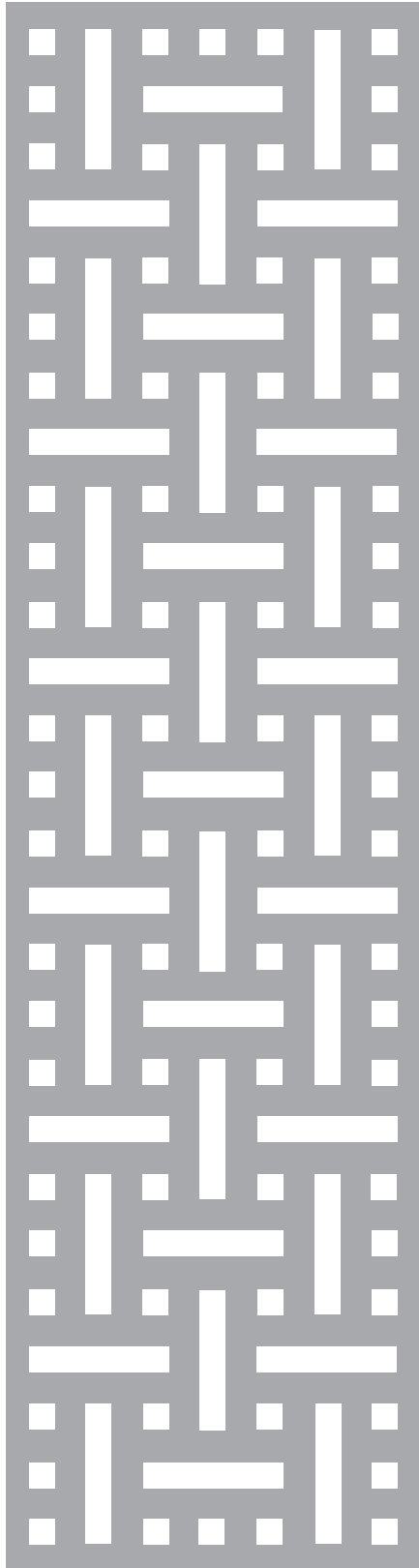


**PARTEX OIL AND GAS**



**75**  
YEARS

**CONTRIBUTING TO THE  
OIL AND GAS INDUSTRY IN  
OMAN**



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## A PARTNERSHIP TIMELINE

### 1937

Concession awarded to Iraq Petroleum Company (IPC), with the active involvement of Mr. Calouste Gulbenkian, the founder of Partex.

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### 1957

Discovery of Marmul field [considered uneconomic to develop].

---

### 1960

Dry wells and lack of success led most of the partners to withdraw. Only Shell and Partex opted to remain in Oman and support the government in the search for oil.

---

# PARTEX OIL AND GAS: AN OLD PARTNER OF PDO IN OMAN WITH A LONG TERM VISION



### A HISTORY OF SUCCESS

In 1912, Calouste Gulbenkian actively contributed to the establishment of the Turkish Petroleum Company (TPC), which subsequently became Iraq Petroleum Company (IPC). IPC, on 24 June 1937, signed two 75 year concession agreements with Sultan Said bin Taimur covering Oman and Dhofar.

These contracts were later assigned to PDO's precursor known as Petroleum Development (Oman and Dhofar). Calouste Gulbenkian kept tight control of the IPC consortium until his death in 1955, when most of his personal wealth, including his oil holdings in IPC was bequeathed to a Foundation, based in Portugal. The oil and gas assets are now held by Partex Oil and Gas (Holdings) Corporation, which is fully-owned by the Calouste Gulbenkian Foundation.

Apart from a 2% stake in PDO, PARTEX has participations in Oman LNG and in the Mukhaizna project.

Celebrating the 75 years of active involvement of Partex in the Oman oil and gas industry, this document aims to recall the history of a very successful partnership, covering a wide range of technical contribution and support, including the assignment of highly skilled staff to the Oman operating companies, in which Partex has participating interests.

This partnership is not limited to technology alone. Either through Partex or its sole shareholder, the Calouste Gulbenkian Foundation, it also involves cultural, educational, research and art initiatives of relevance to Oman. We believe that Partex has a role to play in the future of the Oman's oil and gas industry, while contributing to the development of other aspects of the society.

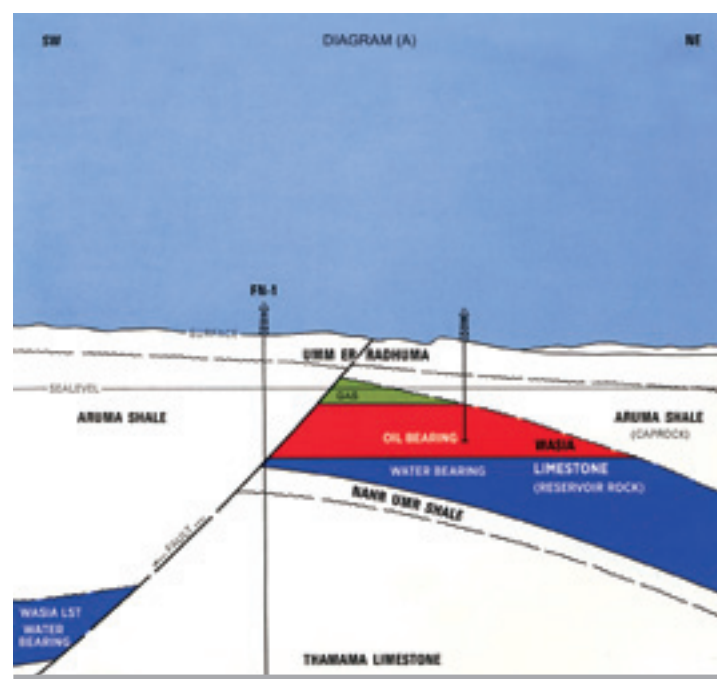
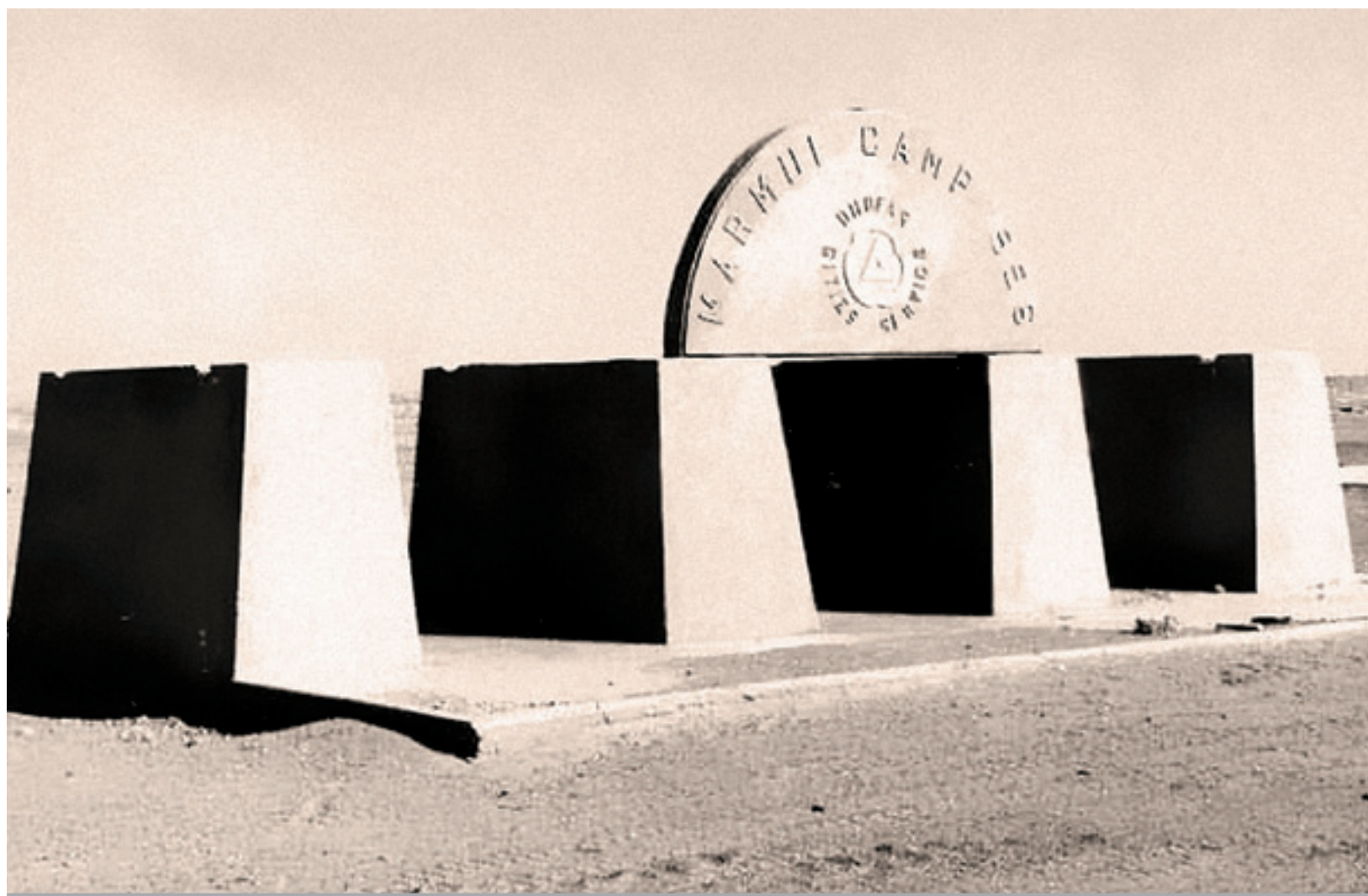
### A LEGACY THAT NEEDS TO BE PRESERVED

When the Iraq Petroleum Company (IPC) exploration of Oman failed to find hydrocarbons in the 1950's with the drilling of Fahud, Ghaba, Haima and Afar dry wells, all partners in the consortium pulled out, except Shell and Partex, who stayed to initiate the next phase of exploration, with Shell as operator. Partex opted to stay on the advice of the company's highly experienced advisors Ziad Beydoun and Eric Tiratsoo, both of whom recognised significant remaining prospectivity in Oman.

