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IN-SITU STRESS MAGNITUDES FROM HYDRAULIC FRACTURING TREATMENT RECORDS: A FEASIBILITY STUDY

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ABSTRACT

This report describes an investigation of the feasibility of extracting information concerning the minimum principal in-situ stress from hydraulic fracturing treatment records. The procedures and limitations of determining earth stress magnitudes from mini-frac and propped fracture treatment records are examined in detail. A case study using selected treatment records from the Strachan, Crimson, Garrington, Caroline, and Ricinus fields in west-central Alberta is presented. Examples of pressure decline behavior from a wide selection of treatments in the Viking, Cardium, Glauconite, Ostracod, and Basal Quartz Formations using different fluids, proppants, and pumping rates are given. It is concluded that the bottomhole ISIP (instantaneous shut-in pressure) can in some cases provide a reasonable upper bound on the minimum principal in situ stress. Digitized treatment records and the raw digital data for 34 hydraulic fractures used in the case study are provided as report appendices.

1.0 Introduction

1.1 General

Earth stresses are the single most important factor affecting the geometry and hence the performance of hydraulic fractures used for well stimulation. More than half of all newly completed wells in Western Canada are hydraulically fractured to improve recovery and many old wells are periodically refractured to remedy formation damage. Fortuitously, hydraulic fracturing pressure treatment records can themselves provide information on the state of in-situ stress which in turn controls the geometry and subsequent production from the large fracture itself.

Given the wealth of data which exists by virtue of this being one of the most common stimulation practices today it is somewhat surprising this information has not been analyzed in more detail to extract earth stress data. Occasionally in the literature reference is made to high fracture gradients which usually implies an apparently high minimum principal stress. Nevertheless, no systematic effort has been made in Western Canada to compile. on a field or regional basis, the distribution of the magnitude of the minimum principal in-situ stress as deduced from fracturing treatment records.

A considerable body of knowledge now exists on the orientation of the principal in-situ stresses in Western Canada. Information on stress magnitudes, on the other hand, is more scarce but is often of considerable value. It is this deficiency which this project will attempt to address.

2.0 Purpose of this Study

The aims of this project were as follows:

1. To review the pertinent petroleum and rock mechanics literature to identify the key variables which affect estimates of the in-situ stresses obtained from hydraulic fracture treatment records.

2. To develop simple procedures for estimating certain principal in-situ stress magnitudes from pressure treatment records.

3. To collect, digitize and analyze a selection of hydraulic fracture treatment records provided by Gulf Canada Resources.

4. To interpret in-situ stress magnitudes from the above pressure records.

1.3 Scope of This Report

An initial overview of hydraulic fracturing for well stimulation is given in Section 2. A lengthy description of various procedures and their limitations for determining in-situ stress magnitudes from mini-frac and propped fracture treatments is provided in Section 3. Geological, reservoir and fracturing data for a selection of wells in the Strachan, Crimson, Garrington, Caroline, Ricinus and Crimson fields are described in Section 4. In the discussion part of this report, Section 5, the following topics are addressed: examples of anomalous fracture pressure behavior; ISIP and closure pressure variations: both spatially and with depth in the study area: reservoir or pore pressure effects: and the implications of this work for regional in-situ stress studies. Conclusions and recommendations for further research are given in Sections 6 and 7, respectively. The digitized pressure and injection rate data for 34 hydraulic fractures are provided in Appendix A. The raw digitized data used to plot these figures are contained in Appendix B.

2.0 An Overview of Hydraulic Fracturing for Well Stimulation

Hydraulic fracturing is a method used to stimulate the flow of gas or oil to a wellbore by improving the relative conductivity of the surrounding geological formation. This is usually done by creating a fracture with a pressurized fluid in the zone of interest and placing a proppant such as sand to prevent the fracture from completely closing. In carbonate formations this fracture may be created with an acid which etches the fracture faces to leave uneven ridges hence removing the need for proppant. In a single well several fractures can be created in different formations. Hydraulic fractures used for stimulation purposes can range in size from 2 to 200 meters in height and up to 1500 m in total length.

Typical well candidates for hydraulic fracturing are those producing from formations with low or impaired permeability, although in the last few years stimulation treatments for formations of moderate permeability have become more commonplace. To correctly design a fracture treatment it is necessary to examine the well's potential and to correctly select the volume, fluid type, rates, proppants and pressures to use to optimize the job. Many factors such as the economics of the well, formation and reservoir properties,rock properties, the in-situ stresses, well spacing, desired propped length, productivity index ratio and other considerations must be evaluated. Large or complex treatments are often designed with the assistance of numerical reservoir simulators which couple the mechanics of a propagating elastic fracture, undergoing continuous leakoff and the multiphase behavior of the fluids in the reservoir which ultimately flow into the fracture.

Basically there are four steps to a hydraulic fracture treatment: the pre-pad, the pad, the proppant carrying fluid, and the flush. The pre-pad consists of pumping a low viscosity base fluid into the formation to initiate breakdown. Sometimes this pre-pad contains fluid loss additives or clay control agents. The pad consists of viscous fluids used to condition the created fracture and to provide fracture width and height thus permitting the entry of proppant. The proppant is then added to the same pad fluid or a similar fluid in increasing concentration. Finally when all the proppant has been added the flush fluid is pumped to place the last of the proppant in the fracture. Ideally the proppant just fills the created fracture space. Figure 2.1 is a schematic illustration of an idealized fracture geometry between two shale barriers.

The pressure-time record of a hydraulic fracture reveals many significant aspects of the fracturing process and has been the subject of considerable study over the last 20 years. As this study deals with the interpretation of a portion of this record it is worthwhile examining the various parts of a typical fracture pressure curve.

Figure 2.2 shows an idealized record as bottomhole pressures for a propagating vertical fracture. The pressure at the start of the treatment is equal to the hydrostatic pressure of the fluid column at point A. As fluid is pumped down the well the pressure is increased to the breakdown or initiation pressure, P_b. The pressure typically drops to the propagation pressure, P_p, until point D when all the fluid and proppant have been pumped and the well is shut-in. The instantaneous shut-in pressure at point E is slightly less than the propagation pressure because there are no longer pressure losses through the perforations and along the fracture. As the pressure declines after shut-in it is sometimes possible to observe a closure pressure, P_{cl}, which is believed to correspond to the minimum principal in-situ stress (total) acting on the fracture faces. The actual closing pressure on the proppant is an effective stress, P_c, which is shown as the closure stress minus the flowing well pressure, P_{wf}. If the well is shut-in long enough the pressure would eventually decline to the reservoir pressure, P_r.

3.0 Procedures for Determining In-Situ Stresses from Hydraulic Fracturing Treatment Records

3.1 Overview

Traditionally the determination of the in-situ stress regime by the geoscience community has been done with a rather strict set procedures: open hole, multiple, small volume, low rate injection tests using non-viscous fluids. In the last seven or eight years the hydraulic fracturing industry has been using a variety of pre-treatment injection tests and "mini-fracs" to accomplish similar objectives. While the classic open hole tests can theoretically provide both the minimum and maximum horizontal stresses (for a set of rather ideal conditions) the cased hole mini-fracs can usually only give an estimate of the minimum horizontal in-situ stress. In the case of the mini-frac this stress is equated with the fracture closure pressure while in the classic micro-frac the ISIP is thought to be nearly if not exactly equal to the closure pressure or minimum horizontal in-situ stress.

The selection of the minimum and maximum horizontal in-situ stresses from actual hydraulic fracture treatment records has not been considered a very reliable technique, given the multitude of factors which can affect the bottomhole treatment pressure. This study will examine a selection of such treatment data and a few mini-fracs conducted in conjunction with them with a view to assessing whether useful stress data can be obtained.

A review of the petroleum and rock mechanics literature has revealed only a few cases where inferences about the in-situ stress regime have been made on the basis of propped fracture treatment ISIP's. For example see McLennan et al (1982, 1983) at Caroline and Kakwa, Alberta, and Hansen and Purcell (1986) at Belridge, California. Warpinski et al (1987) also report some interesting comparisons between micro-, mini- and main fracture treatments at the multiwell experiment in Colorado. In general there is relatively good general correspondence between the incidence of high fracture treatment ISIP's and other independent measures of the in-situ stress such as mini-fracs or micro-fracs. As far as we are aware, however, no one has conducted a detailed comparison between an extensive dataset composed of all three measurements.

For many years it was generally believed that the fracture treatment bottomhole ISIP represented the minimum horizontal in-situ stress. However, with the popularity of the Nolte-type analysis (Nolte, 1979,1982) for interpreting fracturing pressures it is now believed that a lower stress, called the closure pressure, is a better representation of the minimum horizontal in-situ stress. Nevertheless, it is common practice in the industry to equate high ISIP's in a region with high in-situ stresses although it is not clear why the two should be related solely on the basis of the stress regime alone.

The closure pressure is ideally obtained from a pump-in/flow back test conducted prior to the main treatment. A slightly less accurate estimate can be obtained from the shut-in pressure decline after a mini-frac. The latter method is often preferred over the former as a pre-treatment calibration test because it offers more information about fluid efficiency and leakoff characteristics. An upper bound estimate of the closure pressure is also sometimes obtained from a step rate test. Details on these techniques and their applicability can be found in standard service company publications such as Halliburton Services (1987) or the recent Dowell Schlumberger textbook on Reservoir Stimulation edited by Economides and Nolte (1987).

For the purpose of this report only the shut-in pressure decline technique, which is applicable to micro-, mini- and main fracture treatments, will be considered since pressure decline information is usually available for most fracture treatments.

3.2 Pressure Decline Interpretation

The analysis of fracturing pressures is similar to pressure transient analysis in reservoir engineering although the procedures for doing so are much less developed at this time. In the classic treatment of the problem Nolte (1979, 1982) established the principles for conducting this type of analysis. The following remarks and example are taken directly from his 1982 paper on the topic.

Figure 3.1 shows a typical recording of the bottomhole pressure during a propped fracture treatment. The figure shows that during the first half of the treatment the pressure is increasing while during the last half the pressure remained essentially constant. During the initial time interval after shut-in the pressure is declining as the fracture is closing due to fluid loss with the rate of loss proportional to the rate of pressure decline. The increasing rate of pressure decline after time 44 is interpreted by Nolte to correspond to the increasing stiffness of the fracture closing on the proppant at the wellbore. Beyond time time 44 the fracture is essentially closed on the proppant and the decline is due to fluid loss during the treatment. At time 56 the pressure has decayed back to the initial reservoir pressure.

Note the absence of a conspicuous ISIP on this bottomhole pressure plot. This reflects the fact that in this case most of the friction loss after extension is due to pipe friction as opposed to losses through the perforations. The surface pressure records from a select area in west-central Alberta which will be examined for this study typically show a rather abrupt drop in pressure to a well-defined ISIP on shut-in, however the closure pressure is seldom if ever visible for the time interval monitored afterwards.

There continues to be some confusion in the definition of the terms used to describe the fracture behavior during the shut-in period. Since nomenclature is most important in better understanding and describing some of the mechanisms occurring downhole a number of definitions will be offered here. Several of these terms have been extracted from a most important paper on the topic presented by McLennan and Roegiers in 1982.

Shut-in Pressure is the pressure as a function of time after the termination of pumping. This pressure reflects a total stress in the medium.

Instantaneous Shut-In Pressure is the pressure immediately after shut-in. This is the final propagation pressure minus the friction pressure. Under appropriate conditions the shut-in pressure may be close to or equal to the minimum in-situ stress (eg. a micro-frac test). In some parts of the fracturing industry the ISIP is used to denote only a surface pressure however for the purpose of this report it will denote either a surface or a bottomhole pressure depending on the context it is used in.

Closure Pressure as defined by Nolte (1982) is "the fluid pressure required to initiate the opening of an existing fracture. This pressure is equal to and counteracts the stress in the rock perpendicular to the fracture plane. This stress is the minimum principal stress. The closure pressure will be equal to or less than the breakdown pressure required to initiate the fracture and less than the pressure required to extend and existing fracture."

As pointed out by McLennan and Roegiers (1982) closure pressure has also been interpreted as " (1) the pressure required to hold the fracture open after initiation, or (2) the pressure required to keep the fracture from just closing". As will be discussed in Section 3.4 of this report they point out the problems of fracture hyteresis and local changes in the total stress regime due to pore pressure alteration. These factors and others tend to bias the results obtainable from a mini-frac or main treatment; the closure pressure does not necessarily provide a measure of the far-field minimum principal in-situ stress.

Gradient Various types of fracture gradients are reported in the literature for many locations around the world. As pointed out by McLennan and Roegiers (1982) this is perhaps one of the most maligned terms in use today. Rather than use this ambiguous term in this report the term gradient shall only be applied to clearly denoted bottomhole pressures, eg. Bottomhole ISIP gradient. In fact the use of average gradients as these can sometimes be deceiving since local gradients over a given depth interval can be substantially different from a gradient based on a single data point, extrapolated to surface. Instead it is more appropriate to think of the gradients reported here as simply depth normalized pressures.

For the purposes of this report the procedures and nomenclature used in the analysis of fracturing pressures will be those advocated by Nolte and others over the past eight years.These are perhaps best summarized in the recent book on fracture stimulation by Economides and Nolte (1987).

3.3 Calculation of Bottomhole Shut-In and Closure Pressures

The calculation of the bottomhole shut-in pressure to determine the ISIP or the closure pressure is relatively straight forward for non-energized flush fluids. The surface shut-in pressure (ISIP or closure) is added to the calculated hydrostatic head due to the static fluid column. This is simply the product of the density of the flush fluid times gravitational acceleration times the depth of the stimulated zone.

In the case of a fluid column energized with carbon dioxide or nitrogen the calculation of the hydrostatic pressure is more complicated. This is because of the temperature and pressure dependance of a commingled fluid column. Computer programs exist to solve the equations of state for carbon dioxide and nitrogen and permit the calculation of the true hydrostatic (for example, Hendricks et al, 1975). Since ten of the fracture treatments examined in this study had energized flush fluids it was necessary to calculate the hydrostatic pressure of the commingled fluid column. Rather than repeat a description of the procedures used for these calculations the reader is referred to two excellent publications prepared by Halliburton Services - Oil Field Nitrogen Services Handbook (1978) and the Oilfield Carbon Dioxide Services Handbook (1980). A series of charts, formulae and examples are used to correct for the energizing fluid knowing the surface ISIP, the flush fluid density, the gas concentration and the temperature gradient. Typically a difference of between 3 and 8% was observed in the calculation of the hydrostatic compared to what would have been calculated if the energizing fluid had not been accounted for.

3.4 Problems and Limitations

Considerable work has been done in the last two decades on refining the techniques used to conduct in-situ stress measurements in deep wells. The limitations and problems with the classic micro-frac technique have been described by many. These same limitations and problems apply to interpreting the in-situ stresses from larger volume, higher rate mini-fracs and propped fracture treatments. A compilation of these factors, problems and limitations is given in Table 3.1.

In summary, there has not been enough experimental work, either in the laboratory or the field, to resolve the relative significance of each of these effects, be that for the controlled micro-frac or the more complicated mini-frac or propped fracture treatment.

4.0 A Case Study from Western Canada

4.1 General

For this study a total of 35 hydraulic fracturing records obtained from Gulf Canada Resources Ltd. were examined and analyzed. This included fracture treatment reports and other pertinent previously publicly disclosed reservoir, geological and well performance data from the Caroline, Strachan, Ricinus, Crimson and Garrington gas fields in west-central Alberta. Most of the fracture stimulation treatments were conducted between 1982 and 1985.

The records examined in this study were selected from a total of 19 wells. The selection does not include all the wells and formations fracture stimulated in these fields for which Gulf Canada has an interest. In four of the wells examined mini-fracs were conducted prior to the main treatments. This information has been included for comparison purposes. One injection test and a series of pre-pad acid squeezes have also been analyzed and included in this compilation.

Figure 4.1 is a general location map showing the study area and the producing fields from which most of this data were obtained. Figure 4.2 is a detailed map of the study area showing the wells and the location of two cross-sections lines.

Table 4.1 is a list of the wells and fracture treatments referred to in this study. Each fracture has been identified by the field, its location, KB and surface elevation, geological formation, perforation interval, true mid-point depth of the treatment, mid-point elevation, fracture type and the service company who conducted the treatment.

4.2 Geological Setting

4.2.1 General

It was not the purpose of this study to undertake a geological evaluation of the regional or local subsurface geology although it did become apparent at a later stage of the analysis that a better understanding of the structural geology and stratigraphic continuity in the region would have been most helpful. Only a brief description of the formations of interest and the structural geology will be presented here. Further details of the geology of several of the stimulated formations can be found in the following publications: Williams (1963), Berven (1966), Currie and Nwachukwu (1974), Walker (1983), Walker (1985), Hein et al (1986), Leckie (1986).

Hydraulic fracture stimulation treatments conducted in five formations are reported in this study. The formations are, in order of increasing age: the Cardium, Viking, Glauconite, Ostracod, and the Basal Quartz. The names of the stimulated formations were taken directly from the treatment reports however formation tops, from PICS and ERCB files, were examined to confirm the perforation intervals reported.

4.2.2 Stratigraphy

Figure 4.3 is a table of formations for the area showing the five formations referred to as well as the thick shale sequences separating the upper Createaceous Cardium and Viking Formations. The entire geological section examined in this study comprises sediments of the Colorado and Mannville Groups.

The Cardium Formation is the youngest of the reservoir rocks considered in this study. These late Cretaceous sandstones are over- and underlain by fine grained mudrocks and siltstones of the Colorado Shale. Only Cardium sands in the Ricinus and Strachan fields are reported on in this study.

Viking Formation sandstones in the Strachan and Garrington fields are of Early Cretaceous age and are the oldest sandstones of the Colorado Group. They are over- and underlain by fine grained sediments of the Joli Fou Formation.

The Glauconite Formation sandstones are part of the Upper Mannville Group, are Early Cretaceous in age and are overlain by the Clearwater Shale. Glauconite sandstones are produced in each of the five fields examined in this study.

Directly beneath the Glauconite Formation are the carbonate-rich sandstones and limestones of the Ostracod Formation, which is part of the Lower Mannville Group.

The Ostracod is directly underlain by the sometimes difficult to distinguish Basal Quartz (Ellerslie) Formation. It is often broken into two distinct zones or members - and A and a B or the Upper and Lower Basal Quartz.

Figure 4.4 is a southwest-northeast structural cross-section through the western part of the study area as originally located on Figure 4.2. Only the elevation of the formation tops are shown since the typical formation thickness is less than 5 meters and would barely be distinguishable on this drawing. No attempt has been made to show the presence of major faults on this drawing although there is a strong indication of a major discontinuity southwest of the Strachan 11-27 well. Data is only shown to the top of the Basal

Quartz Formation. Aside from the significant apparent formation dip to the southwest note the greater than 300 m elevation difference between Ricinius 7-33 and Strachan 6-14.

Figure 4.5 is a northwest-southeast cross-section through selected wells in the Strachan, Crimson, and Caroline fields. Note the slight apparent dip to the northwest, much less than that seen on Figure 4.4, although there is a considerable portion of this cross-section without any data. Locally there is less than a 100 m elevation difference in the area.

Table 4.2 is a compilation of formation tops for each of the wells cited in this study and used in the construction of the aforementioned cross-sections. This information has been obtained from a variety of sources - fracture treatment records, geological reports, and where necessary ERCB and/or PICS well files. The absolute accuracy of this data can not be guaranteed since there were occasionally discrepancies noted between the tops reported in the well files and those in the ERCB and PICS files. A more thorough examination of the data would be necessary to resolve these problems.

4.2.3 Structural Geology

Without better well control or seismic data it is not possible to confidently assess the nature of the structural geology at the depths examined in this study area. This could however be undertaken with the vast amount of drilling data that exists in the region.

A brief examination of some of the geological literature pertaining to the region does reveal some interesting information. Walker et al (1983, 1985) for instance shows the faulted portions of the Ricinus field which straddle the triangle zone - the beginnings of the foothills deformation belt. There is apparently less pronounced faulting in the northern part of the field compared to South Ricinus where the Cardium formation, for instance, can repeat 4 or 5 times. For another example see the cross-section on page 54 in Currie and Nwachukwu (1974).

A detailed evaluation of the tectonics of the area was not part of this work however it soon became apparent that significant portions of the Ricinus, Strachan and perhaps Crimson fields lie within or very close to the deformed thrust or faulted zone. As will be seen later, perhaps a better understanding of the relationship between the local minimum horizontal in situ stresses and the structural geology could be gained with further geological work in the vicinity.

The Caroline and Garrington fields would appear to be structurally unaffected by the deformation further to the west.

4.4 Fracture Treatment Data

4.4.1 Procedures

Production data files for selected wells in the study area were examined over a period of approximately two weeks on Gulf Canada premises. Copies of the pertinent stimulation reports, charts and other related data were made and examined in more detail in our office to derive the pressure and rate data of interest.

The hydraulic fracturing treatment data collected takes several forms. The most common pressure record for most of the fractures conducted prior to 1975 is the simple circular chart record. These types of records provide basic pressure data during the treatment and the shut-in period, although typically they are of lower quality and less accurate. Furthermore the data is recorded on charts with curvilinear coordinates which makes digitizing difficult. Sometimes the data quality is poor because of leaking or dry pens, skipped sections, and the absence of comments or annotations indicating the sequence of steps taken during the treatment.

More recently analog strip charts with records of surface pressure (and bottomhole if measured), injection rate, and proppant concentration have become more popular. These charts can very in length from a normal letter-sized sheet of paper right up to 3 meters.

Very recently with the advent of on-site computer vans for monitoring hydraulic fracture jobs it has become more commonplace to digitally record the surface pressure, injection rate, proppant concentration and occasionally viscosity. For the few wells in the study area where mini-fracs were run prior to the main treatment a listing of the digital data was sometimes included with the service company report. This data is considered the most accurate available and enhances the reliability of the selection of the ISIP and the closure pressure from the decline portion of the shut-in curves.

Most of the data examined in this study was recorded in metric units although there were occasionally Imperial units used in the digitally recorded data when an on-site computer van was used.

As an example of the type of records which were examined for this study a typical circular chart record and a reduced analog strip chart are shown in Figures 4.6 and 4.7.

To permit the display of all of the data used in this study at common scales and to allow for detailed decline curve analysis using a consistent technique it was decided to digitize all of the pressure and injection rate data. This was accomplished using an Apple Macintosh Plus computer, a Summagraphics MacTablet 12" x 12" digitizing tablet, and software for capturing the data as pixel coordinates in a graphics application package. The pixel coordinates were then manipulated in a spreadsheet application to give the desired format for replotting using a standard scientific graphing package.

The Summagraphics MacTablet digitizing tablet has a resolution of 20 lines per mm while digitizing and an absolute accuracy of 0.25 mm. The resolution of the screen image from which the coordinates were obtained was 72 dots per inch or 0.352 mm per pixel, which typically meant the digitized pressure data, for instance, had an accuracy of about 1 MPa. This is probably about the same accuracy as most of the surface pressure measuring equipment. The injection rate data was digitized at a resolution considerably better than the flowmeter recorded rates (resolution typically $\pm$ 0.1 m^3/min).

Proppant concentration data, which would be more important in the analysis of fracture geometry or the calculation of bottomhole pressure during fracture propagation, was only provided in a few records and hence was not digitized for this work.

Early in this study it became apparent that it would be most time consuming and probably futile to attempt to develop accurate friction pressure relationships for the assortment of fluids and proppant concentrations used in the 35 fractures examined. Hence no effort was spent trying to calculate the bottomhole treatment pressure during the treatments, although for two wells the service company calculated bottomhole pressures were digitized (see Figures A.22, A.23 and A.30 in Appendix A).

Several problems arose in the process of digitizing this assortment of circular, strip, and digital records of several different sizes, scales and quality. Occasionally some of the records had very fine detail in the shut-in portion of the pressure record which was difficult to accurately digitize at a scale suitable for more sophisticated graphical analysis. Sometimes there were obviously erroneous or improperly scaled data, eg. misaligned paper; pressure and injection rate records which started at different times; shut-in on the injection rate plot which did not correspond to that on the pressure plot; change of scales without a record of doing so; pen skipping. In only a few cases were failed downhole equipment or surface recording equipment cited as the reason for irregularities in the data, eg. a failed packer or pump. For the most part corrections were made to these poorer quality records.

Some experimentation was necessary to define the best time interval to digitize the data at. Conceivably with some records the data could have been digitized at an interval of less than 5 seconds, however this would have generated very large amounts of data which would have made the storage, manipulation and analysis of the information very cumbersome and time consuming. Furthermore this kind of accuracy in the digitizing process would have exceeded that actually present when the data was recorded in the first place. Instead of using the stream mode digitizing option the data was instead acquired on intervals of between 10 and 15 seconds in the more critical parts of the pressure curve. In other parts of the pressure plot the data was digitized on intervals of typically not less than 1 minute - a spacing which was adequate for displaying the data once replotted on common scales.

There was also some difficulty encountered when the record being digitized was quite long which necessitated it being shifted several times across the digitizing tablet. Because of the difficulty in very precisely relocating the origin some error was introduced in these very long records, but probably less than 1.5 MPa. Where noticeable the digitized record was corrected to remove the error due to the shifting of the record.

Since the circular charts as shown in the example on Figure 4.6 have curvilinear grid lines it was not possible to digitize the data without writing a coordinate conversion program. As an alternative, which proved much faster and probably just as accurate, the pressure data for these records were manually picked off these curves at appropriate time intervals. It was not possible, except in only a few cases, to confidently select data from the shut-in portion of the pressure curve which would permit the identification of the closure pressure. The ISIP, however, was more easily selected from most of these records. The injection rate data for these stimulation treatments were usually selected from the tabular listing provided with most of the service company reports.

In general the digitizing process permitted the very accurate recording of the shut-in data over select intervals, however, sometimes this accuracy exceeded that which was actually present during the original recording of the data.

4.4.2 Fracturing Fluid and Rate Data

Table 4.3 provides similar well, formation and depth information as Table 4.1 and includes specifics concerning the fracturing fluid, fluid density, concentration of carbon dioxide or nitrogen energizing fluids, total fluid volume pumped, total pumping time and the mean pumping rate.

Where possible the fracturing fluid used has been identified with the actual trade name used so as to permit the identification of the fluid properties at a latter time if additional analyses are to be done with this dataset. Rheological properties over a range of temperature can be found in most service company handbooks.

Fluid density data was obtained directly from the service company fracture proposal or was back calculated from hydrostatic head estimates in the report or the well file. The fluid densities reported in this table are only those of the flush fluid, which is not necessarily the same fluid as that used in the main treatment. In the case of two fracture stimulation treatments, Ricinus 7-33 and Strachan 3-17, both in the Ostracod Formation, the density of the methanol/water mixture is reported as foam quality. Since both of these fractures sanded off a flush fluid density was not used to find the hydrostatic head.

Carbon dioxide and nitrogen concentrations are given in scm/m3 (standard cubic meters per cubic meter).

The total fluid volume data is for the fracturing fluid into the formation only and was selected directly from the service company reports. This same information could be integrated from the injection rate curves. In some cases a discrepancy was noted between the reported injection rates and the total fluid volume pumped in a treatment. When a mini-frac was conducted prior to the main frac treatment the total fluid volume pumped did not include the previous mini-frac volume. The pumping time shown on this table is for only the period of time when fluid is being pumped, ie. intermittent shut-in periods are not included.

Figure 4.8 is a column graph showing the distribution of the main fracture treatments and mini-fracs by service company. The one mini-frac indicated for Nowsco is actually a series of pre-pad acid squeezes. Note the greater number of mini-fracs pumped by Dowell Schlumberger.

Figure 4.9 is a column graph showing the distribution of the fracturing fluid types used in this study including the number of energized wells. Note the much greater use of energized fluids for gelled oil and reformate. Carbon dioxide was apparently more popular than nitrogen for this selection of wells.

4.4.3 Fracturing and Reservoir Pressure Data

Table 4.4 provides the same well and formation identifier information as the previous Table 4.3 and includes selected fracturing pressure data and calculated bottomhole pressures.

The maximum surface pressure is the highest recorded pressure obtained off the fracture treatment record. Typically this occurs at breakdown although sometimes it was visible at sand-off conditions or when the maximum permissible injection pressure was reached.

The surface instantaneous shut-in pressures (ISIP) were determined from an examination of the decline portion of the pressure plots compiled in Appendix A. For the sake of consistency the first inflection point on the linear plot where the decline curve departs from a straight line was selected as the ISIP. This by no means the only method available, however it does allow for a consistent evaluation of this important parameter. The ISIP taken from the fracture treatment records provides an upper bound estimate on the minimum horizontal in-situ stress. In most cases the ISIP picked from the digitized curves differed only slightly from that reported in the fracture treatment report where a rough eyeball estimate was probably used.

In the case of the few reported mini-fracs in the study area the closure pressure, where it can be determined, is generally thought to be equal to the minimum horizontal in-situ stress.

Occasionally if there was ambiguous data such as a sand-off where there was no sharp inflection point visible, a value for the ISIP is not reported. In a few cases, which will be discussed in Section 5 there were several inflection points visible on the decline portion of the curve.

The fluid column or hydrostatic pressure for the flush fluid may be calculated for non-energized fluids as simply the product of the density times gravitational acceleration times the depth. See Section 3.4 and Halliburton Services (1978, 1980) for an explanation of how the hydrostatic head of a commingled fluid column is determined. The Bottomhole (BH) ISIP is found by summing the calculated fluid column pressure and the recorded surface shut-in pressure.

As previously described in Section 3.2 the prevailing belief in the fracturing industry is that the closure pressure as measured in a pump-in flow-back test or from the pressure decline portion of a mini-frac, is the minimum in-situ earth stress acting on the fracture face. The ISIP represents the minimum pressure, minus friction to propagate the fracture and only in the case of clear, small volume, ungelled fluids does the ISIP probably provide a good estimate of the minimum principal in situ stress. Several workers have suggested that a substantial difference between the ISIP and the closure pressure, implies that the fracture is still propagating after the well has been shut in.

Closure stress can not always be easily discerned on the pressure decline after shut-in during a mini-frac. Considerably more difficulty was experienced in trying to select the closure pressure from the shut-in portion of a treatment fracture with proppant. From the fracture treatment records examined in this study only the four mini-fracs showed distinguishable closure pressures, albeit sometimes not very distinct ones. These closure pressures were obtained by replotting the digitized data on pressure versus square root of time and log t scales. In most cases the values selected were within 1 MPa of the value reported in the fracture treatment report provided to Gulf Canada by the service company. Theoretically, it should be possible to select the closure pressure from the decline portion of the main treatment pressure decline curve after the ISIP (see Nolte, 1982). It would appear, however, for this dataset that other complicating factors and the slow leakoff of the fracturing fluid in these gas reservoirs does not permit the identification of this critical pressure, at least for the time period normally monitored after these fracture treatments, eg. 20 minutes or less.

A variety of reservoir pressure data for each of the fractured zones was collected from the well files if it was available. Most of this information was contained in the final fracture design proposal, however, the data was also obtained from selected build-up tests, ERCB data files, and well status reports. A brief examination of the ERCB Pool data file was also made to determine the initial pool reservoir pressure and the datum at which it was obtained. This information could not, however, be confidently used to determine the relevant reservoir pressure in the very well where the frac was pumped, on the day the fracture treatment was pumped. It should also be noted that the reservoir pressure in these gas reservoirs has dropped considerably since these wells were first drilled. A more extensive search of the ERCB's or Gulf Canada's files would likely be necessary to track the decline of the reservoir pressure more accurately over time. However, for the purpose of this study the reservoir pressures given in the fracture service company reports and proposals will be assumed to be the best available estimate at the time of the treatment.

Table 4.5 gives three calculated bottomhole pressure gradients: the bottomhole ISIP gradient, the bottomhole closure pressure gradient and the reservoir pressure gradient. The gradients were determined by dividing the respective values by the true depth below ground surface to the mid-point of the perforations where the treatment was conducted.

5.0 Discussion

5.1 Shut-In Pressure Decline Behavior

A total of 34 digitized pressure and injection rate records for the 35 fracture treatments, mini-fracs and injection tests listed in Table 4.1 are included with this report as Appendix A. A listing of the digitized pressure and rate data for each of these fractures has also been included with the report as Appendix B. Many different varieties of pressure-time behavior can be seen on these records including several peculiar forms of pressure decline following shut-in. Only a few plots from the four mini-fracs and even fewer for the main fracture treatments exhibit classical pressure decline behavior as described by Nolte (1979, 1982), ie. well defined ISIP's and closure pressures.

Abnormalities in the pressure decline after shut-in can be the result of any number of factors as previously described in Section 3.4. These include: proppant interference; intersection and leak-off into natural fractures or secondary induced fractures; high perforation friction losses; uneven closure along the fracture length; settlement and adjustment of the proppant pack; and possibly the continued propagation of the fracture.

To illustrate some of the different forms of pressure decline behavior observed, four examples from Appendix A will be discussed. For comparison purposes all of these curves are shown together on Figure 5.1.

Figure 5.1(a) shows the treatment pressure record for a frac in the Ostracod Formation at Gulf Amoco et al Caroline 6-5-36-6W5. The surface pressures shown were selected from a circular pressure chart, while the injection rate data was selected from the treatment report provided by the service company. Note the rise in the service treatment pressure as the job nears completion and all of the proppant has been pumped. At the moment the pumps were stopped at 32 minutes the surface pump pressure dropped abruptly to an ISIP of 30.0 MPa. For about 18 minutes following shut-in the surface pressure declined only slightly, No obvious inflection point , indicative of closure, could be seen in this part of the curve with given data density.

Figure 5.1(b) illustrates the main fracture treatment in the Cardium Formation at Gulf et al Strachan 10-13-38-10W5. Note the initial breakdown and extension pressure obtained in a preliminary injection test conducted at a rate of between 2.0 and 2.5 m3/min, without proppant. An initial well defined surface ISIP of 29.0 MPa was recorded when the well was shut-in after 8 minutes. There is a much more erratic extension pressure record during the propagation of the main fracture as proppant was added during the remainder of the treatment - possibly indicative of the intersection of natural fractures. A second clear surface ISIP of 30.0 MPa is seen when the well is shut-in after nearly 48 minutes. Although there is some erratic pressure behavior during the shut-in portion a clear closure pressure cannot be discerned from this relatively short shut-in period. Note the pronounced water hammer effect arising from wellbore pressure oscillations when the well was shut-in.

Figure 5.1(c) shows both a pre-frac injection test and a mini-frac in the Glauconite Formation of Gulf Amoco Caroline 8-17-36-6W5. Sometimes a low rate, pre-frac injection test is used to provide a more accurate estimate of the closure pressure. The mini-frac is used to estimate the closure pressure and time, as well as the fluid leak-off coefficient and efficiency. In the given example an ISIP of 14.5 MPa is obtained from the injection test, when taken as the first deviation from the linear decline after shut-in. Replotting on square root of time and log time scales did not reveal significantly lower or different closure pressure. In this case the closure pressure is probably identical to the selected ISIP.

After an adequate shut-in period a mini-frac conducted with a higher injection rate of over 4 m3/min gave a similar propagation or extension pressure, however upon shut-in, the ISIP was significantly higher than that observed in the previous injection test. A closure pressure of 15.2 MPa was determined from the pressure decline by replotting the data on a square root of time scale. Not surprisingly this closure pressure is nearly identical with the ISIP and the closure pressure of the previous injection test. The main fracture treatment sanded off, hence an ISIP or closure pressure could not be determined to compare to these values.

Figure 5.1(d) shows the surface pressure and injection rate data from the main fracture treatment in the Glauconite Formation of Gulf et al Ricinus 7-33-36-10W5, the second deepest fracture treatment examined in this study (mid-point depth 3622.9 m). Note the initially high breakdown pressure immediately followed by another high pressure corresponding to a spike in the injection rate at about 12 minutes. The lower injection rate of slightly less than 3 m3/min resulted in a corresponding decrease in the surface extension or propagation pressure until about 60 minutes into the treatment when an abrupt rise in the pressure signalled an approaching sand-off condition. At approximately 64 minutes into the treatment the flush was begun. A sand-off condition was reached at about 70 minutes whereupon the well was shut-in. There was only a slight decline in the shut-in pressure over the next 30 minutes. Obviously the surface ISIP and closure pressures could not be determined from this decline curve.

5.2 Mini-Frac vs. Fracture Treatment Pressure Decline

An important point to consider in this study is how the ISIP and closure pressure from a mini-frac compare to those of an actual fracture treatment with proppant conducted in the same well. Procedures for determining the closure pressure or minimum horizontal in-situ stress from a mini-frac are fairly well established in the fracturing industry, and might be useful for determining the same parameter from the main treatment pressure decline.

To compare these two types of data the mini-frac and main fracture treatment data from the Gulf et al Ricinus 2-26-36-9W5 treatment in the Cardium Formation were selected. The relevant pressure and injection rate plots are shown in Figure 5.2. Using the friction pressure relationships developed at Dowell Schlumberger the bottomhole pressure during both the mini-frac and the main treatment were also calculated and are shown on this figure.

In the mini-frac a distinct surface ISIP of 25.5 MPa was recorded on shut-in. After a relatively long shut-in time a surface closure pressure was detected on the decline curve at 12.1 MPa. A plot using the square root of the time since shut-in versus pressure was used. These two surface pressures translate to downhole pressures of 50.9 and 37.5 MPa, respectively. Note the long term decline of the bottomhole mini-frac pressure to approximately the estimated reservoir pressure of 26.3 MPa. It is worthwhile noting that this is the only mini-frac or main treatment pressure decline for wells examined in this study which displays classic pressure decline behavior with easily distinguishable ISIP's and closure pressures.

In the main treatment the ISIP of 24.3 MPa is nearly identical to that of the mini-frac, however a very irregular stepped decline curve followed the shut-in of the well. Selection of the first inflection point on a pressure vs t plot would probably give an erroneously high estimate of the closure pressure, at least compared to that measured in the mini-frac. Probably the stepped decline curve arises from the interference of proppant during the uneven closure of the fracture. Alternatively multiple intersecting natural fractures or perhaps induced secondary fractures could be causing this irregular pattern.

In summary, for the given example, there is a very good opportunity to match the mini-frac ISIP using the main treatment data and hence provide an upper bound limit on the minimum horizontal in-situ stress. There was, however no possibility of matching the mini-frac measured closure stress because of suspected proppant interference effects. In this case the assumption that the main treatment ISIP is approximately equal to the closure pressure or minimum earth stress would have resulted in a substantial overestimate of the value by almost 36%. Because of the relatively short duration of most shut-in periods it is most likely that the closure pressure will not be seen in all but a few cases with smaller treatment volumes at shallower depth.

5.3 Variation in ISIP and Closure Pressure with Depth

To investigate trends in the fracturing pressure in the study area the values of the bottomhole ISIP (an upper bound estimate on the minimum principal stress) were plotted against depth below the ground surface. Figure 5.3 shows the 18 ISIP's are all in the 2500-3500 m depth range. A linear regression line was fit to the data and gave an intercept of -22.3 MPa and a slope of 26.4 kPa/m with a correlation coefficient of 0.84 - not an unreasonable relationship except perhaps for the value of the intercept. The normal interpretation of the minimum horizontal in-situ stress in an eroded sedimentary basin would give a positive intercept reflecting the removal of the overburden. The slope of the regression line (not to be confused with the average "gradient" which must go through the origin) is also perhaps a little higher than expected. A line showing an estimated vertical overburden stress gradient of 25 kPa/m has also been displayed for comparison.

As an alternative to plotting the bottomhole ISIP data versus depth (the most common method of displaying in-situ stress data) Figure 5.4 shows the same data plotted against depth below sea level. While the linear regression line fit (r=0.79) to the data gives a slightly less significant fit compared to Figure 5.3 (r=0.84) the intercept is remarkably close to zero. This could simply be a fortuitous fit to the data or on the other hand, a relationship between the measured present day stresses and a much earlier stress regime could be indicated. A more definitive explanation for this regression line fit cannot be offered at this time.

Figure 5.5 is a plot of the mini-frac bottomhole ISIP's versus depth for the 5 wells in the study area where these tests were conducted. The value of the ISIP for the Caroline 8-17 frac in the Glauconite Formation at 2736.3 m depth is for a pre-frac injection test, rather than a mini-frac, since the former was felt to better represent the ISIP least affected by the pumped fluid volume.

Similarly the value of 64.5 MPa shown for the Strachan 10-29 well is the minimum ISIP taken from a series of pre-pad acid squeezes. Because of the relatively sparse amount of data on this plot, and perhaps differences in how this data was derived the linear regression line fit to the the dataset is not particularly good (r=0.72). The intercept of -45.7 MPa and the relatively steep slope of 33.6 kPa/m also seems somewhat anomalous for an upper bound estimate on the minimum horizontal in-situ stress profile with depth.

Figure 5.6 shows the mini-frac closure pressure plotted against depth for the four wells where a closure stress could be discerned from a mini-frac pressure decline after shut-in. There is not a sufficient amount of data to fit a meaningful regression line to these values, although a trend of decreasing closure pressure with depth might be suggested on the basis of these few points.

Obviously more mini-frac ISIP and closure pressure data are required to more accurately define the variation of this parameter with depth.

Figure 5.7 shows the same main fracture treatment bottomhole ISIP data as plotted on Figure 5.3, except at an expanded scale with different symbols for each formation. There is not enough data to statistically evaluate the trends with depth for each formation although it is fair to say that there is not a consistent trend for any one formation; the data appears to have an inherent scatter, sometimes quite different from the general trend of the entire set of data. One notable observation of uncertain importance, is that the highest values seem to define a distinct upper bound limit on the ISIP gradient over this interval. Whether this upper bound defines an actual in-situ stress condition and the values below this boundary are a consequence of geological scatter, pore pressure depletion effects or other phenomena cannot be explained at this time.

5.4 Spatial Variations in the Bottomhole ISIP Gradient

To evaluate whether there were local parts of the study area which showed higher stress levels the bottomhole ISIP gradients (ie. ISIP divided by depth) from the main fracture treatments were shown on a Base map (Figure 5.8). When two formations were fractured in the same well both ISIP gradients are shown. In one case, Caroline 8-17, the ISIP gradient calculated from a mini-frac ISIP is given.

Despite the uncertainty in the accurate selection of the value of the ISIP and how close it corresponds to the minimum in-situ stress there appears to be some pattern in the gradients displayed on Figure 5.8. Southwest of Strachan the gradients in the Glauconite and Ostracod formations are slightly higher than those to the northeast, closer to Strachan and the cluster of values around the town of Caroline. The exact location of the first frontal thrust in this area has not been mapped as part of this study, however the change in surface topography and the dip of the Cretaceous strata in the area (see Figure 4.4) would suggest that a NW-SE line separating the ISIP gradients into domains might correspond to the location of this major fault surface.

Figure 5.9 shows a southwest-northeast cross-section through the study area with ISIP gradients displayed at their measured depths. Note the suggestion of a west dipping fault west of the Strachan 11-27 well; the dip on the strata west of here increases markedly. There would appear to be slightly higher ISIP gradients closer to this structural discontinuity as opposed to the gradients northeast of this location. Southwest of Strachan 11-27 the average ISIP gradient is 20.1 kPa/m while northwest of here the average gradient is 17.5 kPa/m. A more exact relationship between the ISIP gradients and the structural disturbance in the area cannot be determined without more fracturing data and a better understanding of the location of fault surfaces in the area.

Figure 5.10 shows a northwest-southeast cross-section through the study area with the measured bottomhole ISIP gradients displayed. Gradients along this cross-section appear to be more uniform with a range of 16.4 to 20.5 kPa/m and an average (for all formations) of 18.1 kPa/m. It appears that formations which have been hydraulically fractured along this cross-section are less affected by the presence of the faults located to the west than the area shown in Figure 5.9.

5.5 The Influence of Reservoir Pore Pressure

Salz (1977), Whitehead et al (1987) and others have documented the effects of reservoir fluid pressure on the in-situ stresses obtained from hydraulic fracturing pressure records. It is well known that a depleted part of a reservoir will typically show a lower minimum horizontal in-situ stress than adjacent parts of the same reservoir still at the virgin reservoir pressure. This section will briefly investigate if there is a general relationship between the measured bottomhole ISIP's from the main fracture treatments and the reported reservoir pressure data collected from Gulf Canada well files.

As may be seen in Table 4.5, reservoir pressures were obtained from a variety of sources: pre-frac build-up analyses,pre-frac design calculations, post-frac pressure transient analyses, completion programs, and in one case, a geological prognosis. It was not possible during this study to determine the precise reservoir pressure of the given wells at the time they were stimulated. Because of the half hazard collection of reservoir pressure data given here no guarantee of its accuracy nor reliability can be offered. However, as a rough guide this information will serve to illustrate whether the reservoir pressure data which is readily available is of any use in interpreting the in-situ stress regime present in the study area.

Initially the reservoir pressure data were plotted versus depth below the ground surface. As may be seen on Figure 5.11 a least squares linear regression fit to all the data gives a line with a substantial intercept (12.7 MPa), however the fit is not significant with r=0.29. For illustration a fluid gradient for fresh water of 9.82 kPa/m is shown on the same plot. Interestingly this line seems to define a maximum to the given data with only a few exceptions.

When the same data are plotted by formation as shown in Figure 5.12 there is nothing further revealed. The few points for the Ostracod Formation for instance show an increase in the reservoir pressure with depth while the Glauconite and Basal Quartz data are quite scattered.

It is apparent that there is considerable scatter in this collection of reservoir pressure data. It is not known at this time whether this variability represents true fluid pressure differences between the various wells, a reflection of the fact that the data was obtained from well files and reports where the test techniques and methods of analysis varied, or perhaps, the fact that these measurements may not have been made immediately prior to the fracture stimulation treatment and hence could be artificially high.

Figure 5.13 shows a cross-plot of the main treatment bottomhole ISIP versus the reservoir pressure for the wells where both types of data were available. If the reservoir pressure (which in the case of this dataset may not necessarily be the value at the time of the treatment) is affecting the ISIP one would expect a significant relationship between the two variables. Additional data of higher quality and reliability is required to more confidently assess the role pore pressure may be playing in determining the bottomhole ISIP and/or closure pressure.

As a final investigation into the factors affecting the bottomhole ISIP the role of the total fluid volume pumped has been examined. Several workers have noted a rise in the ISIP's taken at periodic shut-in's throughout a treatment as an increasing volume of fluid is pumped. This "back pressure" as it is sometimes called is simply the elevation of the local pore pressure about the fracture face and hence the total stress which the pressurized fluid in the fracture must balance. Figure 5.14 shows a cross-plot of the pumped volume and the bottomhole ISIP gradient data for both mini-fracs and the main treatments pumped. The ISIP data is plotted as gradients to normalize the data for depth. On the basis of this plot there would appear to be no obvious relationship between these two variables although the separation of the other factors might reveal trends not otherwise visible.

5.6 Implications for Understanding the In-Situ Stress Regime

5.6.1 Selecting the Minimum Horizontal In-Situ Stress

The purpose of this study was to investigate the feasibility of extracting in-situ stress information from hydraulic fracture treatment records. After examining the literature concerning the interpretation of mini-frac and propped fracture treatment pressure decline curves it is apparent that there is no clear concensus on how these curves should be interpreted. Furthermore, there are a multitude of factors which affect the interpreted stress values obtained from these fracture treatments, the most notable of these being the pore pressure effects. Despite these problems the selection of an upper bound to the minimum in-situ stress, equal to the bottomhole ISIP, seems justified, at least for the purpose of looking at general trends over a large area.

On the other hand, given what appears to be inherent variability due to other geological factors and perhaps stress heterogeneities, it is probably only possible to extrapolate stress magnitudes over only a very short distance, ie. less than 1 km.

There are also many more matters to be resolved in explaining the differences noted in a small area between micro-, mini-, and main fracture treatments. Until more detailed studies in a number of geological environments are conducted it will be difficult to know how close the upper bound ISIP is to the far-field minimum principal in-situ stress.

5.6.2 Scale of Variability

As noted recently by Bell and Woodland (1988) in their compilation of industry mini-frac data for Alberta there is a disturbingly large variation in the depth normalized ISIP or closure pressure data. Their interpreted minimum horizontal in-situ stresses typically varied by MPa between 2500-3500m depth. In fact regression lines fit to the data were not statistically significant. Whether the variability in this data is due to some explicable factor such as pore pressure or is an artifact of the test procedure is unknown at this time. Similar, but slightly less variability can be seen with the dataset of ISIP's obtained from propped fracture treatments used for this study.

It therefore appears that it is probably near to impossible to map the minimum horizontal in-situ stress, at least as interpreted in the above work, on a large regional scale (eg. province wide). It is likely that only broad trends in the stress regime, eg. differences between the plains and foothills, can be noted from such data. Furthermore it is likely that the horizontal in-situ stress can not even be mapped on a smaller regional basis with great confidence.

For the purpose of well stimulation design this kind of regional data can only be used as a general guideline; certainly fracture height containment analysis could not be conducted with this type of information.

5.6.3 Geological Factors

While all of the mini-fracs and main treatments described in this report were supposedly conducted in sandstone and sandy limestone reservoir rocks it is highly probable that a great number of these fractures penetrated into adjacent shale or siltstone barrier rocks. On one hand it might be thought that taking a measurement over a larger area would give a better average stress value. It is also conceivable, however, that fractures penetrating into adjacent shale sections might encounter defects such as joints, other natural fractures, and weaker and possibly de-stressed zones. The consequence of penetrating into other layers is therefore not clear; hydraulic fracture measurements made with large fluid volumes might give artificially lower stresses because of the presence of rock defects, or alternatively higher stresses if competent higher stressed barrier rocks are penetrated. More field and experimental work needs to be conducted on this perplexing topic.

6.0 Conclusions

This study has examined the feasibility of extracting information about the minimum principal in situ stress from hydraulic fracturing treatment records. A total of 34 injection tests, mini-fracs and main treatment records from an area of west-central Alberta were digitized and analyzed using common procedures. The following conclusions can be drawn from this study:

1. The mean of the depth normalized ISIP's ("frac gradient") for 18 propped fracture treatments in the study area was 18.8 kPa/m with a standard deviation of 1.6 kPa/m. The mean of the depth normalized ISIP's from 4 mini-fracs, 1 injection test and 1 pre-pad acid squeeze was 17.4 kPa/m with a standard deviation of 2.5 kPa/m. The mean of the depth normalized closure pressure from 4 mini-fracs and 1 injection test was 14.0 kPa/m with a standard deviation of 1.7 kPa/m.

2. The bottomhole ISIP's obtained from these hydraulic fracture treatment records provides an upper bound estimate on the minimum horizontal in-situ stress, although it is possible for this value to be greater than the bottomhole closure pressure, which has generally been accepted as an exact measure of the minimum in-situ stress, by upwards of 30 to 40%.

3. In general, it is not possible to determine the closure pressure from the vast majority of propped fracture treatments in low permeability reservoirs because the time to closure is usually much longer than the operators are prepared to wait. Furthermore, there is considerable evidence that proppant interference and pore pressure effects would adversely affect the determination of the true minimum in-situ horizontal stress.

4. The determination of the maximum in-situ horizontal stress from propped fracture treatment data would only be possible if an accurate calculation of the bottomhole pressures could be made and a clearly defined breakdown pressure detected during the initial portion of the treatment. Although this was not attempted as part of this investigation an inspection of the records from the study area suggests that many of the treatments did not display classic breakdown pressure behavior. This could be a consequence of near-wellbore perforation effects, pre-existing discontinuities and defects, or abnormal stress concentrations.

5. There would appear to be a considerable amount of scatter in the ISIP data, both spatially and vertically, in the study area. This variation is attributable to depleted pore pressure effects, operational factors during the tests, and possibly the influence of nearby faults associated with the edge of the deformation belt.

6. Because of the scatter in this dataset it was not possible to map spatial trends in either the ISIP or the pore pressure, by either formation or depth. There does, however, appear to be a trend to increasing ISIP gradient as one approaches the deformation belt in a south-westerly direction.

7. There are numerous reservoir, geological, operational, wellbore and interpretation factors which complicate the selection of the appropriate minimum principal in-situ stress from micro-, mini-, and main fracture treatment pressure records. The factors though to have the most significant effect are as follows: reservoir pore pressure depletion; continued fracture growth after shut-in, supercharging or local poroelastic effects; multiple fractures or natural defects; proppant interference; and afterflow or wellbore storage. There would still appear to be some fundamental uncertainties in aspects of the fracture mechanics applied to this problem. Much work remains in distinguishing the relative importance of these competing factors.

8. It is highly likely that minimum in-situ stresses extracted from mini-fracs and propped fracture treatments in thin sandstone reservoirs would underestimate the true far-field minimum principal stress in the surrounding rock mass which is largely composed of fine grained shale. In addition to some of the reasons

cited above in (7) this is probably because these large volume, high rate hydraulic fractures seek out the weakest, destressed portions of the tested or stimulated interval.

7.0 Recommendations

1. The hydraulic fracture treatment dataset collected for this study (Appendices A and B) should be analyzed to evaluate the vertical and lateral growth characteristics of this group of fractures. Such an analysis using various models for different fracture geometries (eg. PKN and KGD) would greatly assist the interpretation of the external stresses and provide valuable insight into the role of intersecting natural fractures, multiple induced fractures and nearby weakened or destressed zones.

2. A detailed geological evaluation of the study area including the subsurface mapping of the distribution of faults and deformed strata associated with the edge of the deformation belt would be a prerequisite to understanding the effect of the local geological structure on the ISIP and closure stresses in the area. With a finite element program it would also be possible to model the elastic stresses in the subsurface along a cross-section using a variety of tectonic or residual in-situ stress assumptions, multiple layers of varying properties, and weak or previously sheared discontinuities.

3. The pore pressure regime in both the Cretaceous shales and the sandstone reservoir rocks in the study area could be investigated by examining ERCB records and perhaps more indirectly with the use of sonic log delta t plots. This information could possibly also be used to study the degree of compaction present in these sediments, and hence evidence for once higher or lower in-situ stresses.

4. It became apparent early in this study that there are numerous factors which affect the determination, from fracture treatment records, of the far-field minimum principal stress. Furthermore there are sometimes substantial differences between the stresses determined from micro-fracs, mini-fracs and main treatment fractures in the same field or even the same well. A detailed look at these discrepancies for a select area in Alberta, where all three measurements have been made, would go a long way to resolving some of the more fundamental problems faced in interpreting these pressure records.

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Table 3.1: Factors Affecting the Determination of the Far Field Minimum Principal In-Situ Stress Using Pressure Decline from Mini-fracs and Propped Fracture Treatments

Influencing Factor/Problem	Explanation	Probable Effect[1] on the: ISIP	Closure Pressure
RESERVOIR/GEOLOGICAL FACTORS			
1. Depleted reservoir (pore) pressure	• Reduction in pore pressure reduces the total stress in the reservoir	decrease	decrease
2. Heterogeneities in the in-situ stress	• Local stress concentrations because of thermal or geological effects	variable	variable
3. Naturally fractured zones	• Act as preferential induced fracture pathways or a sink for injected fluid, especially at low rates		
	• Except for fractures oriented parallel to S_H the measured fracture pressures are probably greater than S_h	increase	increase
4. Time dependent rock effects (eg. creep)	• Affects the rate and eventual time of closure in visco-elastic rocks		
	• Fractures could pinch near the wellbore	nil	increase
5. Weak and friable lithologies (eg. coal)	• Typically observe high net fracture propagation pressures over closure and ISIP possible due to a combination of effects: fracture tip plugging, proppant bridging, and natural fractures	increase	increase
6. High permeability streaks	• As with naturally fractured zones these streaks can act as a sink for injected fluid, thus obscuring the point of closure on the induced fracture.	increase	increase
7. Extreme formation damage	• Permanent permeability impairment in near wellbore vicinity	possible increase	possible increase[2]

1. As would be determined by simple graphical procedures. These changes may actually occur or may be only perceived. The influencing factors decribed here are not mutually exclusive; several of these factors may act together or individually to affect the ISIP and closure pressure.
2. In formations with low leakoff a common tendency is to select too high a closure pressure.

Table 3.1 (continued)

WELLBORE FACTORS			
8. High perforation friction	• High losses can obscure information on the fracture pressure decline curve	typically an increase	nil?
9. Cased vs. uncased completions	• Cased completions create a more tortuous path for the flow of fracturing fluids and may show higher shut-in and closure pressures	increase	increase
10. Near wellbore stress concentrations	• Arise from the interaction of the well casing, cement, perforations, pore pressure and the perturbations of the elastic stress field about the borehole, especially for low injection volumes	increase	increase
11. Packer and/or joint leaks	• During shut-in leaks over the entire length of the casing or tubing or a leaky packer can reduce the pressure measured at surface	decrease	decrease
12. Wellbore storage or afterflow	• Not all the fracture fluid on shut-in leaks into the formation. Some flows back into the wellbore leading to a pressure decline not exclusively due to fracture closure	variable?	increase
FRACTURE BEHAVIOR FACTORS			
13. Continued fracture growth after shut-in	• Commonly observed behavior where high overpressures present (ISIP -closure pressure)	increase	nil
14. Local pore pressure increase near fracture face ("supercharging")	• Local increase in pore pressure increases the total stress (especially for high volume, high rates) • Process governed by complex poroelastic effects	increase	increase
15. Proppant interference,bridging	• In propped treatments differential proppant settlement , readjustment during closure and bridging can lead to uneven and early closure	nil	increase
16. Uneven or incomplete fracture closure	• In unpropped treatments this may be a consequence of plastic deformation, shear displacement on the fracture, and/or mismatched asperities	nil	increase
17. Induced fracture not orthogonal to far field minimum principal stress	• Possible in the near wellbore area (<5 x wellbore Dia.) due to stress concentrations, defects or anisotropy	increase	increase
18. Asymmetrical fracture growth	• The propagating fracture seeks out the lower stressed zone	decrease	decrease

Table 3.1 (continued)

19. Branching or multiple fracture growth	• Growth mechanism suspected of giving rise to high net overpressures in some formations • May perturb local stress regime and interact with natural defects	increase	increase
20. Combined vertical and horizontal fracture growth	• Suspected mechanism in some formations such as oil sands and coal • Probably a consequence of propagation along weak or previously sheared interfaces	ambiguous	increase
21. Unexplained cyclic fracture growth	• Intermittent opening and closing during propagation of fracture not consistent with classic borehole fracture model	variable	variable
22. Fracture tip plugging	• Blunting or plugging of fracture tip with fines • Suspected in some coals, sandstones	increase	increase
23. Viscous and/or turbulent friction	• Leads to the selection of a higher ISIP than the true ISIP[3] present in the fracture once the overpressure dissipates	increase	nil?
24. Fracture toughness effects at tip	• Leads to artificially higher ISIP and high overpressures	increase	nil?
OPERATIONAL/ANALYSIS FACTORS			
25. Use of viscous fluids	• Uncertain explanation of the peculiar phenomenon that fractures conducted with viscous fluids typically have higher ISIP's and closure stresses than those measured with clear fluids, eg. water	increase	increase
	• In low permeability reservoirs the extremely long leakoff period may lead to the selection of an early but erroneous closure time	nil	increase
26. Uncycled tests	• Unlike low rate, small volume micro-fracs conducted with multiple cycles mini-fracs are seldom conducted more than once in the same interval • Cycling possibly removes initial hoop stress effects, cleans up the perforations, and allows the fracture to "breathe" thus reducing the ISIP and closure pressures slightly (or at least making their selection easier)	decrease	decrease

Table 3.1 (continued)

27. Data recording rate	• Unless the fracture decline pressures are recorded at intervals of 10-20 seconds or less it is possible in many cases to not detect the point of closure and or the ISIP. • The tendancy is therefore to select a greater value than should be picked	increase	increase
28. Method of analysis	• Considerable differences of up to 10% possible depending on the method used	variable	variable

3. True ISIP is defined here as the static pressure in the fracture after the well has been shut-in and the fracture has completely stopped propagating.

