

Energy equity market experiences resurgence

With oil prices surpassing the \$20-a-barrel mark by mid year and rising in the third quarter, a cautious optimism returned to the energy equity market, as energy company filings increased substantially. Of the 35 E&P company security filings from mid April to late August, 24 involved common or preferred stock offerings in addition to debt issues and other securities. This is unlike the previous year, when upstream companies brought mainly debt securities to the market.

Wayne W. Andrews, vice president of equity research at Raymond James & Assoc. Inc., said, "I've not seen market strength like this in the last two years." He cited the recent Apache Corp. equity offering that pulled in substantially more funds than targeted for a major Gulf of Mexico acquisition from Shell Corp. Andrews expects that many E&P stocks will reach all-time highs by the end of the fourth quarter.

The resurgence in capital-markets transactions will likely continue as long as the commodity price outlook remains bright because independents require capital to grow. "It is likely that transactions over the next few quarters will be heavily weighted towards equity because so many independents are overleveraged," said Steve Pully, managing director natural resources group at Bear Stearns in Dallas.

He remarked that debt offerings might also be less frequent because the royalty trust structure is another available capital alternative that partly eliminates the need to assume more debt. With respect to initial public offerings (IPOs), Pully said, "We will see some energy IPOs if the overall market holds up and the commodity outlook remains bright, but the market will be much more selective than during the 1997-98 period. That selectivity will favor larger companies and experienced management teams with proven records."

Please see Equity on Page 2

Inside Reservoir Solutions newsletter

- Deepwater reserves booking varies..... Pg. 3
- R.S. says systems are Y2K compliant..... Pg. 4
- CBM operators differ in approaches.....Pg. 4
- Intensive Petrovera evaluation pays off... Pg. 6
- Rosewood outsources modeling..... Pg. 6
- Integration helps define seismic role... Pg. 7

Gas property computations offered in ResGAS download



The Reservoir Gas Analysis Software (ResGAS) for calculating gas properties is the latest, free, downloadable software offered on the Ryder Scott web site at www.ryderscott.com.

A ResGAS user can compute the critical pressures and temperatures, specific gravities and heating values of a gas stream.

The Excel 97 application works with the previously released Reservoir Solutions Modules program (See *Reservoir Solutions* newsletter, Vol. 2, No. 2.) Both programs are automatically downloaded from the ResGAS section on the Ryder Scott site.

The computation of gas properties includes corrections for contaminants and adjustments for condensate content. ResGAS also calculates wet gas in place and recoverable wet-, dry- and sales-gas volumes as well as recoverable condensate volumes. The program computes the estimated recovery of propane, butane and sulfur and approximates the BTU content of separator and gas sales. A user must enter separator-gas component percentages derived from laboratory analysis and other data input, including well and reservoir parameters and recovery factors.

The application features easy-to-use interfaces. The user enters data in a template and after a couple of mouse clicks, the results are displayed in tabular format. Consistent with the other Ryder Scott freeware, the program results can be printed in black-and-white or color, presentation-quality, hard-copy output.

During downloading, installation instructions are received in a separate Excel or Word 97 file that can be opened and printed. Installation is simple and involves loading self-extracting files in the Excel start directory. Also, the user will be able to print and read a downloaded document that serves as the user manual.

ResGAS is the fifth in a continuing series of periodic releases available to the industry over the Internet. Users must fill out and submit request forms posted on the Ryder Scott web site to receive the e-mailed passwords that enable the programs. The completed request forms provide contact information to Ryder Scott, so the firm can e-mail program upgrades to users. Users must also have Windows 95 or later 9x versions, Microsoft Excel 97 software and an Internet connection.

Please see ResGAS on Page 8

Equity—Cont. from Page 1

Reputable consulting firms

A lead investment bank underwriting an initial public offering (IPO) usually takes the initiative in putting together a team consisting of other underwriters and accounting, law, engineering and public relations firms. Typically, the lead underwriter recommends one or more independent petroleum consulting firms to certify the reserves in the property portfolio. The principal asset of these planned IPOs is oil and gas reserves, which are often the main determinant of value in the public market.

“The engineering report typically sets the floor price of the enterprise,” said Andrews. “The value of future operations and projects set forth in the prospectus is the upside in the investment. Based on the floor price of engineered reserves plus a risked assessment of upside potential, investors will determine the right price to pay for the offered security.”

Experience, resources and reputation are three critical qualifications for independent petroleum engineering firms, said Pully.

“Investors want the engineering firm to have experience evaluating the issuer’s reserves or experience in similar geology,” he said. “Also, because IPOs often move very quickly, the engineering firm must have broad resources to appropriately staff the projects.”