It is also our firm belief that this history of success and all its achievements represent a vastly rich legacy, of knowledge and experience that needs to be preserved and translated into the new challenges which the Oman oil and gas industry will be facing in the increasingly complex projects of the decades to come.



Top: Rig drilling at Fahud-1.  
Above: Fahud-1 rig geologist overlooking the drill-site in 1956.



Top: Plaque erected by Dhofar Cities Service following the discovery of oil at Marmul in 1956.

Above left: The Mosprince Tanker – First shipment of crude, 1967.

Above right: Section through Fahud field, showing how the original Fahud-1 well failed to strike the oil-bearing formation.



## A PARTNERSHIP TIMELINE

**1962**

Discovery of Yibal field.

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**1963**

Natih field was discovered.

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**1964**

Oil was discovered at Fahud, on the other side of a faultline, 200 meters away from the location where IPC had drilled Fahud-1.

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**PARTEX IN OMAN**





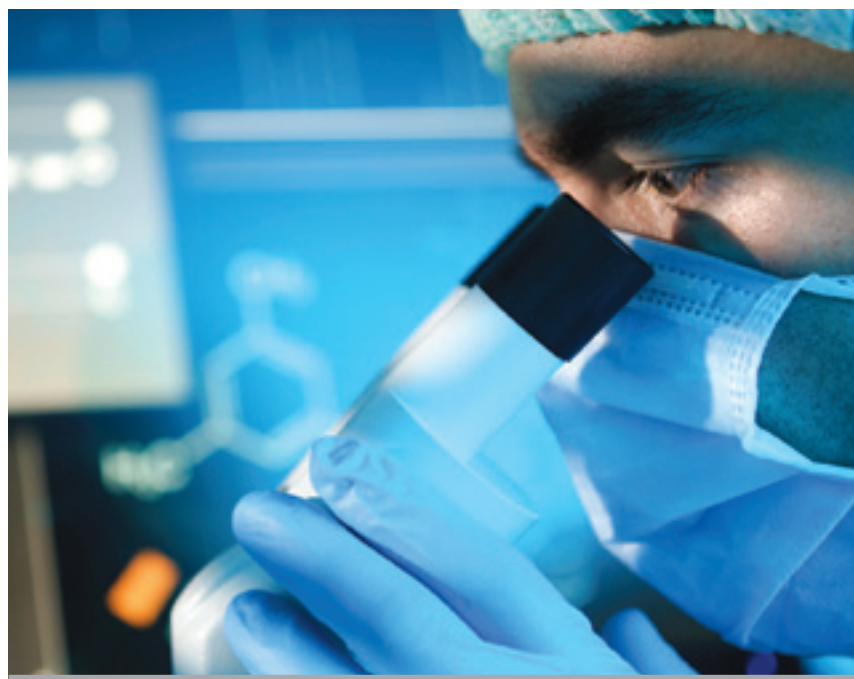
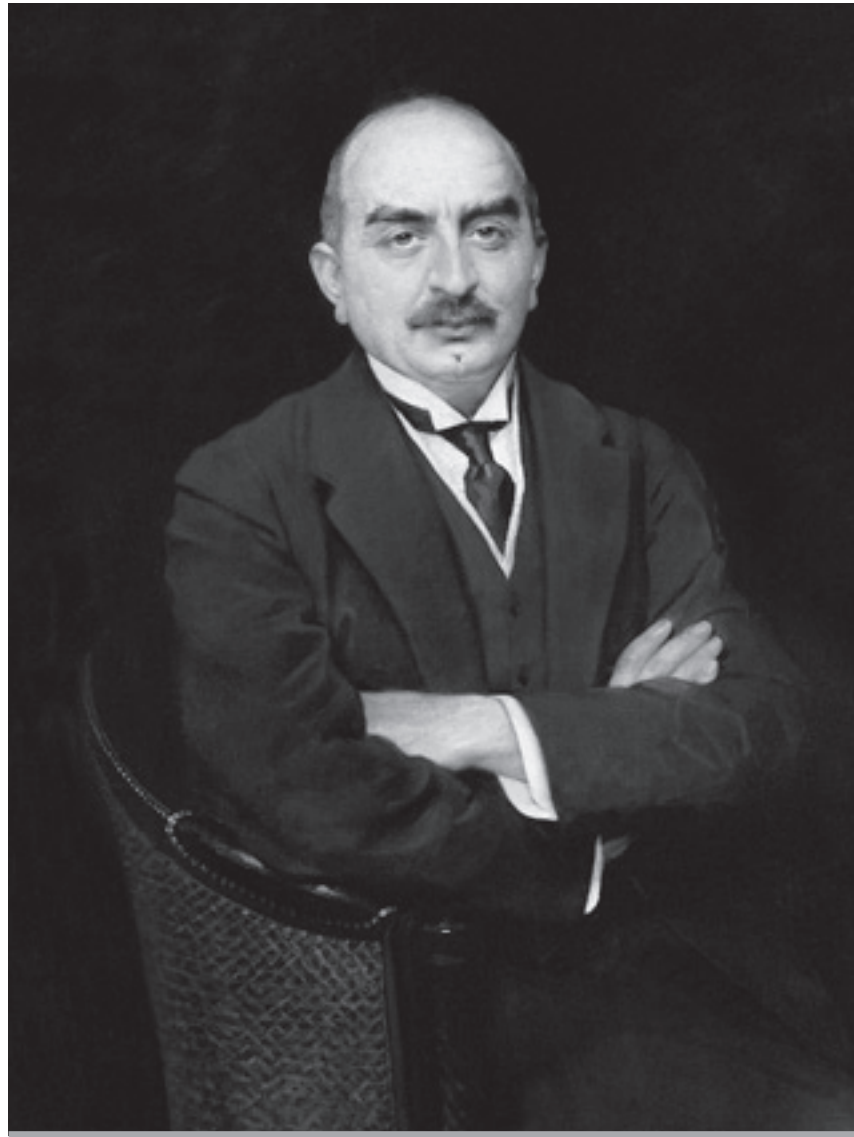
### HISTORY OF A PARTNERSHIP

Partex has been involved in Oman's oil and gas industry since 1937. The Founder of the Group, Calouste Gulbenkian, was instrumental in establishing the bridge between the Sultanate of Oman and the International Oil Companies, in order to set-up a constructive approach for the Joint Venture.

Partex inherited this vision from its Founder and throughout the years, in spite of being a minority shareholder, Partex fulfilled its role as an active partner, always seeking a positive consensual outcome contributing with its skills, endeavouring to establish a high quality common view and working to seek an alignment with the interests of Oman.

### PARTEX IDENTITY

Partex has a very long history with 75 years of experience in the oil industry; it is a long-standing partner of the Middle East governments and national oil companies since the beginning of the exploration of oil and gas in the region. It is important to stress that, although Partex is not a major, it is an oil and gas Group with a unique feature in the industry: all its profits revert to its sole shareholder, the Calouste Gulbenkian Foundation, which uses them for the benefit of mankind, through Education, Science, Culture and Social projects and initiatives.



*Top left: Calouste Gulbenkian.  
Left below: In the Calouste Gulbenkian Foundation  
Research Center.  
Right: Calouste Gulbenkian Foundation Headquarters  
in Lisbon.*



CULTURAL AND EDUCATIONAL INITIATIVES

Partex and its shareholder, the Calouste Gulbenkian Foundation, have developed along the years important projects in cooperation with Oman entities, which are briefly described below.

ISLAMIC ART EXHIBITION HELD IN MUSCAT BAIT AL ZUBAIR MUSEUM IN 2006

Developing the work done to encourage international awareness of its collection, the Calouste Gulbenkian Foundation, in association with its subsidiary Partex Oil and Gas (Holdings) Corporation, exhibited Islamic Art at the Bait al Zubair Museum in the capital of the Sultanate of Oman, as part of the celebrations to mark Muscat as the Cultural Capital of the Arab World in 2006. The exhibition was on display from 18th February until 18th April 2006. H.E. Nasser bin Khamis Al Jashmi, Undersecretary of the Ministry of Oil and Gas, inaugurated the exhibition, which included various pieces from a broad range of Islamic art, produced between the late twelfth and the twentieth centuries in the same geographical areas as those represented in the Calouste Gulbenkian Museum's permanent exhibition, which demonstrates the exceptional quality of the Islamic section of the Collection.

It simultaneously confirms the firm belief that culture is one of the finest means of communication between different countries.

EXHIBITION "PORTUGAL AND THE WORLD IN THE 16TH AND 17TH CENTURIES" IN 2007

In 2007, the Calouste Gulbenkian Foundation joined the Sultan Qaboos Cultural Centre in sponsoring a major Exhibition at the Smithsonian Institution in Washington D.C. entitled "Encompassing the Globe: Portugal and the World in the 16th and 17th Centuries".

