BULLETIN

Corpus Christi
Geological Society

and

Coastal Bend
Geophysical Society

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P.O. BOX 1068* C.C. TX. 78403
2016-2017
www.ccgeo.org

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President Elect			
Vice President	William Thompson	361-242-3113	arrangements@ccgeo.org
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Councilor I	Rick Paige	361-884-8824	rickp@suemaur.com
Councilor II	Randy Bissell	361-885-0113	randyb@headington.com

AAPG DELEGATE

EDITORS

Bulletin Editor	Marian Wiedmann	361-855-2542	wiedgulf@gmail.com
Bulletin Tech. Editor	Sebastian Wiedmann	361-946-4430	swiedmann.geo@gmail.com
Web Master	Josh Pollard	361-654-3100	support@interconnect.net

GEOLOGICAL SOCIETY COMMITTEES & CHAIRPERSONS

Advertising/Bus. Cards	Robby Sterett	361-739-5618	robert.sterett@gmail.com
Arrangements	Wes Gisler &	830-239-4651	arrangements@ccgeo.org
	Will Graham	361-885-0110	willg@headingtonenergy.com
Bloodmobile	Mike Lucente	361-883-0923	mikel@lmpexploration.com
Earth Day	Alan Costello	361-888-4792	acostello@royalcctx.com
Continuing Ed.	Stephen Thomas	361-660-8694	sthomas@spnaturalresources.com
Education	Dawn Bissell	361-960-2151	bissells@swbell.net
Scholarship	J. R. Jones	361-779-0537	jrjones5426@aol.com
Fishing Tournament	Leighton Devine	361-882-8400	ldevine@suemaur.com
History	Ray Govett	361-855-0134	ray30@hotmail.com
Membership	Dorothy Jordan	361-885-0110	dorothyj@headington.com
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Type Logs	Frank Cornish	361-883-0923	frank.cornish@gmail.com
University Liaison	Casey Mibb	361-726-1092	clmibb@yahoo.com
	Wesley Garcia		

COASTAL BEND GEOPHYSICAL SOCIETY
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2016-2017

OFFICERS

President	Lonnie Blake	361-883-2831	lonnie_blake@eogresources.com
Vice President	Dr. Subbarao Yelisettl	361-593-4894	subbarao.yelisetti@tamuk.edu
Secretary/Treasurer	Matt Hammer	361-888-4792	mhammer@royalcctx.com
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Education	Dr. Robert Schneider		

Visit the geological web site at www.ccgeo.org

CCGS/CBGS JOINT MEETING SCHEDULE 2016-2017

September 2016

S	M	T	W	Th	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

GCAGS Convention
"Explore The Future"
September 18-20, 2016
Corpus Christi, TX.

October 2016

S	M	T	W	Th	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

GCAGS Post-Convention
Party & Society Kickoff
Bar-B-Q
Thursday, October 13
5:30 to 8:00 p.m.

November 2016

S	M	T	W	Th	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

11:30am-1:00pm.
Speaker: Bruce Moriarty, Principal Geophysical Advisor, Lumina Geophysical
"Simultaneous Inversion of Spectrally-Broadened 3D Seismic Data: Case Study for the Olmos Unconventional Play, South Texas"

December 2016

S	M	T	W	Th	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Combined November/December for the Holidays.

January 2017

S	M	T	W	Th	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
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29	30	31				

February 2017

S	M	T	W	Th	F	S
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5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28				

CCGS/CBGS Joint Meeting Schedule 2016-2017

March 2017							April 2017							May 2017						
S	**M**	**T**	**W**	**Th**	**F**	**S**	**S**	**M**	**T**	**W**	**Th**	**F**	**S**	**S**	**M**	**T**	**W**	**Th**	**F**	**S**
			1	**2**	**3**	**4**							**1**		**1**	**2**	**3**	**4**	**5**	**6**
5	**6**	**7**	**8**	**9**	**10**	**11**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
12	**13**	**14**	**15**	**16**	**17**	**18**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
19	**20**	**21**	**22**	**23**	**24**	**25**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
26	**27**	**28**	**29**	**30**	**31**		**23**	**24**	**25**	**26**	**27**	**28**	**29**	**28**	**29**	**30**	**31**			
							30													

March: Combined February/March for Spring Break

April: 11:30a.m.-1:00p.m.
Speaker: Rocky Roden, Geophysical Insights
"Interpreting Below Seismic Tuning Using Multi-Attribute Analysis"

May: 11:30a.m.-1:00p.m.
Speaker: David L. Krams, P.F. Director of Engineering Services, Port of Corpus Christi Authority. "The Port of Corpus Christi – Past, Present and a Big Future"

Calendar of Meetings and Events

Calendar of Area Monthly Meetings

Corpus Christi Geological/Geophysical Society	Third Wed.—11:30a.m.
SIPES Corpus Christi Luncheons	Last Tues.—11:30a.m.
South Texas Geological Society Luncheons	Second Wed—noon San Antonio
San Antonio Geophysical Society Meetings	Fourth Tuesday
Austin Geological Society	First Monday
Austin Chapter of SIPES	First Thursday
Houston Geological Society Luncheons	Last Wednesday
Central Texas Section of Society of Mining, Metalllurgy & Exp	2nd Tues every other month in San Antonio

PRESIDENT'S LETTER

It's hard to believe that I am writing this article in March for April publication..... this year has flown by!

At the beginning of the 2016-17 year, the Executive Committee planned to revise the CCGS Bylaws for presentation to the membership and a vote in May. The revision would have been the first since 1986 and brought the Bylaws in line with the way that CCGS is presently operating.

During the Executive Committee meeting after the February luncheon meeting, we realized that the CCGS is changing rapidly from the way the Bylaws described to the way we have operated in the past few years to something completely different. Many of our members are retiring and choosing to move away from the area and/or be less active in the Society.

Right now is the time of year that we are supposed to be finding the officers and other volunteers to serve for the 2017-18 year. Anyone who is interested in serving, please speak up!

Often when members are asked to serve as an officer, they say that they don't have five years to tie up in serving as one officer, then another, and finally as President. That's not what serving the CCGS is all about!

The Executive Committee would like to have more talks from local members in the coming years. We have many students from local universities who attend luncheon meetings. Talks on local subjects or “how-to” topics would serve our younger members well.

If you have ideas on these topics, please let one of the Executive Committee members know. This is your Society, too!

Barbara Beynon
CCGS President

PRESIDENT'S LETTER

News -

Rig counts are going up. Oil and gas prices are going down, when this was written oil was below $50, gas was below $3.00. What's next?

