MERCURY POROSIMETRY PROTOCOL FOR RAPID DETERMINATION OF PETROPHYSICAL AND RESERVOIR QUALITY PROPERTIES

John Shafer[1] & John Neasham[2]
[1]Reservoir Management Group, [2]PoroTechnology

ABSTRACT

Dean-Stark water saturation data can provide an indication of the appropriate Archie parameters to use in early log analysis prior to obtaining centrifuge or porous plate primary drainage capillary pressure and electrical property data. But this is only true if the core water saturation is unaltered during coring and the cored interval is structurally high enough to be above the transitional zone. Alternatively, high-pressure (to 60,000 psia) mercury injection capillary pressure (MICP) can quickly provide drainage capillary pressure properties of samples and assist in early log analysis and reservoir quality assessment. This paper focuses on experimental protocol for obtaining valid MICP data, particularly when dealing with friable-to-unconsolidated sands and compressible high entry pressure clastics and carbonates.

Important protocol issues include proper sample preparation for varying sample types, with poorly consolidated sands being radially jacketed with metallic foil and capped with properly sized end screens. Samples should preferably be radially jacketed to obtain 1-D drainage capillary pressure data. High pressure MICP requires a "blank sample" MICP correction data for glass cell and sample grain compressibility factors. High entry pressure compressible samples such as chalks, diatomite, and kerogen-rich carbonates can have apparent MICP-measured porosities significantly less than core porosities.

Mercury injection capillary pressure data from representative core sampling can provide a rapid indication of ranges in the various petrophysical and reservoir quality properties of the various lithologies. This preliminary "screening" will also assist in the optimization of follow-up special core analysis program involving significantly greater measurement costs and completion times.

INTRODUCTION

The basis for calculating reservoir original oil-in-place (OOIP) is often from log-derived saturations. In massive sands with no bed-boundary effects, the log-derived saturations should be fairly accurate if Archie parameters are known. Beds below one foot thick are generally not resolvable; thus the calculated saturations are between that of the sands and interbedded shales.

Dean-Stark fluid saturations may provide an indication of reservoir water saturations above the transition zone if there has been only minimal invasion by the coring mud brine phase (Woodhouse, 1998). This data will assist in initial log analysis for calculation of net hydrocarbon pore volumes over logged intervals. Determination of OOIP for the entire reservoir, including those portions not cored and/or logged, requires primary drainage capillary pressure

curves for the major log-based/core-based facies for the initialization of the reservoir model (simulator).

Primary drainage capillary pressure data typically requires one-to-three months to obtain by either the porous plate or the centrifuge technique. Because of the time and cost involved in obtaining these data, the number of plugs/facies investigated is often severely restricted. Ideally, the plugs selected for primary drainage capillary pressure, as well as special core analysis in general, should cover the range of lithologies and facies observed in the reservoir. Data such as core description, porosity, permeability, grain size distribution, NMR T2 distribution, mineralogy, and log response (including image logs) should help in the plug selection. A reasonably good correlation is commonly observed between permeability and irreducible saturation (Swi). However, this relationship may not be good for samples with clay clasts, microporous grains, or other rock properties that have less impact on permeability but a strong impact on Swi. In these cases, having a quick cost-effective method to assess capillary pressure can assist in selecting a sample suite for what is typically an expensive and lengthy special core analysis program. High-pressure mercury injection capillary pressure (MICP) provides such a technique.

Much is published about MICP, and it has been used for decades to provide drainage capillary pressure data. Much less is published about sample preparation and data analysis protocol required to obtain MICP rock property information which is the focus of this paper.

BACKGROUND

High-pressure (to 60,000 psia) mercury (Hg) capillary pressure (MICP) testing of reservoir and non-reservoir (e.g., seal) rock samples is today a "routine" analytical procedure for geological/petrophysical evaluation of conventional core, sidewalls, and cuttings. The American Society for Testing and Materials has published a MICP testing protocol standard; D4404-84 (1998). Mercury injection (intrusion) provides for the rapid quantification of a sample's interconnected pore system and the size distribution of pore apertures (capillaries) that strongly influence non-wetting phase (e.g., hydrocarbon) saturations and fluid flow (e.g., permeability). Mercury intrusion porosimeters had an upper pressure range of 2000 to 10,000 psia capabilities in the decades prior to 1990. Current high pressure instrumentation allows for MICP testing of rock material ranging from approximately 1.0 inch diameter x 1.0 inch length down to samples weighing approximately one gram. Cuttings should be "picked" under a binocular microscope, and they are analyzed using "powder" sample holders (i.e., penetrometers).