PRESERVATION OF HISTORICAL HERITAGE

The Portuguese were present in Muscat for over a century, building the Al Jalali and Al Mirani Forts, before being expelled in 1650 by Sultan bin Saif Al Yarubi. Much later, in the 20th century, the Calouste Gulbenkian Foundation, present in Oman through its participation in the oil and gas exploration, supported the renovation of those forts. Dr. Emílio Rui Vilar, President of the Foundation, stated "our role as a cultural foundation is to help bridge the gaps between civilisations, the great religions and different ethnic groups".



Top: Velvet length  
Turkey, Bursa, late 16th - early 17th century,  
Ottoman period silk and silver threads  
Lisbon, Calouste Gulbenkian Museum.

Right: Kulliyat of Sa'di  
Persia, 17th century, Safavid period  
Ink, gold and coloured pigments on paper  
Lisbon, Calouste Gulbenkian Museum.

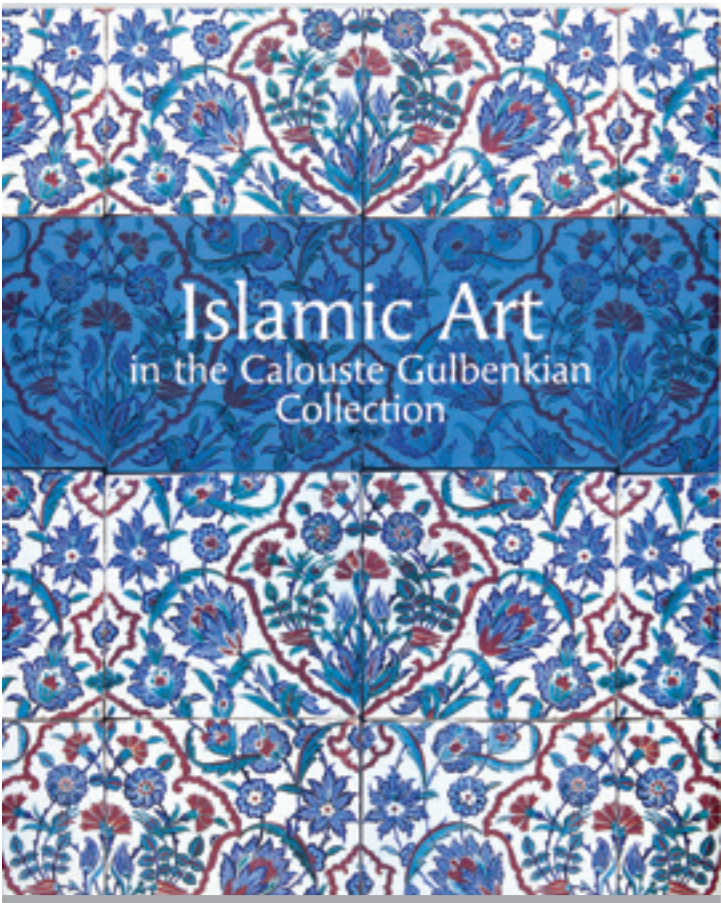


*H.E. Nasser bin Khamis Al Jashmi, Undersecretary of the Ministry of Oil & Gas of the Sultanate of Oman with Dr. Emílio Rui Vilar and Dr. Eduardo Marçal Grilo of the Gukbenkian Foundation, at the inauguration of the Islamic Art Exhibition in Muscat.*



Top: Mosque Lamp  
Egypt (or Syria), circa 1354-1361,  
Mamluk period made for Sultan Al  
Malik (Sultan Al Nasir Hasan ibn  
Muhammad), Calouste Gulbenkian  
Museum.

Right: A profusely illustrated  
catalogue was published (in  
English and Arabic editions) to  
accompany the exhibition.






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**COOPERATION WITH THE MINISTRY  
OF HERITAGE AND CULTURE**

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The Ministry of Heritage and Culture of the Sultanate of Oman signed a Memorandum of Understanding with the Calouste Gulbenkian Foundation in February 2012, aiming at enhancing cooperation in various fields, including supporting the Ministry's initiatives to promote the museum sector in Oman. The agreement will help promote and manage an integrated programme in the field of restoration and preventive conservation, museum management, training of staff, as well as a long-term programme to boost cultural activities and exhibitions in Oman and Portugal.

*H.E. Salim bin Mohammed Al Mahrouqi, the Undersecretary for Heritage Affairs and Dr. Emilio Rui Vilar, Chairman of the Calouste Gulbenkian Foundation signing a MoU for cooperation in the promotion of the museum sector in Oman.*



## A PARTNERSHIP TIMELINE

### 1967

June: The Compagnie Francaise des Pétroles (TOTAL today) rejoined the partnership by acquiring two-thirds of PARTEX equity share. Petroleum Development (Oman) was created with the following shareholding: Shell 85%, Compagnie Francaise des Pétroles 10% and Partex 5%.

July: First shipment of crude – “The Mosprince Tanker”

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### 1970

His Majesty Sultan Qaboos made his first visit to the PD(O) offices.

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### 1970 – 73

The Marmul field was shown to be commercially viable upon reappraisal.

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## OIL AND GAS PARTNERSHIPS





**PDO OIL EXPLORATION AND PRODUCTION**

In Oman, Partex is a partner with some of the largest oil and gas companies in the world.

Until the signature of the participation agreement with the Government in the 70s, the Partex Oil and Gas held 5% of the concessions. After the 60% nationalization by the Government, the Group's participation was reduced proportionally to 2%, the present holding.

The Gulbenkian Foundation's president, Dr. Emilio Rui Vilar, highlighted to PDO's publication Al Fahal that, despite the lack of oil discoveries in the 1950s, Partex oil experts remained convinced of the Sultanate's hydrocarbons potential. Some partners exited the consortium but Partex increased its holding in PDO from 5% to 15%. It was finally rewarded in 1964 when PDO announced its first commercial discovery of oil at Yibal. In 1967, Total rejoined the partnership by taking over 10% of Partex's equity share, who returned to its original 5% participation.

In 1964, oil was also discovered in Fahud, on the other side of a faultline from the location where Fahud-1 (1956-57) had been drilled and abandoned as a dry well. In fact, the Fahud oil field had been missed by only some 200m.

In 1967, one of the major milestones in PDO's history was achieved, the first shipment of crude by the "The Mosprince Tanker".

In the 70s and 80s major discoveries were made and by the end of 1984, the average daily production had risen to 400,000 barrels a day with reserves at 3.8 billion barrels.

In 1996, PDO concluded an agreement with the Government of Oman to develop the Central Oman gas fields in order to supply gas to an LNG plant in Qalhat, near Sur.

By the end of 2000, oil reserves had increased to 5 billion barrels and production had steadily increased to 840,000 barrels per day.

PDO today produces oil and gas from 3,750 wells in 120 fields, operates 16,000 kilometers of pipelines, numerous oil-processing

facilities and three gas-processing plants. PDO also operates the oil terminal at Mina Al Fahal.

PDO Study Centre was set up in June 2003, to attract and develop first rate technical professionals capable of conducting subsurface studies and development plans that would support the mid to long term goals of PDO. As part of that process, one member of Partex staff was assigned by PDO to the Study Centre. In fact, along the years, Partex always focused on the training of its staff to acquire skills for better field development planning. It is the firm belief of Partex that every field development project needs to be supported by technically sound geological and engineering studies.

**OLNG/QLNG LIQUIFIED NATURAL GAS**

Partex is sharing OLNG with the Government of Oman, Shell, Total, Korea LNG, Mitsui, Mitsubishi and Itochu.

In 2000, His Majesty the Sultan officially opened the LNG plant. The first downstream cargo of LNG was shipped to Korea in April 2000.

OLNG produces LNG from the two trains at its plant located near Sur and sells it mainly to Korea and Japan. A third train is owned by a separate company, Qalhat LNG, shared by the Government of Oman, OLNG, Union Fenosa, Mitsubishi, Osaka Gas and Itochu. Partex is thus, indirectly, also a partner in QLNG.



*Top: Paulo Bizarro a Partex senior geologist assigned to PDO's Study Centre, receiving the Chairman's Award for Excellence from the hands of Dr. Abdulla Al Lamki.*