CBGS Business -

CBGS will be hosting a Basic Seismic Attributes Course, 9-4 Friday April 28th, EOG 3rd Floor Conference Center, Instructor is Dr. Robert Schneider

Students $10, CBGS Members $30, Non CBGS Members $50 (Includes $20 for CBGS membership)

All proceeds go to the TAMUK Geophysics Program

Contact Robert.Schneider@tamuk.edu or Lonnie_Blake@eogresources.com

CBGS will hold its annual Golf Tournament to fund its scholarship program on October 6, 2017 at Northshore Country Club
To participate or sponsor, please contact Lonnie Blake, 361 887 2665, Lonnie_Blake@eogresources.com
Thanks to Fermin Munoz for his help in organizing this tournament the last few years. Any one who wants to help, contact Lonnie Blake

Education/Events -

- GSH

Geophysical Acquisition: Advanced Technologies Revealing Challenging Targets, April 12-13, Simulcast, Numerous Speakers
Carbonate Essentials: April 25-26, Webinar, Christopher Liner
Basic Signal Processing: May 23-26, Webinar, Enders Robinson and Sven Treitel
Introduction to Borehole Acoustics: July 25-28, Webinar, Mathew Blyth
Numerous technical luncheons if you happen to be in Houston. Check following link. Geophysical Society of Houston Calendar
CBGS has a revenue sharing agreement with GSH.
Mention CBGS if you register for GSH events.

- HGS

Unconventional Mechanics, Houston, Nov 8-9

- SEG

MicroSeismic and Hydraulic Fracture Mechanisms, Jun 19-21, Spring, Texas
SEG has 450+ eLearning courses online from $0.99 to $150.00(most expensive I saw) http: //www.seg.org/professional-development/seg-on-demand
Annual SEG Convention, Houston, Sept 24-27

- AAPG

Annual AAPG Convention, Houston, April 3-5
URTEC, Austin, July 24-26

- Offshore Technology Conference, May 1-4, Houston
- NAPE, Aug 16-17, Houston
- SPE Convention, Oct 9-11, San Antonio, Texas

Monthly Saying

Be careful what you wish for because you will get it. Be even more careful what you work for because you will get it even more quickly - Colin Cunningham

Monthly Summary

Texas Oil and Gas Info	Current Month	Last Month	Difference
Texas Production	MMBO/BCF	MMBO/BCF	MMBO/BCF
Oil	86.9	91.3	-4.4
Condensate	10.2	10.8	-0.6
Gas	615.5	650.6	-35.1
	Current Month	Yr to date - 2017	Yr to date - 2016
Texas Drilling Permits	991	1,947	1,083
Oil wells	258	517	300
Oil and Gas	640	1,247	634
Gas wells	37	104	69
Other	12	16	12
Total Completions	677	1,213	2,270
Oil Completions	533	951	1,773
Gas Completions	95	179	383
New Field Discoveries	4	6	2
Other	49	83	114

Lonnie Blake
CBGS President

CORPUS CHRISTI GEOLOGICAL SOCIETY
COASTAL BEND GEOPHYSICAL SOCIETY

LUNCHEON MEETING ANNOUNCEMENT

WEDNESDAY, APRIL 19th, 2017

Location: Congressman Solomon P. Ortiz International Center, 402 Harbor Drive, Corpus Christi, TX 78401 http://ortizcenter.com

Bar Sponsor: To be announced ***(sponsors needed!)***

Student Sponsor: Core Laboratories and Corpus Christi Geological Society

Time: 11:30 am Bar, Lunch follows at 11:45 am, Speaker at 12:00 pm

Cost: $25.00 (additional $10.00 surcharge without reservation; No-shows may be billed and non-RSVP attendees cannot be guaranteed a lunch); ***FREE*** for students with reservation (discounted by our generous sponsors)!

Reservations: Please **RSVP** by 4PM on the FRIDAY before the meeting!
E-Mail: *wes@gislerbrotherslogging.com*

Please note that luncheon RSVPs are a commitment to the Ortiz Center and must be paid even if you can't attend the luncheon.

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Interpreting Below Seismic Tuning using Multi-Attribute Analysis

learning of new processes in visualizing thin beds and facies with machine learning technology, covering topics including:

- Rayleigh's Criterion and the classical basis of seismic tuning
- Work by Brown et al. (1984,1986) and Connolly (2007) on thin bed calculations
- Phenomena at or below tuning
- Applications of attributes to the wedge model
- How multi-attribute classification techniques that use machine learning enable visualization below tuning
- Case studies in the application of this new technique in conventional and unconventional geologic settings

Presented by:

Rocky Roden,

President and Chief Geophysicist, Rocky Ridge Resources

Senior Consulting Geophysicist, Geophysical Insights

About our Presenter:

Rocky Roden earned his Bachelor of Science in Oceanographic Technology – Geology from Lamar University in 1975, and his Master of Science in Geological and Geophysical Oceanography from Texas A&M University in 1980. He served as Chief Geophysicist for Repsol/YPF, advising on strategy, interpretation, and technical analysis for exploration and development in, Argentina, Spain, Egypt, Bolivia, Ecuador, Peru, Brazil, Venezuela, Malaysia, and Indonesia, and the United States, including the onshore and offshore Gulf Coast, the Gulf of Mexico OCS. He has also served as Chief Consulting Geoscientist for Seismic Micro-Technology.

Rocky presently serves as the President and Chief Geophysicist for Rocky Ridge Resources, advising numerous companies on geoscience technical issues, including Anadarko, Noble, Oxy, Marathon, Repsol/YPF, Devon, ENI, Total, Maersk, Energy XXI, Nexen, Lake Ronel, ONGC, Ecopetrol, Pemex, BHP, and others. He also presently serves as a principal in the coordination of an industry-wide consortium of 42 oil companies in the development of a seismic amplitude risk analysis program and prospect database, as well as a co-instructor for a DHI Risk Analysis Course with Rose and Associates. Rocky is a Senior Consulting Geophysicist with Geophysical Insights.

