372.2 frbrwtr
A-24 Grt Plns Triad Crimson Lake 9-23A 09-23-040-09 W5M KB. 1053.1													
A-24-5	2571.3-2611.5	BFS VKNG	-	20	-	15	32922	31923	-	10515	4688	5516	243.8 wtrcush 82.3 gcmud
A-24-10	3221.1-3231.8	WBMN	-	45	-	30	39817	39645	-	18099	7929	18099	762.0 wtrcush 9.1 mud
A-24-11	3439.7-3467.4	NSKU	-	60	-	30	43161	43540	-	27958	9825	10170	917.4 wtrcush 33.5 mud

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO		SI		Pressures (kPa) HP		SIP		FP		Recovery (m)
A-24-12	3484.2-3504.9	NSKU	-	105	-	30	44333	44747	-	30406	14203	30337	1828.8 sulbrwtr 914.4 wtrcush
A-25 Calstan South Morningside 14-20 14-20-041-27 W4M KB. 924.5													
A-25-18	2449.4-2461.6	CKGK	-	60	-	30	30275	30254	-	22063	4592	4985	411.5 wtrcush 54.9 wtrcmud
A-25-19	2735.9-2742.0	EKPP	-	90	-	30	34612	34488	-	6984	6060	6060	609.6 wtrcush 3.0 mud
A-25-20	2754.8-2761.5	EKPP	-	70	-	30	34101	34308	-	19940	6467	6516	630.9 wtrcush 7.6 mud
A-26 Union Robson 14-34 14-34-043-14 W4M KB. 690.4													
			-	-	-	-	-	-	-	-	-	-	-
A-27 Gulf CDR Bell 10-15-42-11 10-15-042-11 W4M KB. 691.3													
A-27-1	1555.7-1645.9	WPGS ASRN ODVC	-	90	-	-	-	-	-	15017	-	8122	688.8 swtr
A-28 Petcal Dina 10-32-45-1 10-32-045-01 W4M KB. 630.9													
			-	-	-	-	-	-	-	-	-	-	-
A-29 Calstan Pacific Marwayne 14-29-52-2 14-29-052-02 W4M KB. 636.7													
			-	-	-	-	-	-	-	-	-	-	-
A-30 Husky DH Vermilion 11-19-50-6 11-19-050-06 W4M KB. 624.5													
			-	-	-	-	-	-	-	-	-	-	-

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes)				Pressures (kPa)						Recovery (m)
			VO		SI		HP		SIP		FP		
A-31 IMP Dinant No.1 16-17-048-20 W4M KB. 755.6													
			-	-	-	-	-	-	-	-	-	-	-
A-32 Texaco Wizard Lake CPR No. 8-3 15-21-048-27 W4M KB. 774.8													
A-32-1	2888.9-2904.7	GRNW	-	60	-	15	-	-	-	7584	-	7584	603.5 wtrcush 82.3 gcmud
A-33 Select Oils Chip Lake #1 04-29-053-10 W5M KB. 820.2													
A-33-7	1943.4-1951.6	BNFF	-	30	-	-	-	-	-	-	-	-	670.6 swtr
A-33-9	1868.1-1871.2	ELRL	-	973	-	-	-	-	-	-	-	-	6.1 mud 975.4 frwtr
A-33-10	1868.1-1871.2	ELRL	-	192	-	-	-	-	-	-	-	-	219.5 frwtr
A-34 Mobil Etal Wolf 11-33-51-16 11-33-051-16 W5M KB. 969.0													
A-34-1	3698.1-3718.0	SHM	5	30	30	60	39604	38252	35212	35356	28062	35212	640.1 sulswtr 30.5 mud
A-35 Columbian Mobil Berland 3-23-57-24 03-23-057-24 W5M KB. 1039.4													
			-	-	-	-	-	-	-	-	-	-	-
A-36 Fina Etal Sundance 6-13-58-18 06-13-058-18 W5M KB. 1116.2													
			-	-	-	-	-	-	-	-	-	-	-
A-37 Fina Green Court 10-18-61-6 10-18-061-06 W5M KB. 681.5													
A-37-4	1566.1-1590.4	BLRG	3	60	30	30	18333	18133	12879	12879	7040	12879	1179.6 sulwtr

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes)				Pressures (kPa)						Recovery (m)
			VO			SI	HP		SIP		FP		
A-38 IMP Bailey Selburn Riverdale 1-27 01-27-060-26 W4M KB. 650.1													
A-38-10	1602.0-1614.2	BHL	-	60	-	30	20477	20133	-	12824	4482	8756	624.8 swtr
A-38-11	1871.5-1888.2	KEGR	-	35	-	30	22063	21718	-	18064	10411	17237	1205.5 swtr
A-39 Crown Edward No.1 08-26-060-16 W4M KB. 681.8													
A-39-13	1827.3-1834.0	MCMB	-	60	-	-	-	-	-	-	-	-	1432.6 swtr
A-40 Pacific Sunray Elk Point #1 16-28-056-08 W4M KB. 630.0													
A-40-14	1491.1-1507.2	BDBD	-	60	-	-	-	-	-	-	-	12155	984.5 swtr
A-41 MCD Chieflo Labie 10-11-67-12 10-11-067-12 W4M KB. 597.7													
			-	-	-	-	-	-	-	-	-	-	-
A-42 Arco B.A. Venice 10-12-66-15 10-12-066-15 W4M KB. 578.8													
A-42-6	1531.6-1562.2	BDBD	3	60	30	90	18092	18009	14844	14906	10976	14858	1089.7 swtr 213.4 mud
A-43 Home KCL Alminex Tieland 12-14-67-2 12-14-067-02 W5M KB. 619.4													
			-	-	-	-	-	-	-	-	-	-	-
A-44 Home Etal Regent Swan Hills 8-11 08-11-068-10 W5M KB. 970.2													
A-44-14	2415.2-2422.2	SLVP	-	60	20	30	30130	30130	2965	3571	2779	2779	243.8 wtrcush 6.1 mud
A-44-15	2440.8-2443.9	GLWD	-	70	20	30	30171	30309	21450	17168	3689	3751	27.4 o 61.0 swtr 304.8 wtrcush
A-44-17	2545.7-2558.2	MSKG	-	60	20	30	32192	31826	23442	23442	19719	23201	1645.9 swtr 335.3 wtrcush