*Left: LNG shipment at OLNG terminal.*

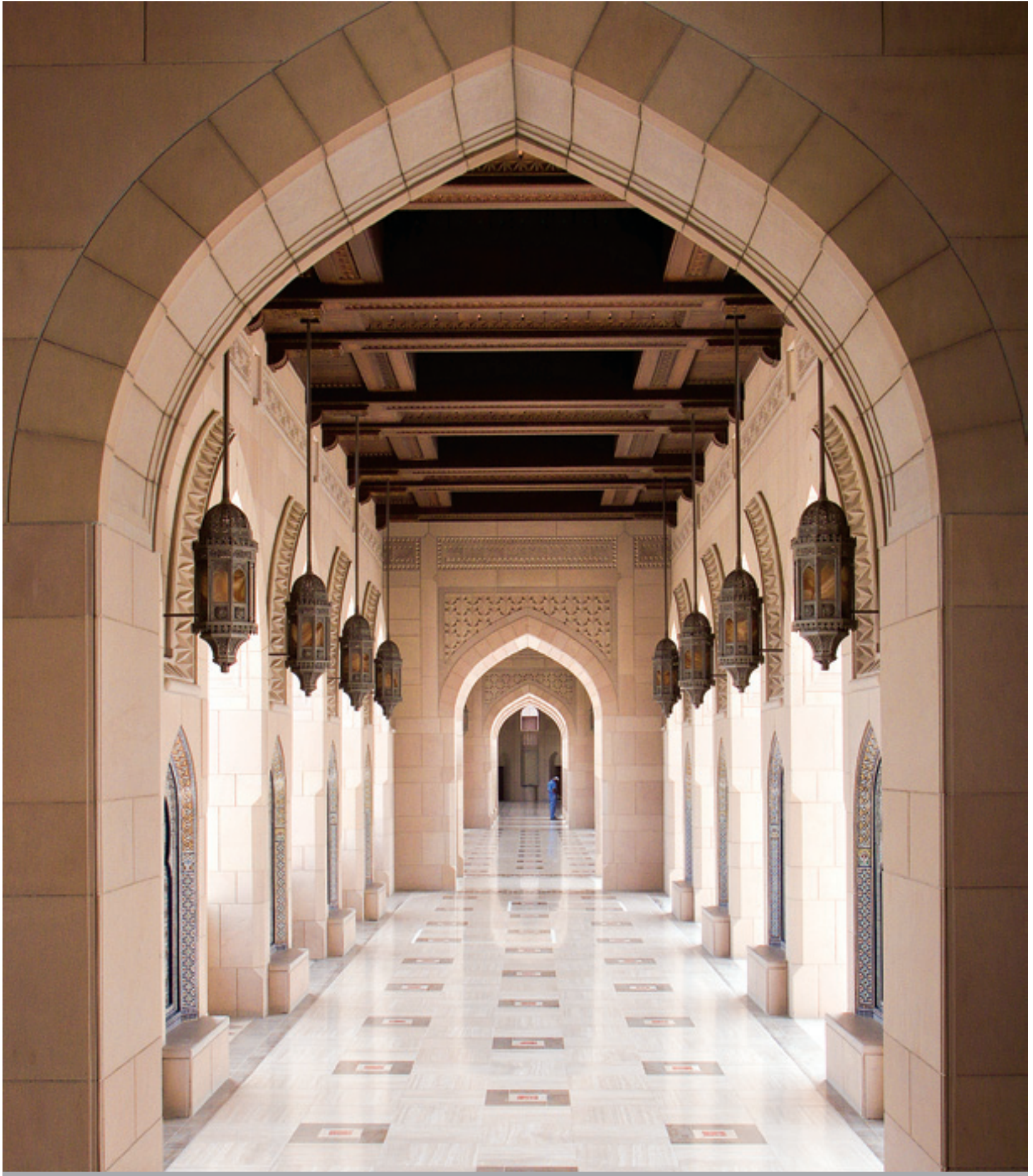


Photo: Courtesy of Paulo Bizarro.

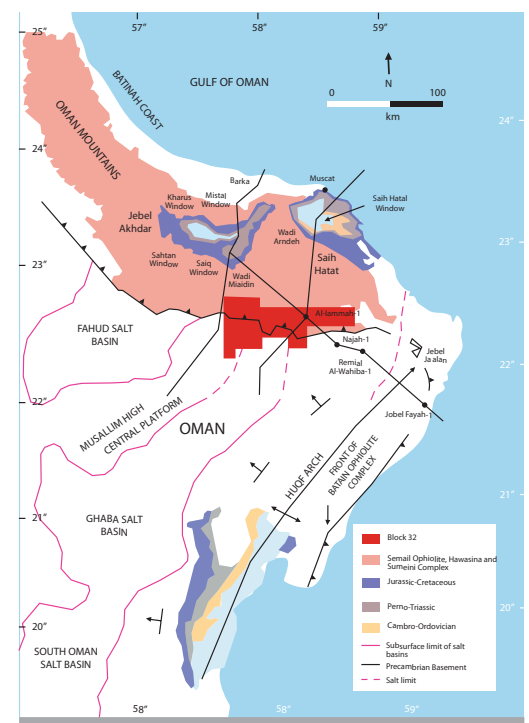


**JOINT VENTURE BETWEEN OMAN OIL COMPANY AND PARTEX IN KAZAKHSTAN**

The Partex Oil and Gas Group became a partner with Oman Oil Company (OOC), a company wholly-owned by the Government of Oman, in the development of a field in West Kazakhstan. Partex Oil and Gas owned a 50% working interest in the Dunga field Production Sharing Agreement and was the operator for the construction and commissioning of the pilot phase operation of the field. In 2002, Partex and OOC decided to reduce their participating interests to 20% each, through a farm-out to Maersk Oil Kazakhstan, which became the operator of the field.

**BLOCK 32 EXPLORATION**

The Block 32 contract was ratified by Royal Decree on September 23rd 1996. The work obligations in the initial three year exploration period consisted of seismic and the drilling of one deep well to the Amin Formation. Seismic acquisition, processing and reprocessing were completed in 1997-98 and the deep vertical exploration well Sinaw A-1 was spudded on the August 17, 1998 and reached the TD of 16,151 ft on February 22, 1999. The primary objective was to evaluate the Amin Sandstone, with the Barik and Miqrat Sandstones as the secondary objectives. Unfortunately, the reservoirs showed poor quality with no hydrocarbon presence.



Above: Regional location map of Oman (modified after Gorin et al., 1982) showing the location of Block 32.

Top and left: Dunga field development - A partnership between Partex, Oman Oil Company and Maersk in Kazakhstan. (Photos: Courtesy of Fernando Alves).



#### MUKHAIZNA HEAVY OIL

In June 2006 the Government of Oman awarded the field to a consortium led by Oxy, as operator with a 45% stake. The other partners are Oman Oil Company with 20%, Shell with 17%, Liwa Energy with 15%, Total E&P Oman with 2% and Partex Oman Corporation with 1%.

This field is being developed through an Enhanced Oil Recovery (EOR) technology, based on an extensive steam flood injection system. Mukhaizna has about 2 billion barrels of oil in place. Steam production facilities will continue being developed until 2014, in order to achieve a plateau production rate of 150,000 barrels per day.



Left: View of the construction site  
Above: Mukhaizna Block 53.



## A PARTNERSHIP TIMELINE

### 1974

The Government of Oman acquired a 60% shareholding in the Petroleum Development (Oman). As a result, the foreign interest in PD(O) became: Shell (34%), Compagnie Francaise des Pétroles (4%) and Partex (2%).

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### 1975

Global North, Saih Nihayda, Saih Rawl, Qarn Alam and Habur fields were on stream by 1975. Production averaged 341,000 bpd.

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### 1980

Petroleum Development Oman – now without parentheses in its name – was registered by Royal Decree.

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# PARTEX COMMITMENT TO OIL AND GAS OPERATIONS IN OMAN



TECHNICAL SUPPORT TO OPERATIONS

Throughout the years Partex has been committed to the success of Oman operations by making our most experienced people available for representation (committees, workshops, Value Assurance Reviews, technical seminars, audits, etc.), ensuring a continuity of knowledge which can maximize the quality of Partex support.

Partex gives Research & Development a strong role in its technology area. Partex technology for Reservoir Characterization, Produced Water Treatment and Crude Oil Degassing & Stabilization are being introduced in Oman. Other areas of research, such as Microbial Enhanced Oil Recovery (MEOR) are actively being pursued in Partex, to be shared with our partners as soon as the processes are proven.

Seismic inversion pilot studies in PDO and Mukhaizna were conducted to evaluate its potential added value to the operations.

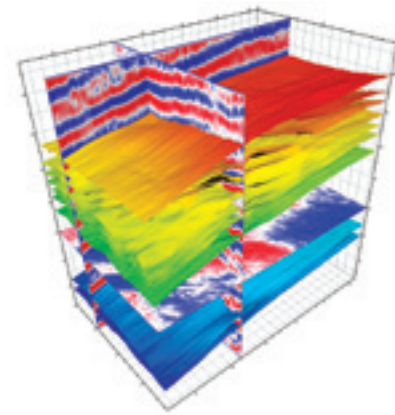
OUR COMMITMENT IN TERMS OF STAFF

The commitment of Partex is to support the operations with highly qualified seconded and support staff, who are knowledgeable in their areas of expertise and able to transfer technology, to train young Omani Nationals, to build a good atmosphere and foster the exchange of ideas and concepts, thus contributing to the progress of Oman operations.

Several members of the Partex staff had a key role, in the application of new technologies in the region, such as the application of an integrated system of reservoir characterization technologies and the study of the hydrocarbon fluid behaviour in gas injection projects.