This paper focuses on the protocols for obtaining high pressure MICP data on core plugs. Currently there are other types of mercury injection porosimeters which will not be discussed directly but have some protocols, such as sample preparation, in common. For example, whereas the high-pressure mercury porosimeters analyze samples at zero confining stress, some low pressure (2,000 psia) mercury injection porosimeters are designed to obtain data with the sample confined at reservoir stress. In these systems, samples are mounted in a triaxial core holder at a confining pressure, and mercury is injected into the evacuated pore system. As the mercury injection pressure increases the confining pressure is accordingly increased to maintain a constant net confining stress. Another low pressure (i.e., ~1,000 psia) technique is the APEX

method (Yuan, 1990), in which the mercury is injected at a constant slow rate and the pressure fluctuations are monitored to provide pore-body and pore-throat size distribution information.

Theory

A fluid will not enter a rock pore body via the pore aperture without pressure if it does not wet the pore surface. Thus the external pressure required to force a non-wetting liquid (e.g., mercury) into a pore is inversely related to the pore aperture diameter or radius. The Laplace equation converts capillary pressure to pore radius of porous media assuming a cylindrical pore model as follows:

Pore radius = $r = 2\gamma(\cos\theta)/P$ equation 1

Where:

r = pore aperture radius intruded

γ = interfacial tension of mercury

θ = contact angle between mercury and the pore surface

P = absolute injection pressure

This paper presents rock property data derived from MICP sample tests using 117 logarithmically-spaced pressure steps from ~1.6 to 60,000 psia, which measures the percent of a sample's pore volume (PV) bounded pore apertures ranging from ~140 microns down to ~0.0036 microns diameter. MICP testing procedures also allow for the initial pressure (i.e., mercury filling pressure) to be lowered to ~0.6 psia, which relates to Hg-intrusion through pore throat diameters of ~400 microns.

A rock sample is placed in a glass cup called a "penetrometer", which holds a known amount of mercury at the start of a MICP test. The penetrometer is initially filled with mercury at a pre-set filling pressure, and then subjected to a series of low-pressure steps up to an approximately 26 psia. It is then transferred to a high-pressure cell to complete mercury injection to 60,000 psia. During the high-pressure phase, the penetrometer is immersed in a bath of oil (pressure transfer fluid) inside a steel pressure vessel. As the oil pressure is increased in the pressure vessel the oil moves the mercury meniscus down the penetrometer stem as mercury is intruded into the sample. The position of the mercury meniscus in the penetrometer stem is monitored by capacitance.

Basic MICP output data includes (a) the drainage capillary pressure curve graphically plotting sample PV occupied by Hg (i.e., non-wetting phase saturation) as a function of increasing Hg intrusion pressure and (b) a "pore throat diameter (or radius) distribution" curve. Analysis of the sample MICP data also allows for determination of porosity and grain density at 60,000 psia Hg intrusion pressure and empirically calculated permeability (Swanson, 1978). From these MICP-derived petrophysical parameters, one has a quantitative basis for distinguishing between "reservoir" and "non-reservoir" rock samples representing selected zones of interest within a wellbore. MICP characterization of a rock sample's pore aperture size distribution (radius or diameter) and its pore volume bounded by these pore apertures is also used to: calibrate network flow models, compare with NMR predicted pore body distribution, and design mud solid size distribution. The latter is based on reservoir rock's pore aperture size distribution to minimizing drilling spurt lost to achieve low invasion coring

Figure 1A & B presents MICP data for four samples having similar porosities but air permeabilities ranging from 9,000 md down to 0.03 md. Figure 1A is a composite plot of capillary pressure drainage curves showing wetting phase saturation (100% - cumulative % mercury intrusion) versus the mercury intrusion pressure. Figure 1B is a composite histogram plot of incremental mercury intrusion at each pressure step, with intrusion pressures converted to equivalent pore aperture diameters using Equation #1. Although these samples have similar, high porosities (i.e., ~28%), the broad range in permeability values is clearly evident in the relatively low intrusion pressure of 4 psi for the highest permeability sample (Kg = 9,000 md) compared to 5,000 psi for the lowest permeability sample (Kg = 0.03 md). These contrasting initial pore entry pressures reflect major differences in size of the pore aperture diameters controlling fluid flow through the rock matrix. Also MICP incremental intrusion data for the 10 md sample identifies a reservoir rock type containing a more pronounced bimodal pore aperture size distribution.