The importance of the reputation of the firm cannot be overstated. “Underwriters look for engineers with well-known, well-respected names that savvy energy investors will recognize and relate with quality work and conservative projections,” said Andrews. “Investors have to be able to count on the fact that the engineered reserves are real and will be produced.”

The core group of investors necessary to get a deal done is quite savvy when it comes to recognizing major consulting firms. “If the name of the firm is not easily recognizable or the firm does not have a conservative reputation, many investors will proceed more cautiously,” said Pully. “The reserve report is also critical, especially for offerings that are completed close to the report date.”

IPOs using Ryder Scott

When selecting an outside consulting firm to assist in the preparation and filing of a company’s reserves report for an initial public offering (IPO), primary considerations usually go to a firm with significant experience in public offerings

and ongoing public company representation. Ryder Scott’s experience assisting with IPOs is extensive.

The firm has certified petroleum reserves and performed economic analyses in connection with public offerings by U.S. companies ranging in size from \$6.5 billion in market capitalization to smaller independents. Also, Ryder Scott is currently certifying reserves for two multi-billion-dollar national oil companies in Asia that are privatizing.

Ryder Scott has certified reserves for initial public offerings from Union Pacific Resources Corp., Pennzenergy (Pennzoil), Seven Seas Petroleum Inc., Carrizo Oil & Gas Inc., Edge Petroleum Corp., Newfield Exploration Co., Petsec Energy Inc., Soco International plc, 3DX Technologies Inc., Louis Dreyfus Natural Gas Corp., Eastern American Natural Gas Trust, General Atlantic Energy Corp., OEDC E&P LP, Kelley Oil Corp., Brooklyn Union Exploration Co., Houston Exploration Co., Spinnaker Exploration Co. and Eastern States Oil & Gas Inc. These companies are listed on the New York Stock Exchange, Nasdaq, Amex, London Stock Exchange, Toronto Stock Exchange and other exchanges. The total aggregate market capitalization for these companies is in the tens of billions of dollars.

Publisher’s Statement

Reservoir Solutions newsletter is published quarterly by Ryder Scott Company LP Petroleum Consultants. Established in 1937, the reservoir evaluation consulting firm performs more than 1,000 studies a year. Ryder Scott has issued reports on more than 200,000 wells or producing entities in North America. The firm has also evaluated hundreds of international oil and gas properties involving thousands of wells. Ryder Scott multidisciplinary studies incorporate geophysics, petrophysics, geology, petroleum engineering, reservoir simulation and economics. With 115 employees, including 64 engineers and geoscientists, Ryder Scott has the capability to complete the largest, most complex reservoir-evaluation projects in a timely manner.

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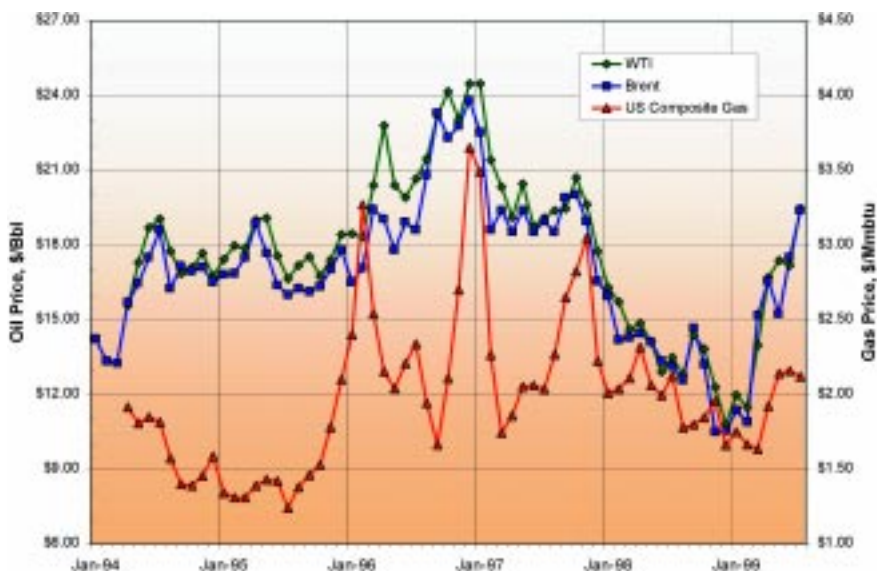
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Benchmark oil and U.S. composite gas price history



The West Texas Intermediate Crude (WTI) prices are the posted prices of Exxon Co. USA published in the *Crude Oil Price Bulletin Summary*. Composite spot gas prices are the wellhead prices published in the *Natural Gas Week* newsletter. Brent oil prices are the published, posted prices available to the general public from commodity quotation services over the Internet.