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO			SI	Pressures (kPa) HP		SIP		FP		Recovery (m)
A-44-18	2666.4-2680.1	MCMB	-	60	20	30	33715	32585	-	22001	5812	5861	518.2 wtrcush 109.7 wtrcmud
A-44-19	2713.0-2725.2	MCMB	-	75	20	30	33764	33474	-	22822	6378	6791	54.9 swtr 548.6 wtrcush 54.9 mud
A-45 BA Sweathouse 10-9-68-17 10-09-068-17 W5M KB. 907.4													
A-45-4	2330.2-2337.8	WRBR	3	90	60	60	24773	24607	22208	22160	13038	22146	1953.8 sulswtr 54.9 wtrcmud
A-45-5	2971.8-3008.4	MCMB	4	60	36	30	34494	33577	28269	25869	5412	10397	629.4 swtr 304.8 wtrcush
A-46 B.A. Little Smoky In 1-27-67-22 1-27-67-22 W5M KB. 681.1													
A-46-1	3037.8-3043.9	GRNW	-	120	-	20	-	-	-	3100	-	1225	167.8 mudfrwtr 594.8 frwtr 100.65 swtr
A-46-2	3091.8-3096.4	GRNW	-	120	-	30	-	-	-	4700	-	3300	162.5 wtrcush 1471.6 swtr
A-46-3	3114.5-3120.8	GRNW	-	120	-	30	-	-	-	4290	-	1425	762.5 wtrcush 640 swtr
A-46-4	3182.1-3196.3	GRNW	-	120	-	30	-	-	-	3900	-	2050	879.9 wtrcush 56.4 swtr
A-47 Pan Am G-1 Gold Cr. 10-16-69-5 10-16-069-05 W6M KB. 660.8													
A-47-4	3314.7-3354.3	WBMN	7	164	60	60	40527	39941	30440	21436	13293	13652	1371.6 wtrcush 30.5 gcmud
A-47-6	3354.3-3386.3	WBMN	5	90	60	60	41396	41293	34998	35205	14086	28372	1941.6 sulswtr 702.0 wtrcush

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO		Times (minutes) SI		Pressures (kPa) HP		Pressures (kPa) SIP		Pressures (kPa) FP		Recovery (m)
A-48	Mesa Texcan Saddle Hills 7-6-76-9	07-06-076-09 W6M KB. 877.2											
A-48-2	2329.3-2341.5	BLLY	15	90	60	90	24883	24883	18506	16320	3523	3744	371.9 frwtr
A-49	White Rose Etal Adrano 6-32-75-25	06-32-075-25 W5M KB. 620.3											
A-49-4	2762.1-2813.0	GRNW	-	30	-	30	36935	36811	-	27158	8053	15755	883.9 swtr 609.6 wtrcush
A-50	Pure TPC&O High Prairie 6-7-74-16	06-07-074-16 W5M											
A-5-10	2256.7-2261.6	GLWD	-	120	50	30	24911	24042	23739	23497	9205	23339	2008.6 swtr 64.0 mud
A-51	Baysel Etal Kinuso 4-12-74-10	04-12-074-10 W5M KB. 584.6											
			-	-	-	-	-	-	-	-	-	-	-
A-52	Home Martin Hills 4-16-74-24	04-16-074-24 W4M KB. 676.0											
A-52-4	1542.3-1556.9	CNGG	-	45	30	45	20112	19947	18609	18643	10887	18595	1371.6 swtr 54.9 mud
A-53	Imperial Wolverine 7-24-76-18	07-24-076-18 W4M KB. 626.1											
			-	-	-	-	-	-	-	-	-	-	-
A-60	Atlantic Ioe Utikuma 4-2-83-9	04-02-083-09 W5M KB.670.0											
A-60-2	1777.0-1807.8	KEGR GRNW	5	60	30	90	22463	21753	18244	18264	15465	18202	1549.3 swtr 1585.9 mud
A-61	Can Dehli Etal Cadotte 5-32-83-16	05-32-083-16 W5M KB. 709.3											
A-61-1	1866.0-1873.6	SLVP	-	60	-	-	-	-	-	-	-	-	274.3 swtr 6.1 wtrcmud

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes)				Pressures (kPa)						Recovery (m)
				VO		SI	HP			SIP		FP	
A-62 Stanound Grimshaw #1 16-13-083-24 W5M KB. 643.4													
			-	-	-	-	-	-	-	-	-	-	-
A-63 Amoco C-1 Josephine 11-17-83-9 11-17-083-09 W6M KB. 676.0													
			-	-	-	-	-	-	-	-	-	-	-
A-64 Pan Am A-1 Ooig River 10-27-90-11 10-27-090-11 W6M KB. 948.5													
A-64-4	2898.6-2921.2	GLWD	120	15	-	60	33853	33315	-	9894	5088	4371	304.8 wtrcush 103.6 gcmud
A-65 Union North Star 4-14-90-24 04-14-090-24 W5M KB. 651.7													
A-65-2	1994.0-2035.5	SLVP	-	90	31	30	-	25187	-	21050	16203	20939	1472.2 swtr 384.0 mud
A-66 Uno Tex Champlain Golden 1-10-90-16 01-10-090-16 W5M KB. 694.6													
A-66-5	1670.3-1691.6	SLVP	-	90	40	30	20905	20905	16382	15217	3110	14258	1240.5 swtr 54.9 mud
A-67 Union Red Earth 8-6-91-8 08-06-091-08 W5M KB. 498.7													
			-	-	-	-	-	-	-	-	-	-	-
A-73 Honolulu Union Wabasca 6-5-98-10 06-05-098-10 W5M KB. 607.5													
			-	-	-	-	-	-	-	-	-	-	-

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO			SI	Pressures (kPa) HP		SIP		FP		Recovery (m)
A-74	Amerada Etal Wolverine 13-29-98-16	13-29-098-16 W5M	KB. 445.6										
A-74-1	1551.4-1597.5	KEGR	5	45	40	30	19671	19498	-	17492	9846	17354	1534.7 swtr
A-75	HHS Security Kemp 6-27-99-22	06-27-099-22 W5M	KB. 466.0										
			-	-	-	-	-	-	-	-	-	-	-
A-76	Pan Am Ioe B-1 Chinchaga 6-8-99-7	06-08-099-07 W6M	KB. 698.3										
A-76-5	2222.0-2228.1	MSKG	-	110	120	120	25821	25800	-	22987	2027	2751	213.4 swtr 1432.6 mud
A-77	Trend Ioe Rains 15-14-105-8	15-14-105-08 W6M	KB. 691.6										
			-	-	-	-	-	-	-	-	-	-	-
A-78	CDN-SUP C+E Sun Bede 10-15-106-1	10-15-106-01 W6M	KB. 436.5										
			-	-	-	-	-	-	-	-	-	-	-
A-79	Pinn Japex BVX Boyer 11-15-106-17	11-15-106-17 W5M	KB. 338.9										
			-	-	-	-	-	-	-	-	-	-	-
A-83	Arco Mobil Margaret 4-14-115-8	04-14-115-08 W5M	KB. 883.0										
			-	-	-	-	-	-	-	-	-	-	-
A-84	Shell Etal Rapids 2-28-114-17	02-28-114-17 W5M	KB. 489.5										
			-	-	-	-	-	-	-	-	-	-	-