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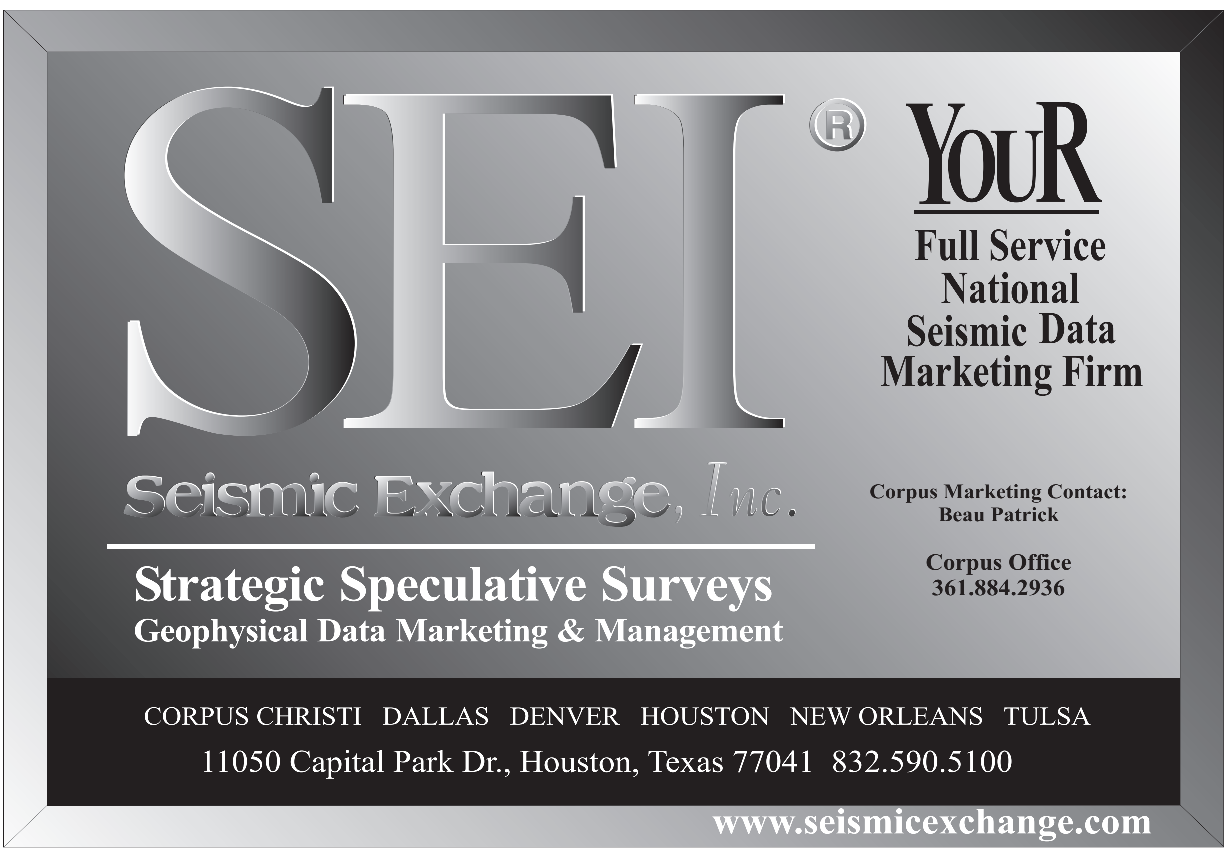
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Combining BroadSeis 3D HD-WAZ data in a reservoir-driven processing approach for field development

Gabino Castillo[1*], Rob Mayer[1], Paola Fonseca[1], Maria Coronado[1], Cesar Marin[1], Enrique Casana[1], Jo Firth[1], Jeshurun Hembd[1], Taylor Goss[1], Chu-Ong Ting[1], Madain Moreno Vidal[2], Enrique Trejo Vazquez[2] and Federico Fernandez Quiroz[2] **describe how broadband, wide-azimuth tailored acquisition played a key role in the advanced rock property estimation and seismic characterization of a shallow-water carbonate reservoir located offshore Gulf of Mexico.**

The advent and integration of new technologies in seismic acquisition, processing and reservoir characterization are allowing for a better understanding of the geologic processes playing a part in the creation of hydrocarbon reservoirs in the subsurface. Extended seismic bandwidths provided by broadband acquisitions (BroadSeis), improved illumination from wide-azimuth (WAZ) configurations and high spatial resolution made possible by dense acquisition techniques are all new technologies producing visually compelling imaging and reservoir results. In addition, application of the latest reservoir characterization tools and workflows on these data are bringing greater insight into the inner workings of petroleum reservoirs.

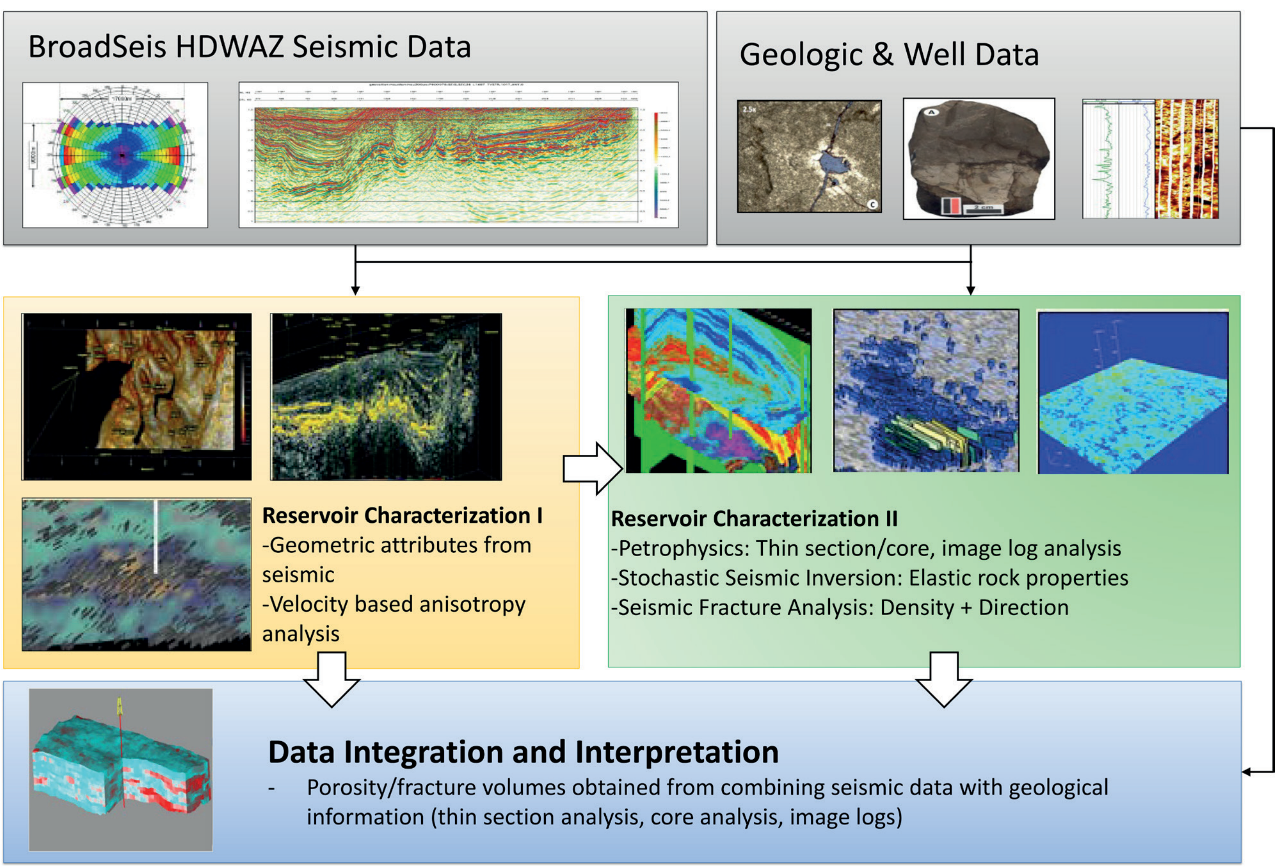


Figure 1 *A tailored acquisition, processing and reservoir characterization workflow.*