Ryder Scott survey indicates highly varying booking practices used for Gulf of Mexico deepwater reserves

Ryder Scott conducted the Deepwater Reserves Booking Practices Survey in May 1999 to learn more about the industry's standard operating practices for the initial internal booking and external reporting of Gulf of Mexico (GOM) deepwater petroleum reserves. Many operators and interest holders had expressed questions concerning the industry "norm" for initially booking proved reserves in GOM deepwater fields.

Ryder Scott mailed two-page questionnaires to all 24 operating companies in the deepwater GOM. Fifteen out of 24 mailed questionnaires were completed and returned resulting in a response rate of greater than 62 percent. In mail surveys, response rates are often low and 3 to 12 percent is typically constitutes a high rate of return. In comparison, the response rate

to the booking practices survey was exceedingly high.

However, any opinions on the statistical significance of the survey are debatable, because experts generally disagree on what constitutes a low response rate. Some experts define "low" as less than 70 percent. Furthermore, because the survey universe is so small, a much higher return rate than 3 to 12 percent is required to generalize about the group as a whole.

The survey results support the hypothesis that in some cases, actual booking practices differ significantly because they run the gamut from strict to liberal interpretations of U.S. reporting guidelines. For instance, more than 73 percent of the respondents indicated that they do not require conclusive flow tests before booking reserves. However, almost three out of four (73 percent) responded that they thought that flow testing discovery wells to determine potential production rates for platform-facility design was a sound engineering and geological practice.

Also looser interpretations were indicated in the survey for reserves determinations under economic limits and petroleum-price parameters. While about 47 percent used constant, year-end pricing, 27 percent used flat yearly averages and the same percent used escalated pricing.

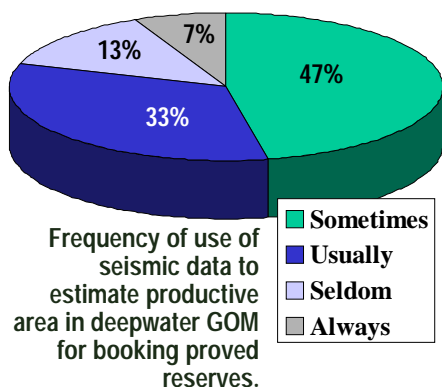
Reflecting more conservative interpretations, more than 71 percent of

respondents indicated that they do require some level of approved capital commitments for field development before booking the reserves as proved. One-third of the respondents required internal approval of all field-development costs before booking.

Also, about 87 percent of the respondents did not reduce operating-cost projections for future years (and therefore increase estimates of commercially recoverable reserves) to account for the effects of possible future improvements in technological developments or for learning-curve improvements (repeat efficiency).

Respondents indicated that besides flow testing, they used the following tools, in addition to others, to assess recovery factors: analog fields (10 replies), reservoir simulation (seven replies), whole cores (three replies) and geological modeling (two replies). The following methods for calculating recovery factors were mentioned once from the 15 respondents: material balance, assuming abandonment pressures (gas), log data, risk analysis and other correlations.

In summation, most GOM deepwater operators indicated that they loosely interpret U.S. regulatory-reporting guidelines for conclusive flow testing before booking reserves as proved. Also, almost half loosely interpreted the guidelines requiring the use of year-end petroleum pricing as they opted for other pricing methods.



Millennium bug no threat to report generation at Ryder Scott

Y2K

After analyzing the computer systems used to generate client reports, Ryder Scott concluded that Y2K issues are not a direct threat.

"In safeguarding the interests of our clients, we have investigated the ways in which we interact and exchange information," said Ron Harrell, president.

"The major product that Ryder Scott provides to the client is in the form of written reports. It is imperative from our perspective that we deliver this product on time and

correct. We have found that the normal business operations of Ryder Scott and those operations of our clients impacted by Ryder Scott will not be impaired because of potential failures related to Year 2000 problems."

Most software that Ryder Scott develops and maintains in-house has been created within the last three to five years to be Y2K compliant. In addition, the firm has migrated from a mainframe environment to a PC-network environment in which all system hardware and software are less than two-years old and Y2K compliant.

