Advanced Reservoir Characterization Group, USA

Drilling and Technical Support for the Upstream Domestic and International Energy Industry

Advanced Reservoir Characterization Group (ARC GROUP), USA

Mature Oil and Gas Field Development and Exploration Services

Drilling and Technical Support for the Upstream Domestic and International Energy Industry

14803 FM 2769
Leander, Texas 78641
(512) 249-5433
Email: tylern@arcgroupllc.com
Web site: http://www.arcgroupllc.com

Advanced Reservoir Characterization Group, USA

Drilling and Technical Support for the Upstream Domestic and International Energy Industry

Corporate Profile

•The ARC Group is an independent firm providing advisory services and technical project support to the upstream domestic and international energy industry.

•We specialize in integrated geoscientific and engineering analyses of exploratory and producing properties and projects.

•We provide full-service contracting and consulting, from seismic interpretation and visualization to simulation, by offering a wide range of integrated, multidisciplinary hydrocarbon discovery and recovery optimization services for both the domestic and international energy industry.

•The ARC Group is Austin, Texas-based but maintains professional associations with sister consulting firms in Houston and Dallas.

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Reservoir Characterization Experience

• The ARC Group's experience in national and international basin analysis and advanced reservoir characterization has been developed over more than two decades of successful R&D in the United States, Argentina, Australia, Colombia, Mexico, Trinidad and Venezuela.

• We have also provided technology transfer workshops in basin analysis, reservoir characterization, marginal-field reactivation, and coalbed methane E&P in Austria, Brazil, China, Mexico, Peru, South Africa, and Trinidad.

• Our experienced, multidisciplinary core of staff members are fully time-dedicated.

• In-house expertise includes play analysis, sequence stratigraphy; basin analysis; reservoir architectural and attribute analysis; reservoir geophysics including high-resolution 2-D and 3-D seismic interpretation (supported by in-house 3-D visualization software); petrophysics; well completion and stimulation; and production engineering.

• Projects are undertaken using a synergistic approach and appropriately experienced staffers are assembled to address project-specific problems.

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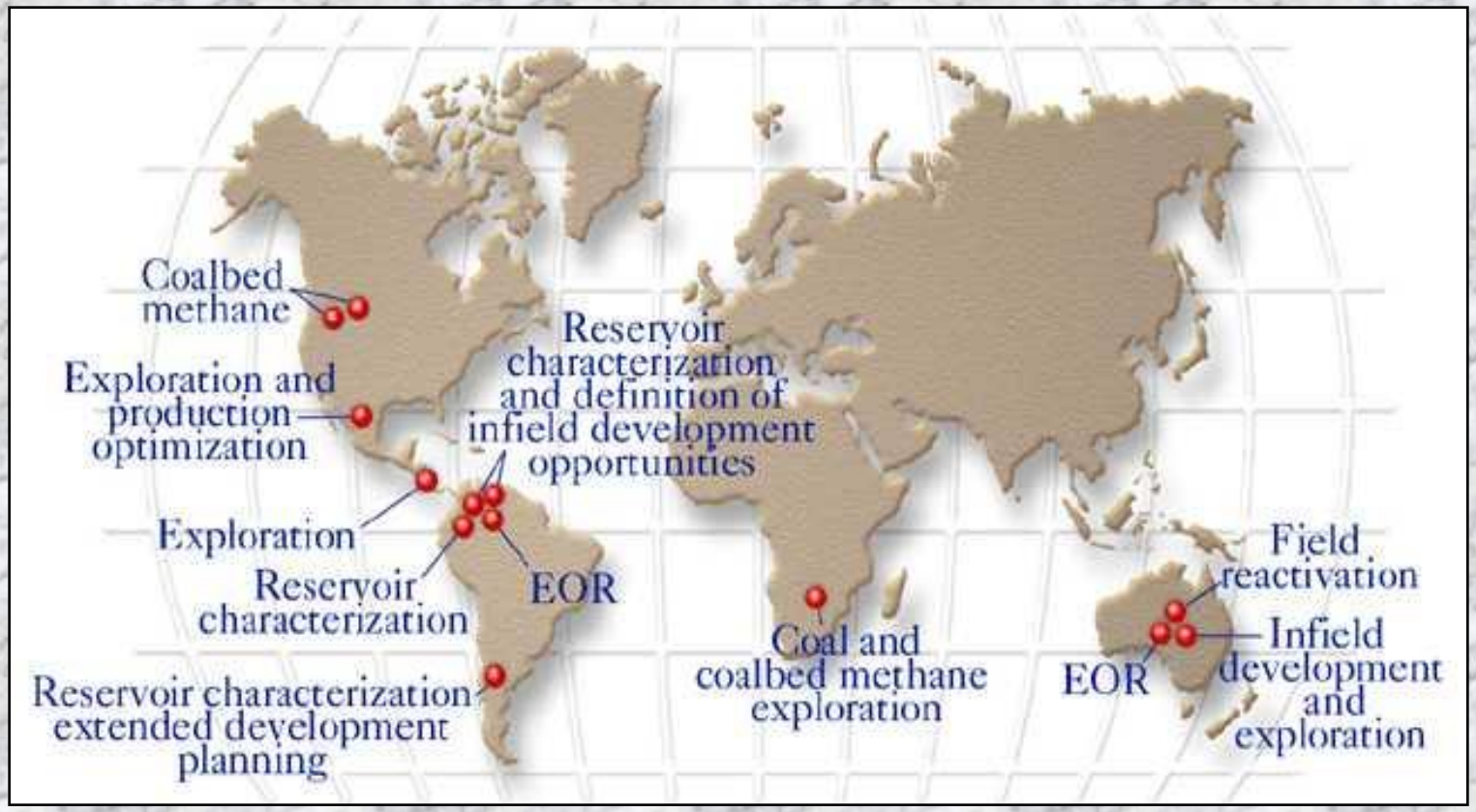
Reservoir Characterization Programs