[1] *CGG.*
[2] *Pemex.*
[*] *Corresponding author, E-mail: gabino.castillo@cgg.com*


SABALO
ENERGY

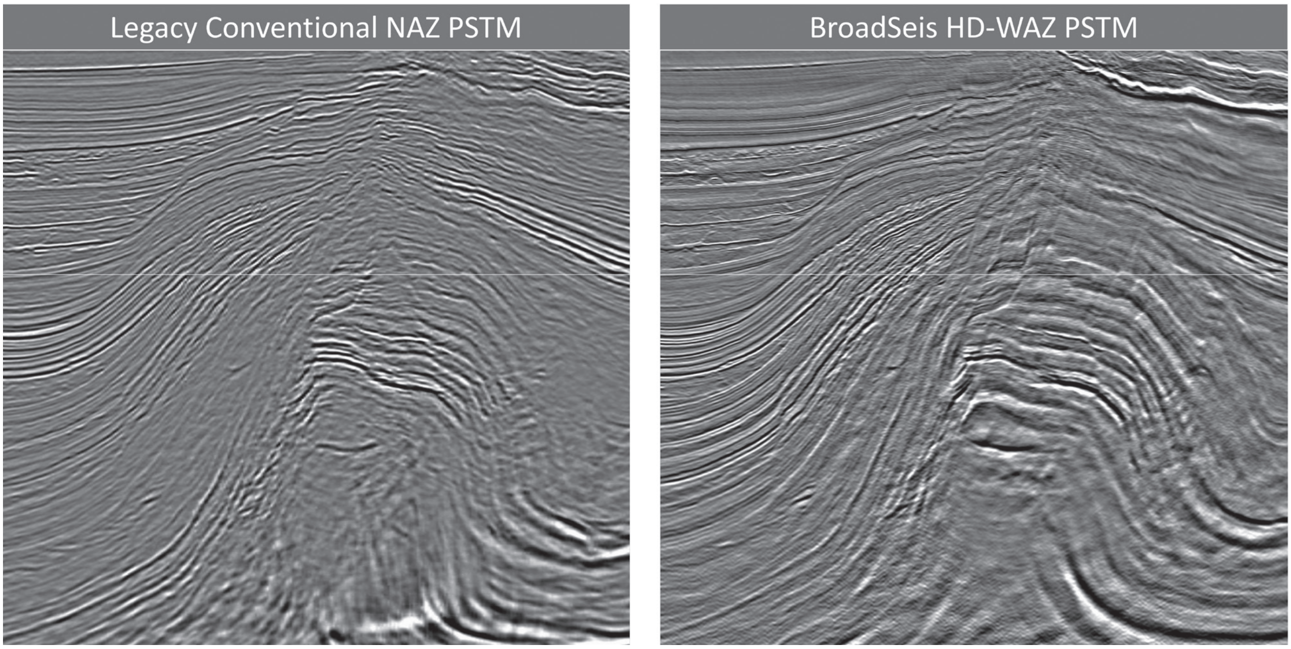


***Figure 2** Legacy conventionally acquired Narrow-Azimuth (NAZ) data (left) compared to High-Density Wide-Azimuth (HD-WAZ) data (right) showing improved illumination and resolution for structural and stratigraphic interpretations.*

Seismic acquisition and processing

In order to gain a detailed quantitative understanding of the reservoir, a team of geoscientists conceived a survey design and reservoir-driven processing flow to meet the reservoir characterization objectives. The resulting broadband high-density wide-azimuth (HD-WAZ) survey was acquired for Pemex targeting a shallow-water Gulf of Mexico reservoir. On this survey, four sources and 24 streamers were deployed in a multi-vessel arrangement using CGG's BroadSeis seismic acquisition methodology, delivering detailed high-resolution images that are ideal for both structural interpretation and reservoir characterization. High temporal resolution was provided by variable-depth streamer acquisition, enabling broadband imaging from 2.5 to 150 Hz. High spatial resolution was required in both inline and crossline directions, necessitating a dense shot grid and interleaved sail lines. Continuous recording was employed to maximize record length despite the close shotpoint interval.

A fully integrated reservoir-oriented processing sequence was applied to the data to facilitate a detailed reservoir characterization study. Key processing steps included demultiple, velocity analysis, deghosting (Soubaras, 2010) and Kirchhoff migration. The shallow water depth resulted in strong multiples throughout the dataset, necessitating a multi-step 3D prediction and subtraction flow to uncover the underlying primaries. Geology-based rock property models yielded a series of synthetic seismic forward models that were utilized for amplitude and phase preservation and refinement of the pre-stack migration velocity model. Broadband deghosting and pre-stack Kirchhoff migration yielded an image with substantial improvements over the legacy conventional narrow-azimuth (NAZ) data, including higher definition in the shallow section, sharper fault plane imaging and

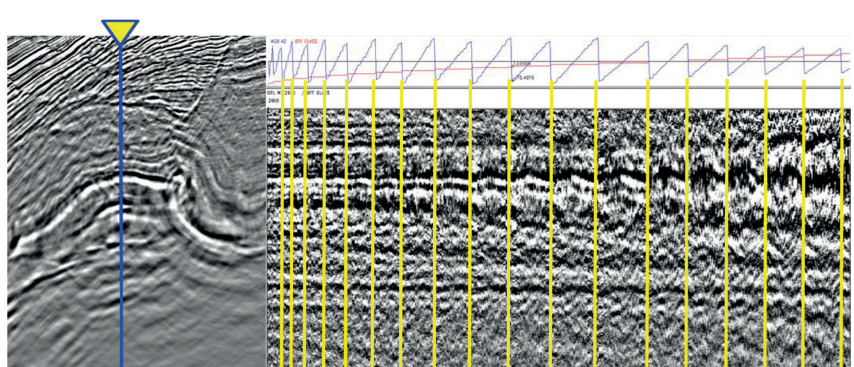


***Figure 3** A single prestack-migrated gather (right) from the HD-WAZ data. The yellow vertical lines in the gather group traces have the same offset, yet different azimuths from 0 to 180 degrees. The angle-dependent time differences are caused by azimuthal anisotropy and highly related to fracture orientation and density.*