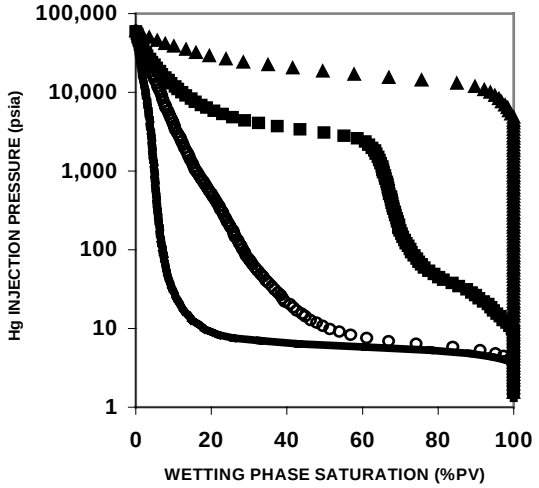

Figure 1A. Cumulative Hg intrusion, expressed as wetting phase saturation, versus Hg injection pressure data for 4 samples with permeability values of 9,000md (solid curve), 1,514 md (open circles), 10 md (solid squares), and 0.03 md (solid triangle).

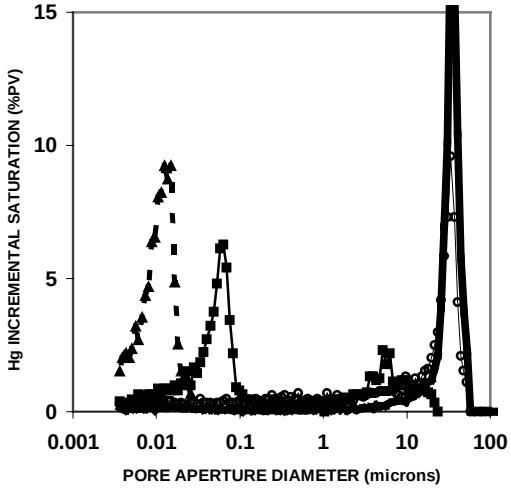

Figure 1B. Incremental Hg intrusion versus pore aperture throat diameter data for 4 samples with permeability values of 9,000md (solid curve), 1,514 md (open circles), 10 md (solid squares), and 0.03 md (solid triangle and dotted line).

RESULTS AND DISCUSSION

Sample size

One of the advantages of MICP over other capillary pressure techniques is that the samples can be much smaller than conventional core plugs, irregular in shape, broken into several pieces (i.e., core chips), or washed cuttings. Percolation theory (Hirsch et al, 1994A, 1994B, 1995) has established that sample size and shape can also affect capillary pressure data, with smaller samples having higher "surface area/sample bulk volume" ratios tending to cause slightly lower initial pore aperture entry pressures and, hence, a more optimistic capillary pressure curve.

Ideally a sample analyzed by MICP should be as large as possible but still compatible with the bulk and pore volume capacity of the glass penetrometer.

1-Dimension Drainage

Hirsch et al (1994A, 1994B, 1995) has shown by percolation theory that different capillary pressure curves will result from 3-D drainage versus 1-D drainage testing of a sample. One-Dimensional drainage results in a more pessimistic capillary pressure curve. Laminated cap or seal rock core samples should have 1-D mercury intrusion to ensure that intrusion is perpendicular to bedding for sealing capacity for assessing vertical hydrocarbon migration.

The preferred primary drainage capillary pressure measurement protocol for porous plate or centrifuge requires that the sample be confined at reservoir net confining stress. Thus capillary pressure data obtained for such experiments is that of one-dimensional drainage similar to that in the reservoir. If MICP is to supplement or replace porous plate or centrifuge capillary pressure data, then it is also preferable to obtain such data in a 1-D manner. This implies that even consolidated samples ideally should be radially jacketed with Teflon tape or heat shrink tubing, metal foil, or coated with epoxy to ensure 1-D capillary pressure data.