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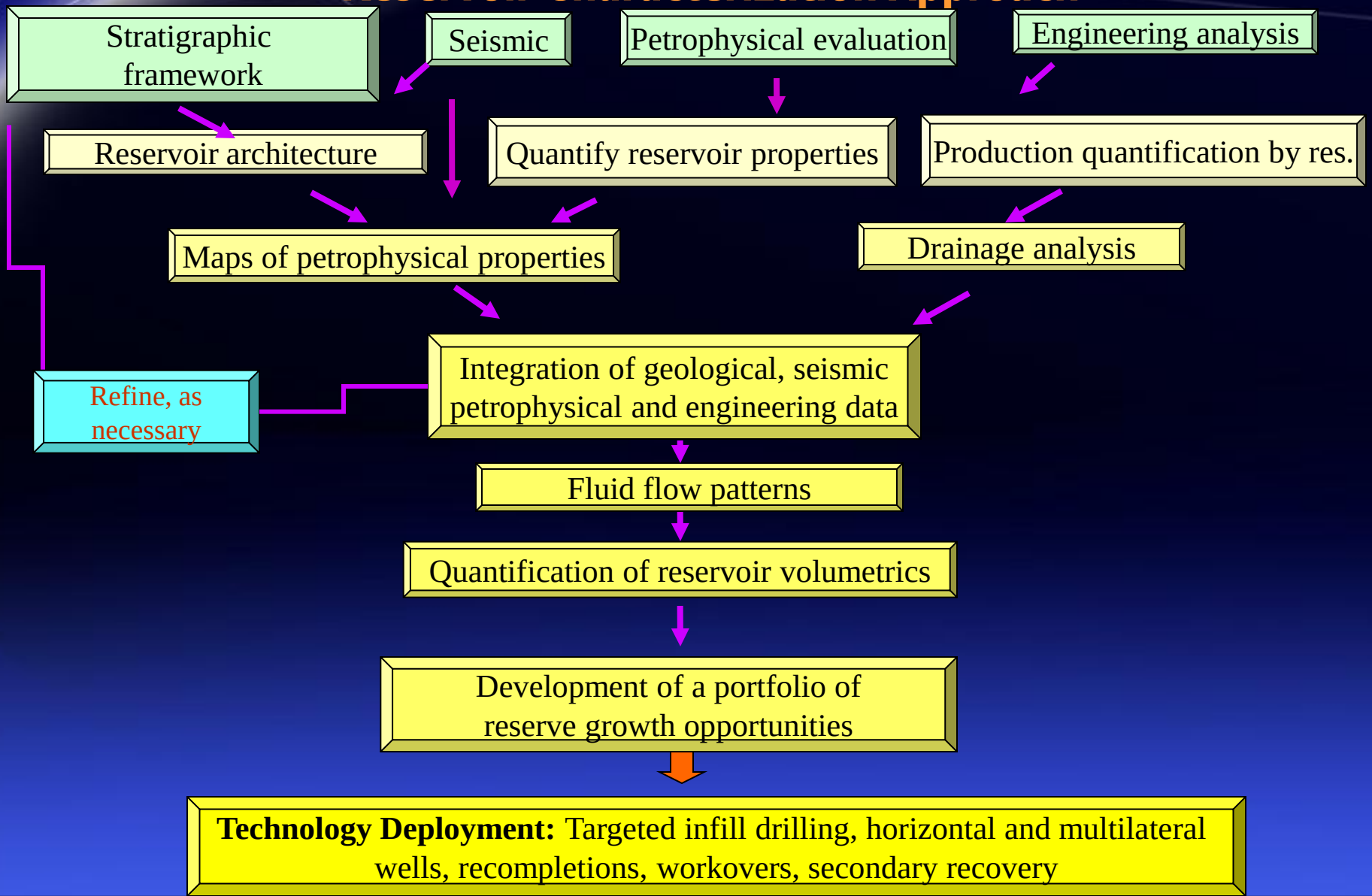
Approaches to Advanced Reservoir Characterization

- Integrated characterization of heterogeneous reservoirs is proving to be a fertile source of new reserves in mature oil and gas provinces around the world.
- Field re-exploration strategies such as resource-targeted infill drilling and field extension wells, together with strategic recompletions and waterflood optimization strategies, the designs and locations of which are based on sophisticated reservoir characterization studies, are now the preferred approach to the revitalization of mature fields.
- These approaches have captured almost two thirds of the 40 billion barrels of oil that have been added to the US reserve base over the past 20 years.

Res Q™

ARC GROUP's Trademarked Reservoir Characterization Approach



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Opportunity: Realizing Reserve Growth in Complex Reservoirs

- ARC's approach to integrated characterization of heterogeneous reservoirs follows a three step process that (i) establishes the stratigraphic and structural framework of the component reservoirs of the field, (ii) establishes fluid character, location and flow characteristics, and (iii) identifies the residency, and quantifies the magnitude, of the remaining oil or gas.
- Steps one and two are iterative, and step three becomes the basis for designing a portfolio of advanced recovery opportunities in the field being characterized. This three-step path can be referred to as the *static* model.
- ARC Group also offers reservoir simulation based on the results of the static model to provide a *dynamic*-model analysis of production response to proposed recovery strategies

The ARC Group, LLC.

Advanced Reservoir Characterization and Exploration Services

Recent Company Project Collaboration and Reservoir Characterization Programs Include:

PEDVSA Intevep (Venezuela)
Staatsolie (Suriname)
PEMEX Exploracion and Produccion (Mexico)
Petrobras and Ecopetrol (Colombia)
PETROBRAS INTERNATIONAL BRASPETROL B.V.
Hocol (Colombia)
Petrotrin (Trinidad)
Trinmar (Trinidad)
Lease Operators (Trinidad)
Neal and Massy (Trinidad)
SCOTIA Group (Texas)
SCHLUMBERGER (USA)

The ARC Group, LLC.

Advanced Reservoir Characterization and Exploration Services

Recent Company Project Collaboration and Reservoir Characterization Programs (Continued):

Object Reservoir (Texas)

Compañia Pena Sanchez,, S.A. de C.V. (Veracruz, Mexico)

Compañia Mexicana de Exploraciones, S.A. de C.V. (Mexico)

CGG/VERITAS (Mexico)

YPF-REPSOL (Argentina)

Reliance Industries (India)

Perenco (Colombia)

Nexen (Colombia)

Ecopetrol (Colombia)

Rosewood (USA)

IMP (Mexico)

Paradigm/NSA (Mexico)

Total Fina Elf (USA)

Reliance Industries Ltd.