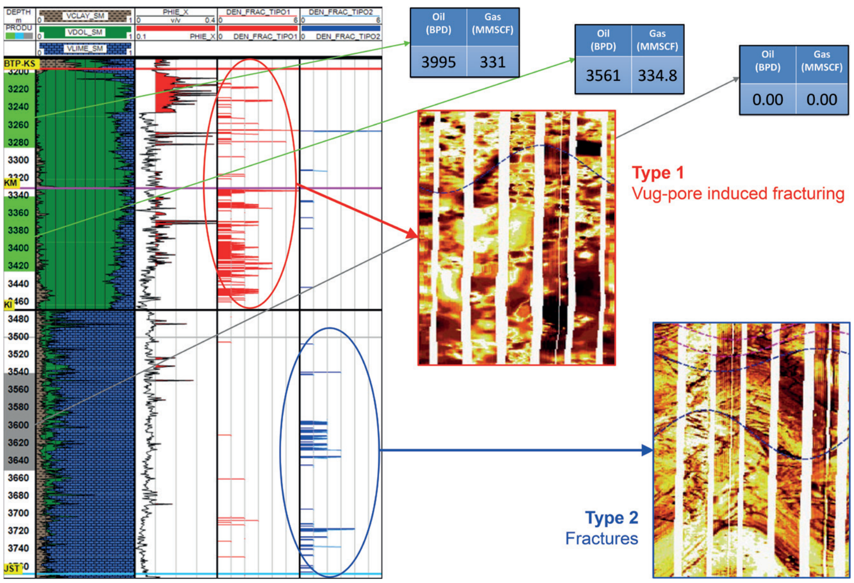


Figure 4 *Type 1 fractures, associated with vuggy porosity, correspond to high total porosity areas and producing intervals. Type 2 fractures are associated with low-porosity intervals and poor or no hydrocarbon production.*

superior definition of deep structures as shown in Figure 2. However, the benefits of the new dataset for the purposes of the reservoir characterization study were even more apparent in the pre-stack domain. Figure 3 shows a pre-stack time-migrated gather near one of the well locations. The high fold and azimuthal sampling of the high-density WAZ data yields a dense sampling of azimuths within each offset class. In the displayed location, azimuthal anisotropy effects appear in the timing variations within each offset class, providing valuable information for fracture characterization.

Reservoir characterization

The primary objective of the reservoir characterization was to identify and quantify the generation of secondary porosity within the carbonate reservoir. In the target reservoir, porosity has been enhanced as a combined result of fractures, dissolution voids (causing vuggy to cavernous porosity) and dolomitization of the original limestone. The geological processes responsible for this porosity enhancement are complex and include both regional and local tectonics together with a complex diagenetic history. Understanding the significance of the altered seismic data response associated with the effects of these geological processes is critical to the understanding of the geological model.

Upon completion of the acquisition and reservoir-driven seismic processing stages, the reservoir characterization study was initiated and divided into three phases, as shown in Figure 1. The first phase focused on the generation of geometrical attributes, spectral decomposition and initial fracture analysis based on Horizontal Transverse Isotropy (HTI). During phase two, geological and petrophysical analyses were carried out on well data to identify reservoir properties such as porosity, lithology and fracturing. This information, combined with the subsequent rock physics analysis, allowed for the calibration of well data to seismic attribute volumes derived from elastic and azimuthal inversion processes. The last phase integrated and analysed geological, petrophysical and seismic data to identify prospective areas and high-grade locations for new wells.

Petrophysical and geological analysis

The objectives for this phase were as follows:

- QC and edit logs to perform petrophysical evaluations and rock physics analysis.
- Conduct petrophysical evaluations to characterize the reservoir, using the selected wells and integrating all available information to calibrate with reservoir properties.
- Identify the best elastic properties to characterize the lithological end-members in the field.
- Find the best correlations between petrophysical and elastic properties.

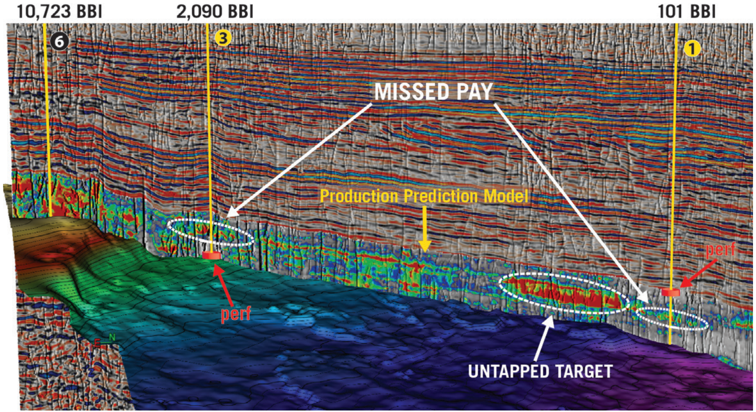
Seismic-based predictions of lithofacies and fracture density were challenging to obtain due to the complex nature of the secondary porosity. Significant effort was made to constrain these predictions using geologic interpretations from wireline and image logs, thin sections and core data analysis. Based on this analysis, the reservoir was subdivided into two basic classes:

Type 1: Fractures associated with vuggy porosity, within a high-porosity dolostone.

Type 2: Non-vuggy fracturing associated with low-porosity limestone.

Figure 4 shows well-log examples of these end members (limestone/dolostone) and highlights the significant differences in effective porosity (track 2). Type 1 fractures are associated with the presence of dolostone and are high-porosity reservoirs, whereas type 2 fractures are associated with the presence of limestone, low porosities, and are non-producing intervals.

SEISMIC-BASED ANALYTICS



An arbitrary line through 3 vertical wells in the West Texas Permian Basin shows the lateral variations of the Production Prediction Model and reveals refrac potential for Wells 1 and 3 where the red disks indicate the actual completion intervals and the white circles highlight the missed pay. Note the untapped target near Well 1.

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The improved reservoir properties in the type 1 intervals result from the presence of large, vugular pores in which pore connectivity is significantly enhanced by the presence of fractures. This not only accounts for the higher log porosities, but also has implications for improved permeability relative to type 2 intervals.

Seismic azimuthal anisotropy shows a clear difference in areas characterized by type 2 vertically oriented stress fractures. Attributes from this anisotropy can be compared with image logs to determine the relationship between the two data types in order to predict fracture density away from the wells.

The distribution of the type 1 vuggy porosity appears to be less regular and predictable than the type 2 stress fractures, showing less noticeable seismic azimuthal anisotropy. An alternative methodology was therefore required to characterize the fractures and vugs, and predict the orientation, magnitude and secondary porosity effect. To identify these prospective areas, porosity discretization was carried out based on petrophysical information. The discretization process involved the separation of the different components that contribute to the total porosity calculated within any interval in the reservoir (matrix, vugs, micro-fractures, fractures) and, as a result, it was determined that type 1 fracturing contributed to reservoirs where total porosity values are in excess of 10%. Pore size was also determined to have had an effect on overall reservoir quality; samples with large vuggy or cavernous porosity >16 mm in diameter ('megapores') (Flügel, 2013) correspond to the best producing intervals. Additionally, rock physics analysis identified a good separation of these high-porosity areas from background values based on elastic parameters. Figure 5 shows an example of the final porosity discretization carried out for one of the control wells, as well as the observed relationship between calculated total porosity and acoustic impedance (upper right), and acoustic vs. elastic impedance (lower right).