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes)				Pressures (kPa)						Recovery (m)
				VO		SI	HP		SIP		FP		
A-85 Home Almx Melvin 10-17-115-23 10-17-115-23 W5M KB. 342.9													
			-	-	-	-	-	-	-	-	-	-	-
A-86 SOBC BA Vardie 10-30-114-8 10-30-114-08 W6M KB. 375.8													
			-	-	-	-	-	-	-	-	-	-	-
A-87 BA North Bistcho 11-5-122-9 11-05-122-09 W6M KB. 595.6													
A-87-2	1610.9-1629.2	MSKG	-	75	-	-	-	-	-	-	-	-	460.2 gcswtr 152.4 wtrcush
A-88 Mobil Etal Cameron 9-9-123-23 09-09-123-23 W5M KB. 701.6													
A-88-4	1596.8-1612.4	MSKG	5	55	55	57	18326	18326	12162	12162	3668	12059	1030.2 sulgcwtr
A-90 Shell Etal Yates 7-25-120-10 07-25-120-10 W5M KB. 836.1													
			-	-	-	-	-	-	-	-	-	-	-
A-101 Atkinson Etal Wild Hay 12-11-56-24 12-11-056-24 W5M KB. 1161.9													
A-101-2	4405.6-4553.7	SHM GLWD	15	248	60	240	55082	54125	41217	40279	19478	16534	536.4 wtrcush 312.4 gcmud
A-101-3	3347.9-3351.6	MNTN	15	120	60	120	40948	40507	23463	22456	6922	9287	313.9 swtr 319.1 wtrcush 96.9 gcmud
A-102 Imperial Clyde #1 09-29-059-24 W4M KB. 629.4													
A-102-13	1781.3-1793.7	MSKG	-	45	-	-	-	-	-	-	-	-	1316.7 swtr

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes)				Pressures (kPa)						Recovery (m)
				VO		SI	HP		SIP		FP		
A-2 Home Pacific Knappen 16-29-1-11 16-29-001-11 W4M KB. 983.0													
			-	-	-	-	-	-	-	-	-	-	-
A-3 BA HB Verdigris 7-26-3-14 07-26-003-14 W4M KB. 939.4													
A-3-12	1555.4-1584.7	BHL	-	40	-	15	18940	18836	-	12824	931	3337	329.2 swtr
A-3-14	1900.1-1928.5	MCMB	-	50	-	15	23608	23484	-	16092	8812	15644	1524.0 swtr

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Time (minutes)				Pressures (kPa)						Recovery (m)
			VO		SI		HP		SIP		FP		
BC-01 Imperial Pac Kilkerran 12-31-78-14 12-31-078-14 W6M KB. 741.6													
BC-01-12	2409.7-2427.7	BLLY	-	80	30	60	32454	32454	23677	23256	9542	3806	27.4 gcwtr 274.3 wtrcush 109.7 gcmud
BC-01-13	2427.1-2430.8	BLLY	-	75	-	30	33102	32364	-	21277	3054	3296	274.3 wtrcush 18.3 mud
BC-01-14	2820.3-2832.5	UDBT	-	30	30	30	38307	38225	7750	11252	7377	7391	713.2 wtrcush 6.1 mud
BC-01-16	2932.8-2937.7	UDBT	-	60	30	30	53683	53262	14520	8991	8460	8460	823.0 wtrcush 3.0 wtrcmud
BC-01-17	3603.7-3611.9	WBMN	-	45	-	15	37480	37480	-	20195	11411	11411	1106.4 wtrcush 9.1 mud
BC-02 Imperial Pacific Golata 8298315 08-29-083-15 W6M KB. 750.1													
BC-02-14	2818.2-2828.8	ELKN	-	60	61	60	35942	35784	19891	20898	4661	4482	388.6 wtrcush 13.7 mud
BC-02-19	2430.8-2446.0	KSKN	-	60	-	60	30268	28813	-	14617	11756	11907	941.8 wtrcush 137.2 wtrcmud
BC-03 Ioe Pac Siphon 5208615 05-20-086-15 W6M KB. 769.6													
			-	-	-	-	-	-	-	-	-	-	-
BC-04 Texaco Neanig Creek A79B1 200-A-079-B/094-H-04-00 KB. 909.5													
			-	-	-	-	-	-	-	-	-	-	-
BC-05 Philips Minaker A-25-D 200-A-025-D/094-G-15-00 KB. 786.7													
BC-05-10	2910.2-2927.0	SLVP	5	150	30	30	43596	43223	5288	3951	3378	3351	304.8 wtrcush 9.1 mud

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO			SI	Pressures (kPa) HP		SIP		FP		Recovery (m)
BC-05-11	2910.2-2938.6	SLVP	1	90	30	30	42775	42761	6081	4116	3923	3923	286.5 wtrcush 21.3 mud
BC-05-12	2910.2-2955.6	SLVP	1	90	30	30	41217	41113	29089	28468	6895	7205	304.8 wtrcush 137.2 mud
BC-05-13	2910.2-2960.8	SLVP	1	90	30	30	41072	40920	28910	27696	4675	5888	140.2 swtr 304.8 wtrcush 24.4 mud
BC-05-14	2910.2-2977.6	SLVP	1	90	30	90	39279	39266	28937	28979	2420	8350	379.5 sulgcswtr 38.1 mud
BC-06 HB Imperial Union Paddy A49B 200-A-049-B/094-H-16-00 KB. 722.7													
BC-06-10	2423.2-2426.2	SLVP	-	60	-	-	29096	27648	-	-	3447	3447	304.8 wtrcush 3.0 mud
BC-06-12	2405.8-2408.5	SLVP	-	45	-	30	28751	27096	-	21098	3378	3378	9.1 sulwtr 304.8 wtrcush
BC-06-13	2439.3-2457.6	SLVP	-	60	-	20	29716	28475	-	4688	3792	3723	304.8 wtrcush 9.1 gcmud
BC-06-14	2473.5-2484.1	MSKG	-	70	-	35	30199	29165	-	20753	3930	3930	9.1 sulswtr 350.5 wtrcush
BC-06-15	2490.2-2505.5	MSKG	-	75	-	30	30337	28958	-	19581	4344	4344	137.2 sulbrwtr 378.0 wtrcush
BC-06-16	2552.4-2572.2	MSKG	-	45	-	20	31854	29923	-	12376	4964	4964	33.5 sulgcwtr 411.5 wtrcush
BC-06-17	2643.2-2667.6	MSKG	-	35	-	20	33440	31095	-	7412	6343	6343	533.4 wtrcush 9.1 mud
BC-06-18	2720.9-2730.1	MSKG	-	60	-	20	33509	33095	-	13100	7377	7377	658.4 wtrcush 45.7 mud
BC-06-19	2777.9-2787.1	MSKG	-	45	-	20	33302	33233	-	6826	6447	6550	631.2 wtrcush 3.0 mud
BC-06-20	2796.8-2799.9	MSKG	-	60	-	30	35025	33198	-	7826	7102	7102	667.5 wtrcush 9.1 mud