Mercury Contact Angle

The conversion of mercury injection pressure to pore throat diameter, Laplace equation (#1), requires the interfacial tension (IFT) and contact angle. The IFT of mercury is 484 dynes/cm and the advancing contact angle typically reported for mercury-air-quartz in the literature is about 140° degrees ($\cos 140° = -0.77$). Dumore′ et al (1974), Good et al (1981), and Ma et al (1991) considered the contact angle to be a function of surface roughness and proposed that the contact angle should be 180° degrees ($\cos 180 = -1.00$). Given the potential dependence on surface roughness, the contact angle should depend on pore morphology, pore-lining clays versus quartz overgrowths with smooth flat surfaces. Although the difference between using a contact angle of 140° and 180° is a factor of 1.30 there are other factors that probably affect the MICP data more.

Blank Cell Corrections

During MICP testing to 60,000 psia, the glass penetrometer, high-pressure oil, mercury, and rock material all undergo varying degrees of compression. Such compression and related thermal factors are recorded during the test as small but measurable intrusion/extrusion data. MICP instrumentation software allows for incorporation of a “Blank Correction File” into the sample test “raw data”, which adjusts the generated MICP raw data output for equipment related compressibility effects but not for sample grain compressibility. Blank cell corrections can be particularly significant when analyzing rocks with very low porosities, 1-4%, or MICP tests involving relatively small, porous samples analyzed in the larger penetrometer cups, which creates relatively large mercury to sample bulk volume ratios.

MICP sample data may or may not included a “blank correction file” adjustment to the generated raw data. And if it does, it may be either 1) a “blank correction by formula” file contained in the MICP instrumentation software or 2) an “operator generated” blank correction file. The latter is created by analyzing a non-porous sample with the bulk volume and composition similar to the porous sample being tested (e.g., a quartz crystal vs. a quartz-rich sandstone). The operator generated blank correction files are generally preferable, as they best correct for the combined high compressional/heating effects on mercury, oil, penetrometer, and sample. Table 1 shows

the change in MICP measured sample porosity using two different types of blank correction files for both porous permeable sandstone and low porosity shale. For both of these rock types, the MICP porosity is lower using the "quartz blank correction" file versus the "blank correction by formula" file; i.e., the sandstone and shale porosity are lower by 5% and 26%, respectively.

	MICP Porosities (%BV) @ 60,000 psia	
Rock Type	BLANK CORRECTION BY FORMULA	QUARTZ BLANK CORRECTION
Shale	3.66%	2.71%
Sandstone	31.2%	29.8%

Table 1: MICP BLANK CORRECTIONS

Conformance/Closure Corrections

The MICP test measures and records Hg intrusion data for each pressure step. The first pressure step is the pressure increase from the "mercury fill pressure" to the first pressure point (e.g., 1.6 - 1.8 psia). As each pressure step is sequentially performed, mercury progressively fills (i.e., "conforms to" or "closes around") any sample surface irregularities such as microfractures and is, hence, recorded as Hg intrusion. At some higher pressure step, however, sufficient pressure is achieved to cause mercury (i.e., the non-wetting phase) to intrude the largest pore throats controlling the sample's PV. The pressure at which mercury commences to occupy the actual pore system of the sample being tested is called the "initial pore entry pressure" or "closure pressure". All intrusion data recorded up to this initial entry pressure is subtracted from the MICP raw data output as the "closure correction".

Selection of the closure pressure for a given MICP test is determined by generating a X-Y plot of "percent sample bulk volume (BV) occupied by mercury" vs. "Hg intrusion pressure", (Figure 2). This semi-log plot allows identification of an "inflection point" indicating a "sudden" increase in the amount of mercury intrusion. This inflection point, termed the "closure pressure", identifies the pressure at which mercury begins to occupy sample pore volume bounded by the largest pore throats; Pittman (1992).

Closure pressures for rocks with relatively high (i.e., >~1,000 psia) initial pore entry pressures must also take into account sample bulk compressibility not accounted for by blank correction files. Samples with high compressibility (e.g., shales, chalks, diatomites, and kerogen-rich carbonates (kerogen has grain compressibility 100 times that of quartz or carbonates)) will compact at higher MICP test pressures prior to reaching the initial pore entry pressure. Such "compaction" of the sample's bulk volume is recorded as mercury intrusion particularly if the entry pressure is in the stress region of pore collapse. The shape of the percent sample bulk volume (BV) occupied by mercury versus Hg intrusion pressure, (Figure 2) for the 0.03 md sample, illustrates how bulk compressibility effects make selecting the point at which mercury enters the rock matrix somewhat subjective. Is it as low as 4,000 psia or as high as 10,000 psia?