Seismic attributes

The seismic characterization phase of this project focused on obtaining elastic impedances (P-impedance, S-Impedance) and anisotropy-based seismic attributes (Castillo and Van de Coevering, 2013). With judicious geologic constraints, fracture information can be inferred from these anisotropy-based attributes. Pre-stack azimuthal velocity analysis and azimuthal seismic inversion yield fracture-based attributes including: normal and tangential weakness, anisotropic gradient, fracture strike, Vfast, Vslow and the orientation of Vfast.

Rock physics analysis indicated that high-porosity intervals could be identified with a good deal of certainty on the basis of elastic parameters. However, in order to separate the end-member lithologies into their discrete porosity units, the uncertainty associated with lithology identification and porosity calculation needed to be reduced to a minimum. Elastic attributes obtained from deterministic and stochastic inversion analysis, as well as anisotropic parameters obtained by means of the azimuthal inversion process, were used as inputs for a multi-attribute analysis designed to improve lithology and porosity calculations.

Prestack seismic inversion is required to extract the P-impedance and S-impedance volumes from the seismic data. As the earth has filtered both high and low frequencies from the original seismic source, the low-frequency band must be recovered from geologic constraints. As a development project with sufficient well control, a low frequency model was constructed with seismically-guided interpolation of filtered impedances from the well logs.

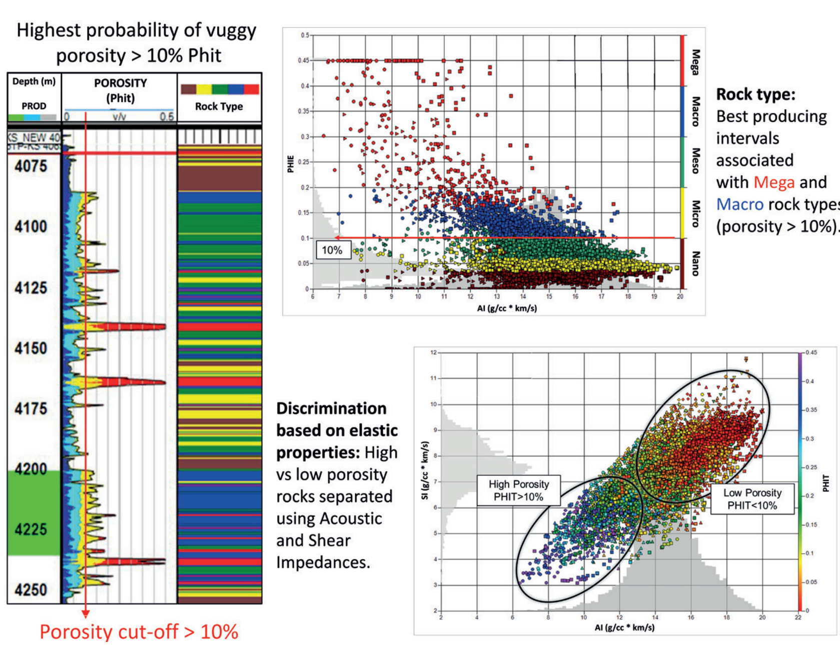

Figure 5 The image on the left shows the resulting porosity discretization, in which most producing intervals are associated with porosity values in excess of 10%. The top cross plot shows the discretized porosity groups vs. Acoustic impedance. The cross plot at bottom right shows P-Impedance values plotted against S-Impedance and coloured by total porosity. Note how points associated with high porosity separate in the bottom left corner of the plot.

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The broader frequency spectrum obtained as a result of broadband acquisition and processing proved valuable in the creation of reservoir property volumes such as porosity and lithology. Specifically, the improvement in the low-frequency component reduced the reliance on the pre-stack inversion low frequency model, leading to higher confidence in the multi-attribute seismic analysis prediction of rock property volumes.

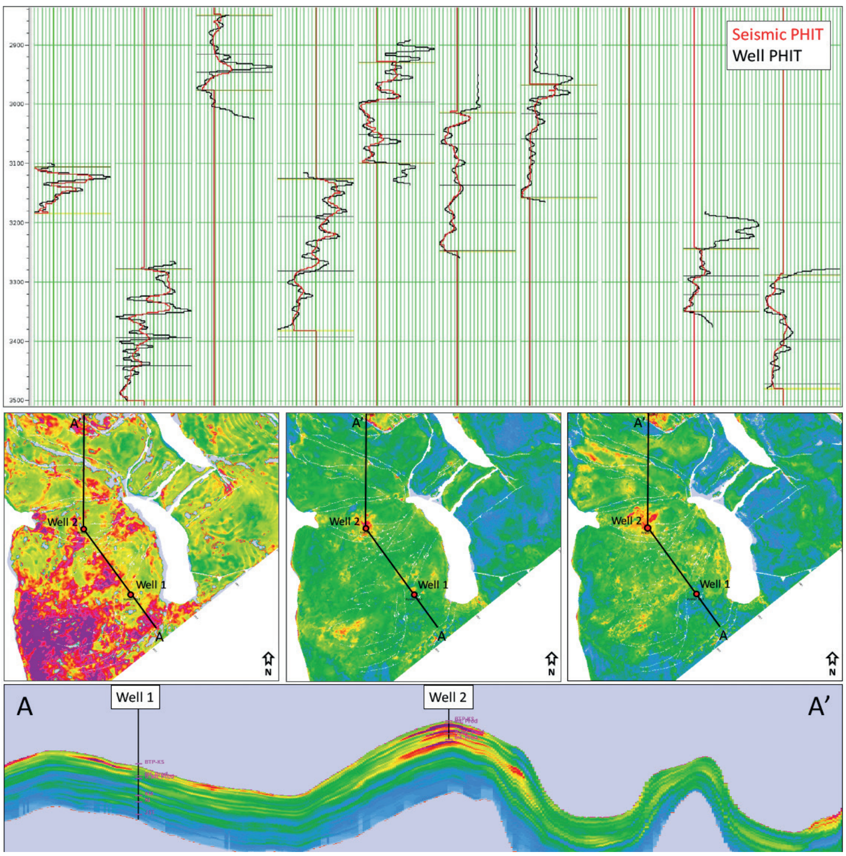

Figure 6 Porosity estimation from seismic data compared to calculated porosity from well data (top). The resulting porosity volume allows for the extraction of the maps shown, which are helpful in identifying the highest porosity areas at different stratigraphic intervals.