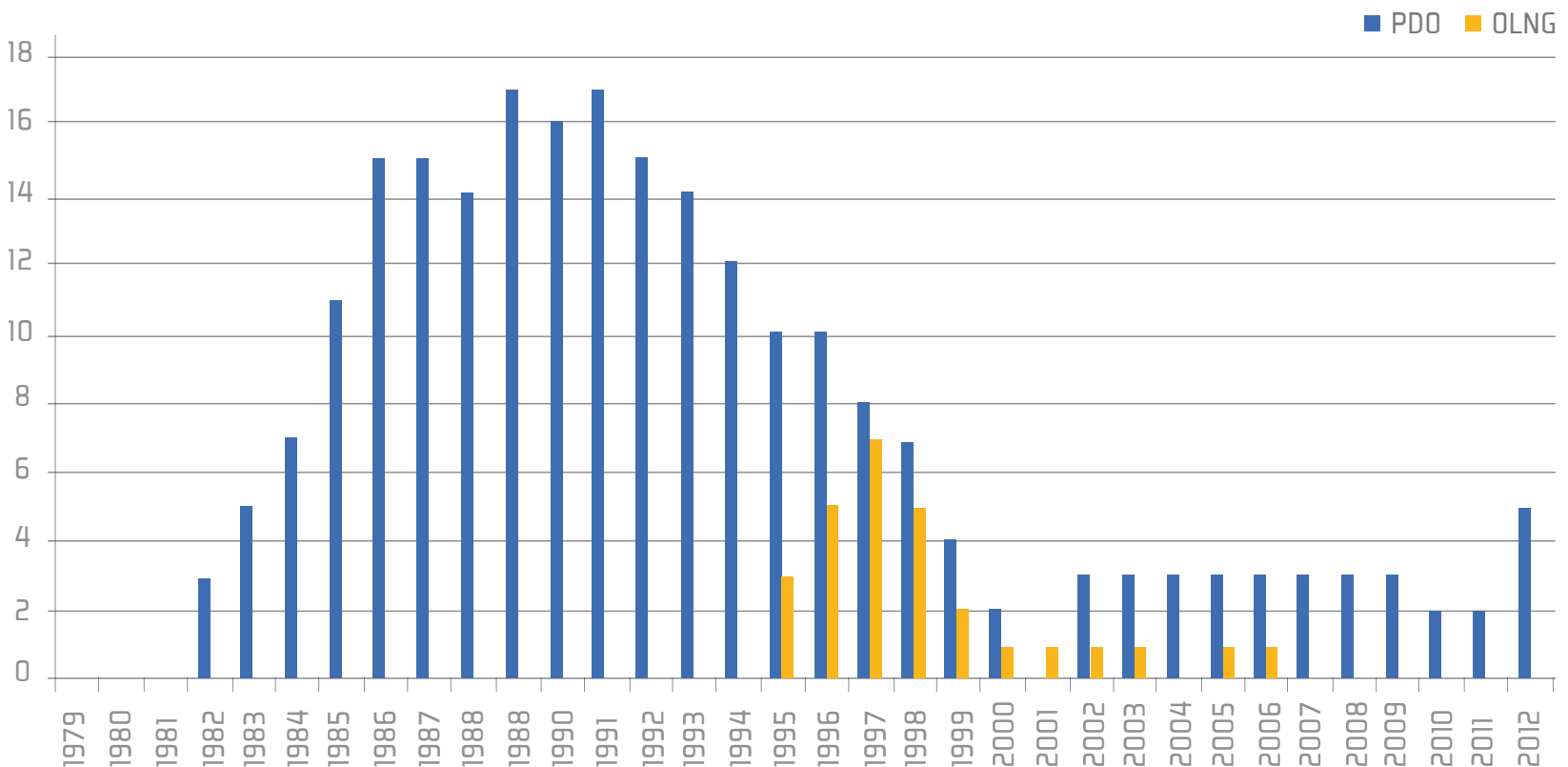
CONTRIBUTION TO TRAINING AND DEVELOPMENT

Partex is also committed to support the training of Omani Nationals using a variety of approaches including cross-posting, the organization of Technical Seminars and Workshops and the cooperation with the Oman operations and Sultan Qaboos University, to share Partex Technology and Research and Development projects.



Above: Seismic Interpretation.  
Below: This figure confirms the effort of Partex to provide a strong expertise presence in the operating companies, a clear sign of the Partex commitment to the development of the oil and gas industry in Oman.

SECONDMENT HISTORY IN OMAN - 1982-2012









## A PARTNERSHIP TIMELINE

### 1986

Horizontal wells made their debut in PDO.

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### 1994

Oman LNG was registered as an Omani Company.

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### 1996

PDO concluded an agreement with the Government to develop the Central Oman gas fields in order that they may supply gas to the new LNG plant in Qalhat, near Sur.

His Majesty Sultan Qaboos bin Said laid the foundation stone at the LNG plant site.

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## SHARING OF TECHNOLOGY



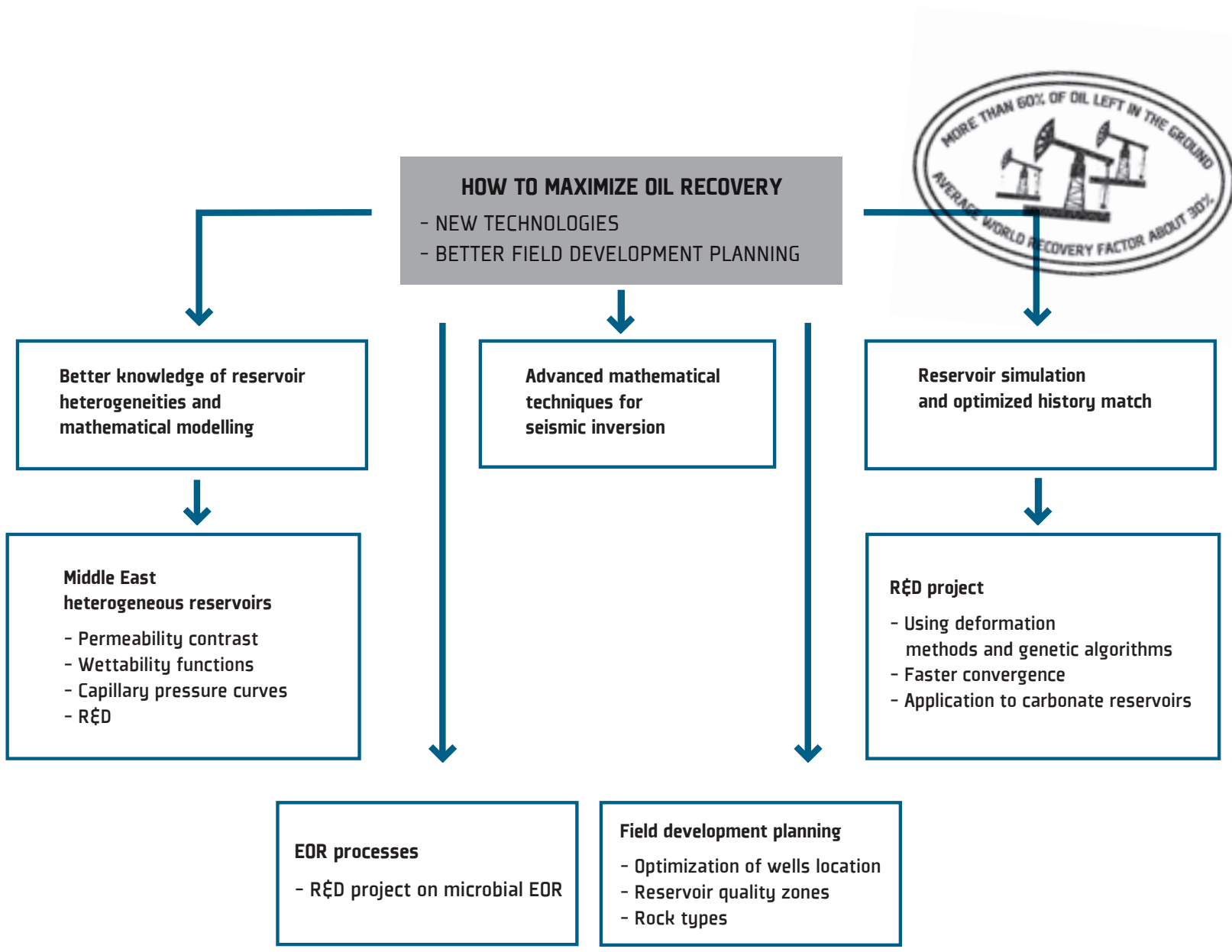
PARTEX'S CONTRIBUTION TO RESERVOIR MANAGEMENT, FIELD DEVELOPMENT PLANNING AND R&D PROJECTS

PDO needs to remain a world class operator in a future of more complex projects based on the application of new technologies, the access to the best expertise and the contributions of its shareholders.

The commitment of Partex to contribute to this target is to reinforce the current background of technical activities relevant to PDO challenges.

- R&D projects in Reservoir Characterization
- Seismic Inversion Algorithm that was tested in PDO and Mukhaizna allowing understanding of reservoir heterogeneities;

- Project on the Characterization of Fractures for carbonate reservoirs;
- Studies on the optimization of oil production from complex reservoirs;
- Studies related to Enhanced Oil Recovery (EOR) Projects;
- Geostatistical History Matching;
- Projects in the area of Surface Facilities like Crude Oil Degassing and Stabilization;
- Microbial Technology MEOR for heavy oil upgrade and water treatment;
- Water Bacterial Treatment;
- EOR projects in mature and marginal fields;
- Heavy oil field technologies.



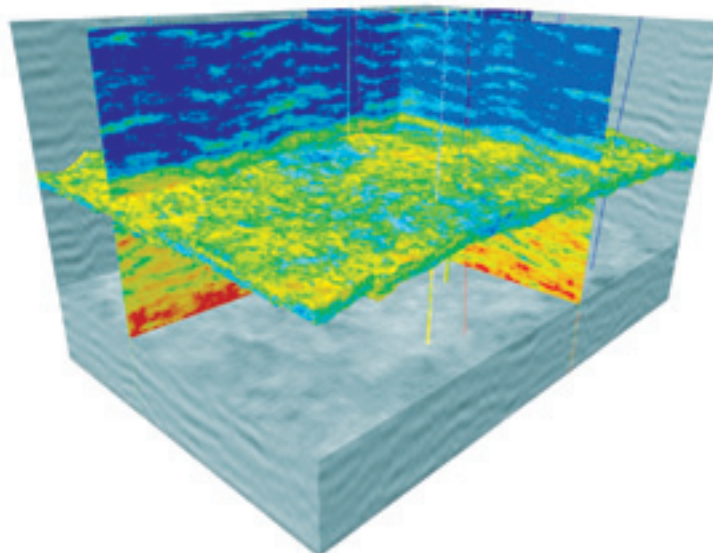
**Partex R&D projects in Reservoir Characterization** developed with the Technical University of Lisbon aimed at building more reliable Reservoir Models integrating Geological, Petrophysical and Seismic Information, led to applications to fields in the Middle East, relevant to the understanding of reservoir performance and optimization of field development.