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO			SI	Pressures (kPa) HP		SIP		FP		Recovery (m)
BC-07 Imperial Kahntah 1B29C 200-B-029-C/094-I-07-00 KB. 437.1													
			-	-	-	-	-	-	-	-	-	-	-
BC-08 Imperial Sikanni Chief 1 200-B-092-D/094-I-04-00 KB. 585.2													
BC-08-9	2369.8-2385.1	SLVP	-	70	-	15	28331	27455	-	3096	2565	2565	246.9 wtrcush 9.1 mud
BC-08-10	2472.8-2488.1	MSKG	-	60	-	20	28620	26786	-	19822	10480	15941	1127.5 sulgcbrwtr 356.6 wtrcush
BC-08-11	2488.1-2498.8	MSKG	-	60	-	20	27869	27869	-	23077	4061	5909	219.5 sulgcswtr 356.6 wtrcush
BC-08-12	3014.5-3026.7	CMBR	-	60	-	10	37590	35487	-	159277	10128	10128	960.1 wtrcush 9.1 mud
BC-08-15	2777.6-2802.6	CNCG	-	60	-	30	33729	33426	-	29489	6736	6736	658.4 wtrcush 9.1 mud
BC-09 Altair Etal Tenaka D-82-L 200-D-082-L/094-J-02-00 KB. 557.8													
			-	-	-	-	-	-	-	-	-	-	-
BC-10 Pacific Muskwa B-94-L 200-B-094-L/094-J-11-00 KB. 584.3													
BC-10-6	2776.7-2779.6	SLVP	-	120	-	120	30061	30061	-	-	-	7095	579.1 gcswtr 268.2 wtrcush
BC-11 BA Shell Klua Creek 2 200-A-056-H/094-J-09-00 KB. 454.2													
			-	-	-	-	-	-	-	-	-	-	-
BC-12 Imp Kyklo B73F 200-B-073-F/094-I-11-00 KB. 420.9													
BC-12-1	1906.5-1915.7	SLVP	-	125	71	63	23794	22856	18568	18409	2227	2896	310.9 sulswtr

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO			SI	Pressures (kPa) HP		SIP		FP		Recovery (m)
BC-13 Texaco NFA Hay B-62-G 200-B-062-G/094-I-08-00 KB. 457.8													
BC-13-1	1828.8-1930.3	SLVP	-	60	60	60	19464	19464	17354	17354	15437	17327	1310.6 swtr 373.4 wtrcmud
BC-14 West Nat Kotcho Lake D-39-J 200-D-039-J/094-I-14-00 KB. 613.0													
			-	-	-	-	-	-	-	-	-	-	-
BC-15 Aquit Elf Julia B-14-A 200-B-014-A/094-O-01-00 KB. 483.7													
			-	-	-	-	-	-	-	-	-	-	-
BC-16 West Nat Etal Evie Lake B89E 200-B-089-E/094-J-15-00 KB. 592.2													
BC-16-11	2254.9-2266.5	SLVP	-	90	30	30	24366	24249	22780	21663	1207	683	228.0 swtr 9.4 gcmud
BC-16-14	2296.7-2304.3	SLVP	-	90	30	30	26042	24738	15051	18588	4923	5792	286.5 gcswtr 30.5 gcmud
BC-17 Mobil Etal Valiant A-5-K 200-A-005-K/094-O-03-00 KB. 345.3													
			-	-	-	-	-	-	-	-	-	-	-
BC-18 HB Sush A-6-C 200-A-006-C/094-O-08-00 KB. 457.2													
			-	-	-	-	-	-	-	-	-	-	-
BC-19 Chevron North Helmet A-54-B 200-A-054-B/094-P-10-00 KB. 468.8													
			-	-	-	-	-	-	-	-	-	-	-

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO			SI	Pressures (kPa) HP		SIP		FP		Recovery (m)
NWT-02 Fina Gulf Trainor Lk. B-24 300-B-24-6010-11945-0													
NWT-02-1	1581.9-1601.4	KEGR	5	60	30	90	17540	17285	14389	14382	13631	14382	1072.3 swtr 253.0 wtrcmud
NWT-03 Imperial Island River No. 1 300-G-50-6010-121000-0 KB. 697.4													
NWT-03-5	2380.5-2392.1	KEGR	-	60	-	25	-	30337	-	20684	3103	5585	288.0 sulgcswtr 246.9 wtrcush
NWT-04 Home Signal CSP Celibeta No. 1 300-I-44-6010-12215-0 KB. 453.8													
			-	-	-	-	-	-	-	-	-	-	-
NWT-05 Murphy Etal Netla M-31 300-M-31-6100-12300-0 KB. 217.3													
NWT-05-4	1572.8-1629.2	BRCK	3	90	60	90	-	16906	16347	16085	1172	3799	295.0 swtr 30.5 mud
NWT-06 Gobles Etal Celibete K-01 300-K-01-6030-12215-0 KB. 504.7													
NWT-06-1	2289.0-2467.7	SLVP	5	75	30	75	26262	24794	21443	21339	6591	15899	1005.8 swtr 426.7 mud
NWT-07 Union Pan Am Trainor L-59 300-L-59-6030-12030-0 KB. 574.9													
			-	-	-	-	-	-	-	-	-	-	-
NWT-08 AM Hess Gulf Redknife E-55 300-E-55-6040-11930-0 KB. 383.4													
			-	-	-	-	-	-	-	-	-	-	-

DRILL STEM TEST SUMMARIES

Reference No.	Tested Interval (m)	Strat. Unit	Times (minutes) VO		SI		Pressures (kPa) HP		SIP		FP		Recovery (m)
NWT-21 Scurry CDN SUP KMG PAC COKM L I-49 300-I-49-6100-12145-0 KB. 531.9													
			-	-	-	-	-	-	-	-	-	-	-
NWT-36 FPC Tenneco Root River I 60 300-I-60-6240-12315-0 KB. 508.4													
NWT-36-5	1996.4-2059.2	MTKD	7	60	30	30	20539	20684	16823	16734	3199	11425	1341.1 swtr