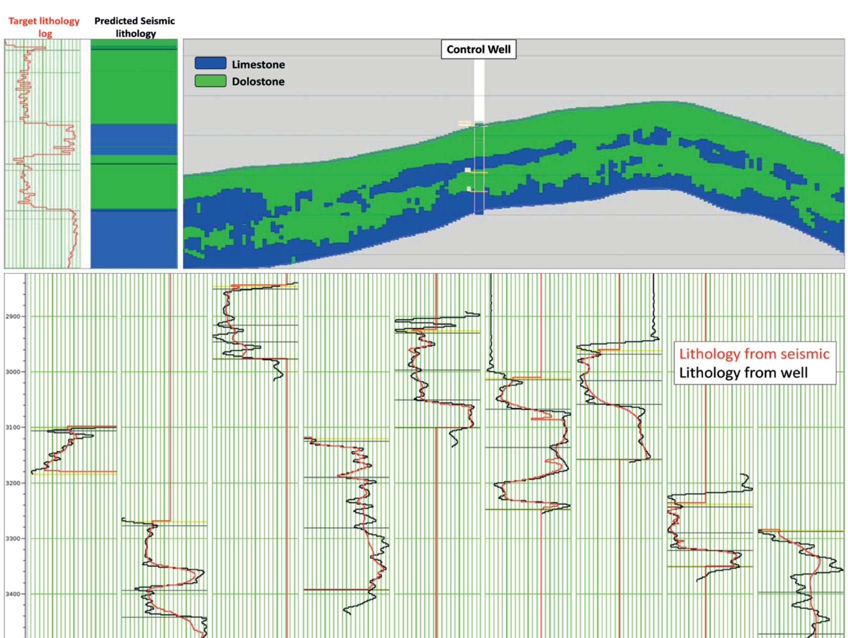

Figure 7 Top image shows a classified lithology cross-section as a result of multi-attribute analysis/ prediction techniques. The bottom image shows lithology estimation at the well locations from seismic data (red trace) compared to calculated lithology from well data (black trace).

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Figure 6 shows the results of the multi-attribute porosity calculation based on seismic inputs at various control wells (top image). The estimated total porosity values from seismic are shown in red, while the total porosity curves from petrophysical analysis are shown in black. Correlation between well data and estimated seismic values is high; it is this type of detail that allowed for a more thorough analysis during the interpretation phase. The maps shown correspond to multiple horizon slices within the reservoir, and show the extent of the high-porosity areas.

The discrimination of high-porosity areas was made possible using elastic parameters. In the absence of high porosity, discrimination between limestone and dolostone

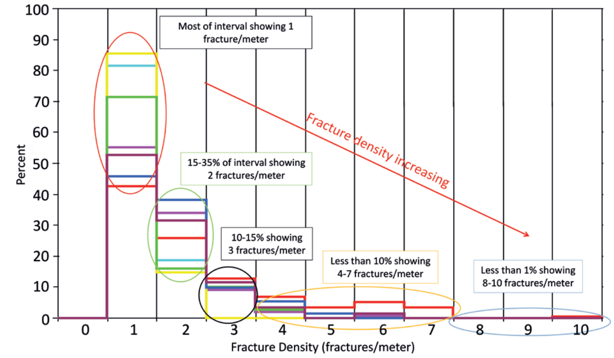

Figure 8 *Image log data showed that only a small percentage of the reservoir was highly fractured (>7 fractures/meter).*

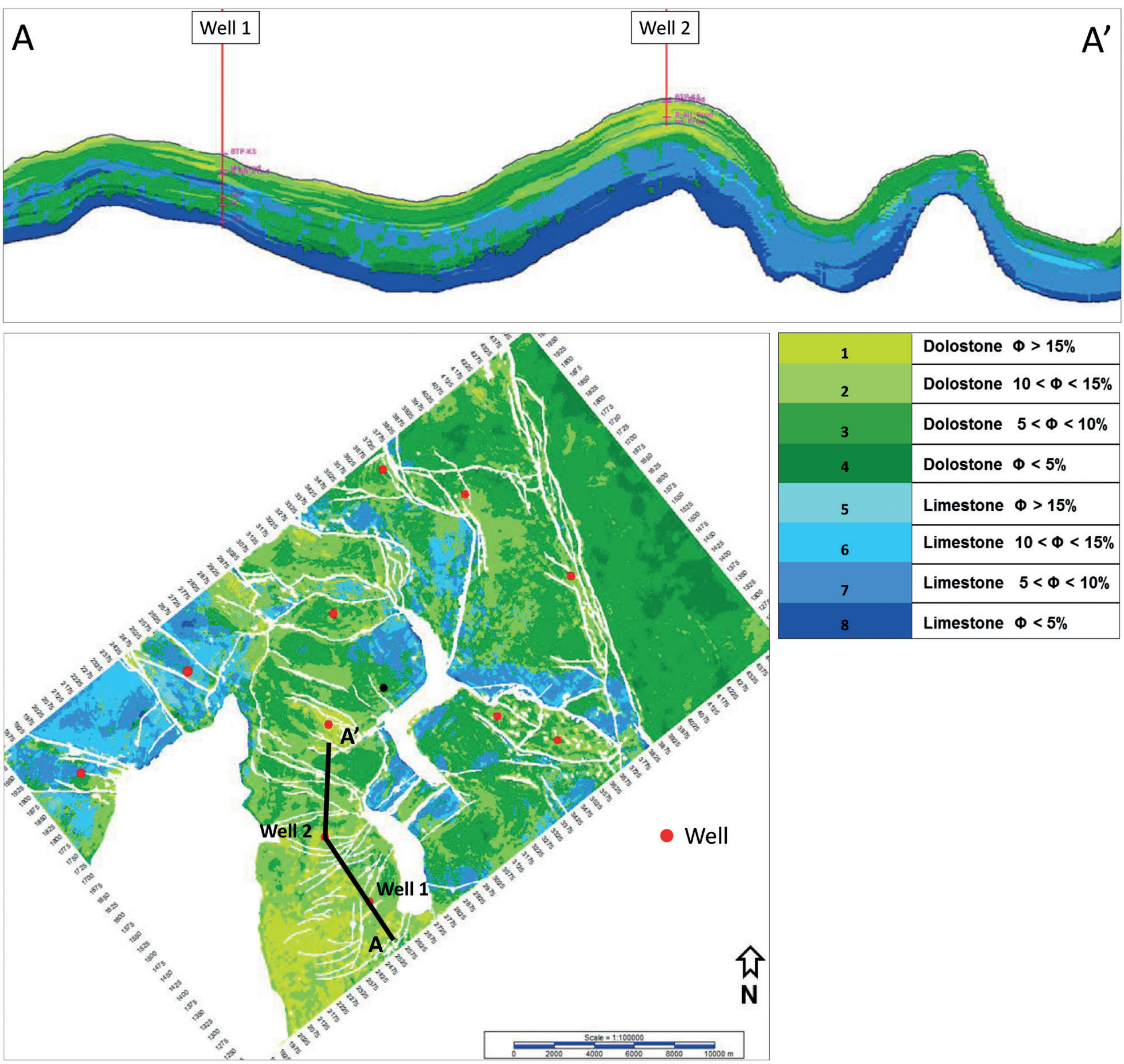

Figure 9 *For interpretation purposes, the two end-member lithologies, limestone and dolostone, were sub-divided into discrete porosity ranges. The resulting volume allows for the identification and mapping of the most prospective groups. In this case, high-porosity dolostones are associated with the best producing intervals.*