**Partex developed a Seismic Inversion Algorithm** that was tested in PDO and Mukhaizna. The impact of this approach is to improve the oil recovery, as a simple 1% improvement in the recovery factor can result in very sizeable additional reserves and production.

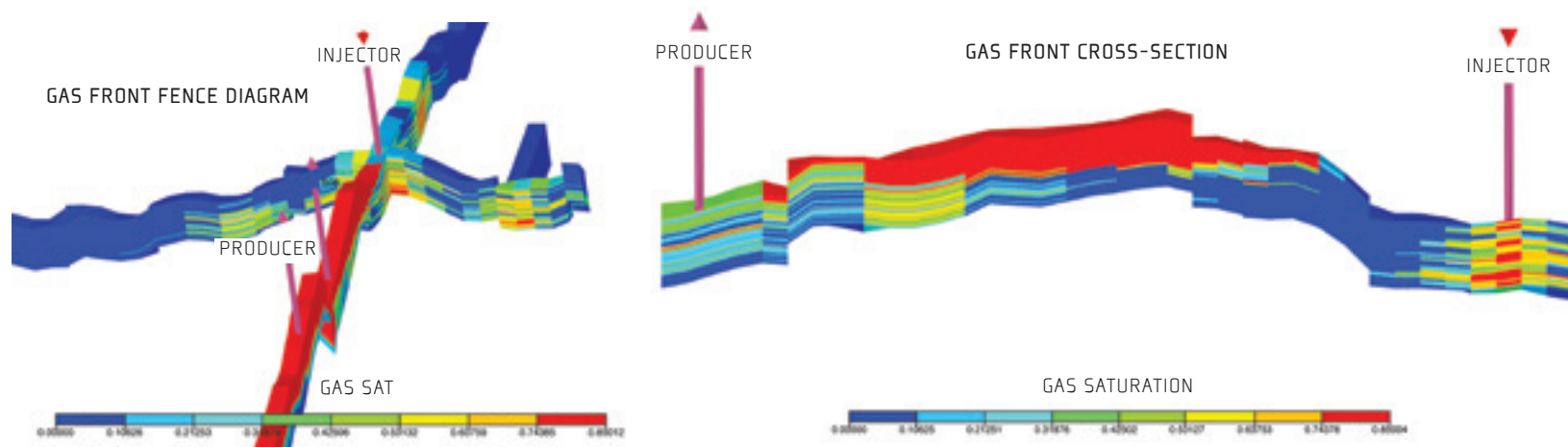
**Partex developed a project on the Characterization of Fractures for carbonate reservoirs**, which has an impact in understanding the role of fractures in fields. This knowledge can help optimize production and oil recovery.

**Sweep efficiency in complex reservoirs** is one of the most critical issues in the maximization of Oman oil reserves. A better understanding of the reservoir fluid mechanisms can give insight into the location of bypassed oil, the identification of the areas not swept by water and the improvements to be introduced in the design of the well completions.

**Partex developed Enhanced Oil Recovery (EOR) projects for the Harweel development.** Partex has skills in the area of Compositional Simulation and Miscible Gas Injection and has experience in the development of Reservoir Simulation Models tailored for Miscible Gas Injection projects, like the Harweel and Budour developments in PDO.



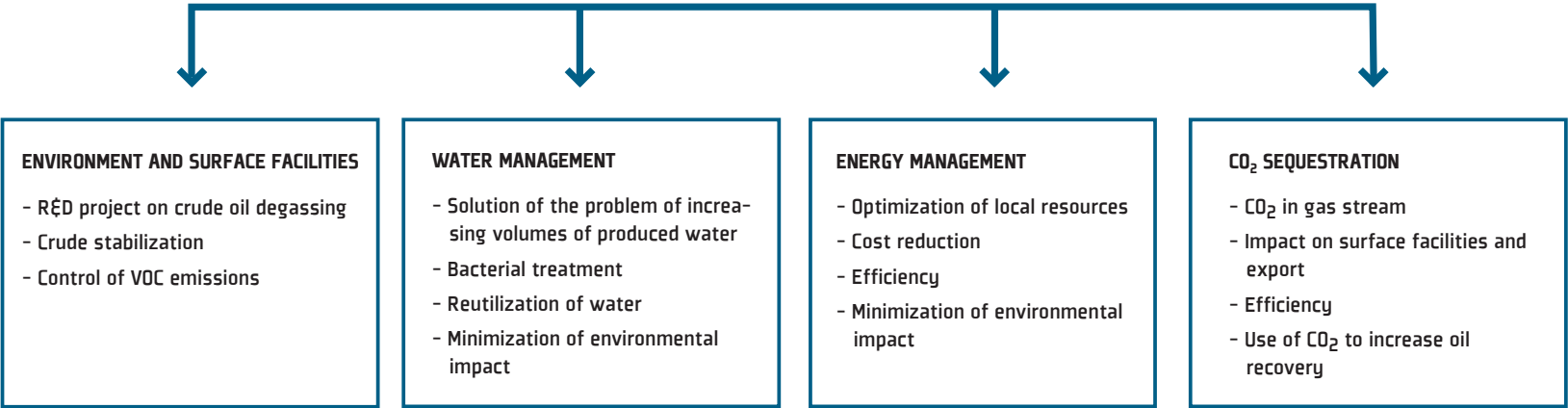
*Global Seismic Inversion:  
Explore the seismic data to the limits.  
Partex has its own Seismic  
Inversion Methodology.*



*Compositional simulation study results for a gas injection project, showing forecasts of the gas front advance.*

**PARTEX BID ON ADVANCED TECHNOLOGY  
IN CHALLENGING AREAS**

*Presented at  
the 14th ADIPEC CEO Summit,  
November 2010.*



**Budour Equation of State (EOS).** Partex conducted a study for PDO to develop an EOS to model the fluid behaviour of the oil and gas system of the Budour field, to be used in its potential EOR projects. This study is similar to the one that Partex conducted for PDO's Harweel field a few years ago and confirms the contribution of Partex in terms of specialized EOR expertise relevant to PDO.

**Partex conducted a project in Geostatistical History Matching** that is important for future PDO Reservoir dynamic models, because it allows a consistent history matching optimization in mature fields with hundreds of wells and large dynamic and production data bases, avoiding the time-consuming and never ending process of model calibration.

**Partex developed projects in the area of Surface Facilities such as Crude Oil Degassing and Stabilization,** aimed at improving the separation of gas from the oil stream, to stabilize the crude, to reduce the economic loss of gas being released to the atmosphere during the exporting process, leading to the improvement of the quality of the environment. These projects have been shared with PDO and Sultan Qaboos University.

The commitment of Partex is to reinforce the R&D projects in these technical niches and provide the knowledge and technology to the Sultan Qaboos University and the operations, as well as training Omani Nationals in these areas of expertise.

**Partex is sponsoring a MEOR (Microbial Enhanced Oil Recovery) R&D Project with Portuguese Universities.** The satisfaction of increasing oil demands require higher energy efficiency and improved oil recovery factors.

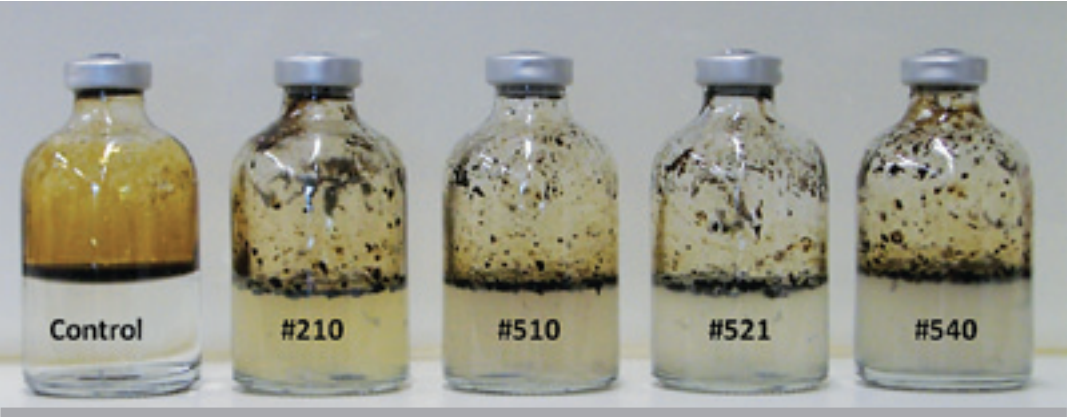
In view of that, Partex decided to develop an economical, simple and environmentally clean MEOR technology that can be applied to increase the oil production and the recovery factor of oil fields. The MEOR technology is based on the use of a microbial culture that can:

- reduce oil viscosity in site, eliminating the use of solvents and dispersants which can be toxic to the environment;
- generate gases (CO<sub>2</sub>) that increase reservoir pressure, thus improving oil displacement;
- generate organic acids that dissolve rock improving permeability;
- improve the displacement through the production of biopolymers;
- alter wettability, reducing residual oil;

- produce bio-surfactants that decrease surface and interfacial tension. This is a recent R&D Project launched by Partex in cooperation with the Aveiro and Minho Universities in Portugal.

**Water Bacterial treatment is a technology that Partex is studying.** The increasing water production in oil fields is an area of concern both for economical and environmental reasons. This water needs to be injected underground or used at surface and its treatment is of the utmost importance both for cost and environmental reasons. Partex is carrying out studies and tests for treatment of produced water in order to make it suitable for injection and ultimately for agricultural and human consumption.