TABLE 4.1: HYDRAULIC FRACTURING DATABASE - GENERAL INFORMATION

FIELD NAME	WELL NO.	K.B. ELEV (m)	GROUND ELEV (m)	FORMATION	TOP PERF (mKB)	BOTTOM PERF (mKB)	MID-POINT TRUE DEPTH(m)	MID-POINT ELEV(m)	FRACTURE TYPE	SERVICE COMPANY
CRIMSON	8-5-38-8W5	1116.6	1111.6	Glauconite	2930	2932	2926.0	-1814.4	MAIN FRAC	DOWELL SCHLUMBERGER
CRIMSON	3-5-38-8W5	1098.3	1092.1	Glauconite	2916	2926	2914.8	-1822.7	MINIFRAC	DOWELL SCHLUMBERGER
		1098.3	1092.1	Glauconite	2916	2926	2914.8	-1822.7	MAIN FRAC	DOWELL SCHLUMBERGER
										DOWELL SCHLUMBERGER
CAROLINE	8-17-36-6W5	1086.09	1081.35	Glauconite	2737	2745	2736.3	-1654.91	INJECTION TEST	DOWELL SCHLUMBERGER
		1086.09	1081.35	Glauconite	2737	2745	2736.3	-1654.91	MINI-FRAC	DOWELL SCHLUMBERGER
		1086.09	1081.35	Glauconite	2737	2745	2736.3	-1654.91	MAIN FRAC	DOWELL SCHLUMBERGER
CAROLINE	6-5-36-6W5	1143.77	1139.42	Ostracod	2835	2850	2838.2	-1698.73	MAIN FRAC (CIRCULAR CHART)	CANADIAN FRACMASTER
		1143.77	1139.42	Upper Basal Quartz	2857.5	2878	2863.4	-1723.98	MAIN FRAC (CIRCULAR CHART)	CANADIAN FRACMASTER
STRACHAN	10-7-37-9W5	1272	1266.7	Glauconite	3331.5	3337	3329.0	-2062.25	MAIN FRAC	HALLIBURTON
STRACHAN	16-3-38-9W5	1191.1	1184.5	Glauconite	3085	3092	3081.9	-1897.4	MAIN FRAC	NOWSCO
		1191.1	1184.5	Ostracod	3129.5	3132.5	3124.4	-1939.9	MAIN FRAC/POOR FEEDRATE	NOWSCO
STRACHAN	10-13-38-10W5	1208.8	1202.6	Cardium	2726.5	2731	2722.6	-1519.95	POOR QUALITY RECORD	HALLIBURTON
STRACHAN	3-17-37-9W5	1293.32	1287.7	Glauconite	3330.5	3340	3329.6	-2041.93	MAIN FRAC	NOWSCO
		1293.32	1287.7	Ostracod	3383	3390	3380.9	-2093.18	PACKER FAILED/FRAC ABORTED	NOWSCO
STRACHAN	10-22-37-9W5	1191.53	1183.22	Ostracod	3183	3193.5	3179.9	-1996.72	MAIN FRAC	CANADIAN FRACMASTER
STRACHAN	6-14-38-9W5	1111.2	1104	Cardium	2459.5	2463	2454.1	-1350.05	MINI-FRAC	DOWELL SCHLUMBERGER
		1111.2	1104	Cardium	2459.5	2463	2454.1	-1350.05	MAIN FRAC	DOWELL SCHLUMBERGER
STRACHAN	11-27-37-9W5	1187.8	1183.7	Viking	2896.2	2898.6	2893.3	-1709.6	MAIN FRAC/Circular chart	CANADIAN FRACMASTER
STRACHAN	10-29-37-9W5	1273.73	1267.63	Viking	3046.5	3048	3041.2	-1773.52	Prepad Acid Squeezes	NOWSCO
		1273.73	1267.63	Viking	3046.5	3048	3041.2	-1773.52	MAIN FRAC	NOWSCO
STRACHAN	7-13-38-9W5	1100	1095.9	Glauconite	2927	2938.5	2928.7	-1832.75	MAIN FRAC	DOWELL SCHLUMBERGER
		1100	1095.9	Basal Quartz	3002	3006	2999.9	-1904	MAIN FRAC	DOWELL SCHLUMBERGER
RICINUS	2-26-36-9W5	1298.55	1291.5	Cardium	2886	2895	2883.4	-1591.95	MINIFRAC	DOWELL SCHLUMBERGER
		1298.55	1291.5	Cardium	2886	2895	2883.4	-1591.95	MAIN FRAC	DOWELL SCHLUMBERGER
RICINUS	7-33-36-10W5	1447.5	1440.15	Glauconite	3628	3632.5	3622.9	-2182.75	MAIN FRAC/ SAND-OFF	HALLIBURTON
		1447.5	1440.15	Ostracod	3676.5	3679.5	3670.7	-2230.5	MAIN FRAC/ SAND-OFF	HALLIBURTON
GARRINGTON	6-9-36-6W5	1122.7	1117.5	Glauconite	2754.5	2760	2752.1	-1634.55	MAIN FRAC/Flush @Max MPa	CANADIAN FRACMASTER
		1122.7	1117.5	Ostracod	2768	2772	2764.8	-1647.3	MAIN FRAC/Flush @Max MPa	CANADIAN FRACMASTER
		1122.7	1117.5	Upper Basal Quartz	2814	2821	2812.3	-1694.8	MAIN FRAC	DRESSER TITAN
		1122.7	1117.5	Lower Basal Quartz	2832	2840.5	2831.1	-1713.55	MAIN FRAC	DRESSER TITAN
GARRINGTON	6-9-37-6W5	1065	1060.5	Viking	2476	2477	2472.0	-1411.5	MAIN FRAC	BJ TITAN
GARRINGTON	14-11-36-6W5	1080.17	1075.27	Glauconite	2673	2678	2670.6	-1595.33	MAIN FRAC	DOWELL SCHLUMBERGER
		1080.17	1075.27	Ostracod+Basal Quartz	2698.5	2735.5	2712.1	-1636.83	MAIN FRAC	DOWELL SCHLUMBERGER
GARRINGTON	6-14-36-6W5	1075.65	1070.75	Ostracod	2696.5	2700	2693.4	-1622.6	MAIN FRAC	HALLIBURTON
		1075.65	1070.75	Basal Quartz A	2713	2714	2708.6	-1637.85	MAIN FRAC	HALLIBURTON

TABLE 4.2: GEOLOGICAL FORMATION TOPS

FIELD	WELL NO.	GROUND DEPTH (mKB)	K.B. ELEV(m)	CARDIUM A DEPTH (mKB)	CARDIUM A ELEV(m)	VIKING DEPTH (mKB)	VIKING ELEV(m)	GLAUCONITE DEPTH (mKB)	GLAUCONITE ELEV(m)	OSTRACOD DEPTH (mKB)	OSTRACOD ELEV(m)	BASAL QTZ DEPTH (mKB)	BASAL QTZ ELEV(m)
CRIMSON	8-5-38-8W5	1111.6	1092.05	2433.4	-1330.7	2762	-1659.3	2926	-1809.7	nd	nd	nd	nd
CRIMSON	3-5-38-8W5	1092.1	1098.3	2422	-1323.68	2749	-1650.68	2915	-1816.7	nd	nd	nd	nd
CAROLINE	8-17-36-6W5	1081.35	1086.09	2244	-1157.91	2532	-1445.91	2709	-1622.91	2759.6	-1673.51	nd	nd
CAROLINE	6-5-36-6W5	1139.42	1143.77	2329	-1185.3	2629.5	-1485.8	2806.7	-1663	2823	-1679.3	2854	-1710.3
STRACHAN	10-7-37-9W5	1266.7	1272	2817.5	-1545.5	3147.5	-1875.5	3329	-2057	3383.5	-2111.5	3398.5	-2126.5
STRACHAN	16-3-38-9W5	1184.45	1191.09	2587	-1395.91	2922	-1730.91	3083	-1891.91	3128.5	-1937.41	3147	-1955.91
STRACHAN	10-13-38-10W	1202.6	1208.8	2700	-1491.2	nd	nd	nd	nd	nd	nd	nd	nd
STRACHAN	3-17-37-9W5	1287.7	1293.32	2805	-1525	3133	-1853	3329.8	-2036.48	3382	-2088.68	3397	-2103.68
STRACHAN	10-22-37-9W5	1183.22	1191.53	2590	-1398.47	2932.5	-1740.97	3126	-1934.47	3181.5	-2002.17	3194	-20014.17
STRACHAN	6-14-38-9W5	1104	1111.2	2459	-1347.8	2786	-1674.8	2962.5	-1851.3	3003	-1891.8	3041	-1929.8
STRACHAN	11-27-37-9W5	1183.7	1187.8	2571.6	-1383.8	2882.6	-1694.8	3108.2	-1920.4	nd	nd	3151.8	-1964
STRACHAN	10-29-37-9W5	1267.63	1273.73	2707.4	-1433.7	3040.8	-1767.1	3229.5	-1955.8	3253	-1979.3	3288.5	-2014.8
STRACHAN	7-13-38-9W5	1095.9	1100	2425	-1324.2	2758	-1657.2	2923.5	-1822.7	2973.5	-1872.5	2996	-1895.2
RICINUS	2-26-36-9W5	1291.5	1298.55	2786	-1487.45	nd	nd	nd	nd	nd	nd	nd	nd
RICINUS	7-33-36-10W5	1440.15	1447.5	3106	-1658.5	3433.5	-1986	3626	-2178.5	3655.5	-2208.5	3728	-2280.5
GARRINGTON	6-9-36-6W5	1117.5	1122.7	2271	-1148.3	2567	-1444.3	2743.5	-1620.8	2763	-1640.3	2792.8	-1670.1
GARRINGTON	6-9-37-6W5	1060.5	1065	2171.2	-1106.2	2474	-1409	nd	nd	nd	nd	nd	nd
GARRINGTON	14-11-36-6W5	1075.27	1080.17	2195	-1114.83	2489	-1408.83	2669.4	-1589.23	2692.3	-1612.1	2715.8	-1636.6
GARRINGTON	6-14-36-6W5	1070.75	1075.65	2186.3	-1110.65	2483.5	-1407.85	-2664.5	-1588.85	2686.7	-1611.05	2708.2	-1532.55

All subsurface depths are meters KB
nd No data

TABLE 4.3: HYDRAULIC FRACTURING DATABASE - FRACTURING FLUID AND RATE DATA

FIELD NAME	WELL NO.	FORMATION	MID-POINT TRUE DEPTH(m)	FRACTURE TYPE	FRACTURING FLUID	FLUID DENSITY (KG/M3)	DENSITY SOURCE	CO2, N2 CONC. (m3/m3)	TOTAL FLUID VOL (m3)	PUMPING TIME (MIN)	MEAN PUMP RATE (m3/MIN)
CRIMSON	8-5-38-8W5	Glauconite	2926.0	MAIN FRAC	YF GO II +CO2	820	estimate	140	130.9	46.0	2.85
CRIMSON	3-5-38-8W5	Glauconite	2914.8	MINIFRAC	YF GO III+DIESEL	814	Frac Proposal	NA	24.0	10.0	2.40
		Glauconite	2914.8	MAIN FRAC	YF GO III	814	Frac Proposal	NA	153.7	52.4	2.93
CAROLINE	8-17-36-6W5	Glauconite	2736.3	INJECTION TEST	L GO	820	estimate	NA	26.2	24.8	1.06
		Glauconite	2736.3	MINI-FRAC	L GO	820	estimate	NA	23.7	9.1	2.60
		Glauconite	2736.3	MAIN FRAC	L GO	820	estimate	NA	55.3	15.9	3.48
CAROLINE	6-5-36-6W5	Ostracod	2838.2	MAIN FRAC (CIRCULAR CHART)	GELLED REFORMATE	880	Frac Proposal	NA	93.9	28.5	3.29
		Upper Basal Quartz	2863.4	MAIN FRAC (CIRCULAR CHART)	METHANOL	948	Frac Proposal	NA	52.4	18.5	2.83
STRACHAN	10-7-37-9W5	Glauconite	3329.0	MAIN FRAC	MY-T-OIL+DIESEL	820	estimate	NA	51.6	21.0	2.46
STRACHAN	16-3-38-9W5	Glauconite	3081.9	MAIN FRAC	GELLED REFORMATE w CO2	814	estimate	140	101.2	42.8	2.36
		Ostracod	3124.4	MAIN FRAC/POOR FEEDRATE	GELLED REFORMATE w CO2	814	estimate	136	54.4	59.3	0.92
STRACHAN	10-13-38-10W5	Cardium	2722.6	POOR QUALITY RECORD	MY-T-OIL+crude oil	865	Frac Proposal	NA	ND	39.1	ND
STRACHAN	3-17-37-9W5	Glauconite	3329.6	MAIN FRAC	GELLED REFORMATE	814	Frac Proposal	NA	192.2	66.9	2.87
		Ostracod	3380.9	PACKER FAILED/FRAC ABORTED	40:60 METHANOL/WATER+CO2	979	Calculated	75-90 Q	13.1	33.5	0.39
STRACHAN	10-22-37-9W5	Ostracod	3179.9	MAIN FRAC	GELLED REFORMATE w CO2	850	Frac Proposal	70	57.4	28.8	1.99
STRACHAN	6-14-38-9W5	Cardium	2454.1	MINI-FRAC	L GO	820	Estimate	NA	48.5	13.0	3.73
		Cardium	2454.1	MAIN FRAC	L GO	820	Estimate	NA	88.0	26.1	3.38
STRACHAN	11-27-37-9W5	Viking	2893.3	MAIN FRAC/Circular chart	OG-3 GELLED REFORMATE	850	Estimate	NA	43.4	25.5	1.70
STRACHAN	10-29-37-9W5	Viking	3041.2	Prepad Acid Squeezes	HCl acid squeezes+GELLED DIESEL	820	Estimate	NA	6.1	16.1	NA
		Viking	3041.2	MAIN FRAC	GELLED DIESEL	820	Estimate	NA	57.7	28.4	2.03
STRACHAN	7-13-38-9W5	Glauconite	2928.7	MAIN FRAC	YF40+CO2(X-linked water gel)	1000	Frac Proposal	100	141.7	56.0	2.53
		Basal Quartz	2999.9	MAIN FRAC	L GO w Diesel +N2	820	Frac Proposal	125	132.0	43.9	3.01
RICINUS	2-26-36-9W5	Cardium	2883.4	MINIFRAC	L GO w Cardium Crude	898	Frac Proposal	NA	30.0	10.0	3.02
		Cardium	2883.4	MAIN FRAC	L GO w Cardium Crude	898	Frac Proposal	NA	73.5	20.8	3.53
RICINUS	7-33-36-10W5	Glauconite	3622.9	MAIN FRAC/ SAND-OFF	MY-T-OIL + REFORMATE	865	Estimate	NA	202.2	66.0	3.06
		Ostracod	3670.7	MAIN FRAC/ SAND-OFF	80% METHANOL/WATER GEL+CO2	960	Calculated	75 Q	80.7	39.0	2.07
GARRINGTON	6-9-36-6W5	Glauconite	2752.1	MAIN FRAC/Flush @Max MPa	OG-3 GELLED REFORMATE	850	Frac Proposal	NA	56.6	24.3	2.33
		Ostracod	2764.8	MAIN FRAC/Flush @Max MPa	OG-3 GELLED REFORMATE	850	Estimate	NA	57.0	24.8	2.30
		Upper Basal Quartz	2812.3	MAIN FRAC	MAXI II +N2/DIESEL FLUSH	815	Estimate	100	114.4	39.0	2.93
		Lower Basal Quartz	2831.1	MAIN FRAC	MAXI II +N2/DIESEL FLUSH	815	Estimate	100	114.7	42.9	2.67
GARRINGTON	6-9-37-6W5	Viking	2472.0	MAIN FRAC	VIKING CRUDE	830	Frac Proposal	NA	86.0	32.1	2.68
GARRINGTON	14-11-36-6W5	Glauconite	2670.6	MAIN FRAC	L GO w Diesel	834	Frac Proposal	NA	86.5	31.0	2.79
		Ostracod+Basal Quartz	2712.1	MAIN FRAC	L GO w Reformate	820	Estimate	NA	155.2	36.0	4.31
GARRINGTON	6-14-36-6W5	Ostracod	2693.4	MAIN FRAC	MY-T-OIL I + REFORMATE w CO2	850	Frac Proposal	110	93.9	37.0	2.54
		Basal Quartz A	2708.6	MAIN FRAC	MY-T-OIL I w CO2	850	Estimate	110	66.6	25.0	2.66

NA Not applicable
ND No data

TABLE 4.4: HYDRAULIC FRACTURING DATABASE - PRESSURE DATA

FIELD NAME	WELL NO.	FORMATION	MID-POINT TRUE DEPTH(m)	FRACTURE TYPE	MAX SURFACE PRES. (MPa)	SURFACE ISIP (MPa)	COMMENT	FLUID COLUMN PRES (MPa)	CALC. BH ISIP (MPa)	SURFACE CLOSURE PRES (MPa)	CALC. BH CLOSURE PRES. (MPa)
CRIMSON	8-5-38-8W5	Glauconite	2926.0	MAIN FRAC	63.0	AD	Unreliable ISIP/Sand-off	23.6	AD	NA	NA
CRIMSON	3-5-38-8W5	Glauconite	2914.8	MINIFRAC	60.5	24.8	Clear ISIP	23.3	48.1	14.6	37.9
		Glauconite	2914.8	MAIN FRAC	61.9	29.9	Clear ISIP	23.3	53.2	ND	ND
CAROLINE	8-17-36-6W5	Glauconite	2736.3	INJECTION TEST	49.9	14.5	1st Inflection	22.0	36.5	14.5	36.5
		Glauconite	2736.3	MINI-FRAC	49.4	27.6	1st Inflection	22.0	49.6	15.2	37.2
		Glauconite	2736.3	MAIN FRAC	55.3	AD	Unreliable ISIP/Sand-off	22.0	AD	ND	ND
CAROLINE	6-5-36-6W5	Ostracod	2838.2	MAIN FRAC (CIRCULAR CHART)	60.0	30.0	1st inflection	24.5	54.5	ND	ND
		Upper Basal Quartz	2863.4	MAIN FRAC (CIRCULAR CHART)	39.0	22.5	clear ISIP	26.7	49.2	ND	ND
STRACHAN	10-7-37-9W5	Glauconite	3329.0	MAIN FRAC	69.0	34.5	Clear ISIP	26.8	61.3	ND	ND
STRACHAN	16-3-38-9W5	Glauconite	3081.9	MAIN FRAC	52.5	31.0	Clear ISIP	24.6	55.6	ND	ND
		Ostracod	3124.4	MAIN FRAC/POOR FEEDRATE	70.0	AD	Unreliable ISIP/Constriction?	25.0	AD	ND	ND
STRACHAN	10-13-38-10W5	Cardium	2722.6	MAIN FRAC	57.0	30.0	Clear ISIP	23.1	53.1	ND	ND
STRACHAN	3-17-37-9W5	Glauconite	3329.6	MAIN FRAC	65.0	42.0	Clear ISIP/Injection test ISIP=30Mpa	26.6	68.6	ND	ND
		Ostracod	3380.9	PACKER FAILED/FRAC ABORTED	69.0	ND	No ISIP pick possible	NA	ND	ND	ND
STRACHAN	10-22-37-9W5	Ostracod	3179.9	MAIN FRAC	72.0	42.0	Clear ISIP	26.5	68.5	ND	ND
STRACHAN	6-14-38-9W5	Cardium	2454.1	MINI-FRAC	46.3	22.9	Clear ISIP	19.8	42.7	21.9	41.7
		Cardium	2454.1	MAIN FRAC	44.2	22.6	Clear ISIP	19.8	42.4	ND	ND
STRACHAN	11-27-37-9W5	Viking	2893.3	MAIN FRAC/Circular chart	55.0	36.0	Clear ISIP/FM pick 34 MPa	24.2	60.2	ND	ND
STRACHAN	10-29-37-9W5	Viking	3041.2	Prepad Acid Squeezes	70.0	40.0	Min ISIP of 6/Range 40-52 Mpa	24.5	64.5	ND	ND
		Viking	3041.2	MAIN FRAC	69.5	AD	Unreliable ISIP/Constriction?	24.5	AD	ND	ND
STRACHAN	7-13-38-9W5	Glauconite	2928.7	MAIN FRAC	43.0	23.0	Clear ISIP	28.8	51.8	ND	ND
		Basal Quartz	2999.9	MAIN FRAC	53.0	30.0	Clear ISIP	24.2	54.2	ND	ND
RICINUS	2-26-36-9W5	Cardium	2883.4	MINIFRAC	52.0	25.5	Clear ISIP	25.4	50.9	12.1	37.5
		Cardium	2883.4	MAIN FRAC	42.3	24.3	Clear ISIP	25.4	49.7	AD	AD
RICINUS	7-33-36-10W5	Glauconite	3622.9	MAIN FRAC/ SAND-OFF	74.4	NA	No ISIP/ Sand-off	30.8	ND	ND	ND
		Ostracod	3670.7	MAIN FRAC/ SAND-OFF	69.0	NA	No ISIP/ Sand-off	NA	ND	ND	ND
GARRINGTON	6-9-36-6W5	Glauconite	2752.1	MAIN FRAC/Flush @Max MPa	68.0	AD	Poor ISIP/Constriction or sand-off?	23.0	ND	ND	ND
		Ostracod	2764.8	MAIN FRAC/Flush @Max MPa	69.0	AD	Poor ISIP/Constriction or sand-off?	23.1	ND	ND	ND
		Upper Basal Quartz	2812.3	MAIN FRAC	69.0	33.0	Clear ISIP	22.5	55.5	ND	ND
		Lower Basal Quartz	2831.1	MAIN FRAC	61.0	38.0	Clear ISIP	22.7	60.7	ND	ND
GARRINGTON	6-9-37-6W5	Viking	2472.0	MAIN FRAC	66.5	19.2	Clear ISIP	20.1	39.3	ND	ND
GARRINGTON	14-11-36-6W5	Glauconite	2670.6	MAIN FRAC	48.0	30.0	Clear ISIP	21.9	51.9	ND	ND
		Ostracod+Basal Quartz	2712.1	MAIN FRAC	67.0	ND	No ISIP given/ Sand-off?	21.8	ND	ND	ND
GARRINGTON	6-14-36-6W5	Ostracod	2693.4	MAIN FRAC	38.5	24.9	Clear ISIP	22.5	47.4	ND	ND
		Basal Quartz A	2708.6	MAIN FRAC	49.0	ND	No ISIP/ Sand-off	22.6	ND	ND	ND

NA Not applicable
ND No data
AD Ambiguous data

TABLE 4.5: HYDRAULIC FRACTURING DATABASE - RESERVOIR PRESSURE AND GRADIENT DATA

FIELD NAME	WELL NO.	FORMATION	MID-POINT TRUE DEPTH(m)	RESERVOIR PRESSURE (MPa)	TEST TYPE	BH ISIP GRADIENT (kPa/m)	CLOSURE PRES. GRADIENT (kPa/m)	RESERVOIR PRES. GRADIENT (kPa/m)
CRIMSON	8-5-38-8W5	Glauconite	2926.0	28.0	Build-up	AD	ND	9.6
CRIMSON	3-5-38-8W5	Glauconite	2914.8	31.6	frac analysis	16.5	13.0	10.8
		Glauconite	2914.8	31.6	frac analysis	18.3	ND	10.8
CAROLINE	8-17-36-6W5	Glauconite	2736.3	ND	NA	13.4	13.6	ND
		Glauconite	2736.3	ND	NA	18.1	13.6	ND
		Glauconite	2736.3	ND	NA	AD'	ND	ND
CAROLINE	6-5-36-6W5	Ostracod	2838.2	26.8	Frac proposal	19.2	ND	9.4
		Upper Basal Quartz	2863.4	22.5	Frac proposal	17.2	ND	7.9
STRACHAN	10-7-37-9W5	Glauconite	3329.0	ND	NA	18.4	ND	ND
STRACHAN	16-3-38-9W5	Glauconite	3081.9	31.0	Frac proposal/Pool data	18.1	ND	10.1
		Ostracod	3124.4	28.0	Frac proposal	AD	ND	9.0
STRACHAN	10-13-38-10W5	Cardium	2722.6	25.7	Frac proposal	19.5	ND	9.4
STRACHAN	3-17-37-9W5	Glauconite	3329.6	18.9	Frac proposal	20.6	ND	5.7
		Ostracod	3380.9	31.0	Frac proposal	ND	ND	9.2
STRACHAN	10-22-37-9W5	Ostracod	3179.9	30.0	Frac proposal	21.6	ND	9.4
STRACHAN	6-14-38-9W5	Cardium	2454.1	ND	NA	17.4	17.0	ND
		Cardium	2454.1	ND	NA	17.3	ND	ND
STRACHAN	11-27-37-9W5	Viking	2893.3	ND	NA	20.8	ND	ND
STRACHAN	10-29-37-9W5	Viking	3041.2	25.0	Gulf compl. program	21.2	ND	8.2
		Viking	3041.2	25.0	Gulf compl. program	ND	ND	8.2
STRACHAN	7-13-38-9W5	Glauconite	2928.7	31.6	Frac proposal	17.7	ND	10.8
		Basal Quartz	2999.9	22.5	Frac proposal	18.1	ND	7.5
RICINUS	2-26-36-9W5	Cardium	2883.4	26.3	Build-up	17.7	13.0	9.1
		Cardium	2883.4	26.3	Build-up	17.2	AD	9.1
RICINUS	7-33-36-10W5	Glauconite	3622.9	ND	NA	ND	ND	ND
		Ostracod	3670.7	ND	NA	ND	ND	ND
GARRINGTON	6-9-36-6W5	Glauconite	2752.1	22.5	Frac proposal	ND	ND	8.2
		Ostracod	2764.8	ND	NA	ND	ND	ND
		Upper Basal Quartz	2812.3	ND	NA	19.7	ND	ND
		Lower Basal Quartz	2831.1	ND	NA	21.4	ND	ND
GARRINGTON	6-9-37-6W5	Viking	2472.0	23.0	Prognosis	15.9	ND	9.3
GARRINGTON	14-11-36-6W5	Glauconite	2670.6	24.0	Frac proposal	19.4	ND	9.0
		Ostracod+Basal Quartz	2712.1	24.0	Frac proposal	ND	ND	8.8
GARRINGTON	6-14-36-6W5	Ostracod	2693.4	ND	NA	17.6	ND	ND
		Basal Quartz A	2708.6	ND	NA	ND	ND	ND

NA Not applicable
ND No data
AD Ambiguous data

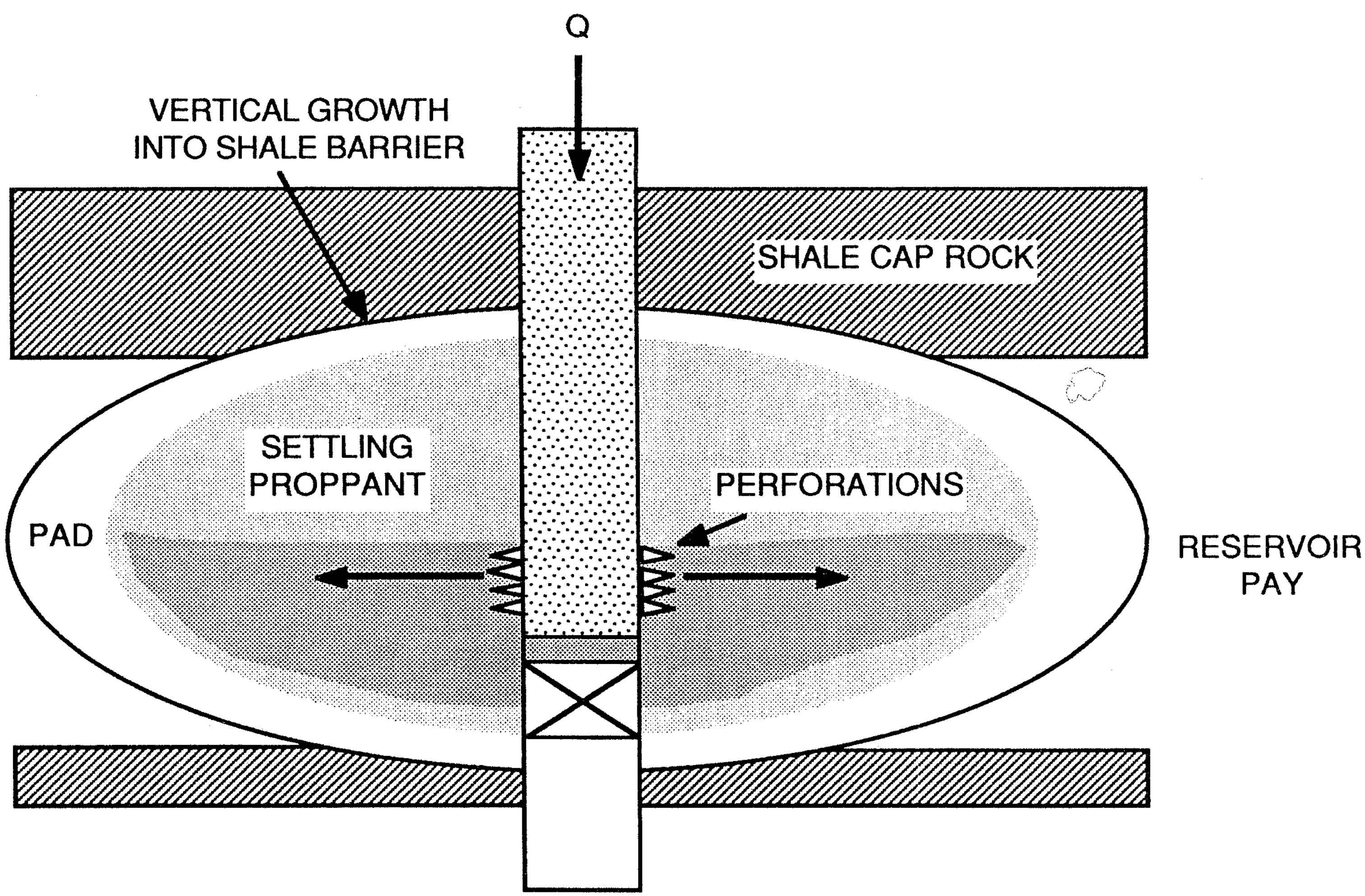
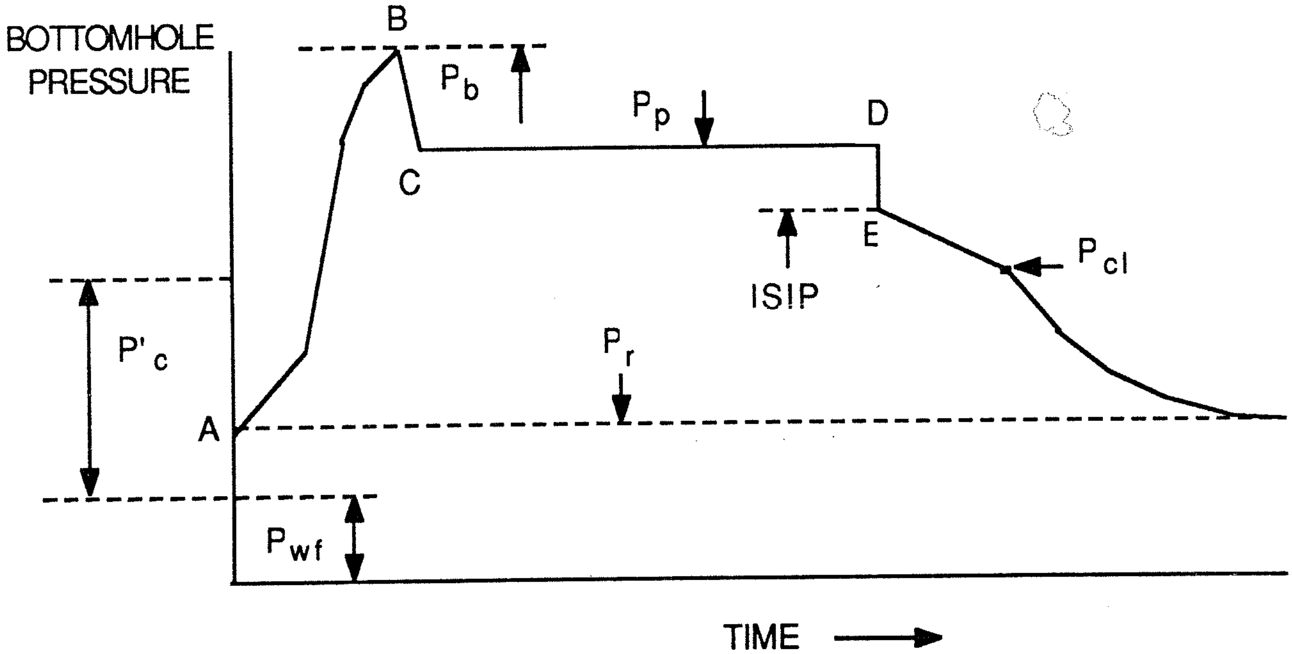


FIGURE 2.1 : IDEALIZED GEOMETRY DURING A HYDRAULIC FRACTURE TREATMENT WITH PROPPANT



Pb = Formation Breakdown Pressure
Pp = Fracture Propagation Pressure
Pr = Reservoir Pressure
ISIP = Instantaneous Shut-in Pressure
P'c = Effective Closing Pressure on Proppant
Pcl = Closure Pressure
Pwf = Bottomhole Flowing Pressure

FIGURE 2.2: IDEALIZED HYDRAULIC FRACTURING TREATMENT PRESSURE CURVE

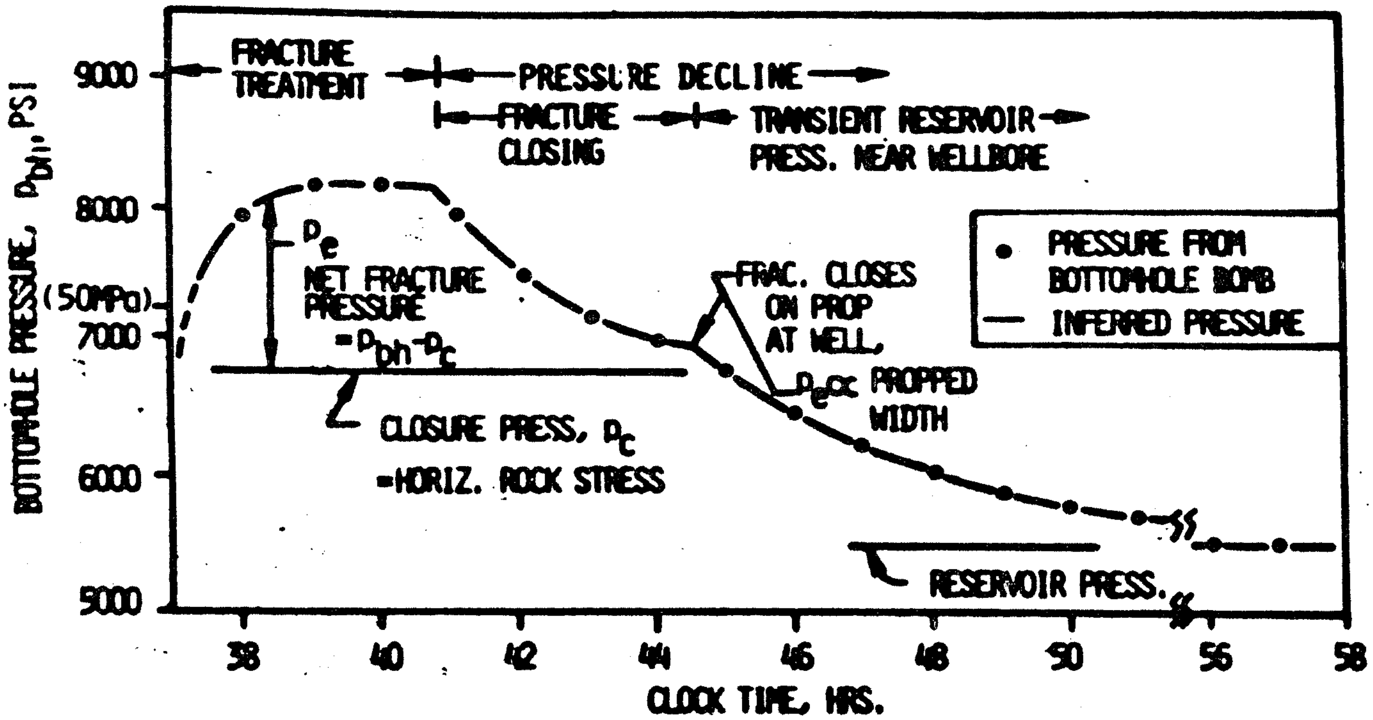


FIGURE 3.1 : BOTTOMHOLE PRESSURE DURING A PROPPED FRACTURE TREATMENT (FROM NOLTE, 1982)

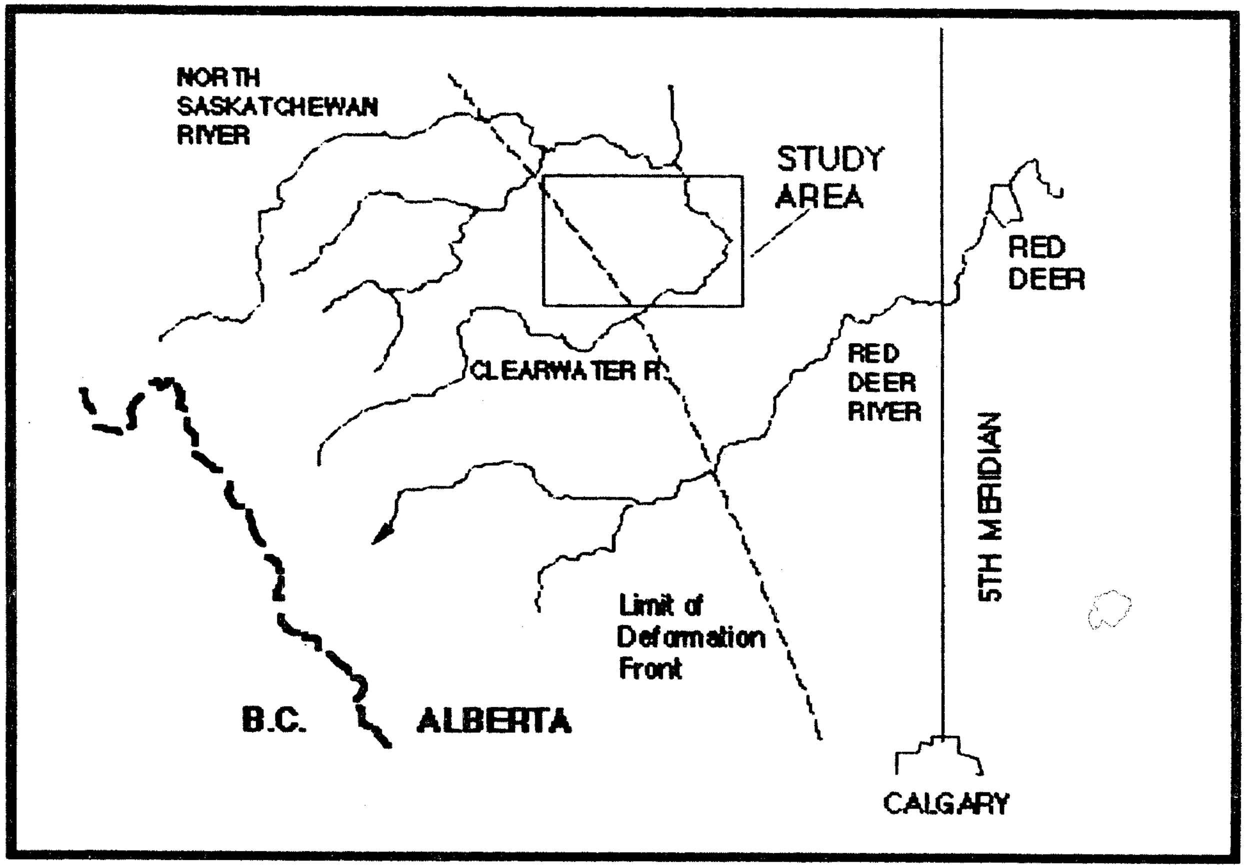


FIGURE 4.1: GENERAL LOCATION MAP

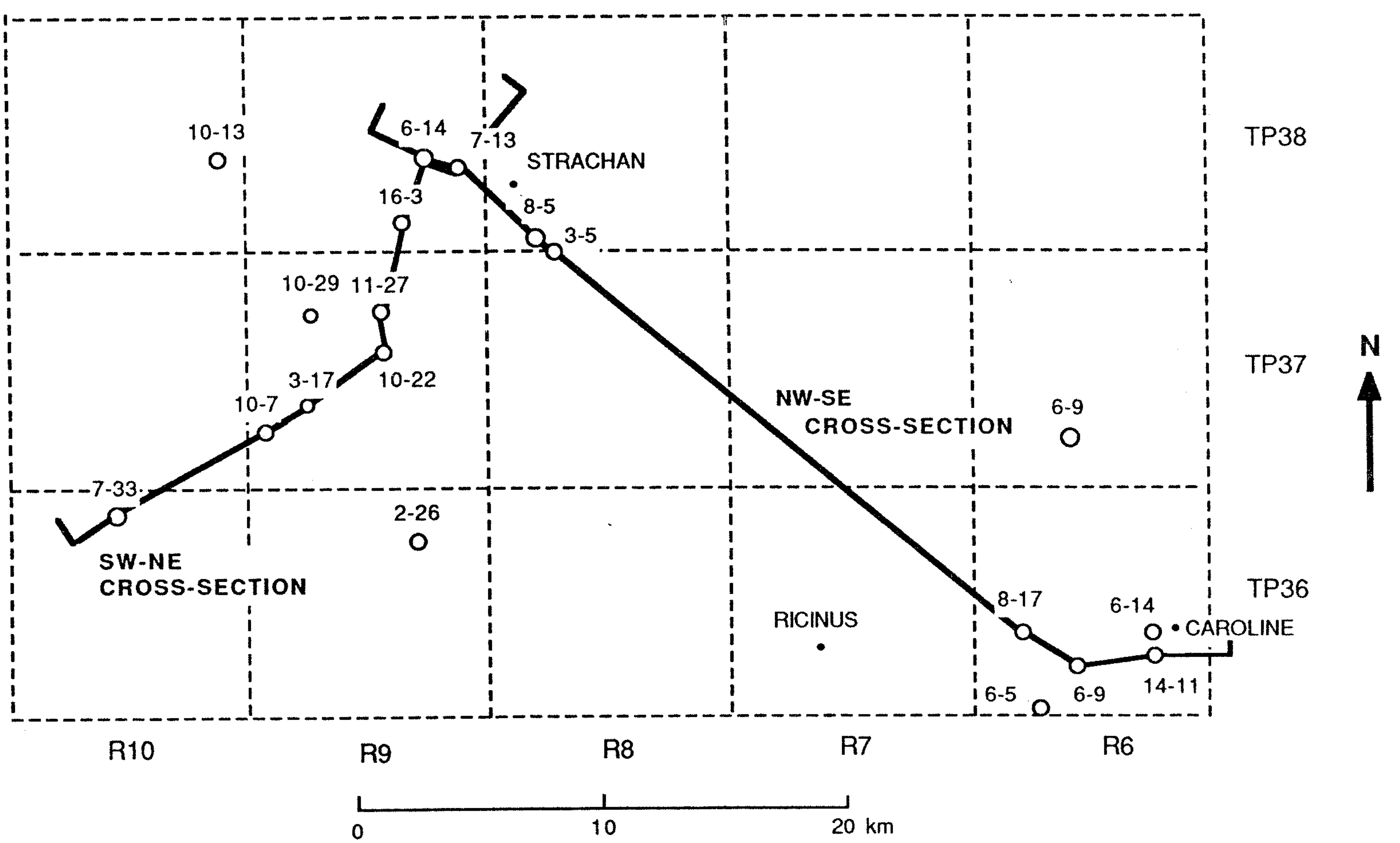


FIGURE 4.2 : GULF CANADA ET AL WELL LOCATIONS USED IN THIS STUDY

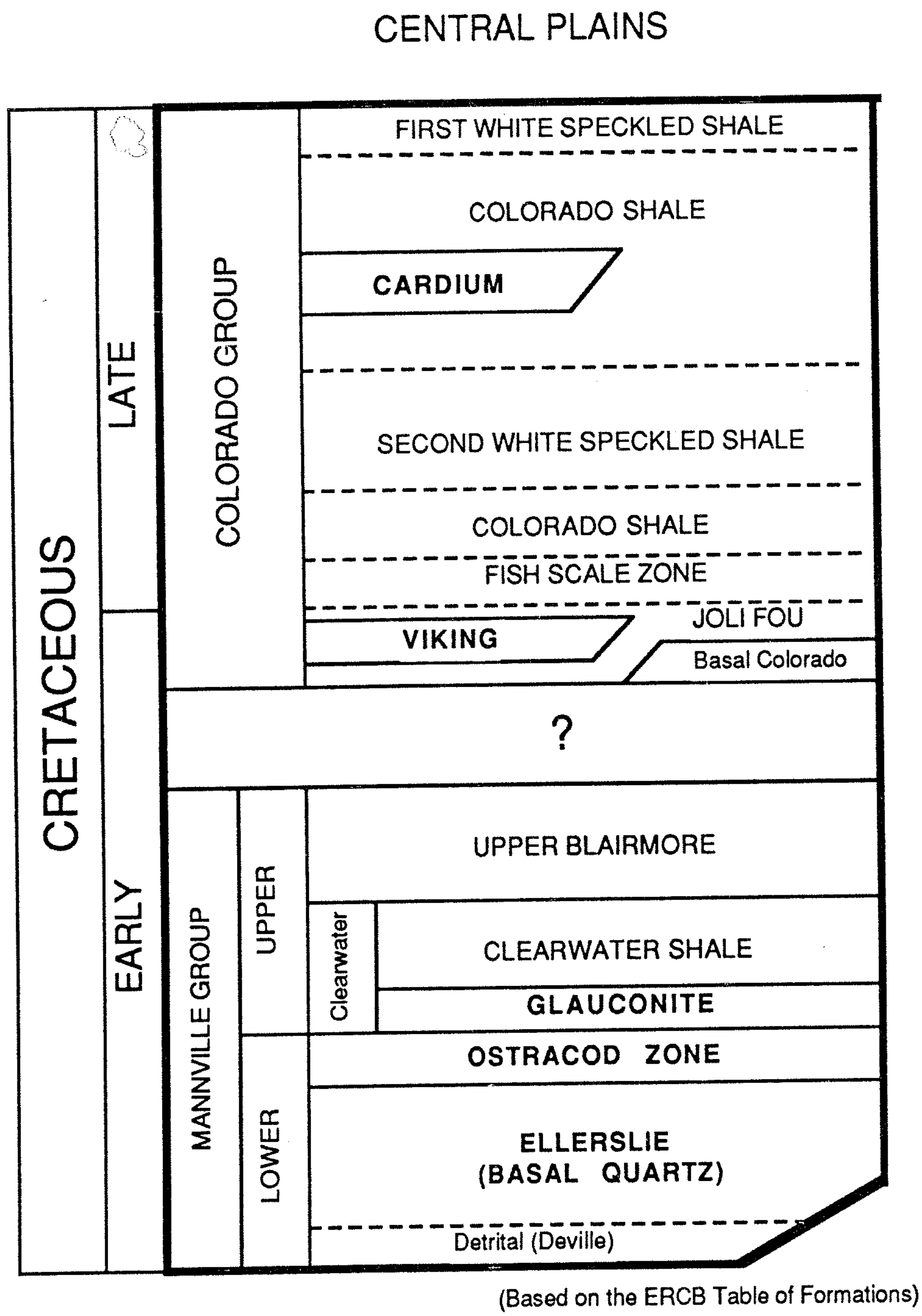


FIGURE 4.3 : TABLE OF FORMATIONS FOR THE STUDY AREA

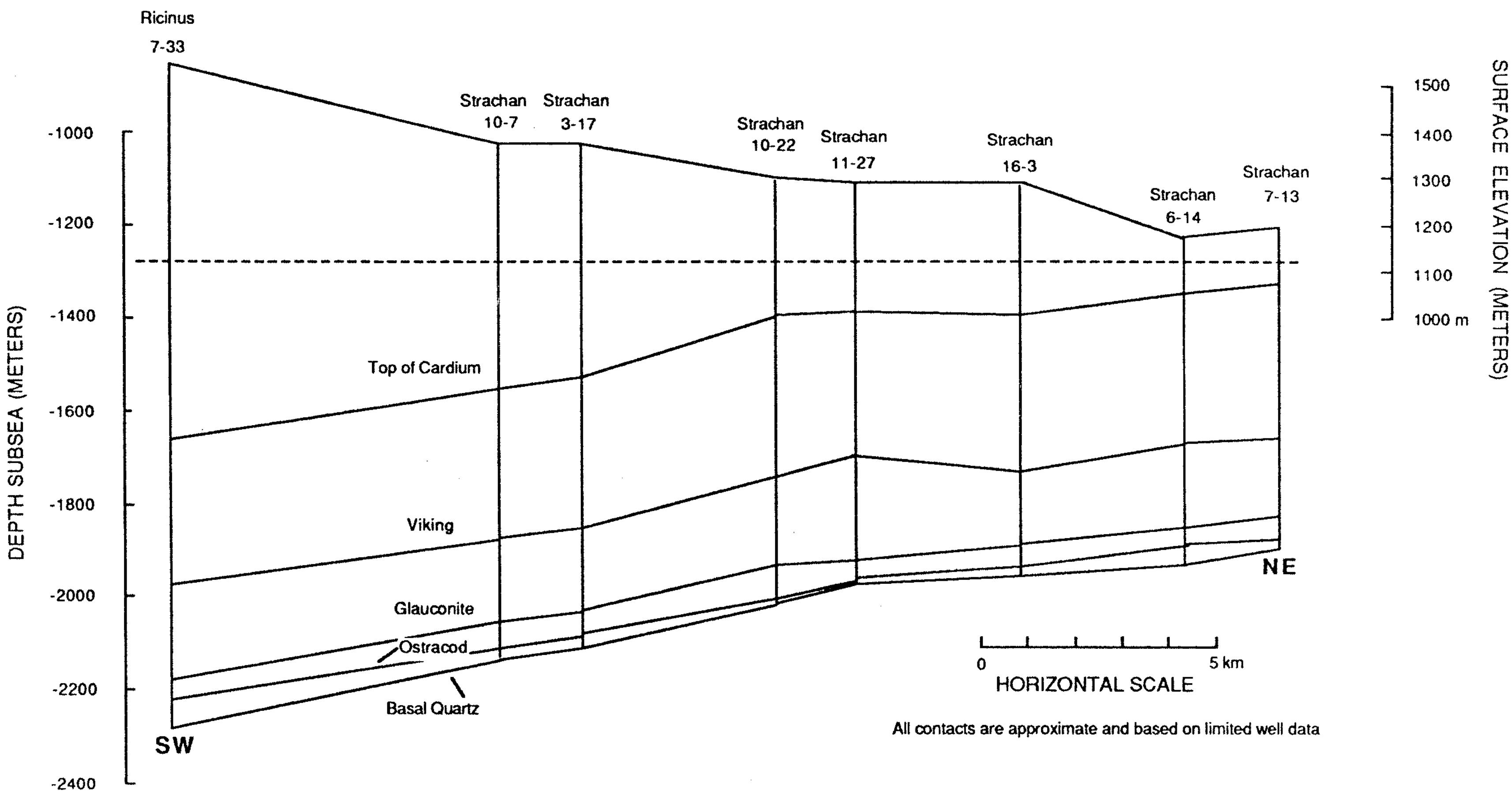


FIGURE 4.4: SOUTHWEST-NORTHEAST GEOLOGICAL CROSS SECTION THROUGH STUDY AREA

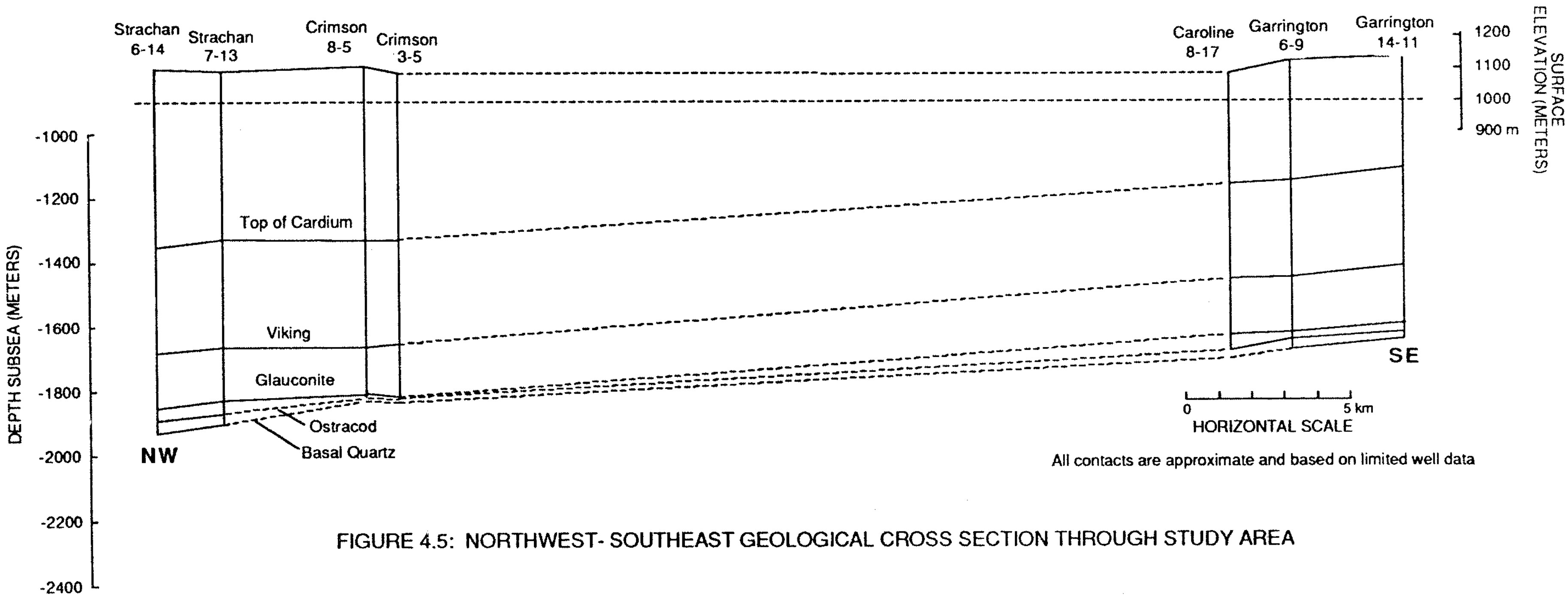


FIGURE 4.5: NORTHWEST- SOUTHEAST GEOLOGICAL CROSS SECTION THROUGH STUDY AREA

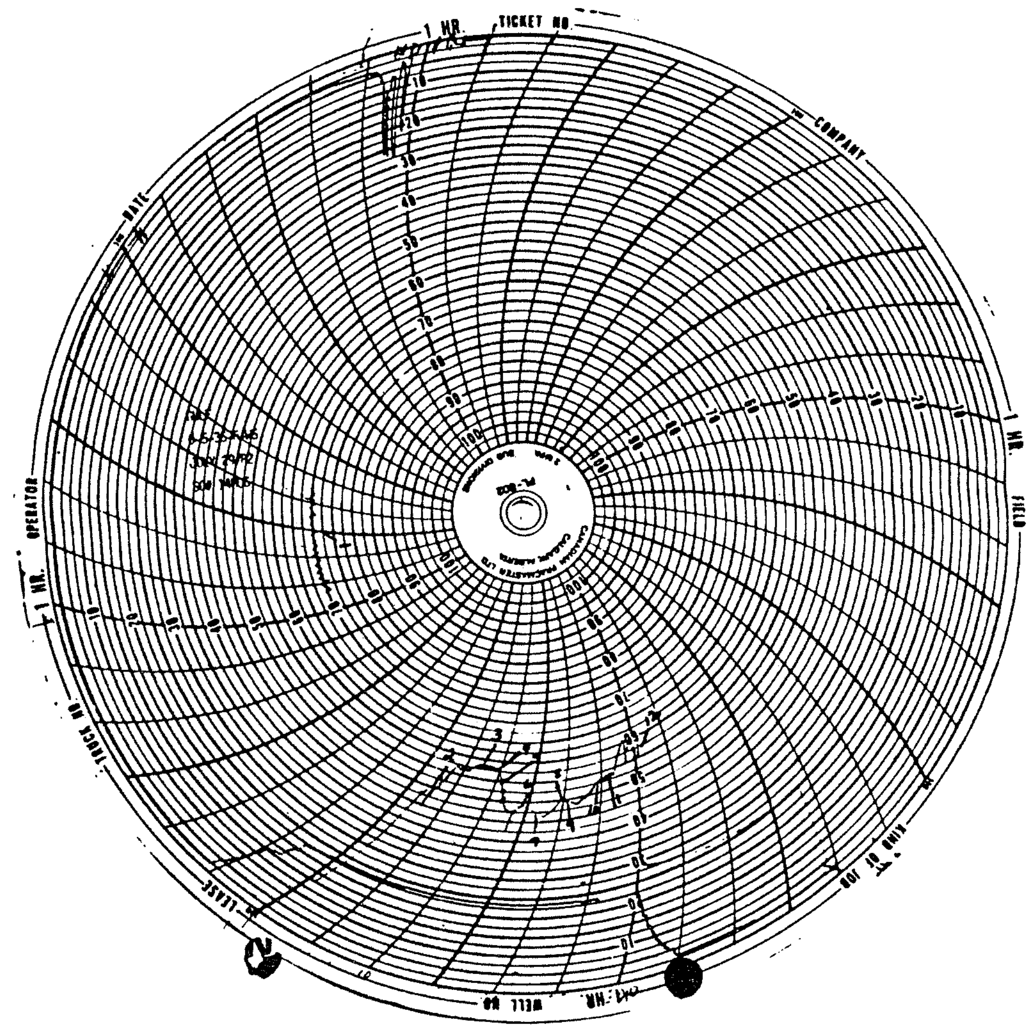


FIGURE 4.6 : EXAMPLE CIRCULAR PRESSURE CHART RECORD FROM
A HYDRAULIC FRACTURE TREATMENT
GULF et al CAROLINE 6-5-36-6W5

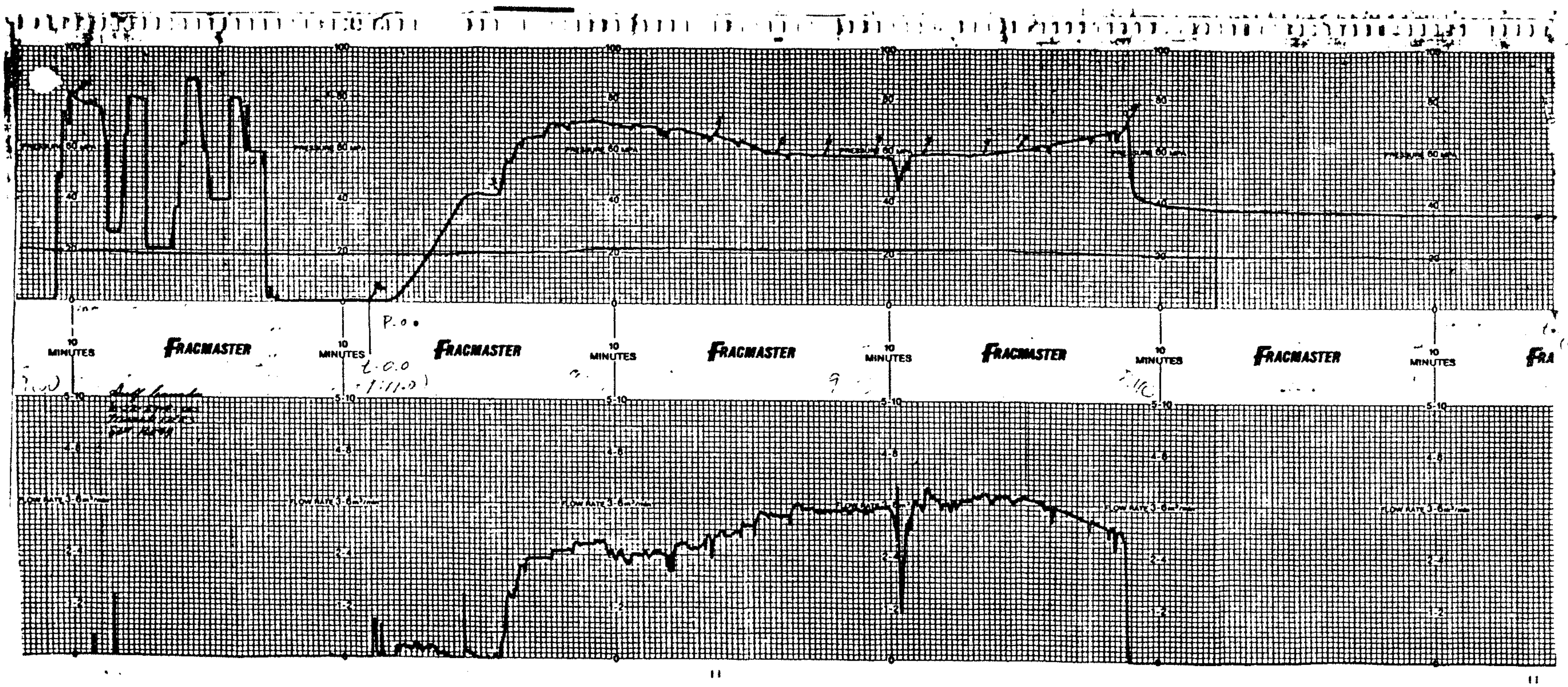


FIGURE 4.7 : EXAMPLE STRIP CHART PRESSURE RECORD OF A HYDRAULIC FRACTURE TREATMENT FOR GULF et el STRACHAN 10-22-37-9W5

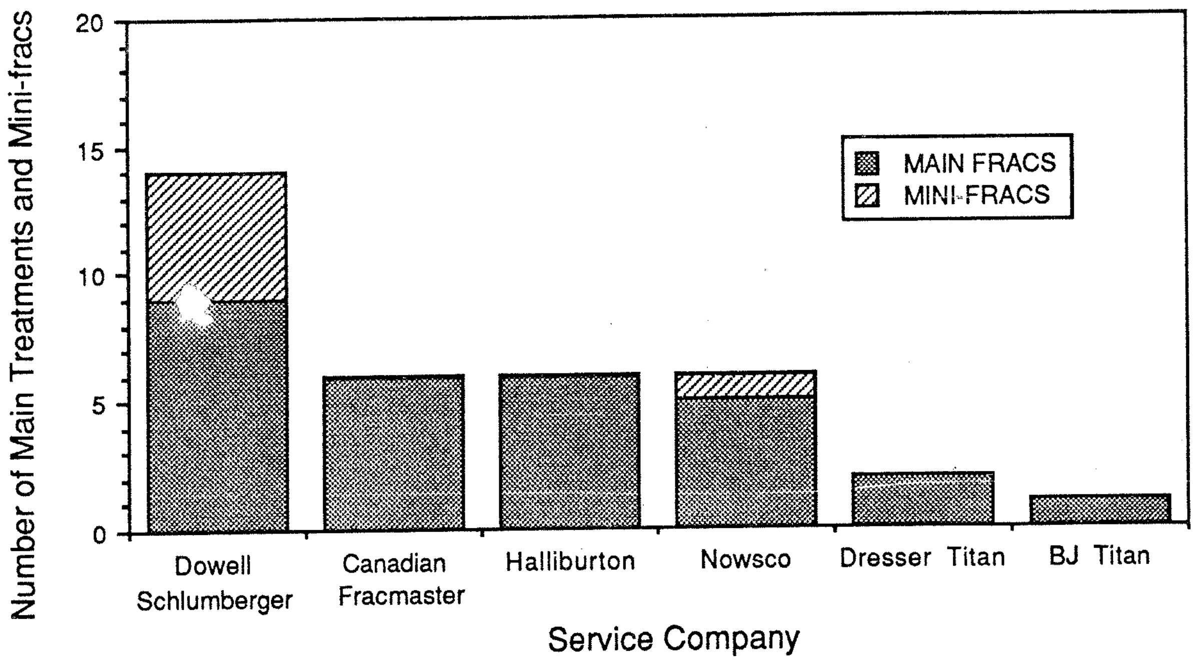


FIGURE 4.8: DISTRIBUTION OF HYDRAULIC FRACTURING RECORDS BY SERVICE COMPANY USED IN THIS STUDY

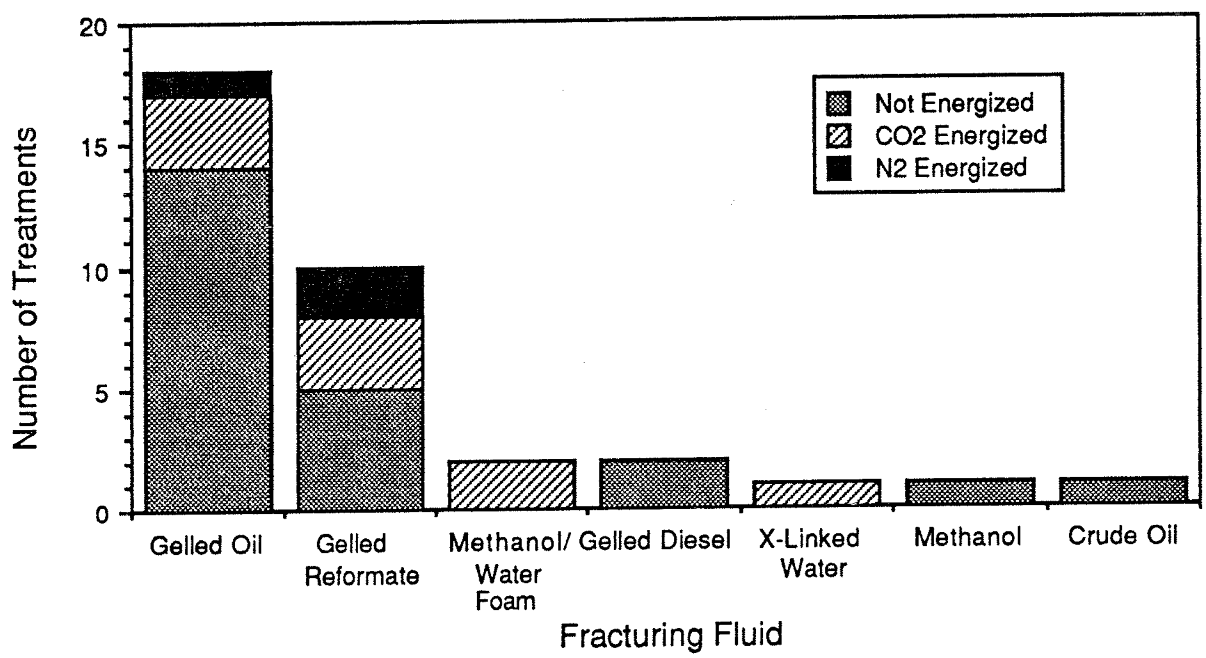


FIGURE 4.9: DISTRIBUTION OF FRACTURING FLUID TYPE USED IN TREATMENTS REPORTED IN THIS STUDY

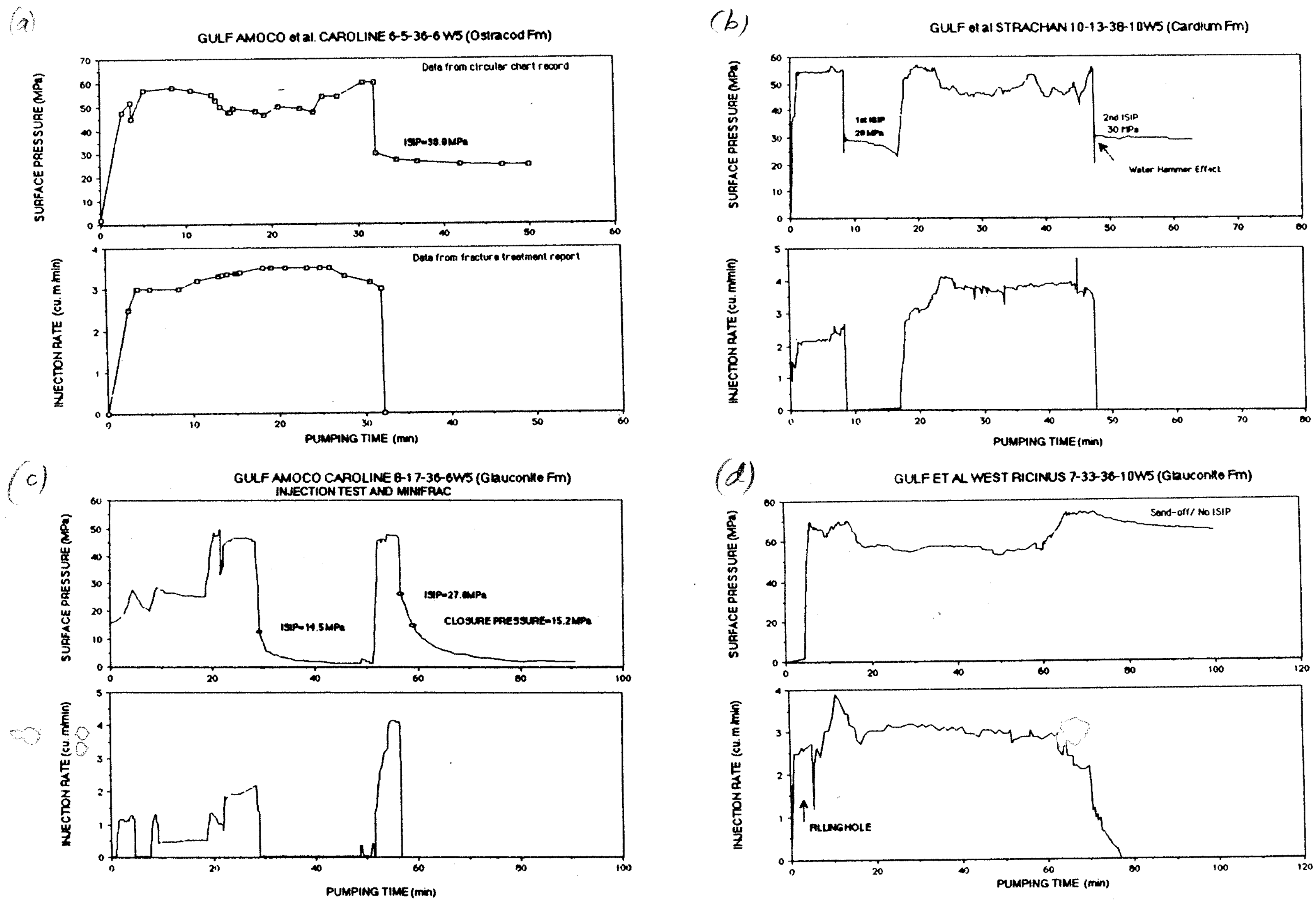


FIGURE 5.1: Examples of (a) main treatment data from a circular pressure chart (b) Two clear ISIP's from a main treatment but insufficient data for a closure pressure determination (c) injection test and mini-frac ISIP's and closure pressure determinations (d) sand-off condition.