MICP data can also be used to obtain dry rock compressibility data prior to initial mercury entry pressure, since the MICP data is recording reduction of the bulk volume with increasing confining stress. For the high entry pressure sample shown in Figure 2, the calculated bulk

compressibility between 10 and 1,000 psia is 20 microsips (1.0E-06/psi) or a bulk modulus of 50,000 psi.

The bulk volume reduction at high confining stress just prior to entry of mercury will impact subsequent data analysis when the mercury does enter the sample. As mercury enters the rock's pore system, the pore pressure will start to approach the confining pressure and the net confining stress will decrease to zero, causing the bulk volume of the sample to dilate. The recorded volume of mercury intrusion would thus be the difference in the amount of mercury entering the rock pore volume and the bulk volume increase of the sample as it dilates. These two opposing factors cannot independently be determined and thus cause an uncertainty in the generated capillary pressure curve and the measured porosity.

The impact of accounting for sample dilation for compressible samples is illustrated in Figure 3 using MICP data for the 0.03 md samples from Figures 1 & 2. Since there is no way to know when and to what extent the sample has dilated, we have processed the MICP data assuming the two extremes. The sample completely dilates or rebounds to its original zero stress porosity either at the initial entry or at the last entry pressure of mercury. Prior to mercury entering sample pores, the pore space is evacuated. Thus as mercury enters the pore system it only transfers pressure to the rock matrix it contacts, vacuum is not pressure transfer medium. Thus the process of bulk volume dilation probably occurs from point of closure to completion of the MICP test at 60,000 psia. Based on the two bounding capillary pressure curves in Figures 3, bulk volume dilation will likely result in lower wetting phase saturations as capillary (injection) pressure initially increases beyond closure pressure. As the capillary pressure approaches 60,000 psia, bulk volume dilation will results in higher wetting phase saturations.

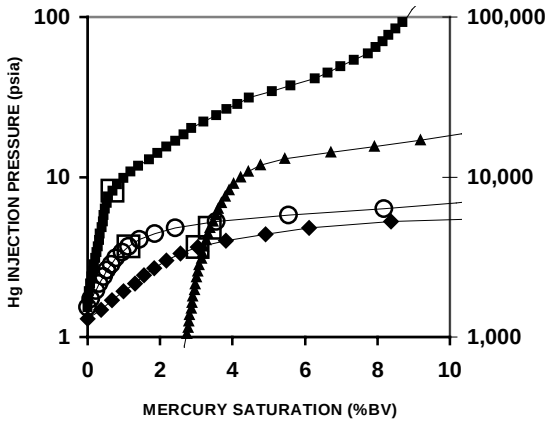

Figure 2. Percent of sample bulk volume occupied by Hg versus Hg intrusion pressure for 4 samples with permeability values of 9,000md (solid diamond), 1,514 md (open circles), 10 md (solid squares), and 0.03 md (solid triangle & right Y axis). Closure pressures designated by large open square.

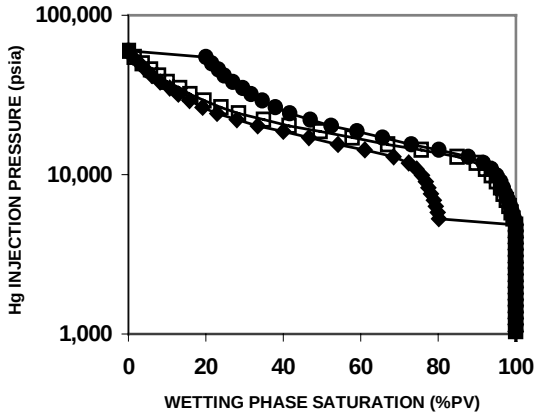

Figure 3. Sample bulk volume dilation affects capillary pressure data; no dilation correction (open squares), dilation correction at initial Hg entry (solid diamonds), and dilation correction at final Hg entry (solid circle).

The magnitude of these potential errors in generated capillary pressure drainage curves is greatest for compressible samples with the relatively high entry pressures. For compressible clastic and carbonate rock types, with mercury initial pore entry pressures in the 100's to 1000's of psia, ignoring dilation may generate pessimistic capillary pressure curves. For cap rock samples, the primary interest is the injection pressure at which mercury first enters the sample. If the Hg confining stress at this point is not similar to that of the reservoir confining stress, then prediction of reservoir entry pressure could be affected.