Nederland and Sewell

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Mature Field Re-exploration and Rejuvenation

Production Reactivation in Mature Fields

• Deployment of advanced reserve growth strategies in mature fields is adding substantial volumes of oil to the US and world-wide reserve base. This reserve growth phenomenon is largely the product of field re-exploration with the concomitant deployment of advanced reservoir imaging and recovery strategies.

• Synthesis of geological, petrophysical, engineering and geophysical data into an integrated, and quantified, reservoir model forms the basis for the development of multi-faceted, production-optimization portfolios that guide the extended development of the candidate fields.

• Successful field rejuvenation projects based on ARC Group's redevelopment portfolios have seen production-decline reversals of five- to ten-fold daily production and recovery of upfront costs expended on reservoir characterization studies in days of incremental production.

Advanced Reservoir Characterization Group, USA

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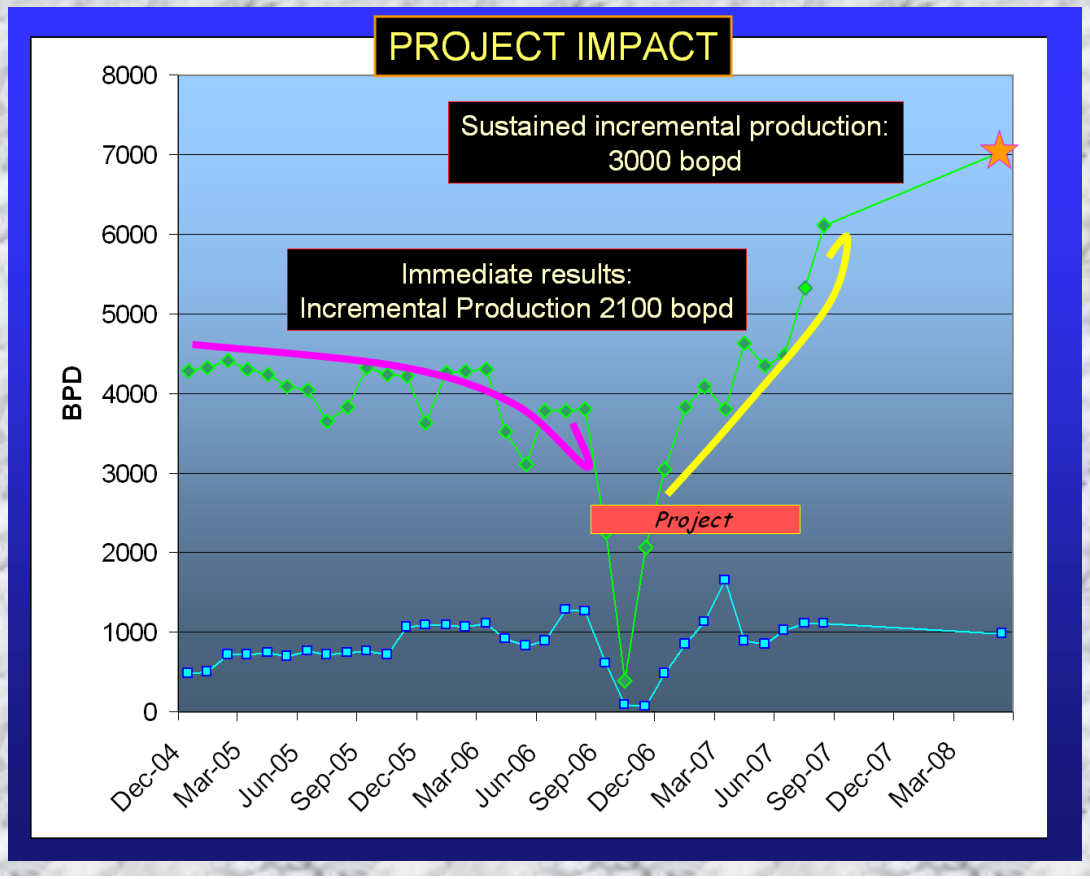
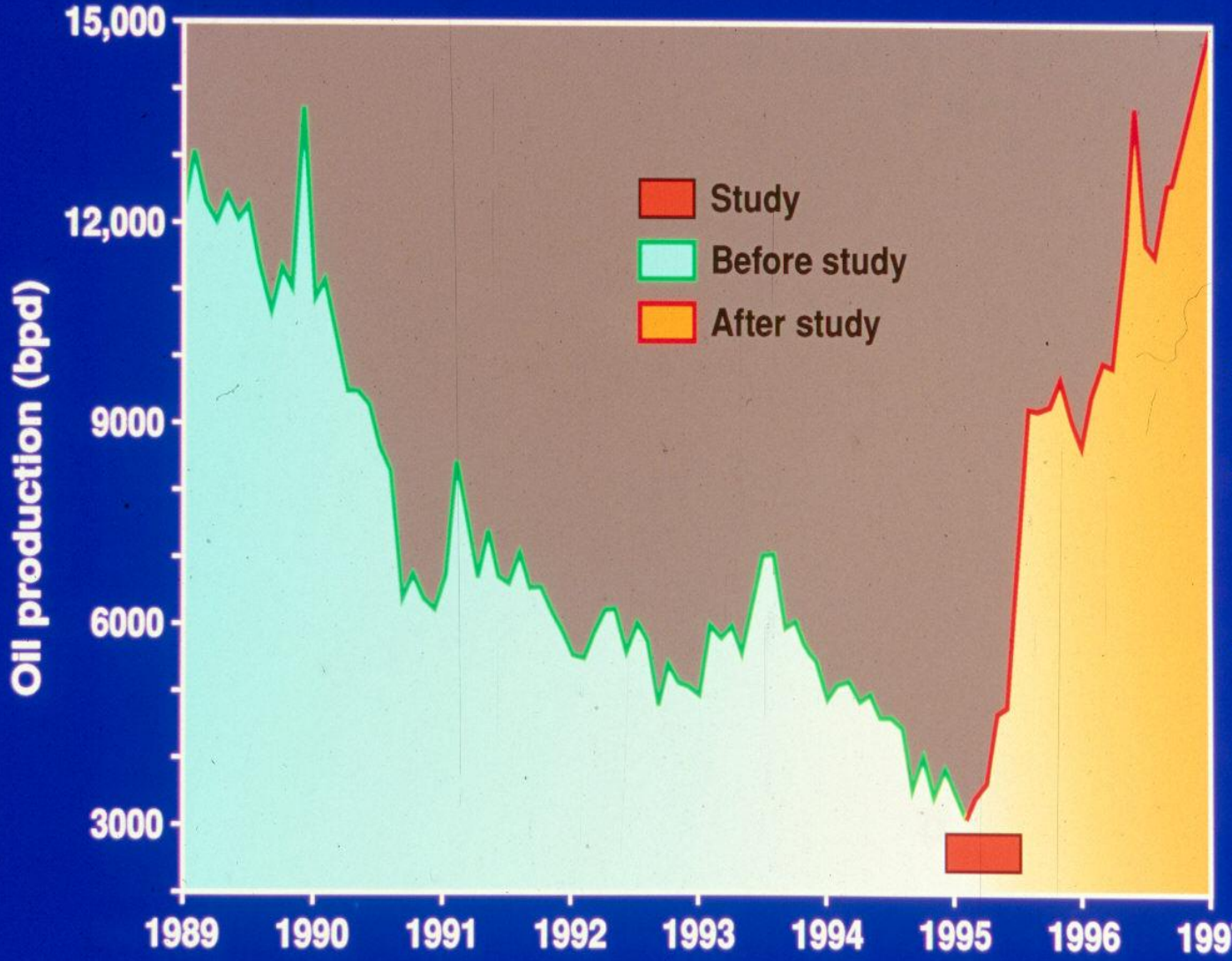