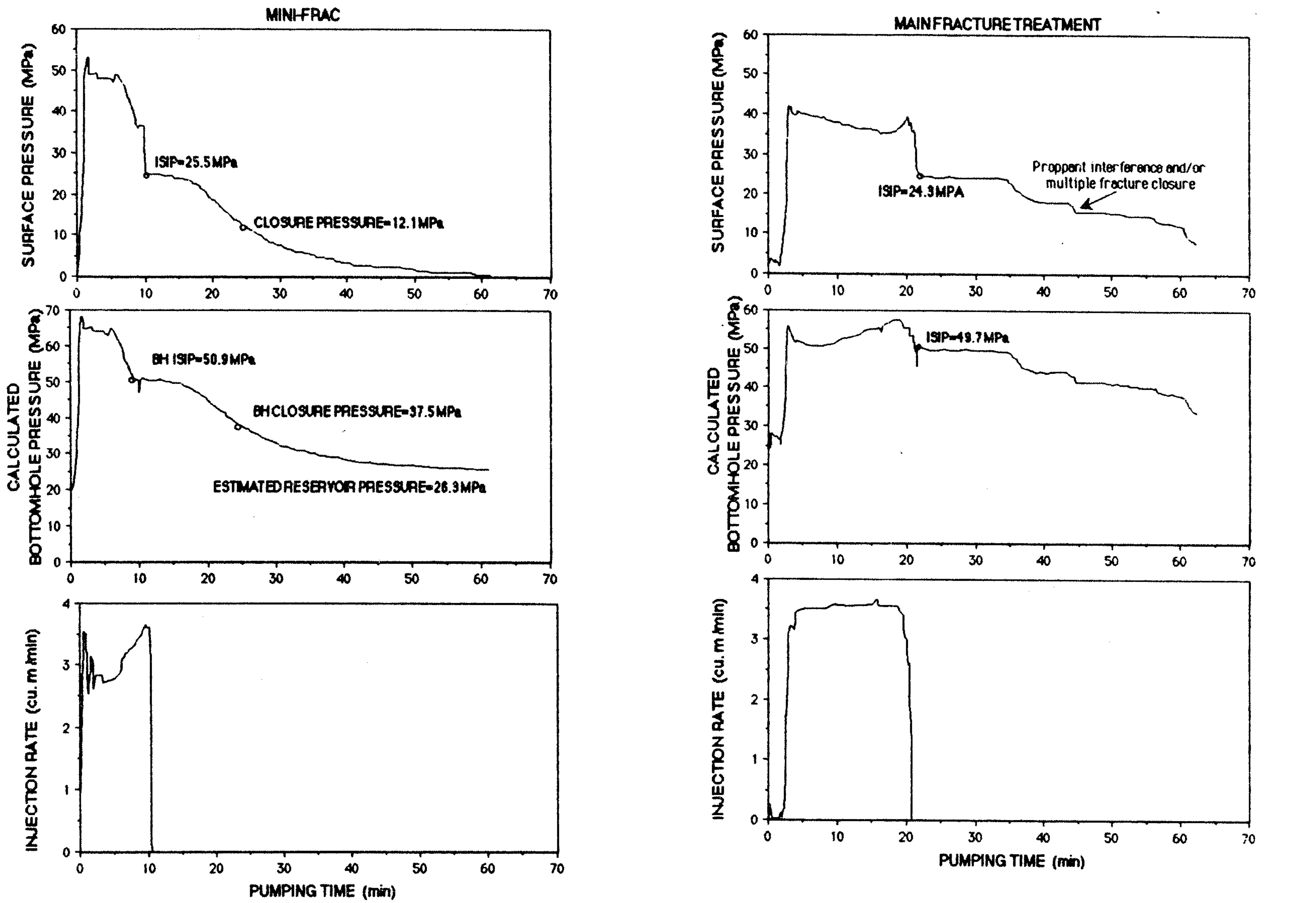


FIGURE 5.2: Comparison of Mini-frac and Main Fracture Treatments for Gulf et al Ricinius 2-26-36-9W5M

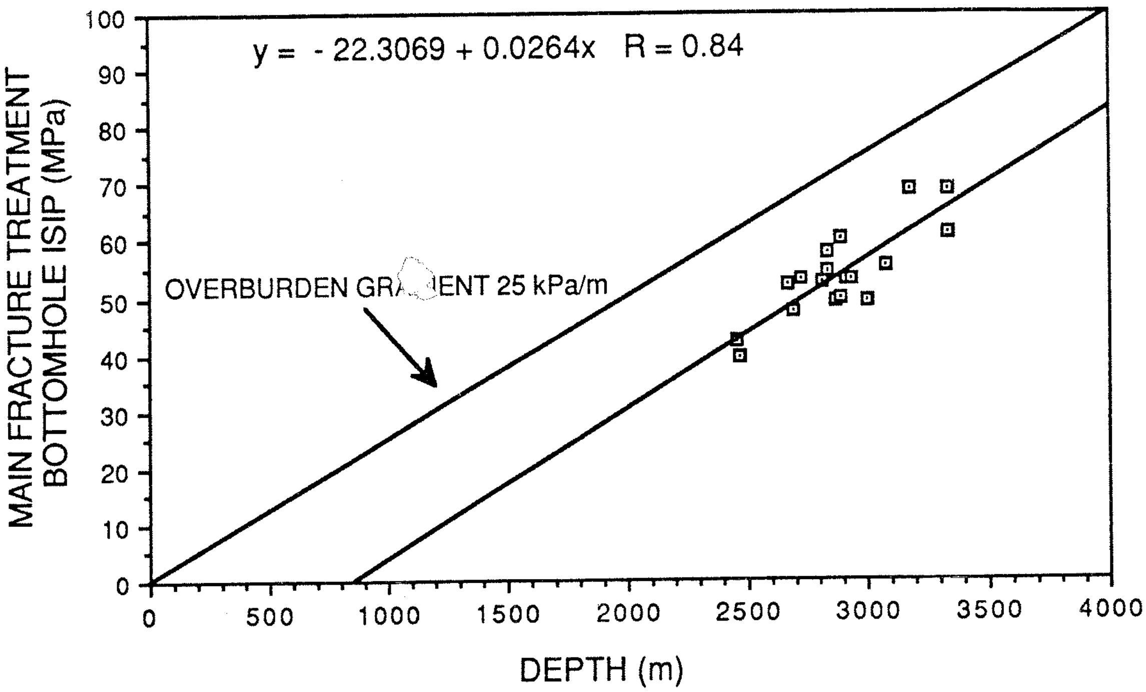


FIGURE 5.3: MAIN FRACTURE TREATMENT BOTTOMHOLE ISIP VERSUS DEPTH

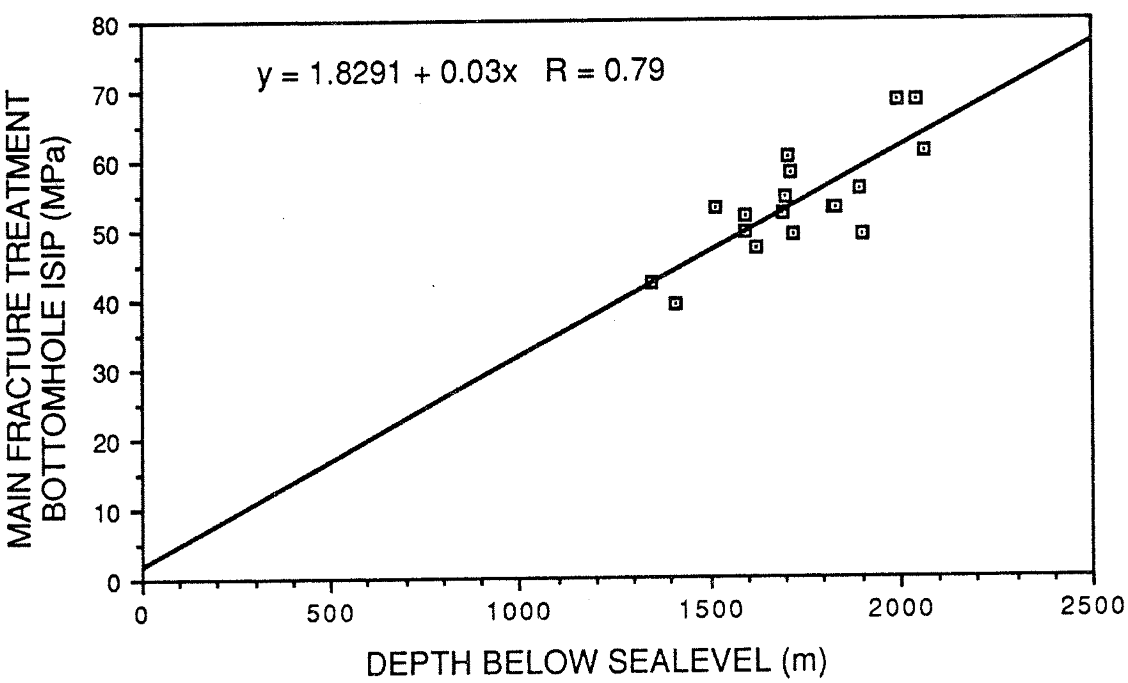


FIGURE 5.4: MAIN FRACTURE TREATMENT BOTTOMHOLE ISIP VERSUS DEPTH BELOW SEALEVEL

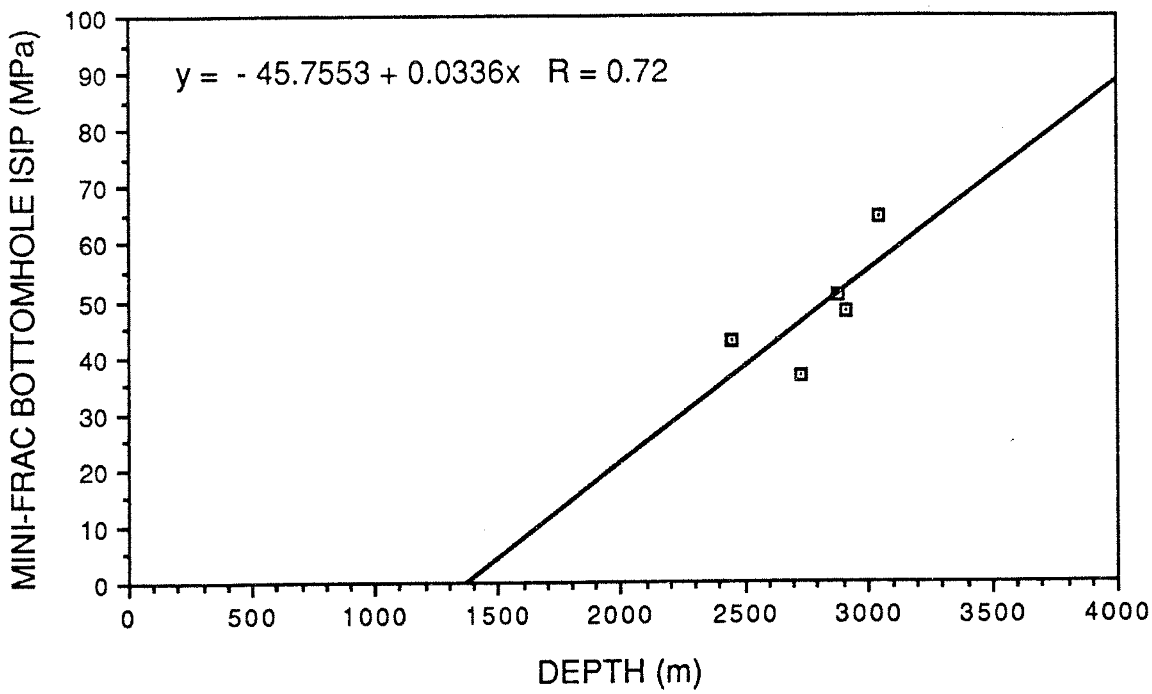


FIGURE 5.5: MINI-FRAC BOTTOMHOLE ISIP VERSUS DEPTH

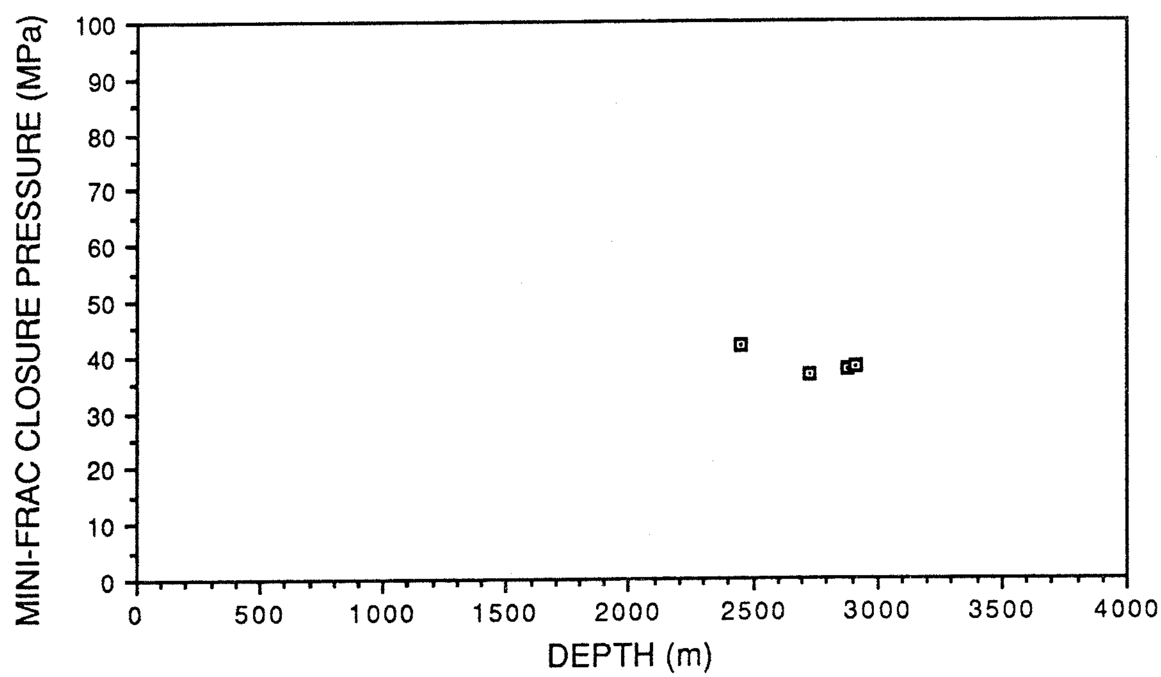


FIGURE 5.6: MINI-FRAC CLOSURE PRESSURE VERSUS DEPTH

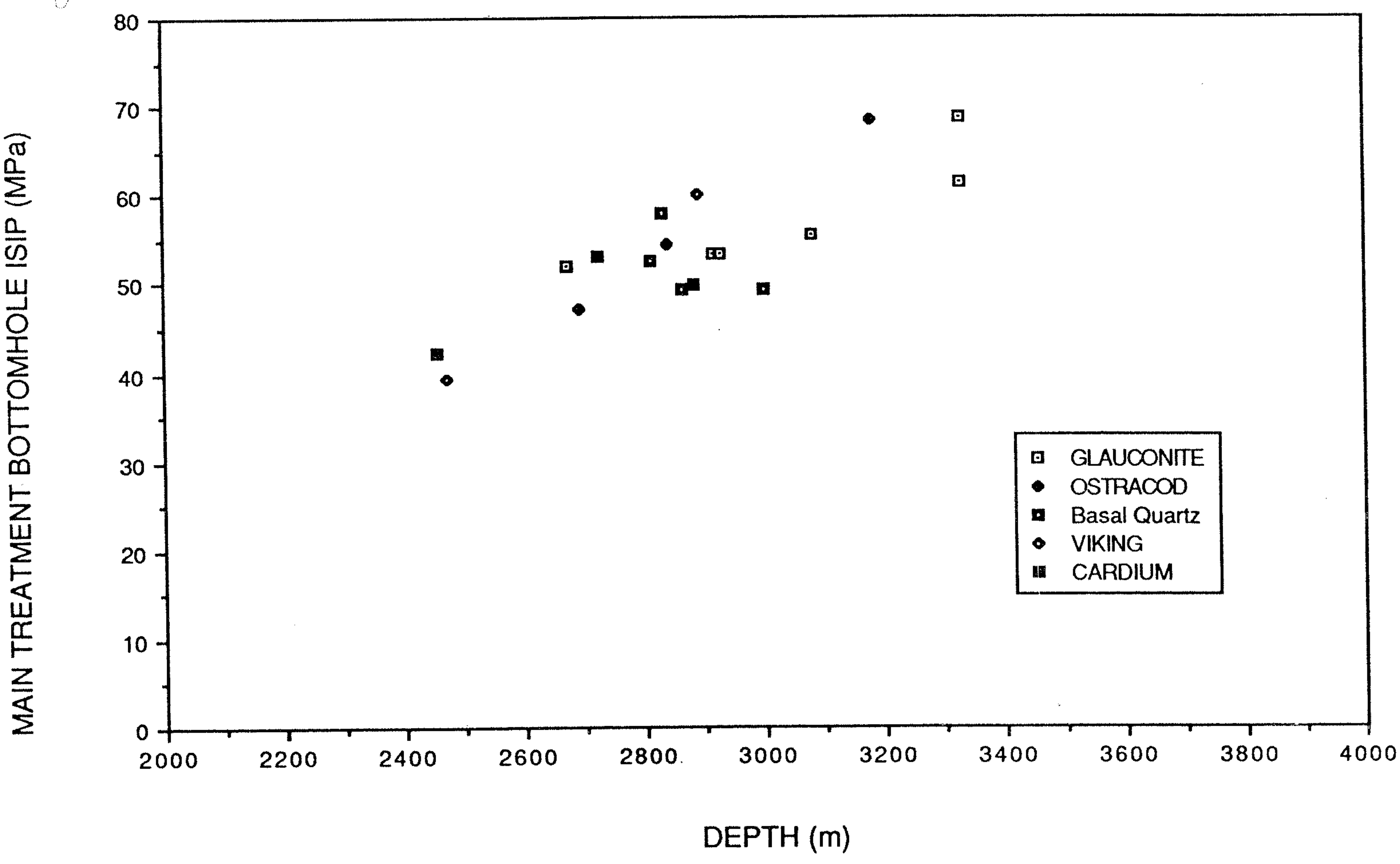


FIGURE 5.7: MAIN FRACTURE TREATMENT BOTTOMHOLE ISIP BY FORMATION VS DEPTH

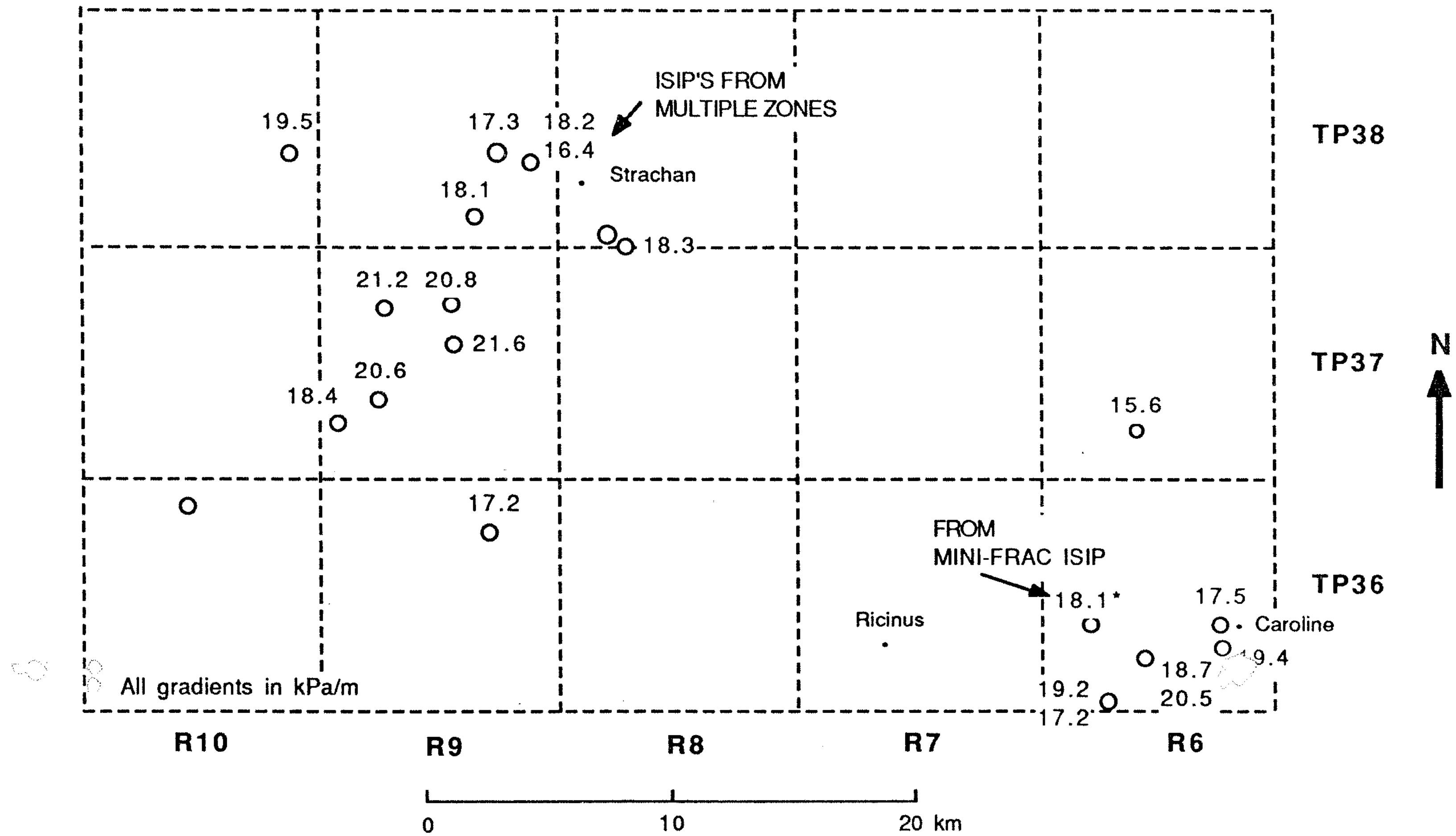


FIGURE 5.8: MAIN TREATMENT BOTTOMHOLE ISIP GRADIENTS IN STUDY AREA

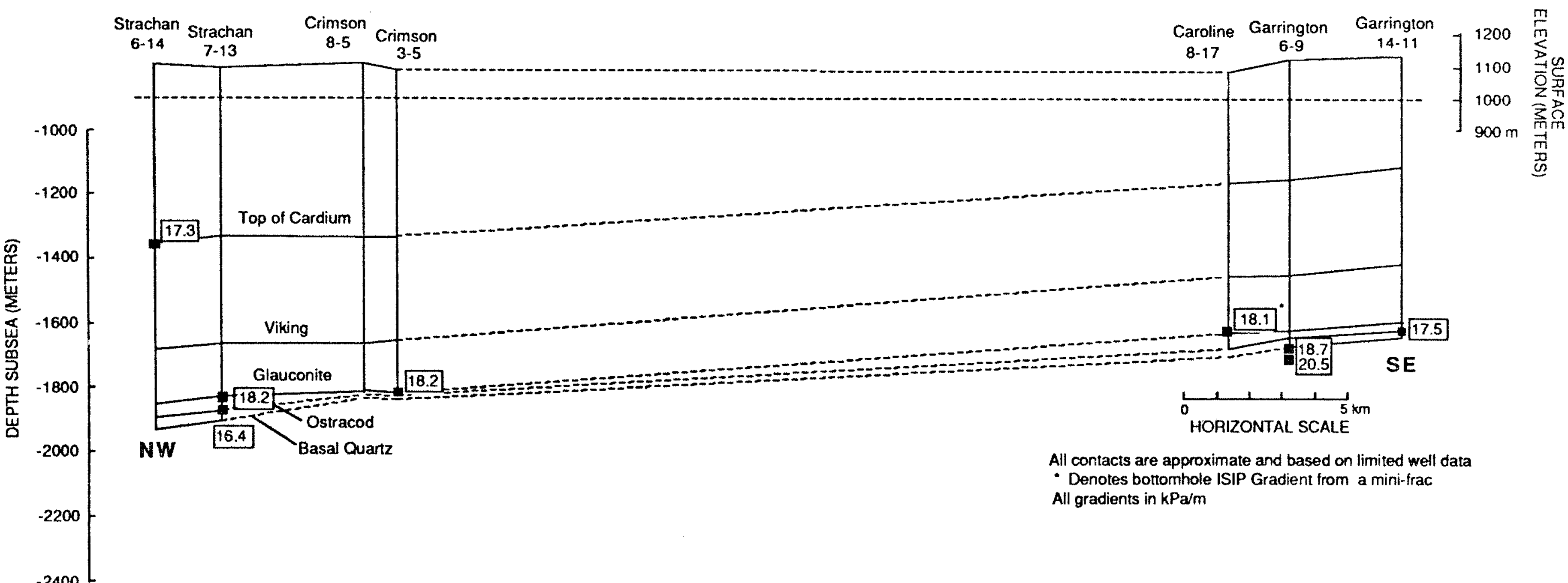


FIGURE 5.10: NORTHWEST- SOUTHEAST CROSS SECTION THROUGH STUDY AREA SHOWING BOTTOMHOLE ISIP GRADIENTS

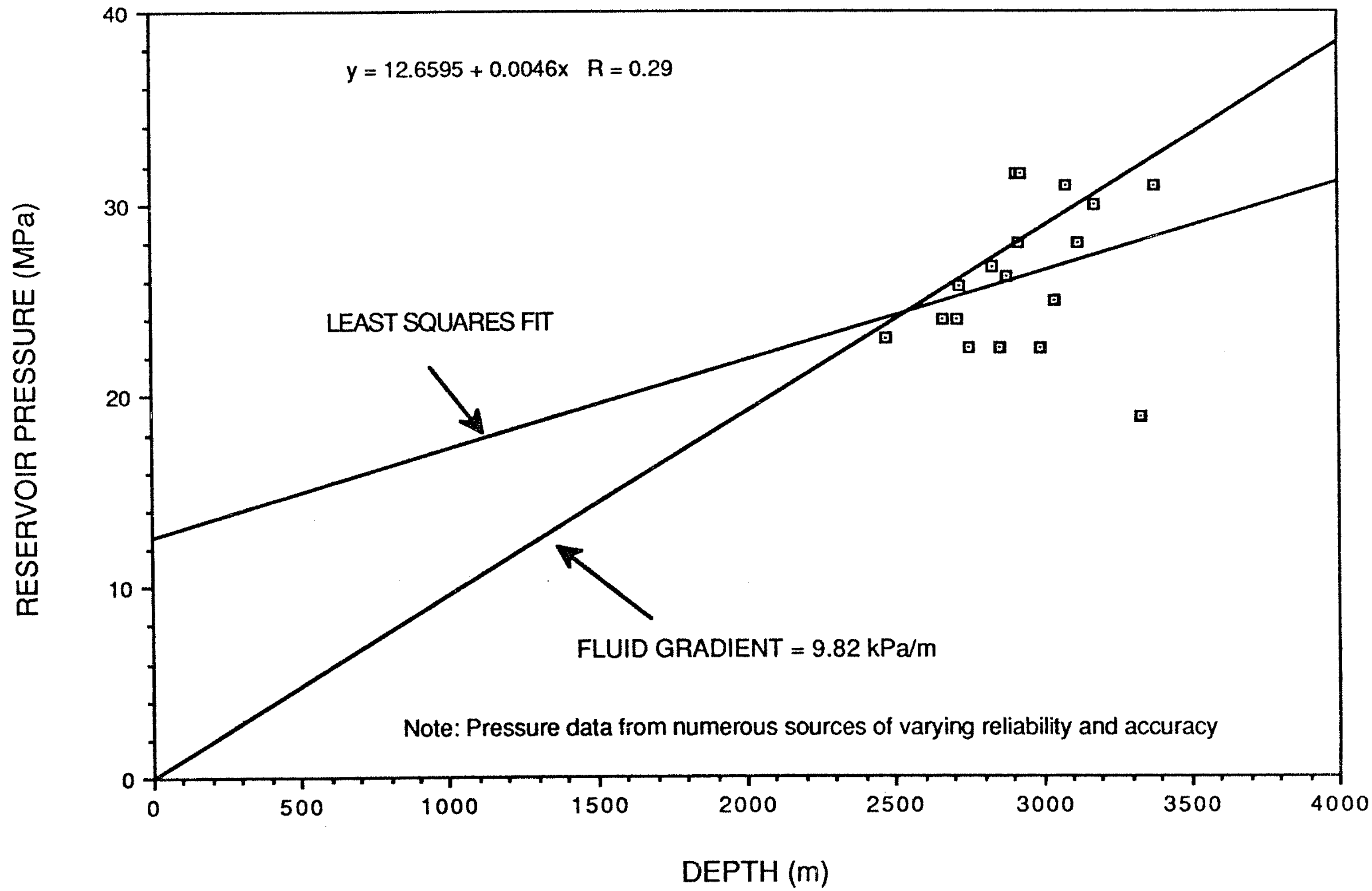


FIGURE 5.11: RESERVOIR PRESSURE VERSUS DEPTH

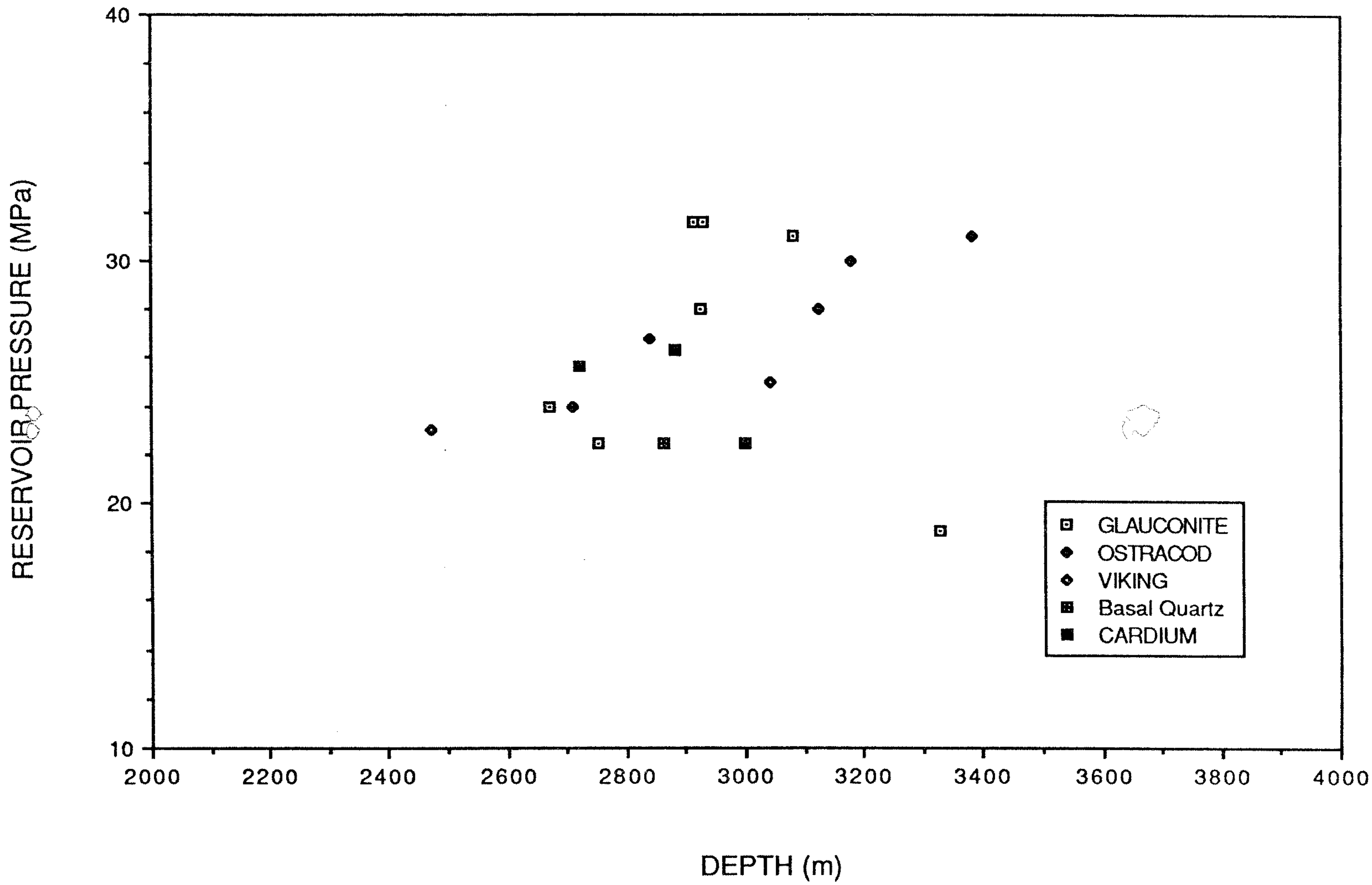


FIGURE 5.12: RESERVOIR PRESSURE BY FORMATION VERSUS DEPTH

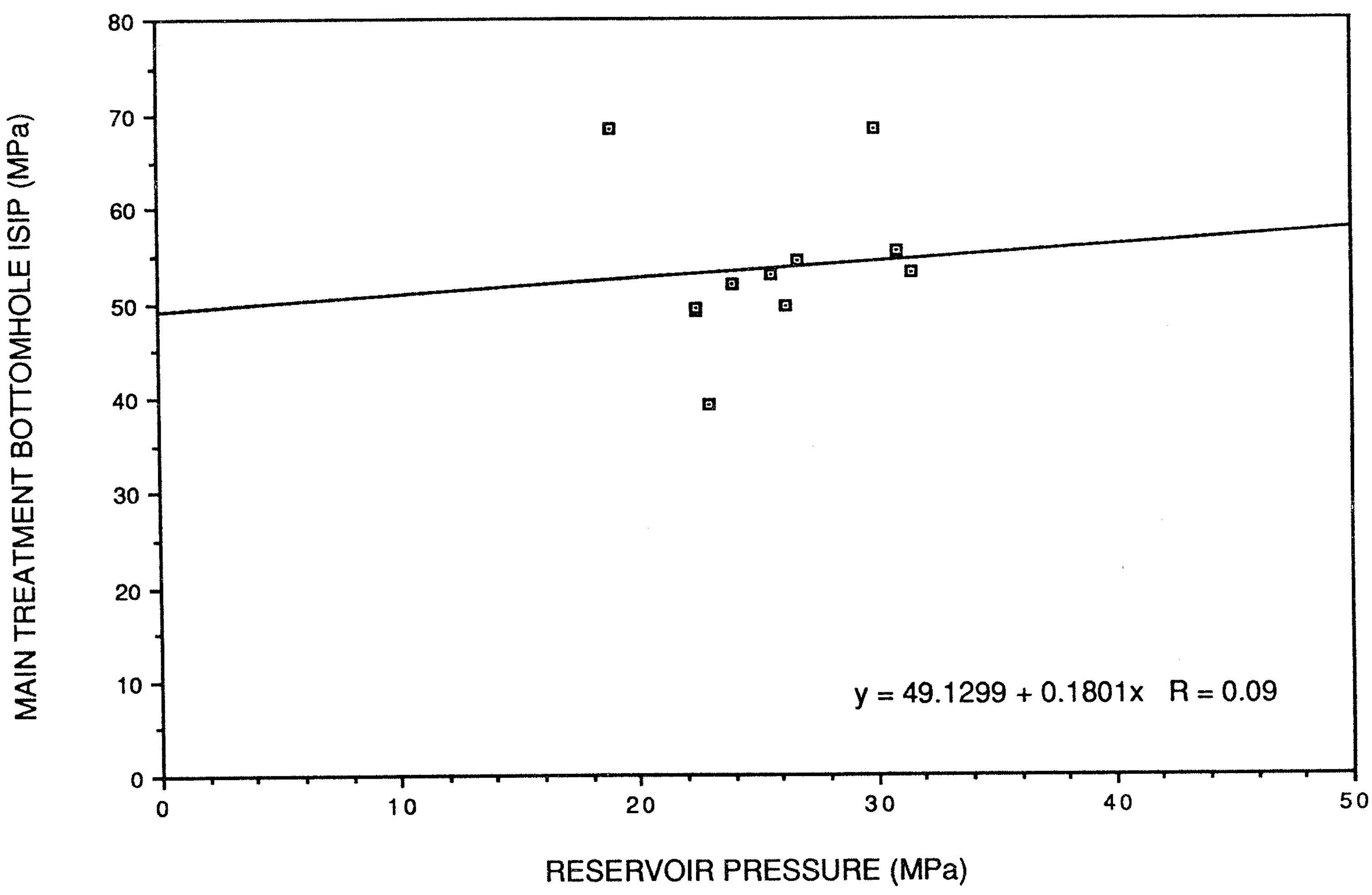


FIGURE 5.13: MAIN FRACTURE TREATMENT BOTTOMHOLE ISIP

VERSUS RESERVOIR PRESSURE

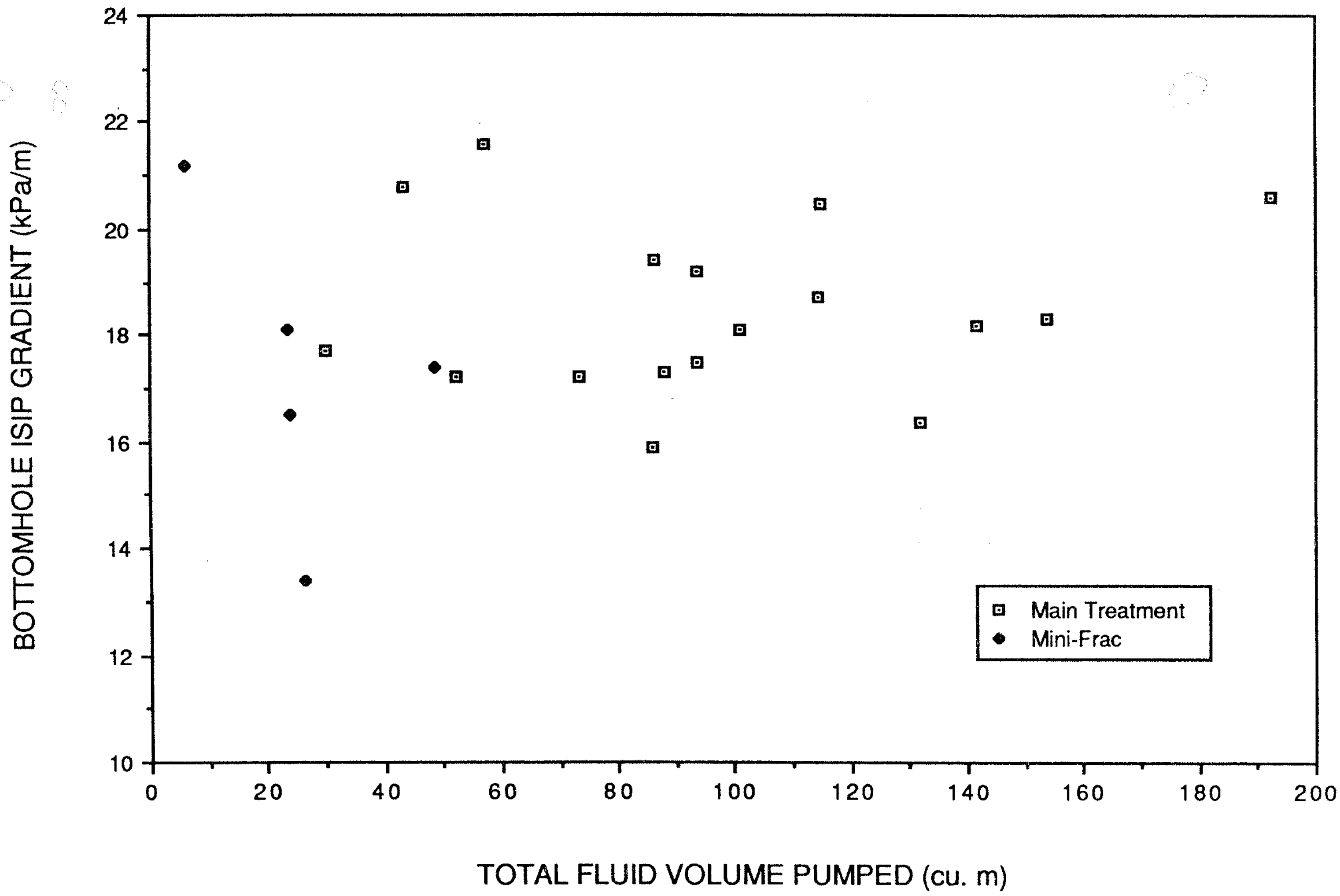


FIGURE 5.14: FRACTURING BOTTOMHOLE ISIP GRADIENTS VS TOTAL FLUID VOLUME

APPENDIX A

DIGITIZED FRACTURE TREATMENT RECORDS

FIGURE A.1: GULF ET AL CRIMSON 8-5-38-8W5 (Glauconite Fm)

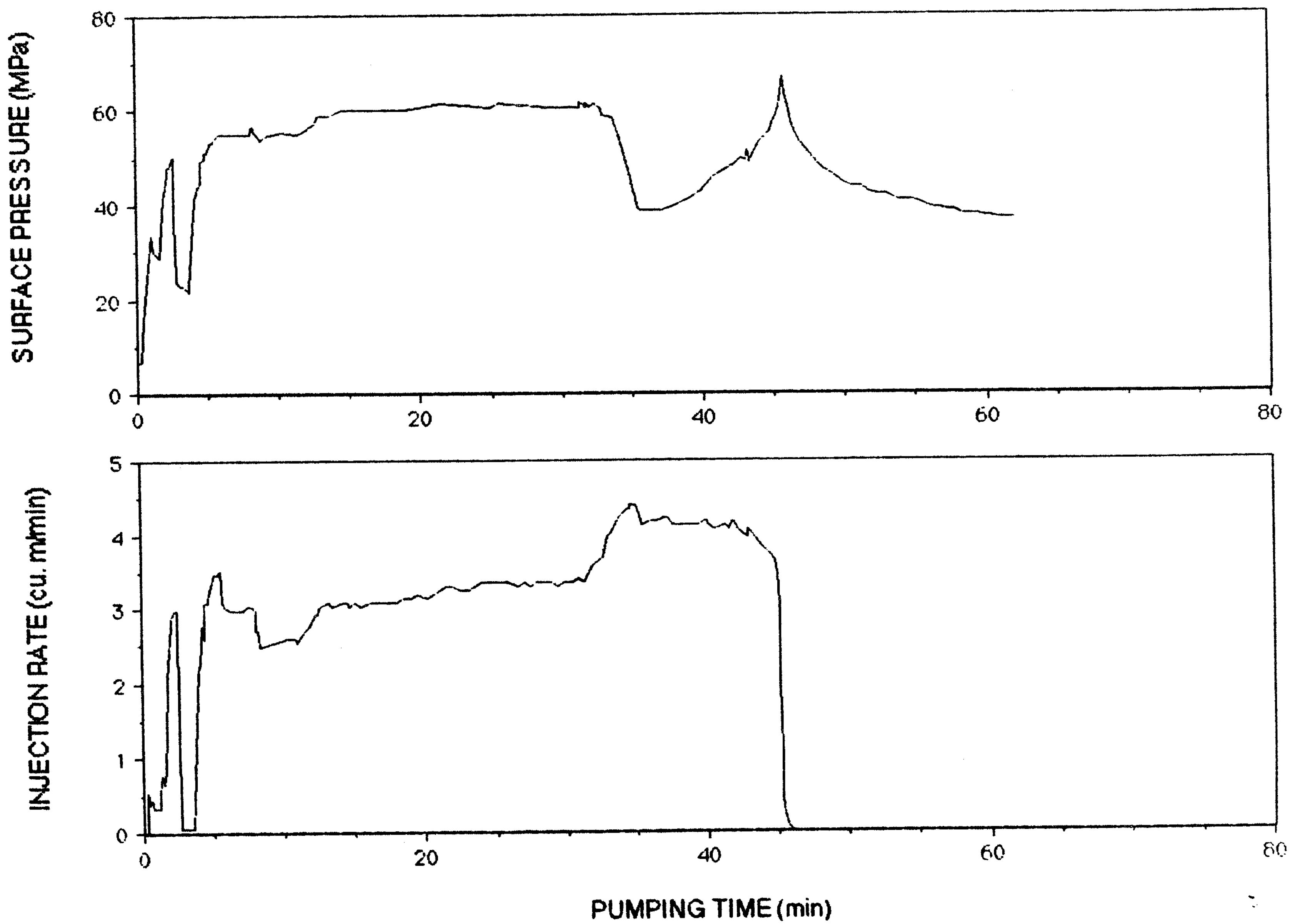


FIGURE A.2: GULF et al. CRIMSON 3-5-38-8-W5M (Glauconite Fm)
MINI-FRAC

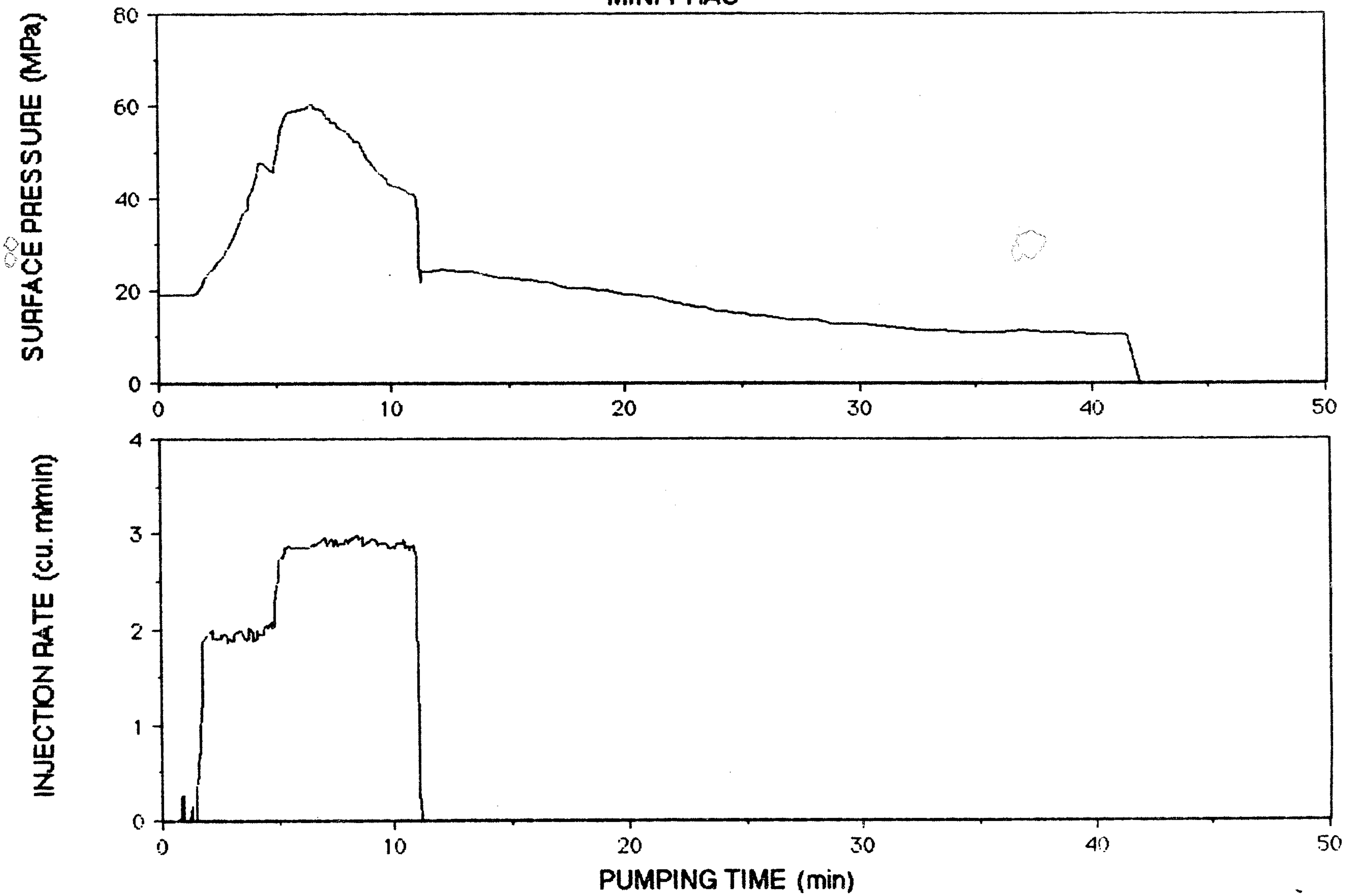


FIGURE A.3: GULF et al. CRIMSON 3-5-38-8-W5M (Glauconite Fm)
MAIN FRACTURE TREATMENT

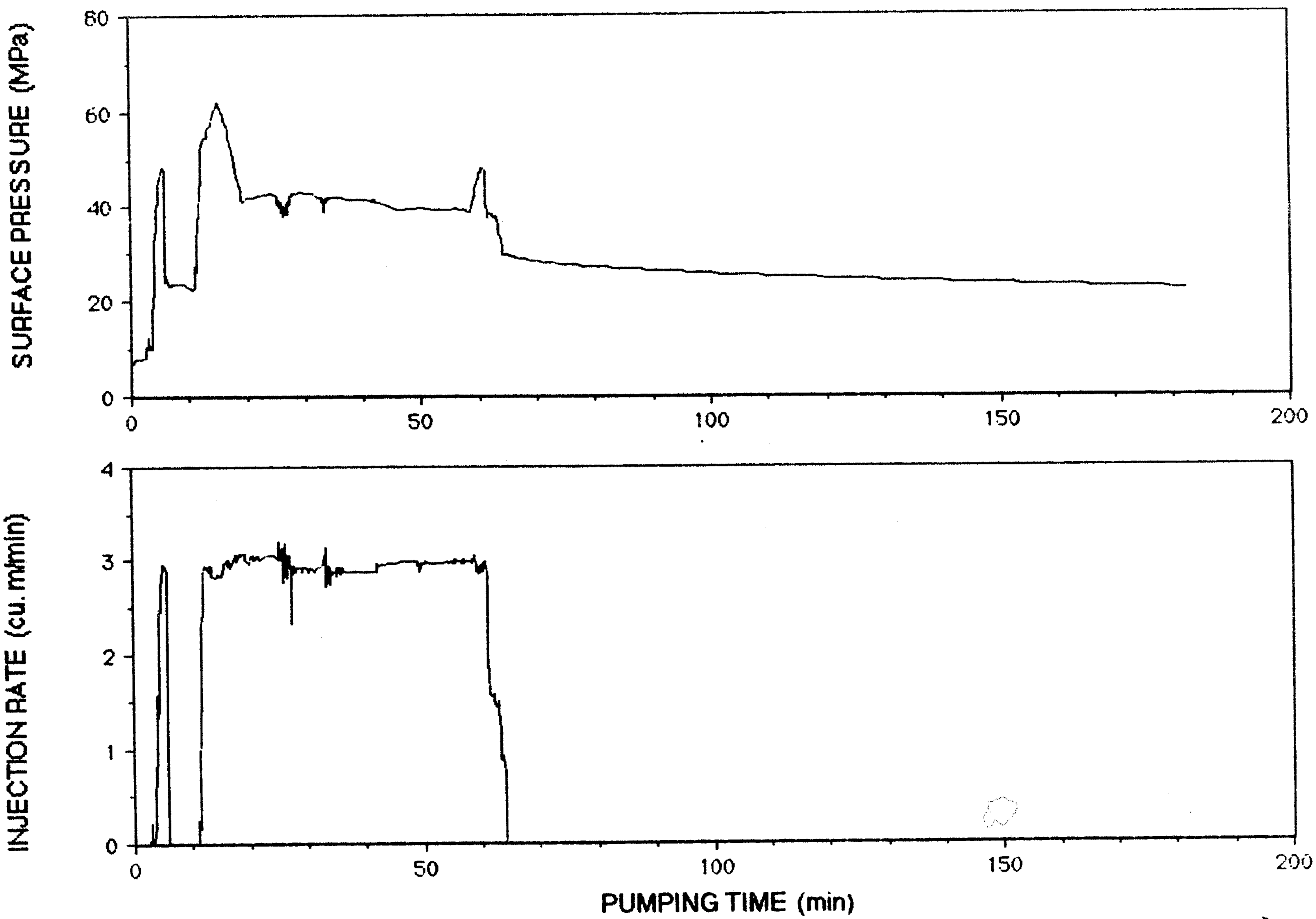


FIGURE A.4: GULF AMOCO CAROLINE 8-17-36-6W5 (Glauconite Fm)
INJECTION TEST AND MINIFRAC

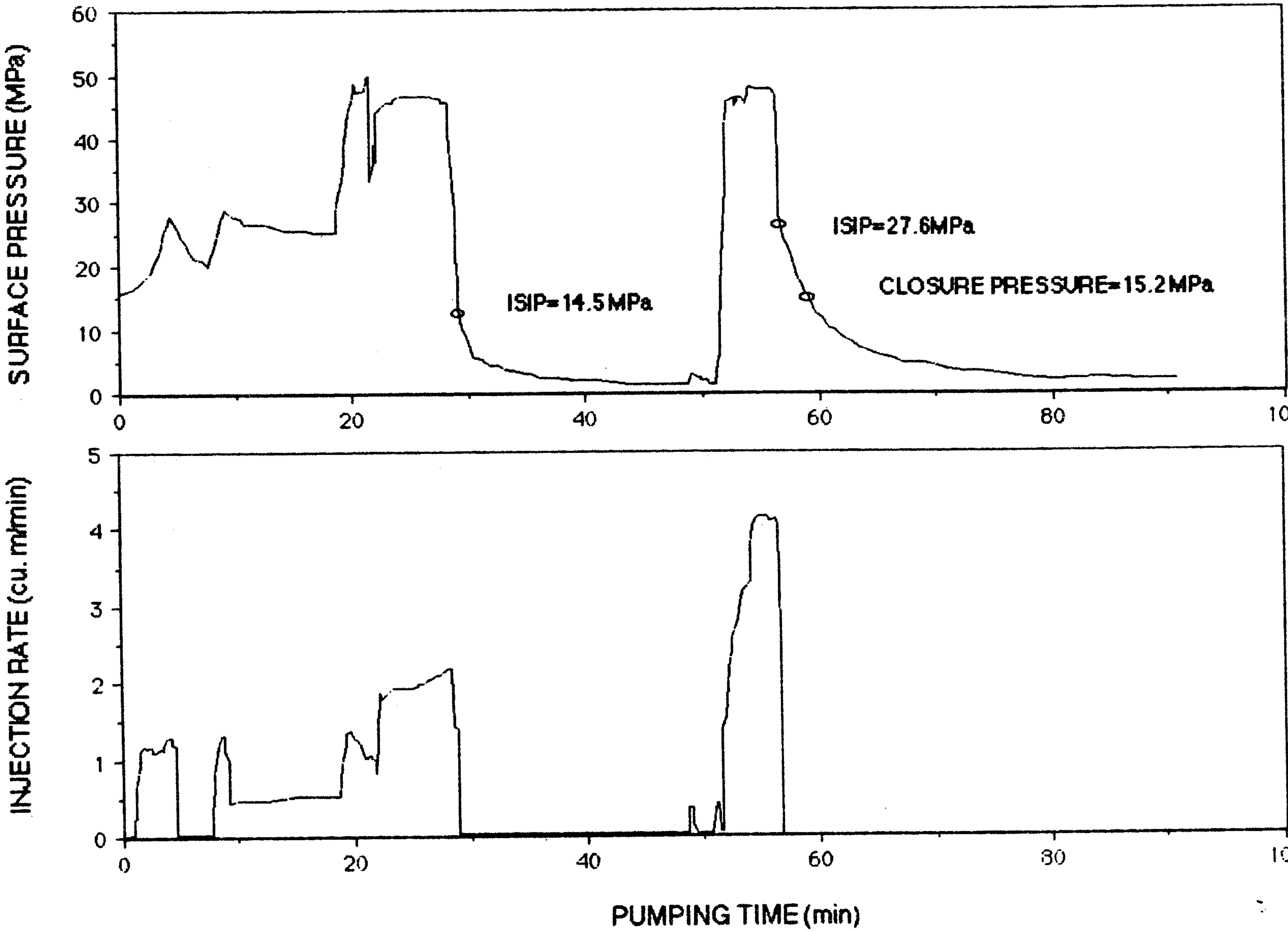


FIGURE A.5: GULF AMOCO CAROLINE 8-17-36-6-W5 (Glauconite Fm)
MAIN FRACTURE TREATMENT

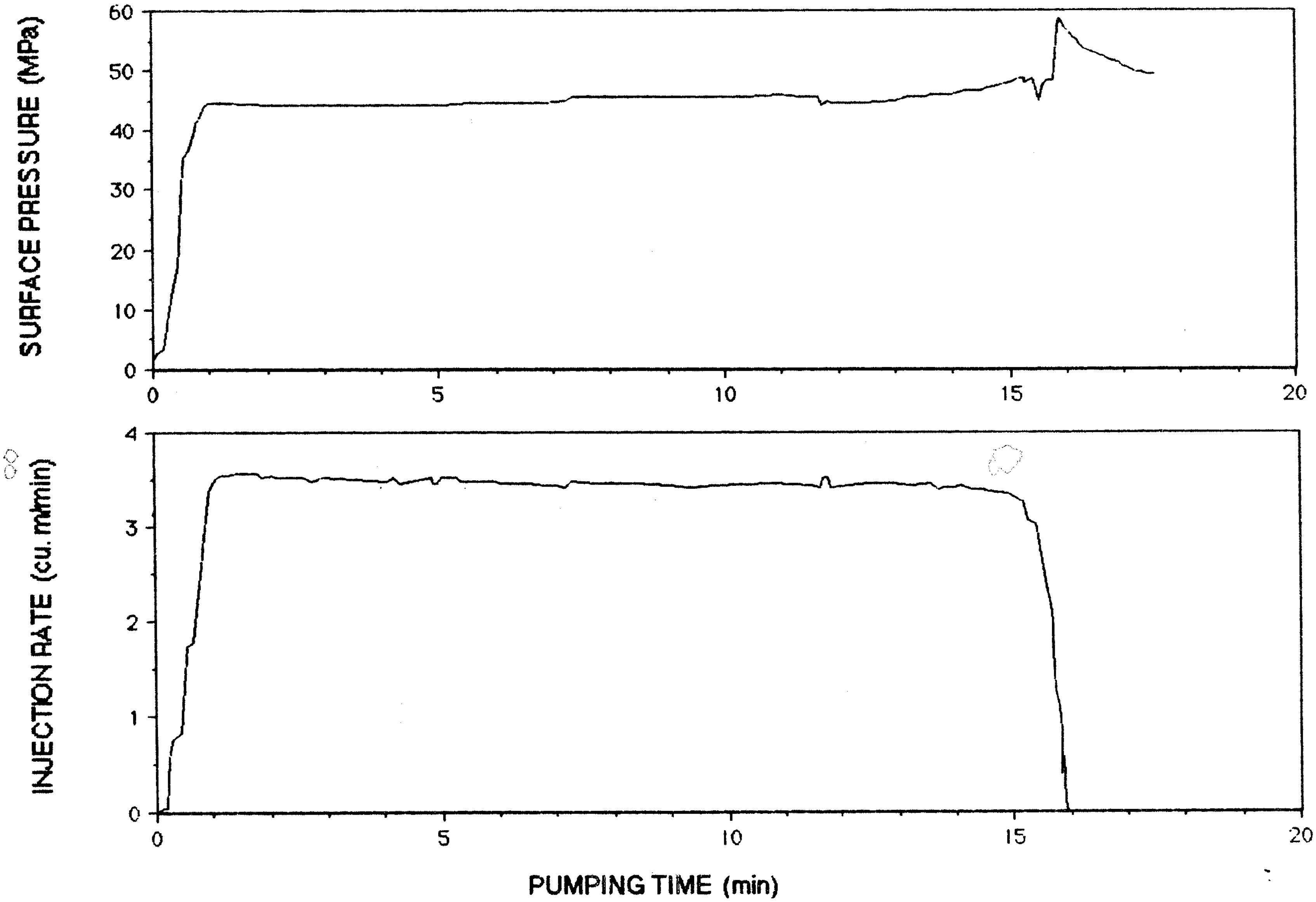


FIGURE A.6: GULF AMOCO et al. CAROLINE 6-5-36-6 W5 (Ostracod Fm)