Ryder Scott is verifying the Y2K

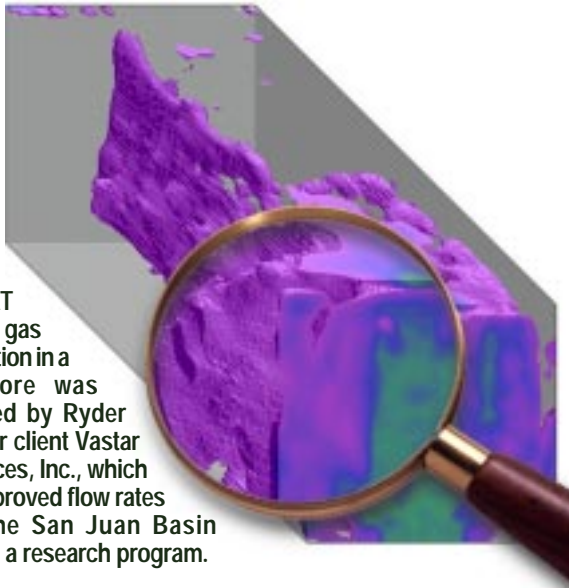
compliance of vendor software used by the firm. However, the main software used to produce reports is developed and maintained in-house, so third-party applications do not affect those core operations and would not impact the firm's ability to deliver reports.

For further information regarding Ryder Scott Year 2000 compliance efforts and how they will help to ensure uninterrupted delivery of services to clients, please contact Mr. Harrell at 713-651-9191, ext. 200, or at his e-mail, ron_harrell@ryderscott.com.

CBM producers succeed with varying approaches

While the rest of the world is beginning to realize the promise of large coalbed methane deposits, E&P companies in the U.S. have taken advantage of economic incentives and new extraction technology for years. Now U.S. CBM production is peaking.

Ryder Scott has performed reservoir studies in all major producing basins in the U.S. as well as elsewhere internationally. The following Ryder Scott clients have taken different approaches to exploiting CBM reserves, but each has been successful.



This CAT scan of gas penetration in a coal core was reviewed by Ryder Scott for client Vastar Resources, Inc., which has improved flow rates from the San Juan Basin through a research program.

Offshore operator, onshore gem

Vastar Resources, Inc. is recognized as a savvy independent offshore operator with a string of profitable finds in the Gulf of Mexico. So what is the company's single largest producing field?

Surprisingly, it's not in the gulf. The Ignacio Blanco Fruitland Coal (IBF) field in the San Juan Basin of New Mexico is the most prolific field in Vastar's portfolio, accounting for nearly one-fifth of Vastar's total production. On a barrel-of-oil-equivalent basis, the field's 250 MMcf of CBM gas per day is more than twice the size of the runner-up South Pass 60 offshore field.

Vastar has stemmed declines in production through continually modifying wellbores and surface facilities, including expanding compression capacities, debottlenecking surface facilities and looping pipelines, refracturing and recompleting wells and drilling infill wells. Vu Dinh, Vastar engineer, said his company also has enjoyed improved performance from open-hole sidetracking.

"We have stepped up CBM activities because of the lower cost drilling operations and low dry-hole risk," he said. Maximizing tax credits for gas production before the 2003 expiration is also a strategy to improve profitability.

Ryder Scott performs an independent audit of the IBF reserves work of Dinh and others within the company. "Ryder Scott's value to our company is in providing outside expertise and different perspectives," he said.

River Gas: Exclusive CBM producer

Northport, Alabama-based River Gas Corp. began as a small, independent CBM producer in the Black Warrior Basin in 1987. Its primary focus was the development of acreage position and capturing methane gas within the Pottsville coal seams. Four years and 535 wells later, the company realized its objectives, but not without some expenses.

"The early stages of dewatering required large up-front capital expenditures and significant negative cash flows. But, by the end of March 1999, 193 BCF of gas has been produced and the project still remains very profitable," said John Hollingshead, engineering manager. "Good preliminary planning, attention to detail and cost-conscious operations have contributed to the project's success."

Using the experience gained at Black Warrior, River Gas began developing the Drunkard's Wash CBM unit in the Uinta Basin in Utah eight years ago. The company became interested in the unit after reviewing data from core holes drilled decades ago by mining companies. This area in the Uinta Basin is one of the best CBM plays outside the San Juan Basin, as some wells in the Cretaceous coals are producing almost 4 MMcf/D of gas.

By 1999, River Gas had drilled approximately 180 wells in Drunkard's Wash with a cumulative production of more than 90 BCF of gas. "Again, we experienced huge capital expenditures and early negative cash flows in the beginning stages of development," said Hollingshead. "However, the current and future outlook for this field is very positive."