WATER ANALYSIS SUMMARIES

Reference No. + Test No.	Tested Interval (m)	Strat. Unit	Ca g/kg	Mg g/kg	Na g/kg	Cl g/kg	SO_4 g/kg	CO_3+HCO_3 g/kg	T.S. g/kg	Recovery
A-1 Texaco Cypress Hills No. 4-13-6-3 04-13-006-03 W4M KB. 1109.5										
A-1-8	1726.7-1738.9	LDUC	1.074	-	-	2.623	3.724	0.344	7.765	396.2 sulgcswtr 27.4 mud
A-1-11	2496.3-2500.9	MCMB	-	-	-	27.246	-	-	27.246	487.7 swtr 9.1 wtrcmud
A-5 B.A. CPOG Carmangay 8-25-12-24 08-25-012-24 W4M KB. 958.6										
A-5-6	1721.2-1733.4	TRVL	0.576	0.134	6.693	1.464	11.000	3.698	23.565	350.5 sulwtr
A-7 BA Grand Forks No. 12-14-12-12 12-14-012-12 W4M KB. 757.4										
A-7-19	1603.2-1613.9	BHL	55.580	10.390	3.243	132.420	0.400	0.723	202.756	1295.4 gcswtr
A-7-20	1684.0-1713.6	EKPP	34.270	5.780	18.270	105.420	0.280	0.054	164.074	670.6 swtr
		UCMB								
A-7-21	2072.6-2086.1	MCMB	1.038	0.148	16.797	19.905	9.000	2.791	49.679	502.9 swtr
A-8 CPOG Princess No. 10-4-19-11 10-04-019-11 W4M KB. 773.0										
A-8-6	1637.7-1650.5	BHL	107.127	11.523	31.200	270.593	0.148	0.712	421.303	302.4 swtr
A-13 T.G.T. Nacmine 6-8-28-21 06-08-028-21 W4M KB. 901.0										
A-13-3	1867.2-1879.4	NSKU	2.040	0.513	11.209	19.300	2.856	1.700	37.618	722.4 gcswtr
A-13-4	1914.1-1929.4	LDUC	3.628	0.949	16.998	32.800	2.411	1.425	58.211	1421.9 sulgcswtr
A-13-5	2258.6-2289.0	BHL	48.997	7.081	37.140	164.000	0.391	0.590	258.199	1658.1 swtr 192.0 wtrcmud
A-21 Imp HB Dickson 1-28-36-3 01-28-036-03 W5M KB. 965.6										
A-21-1	2799.6-2834.9	NSKU	20.266	2.945	60.198	135.351	1.856	0.810	221.836	120.4 sulswtr 562.5 wtrcush
		IRTN								
A-21-2	2996.2-3006.9	IRTN	10.306	1.582	6.814	126.734	1.255	0.361	147.052	54.9 sulgcswtr
										276.1 wtrcush 242.6 ocmud
A-21-3	3048.0-3083.1	CKGK	20.495	2.682	47.322	114.465	2.765	0.935	188.664	193.5 sulswtr 774.8 wtrcush

WATER ANALYSIS SUMMARIES

Reference No. + Test No.	Tested Interval (m)	Strat. Unit	Ca g/kg	Mg g/kg	Na g/kg	Cl g/kg	SO_4 g/kg	CO_3+HCO_3 g/kg	T.S. g/kg	Recovery
A-27 Gulf CDR Bell 10-15-42-11 10-15-042-11 W4M KB. 691.3										
A-27-1	1555.7-1645.9	WPGS ASRN ODVC UCMB	13.116	1.979	81.770	153.944	1.500	0.107	252.416	688.8 swtr
A-45 BA Sweathouse 10-9-68-17 10-09-068-17 W5M KB. 907.4										
A-45-4	2330.2-2337.8	WRBR	16.100	2.360	78.817	119.280	0.384	0.860	217.801	1953.8 sulswtr 54.9 wtrcmud
A-45-5	2971.8-3008.4	MCMB	22.280	2.480	58.675	136.680	0.480	0.149	220.744	629.4 swtr 304.8 wtrcush
A-47 Pan Am G-1 Gold Cr. 10-16-69-5 10-16-069-05 W6M KB. 660.8										
A-47-6	3354.3-3386.3	WBMN	24.024	2.381	70.192	157.200	0.146	0.720	254.663	1941.6 sulswtr 762.0 wtrcush
A-48 Mesa Texcan Saddle Hills 7-6-76-9 07-06-076-09 W6M KB. 877.2										
A-48-2	2329.3-2341.5	BLLY	0.012	0.001	1.768	0.364	2.758	0.560	5.463	371.9 frwtr
A-49 White Rose Etal Adrano 6-32-75-25 06-32-075-25 W5M KB. 620.3										
A-49-4	2762.1-2813.0	GRNW PCMB	24.715	4.300	62.455	152.000	0.391	0.550	244.411	883.9 swtr 609.6 wtrcush
A-50 Pure TPC&O High Prairie 6-7-74-16 06-07-074-16 W5M										
A-50-10	2256.7-2261.6	SLVP GLWD	-	-	-	174.527	0.285	-	174.812	2008.6 swtr 64.0 gcmud
A-52 Home Martin Hills 4-16-74-24 04-16-074-24 W4M KB. 676.0										
A-52-4	1542.3-1556.9	CNCG	101.472	13.333	25.809	258.070	0.048	0.216	398.948	1371.6 swtr 54.9 mud

WATER ANALYSIS SUMMARIES

Reference No. + Test No.	Tested Interval (m)	Strat. Unit	Ca g/kg	Mg g/kg	Na g/kg	Cl g/kg	SO_4 g/kg	CO_3+HCO_3 g/kg	T.S. g/kg	Recovery	
A-60 Atlantic Ioe Utikuma 4-2-83-9 04-02-083-09 W5M KB. 670.0											
A-60-2	1777.0-1807.8	KEGR GRNW	31.712	3.353	69.146	172.200	0.446	0.037	276.894	1549.3 swtr	15859.9 mud
A-61 Can Dehli Etal Cadotte 5-32-83-16 05-32-083-16 W5M KB. 709.3											
A-61-1	1866.0-1873.6	SLVP	10.600	2.381	48.891	100.672	0.460	0.112	163.116	274.3 swtr	6.1 wtrcmud
A-65 Union North Star 4-14-90-24 04-14-090-24 W5M KB. 651.7											
A-65-2	1994.0-2035.5	SLVP	17.917	2.709	53.705	121.976	0.469	0.210	196.986	1472.2 swtr	384.0 mud
A-101 Atkinson Etal Wild Hay 12-11-56-24 12-11-056-24 W5M KB. 1161.9											
A-101-3	3347.9-3351.6	MNTN	1.842	0.277	31.199	51.200	0.562	0.880	85.960	313.9 swtr 96.9 gcmud	319.1 wtrcush
A-3 BA HB Verdigris 7-26-3-14 07-26-003-14 W4M KB. 939.4											
A-3-12	1555.4-1584.7	BHL	7.590	2.030	28.090	61.435	1.440	0.274	100.859	329.2 swtr	
A-3-14	1900.1-1928.5	MCMB PCMB	0.309	0.017	14.978	18.190	4.000	4.382	41.876	1524.0 swtr	