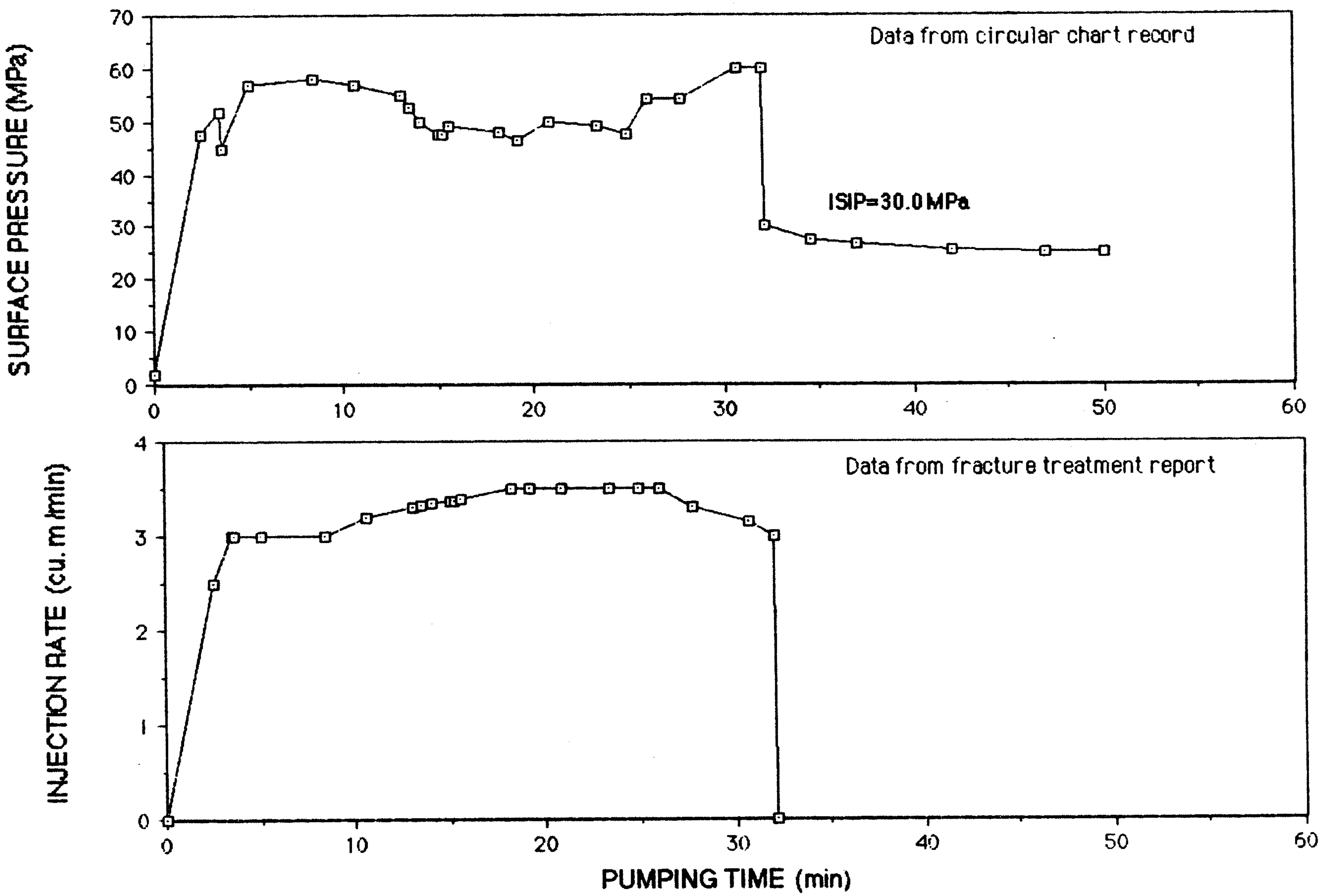


FIGURE A.7: GULF AMOCO et al. CAROLINE 6-5-36-6-W5 (Upper Basal Quartz)

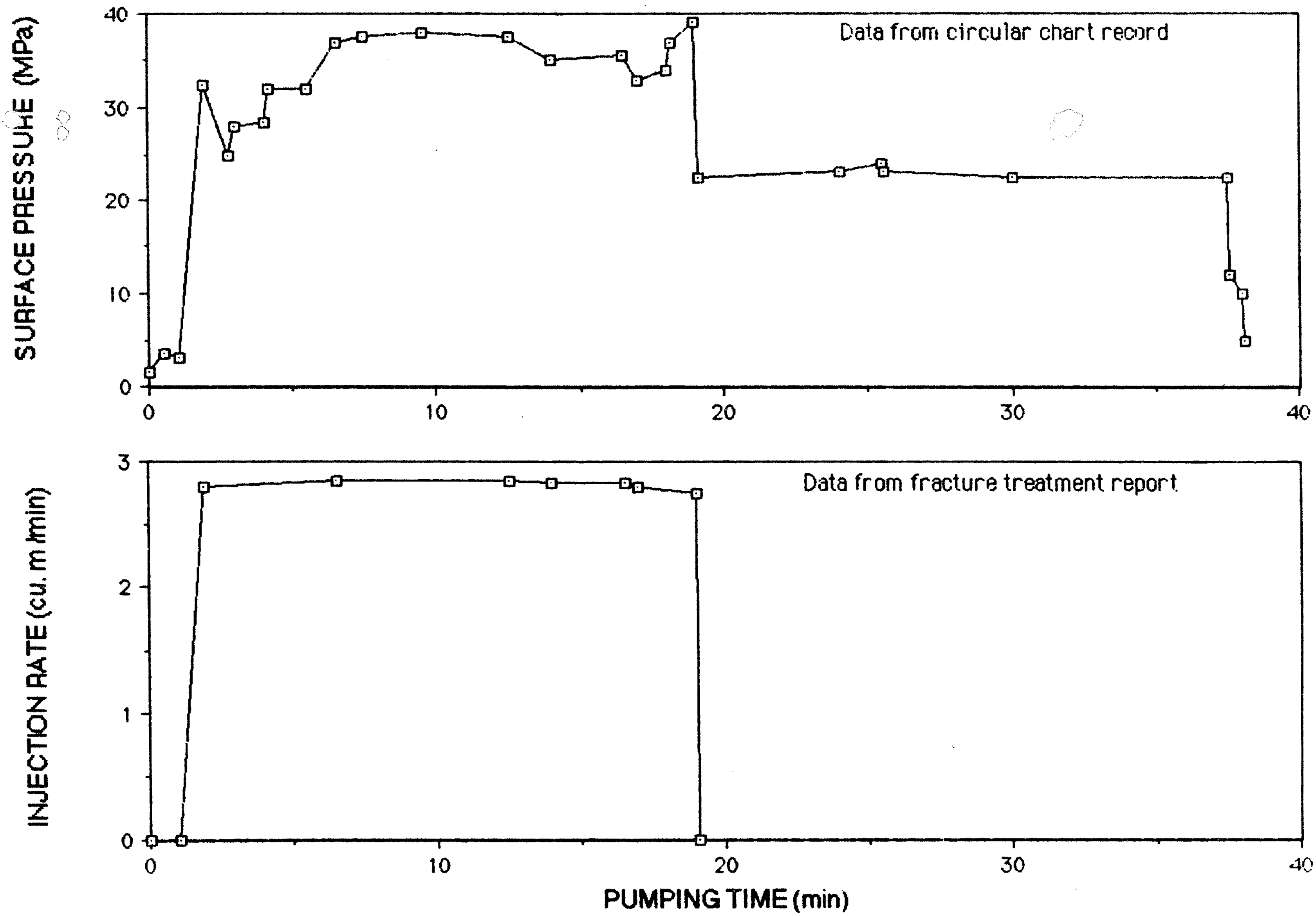


FIGURE A.8: GULF et al. STRACHAN 10-7-37-9-W5 (Glauconite Fm)

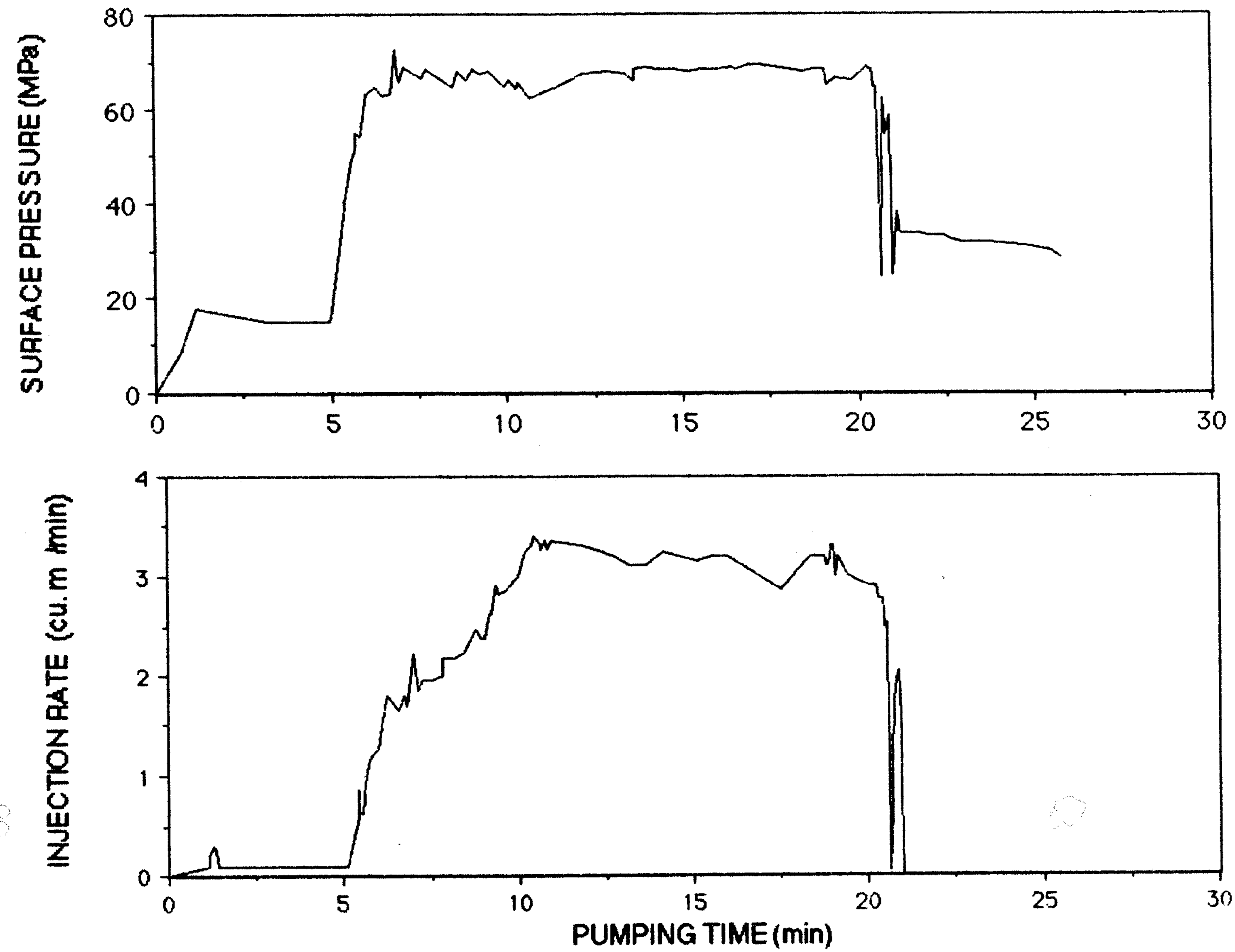


FIGURE A.10: GULF et al. STRACHAN 16-3-38-9-W5 (Ostracod Fm)

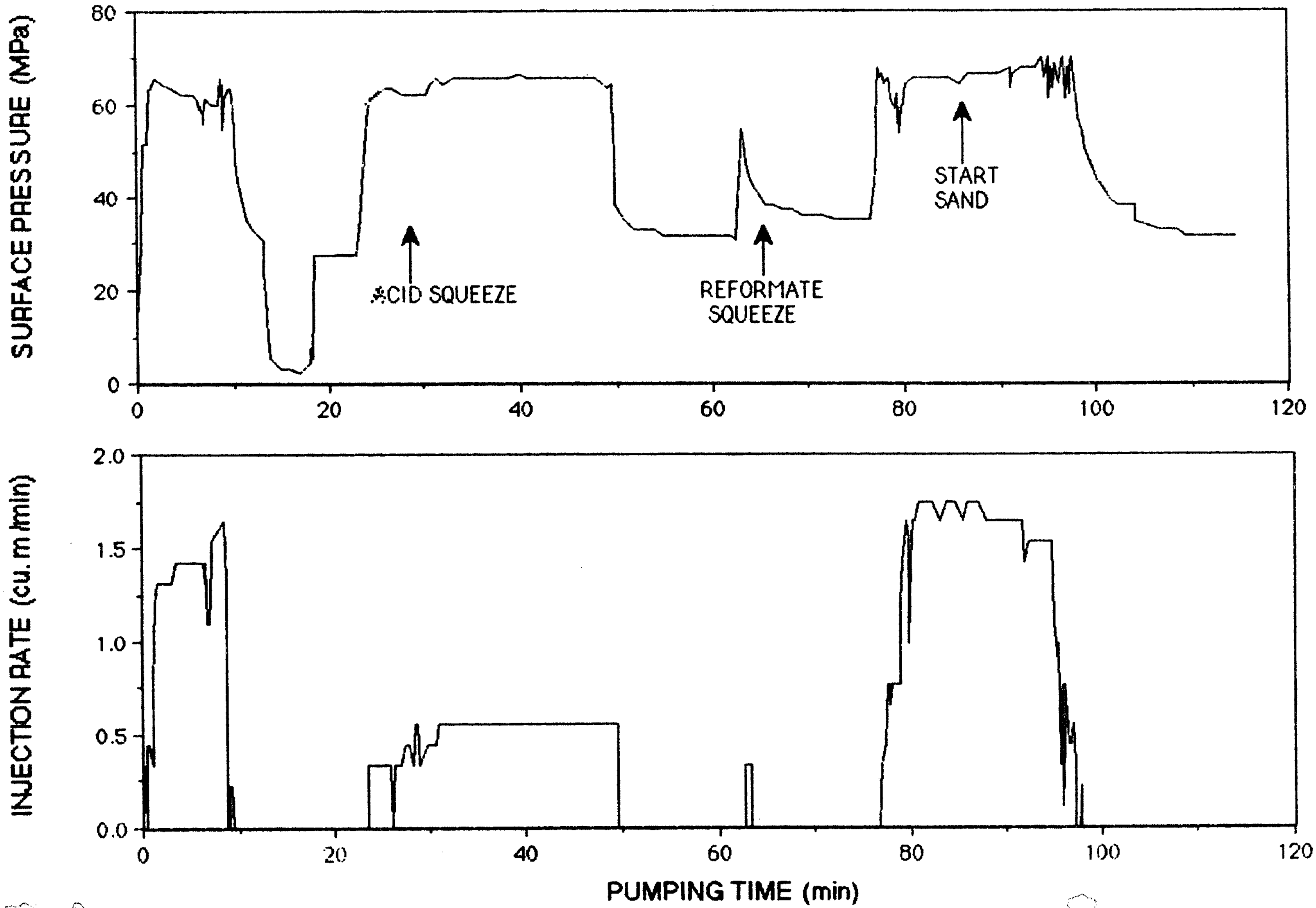


FIGURE A.11: GULF et al STRACHAN 10-13-38-10W5 (Cardium Fm)

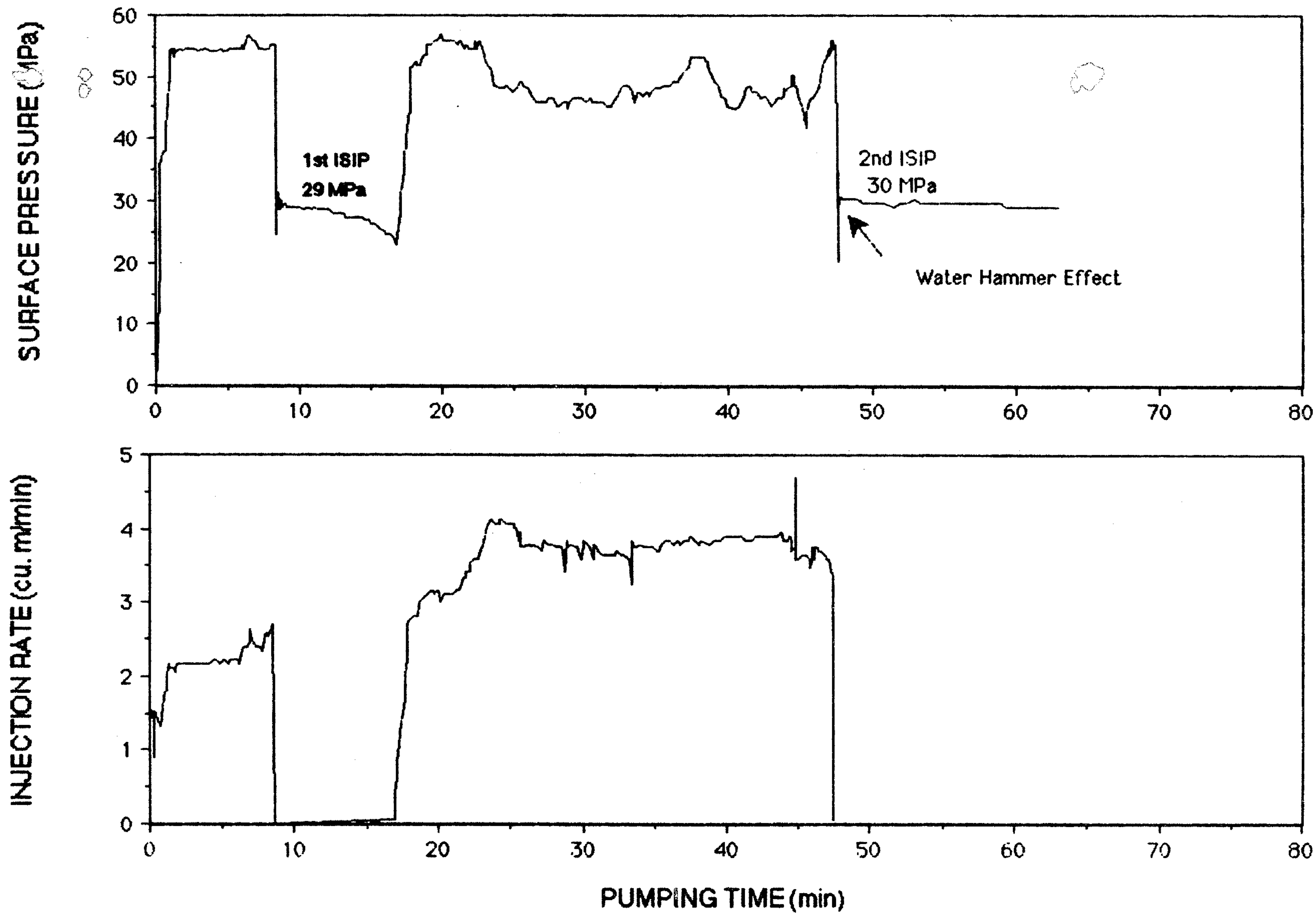


FIGURE A.12: GULF et al STRACHAN 3-17-37-9W5 (Glauconite Fm)

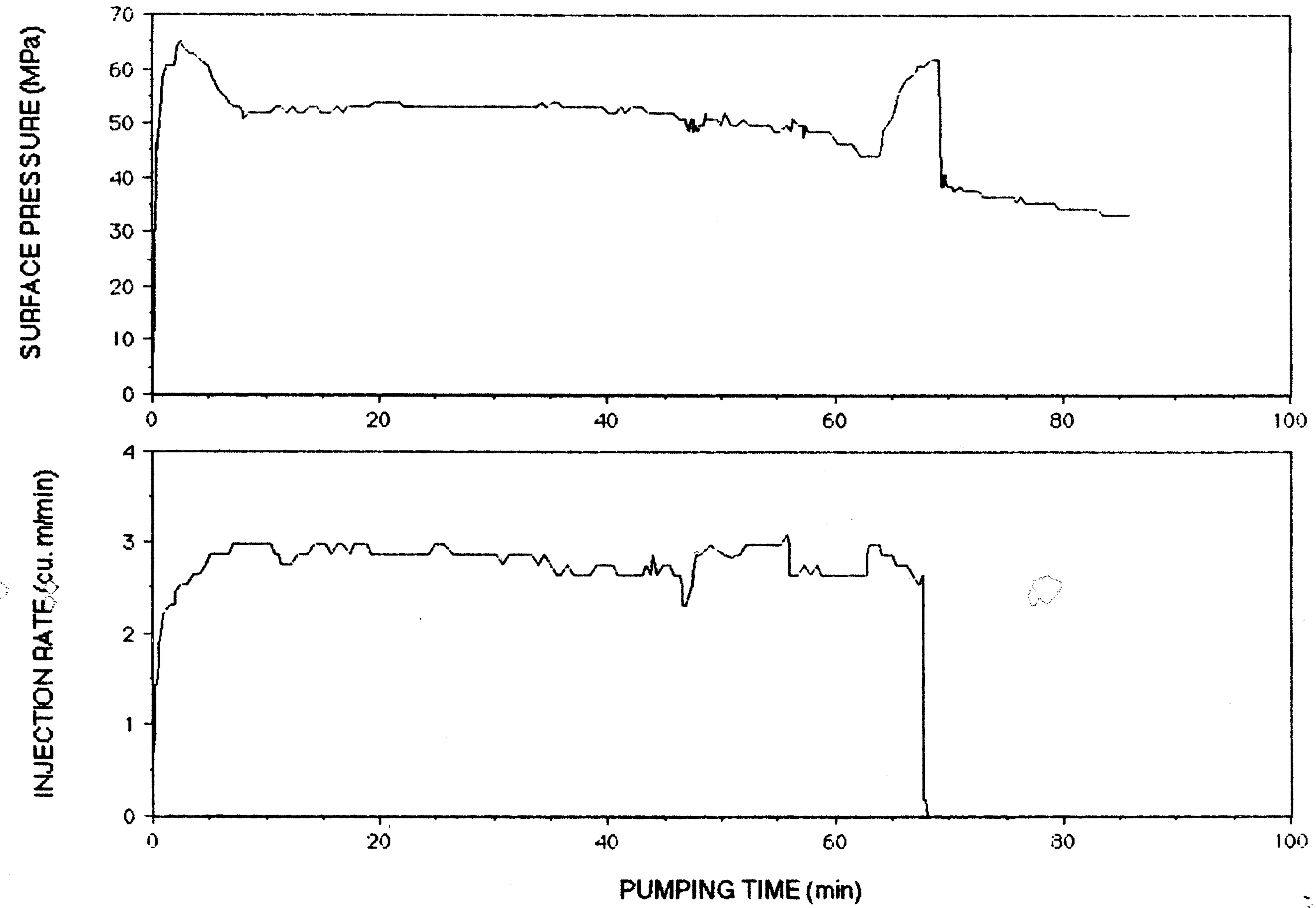


FIGURE A.13: GULF et al. STRACHAN 3-17-37-9-W5 (Ostracod Fm)

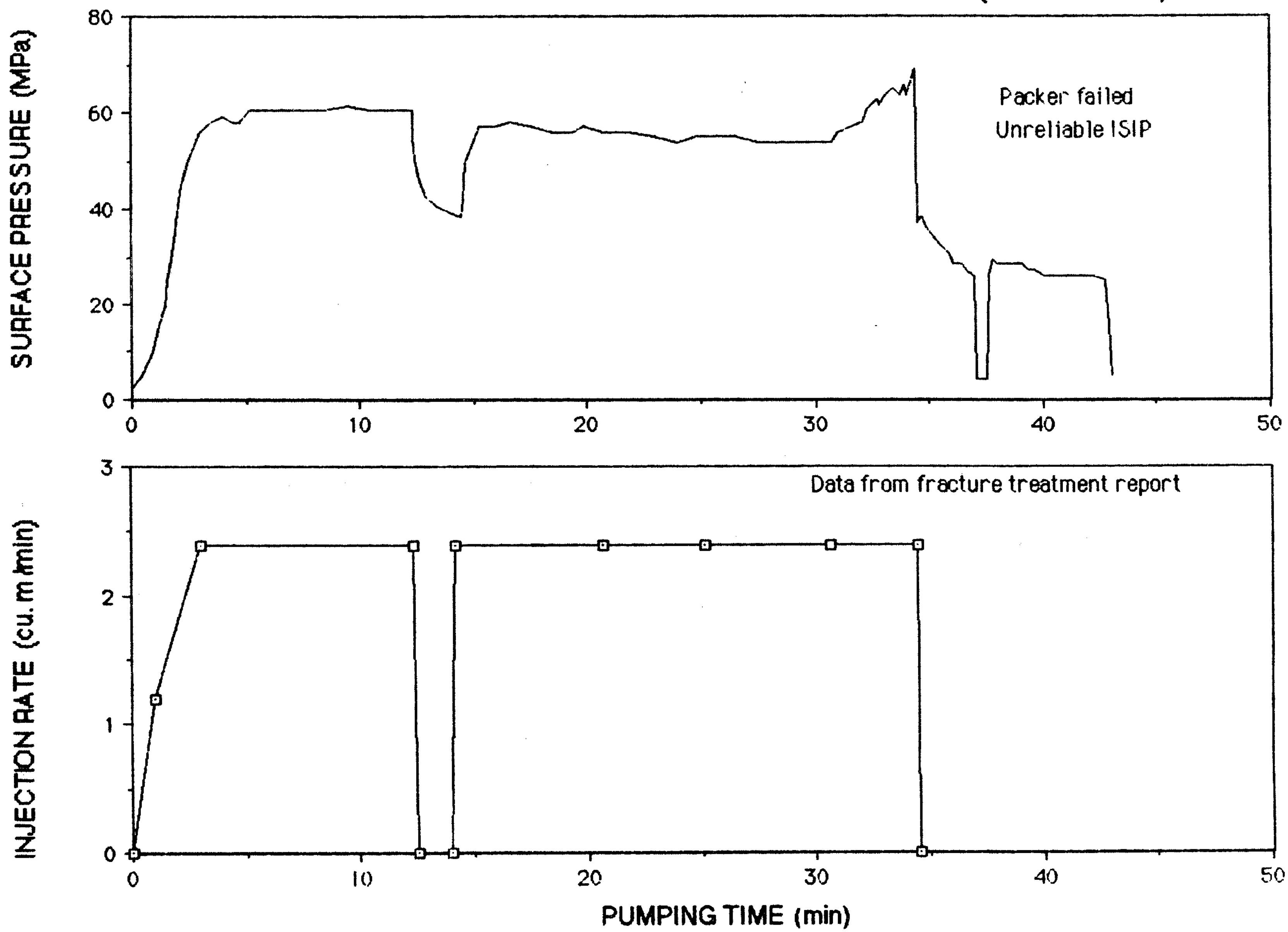


FIGURE A.14: GULF et al. STRACHAN 10-22-37-9-W5 (Ostracod Fm)

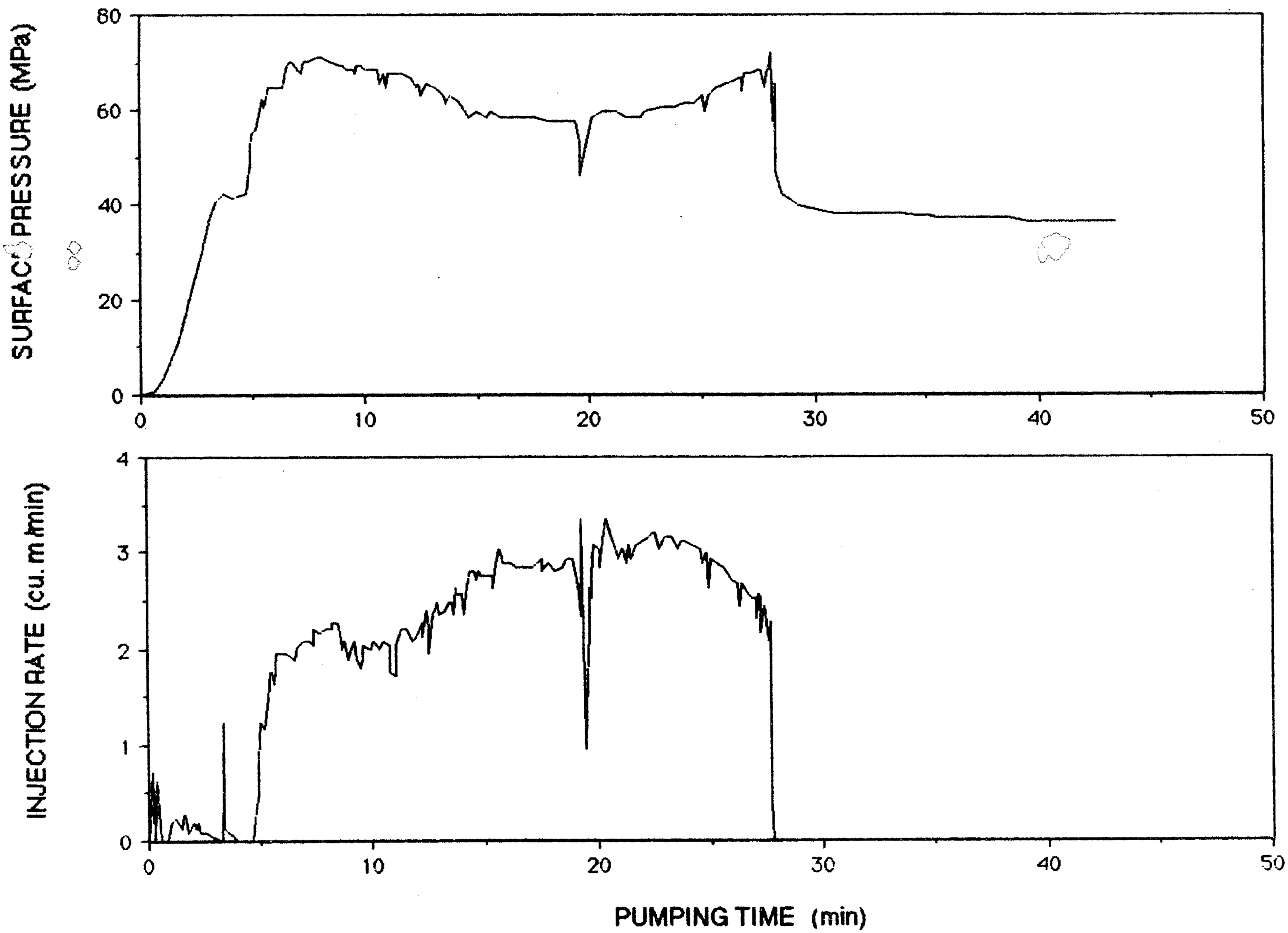


FIGURE A.15: GULF et al. STRACHAN 6-14-38-9-W5M (Cardium Fm)

MINI-FRAC

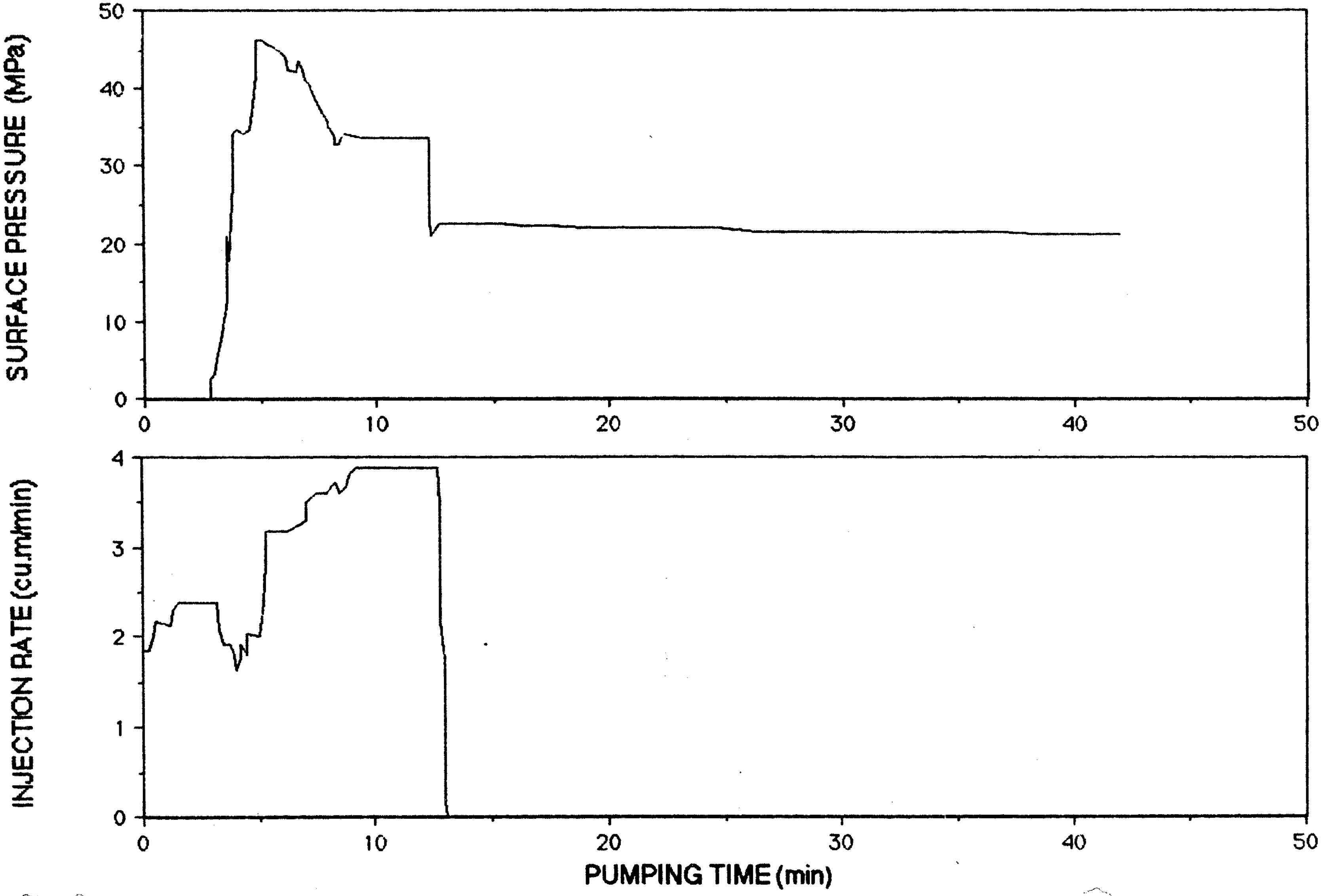


FIGURE A.16: GULF et al. STRACHAN 6-14-38-9-W5M (Cardium Fm)
MAIN FRACTURE TREATMENT

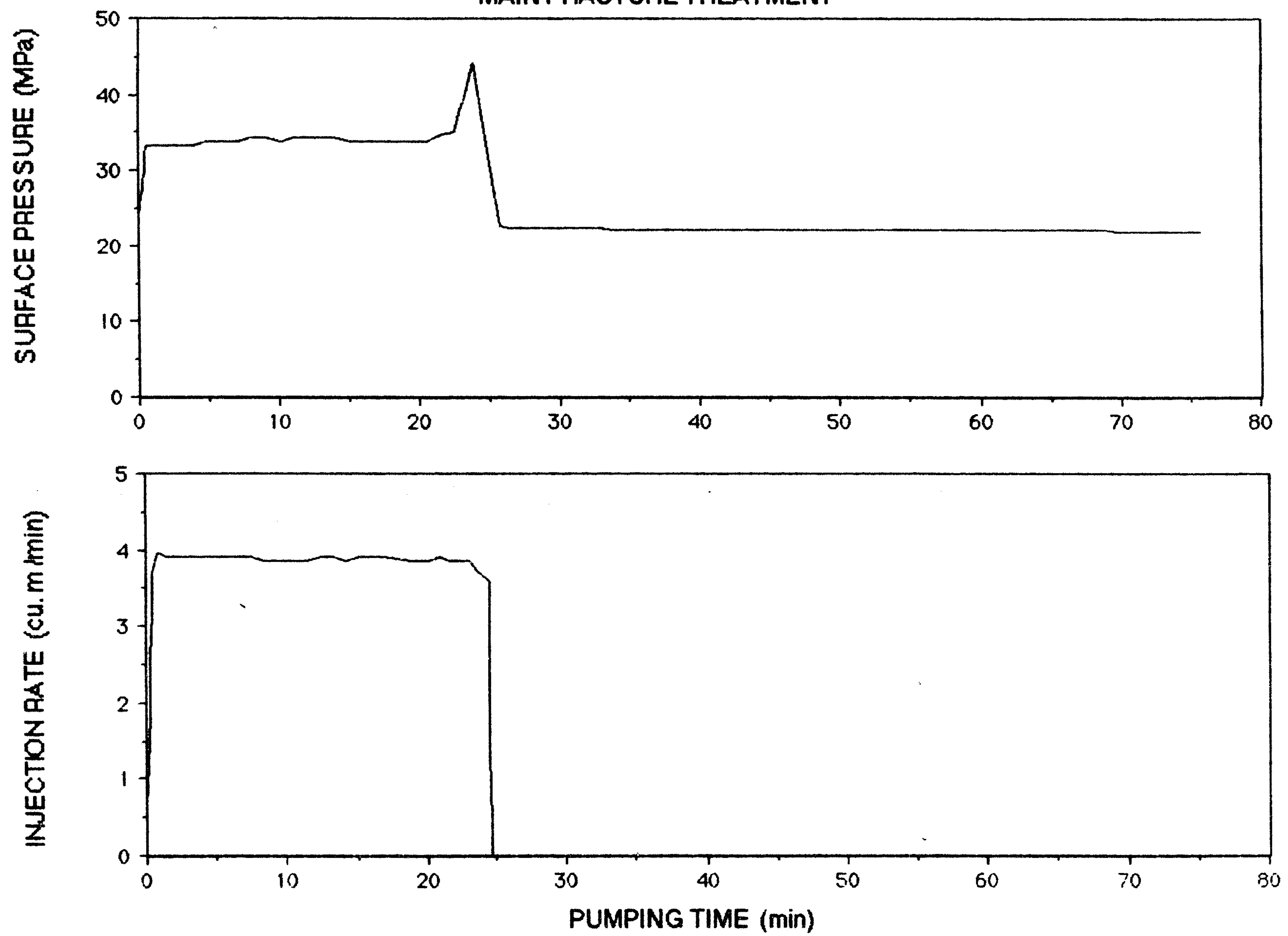


FIGURE A.17: GULF et al. STRACHAN 11-27-37-9-W5 (Viking Fm)

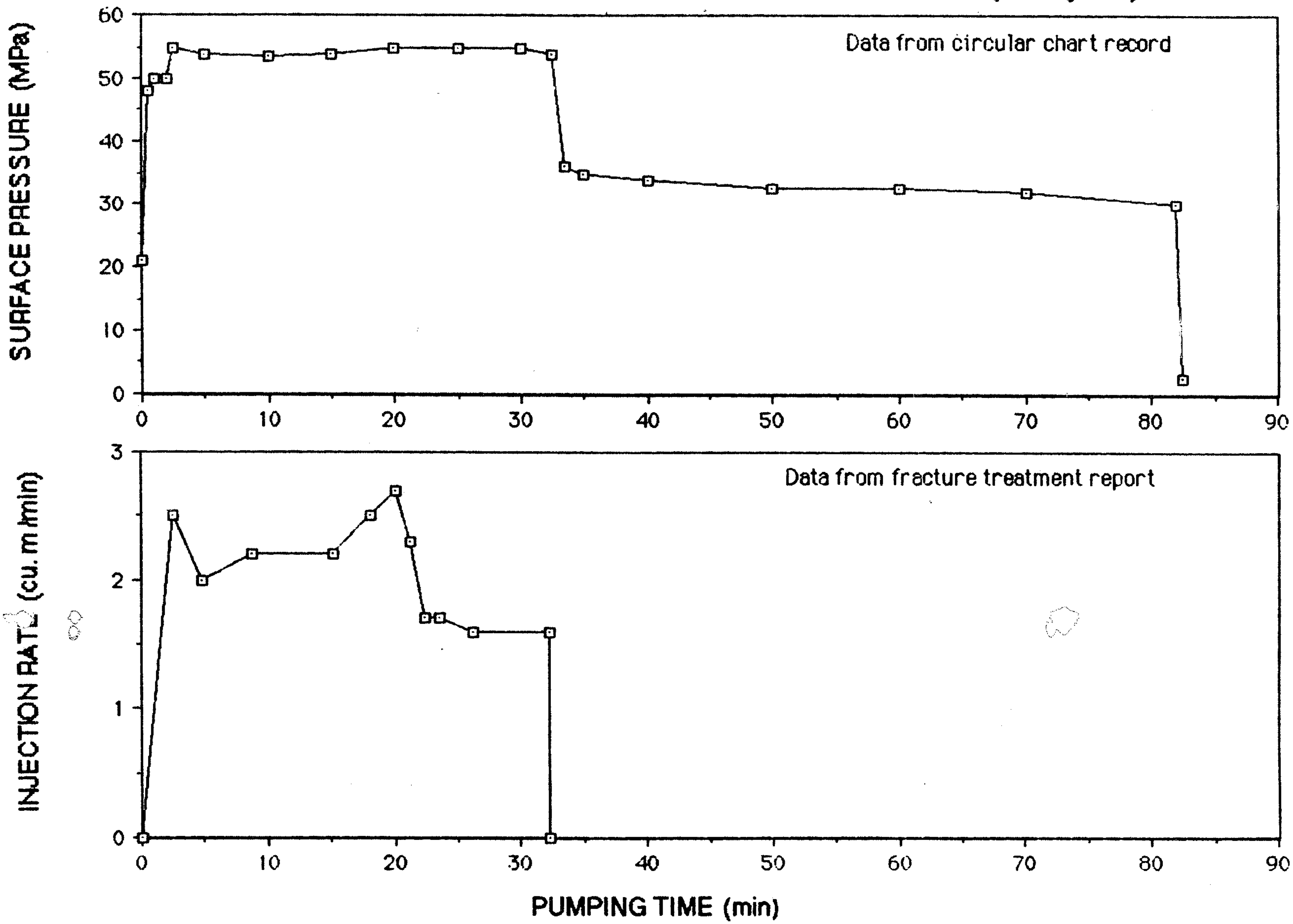


FIGURE A.18: GULF et al. STRACHAN 10-29-37-9-W5M (Viking Fm)
PRE-PAD ACID SQUEEZES

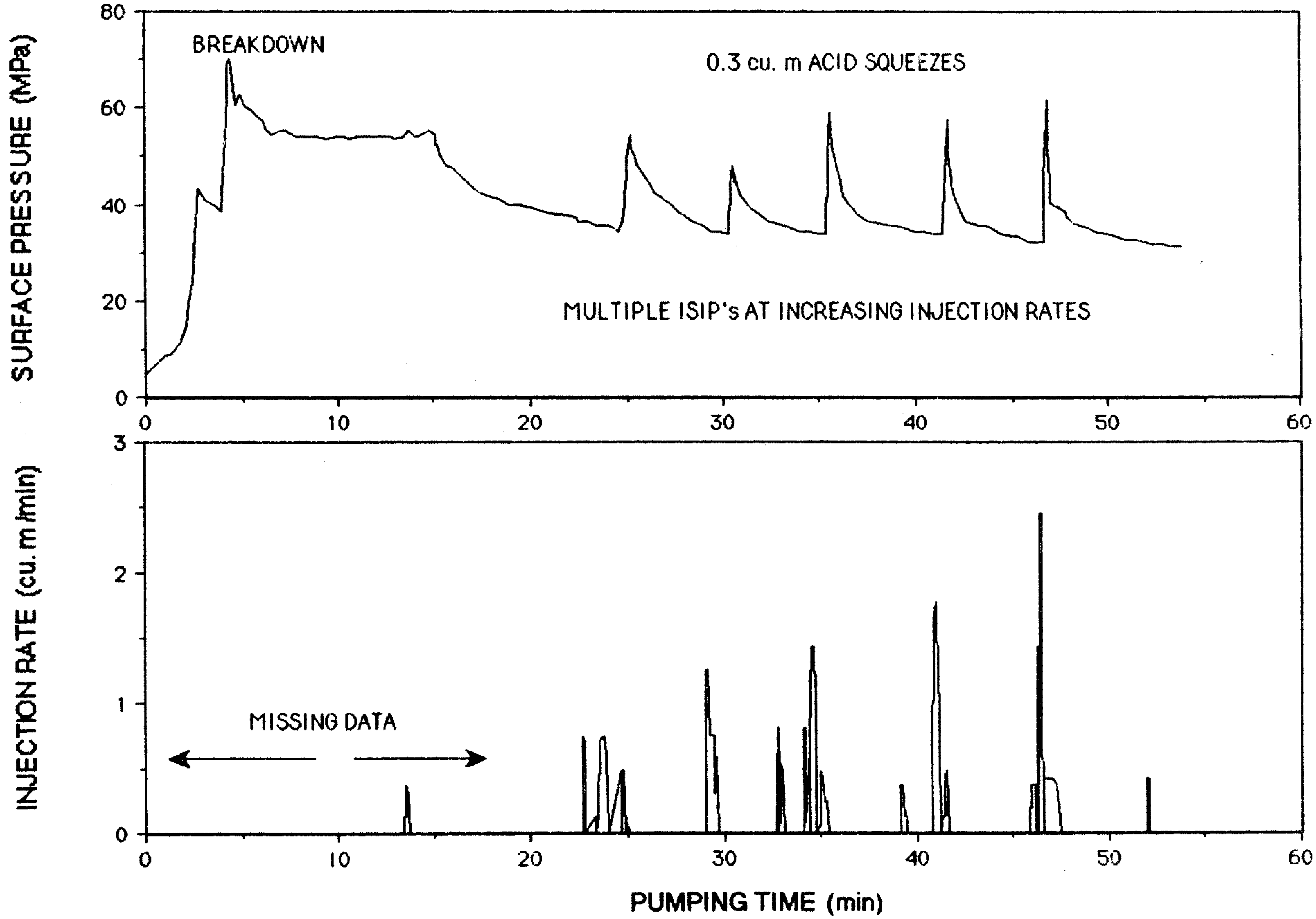


FIGURE A.19: GULF et al. STRACHAN 10-29-37-9-W5M (Viking Fm)
MAIN FRACTURE TREATMENT

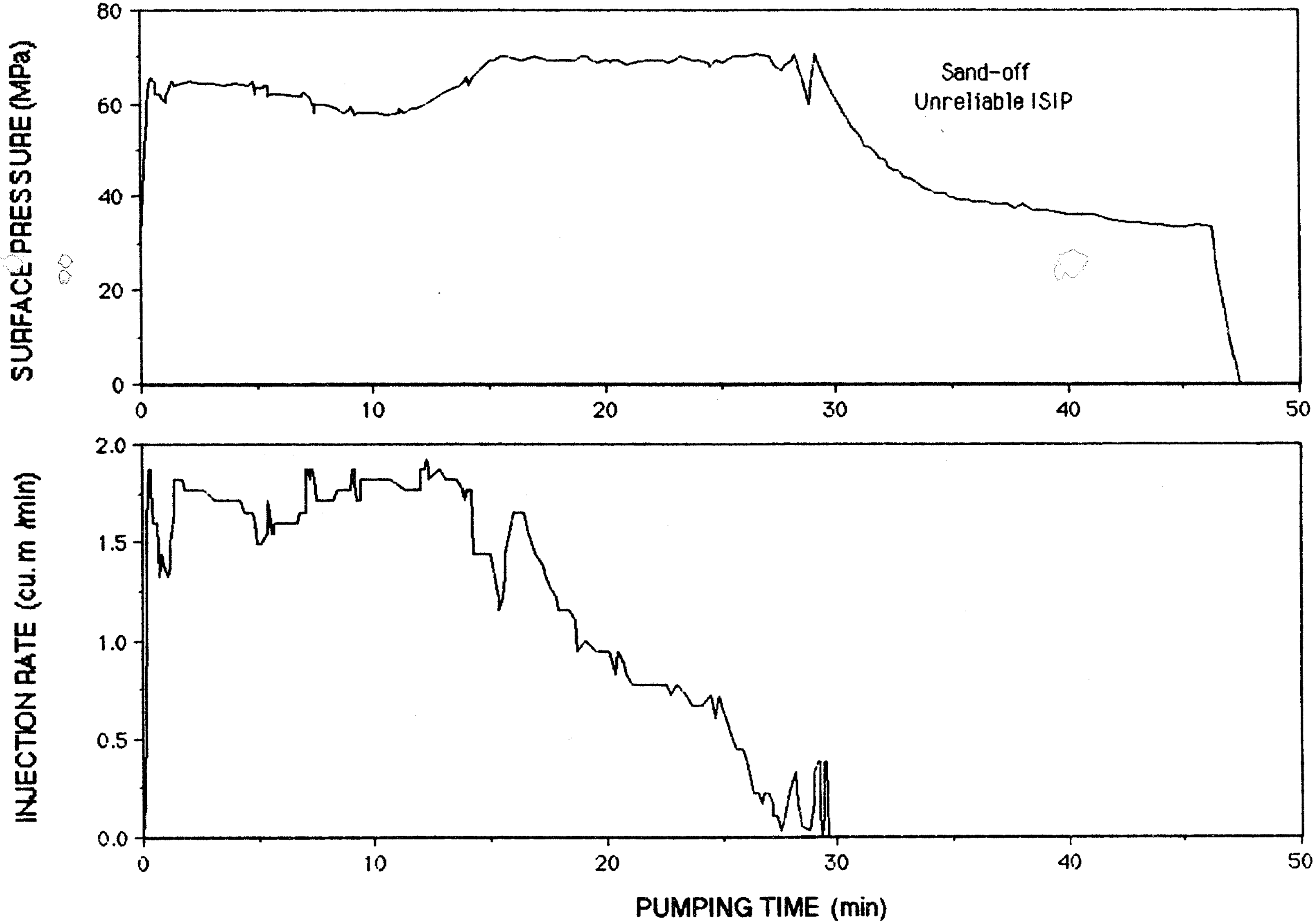


FIGURE A.20: GULF et al. STRACHAN 7-13-38-9-W5 (Glauconite Fm)

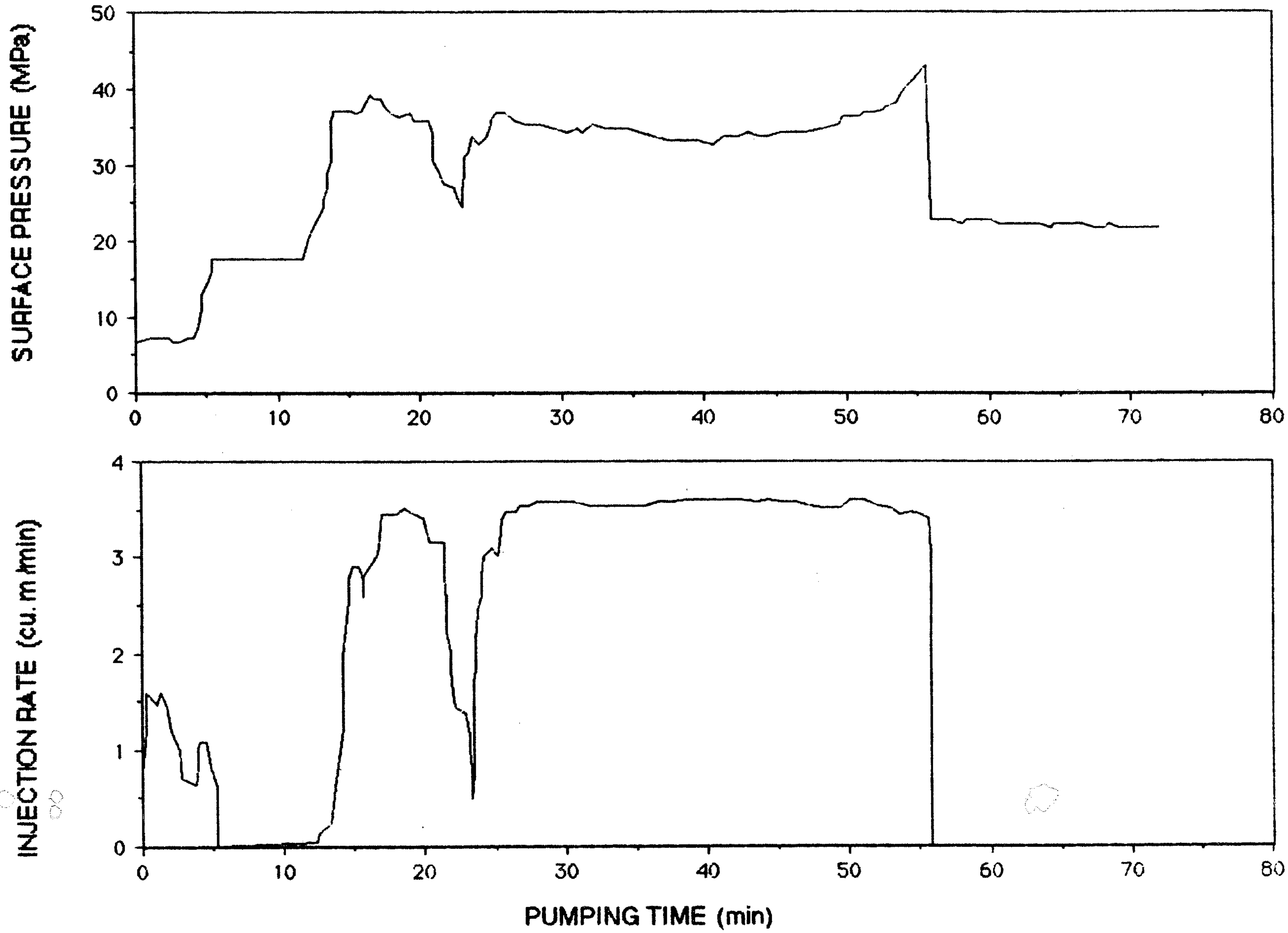


FIGURE A.21: GULF et al. STRACHAN 7-13-38-9-W5 (Basal Quartz Fm)

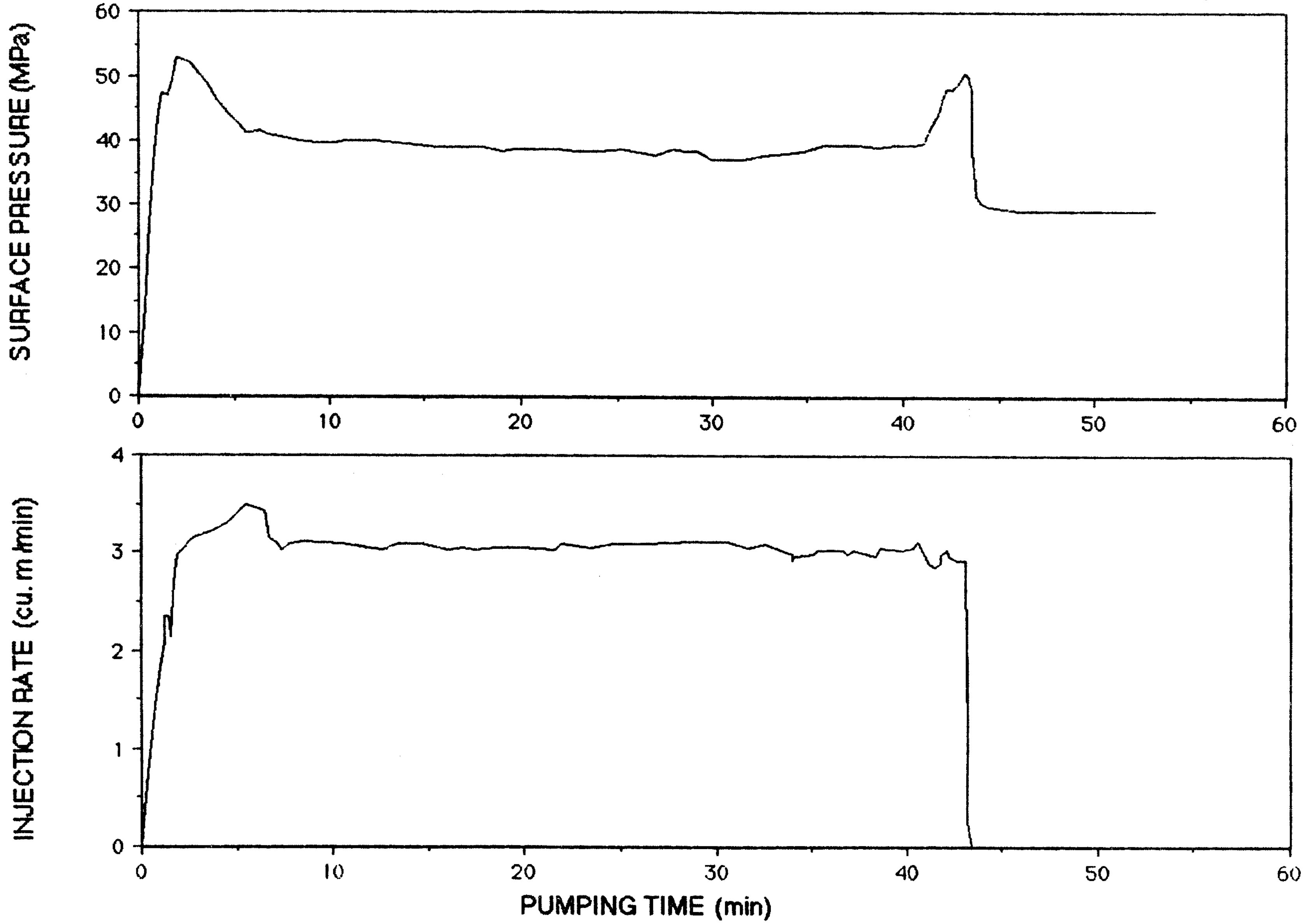


FIGURE A.22: GULF et al. RICINUS 2-26-36-9-W5M (Cardium Fm)