PEMEX
EXPLORACION Y PRODUCCION

Production response to the reactivation of a mature field reactivation project, Salinas Basin, Mexico based on the production-optimization recommendations provided by our staff

Other ARC Group Oil and Gas Field Reactivation Successes

BUDARE FIELD OIL PRODUCTION (1989-1997)



RESULTS

- ★ 20 wells drilled
- ★ 95% success rate
- ★ Two wells with "average" prod.
- ★ 17 excellent wells
- ★ Multiple wells recompleted

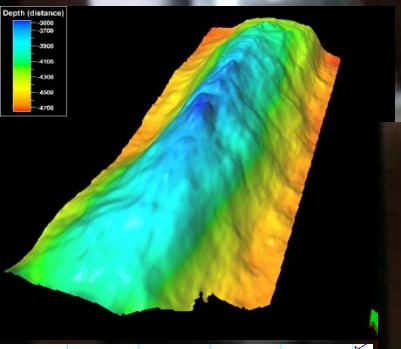
PDVSA
INTEVEP

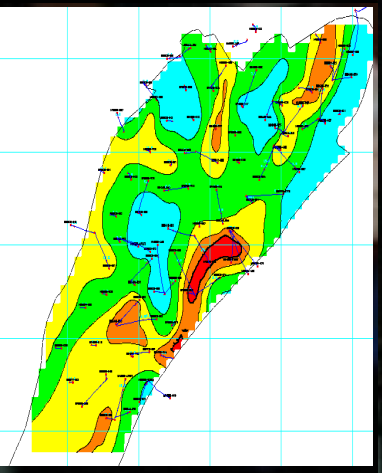
Field Rejuvenation – Early Results

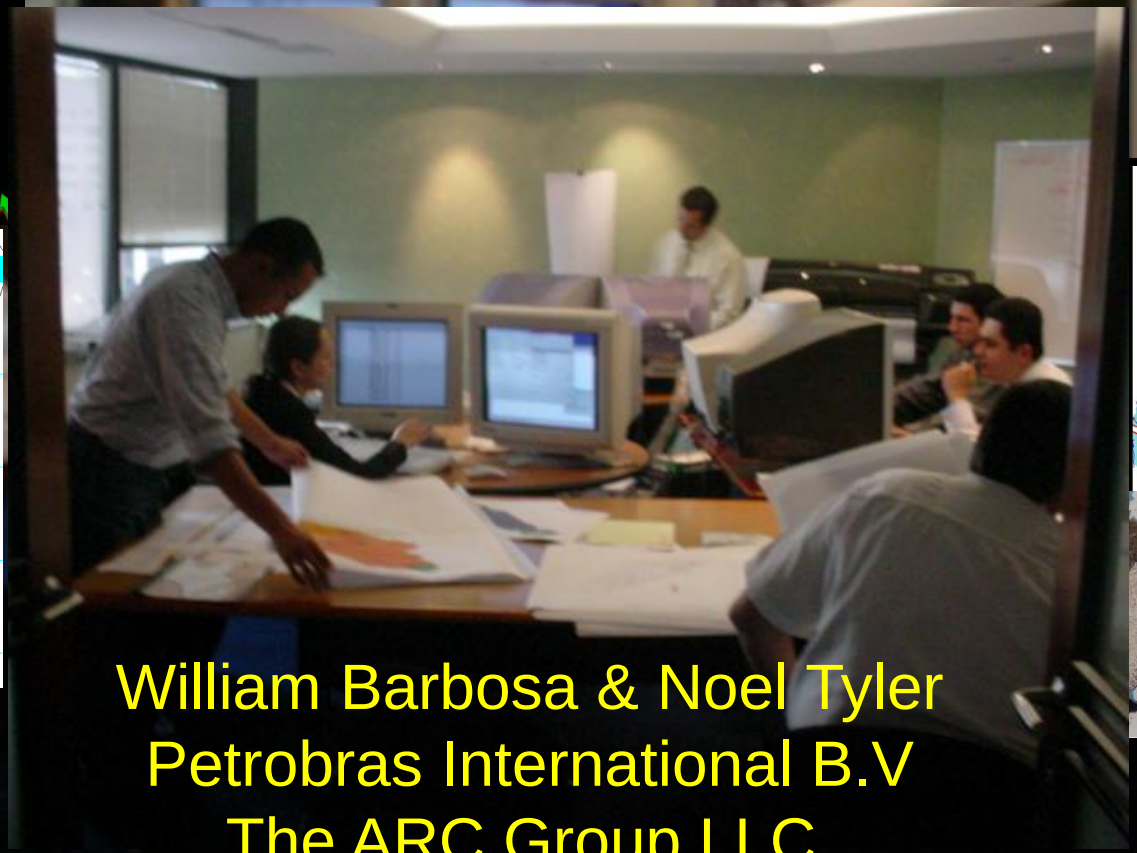
- ✓ Drilled 10 horizontal wells
  - ❖ Account for 59 percent of production
- ✓ 23 new locations identified
- ✓ Identified 75 recompletion opportunities
- ✓ None of the new wells were unsuccessful and all met or exceeded performance predictions
- ✓ *Initial reactivation resulted in incremental production of almost 1,000,000 bbl oil in year 1*