To achieve this objective, several steps are being followed, which include bacterial treatment for hydrocarbon removal with appropriate bacteria, not harmful to water quality and its users.



*Microbial Culture used by MEOR R&D.*

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## PARTEX MAIN STUDIES AND PROJECTS RELEVANT TO OMAN

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### GEOLOGICAL AND GEOPHYSICAL

- Integrated structural aspects of the Yibal Khuff Field development plan
- Core description, open hole logs, core and thin-section photos of the Khuff K2 in well 1, North Oman
- Estimation of Oil - Initially - In - Place (OIIP) in a Heterogeneous Middle East Carbonate Oil Reservoir
- Geology Meets Petrophysics: an Example of a Process-Based Rock Type Methodology for a Khuff Reservoir, North Oman
- Integrated Static Reservoir Modelling of a Khuff Reservoir, North Oman
- The Tórtola Fluvial System. An Analogue for the Upper Gharif of the Sultanate of Oman
- NE Abu Dhabi: New Evidences of Wrench Tectonics Associated with the Development of the Oman Mountains Foredeep

### RESERVOIR STUDIES

- Harweel Cluster Gas Injection Project
- Zauliyah Stochastic Study - Upper Gharif Stochastic Study
- Equation of State Modelling for Budour/ Budour North-East Oil
- Integrated Modelling Techniques for Imbibed Carbonate Reservoirs of North Oman, Lekhwair/Dhulaima Area
- Evaluating Scope for Recovery (SFR) from Stratigraphically Complex Carbonate Reservoirs in the Lekhwair-Dhulaima Area of North Oman
- An Integrated Approach to Reservoir Management of a large Water Flood
- A Pragmatic Approach to Injection Management of a large Water Flood in the largest Oil Field in Oman
- Re-defining the Limits of Ultra - Slim Coiled Tubing Drilling
- Zonal Isolation in Ultra Slim-hole Wells
- Targeting by-passed oil by very Detailed Reservoir Simulation Model
- Accessing Unswept Oil Pockets in a very Mature Oil Field in North Oman

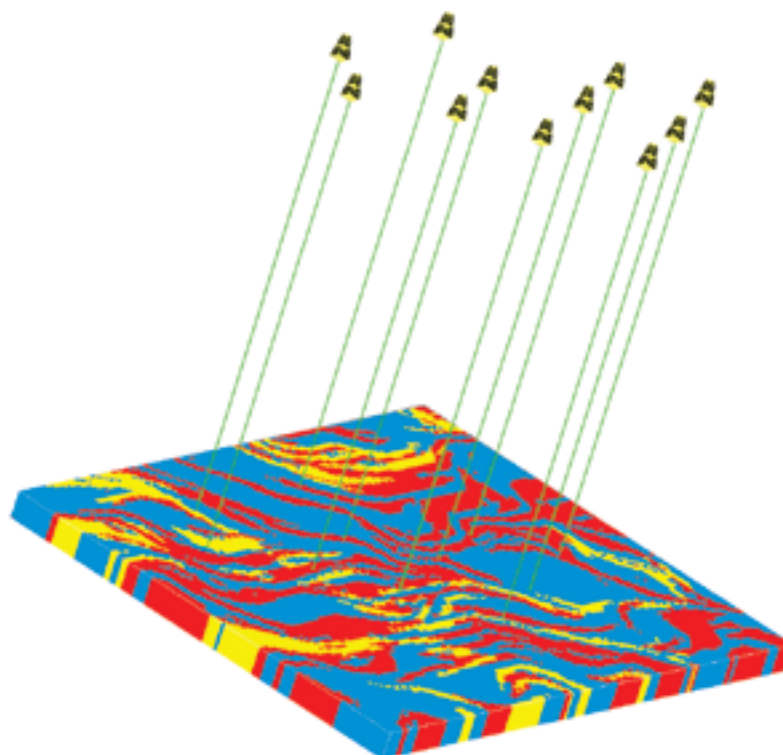
- Reservoir Simulation Optimises the Development of Yibal Field
- Upscaling of Stochastic Models For Reservoir Simulation - An Integrated Approach

### WELL ENGINEERING

Underbalanced Workovers in Mature Low Pressure Fields in Oman.

### RESEARCH & DEVELOPMENT

- Installation for pressure reduction of Hydrocarbon gases in a near Isothermal manner.
- Crude Stabilizer using Localized Underpressure Generation.
- MEOR (Microbial Enhanced Oil Recovery) Project with Portuguese Universities: Biosurfactant-producing microorganisms isolated from Brazilian oils for use in Microbial Enhanced Oil Recovery




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*Fluvial sand channels from upper Gharif Stochastic Study.*

**KNOWLEDGE TRANSFER FROM OTHER AREAS OF THE WORLD**

Partex has exploration and production projects in other areas of the world, involving aspects that are relevant to the Oman reservoirs and can be utilized to optimize oil and production in Oman.

- Compositional simulation study and field implementation of a miscible gas injection project in Abu Dhabi

- Brazil onshore marginal fields: a challenge for commercial development
- Brazil ultradeep offshore
- Angola ultradeep offshore
- Algeria onshore gas
- Kazakhstan tight reservoir requiring hydraulic fracturing operations. Focus on field development planning optimization
- Portugal deep offshore exploration

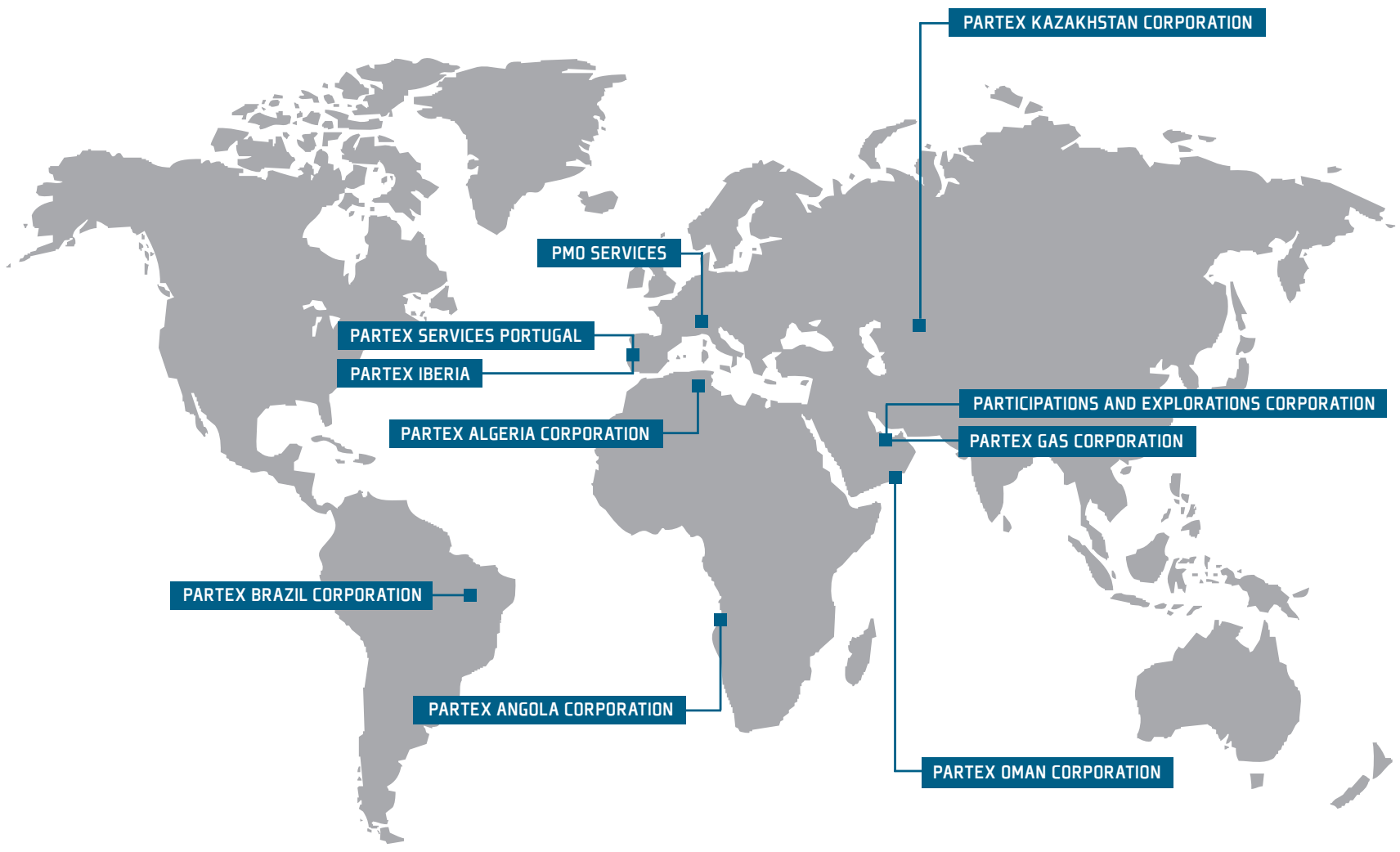




Photo: Courtesy of Paulo Bizarro.





## A PARTNERSHIP TIMELINE

### 1999

Commissioning of the Saih Rawl Central Processing Plant and the gas pipeline from Saih Rawl to Qalhat (352 km).

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### 2000

First LNG produced in February.

First cargo of LNG was shipped to Korea. His Majesty the Sultan officially opened the LNG plant.