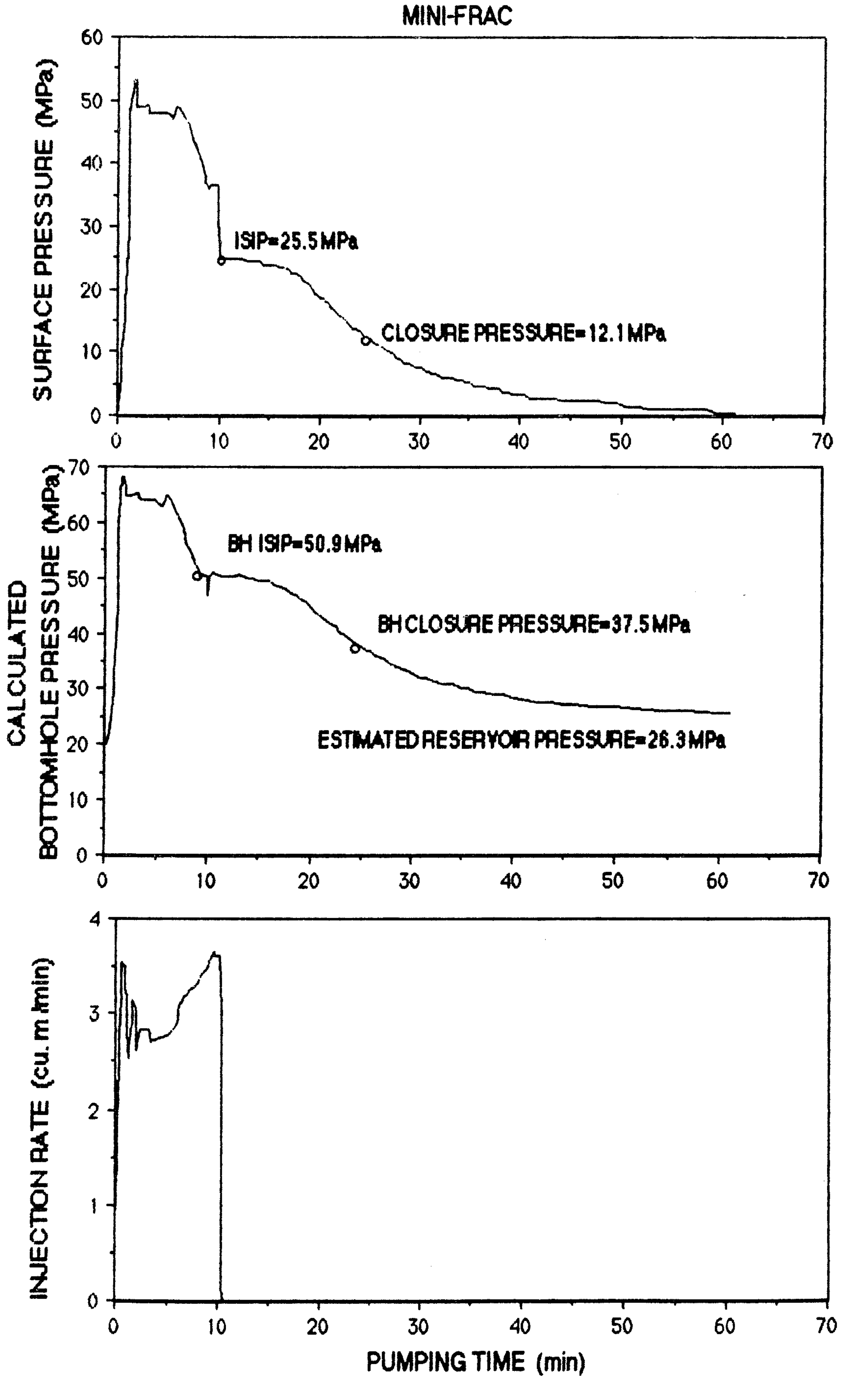


FIGURE A.23: GULF et al. RICINUS 2-26-36-9-W5M (Cardium Fm)

MAIN FRACTURE TREATMENT

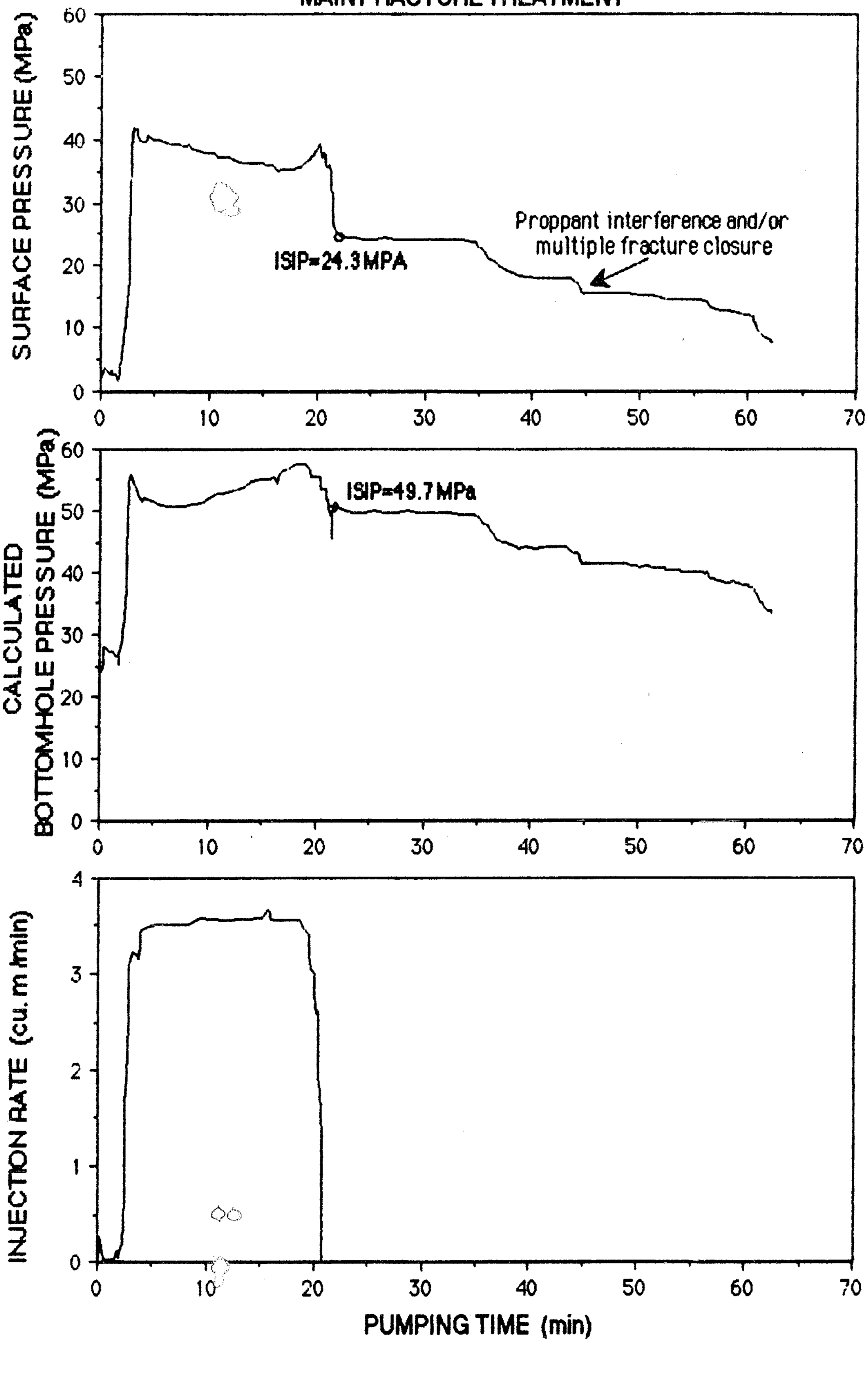


FIGURE A.24: GULF ET AL WEST RICINUS 7-33-36-10W5 (Glauconite Fm)

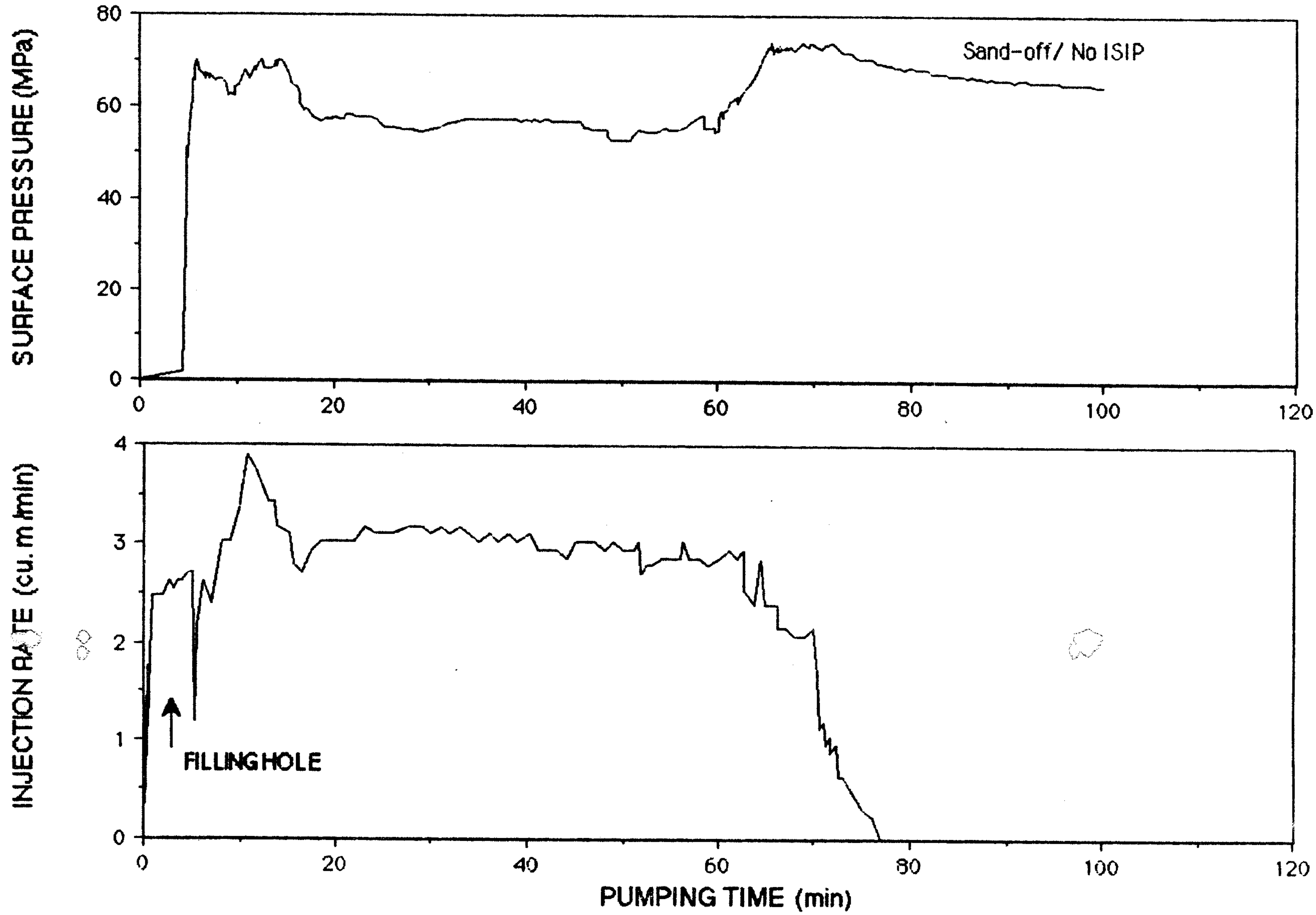


FIGURE A.25: GULF et al. WEST RICINUS 7-33-36-10-W5 (Ostracod Fm)

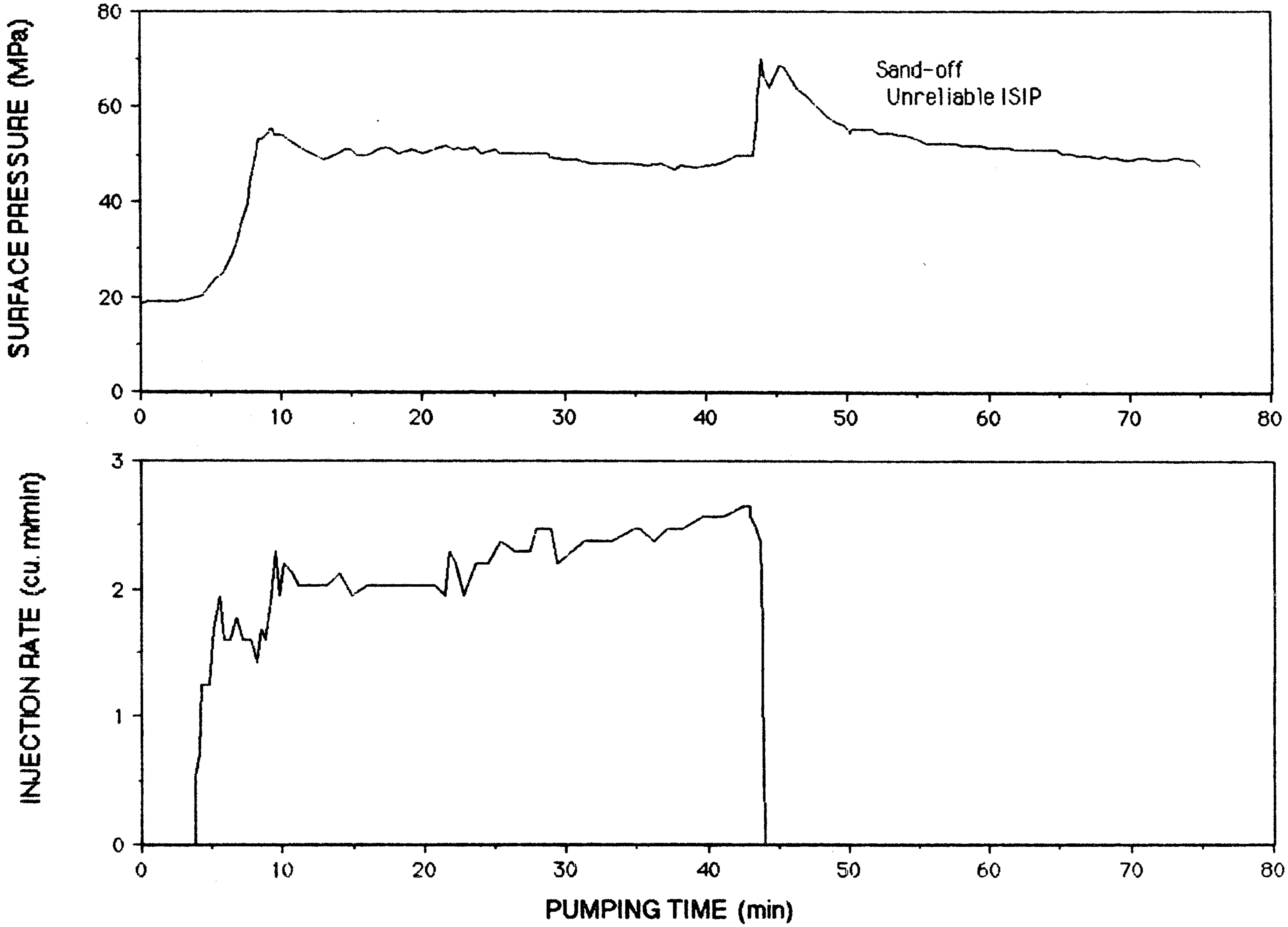


FIGURE A.26: GULF GARRINGTON 6-9-36-6W5 (Glauconite Fm)

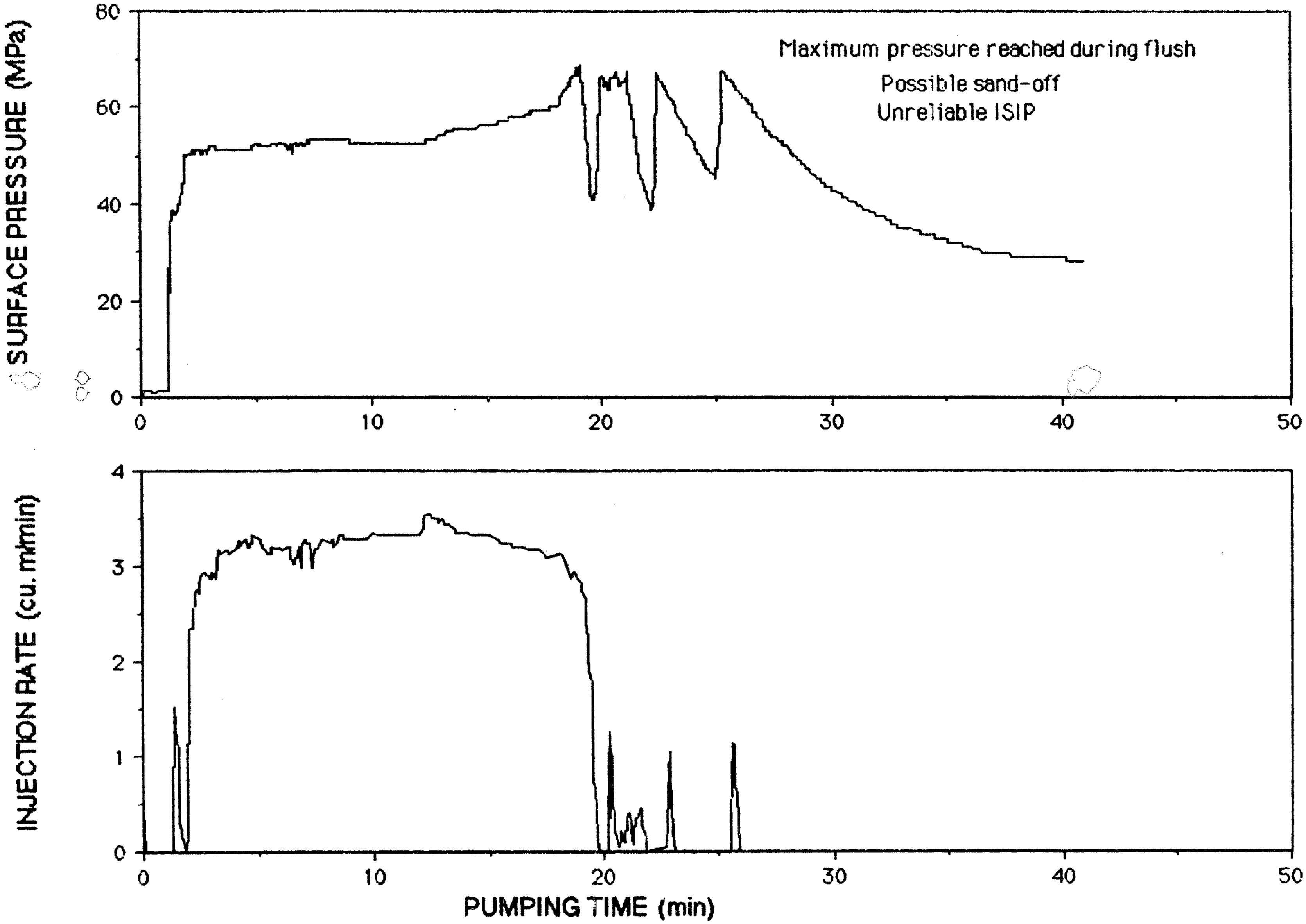


FIGURE A.27: GULF GARRINGTON 6-9-36-6W5 (Ostracod)

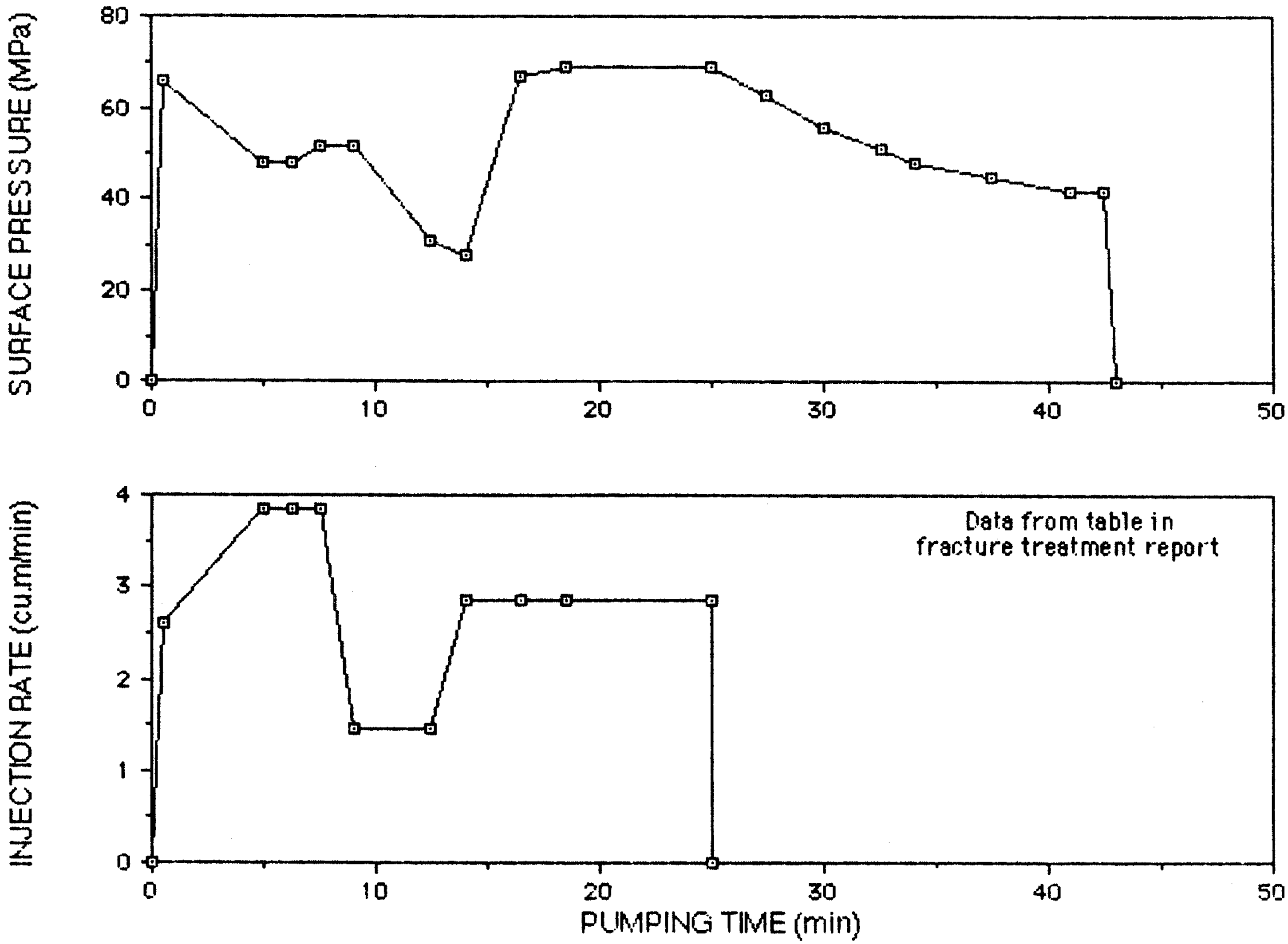


FIGURE A.28: GULF GARRINGTON 6-9-36-W5 (Upper Basal Quartz Fm)

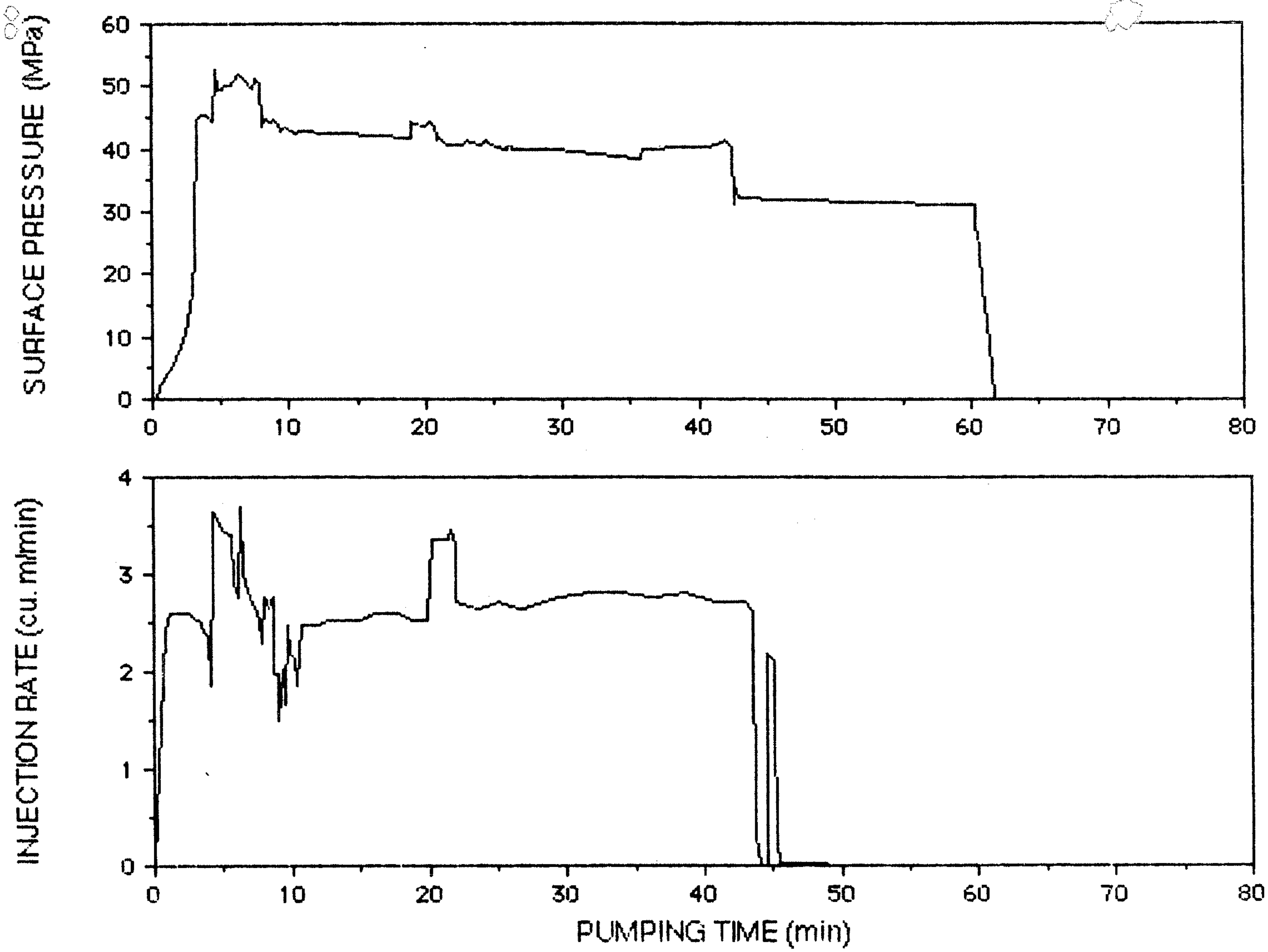


FIGURE A.29: GULF GARRINGTON 6-9-36-6-W5 (Lower Basal Quartz Fm)

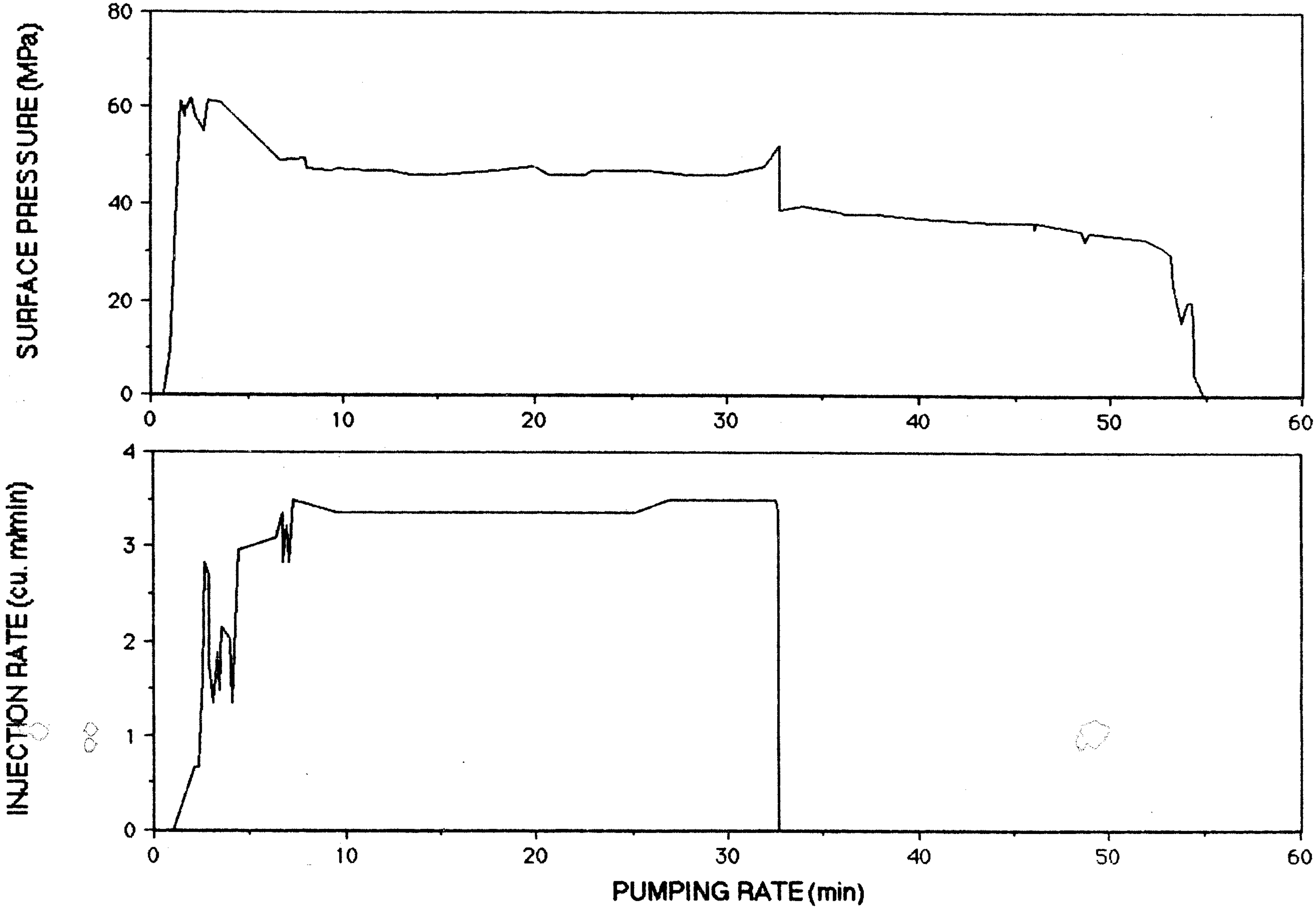
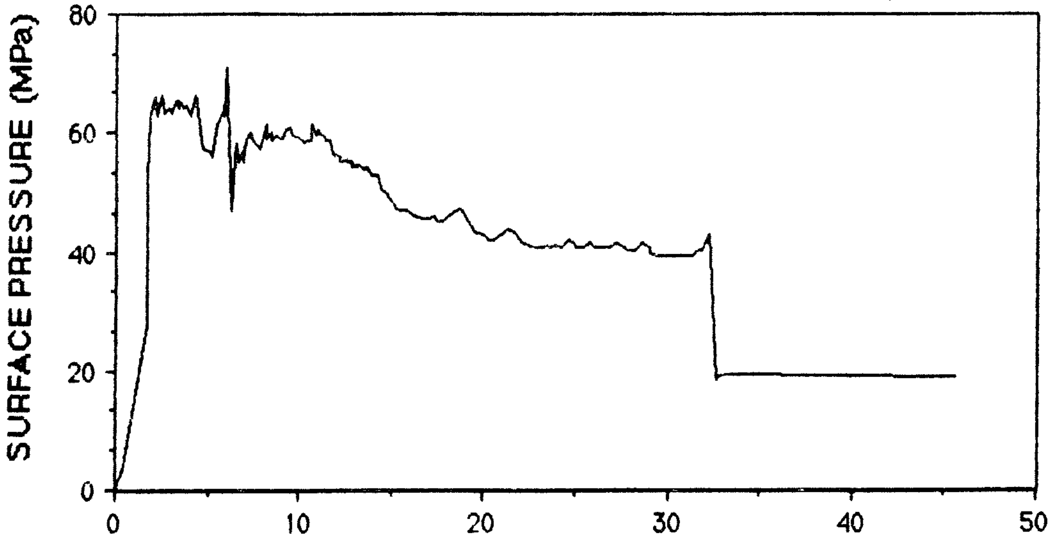
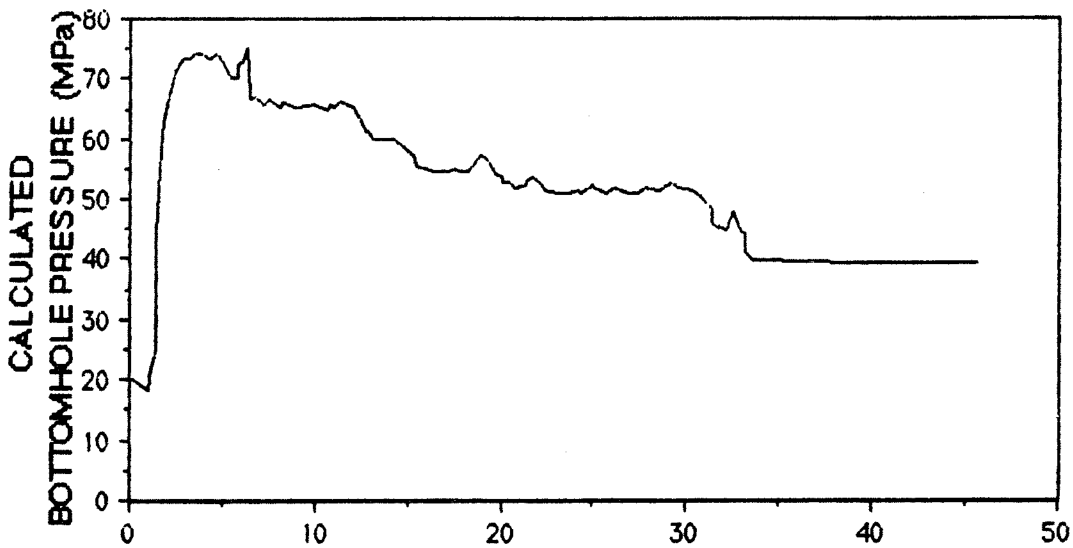


FIGURE A.30: GULF GARRINGTON 6-9-37-6W5 (Viking Fm)





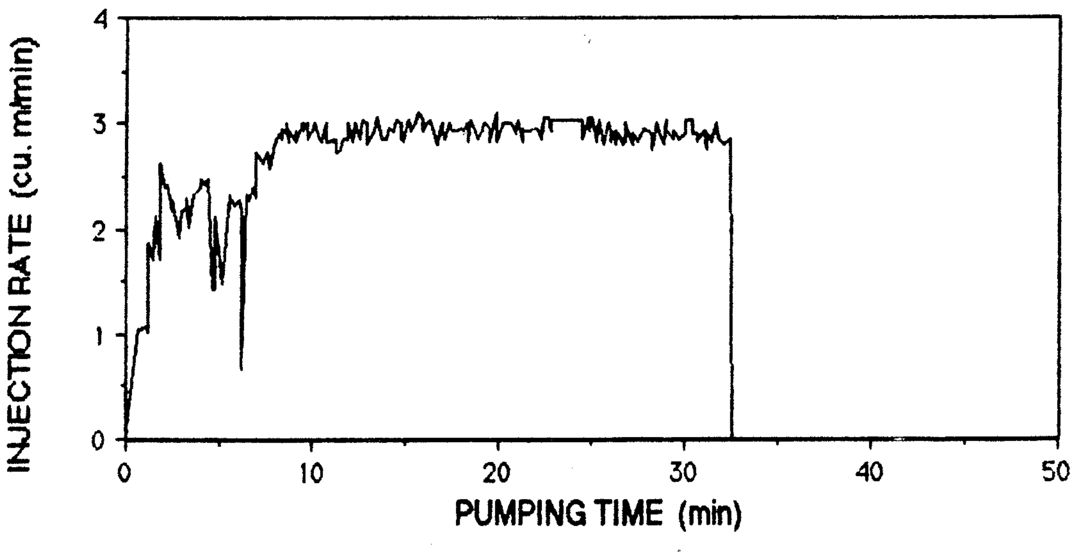


FIGURE A.31. GULF GARRINGTON 14-11-36-6W5 (Glauconite Frn)

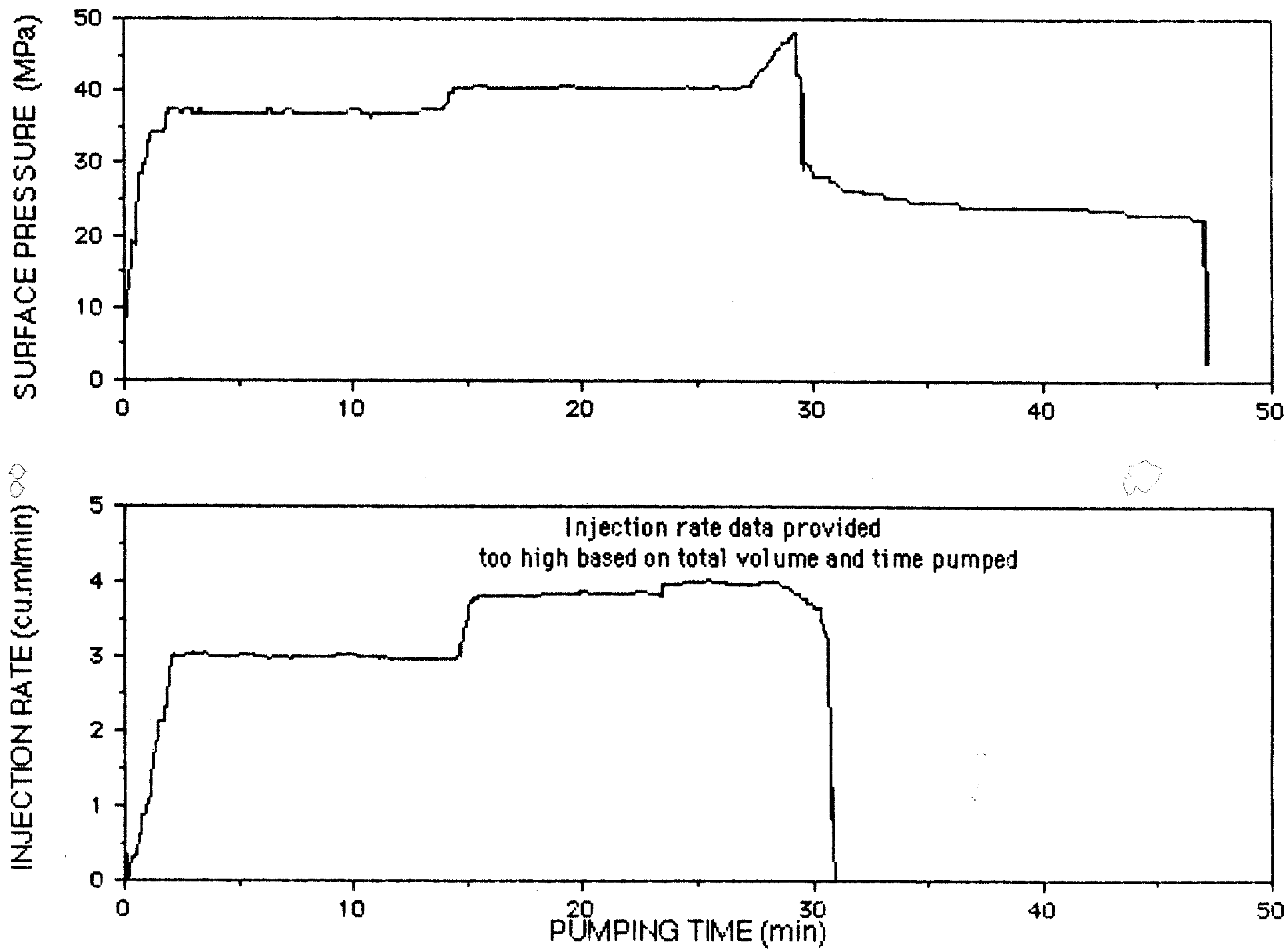


FIGURE A.32: GULF GARRINGTON 6-14-36-6W5 (Ostracod Fm)

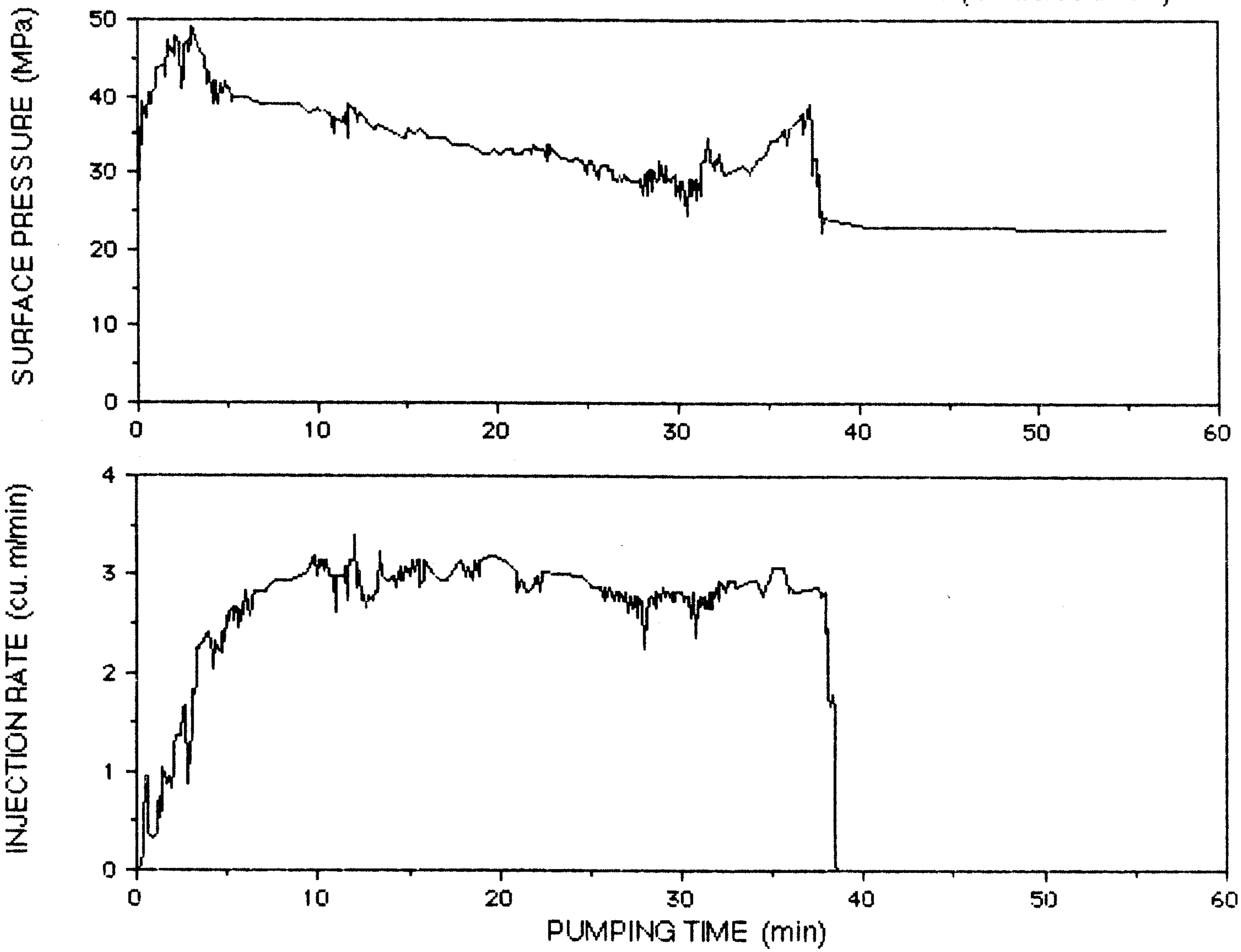
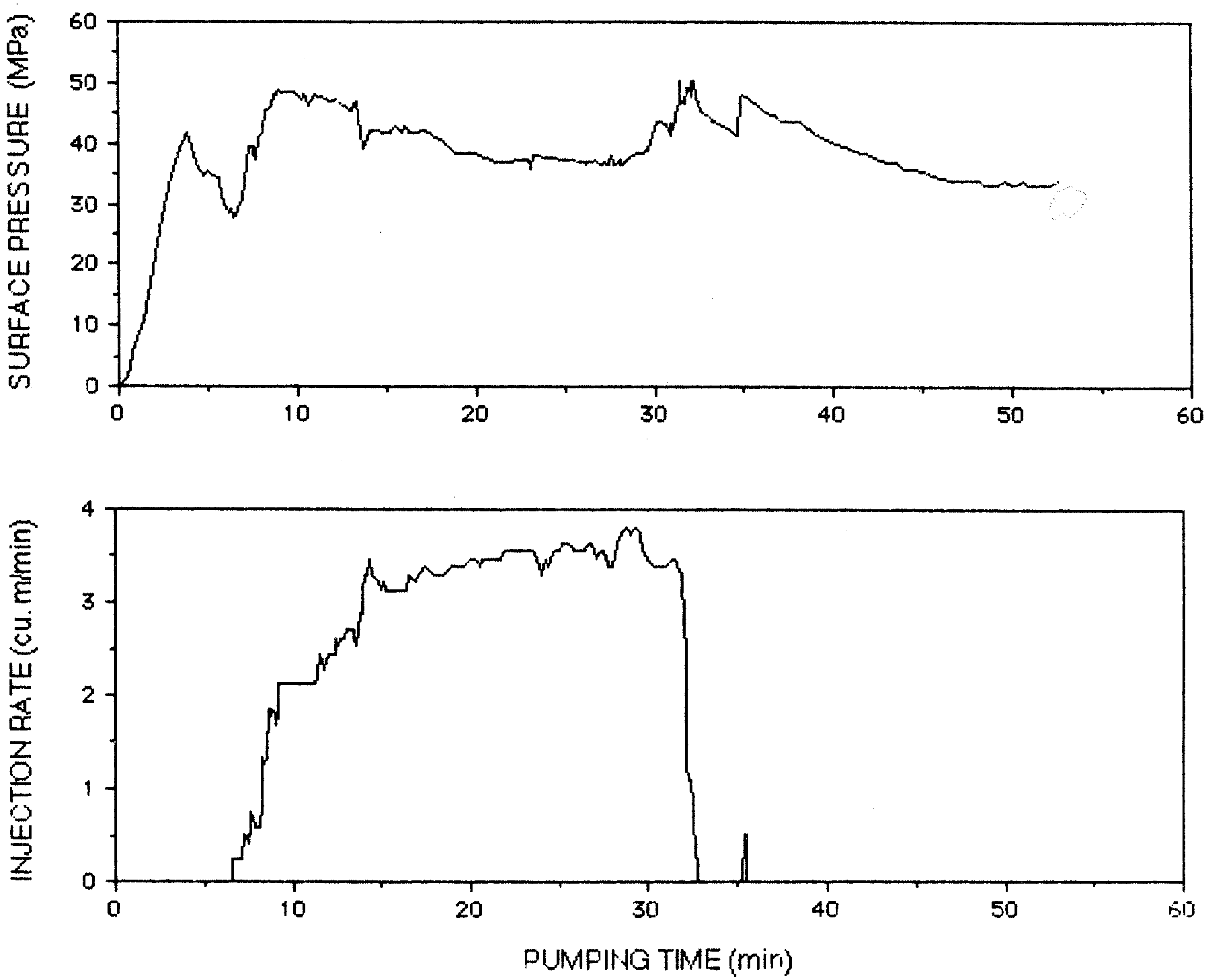


FIGURE A.33: GULF GARRINGTON 6-14-36-6W5 (Basal Quartz "A")



APPENDIX B

DIGITIZED FRACTURE TREATMENT DATA

TABLE B.1: GULF et al.CRIMSON 8-5-38-8W5 (Glauconite Fm)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	0.0	12.67	57.4	0.00	0.00	10.80	2.59
0.00	6.3	12.89	59.1	0.33	0.00	11.03	2.53
0.34	6.8	13.68	59.1	0.33	0.55	11.58	2.70
0.45	15.3	14.57	60.2	0.45	0.39	11.81	2.75
1.01	33.5	18.39	60.2	0.56	0.44	12.14	2.86
1.12	30.1	18.95	60.2	0.78	0.33	12.36	2.92
1.35	29.5	19.96	60.8	1.11	0.33	12.47	2.92
1.57	29.0	21.53	61.3	1.23	0.55	12.59	3.03
1.91	41.5	25.11	60.8	1.34	0.77	13.14	3.08
2.13	46.6	25.67	61.3	1.45	0.66	13.48	3.03
2.13	48.3	29.15	60.8	1.56	0.83	14.15	3.08
2.35	48.3	30.50	60.8	1.78	1.93	14.48	3.08
2.58	50.5	31.39	60.8	1.78	2.09	14.59	3.03
2.69	37.5	31.39	61.9	2.00	2.75	15.15	3.08
2.80	23.9	31.84	60.8	2.12	2.86	15.48	3.03
3.03	22.7	31.84	61.3	2.34	2.97	16.15	3.08
3.25	22.7	32.06	60.8	2.45	2.97	16.60	3.08
3.59	21.6	32.40	61.3	2.67	0.06	17.04	3.08
3.70	22.7	32.85	60.8	2.78	0.06	17.60	3.08
3.92	35.2	32.96	59.1	3.56	0.06	18.04	3.08
4.15	40.9	33.63	58.5	3.90	2.15	18.49	3.14
4.15	41.5	34.20	54.5	4.12	2.26	19.05	3.14
4.37	44.3	34.87	46.6	4.23	2.75	19.49	3.19
4.60	44.9	35.43	39.2	4.34	2.59	20.16	3.14
4.60	49.4	35.65	38.6	4.46	3.08	20.61	3.19
4.82	50.0	36.10	38.6	4.68	3.08	21.16	3.25
4.82	51.1	37.11	38.6	4.68	3.14	21.61	3.30
5.05	51.1	37.89	39.8	5.01	3.36	22.05	3.30
5.27	53.4	39.13	41.5	5.12	3.47	22.61	3.25
5.49	53.4	40.03	43.2	5.46	3.47	23.17	3.25
5.83	55.1	40.92	46.0	5.57	3.52	23.61	3.30
8.07	55.1	42.04	48.3	5.68	3.08	24.06	3.36
8.18	56.8	42.27	48.3	5.90	3.03	24.62	3.36
8.30	55.6	42.83	50.0	6.24	2.97	25.17	3.36
8.41	55.6	43.05	49.4	7.13	2.97	25.62	3.36
8.74	53.9	43.28	51.7	7.46	3.03	25.95	3.36
9.08	54.5	43.39	48.8	7.80	3.03	26.62	3.30
10.31	55.6	44.06	53.4	8.02	2.97	27.07	3.36
11.21	55.1	44.85	55.6	8.02	2.70	27.51	3.30
11.66	55.6	44.96	57.4	8.24	2.70	27.96	3.36
12.11	56.2	45.29	59.1	8.35	2.48	28.07	3.36
12.33	56.8	45.41	60.8	10.25	2.59	28.51	3.36

TABLE B.1: GULF et al.CRIMSON 8-5-38-8W5 (Glauconite Fm)

TIME (min)	SURFACE PRESSURE (MPa)
45.63	63.6
45.74	67.0
45.86	63.0
46.19	59.6
46.30	57.4
46.64	55.1
46.86	53.4
47.42	51.1
47.99	48.8
48.55	47.7
49.22	46.6
50.00	44.9
50.56	43.7
51.24	43.7
51.91	42.6
52.47	42.0
53.03	42.0
53.59	41.5
53.93	40.9
54.38	40.9
54.94	40.9
55.38	40.3
55.95	39.8
56.39	39.2
56.84	39.2
57.40	38.6
57.85	38.6
58.41	38.0
59.08	38.0
59.42	38.0
59.87	37.5
60.43	37.5
60.99	36.9
61.55	36.9
61.89	36.9
62.00	36.9

TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
29.07	3.36	43.88	3.85
29.52	3.30	44.33	3.74
29.96	3.36	44.77	3.63
30.41	3.36	45.00	3.47
30.85	3.41	45.11	3.03
31.30	3.36	45.11	2.04
31.74	3.52	45.22	1.05
31.97	3.58	45.33	0.44
32.30	3.63	45.44	0.22
32.63	3.69	45.67	0.06
32.97	3.96	46.00	0.00
33.30	4.02		
33.53	4.13		
33.86	4.24		
34.08	4.29		
34.42	4.35		
34.53	4.35		
34.64	4.40		
34.97	4.40		
35.31	4.24		
35.53	4.13		
35.98	4.18		
36.53	4.18		
37.20	4.24		
37.65	4.13		
37.98	4.13		
38.43	4.13		
38.87	4.13		
39.43	4.13		
39.87	4.18		
39.99	4.18		
40.21	4.13		
40.65	4.07		
41.32	4.13		
41.66	4.07		
41.77	4.13		
41.88	4.18		
42.21	4.07		
42.55	4.02		
42.88	3.96		
42.99	4.07		
43.33	3.96		

TABLE B.2: GULF et al CRIMSON 3-5-38-8-W5M (Glauconite Fm)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	4.2	8.42	52.2	0.00	0.00	3.10	1.94
0.00	19.2	8.60	52.2	0.69	0.00	3.22	1.96
1.46	19.2	8.95	48.4	0.75	0.03	3.27	1.96
1.64	19.7	9.30	46.5	0.80	0.03	3.39	1.99
1.87	21.1	9.83	44.7	0.80	0.11	3.45	1.96
1.93	22.1	9.89	43.2	0.86	0.11	3.50	1.94
2.11	23.5	10.18	42.8	0.86	0.24	3.56	1.91
2.34	24.9	10.47	42.3	0.86	0.24	3.62	1.91
2.57	26.3	10.65	41.8	0.92	0.27	3.68	1.88
2.75	27.2	10.82	40.9	0.92	0.27	3.73	1.91
3.04	29.6	11.00	40.9	0.92	0.00	3.73	1.99
3.22	31.5	11.11	39.5	1.15	0.00	3.79	2.02
3.39	33.8	11.17	33.8	1.26	0.16	3.91	1.96
3.57	35.7	11.17	25.4	1.26	0.00	3.96	1.88
3.69	36.7	11.23	21.6	1.44	0.00	4.08	1.91
3.80	37.6	11.29	23.9	1.49	0.13	4.13	1.99
3.86	40.0	11.52	23.9	1.49	0.32	4.13	1.94
3.92	40.9	12.17	24.4	1.55	0.46	4.36	1.94
4.04	41.8	12.87	23.9	1.55	0.59	4.36	1.99
4.21	45.1	13.40	23.9	1.61	0.73	4.48	2.04
4.33	48.0	13.81	23.5	1.61	0.94	4.54	2.04
4.50	48.0	14.22	23.0	1.72	1.26	4.59	2.02
4.80	46.5	14.68	22.5	1.72	1.40	4.71	2.07
4.91	46.1	15.15	22.5	1.78	1.61	4.77	2.02
4.97	47.0	15.62	22.1	1.78	1.83	4.82	2.04
5.09	50.8	16.03	22.1	1.78	1.86	4.88	2.12
5.21	54.5	16.38	21.6	2.01	1.94	4.88	2.26
5.38	57.4	16.79	21.6	2.18	1.99	4.94	2.45
5.56	58.8	17.26	21.1	2.24	1.91	5.00	2.50
6.08	59.2	17.61	20.7	2.35	1.91	5.00	2.63
6.38	59.7	18.08	20.7	2.47	1.91	5.05	2.72
6.44	60.2	18.43	20.7	2.53	1.91	5.17	2.77
6.61	60.7	18.84	20.2	2.58	1.94	5.23	2.74
6.73	59.7	19.19	20.2	2.58	1.91	5.28	2.80
7.08	59.2	19.60	19.7	2.64	1.94	5.28	2.85
7.25	57.4	20.01	19.2	2.70	1.94	5.40	2.85
7.31	57.4	20.30	19.2	2.81	1.91	5.46	2.88
7.43	56.4	20.77	18.8	2.87	1.86	5.51	2.88
7.60	56.4	21.12	18.8	2.93	1.91	5.57	2.85
7.66	55.5	21.53	18.3	2.99	1.88	5.86	2.85
8.01	54.5	21.82	17.8	3.10	1.88	6.14	2.85

TABLE B.2: GULF et al CRIMSON 3-5-38-8-W5M (Glauconite Fm)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
22.17	17.4			6.20	2.85	10.97	2.74
22.35	17.4			6.32	2.85	10.97	2.18
22.52	16.9			6.55	2.90	11.03	0.91
22.70	16.9			6.60	2.88	11.08	0.30
23.05	16.4			6.95	2.93	11.14	0.05
23.46	16.4			7.06	2.96	11.14	0.00
23.63	15.9			7.12	2.88		
23.93	15.5			7.29	2.93		
24.28	15.5			7.41	2.90		
24.69	15.0			7.41	2.88		
25.10	15.0			7.47	2.93		
25.39	14.5			7.58	2.88		
25.91	14.5			7.64	2.90		
26.50	14.1			7.87	2.90		
27.03	13.6			7.92	2.93		
27.67	13.6			8.04	2.90		
28.20	13.6			8.21	2.96		
28.84	12.7			8.27	2.93		
29.48	12.7			8.44	2.98		
30.18	12.7			8.50	2.93		
30.94	12.2			8.61	2.96		
31.76	11.7			8.73	2.96		
32.58	11.2			8.73	2.88		
33.52	11.2			9.07	2.93		
34.57	10.8			9.25	2.93		
35.51	10.8			9.36	2.88		
35.98	10.8			9.42	2.90		
35.98	10.8			9.65	2.90		
35.98	10.8			9.76	2.85		
35.98	10.8			9.88	2.85		
37.00	11.3			10.05	2.88		
38.00	11.1			10.05	2.85		
39.00	10.8			10.16	2.90		
40.00	10.6			10.39	2.90		
41.00	10.5			10.45	2.93		
41.50	10.5			10.51	2.85		
42.00	0.0			10.62	2.88		
				10.74	2.82		
				10.80	2.88		
				10.85	2.88		
				10.91	2.82		

TABLE B.3: GULF et al CRIMSON 3-5-38-8-W5M (GLAUCONITE FM) /MAIN FRAC

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
16.35	57.70	26.66	38.30	19.22	3.04	27.07	2.99
16.41	57.30	26.66	39.70	19.39	3.07	27.24	2.88
16.70	56.30	26.77	38.80	19.51	3.01	27.24	2.56
16.87	54.50	26.83	39.20	19.86	2.99	27.30	2.32
17.73	51.70	26.94	41.10	19.97	2.96	27.36	2.40
18.08	48.90	26.94	38.30	20.09	2.99	27.36	2.61
18.48	46.20	27.06	39.70	20.26	2.99	27.42	2.72
19.00	43.40	27.17	38.30	20.43	3.04	27.47	2.83
19.06	42.50	27.23	40.60	20.72	3.04	27.47	2.69
19.23	41.60	27.29	39.70	20.95	3.01	27.53	2.59
19.34	41.10	27.35	42.00	21.30	3.01	27.59	2.72
19.69	41.60	27.40	40.60	21.41	3.04	27.59	2.83
20.27	42.00	27.58	42.50	21.99	3.01	27.82	2.88
21.07	42.00	27.75	42.50	23.15	3.04	27.88	2.88
21.88	42.40	27.98	42.90	24.47	3.04	27.94	2.93
21.85	42.40	28.44	42.90	25.22	3.01	27.99	2.88
21.99	42.40	29.30	43.40	25.28	3.07	28.05	2.88
21.99	42.50	30.00	42.90	25.40	3.20	28.11	2.91
24.30	42.90	31.43	42.90	25.40	3.04	29.09	2.91
25.16	42.50	32.41	42.00	25.45	3.01	29.26	2.88
25.22	42.00	32.99	42.00	25.69	3.01	29.32	2.91
25.33	42.00	32.99	41.10	25.74	3.09	29.84	2.91
25.33	41.10	33.22	41.60	25.86	3.15	30.30	2.88
25.45	41.60	33.22	40.20	25.92	3.15	30.82	2.91
25.45	40.60	33.28	41.10	25.97	2.77	31.46	2.88
25.50	41.10	33.33	38.80	26.15	2.99	31.75	2.91
25.68	41.60	33.39	41.10	26.15	2.83	32.15	2.91
25.74	40.20	33.39	40.60	26.20	2.88	32.55	2.93
25.85	39.20	33.51	41.60	26.20	3.07	32.90	2.96
25.85	40.20	33.51	41.10	26.26	3.17	33.07	2.99
25.91	38.80	33.74	41.10	26.38	2.88	33.19	3.07
25.97	41.10	33.85	42.00	26.55	3.04	33.25	2.93
26.02	40.20	33.91	41.60	26.61	2.88	33.30	3.15
26.14	40.20	34.03	42.00	26.67	2.85	33.36	3.01
26.20	40.20	34.37	42.00	26.67	2.80	33.42	2.72
26.25	38.30	34.54	42.00	26.72	2.83	33.48	2.83
26.25	39.70	34.89	42.00	26.78	2.91	33.59	2.91
26.43	39.70	35.46	42.00	26.78	2.96	33.65	2.88
26.48	38.80	36.33	42.00	26.84	2.99	33.71	2.93
26.54	37.90	37.19	41.60	26.90	3.04	33.88	2.91
26.54	38.80	38.17	41.60	26.96	2.99	34.00	2.88

TABLE B.3: GULF et al CRIMSON 3-5-38-8-W5M (GLAUC(

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TI (m	IN)
0.00	0.00	5.41	48.00	0.	
0.06	4.60	5.64	48.50	2.	
0.06	5.50	5.70	47.60	2.	
0.17	6.50	5.70	42.50	2.	
0.35	6.90	5.70	31.90	2.	
0.58	7.80	5.76	24.00	2.	
0.81	7.80	5.76	24.00	2.	
1.32	7.80	5.82	25.90	2.	
2.48	8.30	6.45	23.10	2.	
2.59	8.80	6.79	23.10	3.4	
2.59	9.70	6.97	23.50	3.	
2.59	10.60	8.98	23.50	3.5	
2.65	10.20	9.38	23.10	3.	
2.76	10.20	10.19	22.60	3.6	
2.76	11.10	10.59	22.20	3.7	
2.82	12.00	10.94	22.60	3.8	
2.88	12.50	10.94	25.90	3.9	
2.94	11.50	11.05	27.70	4.0	
3.17	10.20	11.11	26.30	4.0	1
3.51	10.20	11.28	26.30	4.1	
3.51	12.00	11.40	28.60	4.2	
3.51	14.30	11.51	32.80	4.3	
3.51	15.70	11.69	39.20	4.3	
3.63	16.20	11.92	46.20	4.5	
3.69	16.20	12.09	50.30	4.6	
3.80	17.50	12.21	52.20	4.7	
3.92	22.20	12.38	53.60	4.7	
3.97	24.50	12.72	54.50	4.9	
3.97	28.20	13.01	54.50	4.9	
4.03	30.50	13.24	56.30	5.1	
4.09	30.00	13.47	56.80	5.4	
4.20	32.30	13.76	57.30	5.71	
4.32	35.60	13.88	57.70	5.7	
4.38	37.40	14.05	57.70	5.71	
4.49	39.70	14.45	59.60	5.77	
4.61	41.10	14.57	60.90	5.77	
4.66	42.50	14.97	61.40	5.89	
4.66	42.90	15.03	61.40	10.9	
4.78	42.50	15.20	61.90	11.0	
4.89	44.80	16.01	59.10	11.0	0..
4.95	46.20	16.24	58.20	11.2	0