WATER ANALYSIS SUMMARIES

Reference No. + Test No.	Tested Interval (m)	Strat. Unit	Ca g/kg	Mg g/kg	Na g/kg	Cl g/kg	SO_4 g/kg	CO_3+HCO_3 g/kg	T.S. g/kg	Recovery
BC-01 Imperial Pac Kilkerran 12-31-78-14 12-31-078-14 W6M KB. 741.6										
BC-01-13	2427.1-2430.8	BLLY	3.560	0.097	41.300	63.500	8.630	0.573	117.660	274.3 wtrcush 18.3 mud
BC-05 Philips Minaker A-25-D 200-A-025-D/094-6-15-00 KB. 786.7										
BC-05-13	2910.2-2960.8	SLVP	0.832	0.183	7.858	12.700	0.405	0.835	22.813	140.2 swtr 304.8 wtrcush 24.4 mud
BC-05-14	2910.2-2977.6	SLVP	1.701	0.229	9.018	16.500	0.016	1.850	29.314	379.5 sulgcswtr 38.1 mud
BC-06 HB Imperial Union Paddy A49B 200-A-049-B/094-H-16-00 KB. 722.7										
BC-06-12	2405.8-2408.5	SLVP	0.046	0.052	0.081	0.092	0.035	0.415	0.721	9.1 sulwtr 304.8 wtrcush
BC-06-15	2490.2-2505.5	MSKG	1.956	0.231	9.989	17.262	2.530	0.622	32.590	137.2 sulbrwtr 378.0 wtrcush
BC-06-16	2552.4-2572.2	MSKG	2.040	0.280	10.940	15.130	7.890	0.230	36.510	33.5 sulgcwtr 411.5 wtrcush
BC-08 Imperial Sikanni Chief 1 200-B-092-D/094-I-04-00 KB. 585.2										
BC-08-10	2472.8-2488.1	WATT MSKG	5.556	0.547	36.812	67.019	1.226	0.448	111.608	1127.8 sulgcbrwtr 256.6 wtrcush
BC-08-11	2488.1-2498.8	MSKG	2.050	0.484	11.976	21.524	2.158	0.662	38.854	219.5 sulgcswtr 356.6 wtrcush
BC-10 Pacific Muskwa B-94-L 200-B-094-L/094-J-11-00 KB. 584.3										
BC-10-6	2776.7-2779.6	SLVP	6.608	0.656	30.178	59.600	0.060	0.880	97.982	579.1 gcswtr 268.2 wtrcush
BC-12 Imp Kyklo B73F 200-B-073-F/094-I-11-00 KB. 420.9										
BC-12-1	1906.5-1915.7	SLVP	5.318	0.770	24.690	48.805	0.663	0.768	81.014	310.9 sulswtr
BC-16 West Nat Etal Evie Lake B89E 200-B-089-E/094-J-15-00 KB. 592.2										
BC-16-11	2554.9-2266.5	SLVP	9.828	1.832	35.459	77.000	0.006	0.730	124.855	228.0 swtr 9.4 gcmud
BC-16-14	2296.7-2304.3	SLVP	9.614	1.325	33.976	73.000	-	0.490	118.405	286.5 gcswtr 30.5 gcmud

WATER ANALYSIS SUMMARIES

Reference No. + Test No.	Tested Interval (m)	Strat. Unit	Ca g/kg	Mg g/kg	Na g/kg	Cl g/kg	SO_4 g/kg	CO_3+HCO_3 g/kg	T.S. g/kg	Recovery
NWT-01 Fina Gulf Trainor Lk. B-24 300-B-24-6010-11945-0										
NWT-01-1	1581.9-1601.4	WATT KEGR	10.288	1.314	35.284	75.808	0.407	0.561	123.662	1072.3 swtr 253.0 wtrcmud
NWT-05 Murphy Etal Netla M-31 300-M-31-6100-12300-0 KB. 217.3										
NWT-05-4	1572.8-1629.2	BRCK	9.202	0.678	50.745	96.060	0.330	0.327	157.342	295.0 swtr 30.5 mud
NWT-36 FPC Tenneco Root River I 60 300-I-60-6240-12315-0 KB. 508.4										
NWT-36-5	1996.4-2059.2	MTKD	2.720	0.498	69.437	111.825	1.839	0.307	186.626	1341.1 swtr

WATER ANALYSIS SUMMARIES

Reference No. + Test No.	Tested Interval (m)	Strat. Unit	Ca g/kg	Mg g/kg	Na g/kg	Cl g/kg	SO_4 g/kg	CO_3+HCO_3 g/kg	T.S. g/kg	Recovery
S-1 Neumann No. 12 12-29-002-02 W2M KB. 520.9										
S-1-9	2346.4-2353.4	IKGP	25.570	3.340	75.864	168.640	2.060	0.043	275.047	426.7 swtr
S-1-10	2611.5-2623.7	RDRV	9.090	1.310	99.370	171.960	1.200	0.457	283.387	844.3 swtr
S-1-11	2800.5-2806.6	DDWD	34.000	0.158	88.103	196.160	0.150	0.324	318.895	2225.0 swtr
S-2 Imperial Halkett 15-7-3-8 15-07-003-08 W2M KB. 586.1										
S-2-5	2069.6-2074.8	BDBR	9.200	0.996	81.450	143.750	1.301	0.195	236.892	289.6 brwtr
S-2-9	2193.6-2200.7	DPRW	22.550	2.730	84.968	178.500	0.489	0.115	289.352	387.1 brwtr
S-2-12	2828.2-2835.9	SNMN	0.099	0.020	0.376	0.685	0.043	0.165	1.388	1039.4 gcwtr *
S-2-13	2830.1-2842.3	SNMN	0.047	0.005	0.076	0.160	0.003	0.090	0.381	1234.4 gcwtr *
S-3 Fina Radville 13-4-6-18 13-04-006-18 KB. 663.3										
S-3-1	1495.3-1535.0	SPRF	1.853	0.316	17.356	27.679	4.253	0.272	57.711	274.3 swtr
S-3-3	1538.6-1545.3	MIDL	1.033	0.172	6.932	10.353	3.108	0.631	22.229	3.0 oil 310.9 swtr
S-3-4	1944.6-1956.2	BDBR	1.708	0.291	25.056	40.498	2.943	0.281	70.777	280.4 gcocswtr 15.2 ocmud
S-3-7	2672.5-2696.6	YOMN	4.450	0.518	102.472	147.623	0.814	0.386	256.353	579.1 swtr 27.4 mud
S-5 Imperial Long Range 4-31-1-27 04-31-001-27 W2M KB. 833.3										
S-5-1	1804.4-1817.5	RCLF	0.926	0.345	0.058	0.750	2.495	0.245	4.819	384.0 sulwtr
S-5-3	2183.3-2183.9	BDBR	0.704	0.547	2.118	4.125	2.467	0.280	10.241	2186.9 swtr
S-5-4	2464.3-2476.5	DSBY	1.383	1.005	29.357	48.000	3.439	0.215	83.399	2367.1 sulswtr
S-5-5	2486.3-2496.3	SCDD WPGS	1.976	0.885	41.442	68.000	2.525	0.240	115.068	2365.2 sulswtr
S-5-6	2505.5-2516.1	ASRN IKGP	2.025	0.375	41.896	67.250	2.570	0.270	114.386	2386.6 swtr
S-5-7	2571.9-2580.1	IKGP	1.531	0.255	36.536	57.000	3.634	0.156	99.112	1947.7 swtr
S-5-11	2669.1-2682.8	RDRV	1.482	0.660	27.483	42.250	5.061	1.645	78.581	246.9 swtr 457.2 wtrcush
S-5-14	2738.6-2743.2	YOMN WNPG	1.951	1.080	49.349	80.500	2.681	0.425	135.986	2139.7 sbrwtr 457.2 wtrcush