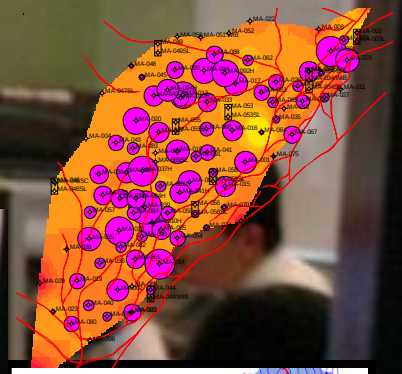
EQUIPOS DE TRABAJO INTERDISCIPLINARIOS, PERMITEN TOMAR GRANDES DECISIONES

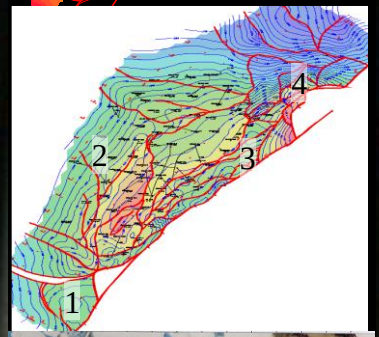
–Ejemplo: Estudio Integrado Campo Yaguará

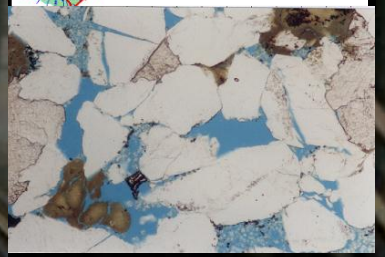








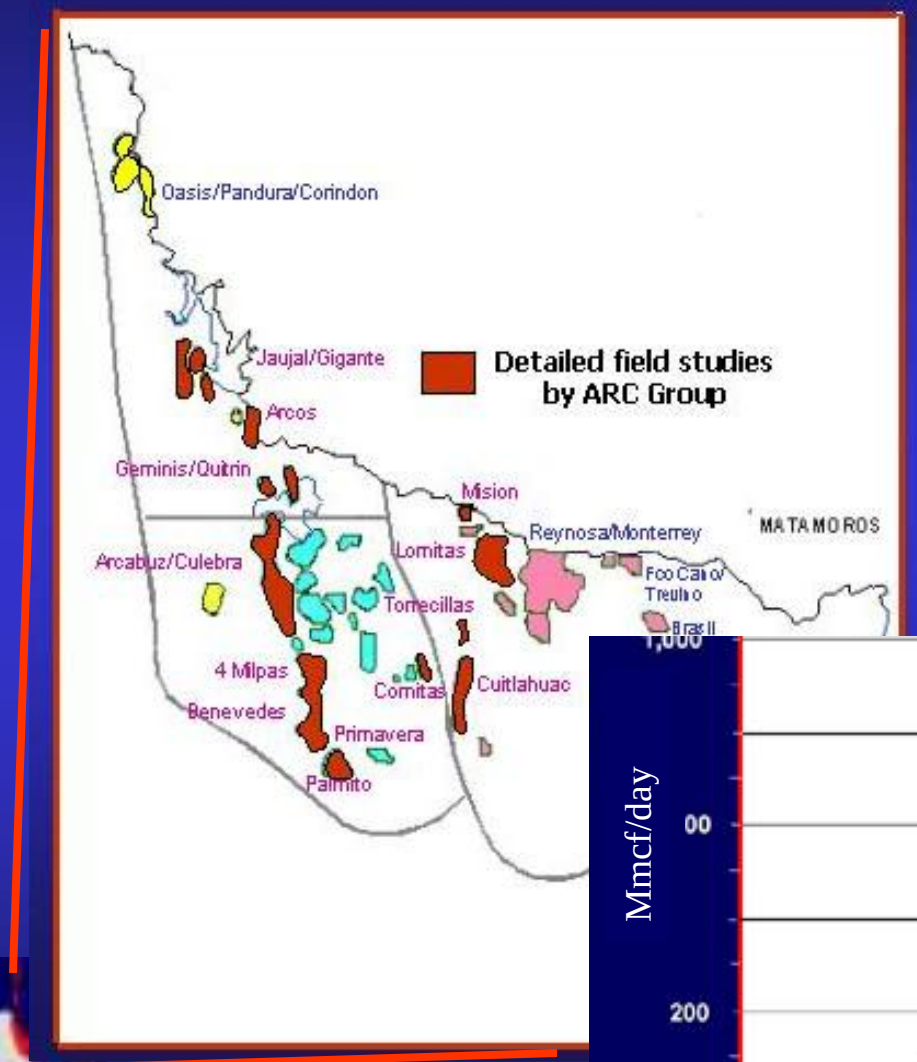




William Barbosa & Noel Tyler
Petrobras International B.V
The ARC Group LLC

SUCCESSFUL FIELD REACTIVATION STUDIES IN MEXICO

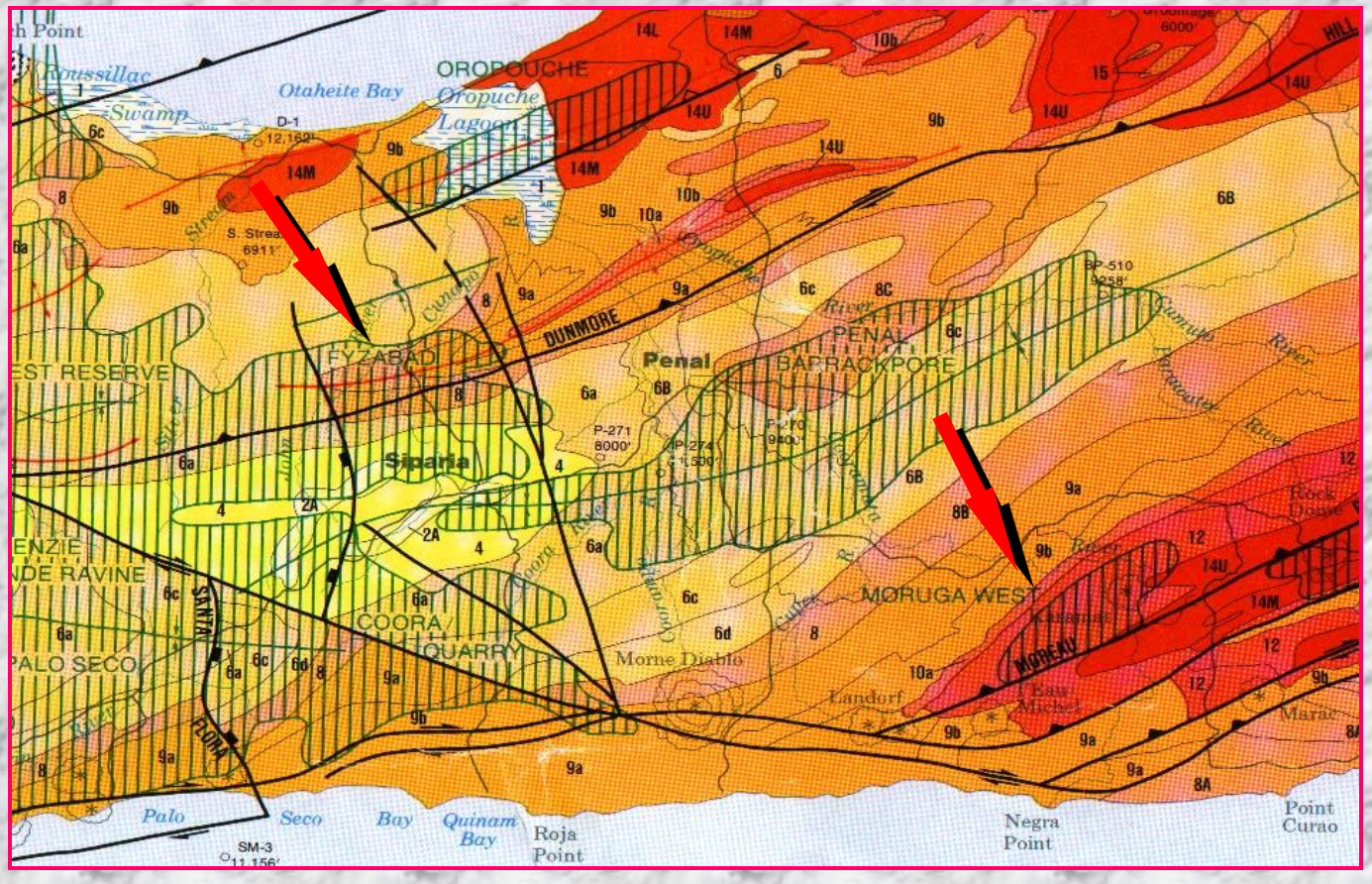
Major Burgos Basin Fields, Mexico



PEMEX
EXPLORACION Y PRODUCCION

Basin Reactivation Results

Field Reactivation Studies Targeting New Well Locations Have Been Undertaken In Parrylands/Guapo, Moruga West, and Fyzabad Onshore Fields, and Main Soldado Offshore Field, Trinidad



2.8 million barrels of oil waiting to be drilled.

Petrotrin multi-disciplinary team impresses

Eight months after the start of the Reservoir Characterization Study, Petrotrin stands to benefit from 2.8 million barrels of oil in reserve growth in the Parrylands area only. The study incorporated different processes/concepts to identify oil reserves on land.

The study was approached from two angles – a Structural and Stratigraphic approach and a Petro-physical and Reservoir Engineering analysis approach.

The team comprised the following members: Dr. Noel Tyler–President of the Advanced Research Characterization and Exploration Services Group (The ARC Group, Austin Texas, USA); Kasarie Singh and Wayne Sumadh (Study Team Leaders); geologists Tricia Andrews, Hasely Vincent, Dane Mayers Mario Carrera and Saira Ragbir; petroleum engineer Wendy Chadee and support personnel from Technical Services, Information Technology, Laboratory Services, Exploration and Joint Ventures, Geological Draughting Services and Field Units.

Their responsibility was to fulfil the mandate of developing a portfolio of reserve growth potential.

Study Team Leader Wayne Sumadh explained that the results of the study was the culmination of eight (8) months of very detailed and intense work which had significant benefits for Petrotrin in the short, medium and long term.