TABLE B.3: GULF et al CRIMSON 3-5-38-8-W5M

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)
16.35	57.70	26.66	38.30
16.41	57.30	26.66	39.70
16.70	56.30	26.77	38.80
16.87	54.50	26.83	39.20
17.73	51.70	26.94	41.10
18.08	48.90	26.94	38.30
18.48	46.20	27.06	39.70
19.00	43.40	27.17	38.30
19.06	42.50	27.23	40.60
19.23	41.60	27.29	39.70
19.34	41.10	27.35	42.00
19.69	41.60	27.40	40.60
20.27	42.00	27.58	42.50
21.07	42.00	27.75	42.50
21.88	42.40	27.98	42.90
21.85	42.40	28.44	42.90
21.99	42.40	29.30	43.40
21.99	42.50	30.00	42.90
24.30	42.90	31.43	42.90
25.16	42.50	32.41	42.00
25.22	42.00	32.99	42.00
25.33	42.00	32.99	41.10
25.33	41.10	33.22	41.60
25.45	41.60	33.22	40.20
25.45	40.60	33.28	41.10
25.50	41.10	33.33	38.80
25.68	41.60	33.39	41.10
25.74	40.20	33.39	40.60
25.85	39.20	33.51	41.60
25.85	40.20	33.51	41.10
25.91	38.80	33.74	41.10
25.97	41.10	33.85	42.00
26.02	40.20	33.91	41.60
26.14	40.20	34.03	42.00
26.20	40.20	34.37	42.00
26.25	38.30	34.54	42.00
26.25	39.70	34.89	42.00
26.43	39.70	35.46	42.00
26.48	38.80	36.33	42.00
26.54	37.90	37.19	41.60
26.54	38.80	38.17	41.60

TABLE B.3: GULF et al CRIMSON 3-5-38-8-W5M (GLAUCONITE FM) /MAIN FRAC

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
16.35	57.70	26.66	38.30	19.22	3.04	27.07	2.99
16.41	57.30	26.66	39.70	19.39	3.07	27.24	2.88
16.70	56.30	26.77	38.80	19.51	3.01	27.24	2.56
16.87	54.50	26.83	39.20	19.86	2.99	27.30	2.32
17.73	51.70	26.94	41.10	19.97	2.96	27.36	2.40
18.08	48.90	26.94	38.30	20.09	2.99	27.36	2.61
18.48	46.20	27.06	39.70	20.26	2.99	27.42	2.72
19.00	43.40	27.17	38.30	20.43	3.04	27.47	2.83
19.06	42.50	27.23	40.60	20.72	3.04	27.47	2.69
19.23	41.60	27.29	39.70	20.95	3.01	27.53	2.59
19.34	41.10	27.35	42.00	21.30	3.01	27.59	2.72
19.69	41.60	27.40	40.60	21.41	3.04	27.59	2.83
20.27	42.00	27.58	42.50	21.99	3.01	27.82	2.88
21.07	42.00	27.75	42.50	23.15	3.04	27.88	2.88
21.88	42.40	27.98	42.90	24.47	3.04	27.94	2.93
21.85	42.40	28.44	42.90	25.22	3.01	27.99	2.88
21.99	42.40	29.30	43.40	25.28	3.07	28.05	2.88
21.99	42.50	30.00	42.90	25.40	3.20	28.11	2.91
24.30	42.90	31.43	42.90	25.40	3.04	29.09	2.91
25.16	42.50	32.41	42.00	25.45	3.01	29.26	2.88
25.22	42.00	32.99	42.00	25.69	3.01	29.32	2.91
25.33	42.00	32.99	41.10	25.74	3.09	29.84	2.91
25.33	41.10	33.22	41.60	25.86	3.15	30.30	2.88
25.45	41.60	33.22	40.20	25.92	3.15	30.82	2.91
25.45	40.60	33.28	41.10	25.97	2.77	31.46	2.88
25.50	41.10	33.33	38.80	26.15	2.99	31.75	2.91
25.68	41.60	33.39	41.10	26.15	2.83	32.15	2.91
25.74	40.20	33.39	40.60	26.20	2.88	32.55	2.93
25.85	39.20	33.51	41.60	26.20	3.07	32.90	2.96
25.85	40.20	33.51	41.10	26.26	3.17	33.07	2.99
25.91	38.80	33.74	41.10	26.38	2.88	33.19	3.07
25.97	41.10	33.85	42.00	26.55	3.04	33.25	2.93
26.02	40.20	33.91	41.60	26.61	2.88	33.30	3.15
26.14	40.20	34.03	42.00	26.67	2.85	33.36	3.01
26.20	40.20	34.37	42.00	26.67	2.80	33.42	2.72
26.25	38.30	34.54	42.00	26.72	2.83	33.48	2.83
26.25	39.70	34.89	42.00	26.78	2.91	33.59	2.91
26.43	39.70	35.46	42.00	26.78	2.96	33.65	2.88
26.48	38.80	36.33	42.00	26.84	2.99	33.71	2.93
26.54	37.90	37.19	41.60	26.90	3.04	33.88	2.91
26.54	38.80	38.17	41.60	26.96	2.99	34.00	2.88

TABLE B.3: GULF et al CRIMSON 3-5-38-8-W5M (GLAUCONITE FM) /MAIN FRAC

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
39.44	41.60	63.10	37.90	34.00	2.75	51.32	2.96
39.90	41.60	63.21	37.50	34.17	2.83	51.93	2.96
40.82	41.60	63.32	36.10	34.23	2.85	52.36	2.96
41.74	41.10	63.38	34.70	34.52	2.88	52.58	2.96
41.91	41.60	63.61	34.30	35.09	2.88	53.35	2.96
42.20	41.60	64.01	33.80	35.15	2.83	53.40	2.96
		64.07	31.50	35.27	2.91	54.23	2.99
42.20	41.60	64.20	29.90	35.44	2.88	54.34	2.96
43.63	41.10	65.00	29.90	35.56	2.91	54.61	2.96
46.14	40.60	66.00	29.70	35.61	2.88	54.88	2.99
50.19	39.30	67.00	29.40	35.79	2.91	55.05	2.96
52.36	39.70	68.00	29.10	35.84	2.85	55.27	2.99
54.19	39.30	69.00	28.80	35.90	2.85	55.60	3.01
55.22	39.30	70.00	28.50	36.02	2.91	55.71	2.96
56.02	39.30	71.00	28.30	36.07	2.88	55.87	2.99
56.87	39.70	72.00	28.20	36.36	2.88	56.64	2.99
57.90	39.30	73.00	28.00	37.40	2.88	56.75	2.96
57.96	39.30	74.00	27.90	37.75	2.88	56.91	3.01
58.53	38.80	75.00	27.70	38.44	2.88	57.02	2.99
59.16	38.80	76.00	27.60	39.60	2.88	57.18	2.96
59.27	40.60	77.00	27.50	40.35	2.88	57.35	2.99
59.50	42.50	78.00	27.40	41.96	2.88	57.51	2.99
59.73	43.80	79.00	27.30	42.02	2.96	57.73	2.99
59.90	45.20	80.00	27.20	42.08	2.93	58.12	2.99
60.18	46.10	81.00	27.10	44.04	2.96	58.39	2.96
60.36	47.00	82.00	27.00	44.50	2.96	58.44	2.99
60.58	47.00	83.00	26.90	45.37	2.96	58.66	3.01
60.87	47.90	84.00	26.90	46.18	2.99	58.88	3.01
61.16	47.90	85.00	26.80	47.39	2.99	58.94	3.04
61.27	47.50	86.00	26.70	48.48	2.99	58.99	3.01
61.38	40.60	87.00	26.60	48.60	2.99	59.10	2.93
61.44	38.80	88.00	26.60	48.77	2.99	59.27	2.93
61.50	37.50	89.00	26.50	49.00	2.99	59.32	2.88
61.61	38.80	90.00	26.40	49.06	2.93	59.43	2.88
61.84	37.90	91.00	26.30	49.18	2.99	59.49	2.91
62.18	38.40	92.00	26.30	49.29	2.96	59.54	2.88
62.30	38.40	93.00	26.20	49.41	2.88	59.59	2.85
62.47	37.90	94.00	26.10	49.58	2.93	59.70	2.88
62.64	37.50	95.00	26.10	49.87	2.96	59.87	2.93
62.75	37.50	96.00	26.00	50.45	2.96	59.98	2.88
62.87	37.50	97.00	26.00	50.45	2.99	60.09	2.91

TABLE B.3: GULF et al CRIMSON 3-5-38-8-W5M (GLAUCONITE FM) /MAIN FRAC

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
98.00	25.90	178.00	22.60	60.25	2.88		
99.00	25.80	180.00	22.50	60.36	2.96		
100.00	25.80	182.00	22.50	60.58	2.99		
102.00	25.70	183.00	22.40	60.64	2.96		
104.00	25.50			60.80	2.93		
106.00	25.40			61.13	2.88		
108.00	25.30			61.18	2.77		
110.00	25.20			61.18	2.37		
112.00	25.10			61.24	1.92		
114.00	25.00			61.29	1.60		
116.00	24.90			61.46	1.57		
118.00	24.80			61.95	1.55		
120.00	24.80			62.11	1.57		
122.00	24.70			62.22	1.55		
124.00	24.60			62.33	1.49		
126.00	24.50			62.39	1.44		
128.00	24.40			62.44	1.47		
130.00	24.30			62.61	1.44		
132.00	24.20			62.72	1.47		
134.00	24.20			62.94	1.49		
136.00	24.10			63.05	1.39		
138.00	24.00			63.10	1.20		
140.00	23.90			63.21	1.01		
142.00	23.90			63.26	0.93		
144.00	23.80			63.37	0.88		
146.00	23.70			63.59	0.88		
148.00	23.60			63.70	0.93		
150.00	23.60			63.76	0.91		
152.00	23.50			63.81	0.75		
154.00	23.40			63.81	0.53		
156.00	23.40			63.87	0.16		
158.00	23.30			63.87	0.00		
160.00	23.20			63.87	0.00		
162.00	23.10						
164.00	23.10						
166.00	23.00						
168.00	22.90						
170.00	22.90						
172.00	22.80						
174.00	22.80						

TABLE B.4:GULF AMOCO CAROLINE 8-17-36-6W5 (INJECTION TEST AND MINIFRAC)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	0.0	19.39	38.7	0.00	0.00	12.27	0.48
0.00	15.9	19.62	41.0	0.69	0.03	15.04	0.51
1.15	16.3	19.85	43.8	0.93	0.03	16.20	0.51
1.85	17.3	20.09	45.7	0.93	0.26	17.13	0.51
2.08	17.7	20.32	47.6	1.16	0.26	18.75	0.51
2.77	19.1	20.32	48.5	1.16	0.64	18.98	0.93
3.00	20.1	20.55	47.1	1.39	0.93	19.21	1.18
3.46	21.9	21.24	47.6	1.39	0.99	19.21	1.28
3.69	23.3	21.24	48.0	1.39	1.09	19.21	1.34
3.92	25.2	21.47	49.0	1.62	1.15	19.67	1.37
4.16	26.6	21.47	49.4	1.85	1.18	19.91	1.25
4.39	28.0	21.70	49.9	2.08	1.15	20.14	1.25
4.62	27.1	21.70	33.6	2.31	1.18	20.60	1.18
5.08	25.7	21.93	35.9	2.55	1.12	20.83	1.02
5.31	24.7	22.16	36.4	2.55	1.09	21.06	1.02
5.77	23.3	21.93	39.2	2.78	1.09	21.29	1.05
6.00	22.4	22.16	42.0	2.78	1.09	21.53	1.05
6.46	21.5	22.16	43.8	3.24	1.15	21.53	1.02
7.16	21.0	23.09	45.7	3.47	1.12	21.76	0.99
7.62	20.1	23.55	45.7	3.47	1.18	21.76	0.83
7.85	21.5	23.78	46.2	3.93	1.28	21.76	0.83
8.31	22.9	24.24	46.6	4.17	1.28	21.99	1.15
8.54	25.7	24.70	46.6	4.17	1.21	21.99	1.47
8.77	27.1	25.16	46.6	4.63	1.18	22.22	1.69
9.00	28.0	25.63	46.6	4.63	0.64	22.45	1.79
9.23	28.9	26.09	46.6	4.63	0.03	22.22	1.88
9.70	28.0	26.55	46.6	7.64	0.03	22.91	1.88
10.39	27.5	27.01	46.6	7.64	0.32	23.38	1.92
10.85	26.6	27.24	46.2	7.87	0.64	24.07	1.92
11.77	26.6	27.70	46.2	7.87	0.83	25.00	1.92
12.70	26.6	27.93	45.7	8.10	0.99	25.46	1.95
14.31	25.7	28.40	45.7	8.33	1.18	25.46	1.98
15.47	25.7	28.40	40.6	8.56	1.31	25.92	1.98
16.16	25.7	28.86	28.5	8.80	1.31	27.08	2.08
16.85	25.2	28.86	21.5	8.80	1.12	27.31	2.08
17.08	25.2	29.09	17.3	9.03	1.05	28.01	2.17
18.70	25.2	29.09	13.1	9.26	0.99	28.47	2.17
18.70	28.5	29.32	11.2	9.26	0.70	28.70	1.44
18.93	30.8	29.55	9.8	9.26	0.45	28.93	1.40
19.16	33.6	29.78	8.4	9.72	0.48	28.93	0.03
19.39	36.4	30.01	7.5	10.65	0.48	48.61	0.03

TABLE B.4:GULF AMOCO CAROLINE 8-17-36-6W5 (INJECTION TEST AND MINIFRAC)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
30.24	6.5	54.02	47.6	48.61	0.35		
30.47	5.6	54.25	48.0	49.07	0.35		
31.17	5.1	54.72	47.6	49.07	0.13		
31.86	4.2	55.41	47.[illegible]	49.30	0.03		
32.55	4.2	56.10	47.6	50.69	0.03		
33.24	3.7	56.33	46.6	50.92	0.42		
34.17	3.3	56.56	35.9	51.15	0.42		
34.86	2.8	56.56	31.3	51.38	0.06		
35.32	2.8	56.56	28.0	51.61	0.06		
36.01	2.3	56.79	26.1	51.61	0.73		
37.40	2.3	57.02	24.3	51.61	1.37		
39.02	1.9	57.25	22.9	51.85	1.53		
41.09	1.9	57.72	21.5	52.08	1.95		
43.86	1.4	57.95	20.1	52.31	2.27		
47.79	1.4	58.18	17.7	52.54	2.36		
48.71	1.4	58.64	16.8	52.54	2.39		
48.94	2.3	58.87	15.9	52.54	2.55		
49.17	2.8	59.10	14.9	52.77	2.71		
49.64	2.3	59.56	13.1	53.00	2.81		
49.87	2.3	59.79	12.6	53.23	3.03		
49.87	1.9	60.26	11.7	53.47	3.16		
50.33	1.9	60.72	10.3	54.16	3.29		
50.56	1.4	61.41	9.8	54.16	3.54		
50.79	1.4	61.87	8.9	54.16	3.77		
51.02	1.4	62.80	7.9	54.39	4.02		
51.25	4.7	63.49	7.0	54.62	4.12		
51.48	6.1	64.18	6.5	54.85	4.15		
51.48	5.6	65.10	6.1	55.55	4.15		
51.48	9.8	65.80	5.6	55.78	4.09		
51.71	21.0	66.49	5.1	56.01	4.09		
51.94	31.7	67.18	4.7	56.24	4.12		
51.94	41.5	68.34	4.7	56.47	4.05		
52.18	44.3	69.03	4.7	56.71	2.55		
52.18	45.7	69.72	4.2	56.71	0.00		
52.87	46.2	71.11	3.7	90.73	0.00		
52.87	44.8	72.26	3.3				
53.10	45.7	73.88	3.3				
53.10	46.2	75.26	2.8				
53.56	46.2	77.57	2.3				
53.79	45.2	80.11	1.[illegible]				
54.02	46.6	84.03	2.3				

TABLE B.5: GULF ET AL. CAROLINE 8-17-36-6W5 (Glauconite Fm)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	0.0	13.24	45.5	0.00	0.00	9.34	3.41
0.00	1.2	13.55	45.5	0.11	0.05	9.41	3.41
0.07	2.9	13.62	45.9	0.17	0.05	9.76	3.44
0.17	3.3	14.00	45.9	0.21	0.57	10.80	3.46
0.31	12.3	14.21	46.7	0.28	0.77	11.50	3.44
0.45	17.2	14.49	46.7	0.45	0.82	11.64	3.41
0.52	30.7	14.60	47.1	0.52	1.46	11.71	3.51
0.56	35.2	15.01	47.9	0.56	1.73	11.78	3.51
0.66	36.9	15.08	48.4	0.66	1.78	11.81	3.41
0.73	39.3	15.15	48.8	0.94	3.36	12.47	3.46
0.77	41.0	15.26	48.8	1.01	3.46	12.75	3.46
0.84	42.2	15.29	47.9	1.08	3.51	12.89	3.46
0.91	43.8	15.43	48.8	1.19	3.54	13.24	3.44
0.98	44.7	15.54	45.1	1.29	3.54	13.55	3.46
1.29	44.7	15.61	47.5	1.43	3.56	13.69	3.39
2.09	44.3	15.68	48.4	1.78	3.56	13.80	3.41
2.23	44.3	15.78	48.4	1.88	3.51	13.97	3.41
3.14	44.3	15.85	57.4	2.06	3.54	14.08	3.44
3.59	44.3	15.89	58.6	2.13	3.51	14.29	3.39
4.01	44.3	15.95	57.4	2.61	3.51	14.49	3.39
4.49	44.3	16.04	56.6	2.75	3.49	14.60	3.36
4.88	44.3	16.12	55.7	2.93	3.51	14.91	3.34
5.05	44.3	16.18	55.1	4.08	3.49	15.19	3.26
5.57	44.7	16.24	54.5	4.18	3.51	15.26	3.07
6.13	44.7	16.31	54.0	4.29	3.46	15.40	3.02
6.65	44.7	16.37	53.6	4.84	3.51	15.57	2.35
6.86	44.7	16.44	53.3	4.88	3.46	15.64	2.15
7.21	45.1	16.55	52.9	4.95	3.46	15.68	1.98
7.35	45.5	16.61	52.6	5.02	3.51	15.68	1.71
8.05	45.5	16.67	52.4	5.26	3.51	15.71	1.26
8.74	45.5	16.79	51.8	5.33	3.49	15.78	1.09
9.51	45.5	16.91	51.3	5.96	3.49	15.82	0.82
10.38	45.5	17.01	50.9	6.03	3.46	15.85	0.57
10.97	45.9	17.10	50.4	6.55	3.46	15.82	0.40
11.36	45.5	17.18	50.0	6.79	3.44	15.89	0.10
11.64	45.5	17.24	49.8	7.04	3.44	15.96	0.00
11.74	44.3	17.31	49.6	7.18	3.41	17.56	0.00
11.84	45.1	17.42	49.4	7.28	3.49		
11.91	44.7	17.56	49.4	7.70	3.46		
12.44	44.7			8.40	3.46		
12.99	45.1			8.99	3.44		

TABLE B.3: GULF et al CRIMSON 3-5-38-8-W5M (GLAUCONITE FM) /MAIN FRAC

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	0.00	5.41	48.00	0.00	0.00	11.26	0.15
0.06	4.60	5.64	48.50	2.42	0.00	11.37	0.24
0.06	5.50	5.70	47.60	2.48	0.05	11.49	0.56
0.17	6.50	5.70	42.50	2.66	0.05	11.49	0.83
0.35	6.90	5.70	31.90	2.66	0.00	11.60	1.60
0.58	7.80	5.76	24.00	2.77	0.00	11.66	1.84
0.81	7.80	5.76	24.00	2.83	0.21	11.72	2.03
1.32	7.80	5.82	25.90	2.94	0.19	11.83	2.16
2.48	8.30	6.45	23.10	2.94	0.00	11.83	2.32
2.59	8.80	6.79	23.10	3.46	0.03	11.95	2.43
2.59	9.70	6.97	23.50	3.52	0.19	12.18	2.85
2.59	10.60	8.98	23.50	3.58	0.24	12.24	2.88
2.65	10.20	9.38	23.10	3.64	0.37	12.29	2.93
2.76	10.20	10.19	22.60	3.69	0.40	12.53	2.93
2.76	11.10	10.59	22.20	3.75	0.48	13.10	2.88
2.82	12.00	10.94	22.60	3.81	0.51	13.22	2.88
2.88	12.50	10.94	25.90	3.98	0.93	13.28	2.93
2.94	11.50	11.05	27.70	4.04	1.28	13.39	2.93
3.17	10.20	11.11	26.30	4.04	1.57	13.68	2.83
3.51	10.20	11.28	26.30	4.16	1.31	14.03	2.83
3.51	12.00	11.40	28.60	4.21	1.41	14.26	2.80
3.51	14.30	11.51	32.80	4.33	2.03	14.55	2.83
3.51	15.70	11.69	39.20	4.39	2.32	14.66	2.85
3.63	16.20	11.92	46.20	4.56	2.45	14.95	2.83
3.69	16.20	12.09	50.30	4.62	2.45	15.30	2.85
3.80	17.50	12.21	52.20	4.79	2.72	15.41	2.83
3.92	22.20	12.38	53.60	4.79	2.67	15.58	2.91
3.97	24.50	12.72	54.50	4.91	2.72	15.82	2.96
3.97	28.20	13.01	54.50	4.96	2.91	16.39	3.01
4.03	30.50	13.24	56.30	5.14	2.96	16.45	2.93
4.09	30.00	13.47	56.80	5.48	2.93	16.57	2.96
4.20	32.30	13.76	57.30	5.71	2.88	16.80	2.99
4.32	35.60	13.88	57.70	5.77	2.48	16.85	2.93
4.38	37.40	14.05	57.70	5.71	1.55	16.97	2.91
4.49	39.70	14.45	59.60	5.77	0.69	17.09	2.96
4.61	41.10	14.57	60.90	5.77	0.27	17.89	3.07
4.66	42.50	14.97	61.40	5.89	0.00	17.95	2.99
4.66	42.90	15.03	61.40	10.97	0.00	18.35	3.04
4.78	42.50	15.20	61.90	11.02	0.24	18.64	3.07
4.89	44.80	16.01	59.10	11.08	0.16	18.70	3.04
4.95	46.20	16.24	58.20	11.20	0.16	18.99	3.07

TABLE B.14 : GULF ET AL STRACHAN 10-22-37-9W5 (OSTRACOD FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	0.0	11.01	64.8	0.00	0.00	7.43	2.21
0.64	0.9	11.10	67.5	0.18	0.72	7.69	2.16
1.00	3.6	11.37	67.5	0.27	0.00	7.96	2.21
1.64	10.8	11.73	67.5	0.36	0.63	8.23	2.21
2.09	18.9	12.10	66.6	0.54	0.00	8.23	2.25
2.55	27.0	12.37	64.8	0.81	0.00	8.50	2.25
2.91	33.3	12.46	65.7	0.98	0.18	8.59	2.16
3.09	36.9	12.55	63.0	1.16	0.23	8.68	1.98
3.37	40.5	12.83	65.7	1.25	0.18	8.77	2.07
3.73	42.3	13.19	64.8	1.43	0.14	8.95	1.89
4.09	41.4	13.55	63.0	1.52	0.27	9.13	2.03
4.73	42.3	13.64	61.2	1.61	0.23	9.21	2.07
4.91	48.6	13.83	63.0	1.70	0.09	9.30	1.89
4.91	52.2	14.10	62.1	1.97	0.18	9.48	1.80
5.00	54.9	14.37	60.3	2.06	0.14	9.57	1.89
5.18	55.8	14.64	58.5	2.24	0.18	9.57	2.03
5.46	62.1	15.01	59.4	2.33	0.09	9.93	1.98
5.55	60.3	15.46	58.5	2.59	0.09	10.02	2.07
5.73	64.8	15.64	59.4	2.86	0.05	10.29	1.98
6.09	64.8	16.10	58.5	3.31	0.00	10.47	2.07
6.37	64.8	16.46	58.5	3.40	1.22	10.56	2.07
6.55	69.3	16.92	58.5	3.42	0.12	10.83	2.03
6.82	70.2	17.55	58.5	4.03	0.00	10.83	1.98
7.09	68.4	18.19	57.6	4.65	0.00	10.83	1.76
7.28	67.5	18.83	57.6	4.74	0.23	11.09	1.71
7.37	70.2	19.37	57.6	4.92	0.50	11.09	2.03
7.55	70.2	19.56	53.1	4.94	0.86	11.27	2.16
7.91	71.1	19.56	45.9	5.01	1.22	11.36	2.21
8.19	71.1	19.74	50.4	5.19	1.17	11.54	2.21
8.55	70.2	19.92	54.0	5.28	1.31	11.81	2.07
9.01	69.3	20.10	58.5	5.37	1.49	11.99	2.12
9.10	69.3	20.65	59.4	5.46	1.76	12.26	2.25
9.28	68.4	21.28	59.4	5.55	1.76	12.26	2.12
9.55	68.4	21.74	58.5	5.64	1.62	12.44	2.39
9.64	67.5	22.38	58.5	5.73	1.94	12.53	2.21
9.73	69.3	22.56	59.4	6.17	1.94	12.53	1.94
9.91	69.3	23.28	60.3	6.62	1.89	12.70	2.35
10.10	68.4	23.83	60.3	6.67	2.00	12.79	2.39
10.64	68.4	24.29	61.2	6.98	2.07	12.88	2.48
10.73	65.7	24.74	61.2	7.25	2.07	12.97	2.35
10.92	67.5	25.10	63.0	7.43	2.03	13.24	2.39

TABLE 8.12 : GULF ET AL STRACHAN 3-17-37-9W5 (GLAUCONITE FORMATION)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0	5.5	15.74	51.78	0	0	16.29	2.99
0.11	13.21	16.3	52.88	0.07	0.63	16.73	2.99
0.23	27.54	16.76	51.78	0.18	0.86	17.4	2.88
0.34	38.56	17[illegible]	52.88	0.18	1.42	17.73	2.99
0.45	46.27	17.66	52.88	0.4	1.42	18.29	2.99
0.45	44.06	18.23	52.88	0.51	1.64	18.84	2.99
0.79	51.78	18.68	52.88	0.51	1.87	19.29	2.88
0.91	58.39	19.13	52.88	0.74	1.98	19.84	2.88
1.36	60.59	19.59	53.98	0.85	2.2	20.29	2.88
1.7	60.59	20.15	53.98	1.62	2.31	20.73	2.88
2.04	60.59	20.49	53.98	2.07	2.31	21.29	2.88
2.26	63.9	20.94	53.98	2.07	2.43	21.51	2.88
2.49	65	21.4	53.98	2.62	2.54	21.73	2.88
2.83	63.9	21.85	53.98	3.07	2.54	22.4	2.88
3.28	62.8	22.19	52.88	3.74	2.65	22.84	2.88
3.74	62.8	22.87	52.88	4.18	2.65	23.29	2.88
4.19	61.69	23.32	52.88	4.74	2.76	23.84	2.88
4.87	60.59	23.78	52.88	5.18	2.88	24.29	2.88
5.32	58.39	24.23	52.88	5.62	2.88	24.84	2.99
5.89	56.19	24.79	52.88	6.29	2.88	25.29	2.99
6.34	55.08	25.47	52.88	6.73	2.88	25.73	2.99
6.79	53.98	25.93	52.88	7.18	2.99	26.4	2.88
7.25	52.88	26.49	52.88	7.62	2.99	26.73	2.88
7.7	52.88	26.95	52.88	8.29	2.99	27.4	2.88
8.04	51.78	27.4	52.88	8.73	2.99	27.84	2.88
8.15	50.68	27.96	52.88	9.18	2.99	28.18	2.88
8.6	51.78	28.53	52.88	9.73	2.99	28.73	2.88
9.06	51.78	28.98	52.88	10.29	2.99	29.29	2.88
9.62	51.78	29.55	52.88	10.51	2.99	29.84	2.88
10.08	51.78	30.12	52.88	10.73	2.88	30.29	2.88
10.42	51.78	30.68	52.88	11.18	2.88	30.84	2.76
10.98	52.88	30.91	52.88	11.29	2.76	31.4	2.88
11.43	52.88	31.36	52.88	11.73	2.76	31.84	2.88
11.89	51.78	31.93	52.88	12.29	2.76	32.4	2.88
12.45	52.88	32.49	52.88	12.73	2.88	32.84	2.88
12.91	51.78	33.17	52.88	13.29	2.88	33.4	2.88
13.36	51.78	33.74	52.88	13.73	2.88	33.95	2.76
13.93	52.88	34[illegible]	53.98	14.29	2.99	34.4	2.88
14.38	52.88	34.64	52.88	14.84	2.99	34.95	2.76
14.83	51.78	35[illegible]	53.98	15.29	2.99	35.51	2.65
15.4	51.78	35.66	53.98	15.73	2.88	35.62	2.65

TABLE 8.6 : GULF AMOCO ET AL CAROLINE 6-5-36-6-W5 (OSTRACOD FM)

TIME (min)	SURFACE PRESSURE (MPa)
0.00	2.0
2.50	47.5
3.50	52.0
3.60	45.0
5.00	57.0
8.50	58.0
10.60	57.0
13.00	55.0
13.50	52.5
14.00	50.0
15.00	47.5
15.30	47.5
15.60	49.0
18.20	48.0
19.20	46.5
20.80	50.0
23.40	49.0
24.90	47.5
26.00	54.0
27.70	54.0
30.70	60.0
32.00	60.0
32.10	30.0
34.50	27.5
37.00	26.5
42.00	25.5
47.00	25.0
50.00	25.0

TIME (min)	INJECTION RATE (cu.m /min)
0.00	0.00
2.50	2.50
3.50	3.00
3.60	3.00
5.00	3.00
8.50	3.00
10.60	3.20
13.00	3.30
13.50	3.32
14.00	3.34
15.00	3.36
15.30	3.38
15.60	3.40
18.20	3.50
19.20	3.50
20.80	3.50
23.40	3.50
24.90	3.50
26.00	3.50
27.70	3.30
30.70	3.15
32.00	3.00
32.10	0.00
33.60	
34.60	
35.10	
35.60	
36.60	
37.10	
42.00	
43.00	
43.50	
44.00	
51.00	

TABLE 5.7 : GULF AMOCO ET AL CAROLINE 6-5-36-6W5 (UPPER BASAL QUARTZ)

TIME (min)	SURFACE PRESSURE (MPa)
0.00	1.5
0.50	3.5
1.00	3.0
1.90	32.5
2.30	25.0
3.00	28.0
4.00	28.5
4.20	32.0
5.50	32.0
6.50	37.0
7.50	37.5
9.50	38.0
12.50	37.5
14.00	35.0
16.50	35.5
17.00	33.0
18.00	34.0
18.20	37.0
19.00	39.0
19.10	22.5
24.00	23.0
25.50	24.0
25.60	23.0
30.00	22.5
37.50	22.5
37.60	12.0
38.00	10.0
38.10	5.0

TIME (min)	INJECTION RATE (cu.m /min)
0.00	0.00
1.00	0.00
1.90	2.80
6.50	2.85
12.50	2.85
14.00	2.84
16.50	2.83
17.00	2.80
19.00	2.75
19.10	0.00

TABLE B.8 : GULF ET AL STRACHAN 10-7-37-9W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	0.0	13.40	67.22	0.00	0.00	10.69	3.28
0.72	8.6	13.64	66.15	1.15	0.08	10.77	3.36
1.16	17.7	13.64	68.30	1.17	0.21	10.86	3.28
3.20	15.1	14.00	68.84	1.26	0.29	10.96	3.36
4.96	15.1	14.33	68.30	1.34	0.25	11.81	3.32
5.04	17.2	14.80	68.30	1.42	0.08	12.25	3.28
5.26	31.7	15.19	67.76	5.13	0.08	12.76	3.20
5.38	39.3	15.60	68.30	5.40	0.57	13.23	3.11
5.43	39.8	16.01	68.30	5.43	0.86	13.69	3.11
5.57	48.4	16.48	68.84	5.46	0.66	14.16	3.24
5.71	51.6	16.57	68.30	5.54	0.61	14.65	3.20
5.73	54.9	16.92	69.37	5.62	0.94	15.11	3.15
5.82	54.3	17.20	69.37	5.76	1.15	15.57	3.20
5.87	53.8	17.67	68.84	5.89	1.23	16.04	3.20
5.90	56.5	18.05	68.30	6.03	1.27	17.56	2.87
6.01	63.5	18.41	67.76	6.11	1.56	17.95	3.03
6.31	64.5	18.74	68.30	6.27	1.80	18.41	3.20
6.51	62.9	19.07	68.30	6.60	1.64	18.76	3.20
6.75	63.5	19.13	65.07	6.76	1.80	18.82	3.11
6.86	72.6	19.40	66.68	6.85	1.68	18.87	3.11
6.89	72.6	19.82	66.15	7.01	2.21	18.93	3.32
6.95	67.2	20.29	68.84	7.12	1.84	19.01	3.32
7.00	65.6	20.31	68.30	7.28	1.97	19.12	3.20
7.14	68.8	20.40	68.30	7.56	1.97	19.09	2.99
7.61	66.7	20.45	64.53	7.83	2.01	19.39	3.03
7.77	68.3	20.56	64.53	7.86	2.17	19.72	2.95
8.52	64.5	20.64	24.20	8.18	2.17	20.05	2.91
8.65	67.8	20.67	30.65	8.51	2.25	20.24	2.91
8.88	66.1	20.73	62.38	8.84	2.46	20.32	2.79
9.10	68.3	20.78	56.47	8.92	2.38	20.40	2.79
9.29	67.2	20.81	54.32	9.06	2.38	20.48	2.50
9.54	67.8	20.84	56.47	9.16	2.62	20.56	2.54
9.95	64.5	20.92	58.62	9.27	2.62	20.65	0.04
10.09	66.1	21.00	24.74	9.41	2.91	20.67	0.61
10.31	64.0	21.03	32.27	9.46	2.83	20.70	1.35
10.36	65.6	21.11	38.18	9.68	2.87	20.76	1.52
10.67	62.4	21.14	34.42	10.04	2.99	20.76	1.76
11.44	64.5	21.20	33.88	10.23	3.24	20.84	1.97
11.47	64.5	21.25	33.34	10.42	3.32	20.89	2.05
12.18	67.2	21.50	33.34	10.45	3.40	20.92	1.56
12.93	67.8	21.75	33.34	10.69	3.32	20.95	0.78

TABLE B.8 : GULF ET AL STRACHAN 10-7-37-9W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)
21.97	32.8
22.22	32.8
22.46	32.8
22.71	32.3
22.93	31.7
23.19	31.7
23.35	31.7
23.65	31.7
24.33	31.1
24.93	30.7
25.46	29.7
25.73	28.5
36.00	16.0
51.00	0.0

TIME (min)	INJECTION RATE (cu.m /min)
21.00	0.00
21.00	0.00

TABLE B.9 : GULF ET AL STRACHAN 16-3-38-9W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	11.0	41.85	43.76	0.00	0.00	26.42	2.48
0.11	27.4	42.96	44.86	0.00	0.34	27.42	2.48
0.22	44.9	43.07	24.11	0.11	0.45	28.41	2.48
0.56	47.0	43.19	32.84	0.11	1.01	29.41	2.48
0.67	52.5	43.30	30.66	0.22	1.24	30.40	2.48
1.23	49.2	44.86	29.57	0.44	1.35	31.51	2.48
1.34	44.9	45.86	29.57	0.55	1.80	32.39	2.36
1.45	48.1	47.87	30.00	1.22	1.91	33.28	2.36
1.67	48.1	48.88	29.57	1.33	1.58	34.38	2.48
2.12	45.9	50.88	30.00	1.33	1.91	35.38	2.48
2.23	45.9	52.78	29.57	3.76	2.03	36.48	2.36
2.34	45.9	54.79	29.57	3.87	2.14	37.48	2.48
3.79	43.8	56.80	29.57	4.98	2.25	37.81	2.36
3.91	44.9	59.81	30.30	5.20	2.25	38.36	2.48
5.02	42.7	59.70	30.30	5.20	2.48	38.69	2.59
5.13	40.5	59.70	29.57	6.41	2.48	39.03	2.70
5.36	43.8			7.41	2.59	39.36	2.59
5.91	41.6			8.40	2.48	40.46	2.70
6.47	43.8			9.40	2.48	41.46	2.59
7.59	41.6			10.39	2.59	41.90	2.59
8.48	41.6			11.50	2.48	42.34	2.48
9.37	41.6			12.49	2.48	42.56	2.25
11.61	41.6			13.49	2.59	42.56	0.90
13.61	41.6			14.37	2.59	42.67	0.00
15.62	40.5			15.48	2.59	43.34	0.00
17.63	38.3			16.47	2.59	44.33	0.00
19.64	37.2			17.47	2.59	45.44	0.00
19.75	36.1			18.46	2.59	46.43	0.00
25.22	37.2			19.57	2.59	47.43	0.00
25.33	33.9			19.90	2.48	48.42	0.00
25.55	38.3			20.34	2.36	49.36	0.00
25.67	36.1			21.45	2.48	50.41	0.00
28.12	38.3			22.44	2.48	51.41	0.00
29.79	39.4			23.33	2.36	52.51	0.00
31.80	38.3			24.43	2.48	53.51	0.00
33.81	38.3			24.65	2.48	54.50	0.00
35.82	39.4			24.99	2.36	55.50	0.00
37.94	40.5			25.10	1.80	56.33	0.00
38.61	38.3			25.21	1.80	57.38	0.00
39.95	40.5			25.32	2.25	58.43	0.00
40.84	40.5			25.43	2.36	59.70	0.00

TABLE B.10 : GULF ET AL STRACHAN 16-3-38-9W5 (OSTRACOD FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	13.1	15.83	3.3	0.00	0.00	18.18	0.00
0.33	29.5	16.84	2.2	0.11	0.33	19.53	0.00
0.33	31.7	17.95	4.4	0.34	0.00	21.44	0.00
0.67	51.4	17.95	7.7	0.45	0.44	22.56	0.00
1.12	51.4	18.28	5.5	0.56	0.44	23.46	0.00
1.34	63.4	18.40	27.3	1.01	0.33	23.57	0.11
1.56	63.4	19.07	27.3	1.12	0.77	23.57	0.33
1.90	65.6	19.96	27.3	1.24	1.20	24.13	0.33
2.90	64.5	20.85	27.3	1.57	1.31	24.47	0.33
3.79	63.4	21.85	27.3	2.13	1.31	25.14	0.33
4.91	62.3	22.97	27.3	2.58	1.31	25.82	0.33
5.91	62.3	23.19	35.0	3.03	1.31	26.04	0.00
6.47	61.3	23.52	42.7	3.59	1.42	26.15	0.00
6.58	59.1	23.75	48.1	4.15	1.42	26.38	0.33
6.69	60.2	23.97	53.6	4.83	1.42	26.94	0.33
7.02	58.0	24.19	59.1	5.39	1.42	27.50	0.44
7.02	55.8	24.64	61.3	6.06	1.42	27.95	0.44
7.14	58.0	25.31	62.3	6.40	1.42	28.40	0.33
7.25	61.3	25.87	63.4	6.51	1.31	28.51	0.55
7.92	60.2	26.87	63.4	6.62	1.42	28.74	0.55
8.59	60.2	27.87	62.3	6.85	1.09	28.96	0.33
8.70	65.6	28.88	62.3	7.07	1.09	29.86	0.44
8.92	64.5	29.88	62.3	7.18	1.42	30.64	0.44
8.81	62.3	30.44	62.3	7.30	1.53	30.87	0.55
9.03	54.7	30.66	64.5	8.64	1.64	31.88	0.55
9.25	61.3	31.33	65.6	8.76	1.31	32.78	0.55
9.59	63.4	32.11	64.5	8.76	1.20	33.68	0.55
9.92	63.4	33.11	65.6	8.87	0.33	35.02	0.55
10.03	59.1	34.00	65.6	8.87	0.00	36.26	0.55
10.26	48.1	34.90	65.6	9.09	0.00	37.60	0.55
10.48	43.8	35.90	65.6	9.09	0.22	39.06	0.55
10.93	39.4	36.90	65.6	9.32	0.22	40.19	0.55
11.48	35.0	37.46	65.6	9.43	0.00	41.53	0.55
12.15	32.8	38.02	65.6	9.88	0.00	43.10	0.55
12.82	31.7	38.91	65.6	12.15	0.00	44.68	0.55
13.27	30.6	39.91	66.7	13.53	0.00	45.91	0.55
13.27	24.1	40.92	65.6	14.17	0.00	47.14	0.55
13.49	18.6	42.03	65.6	14.68	0.00	48.27	0.55
13.60	9.8	42.92	65.6	15.46	0.00	48.94	0.55
13.94	5.5	43.70	65.6	16.16	0.00	49.50	0.55
14.94	3.3	44.93	65.6	17.37	0.00	49.61	0.00

TABLE B.10 : GULF ET AL STRACHAN 16-3-38-9W5 (OSTRACOD FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
45.93	65.6	75.81	35.0	49.73	0.00	93.05	1.53
46.94	65.6	76.59	35.0	62.64	0.00	93.62	1.53
47.83	65.6	76.82	42.7	62.64	0.33	94.06	1.53
48.72	64.5	77.04	50.3	63.42	0.33	94.40	1.53
49.28	63.4	77.15	56.9	63.42	0.00	94.85	1.53
49.61	64.5	77.37	67.8	76.89	0.00	94.96	1.09
49.61	61.3	77.49	65.6	77.00	0.33	95.52	0.98
49.95	48.1	77.82	66.7	77.45	0.44	95.41	0.88
49.95	38.3	78.04	64.5	77.56	0.77	95.64	0.33
50.51	36.1	78.38	65.6	77.79	0.77	95.75	0.66
50.84	35.0	78.60	61.3	77.90	0.66	95.86	0.77
51.84	32.8	78.82	60.2	78.13	0.77	95.97	0.11
52.85	32.8	79.05	59.1	78.91	0.77	96.09	0.44
53.96	32.8	79.27	62.3	78.91	1.20	96.09	0.77
54.96	31.7	79.38	61.3	79.14	1.42	96.20	0.77
55.86	31.7	79.60	53.6	79.47	1.53	96.42	0.44
56.86	31.7	79.72	59.1	79.58	1.64	96.76	0.44
57.98	31.7	79.94	60.2	79.81	1.53	96.87	0.55
58.98	31.7	80.16	64.5	79.92	0.98	97.10	0.33
59.98	31.7	81.05	65.6	80.03	1.42	97.10	0.00
60.87	31.7	81.95	65.6	80.37	1.64	97.66	0.00
61.88	31.7	82.95	65.6	80.48	1.64	97.77	0.22
62.43	30.6	83.84	65.6	80.93	1.75	97.88	0.00
62.66	39.4	84.84	65.6	81.38	1.75	114.50	0.00
62.77	45.9	85.85	64.5	82.17	1.75		
63.10	54.7	86.85	66.7	83.18	1.64		
63.22	51.4	87.85	66.7	83.85	1.75		
63.44	47.0	88.86	66.7	84.64	1.75		
64.00	43.8	89.86	66.7	85.53	1.64		
64.44	41.6	91.31	67.8	86.10	1.75		
64.89	40.5	91.31	63.4	86.77	1.75		
65.56	38.3	91.42	66.7	87.11	1.75		
66.45	38.3	92.31	67.8	87.89	1.64		
67.34	37.2	93.32	67.8	88.68	1.64		
68.34	37.2	93.87	67.8	89.24	1.64		
69.35	36.1	94.43	70.0	90.14	1.64		
70.46	36.1	94.66	65.6	90.70	1.64		
71.47	36.1	95.10	70.0	91.26	1.64		
72.69	35.0	95.21	61.3	91.71	1.64		
73.81	35.0	95.44	67.8	91.82	1.42		
74.81	35.0	95.66	63.4	92.27	1.53		

TABLE B.10 : GULF ET AL STRACHAN 16-3-38-9W5 (OSTRACOD FM)

TIME (min)	SURFACE PRESSURE (MPa)
95.88	68.9
96.33	64.5
96.44	68.9
96.66	70.0
97.00	61.3
97.22	67.8
97.33	62.3
97.33	67.8
97.55	70.0
97.78	65.6
98.00	61.3
98.22	56.9
98.67	53.6
99.00	50.3
99.34	48.1
99.67	45.9
100.12	43.8
100.79	41.6
101.57	39.4
102.42	38.3
103.13	38.3
104.19	38.1
104.24	34.7
104.90	34.3
105.51	33.9
106.25	33.2
106.85	32.9
107.70	32.8
108.59	32.8
109.37	31.7
110.38	31.7
111.27	31.7
112.12	31.7
112.83	31.7
113.72	31.7
114.50	31.7

TABLE B.11 : GULF ET AL STRACHAN 10-13-38-10W5 (CARDIUM FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	0.0	7.22	54.8	0.00	0.00	7.29	2.38
0.17	8.9	7.45	54.8	0.06	1.58	7.52	2.38
0.23	19.6	7.62	54.2	0.11	1.43	7.69	2.32
0.29	29.1	7.74	54.8	0.23	1.43	7.86	2.48
0.29	35.8	7.97	54.8	0.23	0.90	7.97	2.59
0.52	38.0	8.14	55.3	0.34	1.53	8.15	2.53
0.69	38.0	8.32	55.3	0.57	1.37	8.49	2.69
0.75	41.9	8.32	40.2	0.75	1.32	8.55	0.00
0.81	45.8	8.32	24.6	0.92	1.58	16.87	0.05
0.92	46.4	8.37	27.9	0.98	1.80	16.92	0.26
0.98	49.7	8.37	32.4	1.15	1.80	16.98	0.42
1.10	54.2	8.43	28.5	1.20	2.01	17.04	0.63
1.21	54.8	8.49	31.3	1.26	2.17	17.15	0.84
1.27	53.1	8.55	28.5	1.38	2.11	17.21	1.06
1.33	54.8	8.60	30.2	1.55	2.11	17.32	1.37
1.39	53.7	8.66	28.5	1.72	2.06	17.50	1.48
1.50	54.2	8.72	30.2	1.78	2.11	17.61	1.69
1.79	54.8	8.78	29.1	1.95	2.17	17.61	1.95
1.85	54.2	8.89	29.6	2.07	2.17	17.73	2.01
2.02	54.8	9.07	29.1	2.35	2.17	17.78	2.22
2.31	54.8	9.24	29.1	2.58	2.17	17.84	2.69
2.48	54.8	9.53	29.1	2.87	2.17	17.96	2.75
2.77	54.8	9.82	29.1	3.10	2.17	18.24	2.80
3.00	54.2	10.05	29.1	3.38	2.17	18.47	2.80
3.35	54.8	10.34	28.5	3.61	2.17	18.59	2.85
3.52	54.8	10.57	29.1	3.84	2.17	18.70	3.01
3.81	54.2	10.80	28.5	4.07	2.17	18.93	3.06
3.98	54.2	11.03	29.1	4.36	2.22	19.22	3.12
4.33	54.2	11.32	28.5	4.59	2.22	19.50	3.17
4.56	54.8	11.55	28.5	4.82	2.17	19.68	3.12
4.74	54.2	11.78	28.5	5.05	2.22	19.96	3.17
4.97	54.2	12.01	28.5	5.34	2.17	20.08	3.01
5.20	54.8	12.36	27.9	5.56	2.22	20.31	3.06
5.43	54.8	12.53	27.9	5.85	2.22	20.48	3.12
5.72	54.8	12.82	27.9	6.02	2.22	20.82	3.12
5.95	54.8	13.05	27.9	6.20	2.17	21.00	3.12
6.06	55.3	13.28	27.4	6.48	2.38	21.28	3.17
6.18	54.8	13.57	27.4	6.65	2.38	21.51	3.17
6.41	57.0	13.80	27.4	6.83	2.43	21.68	3.33
6.70	55.9	14.03	27.4	6.88	2.64	21.86	3.33
6.93	55.9	14.32	27.4	7.06	2.48	21.97	3.43

TABLE B.11 : GULF ET AL STRACHAN 10-13-38-10W5 (CARDIUM FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
14.55	26.8	21.08	55.3	22.20	3.43	29.77	3.64
14.84	26.8	21.31	55.9	22.26	3.54	29.95	3.59
15.01	26.3	21.54	54.8	22.49	3.59	30.00	3.75
15.24	26.3	21.71	55.3	22.72	3.59	30.12	3.86
15.53	25.7	21.94	54.8	22.95	3.70	30.35	3.80
15.82	25.2	22.06	54.8	23.12	3.75	30.58	3.75
16.00	24.6	22.29	54.8	23.29	4.01	30.75	3.59
16.28	24.6	22.29	55.9	23.46	4.07	30.86	3.80
16.52	24.0	22.52	54.8	23.69	4.12	31.15	3.70
16.75	22.9	22.58	55.9	23.98	4.07	31.44	3.64
16.86	25.7	22.92	54.2	24.09	4.07	31.67	3.64
17.03	27.9	23.04	52.5	24.21	4.07	31.90	3.64
17.09	31.3	23.16	52.0	24.27	4.12	32.24	3.64
17.21	32.4	23.33	51.4	24.44	4.12	32.41	3.70
17.27	34.7	23.50	50.9	24.73	4.07	32.64	3.64
17.27	38.0	23.68	48.6	24.90	4.07	32.87	3.64
17.50	38.6	23.85	48.6	25.24	4.07	33.22	3.59
17.50	40.2	24.02	48.1	25.30	4.01	33.39	3.27
17.61	43.0	24.31	48.1	25.41	4.01	33.45	3.70
17.61	43.6	24.48	48.6	25.53	3.86	33.50	3.86
17.73	44.2	24.95	47.5	25.64	3.96	33.62	3.75
17.73	46.9	25.23	48.1	25.70	3.75	33.79	3.75
17.79	51.4	25.47	49.2	25.87	3.75	34.08	3.80
17.96	51.4	25.75	48.6	26.22	3.80	34.36	3.75
18.13	52.5	25.99	48.1	26.39	3.75	34.65	3.75
18.25	52.0	26.27	46.9	26.50	3.80	34.88	3.75
18.54	52.0	26.51	45.8	26.68	3.75	35.11	3.70
18.59	53.1	26.79	45.8	26.85	3.75	35.40	3.70
18.77	53.7	27.02	45.8	27.19	3.70	35.51	3.80
18.94	53.7	27.26	45.8	27.31	3.86	35.74	3.86
18.94	55.3	27.43	46.4	27.54	3.80	36.08	3.86
19.06	55.3	27.78	46.4	27.82	3.80	36.31	3.80
19.29	55.3	28.01	45.3	28.17	3.75	36.66	3.86
19.58	55.9	28.24	45.3	28.45	3.75	36.83	3.80
19.69	55.9	28.53	45.8	28.63	3.70	37.06	3.86
19.81	56.4	28.70	45.8	28.74	3.43	37.35	3.86
19.92	57.0	28.81	44.7	28.86	3.86	37.58	3.91
20.04	55.9	28.93	45.8	28.91	3.75	37.80	3.86
20.33	55.9	29.28	46.4	29.20	3.80	38.15	3.80
20.56	55.9	29.57	46.4	29.49	3.75	38.32	3.86
20.79	55.9	29.80	46.4	29.66	3.75	38.84	3.80

TABLE B.11 : GULF ET AL STRACHAN 10-13-38-10W5 (CARDIUM FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
30.03	45.8	39.50	46.9	39.12	3.86	46.98	3.59
30.32	46.4	39.73	46.4	39.35	3.86	47.21	3.59
30.55	45.8	39.96	45.3	39.58	[illegible]	47.27	3.43
30.78	45.8	40.31	44.7	39.81	3.91	47.39	3.38
31.07	45.8	40.54	44.7	40.10	3.91	47.39	3.27
31.30	45.8	40.77	45.3	40.33	3.91	47.50	0.05
31.59	45.3	41.06	46.4	40.62	3.91		
31.82	45.3	41.29	48.1	40.85	3.91		
32.05	45.8	41.52	48.6	41.07	3.91		
32.34	46.9	41.75	47.5	41.30	3.86		
32.57	48.1	41.98	47.5	41.59	3.86		
32.80	48.6	42.27	46.4	41.82	3.86		
33.09	48.6	42.50	46.9	42.11	3.91		
33.26	47.5	42.73	46.4	42.28	3.91		
33.43	45.8	42.96	45.3	42.62	3.91		
33.61	46.9	43.31	45.8	42.80	3.91		
33.78	47.5	43.48	46.4	43.14	3.91		
34.01	46.9	43.71	46.4	43.31	3.91		
34.36	47.5	43.89	46.9	43.54	3.91		
34.53	46.9	43.89	48.1	43.77	3.96		
34.70	47.5	43.94	47.5	44.00	3.86		
34.99	48.1	44.23	48.1	44.23	3.86		
35.28	48.1	44.46	48.6	44.34	3.91		
35.51	48.6	44.52	50.3	44.52	3.86		
35.80	48.6	44.58	50.3	44.57	3.70		
36.03	48.6	44.64	48.6	44.75	3.75		
36.32	49.2	44.75	48.6	44.80	4.70		
36.49	49.2	44.98	46.9	44.80	3.59		
36.73	49.7	45.21	44.7	45.03	3.59		
37.01	50.9	45.39	43.0	45.26	3.64		
37.30	51.4	45.50	41.9	45.55	3.64		
37.48	53.1	45.56	44.2	45.78	3.59		
37.77	53.1	45.73	46.4	45.84	3.49		
38.00	53.1	45.97	46.4	45.95	3.59		
38.29	53.1	46.20	47.5	46.01	3.75		
38.46	52.5	46.37	48.6	46.12	3.59		
38.63	52.5	46.54	50.3	46.12	3.75		
38.63	51.4	46.72	52.0	46.30	3.75		
39.04	49.2	46.95	53.1	46.41	[illegible]		
39.27	48.6	47.06	54.8	46.58	3.70		
39.38	48.1	47.12	53.7	46.81	3.64		

TABLE B.12 : GULF ET AL STRACHAN 3-17-37-9W5 (GLAUCONITE FORMATION)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)
69.29	60.59	84.01	33.05
69.4	38.56	84.34	33.05
69.51	40.76	84.68	33.05
69.63	38.56	85.02	33.05
69.74	40.76	85.36	33.05
69.85	39.66	85.59	33.05
69.97	38.56	85.82	33.05
70.42	38.56		
70.53	37.45		
71.1	38.56		
71.44	37.45		
71.78	37.45		
72.23	37.45		
72.68	37.45		
73.02	36.35		
73.36	36.35		
73.82	36.35		
74.16	36.35		
74.5	36.35		
74.95	36.35		
75.29	36.35		
75.74	36.35		
75.97	35.25		
76.42	36.35		
76.76	35.25		
77.1	35.25		
77.67	35.25		
77.89	35.25		
78.34	35.25		
78.57	35.25		
79.25	35.25		
79.7	34.15		
80.27	34.15		
80.61	34.15		
81.06	34.15		
81.51	34.15		
81.97	34.15		
82.31	34.15		
82.76	34.15		
83.21	34.15		
83.55	33.05		

TABLE B.11 : GULF ET AL STRACHAN 10-13-38-10W5 (CARDIUM FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)
47.24	54.8	60.98	29.1
47.29	55.9	61.33	29.1
47.35	55.9	61.73	29.1
47.41	54.8	61.96	29.1
47.52	55.3	62.19	29.1
47.58	54.2	62.42	29.1
47.64	20.1	62.65	29.1
47.70	27.4	63.00	29.1
47.76	34.7	63.00	29.1
47.76	29.1		
47.81	30.7		
47.99	30.2		
48.51	30.2		
49.03	30.2		
49.49	29.6		
50.01	29.6		
50.47	29.6		
50.93	29.6		
51.45	29.1		
51.97	29.6		
52.43	29.6		
53.01	30.2		
53.47	29.6		
53.93	29.6		
54.45	29.6		
54.97	29.6		
55.44	29.6		
56.01	29.6		
56.47	29.6		
56.99	29.6		
57.46	29.6		
57.98	29.6		
58.50	29.6		
58.96	29.6		
59.30	29.1		
59.48	29.1		
59.77	29.1		
60.00	29.1		
60.23	29.1		
60.46	29.1		
60.75	29.1		

TABLE B.12 : GULF ET AL STRACHAN 3-17-37-9W5 (GLAUCONITE FORMATION)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)
69.29	60.59	84.01	33.05
69.4	38.56	84.34	33.05
69.51	40.76	84.68	33.05
69.63	38.56	85.02	33.05
69.74	40.76	85.36	33.05
69.85	39.66	85.59	33.05
69.97	38.56	85.82	33.05
70.42	38.56		
70.53	37.45		
71.1	38.56		
71.44	37.45		
71.78	37.45		
72.23	37.45		
72.68	37.45		
73.02	36.35		
73.36	36.35		
73.82	36.35		
74.16	36.35		
74.5	36.35		
74.95	36.35		
75.29	36.35		
75.74	36.35		
75.97	35.25		
76.42	36.35		
76.76	35.25		
77.1	35.25		
77.67	35.25		
77.89	35.25		
78.34	35.25		
78.57	35.25		
79.25	35.25		
79.7	34.15		
80.27	34.15		
80.61	34.15		
81.06	34.15		
81.51	34.15		
81.97	34.15		
82.31	34.15		
82.76	34.15		
83.21	34.15		
83.55	33.05		

TABLE B.12 : GULF ET AL STRACHAN 3-17-37-9W5 (GLAUCONITE FORMATION)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
36.12	52.88	53.44	49.57	35.84	2.65	52.73	2.99
36.68	52.88	53.78	49.57	36.4	2.76	53.28	2.99
37.36	52.88	54.34	49.57	36.95	2.65	53.73	2.99
37.7	52.88	54.68	48.47	37.51	2.65	54.28	2.99
38.27	52.88	55.14	48.47	37.95	2.65	54.84	2.99
38.72	52.88	55.81	49.57	38.4	2.65	55.28	2.99
39.17	52.88	56.15	48.47	38.95	2.76	55.84	3.1
39.63	52.88	56.49	50.68	39.06	2.76	56.06	2.99
40.19	51.78	56.95	49.57	39.51	2.76	56.06	2.65
40.76	51.78	57.29	49.57	39.84	2.76	56.17	2.65
41.21	52.88	57.4	47.37	40.4	2.76	56.62	2.65
41.55	51.78	57.51	49.57	40.84	2.65	56.84	2.65
42.12	52.88	57.63	48.47	41.4	2.65	57.39	2.76
42.57	52.88	57.85	48.47	41.95	2.65	57.84	2.65
43.02	52.88	58.31	48.47	42.51	2.65	58.39	2.76
43.59	51.78	58.87	48.47	42.95	2.65	58.84	2.65
44.15	51.78	59.44	48.47	43.4	2.76	59.39	2.65
44.83	51.78	59.89	47.37	43.73	2.65	59.84	2.65
45.29	51.78	60.34	46.27	43.84	2.65	60.39	2.65
45.85	51.78	61.02	46.27	43.95	2.88	60.84	2.65
46.42	50.68	61.48	46.27	44.06	2.76	61.39	2.65
46.87	50.68	61.82	45.17	44.4	2.65	61.84	2.65
47.44	50.68	62.27	44.06	44.84	2.76	62.39	2.65
47.32	48.47	62.72	44.06	45.51	2.76	62.84	2.65
47.55	50.68	63.17	44.06	45.84	2.65	62.84	2.88
47.66	48.47	63.51	44.06	46.4	2.65	62.95	2.99
47.78	49.57	63.85	44.06	46.51	2.54	63.39	2.99
48	48.47	64.19	45.17	46.51	2.31	63.84	2.99
48.12	49.57	64.31	48.47	46.95	2.31	64.17	2.88
48.57	49.57	64.65	49.57	47.4	2.54	64.62	2.88
48.68	51.78	64.99	50.68	47.62	2.76	64.95	2.88
48.8	50.68	65.32	52.88	47.76	2.88	65.39	2.76
49.36	50.68	65.55	55.08	48.26	2.88	65.84	2.76
49.7	50.68	66.12	57.29	48.78	2.93	66.39	2.76
49.93	49.57	66.57	58.39	49.17	2.99	66.84	2.65
50.38	51.78	67.14	59.49	49.78	2.91	67.39	2.54
50.95	49.57	67.48	60.59	50.37	2.88	67.84	2.65
51.4	49.57	67.93	60.59	50.92	2.85	67.84	0.29
51.97	50.68	68.49	61.69	51.28	2.88	67.84	0.18
52.53	49.57	68.83	61.69	51.73	2.88	67.95	0.18
52.98	49.57	69.17	61.69	52.28	2.99	68.1	0

TABLE B.13: GULF ET AL STRACHAN 3-17-37-9W5 (OSTRACOD FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	2.00	19.89	56.92	38.00	28.36	0.00	0.00
0.44	5.30	20.78	55.82	38.22	28.36	1.00	1.20
0.89	9.69	21.89	55.82	38.56	28.36	3.00	2.40
1.22	15.18	23.00	54.72	38.89	28.36	12.33	2.40
1.44	19.57	24.00	53.62	39.11	28.36	12.50	0.00
1.56	25.07	24.78	54.72	39.33	27.26	14.00	0.00
1.78	29.46	25.00	54.72	39.67	27.26	14.20	2.40
1.89	34.95	25.56	54.72	40.11	26.16	20.70	2.40
2.00	39.34	26.56	54.72	40.78	26.16	25.10	2.40
2.22	44.84	27.56	53.62	41.22	26.16	30.60	2.40
2.44	49.23	28.56	53.62	41.89	26.16	34.50	2.40
3.00	55.82	29.56	53.62	42.22	26.16	34.51	0.00
3.44	58.02	30.67	53.62	42.78	25.07		
4.00	59.12	30.78	53.62	43.00	5.30		
4.44	58.02	31.00	55.82				
4.78	58.02	31.67	56.92				
5.22	60.21	32.11	58.02				
6.00	60.21	32.33	60.21				
6.44	60.21	32.78	62.41				
7.44	60.21	32.89	61.31				
8.44	60.21	33.11	63.51				
9.56	61.31	33.44	64.61				
10.56	60.21	33.56	64.61				
11.56	60.21	33.78	63.51				
12.33	60.21	34.00	65.71				
12.33	54.72	34.11	63.51				
12.44	50.33	34.44	69.00				
12.67	45.93	34.56	37.15				
12.89	42.64	34.67	38.25				
13.44	40.44	34.89	36.05				
14.00	39.34	35.11	34.95				
14.44	38.25	35.44	32.75				
14.56	41.54	35.89	30.56				
14.67	49.23	36.11	28.36				
15.00	53.62	36.44	28.36				
15.33	56.92	36.67	27.26				
16.00	56.92	37.00	26.16				
16.67	58.02	37.11	4.20				
17.56	56.92	37.56	4.20				
18.56	55.82	37.67	26.16				
19.44	55.82	37.78	29.46				