Not accounting for sample dilation can result in calculation of lower porosities, although grain densities will be unaffected. With high entry pressure samples there is also a concern that the sample contains a significant fraction of pore apertures so small (i.e., <0.0036 microns) that at 60,000 psia injection pressure mercury cannot completely saturate the sample pore system. Incomplete saturation will result in lower calculated grain densities. Thus, if the MICP grain densities are correct but the MICP porosities at closure are low compared to ambient stress values, then sample dilation after mercury entry may have caused an uncertainty in the shape of the capillary pressure curve.

Unconsolidated Sands

Obtaining MICP measurements on unconsolidated to semi-consolidated (friable) core typically encountered in offshore deepwater requires a different protocol than conventional (i.e., consolidated) core plugs. As such rock types are usually stored frozen, core plugs to be analyzed are cut with liquid nitrogen using a 3/4 to 1 inch diameter bit directly from the core or downsized from frozen 1.5 inch diameter core plugs. Unconsolidated samples commonly have porosities greater than 30%; thus while a 1 x 1 inch sample may fit within the largest penetrometer cup, the sample pore volume may exceed the maximum amount of mercury held in penetrometer stem volume. In such cases, complete mercury saturation of the sample pore volume will not be achieved during the MICP test. As previously stated, capillary pressure including MICP results are sample size dependent, thus the maximum sample size possible should be used up to the limits of the penetrometer cup size and penetrometer stem mercury capacity.

The properly-sized frozen plug is then jacketed with Teflon tape followed by a nickel-alloy metallic foil. Caution must be exercised in the selection of the metallic jacket composition, as mercury will form an amalgam with certain metals (e.g., lead and tin), thereby both dissolving the metal sleeve during the MICP test and contaminating the mercury. Two stainless steel end screens are then secured to each end of the jacketed sample; a coarser screen mesh (100 mesh or 149 micron openings) against the sand face, and a finer screen mesh (e.g., 250 mesh or 63 micron openings) on the outside which maintains sample integrity while it is thawed and cleaned. Weights of all jacketing materials must be recorded for later determination of sample bulk volume (BV) during MICP analysis.

Prior to MICP analysis the finer end screens are removed, exposing the larger mesh end screens to mercury intrusion. As these unconsolidated samples commonly have permeabilities greater than a Darcy, the mercury filling pressure (i.e., the pressure at which mercury fills the penetrometer cup) is set at a relatively low value (e.g., ~0.6 psia) in order to quantify sample initial pore aperture entry generally in the 0.6-2.0 psia range.

The size (i.e., mesh openings) of the coarser screen contacting the sand plug face must be selected and noted in relation to the MICP test mercury-filling pressure to ascertain when mercury will be intruded through the screen mesh openings; that is, at the filling pressure or during the initial low pressure steps. This determination is important when identifying the closure\conformance pressure for these high permeability samples. The importance of balancing the screen mesh opening size with sample pore aperture size can be illustrated with three examples. The desired case is Example #1.

- Example 1: The mercury filling pressure is below the initial entry pressure of both the end screens and the rock sample. At closure MICP porosity is equivalent to core porosity.
- Example 2: The mercury filling pressure is below the initial entry pressure of the screen, but above the entry pressure of the rock sample. At the pressure at which mercury intrudes through the screen mesh openings, then the void space between the screens and sample face and a percentage of the sample pore volume will also be intruded. As a result, there is no low-pressure (e.g., sample entry pressure to screen entry pressure) capillary pressure data. If the closure pressure is selected as the "screen intrusion" pressure then at closure MICP porosity > core porosity.
- Example 3: The mercury filling pressure is above both the entry pressure of the screen and sample, which causes mercury to enter sample pore volume as it fills the penetrometer and surrounds the sample. This generates incorrect porosity and capillary pressure data. At closure MICP porosity << core porosity.