* Questionable results

WATER ANALYSIS SUMMARIES

Reference No. + Test No.	Tested Interval (m)	Strat. Unit	Ca g/kg	Mg g/kg	Na g/kg	Cl g/kg	SO_4 g/kg	CO_3+HCO_3 g/kg	T.S. g/kg	Recovery	
S-6 Amerada Shell Crown SE 10-26 10-26-001-13 W3M KB. 820.5											
S-6-2	1495.0-1522.5	TOQY BDBR	0.682	0.209	0.569	0.665	2.561	0.240	4.926	1522.5 swtr	
S-6-3	1863.9-1874.5	ASRN IKGP	0.435	0.057	0.477	0.215	1.877	0.125	3.186	304.8 swtr	
S-6-4	2345.7-2361.0	DDWD PCMB	0.592	0.091	3.673	5.690	1.651	0.122	11.819	518.2 gcswtr	442.0 wtrcmud
S-9 BA Etal Wilnichenko No. 2-12 02-12-013-27 W3M KB. 755.9											
S-9-8	1780.0-1794.1	PRVP WPGS	4.668	1.200	113.055	184.580	1.960	0.092	305.555	1444.8 swtr	
S-9-9	1797.1-1809.3	ASRN ODVC	3.860	0.560	111.225	177.780	2.860	0.098	296.383	1179.6 swtr	
S-10 Mobil Etal Dorrell No. 32-9 09-32-006-22 W3M KB. 1054.0											
S-10-8	2079.0-2083.9	SRSR	1.468	1.649	23.209	67.730	1.490	0.670	102.216	400.8 brwtr	
S-10-9	2135.1-2148.5	SRSR FRRD DSBY	1.493	0.266	41.181	64.000	3.815	0.180	110.935	1792.2 brwtr	
S-10-10	2189.4-2194.0	ASRN IKGP	0.659	-	21.133	39.375	4.230	0.458	65.855	402.3 brwtr	
S-10-11	2199.4-2216.2	IKGP	1.427	0.239	87.311	135.500	3.602	0.165	228.244	1453.9 brwtr	
S-10-12	2303.1-2306.7	ODVC	1.778	0.146	88.342	136.500	4.365	0.120	231.251	637.9 brwtr	9.1 mud
S-10-14	2669.4-2673.1	DDWD	0.128	0.023	2.109	2.650	0.889	0.620	6.419	2359.5 brwtr	
S-15 BA Richfield Husky Normandin 14-11 14-11-014-16 W2M KB. 596.5											
S-15-3	2122.9-2137.3	YOMN	2.765	0.410	87.972	139.460	2.800	0.337	233.744	457.2 swtr	

WATER ANALYSIS SUMMARIES

Reference No. + Test No.	Tested Interval (m)	Strat. Unit	Ca g/kg	Mg g/kg	Na g/kg	Cl g/kg	SO_4 g/kg	CO_3+HCO_3 g/kg	T.S. g/kg	Recovery
S-16 Imperial CND SUP Stoughton 3-27 03-27-008-08 W2M KB. 627.3										
S-16-6	1729.7-1738.9	DPRW	4.080	0.640	107.067	173.000	1.467	0.275	286.529	283.5 swtr
S-16-9	2180.5-2192.7	IKGP	3.120	0.669	99.045	159.000	1.537	0.205	263.576	285.0 swtr 219.5 wtrcush
S-16-10	2299.4-2316.2	IKGP	3.576	0.626	114.651	183.000	2.438	0.360	304.651	384.0 swtr
S-16-11	2321.4-2327.5	STNL	8.736	1.033	114.251	194.000	0.802	0.200	319.022	118.9 ocswtr 352.7 wtrcush
S-16-12	2348.5-2365.2	SNMN	24.243	2.721	94.480	196.500	0.403	0.185	318.721	246.9 swtr 384.0 wtrcush
S-20 Imperial Muscow Petung 192116 01-09-021-16 W2M KB. 608.1										
S-20-8	1508.5-1520.0	WPGS	2.070	0.816	58.307	92.000	5.230	0.215	158.638	396.2 swtr
S-20-9	1590.1-1601.7	IKGP	1.987	0.477	52.947	82.750	5.019	0.220	143.400	1024.1 swtr
S-20-10	1788.9-1798.3	YOMN	1.822	0.477	52.574	81.750	4.970	0.510	142.103	1188.7 swtr
S-20-11	1859.9-1871.2	WNPG	1.863	0.402	42.379	66.000	4.974	0.295	115.913	1508.8 swtr
S-22 Imperial Lake Valley 126191 12-06-019-01 W3M KB. 598.0										
S-22-2	1991.6-2000.7	DDWD	2.445	0.817	54.867	88.500	3.662	0.245	150.536	1676.4 swtr 164.6 wtrcush
S-23 BA Moore 6-27 06-27-015-06 W3M KB. 734.9										
S-23-1	1783.1-1794.4	SRSR	0.839	0.113	1.010	0.981	3.000	0.305	6.248	349.9 swtr
S-23-2	1862.3-1871.5	DSBY	1.011	0.141	2.026	2.834	3.100	0.348	9.460	1254.3 swtr
S-23-4	1987.3-1994.9	IKGP	0.817	0.087	1.861	2.677	2.400	0.210	8.052	1752.6 frwtr
S-23-9	2361.9-2366.5	DDWD	6.570	2.250	43.449	83.970	1.500	0.105	137.904	1534.4 swtr
S-23-10	2286.6-2298.2	DDWD PCMB	2.540	1.040	25.025	43.820	2.850	0.323	75.598	1150.0 swtr
S-26 Mobil North Richmond 3-11 01-31-018-28 W3M KB. 768.4										
S-26-17	2207.7-2222.0	DDWD	0.225	0.299	13.177	15.875	1.819	7.530	38.925	1600.2 gcswtr 396.2 wtrcush
S-31 Tidewater Stalwart Crown No. 1 14-10-027-25 W2M KB. 515.7										
S-31-5	1609.6-1612.4	WNPG	2.273	0.592	66.635	104.500	5.408	0.080	179.488	987.6 swtr