In 1998 when falling natural gas prices at least showed more strength relative to plunging oil prices, many domestic upstream independents turned their attention to gas and the potential of CBM. But River Gas, which was built on CBM development, is there for the long haul, regardless of the wild swings in the commodity markets. "While gas prices are important, we remain a 100-percent CBM operator because we feel that we excel in this niche market," said



This River Gas Corp. CBM well site is characterized by a smaller location and minimal surface facilities, which has limited the footprint. In 1995, the Utah Division of Oil, Gas & Mining named River Gas the recipient of the Earth Day award.

Hollingshead. River Gas is currently searching for CBM prospects to further grow the company.

For River Gas, the reserve base is the core of a company's future growth and value. "While CBM finding costs may be very high in early development stages, we have seen these costs drop significantly as more wells are added to the infrastructure. Additionally, with early identification of the coal properties through coring and pilot wells, the drilling risks are minimized and the size of the reserve base can be estimated," said Hollingshead. "Ryder Scott has helped us maximize our reserve base."

Joe Blankenship, a coordinator of CBM reserves evaluation at Ryder Scott, performs a full-scale evaluation of the River Gas properties and Ryder Scott issues an independent reserves report that is presented to lenders for asset-based financing. Blankenship uses CBM evaluation experience and Gas Research Institute (GRI) research to carefully establish parameters, such as density cutoffs for estimating pay, which leads to more accurate property appraisals.

"His extensive work in the San Juan Basin and his understanding of GRI's latest CBM gas-in-place techniques have been instrumental in putting together an accurate picture of the Drunkard's Wash reserves," said Hollingshead.

No deliberate focus on CBM

EnerVest San Juan Operating LLC has always concentrated on natural gas, which accounts for 95 percent of production. Although, the company has conducted CBM operations for years in the San Juan Basin, EnerVest is now increasing activity in conventional gas projects, especially in the Rocky Mountain area. However, the company expects to undertake future CBM projects in the Green River and Powder River basins of Wyoming, said Jack Vaughn, division manager.

"We have declined to participate in CBM projects with a rate of return below our threshold," he said. "Still, because of our successful experience and knowledge of CBM operations, we believe we are well positioned to properly evaluate and consider CBM projects, but there is no deliberate focus there."

Vaughn has found that shallow CBM operations generally have low total drilling and completion costs and simpler, less costly production facili-

ties. Smaller spacing allows amortization of gathering-system and compression-facility costs over a large number of wells. The finding and development costs on an Mcf basis can certainly be attractive, he said, adding that CBM production generally provides long-lived reserves that create a stable asset base.

Most coalbeds are naturally water saturated. Water production reduces hydraulic pressure on the coal and stimulates production. "In certain areas like the Powder River Basin, the water quality is good enough to allow surface disposal, which significantly reduces costs," Vaughn remarked. "However, EnerVest is concerned that surface disposal will be more difficult in the future because of increasing environmental constraints."

Since 1991, EnerVest has regularly used the latest CBM production techniques in the San Juan Basin. Open-hole cavitation has improved

communication with the cleat system and, therefore, recovery. Air drilling has lowered drilling costs and facilitated the cavitation process. Also, EnerVest has devoted a considerable effort to improve reservoir characterization to better understand reservoir performance and evaluate infill-drilling, well-remediation and gathering-system/compression plans.

Ryder Scott has performed economic and reserves evaluations on EnerVest CBM projects for annual reserves reporting and for special projects, such as infill drilling and reservoir characterization.

"EnerVest has benefited from the accurate Ryder Scott appraisals of our CBM projects. We give very strong consideration to the opinions of Ryder Scott in our planning and decision process," said Vaughn. "In addition, the well-earned reputation of Ryder Scott serves us very well with our partners and the financial community."

Ryder Scott: A leader in CBM evaluation



Blankenship

Ryder Scott is considered by many to be a leading evaluation firm for estimating the reserves of CBM reservoirs.

Ryder Scott has evaluated more than 50 CBM fields over the past 10 years, including extensive studies of fields and reservoirs in the San Juan, Black Warrior and Raton basins in the United States.

The San Juan and Black Warrior basins collectively account for about 94 percent of U.S. CBM production. Ryder Scott has extensive experience in the San Juan Basin, the largest developed CBM area in the world. The firm has also evaluated CBM reservoirs in Australia, France, Poland, China and Alaska.

Ryder Scott has found that, because of complex production behavior of CBM fields, the best way to predict performance is to use a three-pronged approach. It comprises volumetric and performance analyses and field analogy to account for all production mechanisms.

Ryder Scott can also use numerical reservoir simulation, when justified. Because of the erratic nature of coal-seam wells, the firm is careful not to rely on decline-trend techniques alone.