TABLE B.14 : GULF ET AL STRACHAN 10-22-37-9W5 (OSTRACOD FM)

TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
27.11	2.6		
27.20	[illegible]5		
27.20	2.2		
27.47	2.4		
27.73	2.3		
27.64	2.1		
27.73	1.8		
27.73	1.6		
27.73	1.3		
27.73	1.0		
27.73	0.7		
27.73	0.4		
27.80	0.0		

TABLE B.14 : GULF ET AL STRACHAN 10-22-37-9W5 (OSTRACOD FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
25.10	62.1			13.42	2.48	19.68	2.62
25.19	59.4			13.51	2.48	19.77	2.53
25.38	63.0			13.60	2.35	19.77	2.75
25.74	64.8			13.69	2.62	19.86	3.07
26.83	66.6			13.69	2.57	20.13	3.02
26.83	63.9			13.96	2.57	20.13	2.84
26.92	67.5			14.05	2.35	20.31	3.20
27.20	67.5			14.14	2.57	20.40	3.34
27.65	68.4			14.22	2.71	20.58	3.20
27.83	64.8			14.31	2.80	20.76	3.07
27.92	67.5			14.49	2.80	20.93	2.93
28.01	68.4			14.58	2.71	21.11	3.02
28.11	72.0			14.67	2.80	21.29	2.89
28.29	65.7			14.85	2.75	21.38	3.07
28.20	57.6			15.03	2.75	21.47	2.93
28.29	49.5			15.39	2.75	21.74	3.07
28.29	46.8			15.39	2.62	22.01	3.11
28.38	45.0			15.48	2.80	22.28	3.16
28.56	42.3			15.57	2.93	22.46	3.20
28.83	41.4			15.66	3.02	22.54	3.20
29.11	40.5			15.75	2.98	22.72	3.02
29.34	39.7			15.84	2.89	22.99	3.16
29.76	39.2			16.19	2.89	23.35	3.16
30.11	38.7			16.46	2.84	23.62	3.02
30.49	38.3			16.73	2.84	23.80	3.11
30.93	37.8			17.09	2.84	23.89	3.11
31.47	37.8			17.53	2.93	24.24	3.07
32.02	37.8			17.53	2.80	24.60	3.02
32.74	37.8			17.80	2.89	24.69	2.89
33.38	37.8			18.07	2.80	24.87	2.98
34.02	37.8			18.43	2.84	24.96	2.62
34.58	37.4			18.61	2.93	25.05	2.93
35.13	37.2			18.97	2.93	25.59	2.84
35.56	36.9			19.15	2.71	25.94	2.71
36.38	36.9			19.23	2.57	26.21	2.66
37.02	36.9			19.30	2.33	26.30	2.44
37.56	36.9			19.32	3.34	26.39	2.66
38.66	36.9			19.50	0.95	26.66	2.57
39.57	36.0			19.55	1.68	26.84	2.53
43.40	36.0			19.68	2.16	27.02	2.53
43.40	36.0			19.68	2.48	27.02	2.30

TABLE B.31 : GULF GARRINGTON 14-11-36-6W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	2.0	0.47	23.1	0.00	0.00	0.70	0.67
0.00	2.6	0.47	24.2	0.08	0.00	0.70	0.64
0.00	3.1	0.58	24.7	0.08	0.04	0.70	0.67
0.00	3.7	0.58	25.3	0.00	0.04	0.70	0.71
0.00	4.2	0.58	25.8	0.00	0.07	0.70	0.74
0.00	4.8	0.58	26.4	0.00	0.11	0.70	0.78
0.00	5.3	0.58	26.9	0.00	0.14	0.70	0.81
0.00	5.9	0.58	27.5	0.00	0.21	0.70	0.85
0.00	6.4	0.58	28.1	0.00	0.25	0.70	0.88
0.00	7.0	0.58	28.6	0.00	0.28	0.77	0.88
0.00	7.5	0.70	28.6	0.00	0.32	0.85	0.88
0.00	8.1	0.81	28.6	0.00	0.35	0.93	0.92
0.12	8.7	0.81	29.2	0.08	0.35	0.93	0.95
0.12	9.2	0.81	29.7	0.08	0.32	0.93	0.99
0.12	9.8	0.93	29.7	0.08	0.25	1.00	1.03
0.12	10.3	0.93	30.3	0.08	0.21	1.00	1.06
0.12	10.9	1.05	30.8	0.08	0.18	1.08	1.13
0.12	11.4	1.05	31.9	0.08	0.14	1.08	1.20
0.12	12.0	1.05	32.5	0.15	0.14	1.08	1.24
0.23	12.5	1.05	33.0	0.15	0.07	1.16	1.27
0.23	13.1	1.16	33.0	0.15	0.11	1.16	1.34
0.23	13.6	1.16	33.6	0.23	0.14	1.16	1.41
0.23	14.2	1.28	34.1	0.23	0.21	1.16	1.45
0.23	14.8	1.40	34.1	0.31	0.25	1.24	1.52
0.35	15.3	1.51	34.1	0.31	0.28	1.24	1.56
0.35	16.4	1.63	34.1	0.31	0.32	1.24	1.59
0.35	17.0	1.75	34.1	0.39	0.32	1.24	1.63
0.35	17.5	1.75	34.7	0.39	0.35	1.24	1.66
0.35	18.1	1.86	34.7	0.46	0.35	1.31	1.73
0.35	18.6	1.86	35.3	0.46	0.39	1.31	1.80
0.47	18.6	1.86	35.8	0.46	0.42	1.31	1.84
0.35	18.6	1.86	36.9	0.54	0.42	1.39	1.87
0.47	18.6	1.98	36.9	0.54	0.46	1.39	1.94
0.47	19.2	1.98	37.5	0.62	0.49	1.39	1.98
0.35	19.2	2.09	37.5	0.62	0.53	1.39	2.01
0.47	19.7	2.21	37.5	0.62	0.57	1.39	2.05
0.47	20.3	2.33	37.5	0.62	0.60	1.47	2.09
0.47	20.8	2.44	36.9	0.62	0.64	1.47	2.12
0.47	21.4	2.56	36.9	0.62	0.60	1.55	2.12
0.47	22.0	2.68	37.5	0.62	0.64	1.62	2.12
0.47	22.5	2.79	37.5	0.70	0.64	1.70	2.12

TABLE B.31 : GULF GARRINGTON 14-11-36-6W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
2.91	37.5	7.21	37.5	1.78	2.16	4.17	3.00
3.02	37.5	7.33	37.5	1.78	2.19	4.25	3.00
3.02	36.9	7.45	36.9	1.78	2.23	4.48	3.00
3.14	36.9	7.56	36.9	1.78	2.26	4.72	3.00
3.26	36.9	7.68	36.9	1.78	2.30	4.87	3.00
3.26	37.5	7.79	36.9	1.86	2.30	5.02	3.04
3.37	37.5	7.91	36.9	1.86	2.40	5.26	3.04
3.37	36.9	8.03	36.9	1.86	2.51	5.41	3.04
3.49	36.9	8.14	36.9	1.86	2.55	5.49	3.04
3.61	36.9	8.26	36.9	1.93	2.58	5.57	3.04
3.72	36.9	8.38	36.9	1.93	2.62	5.64	3.04
3.84	36.9	8.49	36.9	1.93	2.69	5.64	3.00
3.96	36.9	8.61	36.9	1.93	2.79	5.88	3.00
4.07	36.9	8.73	36.9	1.93	2.83	6.18	3.00
4.19	36.9	8.84	36.9	2.01	2.86	6.42	2.97
4.30	36.9	8.96	36.9	2.01	2.90	6.49	3.00
4.42	36.9	9.19	36.9	2.01	2.93	6.57	3.00
4.54	36.9	9.31	36.9	2.01	2.97	6.65	3.00
4.65	36.9	9.54	36.9	2.09	2.97	6.80	3.00
4.77	36.9	9.66	36.9	2.09	3.00	7.03	3.00
4.89	36.9	9.77	36.9	2.16	3.00	7.27	2.97
5.00	36.9	9.89	37.5	2.16	3.04	7.34	3.00
5.12	36.9	10.00	37.5	2.16	3.00	7.42	3.00
5.24	36.9	10.12	37.5	2.24	3.00	7.50	3.00
5.35	36.9	10.24	37.5	2.32	3.00	7.58	3.00
5.47	36.9	10.35	36.9	2.40	3.00	7.73	3.00
5.58	36.9	10.47	36.9	2.47	3.00	8.04	3.00
5.70	36.9	10.70	36.9	2.71	3.04	8.35	3.00
5.82	36.9	10.82	36.4	2.86	3.04	8.50	3.00
5.93	36.9	10.94	36.9	2.94	3.08	8.66	3.00
6.05	36.9	11.05	36.9	3.01	3.08	8.89	3.00
6.17	36.9	11.17	36.9	3.01	3.04	9.04	3.00
6.28	36.9	11.28	36.9	3.17	3.04	9.20	3.00
6.28	37.5	11.40	36.9	3.32	3.04	9.28	3.04
6.40	37.5	11.63	36.9	3.40	3.04	9.43	3.04
6.51	37.5	11.75	36.9	3.48	3.08	9.59	3.04
6.51	36.9	11.98	36.9	3.56	3.04	9.74	3.04
6.75	36.9	12.10	36.9	3.79	3.00	9.90	3.04
6.86	36.9	12.33	36.9	3.87	3.00	9.97	3.04
6.98	36.9	12.45	36.9	3.94	3.00	10.05	3.04
7.10	37.5	12.56	36.9	4.10	3.00	10.13	3.04

TABLE B.31 : GULF GARRINGTON 14-11-36-6W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
12.68	36.9	17.80	40.2	10.20	3.00	14.61	3.15
12.80	36.9	17.92	40.2	10.28	3.00	14.69	3.15
13.03	37.5	18.03	40.2	10.36	3.00	14.69	3.18
13.15	37.5	18.15	40.2	10.44	3.00	14.77	3.22
13.26	37.5	18.38	40.2	10.67	3.00	14.77	3.29
13.38	37.5	18.50	40.2	10.98	3.00	14.84	3.36
13.61	37.5	18.61	40.2	11.13	3.00	14.92	3.43
13.73	37.5	18.73	40.2	11.13	2.97	15.00	3.50
13.84	37.5	19.08	40.8	11.13	3.00	15.00	3.54
13.96	37.5	19.20	40.8	11.21	3.00	15.00	3.57
14.08	38.0	19.31	40.8	11.29	3.00	15.00	3.61
14.19	38.6	19.54	40.8	11.29	2.97	15.00	3.64
14.19	39.1	19.66	40.8	11.36	2.97	15.07	3.71
14.19	39.7	19.78	40.2	11.36	3.00	15.15	3.75
14.31	39.7	20.01	40.2	11.44	3.00	15.23	3.75
14.43	39.7	20.13	40.2	11.60	2.97	15.23	3.78
14.43	40.2	20.24	40.2	11.91	2.97	15.31	3.78
14.54	40.2	20.36	40.2	12.06	2.97	15.38	3.78
14.77	40.2	20.48	40.2	12.29	2.97	15.46	3.82
14.89	40.2	20.71	40.2	12.45	2.97	15.69	3.82
15.01	40.2	20.82	40.2	12.52	2.97	16.00	3.82
15.12	40.2	20.94	40.2	12.60	2.97	16.16	3.82
15.24	40.2	21.06	40.2	12.76	2.97	16.23	3.82
15.36	40.8	21.17	40.2	12.99	2.97	16.31	3.82
15.47	40.8	21.52	40.2	13.06	2.97	16.39	3.82
15.59	40.8	21.64	40.2	13.14	2.97	16.62	3.82
15.71	40.8	21.87	40.2	13.37	2.97	17.01	3.82
15.82	40.8	21.99	40.2	13.53	2.97	17.24	3.82
16.05	40.2	22.10	40.2	13.76	2.97	17.55	3.82
16.29	40.2	22.22	40.2	13.92	2.97	17.63	3.82
16.40	40.2	22.34	40.2	13.99	2.97	17.70	3.82
16.52	40.2	22.45	40.2	14.07	2.97	17.78	3.82
16.64	40.2	22.69	40.2	14.15	2.97	18.01	3.82
16.75	40.2	22.80	40.2	14.22	2.97	18.24	3.85
16.87	40.2	22.92	40.2	14.30	2.97	18.48	3.85
16.99	40.2	23.03	40.2	14.38	2.97	18.79	3.85
17.10	40.2	23.15	40.2	14.46	2.97	18.86	3.85
17.22	40.2	23.27	40.2	14.53	2.97	19.09	3.85
17.33	40.2	23.38	40.2	14.69	3.00	19.33	3.85
17.45	40.2	23.62	40.2	14.69	3.04	19.64	3.85
17.68	40.2	23.73	40.2	14.61	3.08	19.79	3.85

TABLE B.31 : GULF GARRINGTON 14-11-36-6W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
23.85	40.2	29.20	48.0	19.87	3.85	25.90	3.99
23.97	40.2	29.32	48.0	19.87	3.89	26.05	3.99
24.20	40.2	29.32	47.5	19.94	3.89	26.21	3.99
24.31	40.2	29.32	46.9	20.02	3.89	26.28	3.99
24.55	40.8	29.32	46.3	20.41	3.85	26.28	3.96
24.66	40.2	29.32	45.8	20.64	3.85	26.36	3.96
24.90	40.2	29.32	45.2	20.95	3.85	26.52	3.96
25.01	40.2	29.32	44.7	21.26	3.85	26.59	3.96
25.13	40.2	29.32	44.1	21.49	3.85	26.75	3.96
25.36	40.2	29.32	43.6	21.65	3.85	26.83	3.96
25.48	40.2	29.32	43.0	21.80	3.85	27.06	3.96
25.59	40.2	29.32	42.5	22.03	3.85	27.29	3.96
25.71	40.2	29.43	42.5	22.11	3.85	27.52	3.96
25.71	40.8	29.43	41.9	22.34	3.89	27.60	3.96
25.94	40.8	29.55	41.9	22.57	3.89	27.68	3.96
26.06	40.2	29.55	41.4	22.73	3.89	27.68	3.99
26.29	40.2	29.55	40.8	22.81	3.85	27.83	3.99
26.41	40.2	29.55	40.2	22.88	3.85	27.98	3.99
26.52	40.2	29.67	39.7	23.04	3.85	28.06	3.99
26.64	40.2	29.67	39.1	23.19	3.85	28.22	3.99
26.76	40.2	29.55	39.1	23.35	3.85	28.37	3.99
26.99	40.8	29.55	38.6	23.35	3.82	28.45	3.99
27.22	40.8	29.55	38.0	23.42	3.82	28.60	3.96
27.34	40.8	29.55	37.5	23.42	3.85	28.76	3.92
27.34	41.4	29.55	36.9	23.50	3.85	28.84	3.92
27.46	41.4	29.55	36.4	23.50	3.89	28.91	3.92
27.57	41.9	29.67	35.8	23.50	3.92	29.14	3.89
27.69	42.5	29.67	35.3	23.50	3.96	29.22	3.85
27.80	43.0	29.67	34.7	23.58	3.96	29.30	3.85
27.92	43.0	29.55	34.7	23.66	3.96	29.38	3.85
28.04	43.6	29.55	34.1	23.89	3.96	29.45	3.82
28.15	44.1	29.55	33.6	23.96	3.96	29.53	3.78
28.27	44.7	29.55	33.0	24.20	3.96	29.61	3.78
28.39	45.2	29.55	32.5	24.43	3.99	29.69	3.78
28.50	45.8	29.55	31.9	24.58	3.99	29.76	3.71
28.62	45.8	29.55	31.4	24.82	3.99	29.84	3.71
28.74	46.3	29.55	30.8	25.05	3.99	29.92	3.71
28.74	46.9	29.55	30.3	25.28	3.99	29.99	3.68
28.97	46.9	29.67	29.7	25.43	4.03	30.07	3.68
28.97	47.5	29.67	29.2	25.51	4.03	30.07	3.64
29.08	47.5	29.67	29.7	25.74	3.99	30.15	3.64

TABLE B.31 : GULF GARRINGTON 14-11-36-6W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
29.67	30.3	34.32	24.7	30.23	3.64	30.77	1.70
29.67	30.8	34.55	24.7	30.30	3.64	30.77	1.63
29.67	30.3	34.78	24.7	30.30	3.61	30.77	1.56
29.78	30.3	34.90	24.7	30.38	3.61	30.77	1.48
29.90	29.7	35.02	24.7	30.38	3.57	30.77	1.45
29.90	29.2	35.13	24.7	30.38	3.54	30.77	1.41
30.01	28.6	35.37	24.7	30.38	3.50	30.77	1.34
30.01	28.1	35.48	24.7	30.38	3.46	30.85	1.24
30.13	28.1	35.60	24.7	30.46	3.43	30.85	1.17
30.25	28.1	35.72	24.7	30.46	3.36	30.85	1.10
30.36	28.1	35.83	24.7	30.54	3.36	30.85	1.06
30.48	28.1	36.06	24.7	30.54	3.29	30.85	0.99
30.60	28.1	36.30	24.7	30.61	3.22	30.77	0.92
30.71	28.1	36.41	24.2	30.61	3.15	30.77	0.85
30.71	27.5	36.65	24.2	30.61	3.08	30.85	0.74
30.83	27.5	36.76	24.2	30.61	3.00	30.85	0.64
30.95	27.5	36.88	24.2	30.61	2.97	30.85	0.53
31.06	26.9	37.00	24.2	30.61	2.93	30.85	0.46
31.18	26.9	37.11	24.2	30.61	2.90	30.85	0.39
31.41	26.4	37.34	24.2	30.61	2.83	30.85	0.32
31.53	26.4	37.58	24.2	30.61	2.79	30.85	0.28
31.64	26.4	37.69	24.2	30.61	2.76	30.92	0.25
31.76	26.4	37.81	24.2	30.61	2.72	30.92	0.21
31.88	26.4	38.04	24.2	30.61	2.65	30.92	0.14
31.99	26.4	38.16	24.2	30.69	2.58	30.92	0.07
32.23	26.4	38.39	24.2	30.69	2.55	30.92	0.04
32.23	25.8	38.62	24.2	30.69	2.51	30.92	0.00
32.34	25.8	38.74	24.2	30.69	2.44	30.92	0.04
32.46	25.8	38.86	24.2	30.69	2.40	31.00	0.04
32.57	25.8	38.97	24.2	30.69	2.37	30.92	0.00
32.69	25.8	39.21	24.2	30.69	2.33		
32.81	25.8	39.44	24.2	30.77	2.30		
32.92	25.8	39.55	24.2	30.77	2.26		
33.04	25.8	39.67	24.2	30.77	2.23		
33.16	25.3	39.90	24.2	30.77	2.19		
33.39	25.3	40.25	24.2	30.77	2.16		
33.50	25.3	40.37	24.2	30.77	2.09		
33.62	25.3	40.60	24.2	30.77	1.98		
33.74	25.3	40.72	24.2	30.77	1.94		
33.97	25.3	40.83	24.2	30.77	1.87		
34.09	25.3	41.18	24.2	30.77	1.80		

TABLE B.31 : GULF GARRINGTON 14-11-36-6W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
41.30	24.2	47.00	20.3				
41.42	24.2	47.00	19.7				
41.53	24.2	47.00	19.2				
41.76	24.2	47.00	18.6				
41.88	24.2	[illegible].00	18.1				
42.00	24.2	47.00	17.5				
42.11	23.6	47.00	17.0				
42.23	23.6	47.00	16.4				
42.35	23.6	47.12	16.4				
42.46	23.6	47.12	15.9				
42.58	23.6	47.23	15.3				
42.81	23.6	47.23	14.8				
43.04	23.6	47.23	14.2				
43.16	23.6	47.23	13.6				
43.28	23.6	47.23	13.1				
43.39	23.6	47.23	12.5				
43.51	23.6	47.23	12.0				
43.74	23.1	47.23	11.4				
43.98	23.1	47.23	10.9				
44.21	23.1	47.23	10.3				
44.44	23.1	47.23	9.8				
44.56	23.1	47.23	9.2				
44.67	23.1	47.23	8.7				
44.91	23.1	47.23	8.1				
45.02	23.1	47.23	7.5				
45.14	23.1	47.23	7.0				
45.37	23.1	47.23	6.4				
45.60	23.1	47.23	5.9				
45.72	23.1	47.23	5.3				
45.84	23.1	47.12	4.8				
46.07	23.1	47.12	4.2				
46.42	23.1	47.23	4.2				
46.65	22.5	47.23	3.7				
46.77	22.5	47.23	3.1				
46.88	22.5	47.23	2.6				
47.00	22.5	47.12	2.6				
47.12	22.5	47.12	3.1				
47.12	22.0	0.00	2.0				
47.12	21.4						
47.12	20.8						
47.00	20.8						

TABLE B.32 : GULF GARRINGTON 6-14-36-6W5 (OSTRACOD FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
57.00	22.7	31.24	27.2	0.00	0.00	4.22	2.04
40.50	22.9	31.06	29.3	0.28	0.05	4.39	2.30
38.17	24.0	31.00	26.6	0.39	0.21	4.44	2.25
38.05	23.4	30.89	28.8	0.44	0.37	4.67	2.20
37.99	25.0	30.83	27.2	0.44	0.58	4.67	2.30
37.94	22.4	30.77	29.3	0.56	0.79	4.72	2.25
37.88	26.1	30.65	27.2	0.56	0.94	4.78	2.41
37.82	24.5	30.59	29.3	0.67	0.94	4.89	2.30
37.82	29.8	30.54	24.5	0.61	0.68	4.94	2.56
37.76	32.0	30.30	28.8	0.67	0.37	5.06	2.51
37.59	32.0	30.19	26.6	0.83	0.31	5.11	2.62
37.53	29.8	30.07	28.8	0.94	0.31	5.33	2.67
37.53	32.0	29.89	27.2	1.11	0.37	5.39	2.51
37.47	36.8	29.84	29.8	1.11	0.68	5.44	2.67
37.41	35.2	29.66	28.8	1.22	0.73	5.61	2.62
37.35	38.9	29.49	29.3	1.33	0.52	5.67	2.46
37.00	37.8	29.37	28.8	1.39	0.63	5.72	2.62
37.00	35.2	29.31	30.9	1.39	0.89	5.78	2.51
36.83	37.3	29.20	28.8	1.44	1.05	5.83	2.62
36.13	35.7	29.02	31.4	1.72	0.89	5.94	2.83
36.01	33.6	28.96	29.3	1.83	0.94	6.17	2.67
35.96	35.7	28.79	28.8	1.94	0.84	6.22	2.56
35.49	34.1	28.61	30.4	2.00	1.05	6.33	2.67
35.14	34.1	28.55	27.7	2.06	1.26	6.44	2.72
34.91	32.5	28.50	30.4	2.11	1.36	6.50	2.83
34.50	32.0	28.38	29.8	2.39	1.36	7.17	2.83
34.03	29.8	28.32	29.3	2.50	1.62	7.61	2.93
33.62	30.9	28.32	27.2	2.72	1.67	8.06	2.93
33.04	30.4	28.20	29.8	2.83	0.89	8.44	2.93
32.52	29.8	28.09	27.2	2.89	1.26	9.44	3.03
32.40	30.4	27.97	29.3	3.00	1.36	9.89	3.19
32.28	32.5	27.80	28.8	3.00	1.62	10.00	2.98
32.11	30.4	27.51	28.8	3.06	1.83	10.11	3.14
32.05	31.4	27.21	29.3	3.17	1.78	10.22	3.14
31.88	30.9	27.04	29.8	3.28	1.88	10.28	3.03
31.76	31.4	26.92	28.8	3.28	2.25	10.39	3.14
31.64	34.6	26.75	29.8	3.44	2.25	10.50	3.14
31.58	31.4	26.69	28.8	3.72	2.30	10.61	2.98
31.47	31.4	26.57	29.3	3.83	2.35	10.83	2.98
31.35	30.9	26.46	29.3	3.94	2.41	10.94	2.62
31.29	29.8	26.34	30.4	4.17	2.15	11.00	2.98

TABLE B.32 : GULF GARRINGTON 6-14-36-6W5 (OSTRACOD FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
26.17	30.4	17.07	34.6	11.44	2.98	18.56	2.93
26.11	30.9	16.61	34.6	11.50	3.09	18.67	3.14
25.93	30.9	16.14	34.6	11.61	2.72	18.89	2.98
25.76	30.9	15.68	35.7	11.67	2.77	18.94	3.14
25.64	29.8	15.27	35.2	11.67	3.03	19.39	3.19
25.58	29.3	15.09	35.7	11.78	3.14	19.83	3.19
25.35	30.4	14.98	34.6	11.94	3.14	20.33	3.14
25.23	31.4	14.69	34.6	12.00	3.40	20.89	3.03
25.12	31.4	14.39	35.2	12.17	2.88	21.00	2.83
25.00	30.4	13.40	36.2	12.22	3.03	21.17	2.93
24.94	29.8	13.29	35.7	12.33	2.72	21.39	2.83
24.71	31.4	12.76	36.8	12.50	2.77	21.78	2.88
24.30	32.0	12.35	37.8	12.67	2.67	22.06	2.98
24.18	31.4	12.24	36.8	12.72	2.77	22.17	2.83
23.60	32.0	12.06	38.3	13.00	2.72	22.28	3.03
23.31	32.5	11.77	38.9	13.17	2.83	24.50	2.98
23.08	33.0	11.66	34.6	13.33	2.83	25.00	2.88
23.02	33.0	11.60	37.8	13.44	3.24	25.56	2.88
22.96	33.6	11.48	36.8	13.56	2.98	25.78	2.72
22.96	32.5	10.96	37.3	13.89	2.93	25.83	2.88
22.84	33.6	10.90	35.2	14.17	2.98	25.94	2.77
22.79	31.4	10.72	37.8	14.33	2.88	26.06	2.88
22.49	33.0	10.02	38.3	14.44	3.03	26.33	2.72
22.26	33.0	9.56	37.8	14.50	2.93	26.44	2.83
22.20	33.0	9.03	38.9	14.56	3.09	26.56	2.72
22.03	33.6	8.51	38.9	14.72	2.93	26.61	2.83
21.91	32.5	8.04	38.9	14.83	3.09	26.83	2.72
21.79	33.0	7.52	38.9	15.06	2.98	26.94	2.83
21.62	33.0	7.05	38.9	15.22	3.14	27.11	2.62
21.45	33.0	6.53	39.4	15.33	3.03	27.17	2.77
21.33	32.5	6.12	39.9	15.44	3.14	27.28	2.67
20.92	32.5	5.59	39.9	15.61	2.88	27.50	2.77
20.86	33.0	5.42	39.9	15.56	3.14	27.61	2.56
20.45	33.0	5.30	39.4	15.78	2.93	27.61	2.77
20.16	32.5	5.13	41.0	15.89	3.14	27.78	2.67
19.81	33.0	5.01	41.0	16.22	3.03	27.89	2.72
19.58	32.5	4.90	42.1	16.67	2.93	28.00	2.25
19.23	32.5	4.78	40.5	17.17	2.93	28.06	2.62
18.88	33.0	4.66	41.5	17.83	3.14	28.17	2.72
18.47	33.6	4.55	38.9	18.17	2.98	28.33	2.77
17.48	33.6	4.37	42.1	18.28	3.09	28.61	2.67

TABLE B.33 : GULF GARRINGTON 6-14-36-6W5

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	0.0	0.00	0.0	13.13	45.31	12.69	2.62
0.46	1.6	6.57	0.0	13.30	46.89	12.92	2.62
0.75	5.3	6.57	0.3	13.76	38.99	13.03	2.70
1.04	7.9	6.92	0.3	13.93	40.04	13.20	2.70
1.45	10.[illegible]	7.15	0.3	14.17	42.15	13.38	2.70
2.49	27.4	7.21	0.5	15.32	41.62	13.44	2.62
3.01	34.2	7.44	0.4	15.50	42.68	13.61	2.53
3.30	37.9	7.50	0.5	15.96	41.62	13.72	2.70
3.82	41.6	7.61	0.5	16.07	42.68	13.78	2.87
4.34	36.4	7.67	0.7	16.31	41.62	13.90	2.87
4.74	34.8	7.67	0.8	17.17	42.15	13.90	3.12
4.97	35.3	7.78	0.7	18.16	40.57	14.07	3.29
5.26	34.8	7.90	0.6	19.02	38.46	14.18	3.29
5.67	34.2	8.07	0.6	20.06	38.46	14.30	3.46
5.78	31.1	8.25	0.8	21.16	36.88	14.42	3.29
6.13	28.5	8.25	1.4	23.01	37.41	14.82	3.21
6.24	29.0	8.42	1.3	23.13	35.83	14.99	3.12
6.42	27.4	8.53	1.4	23.30	37.94	15.11	3.21
6.59	27.9	8.53	1.6	25.09	37.41	15.22	3.12
6.77	30.0	8.65	1.6	26.25	36.88	15.45	3.12
6.94	30.6	8.65	1.9	26.25	36.36	15.68	3.12
7.34	39.5	8.76	1.8	26.25	36.88	15.86	3.12
7.57	39.5	8.82	1.9	26.25	36.88	16.09	3.12
7.57	37.9	9.00	1.8	26.54	36.88	16.43	3.12
7.75	37.4	9.05	1.7	26.77	37.40	16.49	3.29
7.81	41.1	9.11	1.8	27.00	36.37	16.95	3.21
8.04	41.6	9.17	2.1	27.23	36.88	17.47	3.38
8.27	45.3	9.40	2.1	27.46	36.37	17.93	3.29
8.62	46.4	10.44	2.1	27.63	37.91	18.45	3.29
8.79	47.9	10.73	2.1	27.74	36.37	18.97	3.38
8.90	47.9	11.01	2.1	28.09	37.40	19.49	3.38
8.96	49.0	11.24	2.1	28.15	36.37	20.01	3.46
9.19	48.5	11.36	2.2	28.72	37.91	20.30	3.46
9.89	48.5	11.47	2.5	29.07	38.43	20.53	3.38
10.29	46.9	11.71	2.3	29.64	38.94	20.70	3.46
10.41	47.9	11.88	2.4	30.21	43.58	20.99	3.46
10.70	46.4	11.99	2.5	30.44	43.58	21.51	3.46
11.10	47.9	12.17	2.5	30.56	43.06	21.74	3.46
11.68	47.4	12.40	2.5	30.73	43.06	21.97	3.55
11.85	46.[illegible]	12.45	2.6	30.79	42.03	22.26	3.55
12.20	47.4	12.51	2.5	30.90	43.06	22.49	3.55

TABLE B.33 : GULF GARRINGTON 6-14-36-6W5

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
30.96	41.5	22.78	3.6	42.16	37.91	31.83	3.29
31.08	43.1	23.01	3.6	42.62	37.40	32.00	2.79
31.25	43.6	23.30	3.6	43.14	36.88	32.12	2.45
31.25	44.6	23.53	3.6	43.60	36.88	[illegible]18	1.27
31.42	46.7	23.76	3.5	44.11	35.85	32.23	1.10
31.48	50.3	23.99	3.3	44.63	35.85	32.41	1.10
31.53	47.2	24.22	3.5	45.15	35.34	32.52	0.84
31.76	46.7	24.33	3.4	45.67	34.82	32.58	0.59
31.88	49.2	24.51	3.5	46.12	34.31	32.69	0.42
31.99	49.2	24.74	3.6	46.64	33.79	32.75	0.08
32.11	47.7	24.85	3.6	47.10	33.79	32.81	0.00
32.11	50.3	24.97	3.6	47.62	33.79	35.23	0.00
32.22	50.3	25.20	3.6	48.14	33.79	35.40	0.51
32.40	47.7	25.31	3.6	48.59	33.28	35.46	0.51
32.57	46.7	25.49	3.6	49.11	33.28	35.46	0.00
32.68	45.6	25.77	3.6	49.63	33.79	35.81	0.00
32.80	45.1	26.01	3.6	50.15	33.28	36.10	0.00
32.97	44.6	26.24	3.6	50.60	33.79	36.50	0.00
33.26	43.6	26.47	3.6	51.06	33.28		
33.72	43.1	26.70	3.6	52.10	33.28		
34.18	42.5	26.81	3.6	52.50	33.79		
34.69	41.5	26.99	3.6	52.50	33.79		
34.75	43.6	27.16	3.5				
34.81	45.6	27.33	3.6				
34.87	47.2	27.50	3.6				
34.92	48.2	27.74	3.4				
35.15	47.7	27.97	3.4				
35.33	47.2	28.20	3.6				
35.67	46.7	28.54	3.7				
36.19	45.1	28.72	3.8				
36.70	44.6	29.00	3.7				
37.22	43.6	29.29	3.8				
37.68	43.6	29.52	3.7				
38.20	43.6	29.70	3.6				
38.71	42.5	29.98	3.5				
39.17	41.5	30.27	3.4				
39.69	40.5	30.56	3.4				
40.21	40.0	30.73	3.4				
40.67	39.5	30.96	3.4				
41.18	38.9	31.31	3.5				
41.70	38.4	31.54	3.5				

TABLE B.15 : GULF ET AL STRACHAN 6-14-38-9W5 (CARDIUM FM) MINI-FRAC

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	0.0	10.69	33.7	0.00	0.00	23.08	3.45
2.85	0.0	11.40	33.7	0.00	0.80	23.08	2.92
2.85	2.3	11.83	33.7	0.00	1.65	23.08	2.55
2.99	3.3	12.26	33.7	0.00	1.86	23.08	2.18
3.14	5.1	12.[illegible]	32.7	0.52	1.86	23.34	1.75
3.28	7.5	12.26	30.4	0.78	2.02	23.34	1.17
3.56	12.6	12.26	28.5	1.04	2.18	23.34	0.69
3.71	17.8	12.26	26.2	2.08	2.12	23.34	0.16
3.56	21.0	12.26	24.3	2.33	2.28	23.60	0.00
3.85	27.6	12.26	22.4	2.85	2.39		
3.85	34.1	12.40	21.0	4.41	2.39		
3.99	34.6	12.68	22.4	5.71	2.39		
4.28	34.1	13.54	22.4	5.97	2.07		
4.56	34.6	14.33	22.4	6.22	1.91		
4.70	36.9	15.25	22.4	6.74	1.91		
4.85	41.6	16.29	22.3	7.00	1.81		
4.85	46.3	17.46	22.2	7.26	1.65		
5.13	46.3	18.96	22.0	7.52	1.75		
5.27	45.8	20.52	22.0	7.52	1.91		
5.56	45.4	22.09	22.0	8.04	1.81		
5.84	44.9	23.09	22.0	8.10	2.05		
6.13	44.0	24.66	22.0	9.08	2.02		
6.27	42.6	26.37	21.5	9.34	2.39		
6.56	42.1	27.90	21.5	9.60	2.82		
6.70	43.5	29.50	21.5	9.60	3.19		
6.84	42.6	31.21	21.5	11.15	3.19		
6.98	41.2	33.21	21.5	12.71	3.29		
7.13	40.7	34.92	21.5	12.71	3.51		
7.27	39.8	36.91	21.5	13.49	3.61		
7.41	38.3	38.41	21.3	14.26	3.61		
7.70	36.9	40.41	21.3	15.04	3.72		
7.84	36.0	41.90	21.3	15.30	3.61		
7.98	35.1			15.82	3.66		
8.12	34.1			16.08	3.82		
8.27	33.7			16.60	3.88		
8.27	32.7			18.15	3.88		
8.41	32.7			18.67	3.88		
8.55	33.7			19.19	3.88		
8.69	34.1			19.97	3.88		
9.41	33.7			21.53	3.88		
10.26	33.7			22.82	3.88		

TABLE B.16: GULF ET AL STRACHAN 6-14-38-9W5 (CARDIUM FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	21.6	23.39	40.6	62.80	22.0	0.00	0.00
0.00	23.8	23.52	42.0	63.80	22.0	0.00	0.63
0.13	26.6	23.92	44.2	64.80	22.0	0.13	1.16
0.26	27.5	25.77	22.6	65.80	22.0	0.27	1.85
0.26	28.4	26.47	22.4	66.80	22.0	0.27	2.59
0.26	28.8	26.80	22.4	67.80	22.0	0.40	3.17
0.39	29.7	27.80	22.4	68.80	22.0	0.40	3.70
0.39	31.1	28.80	22.3	69.80	21.9	0.53	3.80
0.39	32.4	29.80	22.3	70.80	21.9	0.67	3.91
0.53	33.4	30.80	22.3	71.80	21.9	0.93	3.96
1.05	33.4	31.80	22.2	72.80	21.9	1.47	3.91
1.71	33.4	32.80	22.2	73.80	21.9	2.27	3.91
2.23	33.4	33.80	22.2	74.80	21.9	3.34	3.91
3.29	33.4	34.80	22.2	75.80	21.9	4.67	3.91
3.81	33.4	35.80	22.2			6.67	3.91
4.73	33.8	36.80	22.1			7.48	3.91
5.52	33.8	37.80	22.2			8.54	3.85
6.18	33.8	38.80	22.2			9.48	3.85
6.97	33.8	39.80	22.1			10.41	3.85
7.88	34.3	40.80	22.1			11.35	3.85
9.07	34.3	41.80	22.1			12.41	3.91
10.12	33.8	42.80	22.1			13.35	3.91
11.04	34.3	43.80	22.1			14.15	3.85
11.96	34.3	44.80	22.1			15.22	3.91
12.88	34.3	45.80	22.1			16.02	3.91
13.93	34.3	46.80	22.1			16.95	3.91
15.11	33.8	47.80	22.1			18.82	3.85
16.03	33.8	48.80	22.1			20.02	3.85
17.21	33.8	49.80	22.1			20.96	3.91
18.40	33.8	50.80	22.1			21.62	3.85
19.45	33.8	51.80	22.1			22.16	3.85
19.84	33.8	52.80	22.1			23.09	3.85
20.50	33.8	53.80	22.0			23.49	3.75
21.16	34.3	54.80	22.0			24.29	3.64
21.81	34.7	55.80	22.0			24.56	3.59
22.08	34.7	56.80	22.0			24.56	2.43
22.60	35.2	57.80	22.0			24.56	1.32
22.73	36.1	58.80	22.0			24.69	0.42
22.87	37.4	59.80	22.0			24.69	0.00
23.13	38.8	60.80	22.0			27.63	0.00
23.26	39.7	61.80	22.0				

TABLE B.17 : GULF ET AL STRACHAN 11-27-37-9W5 (VIKING FM)

TIME (min)	SURFACE PRESSURE (MPa)
0.00	21.0
0.50	48.0
1.00	50.0
2.00	50.0
2.50	55.0
5.00	54.0
10.00	53.5
15.00	54.0
20.00	55.0
25.00	55.0
30.00	55.0
32.50	54.0
33.50	36.0
35.00	35.0
40.00	33.8
50.00	32.5
60.00	32.5
70.00	32.0
82.00	30.0
82.50	2.5

TIME (min)	INJECTION RATE (cu.m /min)
0.00	0.00
2.40	2.50
4.80	2.00
8.70	2.20
15.20	2.20
18.10	2.50
20.00	2.70
21.20	2.30
22.30	1.70
23.60	1.70
26.10	1.60
32.20	1.60
32.30	0.00

TABLE B.18 : GULF ET AL STRACHAN 10-29-37-9W5 (VIKING FM) PRE-PAD ACID SQUEEZES

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	4.60	13.53	54.06	10.00	0.00	32.93	0.08
0.95	8.45	13.76	55.16	13.38	0.00	32.93	0.53
1.34	9.00	14.03	54.06	13.39	0.13	32.99	0.47
1.73	11.20	14.31	54.06	13.45	0.13	33.17	0.00
2.07	14.49	14.43	54.61	13.51	0.36	34.15	0.00
2.24	19.44	14.87	55.16	13.57	0.30	34.16	0.81
2.40	23.84	15.21	54.61	13.66	0.00	34.22	0.81
2.52	30.43	15.21	52.41	22.71	0.00	34.28	0.08
2.63	36.48	15.32	52.41	22.72	0.76	34.40	0.00
2.74	43.07	15.43	50.22	22.78	0.70	34.39	0.64
3.08	40.87	15.77	48.02	22.84	0.00	34.45	0.70
3.63	39.77	16.05	47.47	23.37	0.00	34.51	1.43
3.97	38.67	16.55	45.27	23.36	0.13	34.69	1.43
4.08	45.82	17.00	43.62	23.42	0.13	34.69	1.26
4.14	53.51	17.50	42.52	23.48	0.36	34.81	1.21
4.25	62.31	18.06	41.42	23.54	0.47	34.81	0.00
4.31	68.90	18.51	40.87	23.60	0.70	34.97	0.07
4.36	70.00	19.01	39.77	23.83	0.76	34.98	0.30
4.47	67.80	19.57	39.77	23.95	0.59	35.04	0.47
4.59	63.96	20.02	39.22	24.02	0.00	35.10	0.42
4.70	60.66	21.02	38.12	24.72	0.00	35.22	0.25
4.98	62.86	22.03	37.58	24.71	0.47	35.33	0.25
5.20	60.66	22.42	37.03	24.77	0.47	35.39	0.00
5.54	59.56	22.53	36.48	24.91	0.00	39.21	0.00
5.87	58.46	23.04	36.48	24.95	0.08	39.21	0.36
6.15	57.36	23.54	35.38	25.13	0.00	39.32	0.36
6.32	55.71	24.04	35.38	29.07	0.00	39.38	0.13
6.60	54.61	24.43	34.83	29.11	0.13	39.44	0.13
6.99	55.16	24.66	34.28	29.11	1.26	39.44	0.00
7.38	55.16	24.83	36.48	29.23	1.26	40.85	0.00
7.94	54.06	24.94	39.77	29.29	0.76	40.85	0.98
8.50	54.06	24.99	41.97	29.47	0.76	40.91	1.04
9.00	54.06	25.11	45.82	29.47	0.30	40.91	1.66
9.51	53.51	25.11	49.12	29.52	0.30	41.02	1.77
9.95	54.06	25.16	51.86	29.58	0.59	41.02	1.72
10.46	54.06	25.27	54.61	29.64	0.59	41.02	1.49
10.62	53.51	25.33	51.86	29.72	0.00	41.14	1.43
11.07	54.06	25.44	49.67	32.70	0.00	41.20	0.00
12.08	54.06	25.61	48.02	32.75	0.81	41.25	0.00
12.80	54.06	25.83	46.92	32.81	0.81	41.32	0.13
12.92	53.51	26.00	45.27	32.81	0.01	41.44	0.13

TABLE B.18 : GULF ET AL STRACHAN 10-29-37-9W5 (VIKING FM) PRE-PAD ACID SQUEEZES

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
26.22	44.17	36.90	38.12	41.44	0.36		
26.50	42.52	37.29	37.03	41.55	0.47		
26.84	41.42	37.63	36.48	41.68	0.00		
27.23	40.32	38.13	35.93	45.89	0.00		
27.68	[illegible].67	38.64	35.38	45.90	0.19		
28.07	37.58	38.97	35.38	46.01	0.19		
28.46	36.48	39.42	34.83	46.01	0.36		
29.02	35.38	39.98	34.28	46.13	0.36		
29.41	34.28	40.43	34.28	46.19	0.13		
29.86	34.28	40.98	33.73	46.23	0.01		
30.31	33.73	41.38	33.73	46.32	0.00		
30.31	35.93	41.49	42.52	46.31	0.30		
30.36	37.58	41.71	57.36	46.31	1.26		
30.42	40.32	41.71	50.22	46.31	1.43		
30.47	44.17	41.82	46.92	46.42	1.49		
30.58	48.02	41.99	42.52	46.42	2.34		
30.64	44.72	42.38	38.12	46.42	2.45		
30.70	46.37	42.66	36.48	46.48	2.45		
30.81	44.17	43.00	35.93	46.53	2.06		
30.98	41.42	43.28	35.38	46.54	0.98		
31.31	39.77	43.61	35.38	46.55	0.59		
31.48	39.22	44.00	34.83	46.59	0.53		
31.87	38.12	44.51	33.73	46.60	0.00		
32.37	36.48	45.07	33.18	46.63	0.00		
32.88	35.93	45.35	33.18	46.66	0.42		
33.55	34.83	45.74	32.63	47.01	0.42		
34.11	34.28	45.96	32.08	47.30	0.36		
34.50	34.28	46.30	32.08	47.36	0.19		
35.00	33.73	46.69	32.08	47.52	0.00		
35.34	33.73	46.74	45.27	52.00	0.00		
35.39	39.22	46.91	61.21	52.00	0.42		
35.45	41.97	46.97	51.31	52.11	0.42		
35.51	44.72	47.08	44.72	52.12	0.00		
35.51	49.67	47.08	40.32	53.90	0.00		
35.56	59.01	47.81	38.67				
35.73	51.86	47.86	37.03				
35.90	48.02	48.25	35.93				
36.12	44.72	48.53	35.38				
36.29	41.42	48.98	34.83				
36.46	40.32	49.32	34.28				
36.68	[illegible]9.22	49.96	33.59				

TABLE B.18 : GULF ET AL STRACHAN 10-29-37-9W5 (VIKING FM) PRE-PAD ACID SQUEEZES

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
50.49	33.18						
50.99	32.63						
51.55	32.63						
52.00	32.08						
52.45	31.53						
52.95	31.53						
53.45	30.98						
53.90	30.98						

TABLE B.19 : GULF ET AL STRACHAN 10-29-37-9W5 (VIKING FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	31.09	7.52	59.95	0.00	0.00	6.30	1.60
0.22	50.52	7.91	59.95	0.11	0.17	6.69	1.60
0.28	56.62	8.19	59.40	0.17	1.10	6.81	1.65
0.28	59.95	8.52	58.84	0.17	1.32	7.03	1.65
0.33	64.39	8.75	58.29	0.22	1.60	7.03	1.88
0.45	65.50	9.02	58.84	0.28	1.88	7.14	1.88
0.61	64.39	9.08	59.40	0.34	1.88	7.20	1.82
0.61	62.17	9.19	57.73	0.39	1.77	7.25	1.82
0.78	62.17	9.30	58.29	0.50	1.60	7.25	1.88
0.95	61.06	9.64	58.29	0.61	1.60	7.31	1.88
1.06	60.51	10.14	58.29	0.73	1.32	7.42	1.82
1.11	61.62	10.64	57.73	0.78	1.43	7.48	1.71
1.17	62.73	11.14	58.29	0.89	1.38	7.59	1.71
1.28	63.84	11.20	58.84	1.06	1.32	7.75	1.71
1.34	64.95	11.31	58.29	1.17	1.38	7.92	1.71
1.50	63.84	11.70	58.84	1.23	1.49	8.20	1.71
1.73	64.39	11.92	58.84	1.34	1.65	8.37	1.77
2.12	64.95	12.42	60.51	1.40	1.82	8.59	1.77
2.62	64.39	12.98	62.17	1.56	1.82	8.81	1.77
3.06	64.39	13.15	62.73	1.73	1.82	8.98	1.77
3.57	63.84	13.54	63.28	1.84	1.77	9.04	1.88
4.07	64.39	13.76	63.84	2.06	1.77	9.15	1.88
4.68	63.84	13.98	64.95	2.40	1.77	9.15	1.80
4.73	64.39	14.09	65.50	2.68	1.77	9.26	1.71
4.85	64.95	14.15	63.84	3.07	1.71	9.37	1.71
4.90	62.17	14.32	65.50	3.57	1.71	9.43	1.82
4.96	63.28	14.43	66.06	4.07	1.71	9.65	1.82
5.29	63.28	14.65	67.17	4.18	1.71	10.10	1.82
5.35	63.84	15.09	69.39	4.35	1.65	10.26	1.82
5.51	63.84	15.26	69.39	4.52	1.65	10.71	1.82
5.51	61.62	15.54	69.95	4.74	1.65	11.32	1.77
5.57	62.17	15.82	69.95	4.85	1.60	11.71	1.77
6.13	62.17	16.43	69.39	4.97	1.49	11.94	1.77
6.63	61.62	17.04	69.95	5.13	1.49	11.99	1.88
6.91	61.62	17.66	69.39	5.36	1.54	12.16	1.88
6.96	62.17	18.55	69.39	5.41	1.71	12.22	1.93
7.07	62.73	18.77	69.39	5.47	1.65	12.33	1.88
7.30	61.06	18.99	69.95	5.58	1.54	12.38	1.82
7.41	59.95	19.33	69.95	5.63	1.54	12.77	1.88
7.46	59.40	19.50	69.39	5.69	1.60	13.11	1.82
7.46	58.29	19.77	68.84	5.97	1.60	13.56	1.82

TABLE B.19 : GULF ET AL STRACHAN 10-29-37-9W5 (VIKING FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
20.00	69.39	30.97	53.85	13.78	1.77	22.09	0.77
20.22	69.39	31.14	52.18	13.89	1.71	22.54	0.77
20.28	68.84	31.30	51.07	13.95	1.77	22.76	0.72
20.39	69.39	31.53	50.52	14.17	1.77	23.04	0.77
20.66	69.39	31.69	49.41	[illegible].22	1.43	23.37	0.72
20.83	68.84	31.92	48.30	14.45	1.43	23.65	0.66
21.00	68.28	32.14	47.74	14.73	1.43	23.93	0.66
21.33	68.84	32.31	46.63	14.78	1.43	24.10	0.66
21.83	69.39	32.53	45.52	15.01	1.43	24.49	0.72
22.11	69.39	32.75	45.52	15.17	1.32	24.66	0.61
22.56	69.39	32.92	44.41	15.34	1.21	24.88	0.72
22.73	68.84	33.14	43.85	15.40	1.16	24.93	0.66
23.00	69.39	33.31	43.85	15.51	1.21	25.16	0.61
23.34	69.95	33.53	42.74	15.62	1.32	25.38	0.50
23.90	69.39	33.70	42.19	15.68	1.43	25.60	0.44
24.17	69.39	33.92	41.63	15.84	1.54	25.83	0.44
24.51	68.84	34.14	41.08	16.01	1.65	26.05	0.39
24.62	67.72	34.31	40.52	16.12	1.65	26.16	0.33
24.84	69.39	34.53	40.52	16.29	1.65	26.33	0.22
25.18	68.84	34.76	40.52	16.46	1.65	26.50	0.22
25.62	69.95	34.92	39.97	16.62	1.54	26.66	0.17
26.12	69.95	35.15	39.97	16.90	1.43	26.78	0.22
26.62	70.50	35.31	39.41	17.24	1.38	26.94	0.22
27.13	69.95	35.54	39.41	17.35	1.32	27.11	0.17
27.35	68.28	35.70	39.41	17.57	1.27	27.17	0.11
27.68	67.17	35.93	38.86	17.79	1.21	27.33	0.11
27.91	68.28	36.15	38.86	17.91	1.16	27.52	0.03
28.24	70.50	36.32	38.86	18.13	1.16	27.67	0.11
28.18	69.39	36.54	38.86	18.35	1.16	27.89	0.22
28.57	64.95	36.76	38.30	18.63	1.10	28.11	0.33
28.91	59.95	36.93	38.30	18.74	0.94	28.17	0.33
29.02	64.95	37.15	38.30	19.13	0.99	28.28	0.17
29.19	70.50	37.32	38.30	19.52	0.94	28.45	0.06
29.35	67.72	37.49	38.30	20.14	0.94	28.79	0.03
29.52	65.50	37.71	37.75	20.36	0.83	28.95	0.17
29.74	63.84	38.10	38.30	20.42	0.83	29.01	0.33
29.91	62.17	38.60	37.19	20.47	0.94	29.12	0.39
30.13	59.95	39.10	37.19	20.75	0.88	29.23	0.39
30.36	58.29	39.60	36.64	20.81	0.83	29.23	0.11
30.52	56.62	40.05	36.08	21.09	0.77	29.36	0.00
30.75	54.96	40.61	36.08	21.59	0.77	29.40	0.11

TABLE 8.19 : GULF ET AL STRACHAN 10-29-37-9W5 (VIKING FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
41.11	36.08			29.45	0.39		
41.66	35.53			29.56	0.39		
42.05	34.97			29.66	0.00		
42.72	34.42			38.00	0.00		
43.06	34.42			47.40	0.00		
43.72	33.86						
44.06	33.86						
44.62	33.31						
45.06	33.31						
45.62	33.86						
46.23	33.31						
46.34	29.98						
46.45	24.98						
46.62	19.98						
46.84	14.99						
47.01	9.44						
47.12	5.55						
47.29	4.44						
47.40	0.00						

TABLE B.20 : GULF ET AL STRACHAN 7-13-38-9W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	6.70	15.32	37.30	0.00	0.00	17.97	3.44
1.02	7.22	15.57	36.78	0.00	0.41	18.61	3.50
1.79	7.22	16.09	37.30	0.00	0.77	19.10	3.47
2.30	7.22	16.60	39.37	0.32	1.18	19.90	3.41
2.55	6.[illegible]	16.85	38.85	0.32	1.59	20.06	3.31
3.06	6.70	17.36	38.85	0.96	1.47	20.38	3.15
3.57	7.22	17.62	37.81	1.28	1.59	21.34	3.15
4.09	7.22	18.13	36.78	1.77	1.43	21.34	2.96
4.34	8.26	18.64	36.26	2.09	1.18	21.34	2.80
4.60	10.85	19.40	36.78	2.57	0.99	21.50	2.55
4.60	11.89	19.66	35.74	2.73	0.70	21.50	2.39
4.60	12.92	20.68	35.74	3.21	0.67	21.50	2.23
4.85	13.44	20.94	34.18	3.85	0.64	21.82	2.01
5.11	14.48	20.94	32.11	4.01	0.83	21.82	1.82
5.36	16.03	20.94	30.55	4.01	1.02	21.98	1.59
5.36	17.59	21.45	29.00	4.17	1.08	22.14	1.43
6.13	17.59	21.70	27.44	4.49	1.08	22.79	1.37
6.89	17.59	22.47	26.92	4.81	0.83	23.11	1.15
7.40	17.59	22.72	25.37	5.30	0.61	23.11	0.99
8.17	17.59	22.98	24.33	5.30	0.41	23.27	0.80
8.68	17.59	22.98	26.41	5.30	0.00	23.27	0.64
9.19	17.59	23.23	28.48	12.36	0.03	23.27	0.48
9.96	17.59	23.23	30.55	12.52	0.13	23.43	0.73
10.21	17.59	23.23	31.07	12.84	0.19	23.43	1.05
10.98	17.59	23.49	31.59	13.32	0.22	23.43	1.37
11.23	17.59	23.75	33.67	13.64	0.61	23.43	1.69
11.75	17.59	24.26	32.63	14.28	1.21	23.59	1.82
12.00	18.63	24.77	33.67	14.28	1.63	23.59	2.14
12.26	20.70	25.02	35.22	14.28	1.98	23.75	2.42
12.77	22.78	25.02	35.74	14.44	2.36	23.75	2.45
13.28	24.33	25.53	36.78	14.60	2.55	24.07	2.58
13.28	25.37	26.04	36.78	14.60	2.77	24.07	2.80
13.53	26.92	26.81	35.74	14.92	2.90	24.23	3.00
13.53	29.00	27.57	35.22	15.40	2.90	24.71	3.09
13.79	30.55	28.60	35.22	15.73	2.77	25.19	3.00
13.79	32.63	29.62	34.70	15.73	2.58	25.35	3.15
13.79	34.70	30.38	34.18	15.73	2.80	25.51	3.38
13.79	35.74	31.15	34.70	16.21	2.93	25.83	3.47
13.96	36.80	31.40	34.18	16.69	3.03	26.48	3.47
14.04	37.30	32.17	35.22	16.85	3.19	26.80	3.54
14.81	37.30	33.19	34.70	17.01	3.44	27.44	3.54

TABLE B.20 : GULF ET AL STRACHAN 7-13-38-9W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
33.96	34.70	62.81	22.26	27.92	3.57		
34.72	34.70	63.32	22.26	28.72	3.57		
35.49	34.18	63.57	22.26	29.69	3.57		
36.51	33.67	64.34	21.74	30.65	3.57		
37.53	33.15	64.60	22.26	31.77	3.54		
38.55	33.15	65.36	22.26	32.57	3.54		
39.57	33.15	65.87	22.26	33.70	3.54		
40.60	32.63	66.38	22.26	34.66	3.54		
41.36	33.67	66.64	22.26	35.62	3.54		
42.38	33.67	67.40	21.74	36.42	3.57		
43.15	34.18	67.66	21.74	37.55	3.57		
43.92	33.67	68.17	21.74	38.51	3.60		
44.43	33.67	68.43	22.26	39.47	3.60		
45.45	34.18	69.19	21.74	40.60	3.60		
46.47	34.18	69.45	21.74	41.40	3.60		
47.23	34.18	69.96	21.74	42.36	3.60		
48.51	34.70	70.47	21.74	43.48	3.57		
49.53	35.22	71.23	21.74	44.29	3.60		
49.79	36.26	71.49	21.74	45.25	3.57		
51.06	36.26	72.00	21.74	46.37	3.57		
51.32	36.78			47.34	3.54		
52.09	36.78			48.14	3.50		
52.60	37.30			49.42	3.50		
52.85	37.81			50.06	3.60		
53.62	38.33			51.19	3.60		
53.87	39.37			52.15	3.54		
54.38	40.41			53.11	3.50		
54.89	41.44			53.59	3.44		
55.66	43.00			54.40	3.47		
55.92	22.78			55.04	3.44		
56.94	22.78			55.68	3.41		
57.45	22.78			55.84	3.03		
58.21	22.26			55.84	2.61		
58.47	22.78			55.84	2.26		
58.98	22.78			55.84	1.85		
59.75	22.78			55.84	1.47		
60.26	22.78			55.84	1.05		
60.77	22.26			55.84	0.67		
61.28	22.26			55.84	0.00		
61.79	22.26						
62.30	22.26						

TABLE B.21 : GULF ET AL STRACHAN 7-13-38-9W5 (BASAL QUARTZ FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	0.0	28.60	38.5	0.00	0.00	33.97	2.99
0.34	13.8	29.21	38.5	0.34	0.73	34.04	2.93
0.55	26.7	29.97	37.2	0.81	1.53	34.11	2.96
0.75	36.5	30.65	37.2	0.88	1.66	35.13	2.99
1.03	43.1	31.68	37.2	1.02	1.81	35.33	3.02
1.23	47.4	32.64	37.9	1.15	2.07	36.69	3.02
1.57	47.1	33.87	38.2	1.15	2.36	36.89	2.99
1.71	49.4	34.69	38.5	1.42	2.36	37.23	3.02
1.98	53.0	35.78	39.5	1.49	2.13	38.38	2.96
2.67	52.3	36.74	39.5	1.63	2.55	38.59	3.06
3.08	50.7	37.56	39.5	1.76	2.80	39.74	3.02
3.63	48.7	38.73	39.2	1.83	2.96	40.42	3.06
4.04	46.4	39.61	39.5	2.78	3.15	40.62	3.12
4.65	44.4	40.50	39.5	3.66	3.21	41.09	2.90
5.13	42.8	41.12	39.8	4.54	3.31	41.43	2.86
5.61	41.1	41.46	41.8	5.02	3.41	41.77	2.90
5.95	41.1	41.87	44.1	5.49	3.50	41.77	2.99
6.36	41.5	42.08	46.4	6.44	3.44	42.11	3.02
6.77	40.8	42.35	48.1	6.71	3.15	42.25	2.96
7.53	40.5	42.62	48.1	6.99	3.12	42.72	2.93
8.42	40.2	42.97	49.1	7.39	3.02	43.13	2.93
9.31	39.8	43.31	50.7	7.80	3.09	43.26	1.94
10.19	39.8	43.45	50.4	8.41	3.12	43.20	0.99
10.81	40.2	43.58	48.1	10.58	3.09	43.26	0.26
11.56	40.2	43.58	42.8	12.61	3.02	43.40	0.00
12.45	40.2	43.65	38.5	13.43	3.09		
13.48	39.8	43.72	35.2	14.65	3.09		
14.64	39.5	43.86	31.3	16.00	3.02		
15.67	39.2	44.06	30.3	16.75	3.06		
16.90	39.2	44.47	29.6	17.43	3.02		
18.06	39.2	45.22	29.3	18.58	3.06		
18.54	38.8	46.05	29.0	19.80	3.06		
19.02	38.5	46.94	29.0	21.56	3.02		
19.64	38.8	47.69	29.0	21.97	3.09		
20.53	38.8	48.65	29.0	23.46	3.06		
21.89	38.8	49.88	29.0	24.55	3.09		
22.99	38.5	50.70	29.0	26.31	3.09		
24.08	38.5	51.59	29.0	28.69	3.12		
25.32	38.8	52.55	29.0	30.65	3.12		
27.03	37.9	53.20	29.0	31.67	3.06		
27.92	38.8			32.62	3.09		