APPENDIX C

GEOTHERMAL STUDY

ABBREVIATIONS USED ON MAPS AND IN TABLES

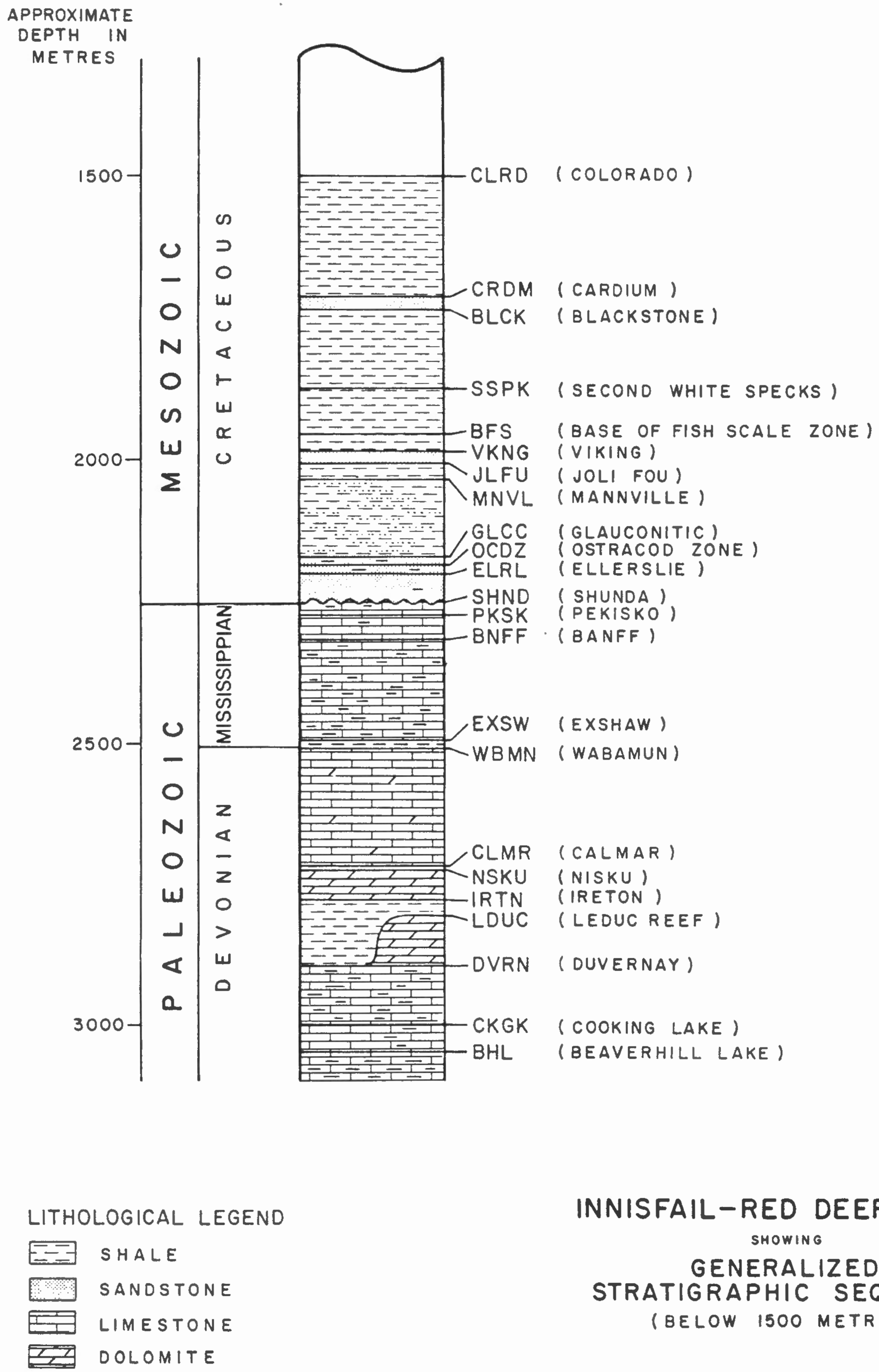
STRATIGRAPHIC ABBREVIATIONS

ASRN	Ashern	LDUC	Leduc
BCMB	Basal Sand (Cambrian)	LVGD	Lower Vanguard
BDBR	Birdbear	MCMB	Middle Cambrian
BDDV	Basal Sand (Devonian)	MIDL	Midale
BFS	Base of Fish Scales	MNTN	Montney
BGVL	Big Valley	MSKG	Muskeg
BHL	Beaverhill Lake	MSNC	Mission Canyon
BLLY	Belloy	MTKD	Mt. Kindle
BLRG	Blue Ridge Member	NSKU	Nisku
BNFF	Banff	OCDZ	Ostracod Zone
BRCK	Bear Rock	ODVC	Ordovician
CDRL	Cathedral	PCMB	Pre-Cambrian
CKGK	Cooking Lake	PDVQ	Pre-Devonian Quartzite
CMBR	Cambrian	PKSK	Pekisko
CNCG	Chinchaga	RDRV	Red River
DDWD	Deadwood	RDVR	Road River
DPRW	Duperow	SHM	Swan Hills
DSBY	Dawson Bay	SLVP	Slave Point
EKPP	Elk Point Group	SNMN	Stony Mountain
ELDN	Eldon	SPRF	Spearfish
ELKS	Elkton South	SPRN	St. Piran
ELRL	Ellerslie	SRSR	Souris River
GLCC	Glauconitic SS	STNL	Stonewall
GLWD	Gilwood	STPN	Stephen
GRNW	Granite Wash	TRVL	Turner Valley
IKGP	Interlake Group	UCMB	Upper Cambrian
JLFU	Joli Fou	VKNG	Viking Zone
IRTN	Ireton	WBMN	Wabamun
KEGR	Keg River	WNPG	Winnipeg
KLUA	Klua	WPGS	Winnipegosis
		YOMN	Yoeman

OTHER ABBREVIATIONS

BRWTR	Brackish Water
COND	Condensate
GCMUD	Gas Cut Mud
GCSWTR	Gas Cut Salt Water
MSULBRWTR	Muddy Sulphurous Brackish Water
MSULWTR	Muddy Sulphurous Water
MSWTR	Muddy Salt Water
OCMUD	Oil Cut Mud
SULGCSWTR	Sulphurous Gas Cut Salt Water
SULGCOCSWTR	Sulphurous Gas Cut Oil Cut Salt Water
SULSWTR	Sulphurous Salt Water
SWTR	Salt Water
WTR	Water
WTRCUSH	Water Cushion
WTRCMUD	Water Cut Mud

FIGURE — 4



INNISFAIL–RED DEER AREA

SHOWING

GENERALIZED STRATIGRAPHIC SEQUENCE

(BELOW 1500 METRES)