During the last decade, Joe Blankenship, a CBM reserves evaluation coordinator at Ryder Scott, has taken advantage of technological advances. Generally, the industry has underestimated reserves in CBM fields, because the gas content and pay counts used for volumetric calculations were too low, he said.

From analyzing historical data, evaluators have learned that desorption data often indicates coal is undersaturated only because of inaccurately low calculations of lost gas. Historical data has also shown the industry that coal beds produce gas, in some cases, even when the ash content and density are greater than previously thought.

"Ryder Scott uses this knowledge base to more accurately evaluate and fully value CBM fields today," said Blankenship.

For further information, contact Mr. Blankenship at 713-651-9191, ext. 282, or at his e-mail, joe_blankenship@ryderscott.com.

Intensive evaluation puts Petrovera heavy-oil partnership on fast track to development

Ryder Scott's quick turnaround in thoroughly evaluating the combined heavy-oil interests of PanCanadian Petroleum Ltd. and Gulf Canada Resources Ltd. this year put the Petrovera Resources partnership on a fast track, enabling it to immediately maximize value.

"We needed to get on with focusing our attention to drilling and recompleting wells and adding value," said John Zahary, president of Petrovera. "We didn't want to use our own staff to quibble over the fine details of value sharing when our staff could be creating much greater value by optimizing and increasing production."

The new joint venture, formed June 17, produces about 34,000 BOE/D and has 1.4 million acres of undeveloped land, making it one of Canada's largest heavy-oil companies. By merging their



The Coleville field on the western Saskatchewan plains was evaluated by Ryder Scott for Petrovera Resources.

interests, Gulf and PanCanadian will cut costs and optimize the combined portfolio of properties for increased development. But before the companies concentrated on taking advantage of the economies of scale, they had to mutually agree on an independent reservoir evaluation firm to assess the values and establish the respective

interests of each stakeholder.

"Ryder Scott Canada was a good choice because the firm had evaluated the Gulf properties and the interests of some PanCanadian partners as well as analogous fields in the area," said Zahary. "The firm is also recognized as a leader for evaluating heavy-oil properties."

After finishing a preliminary audit, the Ryder Scott team headed by engineer Doug Meiklejohn fully evaluated eight properties of PanCanadian in two weeks early this year. After Gulf and PanCanadian reviewed this work and Ryder Scott's prior work for Gulf, they decided to merge those assets and agree to an ownership split. Then Ryder Scott conducted a full multidisciplinary study of all 56 properties during a six- to

Please see Petrovera on Page 8

Rosewood outsources reservoir modeling services

Rosewood Resources Inc., an oil and gas exploration-and-development company headquartered in Dallas, recently commissioned Ryder Scott to develop a reservoir-simulation model of the Casma-Anaco field in eastern Venezuela.

"Even though Ryder Scott is known more for reserves estimation rather than for numerical modeling services, the modeling group is very active on simulation projects for several clients in various oil and gas producing areas," said Dean Rietz, manager of the simulation group.

Smaller independents, which usually do not maintain a reservoir-modeling staff, often outsource technical expertise. "The Ryder Scott simulation capability complemented our existing staff since Rosewood lacks such a capability," said Mark Malinowsky, reservoir engineer at Rosewood. "By fulfilling the simulation portion of the technical scope of work, Ryder Scott provided our study team with the necessary flexibility to focus on other critical study objectives."

Rosewood's internal staff prepared much of the model input including the geological interpretation, fluid properties, relative permeability and historical well-performance information. "Rosewood's experience and knowledge of the Casma-Anaco field, along with their data-

preparation efforts, allowed us to expedite the modeling process thereby keeping the outsourcing expense to a minimum," said Rietz.

This project was characterized by efficient use of electronic file transmissions, which saved time, increased efficiency and reduced costs, including travel expenses. Throughout the entire project implementation, Ryder Scott and Rosewood only met once for a progress report in Houston. All other interactions and data transfers were accomplished through e-mail, telephone and parcel service.

"The e-mail transfers of information involving modeling results were quite timely and efficient. Graphical and tabular output could often be studied at our offices in Dallas within minutes of completing computer runs at Ryder Scott's office in Houston," said Malinowsky.

The Casma-Anaco field, discovered in 1972, is located in a mature producing area. Consequently, high updip gas saturations have naturally occurred in some of the oil reservoirs, said Malinowsky. The prediction of the magnitude and extent of these areas of variable gas saturation has a significant influence on future development plans.

Please see Rosewood on Page 8



The Sedco Forex 50 rig will drill the first horizontal well in the Casma-Anaco field for Rosewood Resources Inc. The Ryder Scott model of a single fault block within one of the main pay zones helped Rosewood locate the well.