Wilfred Harper said that he had heard and read about the benefits of Reservoir Characterization and the type of studies done elsewhere. As a result, a decision was taken to "take the plunge" because of the increased oil production to be derived. Additionally, he pointed out that new oil was the only way to maintain and increase production in the E&PSBU. The Cartographic department came in for high praise for its use of new techniques to assist the study team. This, Mr. Harper said, was one of the reasons why Petrotrin was now in the 1st quartile with respect to technology, as opposed to being in the 4th quartile some time ago. Such was the level of technological expertise, that persons who normally use 3D seismic technology are now using the processes employed by Petrotrin.

He praised the team for completing the project on time, adding that the work would be tested in the coming weeks and months. Further, the team would have the opportunity to present its finding to wider audiences in the near future.

Dr. Noel Tyler, President of the Advanced Research and Characterisation and Exploration Services Group (ARC) praised the team for doing a wonderful job. In his words, he has been "doing this job for a long time, and this was the best experience so far." He further explained that the process has had success in the United States, where 66% of the reserves in the last twenty (20) years has come from the rejuvenation of mature fields. In some cases, the reserves had increased to original rates. The process has also been tested in Venezuela with similar results.

The study was two-fold. Firstly, to increase production; secondly to find out whether the processes and concepts that were applied elsewhere would work in Trinidad & Tobago. Dr. Tyler was quick to point out that his Company, ARC, did not do the work – the Petrotrin team did the work. They simply provided guidance during the study.

Why Parrylands?

Initially, seven (7) areas were selected and the data compiled and evaluated – Parrylands, Barrackpore, Forest Reserve, Moruga East, Oropouche, Catshill and Trinity/Inniss. Eventually, a group of four was chosen and a decision was made based on both the favourable and unfavourable characteristics of the fields. The potential uncovered in Parrylands alone can be extended to an enormous area of South Trinidad.