Reservoir Quality

MICP can be one of the measurements to assist in defining reservoir quality of the various lithologies encountered in a reservoir in terms of Swi and capillary pressure character. Presented in Figure 4 is a montage of low pressure MICP data, grain-size analysis data, and thin section photomicrograph for a one Darcy, unconsolidated sample. The MICP data provides pore throat radius distribution data, while the laser particle-size analysis provides grain "body" size distribution data. Grain-size distribution data can be used to predict a pore aperture distribution, as indicated in Figure 4, with a reasonable match to the MICP data. Since grain-size analysis data does not capture the spatial distribution of grains in an undisturbed sample (i.e., laminations) the shape of the capillary pressure curve predicted from converting a grain "body" size distribution to a pore throat aperture size distribution could potentially be in error.

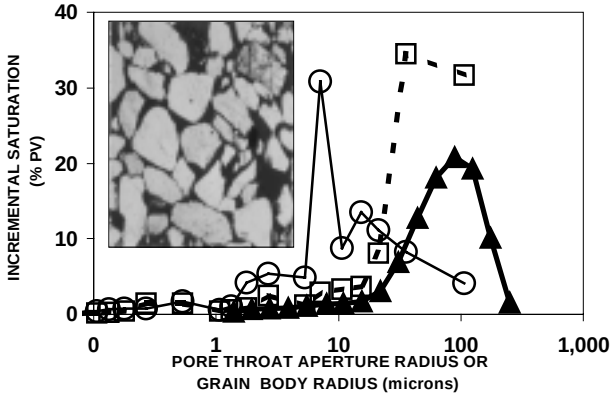

Figure 4. Reservoir quality montage: Comparison of thin section photomicrograph with grain "body" and pore throat aperture size data. Grain "body" size distribution data is from laser grain size analysis (solid triangles), MICP pore throat aperature size distribution (open circles), and predicted pore throat aperture are from grain size analysis (open squares).

MICP data has been used by many as a principal source of primary drainage capillary pressure data. There are two aspects to MICP data that present some uncertainties: (A) high pressure MICP measurements are performed on oven-dried samples and, (B) the uncertainty in what is the most appropriate contact angle to use when converting from an air-mercury system to a reservoir fluid system.

Greder et al (1997) and Shafer et al (1997) indicate that mercury injection capillary pressure data agree favorably to porous plate or centrifuge capillary pressure data when the sample contains little or no clay, and as the amount of clay increases the mercury injection capillary pressure data proportionally becomes more optimistic. The more clay-rich a sample the more clay-bound water it is likely to contain that is driven off during the sample preparation for MICP tests. MICP sample drying at ~100°C is generally necessary to draw the required high vacuum on the sample prior to an MICP test initiation. Low-pressure mercury injection on core plugs mounted in a triaxial core holder can use constant humidity dried samples, which may provide capillary pressure data that better approximates primary drainage capillary pressure behavior of a reservoir fluid system.

A combination of single-point, reservoir fluid, capillary pressure data with a subsequent, full-curve, high-pressure MICP experiment may provide the link to correct for IFT($\cos\theta$) and shaleness. (Ma et al, 1991 & Hill et al, 1979). Twenty years ago, Hill et al recommended several techniques to rescale MICP data to account for sample shaliness.

High-density core sampling and generated capillary pressure data provide information that can reduce the initial uncertainties in log-derived fluid saturations such as net hydrocarbon volume. This is particularly important for alternating high quality/low quality rock sequences less than one-foot thick that is below the resolution of most logs. Mercury injection capillary pressure data for a properly sampled core interval can provide a rapid indication of ranges in various petrophysical and reservoir quality properties, which are required to optimize any follow-up special core analysis program involving significantly greater measurement costs and completion times.

CONCLUSIONS

The following are our protocol recommendations for obtaining accurate mercury injection capillary pressure data:

- Samples should be preferably jacketed to obtain one-dimensional drainage to be consistent with special core analysis data that are typically 1-D. Jacketing is critical to properly simulate flow perpendicular to bedding for samples with laminations or other rock fabric features (cap rock) affecting mercury intrusion.

- The preferred type of blank correction file is one generated by analyzing a non-porous sample with a weight and composition similar to the porous sample to be run later (e.g., a quartz crystal versus a quartz-rich sandstone). This blank correction file accounts for the reduction in sample grain volume due to grain compressibility.

- Unconsolidated samples require jacketing materials compatible with mercury and selection of screen mesh size that keep the sands from flowing out while allowing the mercury to enter at the lowest possible pressure.

- For reservoir quality rock, with mercury enter pressures in the 100's to 1000's of psia the unaccounted and indeterminable sample dilation that occurs after mercury enters the sample may generate pessimistic capillary pressure curves and porosities.

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