Geoscience integration helps define seismic role

—Steve Phillips, geophysicist



Phillips

“Seeing is believing” is a familiar and often reliable adage. But, if spoken while looking at seismic data, another old saying should come to mind, “Skepticism is the first step toward truth”.

Seismic reflection data, especially from high-resolution 3D surveys, help define most oil and gas reservoirs studied by Ryder Scott. The information contained in a seismic-data volume commonly allows mapping and classification of reserves

beyond what is proven by wells alone. However, using this information always requires consideration of the many factors that can conceal, exaggerate or distort reservoir geology.

Getting more from seismic

The initial use of seismic reflection techniques in oil and gas exploration was limited to predicting the location and depth of prospective reservoirs. These days, expectations are much higher for a return on the geophysical investment. As data quality improved, geophysicists observed that high amplitude “bright spots” correlate with natural gas accumulations in some areas. However, the hope for a foolproof hydrocarbon detection method has subsided as drilling reveals at least 14 different geological conditions that can produce strong seismic reflections, 13 of which are not attributable to hydrocarbon pay.

But, the quest for more accurate reservoir geophysics continues. Geophysicists have expanded their contributions to the reservoir-definition task. New field techniques, processing tools and interpretation skills now help operators with the following:

- Classification of reservoir rock type, porosity and fracture trends

- Identification of pore-fluid type and saturation
- Visualization of trap shape and continuity
- Detection of drilling hazards
- 4D production monitoring

Two papers published this year reveal and qualify some of the most advanced techniques yet to better define subsurface anomalies. Bruce S. Hart of the New Mexico Bureau of Mines recently wrote, “The seismic-guided property-prediction approach was popularized only about five years ago when it was demonstrated that log-derived reservoir properties sometimes could be relatively easily correlated to seismic attributes.” (*AAPG Explorer*, April 1999).

His study of the Appleton field (Smackover) in Alabama involved multiple-regression analysis of more than 30 seismic attributes to successfully predict porosity zone thickness away from the existing wellbores. Klaus Guderian, et al., (*The Leading Edge*, March 1999) described how pattern-recognition methods borrowed from satellite-imaging technology produced seismic pore-fluid maps of the Ruehme field in Germany.

The need for integrated studies

Ryder Scott clients are also turning to more sophisticated geophysical analyses to determine reserve volumes. A common thread in the efforts to better define oil and gas reservoirs is the integration of geological and geophysical data. Two recent Gulf of Mexico field projects evaluated by Ryder Scott emphasize the value of this approach.

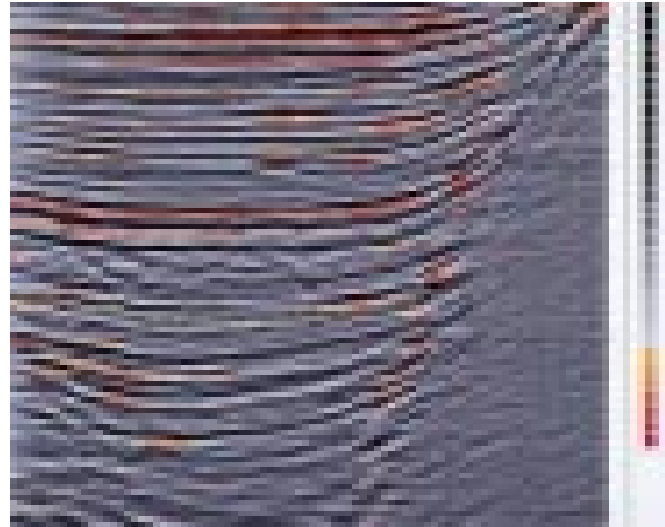


Figure 1

The seismic profile in Figure 1 shows reflection events truncating up-dip against a salt dome. In this example, reservoir structure and faulting are well imaged. The client identified six target intervals on the basis of strong amplitude anomalies (orange-red events). When the well reached total depth, more than 20 pay zones had been penetrated. Therefore, many gas-filled reservoirs, including one of the thickest, exhibited negligible amplitude response.

Despite the erratic nature of the amplitude attribute in the first example, the seismic structure interpretation and well-log petrophysics were combined in the Ryder Scott study to document nearly 100 Bcf of proved gas reserves.