In Parrylands, of the 430 wells, 287 reach the Cruse formation, with only 65 presently producing. Original oil production was just over 27.6 million barrels, with current reserves of 1.34 million barrels that can be tapped immediately. 2.8 million additional barrels of oil reserves have been identified by the study team. This figure does not include any reserve growth from secondary or EOR opportunities, for which there is potential.

The success of Reservoir Characterization in general is dependent on the establishment of a stratigraphic framework, and it was no different for Parrylands. The unfavourable characteristics discovered were not enough to outweigh the favourable aspects

In the course of its deliberations, the team has unearthed 46 new locations along with 7 follow up locations, the latter figure being quite conservative. In addition, there is a total of 20 recompletion opportunities (4 available immediately). Overall the increment from targeted recompletions is 500,000 barrels.

The facilitators along with the co-presenters were extremely excited about these new developments. Even though they admitted to some highly complex formations in the Parrylands area, they were confident that with the talented personnel in the E&PSBU, tapping into oil reserves both in this area and other areas in the South would not be a problem. This study was only the tip of the iceberg and already there are wells in place to test the concepts employed during the study.

Coalbed Gas Resource Assessment and Play Analysis of the Guasare Subbasin, Zulia State, Western Venezuela

Depth Range (ft)	Area (Square Miles)	Average Coal Thickness (ft)	Coal Rank Gas Contents (Scf/ton)	Coal Resources (Billion Short Tons)	Coalbed Gas Resources (Tcf)
< 0 ft	23	100	110	2.732	0.301
0 to 3,000 ft	57	150	180	10.157	1.828
3,000 to 6,000 Ft	63	175	320	13.078	4.191
> 6,000 ft	52	175	420	10.811	4.541
Total	195			36.778	10.861

Dr. Noel Tyler and Mr. Roger Tyler

The ARC Group

Ms. Vania Savian and Mr. Ulneiver Canonico

Mr. Rafael Tocco, Project Manager

PDVSA-INTEVEP

December, 2002

The ARC Group, LLC.

Advanced Reservoir Characterization and Exploration Services

PEMEX EXPLORACION Y PRODUCCION

Modelo Geológico, Caracterización Dinámica e Ingeniería de Yacimientos del Campo Soledad, Porción Sur: Modelo Geológico de Simulación:

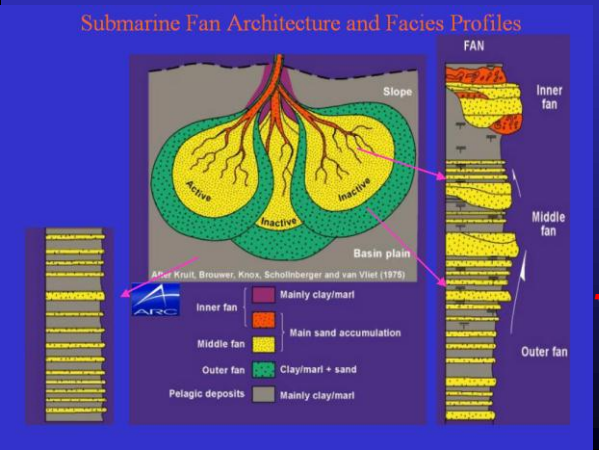
Phase 4 Report

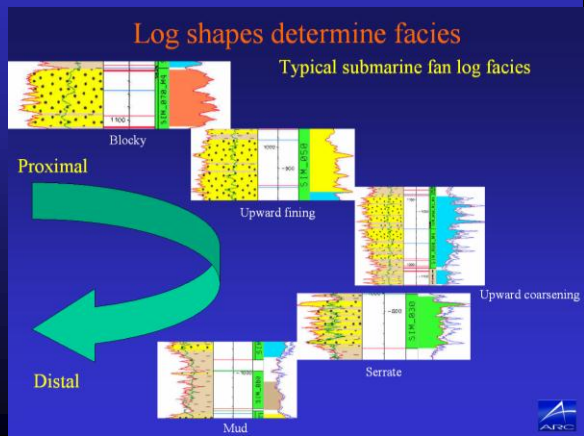
Actualización Modelo Geológico Campo Soledad, Porción Sur.

Prepared for

Compañia Mexicana de Exploraciones, S.A. de C.V.
EMPRESA PARAESTATAL
AV. DIAGONAL DE PATRIOTISMO Nº 1 PISOS 2º, 3º Y 6º
COL. HIPODROMO CONDESA
DELEGACION CUAUHTEMOC
C.P. 06179 MEXICO, D.F.

Dr. Noel Tyler
The ARC Group, Leander, Texas
October 2003





Depositional Systems Analysis, Structural Attributes, Reservoir Characterization, and the Potential for Infield and Field Extension Opportunities, Moruga West Field, Southern Trinidad