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becomes complicated due to the similarity between density and velocity values observed for both lithologies. To produce a reliable seismic lithology volume that would allow for the discrimination between the two end-members (limestone, dolostone), a similar multi-attribute workflow was applied using seismic attributes derived from the different inversion processes (Russell et al., 1997). Figure 7 shows a cross-section of the resulting lithology volume, including lithology information from one of the control wells (top left). Limestone sections are shown in blue, while dolostone sections are shown in green. As can be observed, a high correlation exists between the calculated lithologies at the well location and the estimated lithologies from seismic data.

Integration and interpretation

The inclusion of geological information into the interpretation phase, along with petrophysical and seismic information, significantly enhanced the results. Information obtained from geological studies, including sedimentological core description, petrographic and diagenetic analysis, and structural and fracture studies, provided considerable insight into the reservoir and became an important tool for interpretation of seismic attributes.

Key points to consider for the integration and interpretation phase were as follows:

- Rocks with greater storage and flow capacity show porosity values in excess of 10% and are associated with the presence of vuggy porosity and interconnected fracture systems; they predominantly have dolomitic lithologies.
- Rock physics analysis established that low impedance values, both P and S, are associated with the presence of high porosity (more than 10%).
- The greatest contribution to secondary porosity and improved reservoir quality was dissolution resulting in the creation of vugular porosity. Dolomitization appears widely in the survey area and has a high correlation to improved reservoir performance.
- The integration of fracture information identified by image logs, as seen in Figure 8, was calibrated to the seismic through the use of key attributes such as seismic anisotropy and geometrical attributes. An accurate seismic-based prediction of fracture density greatly assisted in the final classification / ranking approach.

A reservoir classification scheme was selected utilizing seismic lithology and porosity volumes. A single volume was created to assist in the creation of an integrated geological model and used to support field development. Two end-member lithologies, limestone and dolostone, were subdivided into discrete porosity ranges (Figure 9). The map shown is derived from a horizon slice within the reservoir and displays the level of detail that was achieved, allowing for the identification and mapping of the most prospective areas in the field.

Conclusions

New technologies in seismic acquisition, processing and reservoir characterization are resulting in a better understanding of hydrocarbon reservoirs. The broadband acquisition and processing improved the imaging and seismic reservoir characterization compared to legacy conventionally acquired data.

The primary objective to improve the identification of the highest hydrocarbon-producing intervals was achieved with the creation of a classification volume incorporating lithological and porosity-predicted attributes.

Further work on understanding the nature and paragenesis of the limestone, dolomite and vuggy porosity will improve understanding of the properties and distribution of reservoir quality, in particular, permeability characteristics.

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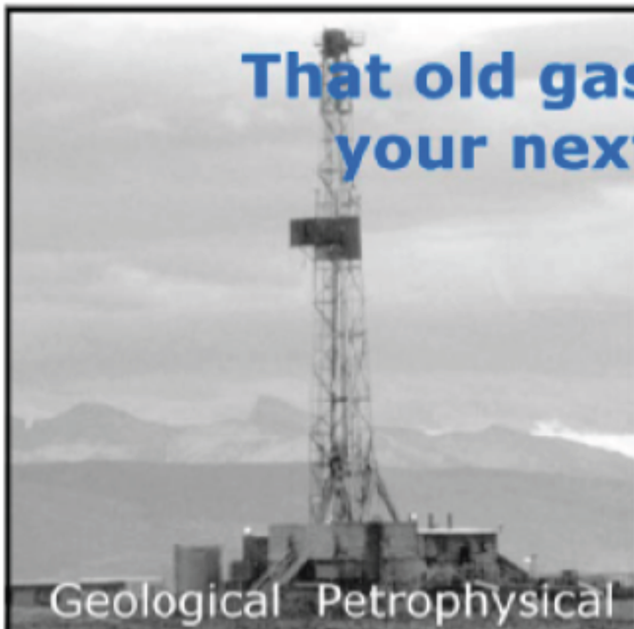

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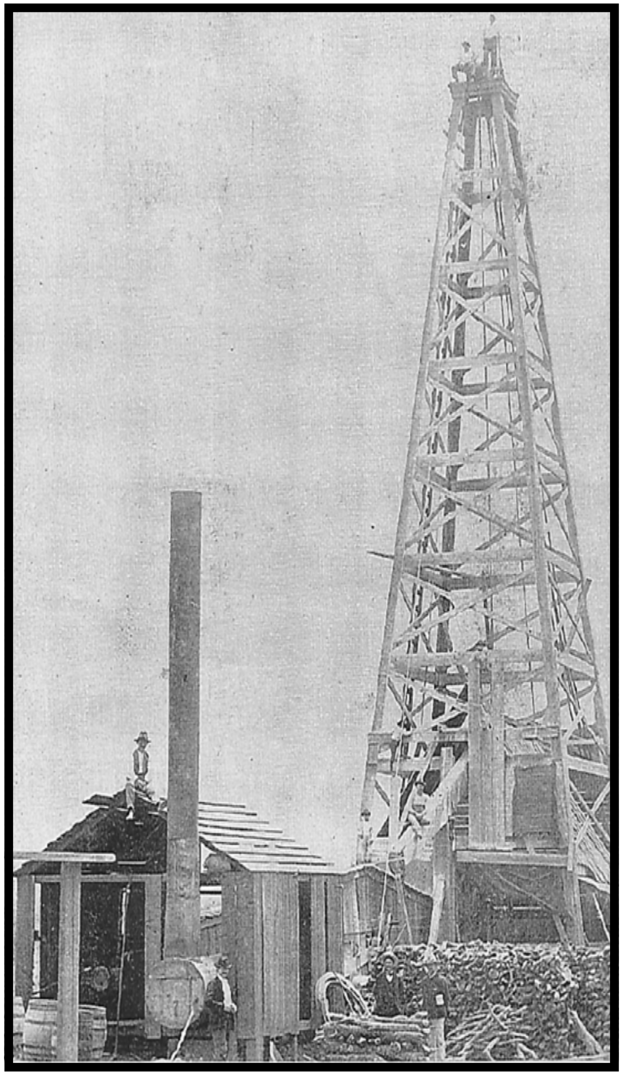

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