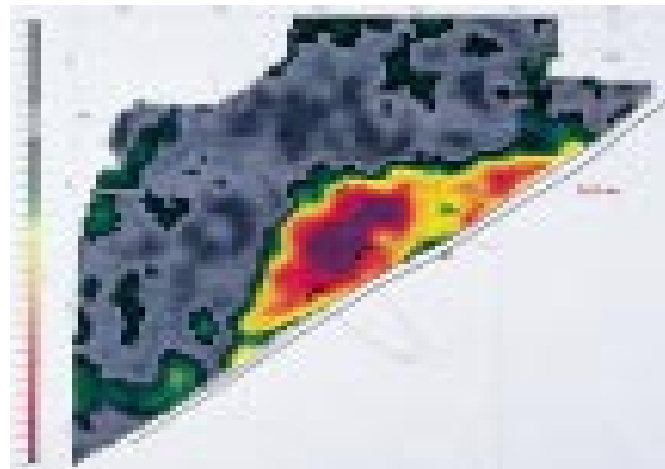


Figure 2

The second example illustrates the opposite problem. Figure 2 is a map of amplitude strength for a reservoir bounded by a fault and dip closure. A significant amplitude anomaly conforms to the structural high, terminates at the fault and appears to define a gas-water contact. The anomaly covers more than 600 acres and could have been interpreted as contributing a relatively large volume of proved reserves to the field. However, the two wells penetrating the feature encountered one of

Please see Seismic on next page

Seismic—Cont. from Page 7

those 13 geologic conditions not attributable to hydrocarbon presence: a porous sand with high water saturation.

In both examples, relying on seismic alone would have led to a serious misinterpretation. Integration of all available data is key to establishing reliable reservoir description. Ryder Scott geophysicists routinely review log, core, well-testing and engineering data as well as seismic information before determining reservoir potential. This approach to seismic interpretation tempers any extrapolations with fundamental petroleum geology and a healthy scientific skepticism.

The skills of the geophysical team at Ryder Scott include:

- 2D / 3D structural and stratigraphic interpretation
- Seismic response modeling
- Attribute extraction
- Time-to-depth conversion
- Experience with Landmark, GeoQuest, Seismic Micro Technology and GeoGraphix software

The previously mentioned integrated software allow the geoscientist to visualize, analyze and interpret seismic, well and log data, providing a more cohesive, accurate interpretation.

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Rosewood—Cont. from Page 6

The model enabled Rosewood to locate probable distributions of updip gas in the reservoir. Ultimately, the model of a single fault block within one of the main pay zones helped Rosewood locate the first horizontal well.

"We learned the most likely location of remaining undrained oil within the reservoir and the relative effectiveness of vertical and horizontal wells regarding recovery of this reserve," said Malinowsky. "I give Ryder Scott superior marks for its performance on this project, both technically and professionally. The people Ryder Scott assigned to the project were qualified, efficient and most importantly, thorough."


For further information on Ryder Scott modeling services, please call Dean Rietz, manager—reservoir simulation, at 713-651-9191, ext. 216, or send him an e-mail at dean_rietz@ryderscott.com.

Petrovera—Cont. from Page 6

eight-week time frame during May to July.

The work involved organizing those properties, understanding the portfolio and ranking the properties to ensure focus on those areas of most value, said Meiklejohn. Ryder Scott took into account historical operating costs and the impact of reduced servicing in 1997-98 when heavy-oil price differentials fell and production declined. The firm estimated higher reserves and additional value in the report for Petrovera because of the rebound in heavy-oil prices in 1998-99.

"With revenues of \$5 or \$6 a barrel, the companies shut in wells and no longer did workovers and pump changes," Meiklejohn said, "Now, however, with today's prices, those shut-ins can be reactivated and production will increase." Besides reviewing production and operating-expense figures, Ryder Scott evaluated well logs and core data to estimate the behind-pipe reserves for the Lindbergh field. The firm's geological team also mapped the heavy-oil pools in Coleville, Coleville South and Frog Lake fields and Ryder Scott reserves analyst Roy Legere evaluated those areas.

"Looking at a large number of wells that were shut-in and estimating the proved nonproducing reserves was very labor-intensive, but Ryder Scott completed it in a pretty impressive time frame," said Zahary. "The area is not mature with a long string of production declines where you simply do decline-curve analysis. There were more technical challenges in looking at the structural geology and reviewing analogs. Ryder Scott's work was most exemplary. They had a good understanding of the properties and did the job quickly, yet thoroughly." 

ResGAS—Cont. from Page 1

Ryder Scott professionals use ResGAS and the other available freeware programs internally. However, these downloadable programs are not designed to be substitutes for the more sophisticated suite of evaluation tools required by and used by Ryder Scott for complete in-depth analyses.

Editor's Note: Ryder Scott does not guarantee or warrant the accuracy or reliability of this software and disclaims its fitness for any particular purpose.

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