Final Presentation

By

Noel Tyler and Roger Tyler

ARC Group

And

Clyde Ramkhalawan

NMERL

Prepared for

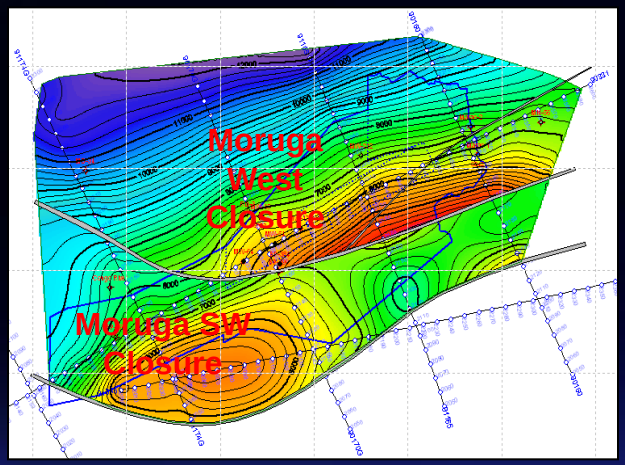
Neal and Massy Energy Resources Ltd

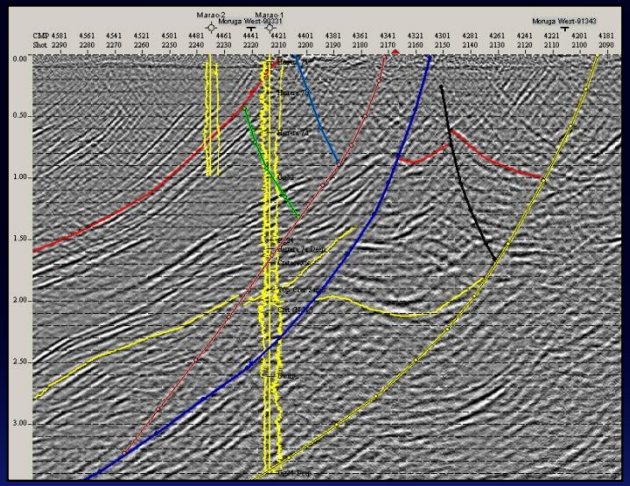
And

Petrotrin

Trinidad and Tobago

October, 2003





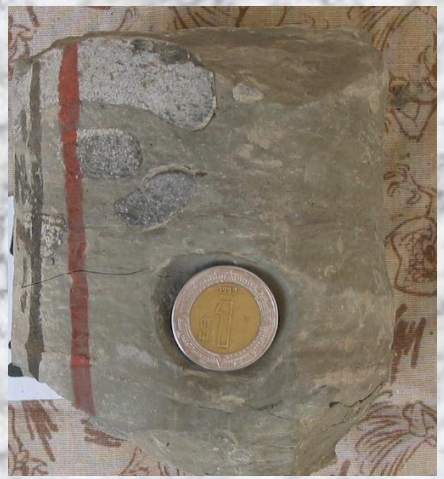
The ARC Group

Austin, Texas, United States of America

Advanced Reservoir Characterization Group, USA

Drilling and Technical Support for the Upstream Domestic and

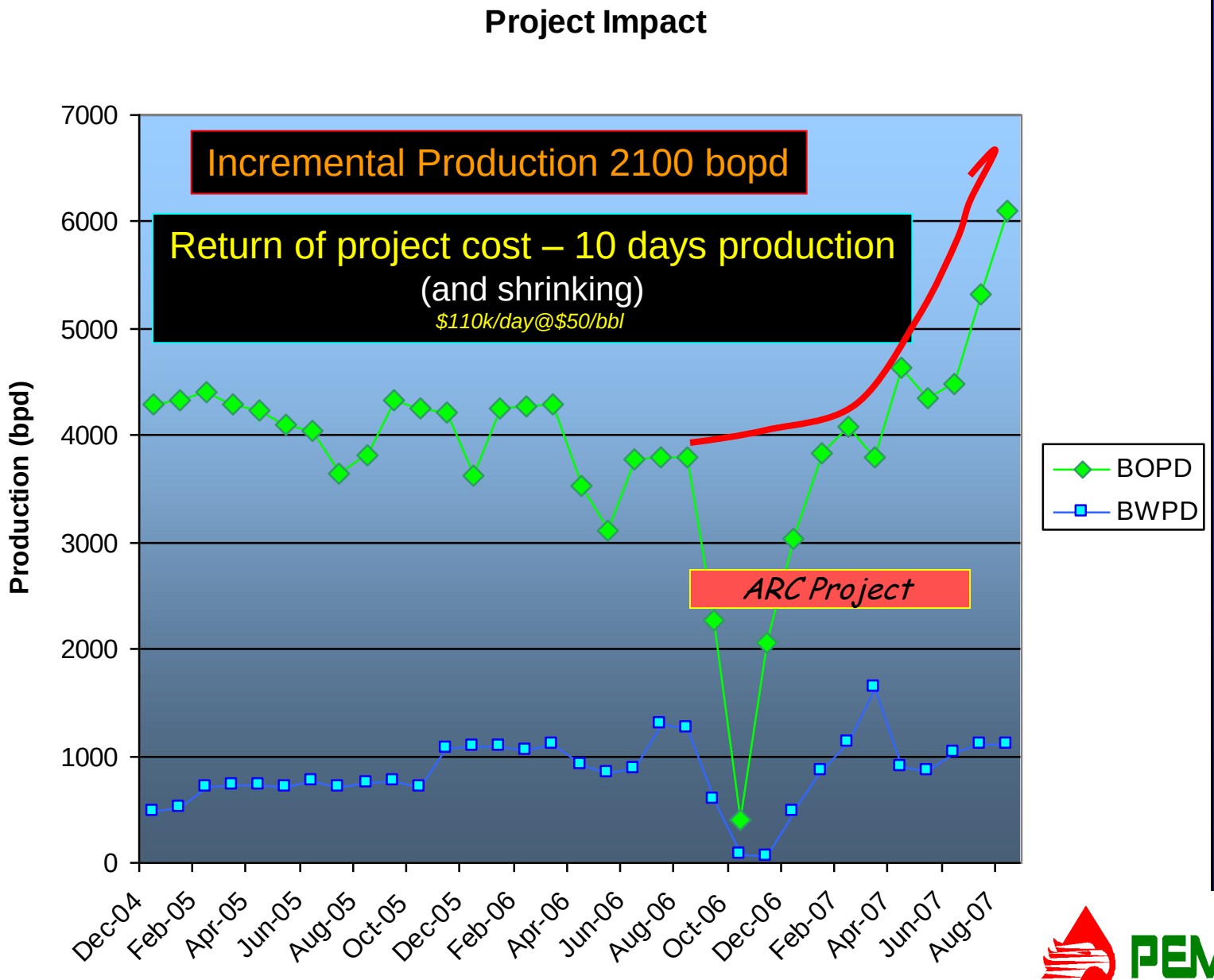
SOLEDAD NORTE CORE DATA PHOTOS
PHASE 1 AND 2 CORE REPORT



PEMEX
EXPLORACION Y PRODUCCION

14803 FM 2769
Leander, Texas 78641
(512) 249-5433
E-mail: tylern@arcgroupllc.com
Web Address: http://www.arcgroupllc.com

Reactivation of a Mature Field in South Mexico and Rate of Return



PEMEX
EXPLORACION Y PRODUCCION

Advanced Reservoir Characterization Group, USA

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To Contact the ARC Group, call, write or email at the following:

ARC GROUP, LLC.	
Direct email	
Noel Tyler, President	**Tylern@arcgroupllc.com**
Roger Tyler, Vice-President	**Tylerr@arcgroupllc.com**
Web Site Address :	**www.arcgroupllc.com**
Telephone Numbers	
voice	512/249-5433
fax	512/249-5392
Address	14803 FM 2769
	Leander
	Texas 78641