TABLE B.22 : GULF ET AL RICINUS 2-26-36-9W5 (CARDIUM FM) MINI-FRAC

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	BOTTOMHOLE PRESSURE (MPa)
0.00	0.0	0.00	0.00	0.00	20.9
0.29	6.0	0.01	0.75	0.18	20.3
0.43	10.1	0.12	1.50	0.36	21.2
0.57	12.4	0.23	1.83	0.45	23.3
0.72	15.2	0.28	2.47	0.73	25.9
0.72	17.5	0.44	2.77	0.82	29.5
0.86	23.5	0.60	3.16	0.82	32.5
1.00	29.0	0.60	3.54	1.09	38.8
1.00	35.0	0.82	3.51	1.18	44.7
1.00	38.3	0.84	3.39	1.18	54.9
1.00	44.2	0.93	3.27	1.27	59.9
1.14	48.4	1.04	3.18	1.36	64.1
1.31	49.8	1.09	2.99	1.45	66.5
1.37	51.1	1.14	2.81	1.54	66.8
1.43	51.6	1.25	2.52	1.63	68.0
1.57	53.0	1.31	2.62	1.82	68.3
1.72	53.0	1.41	2.79	2.00	66.2
1.72	49.3	1.47	2.83	2.00	64.7
1.86	48.9	1.58	2.89	2.36	64.7
2.15	48.9	1.68	3.00	2.91	65.3
2.57	48.9	1.68	3.04	3.27	65.0
2.86	49.3	1.68	3.14	3.27	64.4
3.00	48.9	1.90	3.04	3.81	64.1
3.15	47.9	1.90	2.93	4.54	64.1
3.72	47.9	1.95	2.62	4.72	64.1
4.29	47.9	2.06	2.72	4.99	63.8
4.43	47.9	2.28	2.83	5.54	62.9
4.86	47.9	2.49	2.83	5.72	63.8
5.15	47.5	3.25	2.83	5.81	64.7
5.43	47.0	3.35	2.70	6.08	64.7
5.43	47.0	3.46	2.72	6.45	63.8
5.58	47.9	3.68	2.74	6.72	62.0
5.72	48.9	4.11	2.75	7.36	60.2
5.86	48.9	4.86	2.77	7.63	58.8
6.29	47.9	5.19	2.79	7.90	56.4
7.01	46.1	5.67	2.85	8.35	54.3
7.29	43.8	5.94	2.87	8.72	52.5
7.72	42.4	6.00	2.95	8.99	51.3
8.29	40.1	6.05	3.02	9.17	49.8
8.58	37.8	6.21	3.12	9.44	50.7
8.72	36.9	6.48	3.12	9.90	50.4

TABLE B.22 : GULF ET AL RICINUS 2-26-36-9W5 (CARDIUM FM) MINI-FRAC

TIME (min)	SURFACE PRESSURE (MPa)
9.01	35.9
9.15	36.4
9.87	36.4
9.87	30.9
10.01	26.3
10.15	24.9
10.58	24.9
11.43	24.8
12.18	24.7
12.87	24.4
13.16	24.4
14.01	24.4
14.44	24.0
14.73	24.0
15.30	24.0
15.73	24.0
16.02	23.5
16.30	23.5
16.44	23.5
16.87	23.0
17.16	22.6
17.59	22.6
17.73	22.1
18.02	22.1
18.16	21.7
18.45	21.2
18.45	21.2
18.88	20.7
19.16	20.3
19.30	19.8
19.45	19.4
19.59	19.4
19.88	18.9
20.16	18.4
20.31	18.4
20.59	18.0
20.73	18.0
20.88	17.5
21.02	17.1
21.31	17.1
21.45	16.6

TIME (min)	INJECTION RATE (cu.m /min)
6.59	3.18
6.97	3.20
7.34	3.27
7.67	3.29
8.04	3.33
8.48	3.41
8.91	3.49
9.18	3.54
9.66	3.66
9.66	3.62
10.09	3.60
10.25	3.58
10.31	3.02
10.36	0.14
10.47	0.00

TIME (min)	BOTTOMHOLE PRESSURE (MPa)
9.90	46.8
10.08	50.4
10.53	51.0
10.90	50.7
11.44	50.4
11.90	50.4
12.44	50.1
12.99	50.7
13.44	50.4
13.98	49.8
14.44	49.8
14.89	49.5
15.44	49.5
15.98	49.5
16.44	48.6
17.07	48.3
17.53	48.0
18.16	47.4
18.61	46.8
19.07	46.2
19.52	45.6
19.89	45.0
20.34	44.1
20.88	43.2
21.43	42.4
21.97	41.8
22.52	41.2
22.79	40.3
23.34	39.7
23.88	39.1
24.43	38.2
24.97	37.6
25.61	37.0
25.88	36.7
26.24	36.1
26.79	35.8
27.33	35.2
27.88	34.6
28.69	34.0
29.33	33.4
29.78	33.1

TABLE B.22 : GULF ET AL RICINUS 2-26-36-9W5 (CARDIUM FM) MINI-FRAC

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	BOTTOMHOLE PRESSURE (MPa)
21.74	16.1			30.51	32.5
22.16	15.7			30.87	31.9
22.31	15.2			31.51	31.9
22.59	14.7			32.05	31.6
22.88	14.3			32.51	31.3
23.16	13.8			33.05	31.0
23.59	13.8			33.78	31.0
24.02	13.4			34.14	30.7
24.31	12.4			34.60	30.4
24.59	12.4			35.05	30.1
25.02	12.0			35.69	30.1
25.45	11.5			36.41	29.5
25.88	11.1			37.05	29.2
26.31	10.6			38.23	28.9
26.88	10.1			39.14	28.9
27.31	9.7			40.13	28.3
27.60	9.2			41.32	28.0
28.03	8.8			42.50	27.7
28.46	8.3			43.77	27.4
28.88	8.3			44.95	27.1
29.31	7.8			46.04	27.1
29.74	7.4			47.85	26.8
30.17	7.4			49.85	26.8
30.74	6.9			51.85	26.5
31.03	6.9			54.39	26.2
31.32	6.5			56.93	26.2
31.74	6.5			59.84	25.7
32.32	6.0			61.20	25.7
32.75	6.0				
33.32	6.0				
33.75	5.5				
34.03	5.5				
34.32	5.5				
34.60	5.1				
35.03	5.1				
35.46	4.6				
35.89	4.6				
36.18	4.6				
36.46	4.6				
37.04	4.1				
37.46	4.1				

TABLE B.22 : GULF ET AL RICINUS 2-26-36-9W5 (CARDIUN FM) MINI-FRAC

TIME (min)	SURFACE PRESSURE (MPa)
37.89	4.1
38.32	3.7
38.89	3.7
39.47	3.2
39.89	3.2
40.47	3.2
41.04	2.8
41.90	2.8
42.33	2.8
43.04	2.8
43.61	2.8
44.33	2.3
45.19	2.3
45.90	2.3
46.76	2.3
47.62	2.3
48.62	1.8
49.62	1.8
50.62	1.4
51.76	1.4
52.76	0.9
53.91	0.9
55.48	0.9
56.77	0.9
57.48	0.9
58.34	0.9
59.34	0.5
60.20	0.5
61.20	0.5

TABLE B.23 : GULF ET AL RICINUS 2-26-36-9W5 (CARDIUN FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	BOTTOMHOLE PRESSURE (MPa)
0.00	2.1	0.00	0.00	0.00	25.3
0.18	2.7	0.10	0.14	0.18	24.1
0.27	3.6	0.25	0.27	0.27	25.0
0.53	3.3	0.34	0.17	0.36	28.0
0.80	2.7	0.49	0.03	0.45	28.0
0.80	2.7	1.57	0.03	0.80	27.4
1.07	3.3	1.72	0.11	1.16	27.1
1.07	2.7	2.01	0.05	1.43	26.5
1.33	2.7	2.06	0.17	1.70	26.5
1.60	1.8	2.16	0.17	1.79	25.3
1.69	2.7	2.35	0.18	1.79	26.8
1.69	3.9	2.40	0.68	1.88	28.0
1.78	4.2	2.40	1.16	2.06	29.4
1.87	5.1	2.50	1.66	2.15	30.6
1.96	5.6	2.65	1.90	2.24	32.4
2.13	7.7	2.75	2.51	2.32	33.3
2.13	8.9	2.75	2.79	2.41	37.4
2.22	10.4	2.84	3.07	2.41	43.3
2.31	11.0	3.09	3.22	2.59	53.3
2.58	17.5	3.53	3.20	2.68	54.5
2.67	25.2	3.73	3.16	2.77	55.9
2.76	36.8	3.87	3.26	2.95	55.1
2.84	38.6	3.87	3.41	3.13	54.2
2.93	41.9	4.12	3.46	3.31	53.3
3.02	42.2	4.61	3.49	3.49	52.4
3.20	41.6	5.34	3.52	3.84	51.5
3.29	41.6	6.52	3.52	4.11	52.1
3.38	40.7	8.23	3.52	4.65	51.8
3.56	40.1	9.31	3.58	5.10	51.2
3.91	39.8	11.57	3.55	5.36	50.9
3.91	39.5	15.19	3.58	6.17	50.6
4.09	39.5	15.73	3.67	7.33	50.6
4.18	40.1	15.83	3.66	7.78	50.6
4.27	40.7	15.88	3.58	8.40	50.9
4.27	40.7	16.22	3.55	8.76	50.9
4.62	40.4	17.35	3.56	9.56	51.5
4.80	40.1	17.84	3.56	10.01	52.1
5.33	40.1	18.62	3.55	10.73	52.7
5.87	39.5	19.02	3.46	11.26	52.7
6.40	39.2	19.51	3.40	11.89	53.0
7.20	39.2	19.61	3.19	12.60	53.6

TABLE B.23 : GULF ET AL RICINUS 2-26-36-9W5 (CARDIUN FM)

TIME (min)	SURFACE PRESSURE (MPa)
7.64	38.9
8.00	38.9
8.18	39.2
8.35	38.6
8.98	38.3
9.42	38.0
10.31	38.0
10.67	37.4
11.11	37.1
11.73	37.1
12.18	36.8
12.53	36.5
13.15	36.2
13.60	36.2
14.40	36.2
14.93	36.2
15.11	35.9
15.73	35.9
15.91	35.9
16.26	35.3
16.44	35.1
16.62	35.3
17.06	35.3
17.78	35.3
18.04	35.6
18.49	35.6
18.84	36.2
19.02	36.5
19.37	36.8
19.37	37.1
19.64	37.7
19.82	38.3
20.00	38.6
20.17	39.2
20.26	39.2
20.35	37.4
20.44	37.1
20.62	37.4
20.62	38.0
20.71	37.7
20.80	35.9

TIME (min)	INJECTION RATE (cu.m /min)
19.70	3.05
20.00	3.01
20.10	2.76
20.19	2.57
20.34	2.60
20.39	2.49
20.44	1.92
20.63	1.77
20.73	1.28
20.73	0.11
20.83	0.00

TIME (min)	BOTTOMHOLE PRESSURE (MPa)
13.14	53.9
13.94	54.8
14.75	55.1
15.73	55.1
16.00	55.3
16.36	54.5
16.54	55.9
16.80	56.5
17.43	56.8
17.79	57.4
18.15	57.7
18.95	57.7
19.31	56.8
19.58	55.6
19.84	55.3
20.38	55.3
20.38	53.6
20.92	53.6
20.92	51.8
21.09	51.8
21.18	50.3
21.27	49.2
21.45	49.2
21.54	45.6
21.54	49.5
21.63	50.9
21.81	51.5
21.99	50.6
22.17	50.3
22.70	50.0
23.42	49.8
24.40	49.8
25.30	50.0
26.37	49.8
27.35	49.8
28.42	50.0
29.41	49.8
30.48	49.8
31.37	49.8
32.36	49.8
33.34	49.5

TABLE B.23 : GULF ET AL RICINUS 2-26-36-9W5 (CARDIUM FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	BOTTOMHOLE PRESSURE (MPa)
20.97	35.6			34.23	49.5
21.06	35.9			34.68	49.2
21.24	34.8			35.04	48.9
21.24	31.8			35.40	48.0
21.51	31.5			35.84	47.7
21.51	26.7			36.11	46.8
21.60	25.8			36.38	46.2
21.86	25.0			36.56	45.6
22.13	24.7			36.74	45.3
22.40	24.4			37.01	45.3
22.84	24.4			37.27	44.7
23.55	24.4			37.72	44.7
24.35	24.1			38.08	44.5
25.24	24.1			38.52	44.2
26.22	24.4			38.70	43.9
27.28	24.1			39.33	44.2
28.44	24.1			40.22	43.9
29.68	24.1			41.56	44.2
30.93	24.1			42.46	44.2
31.99	24.1			43.35	44.2
32.88	24.1			43.53	43.9
33.51	24.1			43.89	43.3
34.22	23.8			44.25	43.0
34.66	23.8			44.42	42.4
34.84	23.2			44.51	42.1
35.19	22.9			44.69	41.5
35.37	22.3			45.05	41.5
35.73	21.4			45.68	41.5
35.91	21.1			46.12	41.2
36.35	20.8			46.48	41.5
36.62	20.2			46.84	41.5
36.79	19.9			47.11	41.2
37.06	19.6			47.73	41.2
37.42	19.3			48.18	41.2
37.86	19.0			48.89	41.2
38.39	18.7			49.25	40.9
38.66	18.4			49.52	40.9
40.44	18.1			49.79	40.9
43.19	17.8			49.97	40.6
43.55	17.8			50.41	40.9
43.81	17.5			50.86	40.9

TABLE B.23 : GULF ET AL RICINUS 2-26-36-9W5 (CARDIUN FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	BOTTOMHOLE PRESSURE (MPa)
44.17	17.2			51.13	40.6
44.35	16.6			51.40	40.6
44.44	16.3			51.75	40.6
44.53	16.0			52.11	40.6
44.61	15.7			52.38	40.6
46.21	15.7			52.47	40.3
47.55	15.4			52.92	40.3
48.97	15.4			53.36	40.3
50.04	15.1			53.81	40.3
51.10	15.1			53.90	40.0
51.90	14.9			54.35	40.0
52.52	14.6			54.88	40.0
53.24	14.6			55.51	40.0
53.77	14.6			55.69	40.0
54.92	14.6			55.86	40.0
55.55	14.6			56.04	39.7
56.26	14.3			56.31	40.0
56.35	14.0			56.40	39.7
56.43	13.7			56.49	39.2
56.43	13.7			56.58	38.9
56.79	13.1			56.85	38.9
57.50	12.8			56.94	38.9
58.21	12.8			57.30	38.6
59.01	12.5			57.47	38.6
59.55	12.2			58.01	38.3
60.17	12.2			58.46	38.3
60.43	11.9			58.81	38.6
60.52	11.3			58.90	38.3
60.70	10.7			59.26	38.3
60.88	9.8			59.71	38.0
61.06	9.5			60.07	38.0
61.23	9.2			60.16	37.7
61.41	8.9			60.33	37.7
61.59	8.6			60.51	37.7
61.77	8.3			60.60	37.1
62.03	8.0			60.69	36.8
62.12	7.7			60.78	36.5
62.30	7.7			60.96	35.9
				61.14	35.3
				61.23	35.0
				61.41	35.0

TABLE B.23 : GULF ET AL RICINUS 2-26-36-9W5 (CARDIUN FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	BOTTOMHOLE PRESSURE (MPa)
				61.59	34.4
				61.67	34.1
				61.94	33.9
				62.03	33.9
				62.21	33.9
				62.30	33.6

TABLE B.24 : GULF ET AL WEST RICINUS 7-33-36-10W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	0.0	13.15	68.4	0.00	0.00	26.01	3.10
4.38	1.6	13.48	68.4	0.12	1.35	27.45	3.18
4.55	19.1	13.64	68.4	0.23	0.48	27.97	3.18
4.71	40.5	13.96	68.9	0.35	1.75	29.00	3.18
4.76	50.9	[illegible]13	70.0	0.52	1.11	29.98	3.10
4.87	47.0	14.18	68.9	0.75	1.83	30.96	3.18
4.98	53.1	14.34	70.0	0.92	2.47	31.94	3.10
5.14	58.5	14.56	70.0	1.55	2.47	32.98	3.18
5.36	61.3	14.83	69.5	2.07	2.47	33.95	3.10
5.57	66.2	15.10	68.9	2.53	2.63	34.99	3.02
5.63	65.6	15.32	67.8	2.99	2.55	36.03	3.10
5.74	68.4	15.53	66.7	3.51	2.63	36.95	3.02
5.90	70.0	15.80	65.1	4.03	2.63	37.98	3.10
6.17	67.8	16.02	64.5	4.55	2.71	38.96	3.02
6.49	66.7	16.34	64.0	5.01	2.71	40.11	3.10
6.60	66.7	16.56	62.9	5.29	1.19	41.09	2.95
6.77	66.2	16.72	60.7	5.53	2.15	42.07	2.95
6.87	67.3	16.94	59.1	6.10	2.63	43.10	2.95
7.14	66.2	17.37	59.6	7.08	2.39	44.08	2.87
7.31	66.7	17.86	58.0	8.06	3.02	45.06	3.02
7.58	66.2	18.35	57.4	9.09	3.02	46.10	3.02
7.85	65.6	18.78	56.9	9.96	3.34	47.08	3.02
8.01	66.2	19.21	57.4	10.74	3.90	48.11	2.95
8.28	66.2	19.65	57.4	11.54	3.74	49.03	3.02
8.50	66.2	20.24	58.0	13.06	3.42	50.13	2.95
8.93	64.5	20.73	57.4	13.64	3.42	51.10	2.95
9.20	62.3	21.16	57.4	13.93	3.18	51.68	3.02
9.42	62.9	21.43	58.5	15.08	3.10	51.85	2.71
9.74	62.3	21.65	58.5	15.54	2.79	52.08	2.71
9.85	64.0	22.14	58.5	16.52	2.71	52.48	2.79
10.34	64.5	22.62	58.0	17.15	2.87	53.00	2.79
10.55	65.6	23.11	58.0	17.55	2.95	54.04	2.87
10.82	67.8	23.49	58.0	18.53	3.02	55.02	2.87
11.26	66.2	23.98	58.0	19.57	3.02	56.00	2.87
11.74	67.8	24.41	57.4	20.03	3.02	56.34	3.02
12.01	68.9	25.33	55.8	20.55	3.02	56.97	2.87
12.12	67.8	26.30	55.8	21.01	3.02	58.07	2.87
12.23	68.9	27.28	55.2	22.04	3.02	58.99	2.79
12.45	69.5	2[illegible]30	55.2	23.08	3.18	60.02	2.87
12.72	70.0	29.12	54.7	24.11	3.10	61.06	2.95
12.88	68.4	3[illegible].09	55.2	25.03	3.10	62.04	2.87

TABLE B.24 : GULF ET AL WEST RICINUS 7-33-36-10W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
31.01	55.8	53.57	54.7	62.61	2.95		
31.99	56.3	54.54	55.7	62.73	2.55		
32.96	56.9	54.97	55.2	63.82	2.39		
33.88	57.4	55.46	55.2	64.34	2.87		
34.80	57.4	55.89	55.2	64.74	2.39		
35.72	57.4	56.38	55.7	66.12	2.39		
36.64	57.4	56.86	56.3	66.24	2.15		
37.13	57.4	57.29	56.8	66.99	2.15		
37.72	57.4	57.83	57.8	67.97	2.07		
38.26	57.4	58.26	58.3	69.00	2.07		
38.64	57.4	58.59	58.3	69.86	2.15		
39.13	57.4	58.64	55.7	70.44	1.67		
39.62	56.9	59.23	55.7	70.61	1.11		
40.05	57.4	59.66	55.7	70.96	1.19		
40.59	56.9	59.72	54.7	71.19	0.96		
40.97	57.4	60.15	55.2	71.59	1.04		
41.46	56.9	60.20	57.8	71.71	0.88		
41.94	57.4	60.42	59.3	72.34	0.96		
42.38	57.4	60.53	57.8	72.51	0.64		
42.86	56.9	60.64	59.3	73.03	0.64		
43.35	56.9	61.07	59.9	73.95	0.48		
43.84	56.9	61.50	61.4	75.04	0.32		
44.38	56.9	61.98	62.4	76.08	0.24		
44.76	56.9	62.04	60.9	77.00	0.00		
45.25	56.9	62.47	62.9				
45.73	56.9	62.95	64.0				
46.22	55.8	63.44	65.0				
46.65	55.8	63.87	66.5				
47.09	55.2	64.36	68.1				
47.57	55.2	64.79	70.6				
48.06	55.2	65.22	72.2				
48.44	55.2	65.43	73.2				
48.49	53.6	65.60	72.7				
48.98	53.1	65.65	74.2				
49.52	53.1	65.86	71.7				
49.95	53.1	65.97	72.7				
50.44	53.1	66.13	73.2				
50.93	53.1	66.24	72.2				
51.36	54.1	66.24	72.7				
51.74	55.2	66.46	72.2				
52.66	54.7	66.51	73.2				

TABLE B.24 : GULF ET AL WEST RICINUS 7-33-36-10W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)
66.62	72.7	84.03	67.0
66.89	72.7	84.52	67.0
67.05	72.7	85.00	67.0
67.16	73.2	85.49	67.0
67.27	72.7	85.92	66.5
67.54	73.2	86.35	67.0
68.07	72.2	86.84	66.5
68.51	73.2	87.32	66.5
68.78	74.2	87.81	66.0
68.99	73.7	88.24	66.5
69.42	73.2	88.72	66.0
69.80	74.2	89.21	66.0
70.34	73.2	89.69	66.0
70.88	72.7	90.18	66.0
71.31	73.7	90.66	65.5
71.85	74.2	91.09	66.0
72.33	73.2	91.58	66.0
72.82	72.2	92.01	66.0
73.30	71.7	92.50	65.5
73.79	71.7	92.98	65.5
74.27	71.2	93.47	65.5
74.71	70.6	93.90	65.5
75.14	70.6	94.33	65.5
75.57	70.6	94.87	65.5
76.05	70.6	95.35	65.5
76.54	69.6	95.78	65.0
77.02	69.6	96.27	65.0
77.51	69.1	96.70	65.0
77.94	69.1	97.19	65.0
78.43	68.6	97.67	65.0
78.91	68.6	98.21	65.0
79.40	68.1	98.64	65.0
79.83	68.6	99.13	64.5
80.26	68.6	99.50	64.5
80.74	68.1	99.99	64.5
81.28	68.1		
81.71	68.1		
82.20	67.6		
82.68	67.6		
83.17	67.6		
83.66	67.6		

TABLE B.25 : GULF ET AL WEST RICINUS 7-33-36-10-W5 (OSTRACOD FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	0.0	22.53	51.6	0.00	0.00	26.40	2.30
0.00	18.5	22.92	51.0	3.73	0.00	27.46	2.30
0.50	19.0	23.14	51.0	3.84	0.53	27.96	2.47
1.45	19.0	23.76	51.6	4.12	0.71	28.91	2.47
2.45	19.0	24.20	50.5	4.23	1.24	29.41	2.21
3.40	19.5	25.15	51.0	4.40	1.24	30.41	2.30
4.46	20.1	25.54	50.5	4.85	1.24	31.36	2.39
5.35	23.9	26.54	50.5	5.12	1.68	32.30	2.39
5.86	25.0	27.55	50.5	5.35	1.86	33.25	2.39
6.41	28.2	28.55	50.5	5.63	1.94	34.75	2.47
6.86	32.0	28.89	50.5	5.90	1.59	35.26	2.47
7.19	35.8	29.05	49.4	6.35	1.59	36.20	2.39
7.58	39.6	30.00	48.8	6.68	1.77	37.15	2.47
7.81	44.0	30.95	48.8	7.13	1.59	38.15	2.47
8.14	49.9	31.90	48.3	7.80	1.59	39.60	2.56
8.31	53.2	32.90	48.3	8.13	1.41	41.05	2.56
8.70	53.2	33.85	48.3	8.41	1.68	42.55	2.65
9.15	54.8	34.80	48.3	8.80	1.59	43.00	2.65
9.20	55.3	35.86	47.8	9.19	1.94	43.00	2.56
9.42	55.3	36.86	48.3	9.52	2.30	43.44	2.47
9.48	54.3	37.75	46.7	9.80	1.94	43.78	2.39
10.15	54.3	38.25	47.8	10.14	2.21	43.83	1.68
11.15	52.1	39.20	47.2	10.64	2.12	43.94	1.33
11.60	51.0	40.20	47.8	11.14	2.03	44.00	0.00
12.10	50.5	41.10	48.3	12.09	2.03	44.00	0.00
13.05	48.8	42.16	49.9	13.14	2.03		
14.00	50.5	43.10	49.9	14.04	2.12		
14.55	51.0	43.38	49.9	14.93	1.94		
15.00	51.0	43.55	54.3	15.93	2.03		
15.45	49.9	43.66	58.1	16.93	2.03		
15.95	49.9	43.66	61.9	17.88	2.03		
16.45	50.5	43.77	65.1	18.77	2.03		
16.90	51.0	43.89	70.0	19.77	2.03		
17.40	51.6	44.11	66.7	20.78	2.03		
17.84	51.0	44.55	64.0	21.44	1.94		
18.35	50.5	45.34	68.9	21.72	2.30		
19.35	51.0	45.56	68.4	22.22	2.21		
20.07	50.5	46.06	66.2	22.78	1.94		
20.86	51.0	46.51	64.0	23.73	2.21		
21.75	52.1	47.06	62.9	24.62	2.21		
22.25	51.0	47.45	61.3	25.51	2.39		

TABLE B.25 : GULF ET AL WEST RICINUS 7-33-36-10-W5 (OSTRACOD FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
47.96	60.2	67.31	49.9				
48.46	58.6	67.81	49.4				
48.96	57.5	68.31	49.9				
49.41	57.0	68.76	49.4				
49.85	56.4	69.20	49.4				
50.19	54.8	69.70	48.8				
50.35	55.3	70.20	48.8				
50.86	55.3	70.65	49.4				
51.36	55.3	71.15	49.4				
51.86	55.3	71.60	48.8				
52.31	54.8	72.21	48.8				
52.75	54.8	72.66	48.8				
53.25	54.8	73.05	49.4				
53.76	54.3	73.55	49.4				
54.26	54.3	74.05	48.8				
54.70	53.7	74.55	48.8				
55.15	53.2	75.00	47.8				
55.71	52.6	75.00	47.8				
56.21	52.6						
56.71	52.6						
57.10	52.6						
57.66	52.6						
58.10	52.1						
58.61	52.1						
59.11	52.1						
59.55	52.1						
60.06	51.6						
60.50	51.6						
60.95	51.6						
61.51	51.6						
62.01	51.0						
62.45	51.0						
62.96	51.0						
63.46	51.0						
63.90	51.0						
64.41	51.0						
64.91	51.0						
65.41	50.5						
65.91	50.5						
66.36	49.9						
66.86	49.9						

TABLE B.26 : GULF GARRINGTON 6-9-36-6W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	0.0	1.20	17.8	0.00	0.45	4.10	3.21
0.08	0.0	1.20	18.5	0.08	0.01	4.18	3.28
0.08	0.7	1.20	19.3	1.29	0.01	4.25	3.28
0.08	1.5	1.20	20.0	1.29	0.90	4.25	3.21
0.15	1.5	1.20	20.8	1.37	0.90	4.48	3.28
0.23	1.5	1.28	21.5	1.37	1.53	4.56	3.21
0.30	1.5	1.28	22.3	1.44	1.12	4.63	3.21
0.38	1.5	1.28	23.0	1.52	1.08	4.71	3.24
0.45	1.5	1.20	24.5	1.52	0.30	4.76	3.25
0.45	0.7	1.20	25.2	1.67	0.23	4.78	3.32
0.53	0.7	1.20	26.0	1.67	0.15	5.09	3.28
0.60	0.7	1.20	26.7	1.75	0.12	5.09	3.28
0.68	0.7	1.28	27.5	1.82	0.01	5.16	3.24
0.75	1.5	1.28	28.2	1.90	0.15	5.19	3.21
0.83	1.5	1.28	30.4	1.90	1.12	5.24	3.21
0.90	1.5	1.28	31.2	1.97	1.12	5.28	3.17
0.98	1.5	1.28	31.9	1.97	1.83	5.38	3.16
1.05	1.5	1.28	32.6	2.05	1.90	5.39	3.13
1.13	1.5	1.28	33.4	2.05	2.35	5.54	3.13
1.20	1.5	1.28	34.1	2.20	2.35	5.62	3.21
1.20	2.2	1.28	34.9	2.20	2.57	6.15	3.17
1.20	3.0	1.28	35.6	2.26	2.58	6.23	3.21
1.20	3.7	1.28	36.4	2.28	2.72	6.46	3.21
1.20	4.5	1.35	36.4	2.35	2.76	6.46	3.09
1.20	5.2	1.35	37.1	2.43	2.72	6.54	3.02
1.20	5.9	1.35	37.8	2.51	2.83	6.59	3.02
1.20	6.7	1.35	38.6	2.51	2.83	6.61	3.09
1.20	7.4	1.43	38.6	2.54	2.90	6.68	3.09
1.20	8.2	1.43	37.8	2.66	2.95	6.76	3.21
1.20	8.9	1.50	38.6	2.73	2.95	6.76	3.21
1.20	9.6	1.50	37.8	2.73	2.91	6.83	2.98
1.20	10.4	1.58	37.8	2.81	2.91	6.91	3.21
1.20	11.1	1.65	38.6	2.89	2.87	6.91	3.21
1.20	11.9	1.65	39.3	3.04	2.87	6.94	3.27
1.20	12.6	1.65	40.1	3.04	2.95	7.06	3.28
1.20	13.4	1.73	40.1	3.19	2.87	7.06	3.24
1.20	14.1	1.73	40.8	3.19	2.87	7.21	3.24
1.20	14.8	1.73	41.5	3.27	3.17	7.29	2.98
1.20	15.6	1.80	42.3	3.42	3.13	7.37	2.98
1.20	16.3	1.80	43.0	3.65	3.17	7.39	3.17
1.20	17.1	1.80	43.8	3.80	3.13	7.59	3.21

TABLE B.26 : GULF GARRINGTON 6-9-36-6W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
1.80	44.5	3.61	51.2	7.75	3.28	18.30	3.06
1.88	44.5	3.68	51.2	8.13	3.24	18.61	2.87
1.88	46.0	3.76	51.2	8.20	3.28	18.68	2.95
1.88	46.7	3.83	51.2	8.28	3.21	18.76	2.95
1.95	47.5	3.91	51.2	8.43	3.24	18.91	2.87
1.95	48.2	3.98	51.2	8.51	3.32	19.06	2.83
1.95	49.0	4.06	51.2	8.66	3.32	19.08	2.75
1.95	49.7	4.13	51.2	8.73	3.28	19.21	2.65
1.95	50.5	4.21	51.2	9.11	3.28	19.23	2.41
2.03	50.5	4.28	51.2	9.19	3.28	19.29	2.24
2.03	49.7	4.36	51.2	9.72	3.28	19.36	2.01
2.10	50.5	4.43	51.2	9.95	3.35	19.44	1.83
2.18	50.5	4.51	51.2	10.18	3.32	19.52	1.79
2.25	50.5	4.58	51.2	12.00	3.32	19.52	0.71
2.33	50.5	4.66	51.2	12.15	3.39	19.59	0.67
2.33	51.2	4.73	51.2	12.18	3.50	19.67	0.15
2.41	51.2	4.81	51.2	12.23	3.54	19.67	0.12
2.41	50.5	4.88	51.2	12.45	3.54	19.74	0.01
2.41	51.2	4.88	51.9	12.53	3.50	20.11	0.00
2.48	51.2	4.96	51.9	12.81	3.50	20.12	0.34
2.56	51.2	4.96	52.7	12.83	3.47	20.20	0.34
2.63	51.2	5.03	52.7	12.99	3.50	20.20	1.27
2.63	50.5	5.11	52.7	13.14	3.43	20.28	1.08
2.71	50.5	5.11	51.9	13.29	3.43	20.35	1.01
2.78	50.5	5.19	51.9	13.52	3.39	20.35	0.49
2.78	51.2	5.26	51.9	13.59	3.35	20.43	0.41
2.86	51.2	5.26	52.7	13.90	3.35	20.43	0.19
2.93	50.5	5.26	51.9	13.97	3.35	20.50	0.15
2.93	51.2	5.34	51.9	14.13	3.35	20.58	0.04
3.01	51.2	5.41	51.9	14.20	3.32	20.66	0.12
3.01	51.9	5.49	51.9	15.04	3.32	20.73	0.23
3.08	51.9	5.56	51.9	15.42	3.28	20.87	0.08
3.16	51.9	5.64	51.9	15.49	3.24	20.88	0.23
3.23	51.9	5.64	52.7	15.95	3.24	20.95	0.22
3.31	51.9	5.71	52.7	16.02	3.21	20.96	0.34
3.31	51.2	5.79	52.7	16.56	3.21	21.04	0.41
3.38	51.2	5.86	52.7	16.78	3.17	21.11	0.30
3.46	51.2	5.94	52.7	17.24	3.17	21.11	0.23
3.53	51.2	5.94	51.9	17.39	3.13	21.25	0.07
3.61	51.2	5.94	52.7	17.47	3.09	21.26	0.27
3.68	51.2	6.01	52.7	18.15	3.13	21.34	0.27

TABLE B.26 : GULF GARRINGTON 6-9-36-6W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
6.09	52.7	8.04	53.4	21.34	0.34		
6.16	52.7	8.12	53.4	21.42	0.34		
6.24	52.7	8.19	53.4	21.49	0.41		
6.31	52.7	8.27	53.4	21.49	0.41		
6.31	51.9	8.34	53.4	21.57	0.45		
6.39	51.9	8.42	53.4	21.64	0.27		
6.39	51.2	8.49	53.4	21.79	0.15		
6.46	51.2	8.57	53.4	21.79	0.01		
6.46	51.9	8.64	53.4	22.71	0.04		
6.46	52.7	8.72	53.4	22.78	0.56		
6.54	51.9	8.79	53.4	22.78	0.60		
6.61	51.9	8.87	53.4	22.86	1.05		
6.61	51.2	8.94	53.4	22.86	1.05		
6.61	50.5	9.02	53.4	22.93	0.86		
6.61	51.2	9.09	53.4	22.93	0.79		
6.61	51.9	9.09	52.7	23.01	0.19		
6.69	52.7	9.17	52.7	23.09	0.01		
6.76	52.7	9.24	52.7	25.59	0.01		
6.76	51.9	9.32	52.7	25.59	0.27		
6.84	51.9	9.39	52.7	25.59	0.34		
6.91	51.9	9.47	52.7	25.67	1.12		
6.91	52.7	9.54	52.7	25.74	1.08		
6.99	52.7	9.62	52.7	25.76	0.67		
7.06	52.7	9.69	52.7	25.82	0.60		
7.06	51.9	9.77	52.7	25.90	0.01		
7.14	51.9	9.84	52.7	34.40	0.01		
7.14	52.7	9.92	52.7				
7.21	52.7	9.99	52.7				
7.21	53.4	10.07	52.7				
7.21	52.7	10.14	52.7				
7.29	52.7	10.22	52.7				
7.36	52.7	10.29	52.7				
7.36	53.4	10.37	52.7				
7.44	53.4	10.45	52.7				
7.51	53.4	10.52	52.7				
7.59	53.4	10.60	52.7				
7.66	53.4	10.67	52.7				
7.74	53.4	10.75	52.7				
7.82	53.4	10.82	52.7				
7.89	53.4	10.90	52.7				
7.97	53.4	10.97	52.7				

TABLE B.26 : GULF GARRINGTON 6-9-36-6W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)
11.05	52.7	14.13	55.6	17.21	59.4	19.16	69.0
11.12	52.7	14.20	55.6	17.28	59.4	19.16	68.3
11.20	52.7	14.28	55.6	17.36	59.4	19.16	67.5
11.27	52.7	14.35	55.6	17.43	59.4	19.16	66.8
11.35	52.7	14.43	55.6	17.51	59.4	19.16	66.0
11.42	52.7	14.50	55.6	17.58	59.4	19.16	65.3
11.50	52.7	14.58	55.6	17.66	59.4	19.24	65.3
11.57	52.7	14.73	56.4	17.73	59.4	19.24	64.5
11.65	52.7	14.80	56.4	17.73	60.1	19.24	63.8
11.72	52.7	14.88	56.4	17.81	60.1	19.24	63.1
11.80	52.7	14.95	56.4	17.88	60.1	19.24	62.3
11.87	52.7	15.03	56.4	17.96	60.1	19.24	61.6
11.95	52.7	15.10	56.4	18.03	60.1	19.24	60.8
12.02	52.7	15.18	56.4	18.11	60.1	19.31	60.8
12.10	52.7	15.25	56.4	18.18	60.8	19.31	60.1
12.17	52.7	15.33	56.4	18.26	60.8	19.31	59.4
12.25	52.7	15.40	56.4	18.26	61.6	19.31	58.6
12.32	52.7	15.48	56.4	18.26	62.3	19.31	57.9
12.40	53.4	15.55	57.1	18.33	62.3	19.31	57.1
12.47	53.4	15.63	57.1	18.33	63.1	19.31	56.4
12.55	53.4	15.70	57.1	18.41	63.1	19.31	55.6
12.62	53.4	15.78	57.1	18.41	63.8	19.31	54.9
12.70	53.4	15.86	57.1	18.49	63.8	19.31	54.2
12.77	53.4	15.93	57.1	18.56	64.5	19.31	53.4
12.85	53.4	16.01	57.9	18.56	65.3	19.39	52.7
12.92	54.2	16.08	57.9	18.64	65.3	19.39	51.9
13.00	54.2	16.16	57.9	18.71	65.3	19.39	51.2
13.08	54.2	16.23	57.9	18.71	64.5	19.39	50.5
13.15	54.2	16.38	57.9	18.71	65.3	19.39	49.7
13.23	54.2	16.46	57.9	18.71	66.0	19.39	49.0
13.30	54.9	16.53	57.9	18.79	66.0	19.39	48.2
13.38	54.9	16.61	57.9	18.79	66.8	19.46	48.2
13.45	54.9	16.68	57.9	18.86	66.8	19.46	47.5
13.53	54.9	16.68	58.6	18.94	67.5	19.46	46.7
13.53	55.6	16.76	58.6	18.94	68.3	19.46	46.0
13.68	55.6	16.83	58.6	18.94	67.5	19.46	45.3
13.75	55.6	16.91	59.4	18.94	66.8	19.46	44.5
13.83	55.6	16.98	59.4	19.01	66.8	19.46	43.8
13.90	55.6	16.98	58.6	19.01	67.5	19.54	43.8
13.98	55.6	17.06	59.4	19.09	67.5	19.54	43.0
14.05	55.6	17.13	59.4	19.09	68.3	19.54	42.3

TABLE B.26 : GULF GARRINGTON 6-9-36-6W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)
19.54	41.5	19.99	66.0	21.19	66.0	22.09	40.4
19.61	41.5	20.06	66.0	21.19	65.2	22.17	39.6
19.61	40.8	20.06	66.8	21.19	64.4	22.17	38.9
19.69	40.8	20.06	66.0	21.19	63.6	22.24	39.6
19.69	41.5	20.14	66.0	21.19	62.9	22.[illegible]	40.4
19.69	42.3	20.14	65.3	21.27	62.9	22.24	41.2
19.76	42.3	20.14	64.5	21.27	62.1	22.24	42.0
19.76	43.0	20.21	64.5	21.27	61.3	22.24	42.7
19.76	43.8	20.21	65.3	21.27	60.5	22.32	43.5
19.76	44.5	20.29	65.3	21.34	60.5	22.32	44.3
19.76	45.3	20.29	64.5	21.34	59.8	22.32	45.1
19.76	46.0	20.29	63.8	21.34	59.0	22.32	45.8
19.76	46.7	20.36	64.5	21.34	58.2	22.32	46.6
19.84	46.7	20.36	65.3	21.34	57.4	22.32	47.4
19.84	47.5	20.36	64.5	21.42	57.4	22.32	48.2
19.84	48.2	20.36	63.8	21.42	56.7	22.32	48.9
19.84	49.0	20.44	63.8	21.42	55.9	22.32	49.7
19.84	49.7	20.44	64.5	21.43	54.7	22.32	50.5
19.84	50.5	20.44	65.3	21.44	53.9	22.32	51.3
19.91	50.5	20.44	66.0	21.42	53.6	22.32	52.0
19.91	51.2	20.51	66.0	21.49	53.6	22.32	52.8
19.91	51.9	20.59	66.0	21.49	52.8	22.32	53.6
19.91	52.7	20.59	66.8	21.49	52.0	22.32	54.3
19.91	53.4	20.66	67.5	21.49	51.3	22.32	55.1
19.91	54.2	20.66	66.8	21.49	50.5	22.32	55.9
19.91	54.9	20.66	66.0	21.57	50.5	22.32	56.7
19.91	55.6	20.74	66.0	21.57	49.7	22.32	57.4
19.91	56.4	20.81	66.0	21.57	48.9	22.32	58.2
19.91	57.1	20.81	65.3	21.64	48.2	22.40	59.0
19.91	57.9	20.81	64.5	21.64	47.4	22.40	59.8
19.91	58.6	20.89	64.5	21.64	46.6	22.40	60.5
19.99	58.6	20.89	65.3	21.72	45.8	22.40	61.3
19.99	59.4	20.96	65.3	21.72	45.1	22.40	62.1
19.99	60.1	21.04	65.3	21.79	45.1	22.40	62.9
19.99	60.8	21.04	66.0	21.79	44.3	22.40	63.6
19.99	61.6	21.12	66.0	21.87	43.5	22.40	64.4
19.99	62.3	21.12	66.8	21.87	42.7	22.40	65.2
19.99	63.1	21.12	67.5	21.94	42.7	22.47	65.2
19.99	63.8	21.12	67.5	21.94	42.0	22.47	66.0
19.99	64.5	21.12	66.7	22.02	42.0	22.47	66.7
19.99	65.3	21.12	66.0	22.02	41.2	22.47	67.5

TABLE B.26 : GULF GARRINGTON 6-9-36-6W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)
22.47	66.7	24.43	48.2	25.56	66.0	27.74	52.8
22.55	66.7	24.50	48.2	25.63	66.0	27.82	52.8
22.55	66.0	24.58	48.2	25.71	66.0	27.89	52.8
22.62	65.2	24.58	47.4	25.71	65.2	27.97	52.0
22.70	65.2	24.65	47.4	25.78	65.2	28.04	52.0
22.70	64.4	24.73	46.6	25.78	64.4	28.12	52.0
22.77	64.4	24.80	46.6	25.86	64.4	28.19	51.3
22.85	64.4	24.88	45.8	25.93	64.4	28.27	51.3
22.85	63.6	24.96	45.8	25.93	63.6	28.27	50.5
22.92	63.6	24.96	45.1	26.01	63.6	28.34	50.5
22.92	62.9	25.03	45.1	26.08	62.9	28.42	50.5
23.00	62.1	25.03	45.8	26.16	62.9	28.42	49.7
23.07	62.1	25.03	46.6	26.23	62.9	28.49	49.7
23.07	61.3	25.03	47.4	26.23	62.1	28.57	48.9
23.15	61.3	25.11	47.4	26.31	62.1	28.64	48.9
23.15	60.5	25.11	48.2	26.39	62.1	28.79	48.2
23.22	60.5	25.11	49.7	26.39	61.3	28.87	48.2
23.22	59.8	25.11	50.5	26.46	61.3	28.95	47.4
23.30	59.8	25.11	51.3	26.46	60.5	29.02	47.4
23.30	59.0	25.18	52.8	26.54	60.5	29.10	46.6
23.37	58.2	25.18	53.6	26.61	60.5	29.17	45.8
23.45	57.4	25.18	54.3	26.61	59.8	29.25	45.8
23.52	56.7	25.18	55.9	26.69	59.8	29.32	45.8
23.60	55.9	25.26	56.7	26.69	59.0	29.40	45.1
23.68	55.9	25.26	57.4	26.76	59.0	29.47	45.1
23.68	55.1	25.26	58.2	26.84	59.0	29.55	45.1
23.75	55.1	25.26	59.0	26.84	58.2	29.62	44.3
23.75	54.3	25.26	59.8	26.91	57.4	29.77	44.3
23.83	54.3	25.26	60.5	26.99	57.4	29.77	43.5
23.90	53.6	25.26	61.3	27.06	56.7	29.85	43.5
23.98	52.8	25.26	62.1	27.14	56.7	29.92	43.5
24.05	52.8	25.26	62.9	27.14	55.9	30.00	43.5
24.05	52.0	25.26	64.4	27.21	55.9	30.07	42.7
24.13	52.0	25.26	65.2	27.21	55.1	30.15	42.7
24.13	51.3	25.26	66.0	27.29	55.1	30.23	42.7
24.20	51.3	25.26	66.7	27.36	55.1	30.38	42.0
24.20	50.5	25.26	67.5	27.36	54.3	30.45	42.0
24.28	50.5	25.33	67.5	27.44	54.3	0.00	41.2
24.35	49.7	25.41	67.5	27.51	53.6	30.60	41.2
24.35	48.9	25.48	66.7	27.59	53.6	30.68	41.2
24.43	48.9	25.56	66.7	27.67	53.6	30.75	40.4

TABLE B.26 : GULF GARRINGTON 6-9-36-6W5 (GLAUCONITE FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)
30.83	40.4	33.76	34.2	36.77	29.6	39.94	28.8
30.90	40.4	33.84	34.2	36.85	29.6	40.01	28.8
30.98	40.4	33.91	33.4	37.00	29.6	40.09	28.8
31.05	40.4	33.99	33.4	37.08	29.6	40.16	28.8
31.13	39.6	34.06	33.4	37.15	29.6	40.24	28.0
31.20	39.6	34.14	33.4	37.23	29.6	40.31	28.0
31.28	39.6	34.22	33.4	37.30	29.6	40.39	28.0
31.35	39.6	34.29	33.4	37.38	29.6	40.46	28.0
31.43	38.9	34.37	33.4	37.45	29.6	40.54	28.0
31.50	38.9	34.44	33.4	37.53	29.6	40.61	28.0
31.58	38.9	34.52	33.4	37.60	29.6	40.69	28.0
31.66	38.9	34.52	32.7	37.68	29.6	40.76	28.0
31.73	38.9	34.59	32.7	37.75	29.6	40.84	28.0
31.73	38.1	34.67	32.7	37.83	28.8	40.92	28.0
31.81	38.1	34.74	32.7	37.90	28.8		
31.88	38.1	34.82	32.7	37.98	28.8		
31.96	37.3	34.89	32.7	38.05	28.8		
32.03	37.3	34.97	32.7	38.13	28.8		
32.11	37.3	35.04	32.7	38.21	28.8		
32.18	37.3	35.12	31.9	38.28	28.8		
32.26	37.3	35.19	31.9	38.36	28.8		
32.33	37.3	35.27	31.9	38.43	28.8		
32.41	36.5	35.34	31.9	38.51	28.8		
32.48	36.5	35.42	31.9	38.58	28.8		
32.56	36.5	35.49	31.9	38.66	28.8		
32.63	35.8	35.57	31.9	38.73	28.8		
32.71	35.8	35.65	31.9	38.81	28.8		
32.78	35.8	35.72	31.9	38.88	28.8		
32.86	35.8	35.72	31.1	38.96	28.8		
32.86	35.0	35.80	31.1	39.03	28.8		
32.94	35.0	35.95	31.1	39.11	28.8		
33.01	35.0	36.02	31.1	39.18	28.8		
33.09	35.0	36.10	31.1	39.26	28.8		
33.16	35.0	36.17	30.3	39.33	28.8		
33.24	35.0	36.25	30.3	39.41	28.8		
33.31	35.0	36.32	30.3	39.49	28.8		
33.39	35.0	36.40	30.3	39.56	28.8		
33.46	35.0	36.47	30.3	39.64	28.8		
33.54	35.0	36.55	29.6	39.71	28.8		
33.61	34.2	36.62	29.6	39.79	28.8		
33.69	34.2	36.70	29.6	39.86	28.8		

TABLE B.27 : GULF GARRINGTON 6-9-36-6W5 (OSTRACOD FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m/min)
0	0	0	0
0.5	66	0.5	2.6
5	48	5	3.85
6.3	48	6.3	3.85
7.6	51.5	7.6	3.85
9	51.5	9	1.45
12.5	31	12.5	1.45
14	28	14	2.85
16.5	67	16.5	2.85
18.5	69	18.5	2.85
25	69	25	2.85
25	69	25	0
27.5	63		
30	56		
32.5	51		
34	48		
37.5	45		
41	42		
42.5	42		
43	0		

TABLE B.28: GULF GARRINGTON 6-9-36-W5 (UPPER BASAL QUARTZ)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	0.0	9.77	43.6	0.00	0.00	19.91	2.04
0.40	0.0	10.55	42.4	0.89	1.92	20.24	2.85
0.44	1.8	10.77	43.0	1.22	2.10	21.45	2.85
0.78	3.0	11.55	43.0	1.88	2.10	21.68	2.97
1.11	3.6	12.32	42.4	2.54	2.10	21.90	2.79
1.55	5.4	13.10	42.4	3.21	2.04	22.01	2.21
1.89	7.2	13.99	42.4	3.54	1.92	23.44	2.15
2.11	8.4	18.99	41.8	3.87	1.86	24.99	2.21
2.33	10.2	19.10	44.2	4.09	1.34	26.76	2.15
2.55	12.6	19.87	43.6	4.20	2.74	29.20	2.27
2.67	14.9	20.10	43.6	4.31	3.14	31.63	2.33
2.89	16.7	20.43	44.2	4.98	2.97	33.95	2.33
2.93	19.2	20.65	43.6	5.64	2.91	36.27	2.27
3.00	21.5	20.87	41.2	5.86	2.39	38.60	2.33
3.00	23.3	21.10	41.8	6.08	2.27	41.03	2.21
3.11	25.1	21.54	40.6	6.30	3.20	43.02	2.21
3.33	44.2	22.76	40.6	6.53	2.50	43.57	2.10
3.66	45.3	23.20	41.2	6.86	2.33	43.68	0.29
3.89	45.3	23.98	40.6	7.30	2.15	44.03	0.00
4.22	44.7	24.43	41.2	7.63	2.04	44.68	0.00
4.33	44.2	24.76	40.6	7.85	1.80	44.68	1.69
4.44	44.2	25.98	40.0	8.07	2.27	45.11	1.59
4.66	52.5	26.20	40.6	8.29	2.15	45.12	1.08
4.77	49.5	26.31	40.0	8.63	2.27	45.30	0.25
5.22	49.5	29.53	40.0	8.74	1.46	45.41	0.03
5.33	50.1	35.85	38.3	9.07	1.46	45.85	0.02
5.77	50.1	36.00	39.9	9.07	0.99	47.84	0.02
6.33	51.9	38.98	40.4	9.40	1.51	50.00	0.00
6.66	51.3	40.74	40.4	9.51	1.16	61.80	0.00
7.11	50.1	41.95	41.5	9.73	1.98		
7.33	49.5	42.51	39.9	9.95	1.69		
7.55	51.3	42.62	31.1	10.29	1.63		
7.88	50.1	42.73	33.9	10.40	1.34		
7.99	43.6	42.95	32.2	10.73	1.98		
8.11	45.3	46.36	31.7	11.83	1.98		
8.22	44.2	59.04	31.1	12.61	2.04		
8.44	44.7	60.04	31.1	13.82	2.04		
8.55	44.2	60.37	31.1	15.04	2.04		
8.99	44.7	60.37	27.8	16.04	2.10		
9.22	43.6	60.59	24.0	17.81	2.10		
9.44	43.0	60.81	17.5	18.91	2.04		

TABLE B.28: GULF GARRINGTON 6-9-36-W5 (UPPER BASAL QUARTZ)

TIME (min)	SURFACE PRESSURE (MPa)
61.14	12.0
61.58	4.9
61.69	0.0
61.69	0.5
61.69	0.0
61.80	0.0

TABLE B.29 : GULF ET AL GARRINGTON 6-9-36-6W5 (LOER BASAL QUARTZ FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	INJECTION RATE (cu.m /min)
0.00	0.0	36.18	37.8	0.00	0.00		
0.67	0.0	37.96	37.8	1.92	0.00		
1.01	9.6	40.08	37.2	2.02	0.67		
1.23	30.4	42.09	36.6	2.22	0.67		
1.56	61.4	43.99	36.1	2.42	1.62		
1.79	58.1	46.11	36.1	2.52	2.83		
1.79	60.3	46.11	36.1	2.73	2.69		
1.90	59.7	46.00	36.1	2.73	1.75		
2.12	62.0	46.00	35.0	2.93	1.35		
2.35	58.1	48.48	34.5	3.13	1.89		
2.79	55.2	48.70	32.3	3.23	1.48		
3.02	61.4	48.93	33.9	3.33	2.15		
3.57	60.9	51.85	32.9	3.84	2.02		
4.47	57.5	52.75	30.8	3.94	1.35		
6.70	49.0	53.20	29.7	4.24	2.96		
8.04	49.6	53.31	23.3	6.16	3.10		
8.15	47.3	53.76	15.4	6.46	3.37		
9.38	46.8	54.10	19.6	6.46	2.83		
9.71	47.3	54.33	19.6	6.66	3.23		
11.39	46.8	54.44	10.1	6.77	2.83		
12.51	46.8	54.44	4.2	6.97	3.50		
13.51	46.2	54.89	0.5	9.19	3.37		
14.52	46.2	55.00	0.0	11.01	3.37		
15.07	46.2			12.92	3.37		
17.86	46.8			14.74	3.37		
19.87	47.9			16.56	3.37		
20.21	47.3			18.48	3.37		
20.77	46.2			20.19	3.37		
22.67	46.2			22.11	3.37		
23.00	46.8			24.03	3.37		
25.57	46.8			25.75	3.50		
25.90	46.8			27.57	3.50		
28.02	46.2			29.48	3.50		
29.92	46.2			31.10	3.50		
31.04	46.8			31.30	3.37		
31.93	47.9			31.40	0.14		
32.27	49.6			38.67	0.14		
32.71	51.9			41.60	0.00		
32.71	38.9						
33.94	39.5						
35.95	38.3						

TABLE B.30 : GULF GARRINGTON 6-9-37-6W5 (VIKING FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	BOTTOMHOLE PRESSURE (MPa)
0.00	0.0	0.00	0.00	0.00	0.0
0.39	3.4	0.40	0.64	0.00	0.7
0.59	7.7	0.60	1.05	0.00	20.6
1.62	27.5	0.60	1.01	1.00	18.3
1.62	43.9	0.80	1.05	1.20	21.9
1.62	52.3	0.99	1.08	1.37	24.6
1.82	62.3	1.19	1.01	1.41	27.9
2.02	66.0	1.19	1.18	1.41	44.5
2.22	62.6	1.19	1.85	1.62	58.1
2.42	66.7	1.39	1.72	1.82	62.7
2.62	63.3	1.59	2.12	2.02	66.7
2.82	64.3	1.79	1.72	2.42	71.0
3.02	63.3	1.79	2.63	2.82	73.3
3.22	65.6	1.99	2.39	3.22	73.3
3.42	64.3	2.19	2.43	3.42	74.0
3.42	65.6	2.39	2.16	3.82	74.0
3.62	64.0	2.39	2.26	4.23	73.3
3.82	64.6	2.78	1.92	4.63	74.3
4.02	63.0	2.98	2.16	5.03	72.3
4.22	66.3	3.18	2.19	5.43	70.0
4.62	57.6	3.18	2.29	5.83	70.4
5.02	56.9	3.38	2.02	5.83	72.3
5.22	55.9	3.58	2.33	6.03	73.0
5.42	61.6	3.98	2.39	6.23	75.0
5.82	63.6	3.98	2.46	6.44	67.4
5.82	62.6	4.17	2.43	6.44	66.4
6.02	71.0	4.37	2.46	6.64	67.0
6.22	47.2	4.57	1.42	7.24	65.7
6.42	58.3	4.57	1.52	7.44	66.7
6.62	55.3	4.77	1.42	8.04	65.4
6.82	56.9	4.77	2.12	8.24	66.0
6.82	54.9	5.17	1.48	8.85	65.0
7.02	58.9	5.57	2.33	9.05	65.4
7.22	60.0	5.57	2.19	9.85	65.7
7.42	58.6	5.57	2.29	10.65	64.7
7.62	57.9	5.77	2.22	10.85	65.4
7.82	57.6	5.96	2.26	10.85	65.7
8.22	61.3	6.16	2.16	11.06	65.4
8.22	59.3	6.16	0.67	11.26	66.0
8.42	60.0	6.36	2.33	11.46	66.0
8.42	58.9	6.56	2.26	12.06	65.0

TABLE B.30 : GULF GARRINGTON 6-9-37-6W5 (VIKING FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	BOTTOMHOLE PRESSURE (MPa)
8.62	59.6	6.76	2.39	12.66	61.4
8.82	59.3	6.96	2.29	12.86	61.1
9.02	59.3	6.96	2.73	13.06	60.1
9.22	60.6	7.36	2.63	13.47	60.1
9.22	60.6	7.55	2.73	13.67	60.1
9.42	61.0	7.75	2.56	13.87	60.1
9.62	59.6	7.95	2.80	14.27	59.7
10.02	59.3	8.15	2.90	15.27	57.1
10.22	58.3	8.35	2.86	15.47	55.4
10.42	58.9	8.35	2.97	15.88	55.1
10.62	58.6	8.55	2.90	16.28	54.4
10.62	61.6	8.55	3.00	16.88	54.4
10.82	59.6	8.75	2.83	17.08	54.4
11.02	60.6	8.75	2.93	17.48	54.8
11.02	60.0	8.95	2.86	17.68	54.4
11.22	59.6	9.14	2.93	18.29	54.4
11.42	58.9	9.14	2.83	18.89	57.1
11.62	58.6	9.54	3.00	19.09	56.7
11.82	56.6	9.54	2.93	19.69	54.1
12.22	55.9	9.74	3.00	20.09	53.8
12.22	55.3	9.74	2.86	20.09	52.8
12.62	55.6	9.94	2.93	20.49	52.8
12.62	54.9	10.14	3.00	20.70	51.8
12.82	55.3	10.34	2.86	21.30	52.4
12.82	54.3	10.54	2.83	21.50	53.1
13.02	54.6	10.73	3.00	21.70	53.4
13.02	54.3	10.73	2.83	22.10	52.8
13.22	54.6	10.93	2.83	22.30	51.4
13.42	53.9	11.13	2.86	23.11	50.8
13.62	54.3	11.13	2.83	23.71	51.1
13.82	52.9	11.33	2.86	24.11	51.4
14.21	52.9	11.33	2.73	24.31	51.1
14.41	50.6	11.53	2.76	24.91	52.1
14.81	49.9	11.73	2.86	25.11	51.8
14.81	49.2	11.93	2.86	25.72	51.1
15.01	48.6	11.93	3.00	26.12	51.8
15.21	47.6	12.13	2.83	26.52	51.4
15.41	46.9	12.32	3.00	26.92	51.1
15.81	46.9	12.52	2.86	27.32	51.1
16.21	45.9	12.72	3.03	27.72	51.8
16.61	45.6	12.92	3.00	28.53	51.4

TABLE B.30 : GULF GARRINGTON 6-9-37-6W5 (VIKING FM)

TIME (min)	SURFACE PRESSURE (MPa)
17.01	45.6
17.21	45.9
17.41	45.2
17.81	45.2
18.01	46.2
18.01	46.2
18.61	47.6
19.41	43.5
20.01	42.9
20.21	42.2
20.41	42.2
20.81	42.9
21.01	42.9
21.21	43.9
21.61	43.2
22.01	41.5
22.81	40.9
23.21	40.9
23.41	41.2
23.61	40.9
23.81	41.2
24.21	40.9
24.61	42.2
24.61	41.9
24.81	41.5
25.01	40.5
25.41	40.9
25.81	41.5
26.01	40.9
26.81	40.5
27.01	41.2
27.21	41.5
27.41	41.2
27.81	40.2
28.21	40.2
28.61	41.5
29.01	40.9
29.01	39.9
29.41	39.5
29.41	39.5
30.61	39.5

TIME (min)	INJECTION RATE (cu.m /min)
12.92	2.93
12.92	2.80
13.32	2.93
13.32	2.93
13.52	3.07
13.72	2.86
13.92	2.86
14.11	2.97
14.31	2.93
14.51	3.03
14.71	3.00
14.71	2.86
14.71	2.93
14.91	2.83
15.11	3.03
15.31	2.93
15.51	3.00
15.51	3.00
15.70	3.10
15.70	3.10
15.90	3.03
15.90	2.93
16.10	3.00
16.30	3.03
16.70	2.80
16.90	3.00
16.90	2.90
17.10	2.90
17.10	2.86
17.29	3.00
17.49	2.93
17.69	2.93
17.89	2.97
18.09	2.93
18.29	3.00
18.29	2.83
18.49	3.03
18.88	2.86
19.08	2.93
19.08	2.97
19.28	3.00

TIME (min)	BOTTOMHOLE PRESSURE (MPa)
29.13	52.8
29.53	51.8
30.34	51.4
30.74	50.4
31.34	48.1
31.34	46.1
31.74	45.1
31.74	45.5
32.14	44.8
32.55	47.8
32.95	44.8
33.15	44.1
33.15	41.2
33.55	39.8
33.95	39.8
38.97	39.5
45.60	39.2
45.60	39.2

TABLE B.30 : GULF GARRINGTON 6-9-37-6W5 (VIKING FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	BOTTOMHOLE PRESSURE (MPa)
31.41	39.5	19.48	2.97		
31.61	40.2	19.48	2.83		
31.81	40.2	19.88	3.10		
32.21	42.9	19.88	2.83		
32.61	18.4	20.28	3.00		
32.61	19.1	20.47	3.00		
33.21	19.4	20.67	3.00		
45.40	18.8	20.87	2.90		
45.60	18.8	21.07	3.03		
		21.27	2.83		
		21.27	2.97		
		21.47	2.93		
		21.67	2.93		
		21.87	2.97		
		22.07	2.97		
		22.26	2.86		
		22.46	3.07		
		22.66	3.07		
		22.86	2.93		
		22.86	3.03		
		24.45	3.03		
		24.45	2.86		
		24.85	3.07		
		24.85	2.93		
		25.05	3.07		
		25.25	2.83		
		25.44	3.03		
		25.64	2.80		
		25.84	3.00		
		26.04	2.93		
		26.04	2.83		
		26.24	2.93		
		26.24	2.80		
		26.44	2.90		
		26.64	2.80		
		26.64	2.86		
		26.84	2.83		
		26.84	3.00		
		27.03	2.86		
		27.03	2.86		
		27.23	2.80		

TABLE B.30 : GULF GARRINGTON 6-9-37-6W5 (VIKING FM)

TIME (min)	SURFACE PRESSURE (MPa)	TIME (min)	INJECTION RATE (cu.m /min)	TIME (min)	BOTTOMHOLE PRESSURE (MPa)
		27.23	2.90		
		27.43	2.83		
		27.83	2.97		
		28.23	2.90		
		28.23	2.76		
		28.43	3.00		
		28.62	2.90		
		28.62	2.90		
		28.82	2.80		
		29.02	3.03		
		29.02	2.93		
		29.42	2.86		
		29.42	2.93		
		29.62	2.86		
		30.02	2.90		
		30.02	3.03		
		30.41	3.03		
		30.41	2.90		
		30.61	2.90		
		30.61	2.83		
		31.01	2.93		
		31.21	2.76		
		31.21	2.90		
		31.41	2.83		
		31.61	3.00		
		31.81	2.86		
		32.00	2.80		
		32.40	2.86		
		32.60	0.00		