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**PARTEX COMMITMENT TO KNOWLEDGE DEVELOPMENT**

CONTRIBUTION TO THE SULTAN QABOOS UNIVERSITY

Partex is also committed to reinforcing its relationship with the Sultan Qaboos University in Oman, namely through initiatives like the organization of joint seminars and workshops, transfer of technology and visits to Partex.

Partex delivered a workshop at the Sultan Qaboos University in 2010 about "Reservoir Characterization and Modelling".

This event was part of a Sultan Qaboos University - Partex initiative of knowledge sharing between academia and industry. The workshop was well received by the participants from Sultan Qaboos University and covered key areas of the upstream Oil & Gas business, such as carbonate reservoir characterization, seismic inversion, reservoir simulation and automated history matching.



**PARTEX**  
OIL AND GAS

WORKSHOP ON "RESERVOIR CHARACTERIZATION AND MODELLING" ORGANIZED BY PARTEX IN THE SQU ON 21 NOVEMBER 2010

**WORKSHOP PROGRAM**

PARTEX Corporate Presentation

Reservoir Characterization - Workflow in carbonates

Global Seismic Inversion:  
2 Studies of onshore Abu Dhabi

Oil Recovery Enhancement for Thamama B Lower in an Onshore Abu Dhabi field - Using Conceptual Models to understand Reservoir Behaviour

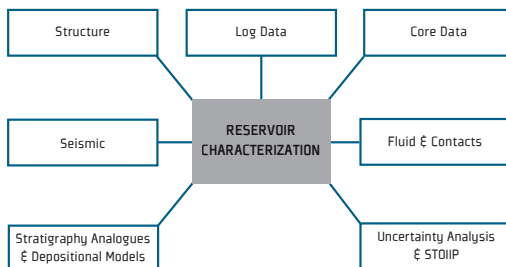
Optimized History Match - Middle East Case Study

PARTEX TECHNOLOGY AND R&D ACTIVITIES

RESERVOIR CHARACTERIZATION -  
WORKFLOW IN CARBONATES

Most of the hydrocarbon reservoirs in the Middle East are carbonate rocks. These are complex reservoirs that require special techniques to characterize the fluid flow behaviour and implement successful Field Development Plans.

This diagram below, reveals a workflow to characterize carbonate reservoirs showing examples, mainly from the Middle East, to illustrate ways to handle the carbonate reservoirs complexity and the impact on reservoir development.

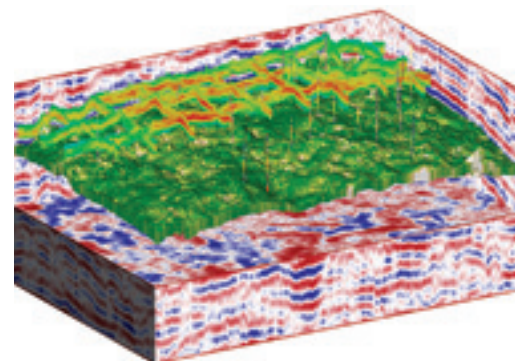


Reservoir Characterization Workflow.

The construction of 3D geological models to predict reservoir performance, implies an integrated multidisciplinary task involving expertise in reservoir geology, geophysics, petrophysics, geostatistics and reservoir engineering.

GLOBAL SEISMIC INVERSION: PILOT STUDIES

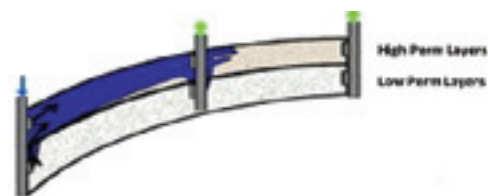
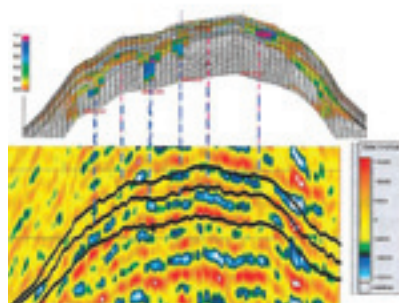
Seismic Inversion is usually used to condition the reservoir model since it is one of the seismic attributes that is closer to the petrophysical properties of the reservoirs, such as porosity. A new version of the stochastic seismic inversion algorithm has been developed by Partex in collaboration with the portuguese Instituto Superior Técnico (IST) and tested in PDO and Mukhaizna reservoirs to evaluate the robustness and efficiency of the new methodology.



Seismic Inversion.

**OIL RECOVERY ENHANCEMENT – USING 4D SEISMIC CONCEPTUAL MODELS TO UNDERSTAND RESERVOIR BEHAVIOUR**

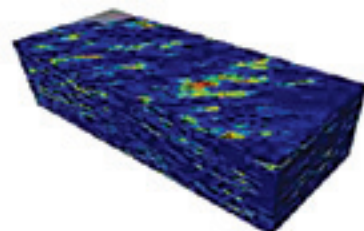
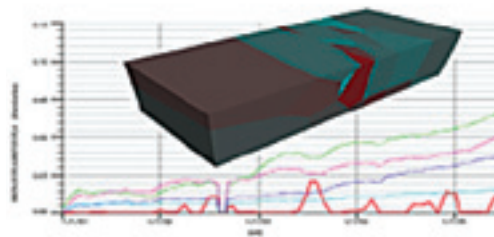
The study objective was to test the issue of waterflood behaviour in highly heterogeneous reservoirs, namely the impact of high permeability contrasts using different capillary pressure models under different wettabilities. A conceptual sector model of a Middle East field was applied to test different modelling scenarios and to establish the main reservoir behaviour issues, in close conjunction with rigorous reservoir monitoring information, including 4D seismic. Simulations tested the role of saturation functions under different wettability behaviours on model sensitivity and the implication of permeability distribution on waterflood performance.



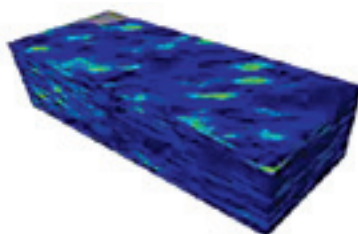
*Evaluation of water front advance using reservoir modelling and 4D seismic.*

**OPTIMIZED HISTORY MATCH – MIDDLE EAST CASE STUDY**

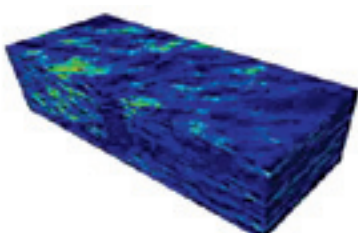
To calibrate the dynamic model with the production data, the history match process can change the petrophysical properties of the model in such way that the geological concepts used to build it are destroyed. The proposed method, based on genetic algorithms and gradual transformation of images with stochastic simulations accelerates the process of history matching.



*One example simulation of the composed permeability model.*



*Average cube of the realizations of the composed permeability model.*



*Variance cube of the realizations of the composed permeability model.*

**PARTEX TECHNICAL PUBLICATIONS**

Partex published many technical papers on Oman Oil and Gas projects, in conferences or publications of prestige, ADIPEC – OGWA, SPE, AAPG and SEG. Technical papers relevant to Oman operations prepared with the contribution of Partex staff comprise the following subjects: Geological and Geophysical, Reservoir Studies and Well Engineering.

The book “The Universe of the Petroleum Industry – from Exploration to Refining” was written in the Portuguese language by two Partex senior staff. It provides a global coverage of the Oil and Gas industry and was published in December 2007 by the Calouste Gulbenkian Foundation, the sole shareholder of Partex Oil and Gas. The book is being used by both students and industry staff and is now moving into its second edition. It comprises 26 chapters organized under eight sections covering the following areas:

- Petroleum Origins and Fundamentals
- Geology and Petroleum Exploration
- Drilling and Reservoir Appraisal
- Oil Field Development
- Production, Transport and Refining
- Natural Gas
- Oil and Gas and the Environment
- Oil and Gas Markets

With the sponsorship of Partex, an English version is under preparation, which will be supplied to Sultan Qaboos University and other entities with which Partex holds a special relationship.



#### OGWA & SPE CONFERENCES

Partex participated for the first time in the Oil and Gas West Asia (OGWA), as Exhibitor, in 2010. The stand attracted a significant number of visitors and was highly appreciated by distinguished members of the Government, namely H.E. Nasser bin Khamis Al Jashmi, Undersecretary of the Ministry of Oil & Gas of the Sultanate of Oman and Dr. Zaid Khamis Al Siyabi, Director General of the Ministry of Oil & Gas, who were welcomed by Dr. Costa Silva, Chairman of Partex Oil and Gas. Members of the management of PDO, OJNG and various senior representatives of our partners also visited the stand.

Partex is again participating in OGWA 2012, with a stand and technical contributions at the associated SPE EOR Conference.





*Above: H.E. Nasser bin Khamis Al Jashmi, Undersecretary of the Ministry of Oil & Gas of the Sultanate of Oman, Dr. Zaid Khamis Al Siyabi, Director General of the Ministry of Oil & Gas, Mr. Amor Al Matani, Deputy General Manager of O LNG and Mr. Saif Al Hinai of PDO's Management, with Dr. António Costa Silva and Mr. José Pereira of Partex, during the visit to the Partex stand.*

*Left: Partex stand in OGWA 2010.*



## A PARTNERSHIP TIMELINE

### 2004

Oman LNG signs an agreement with the Government of Oman, becoming a shareholder in QLNG.

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### 2005

Gas plant commissioned in Saih Nihayda.

QLNG train commences operation in December.

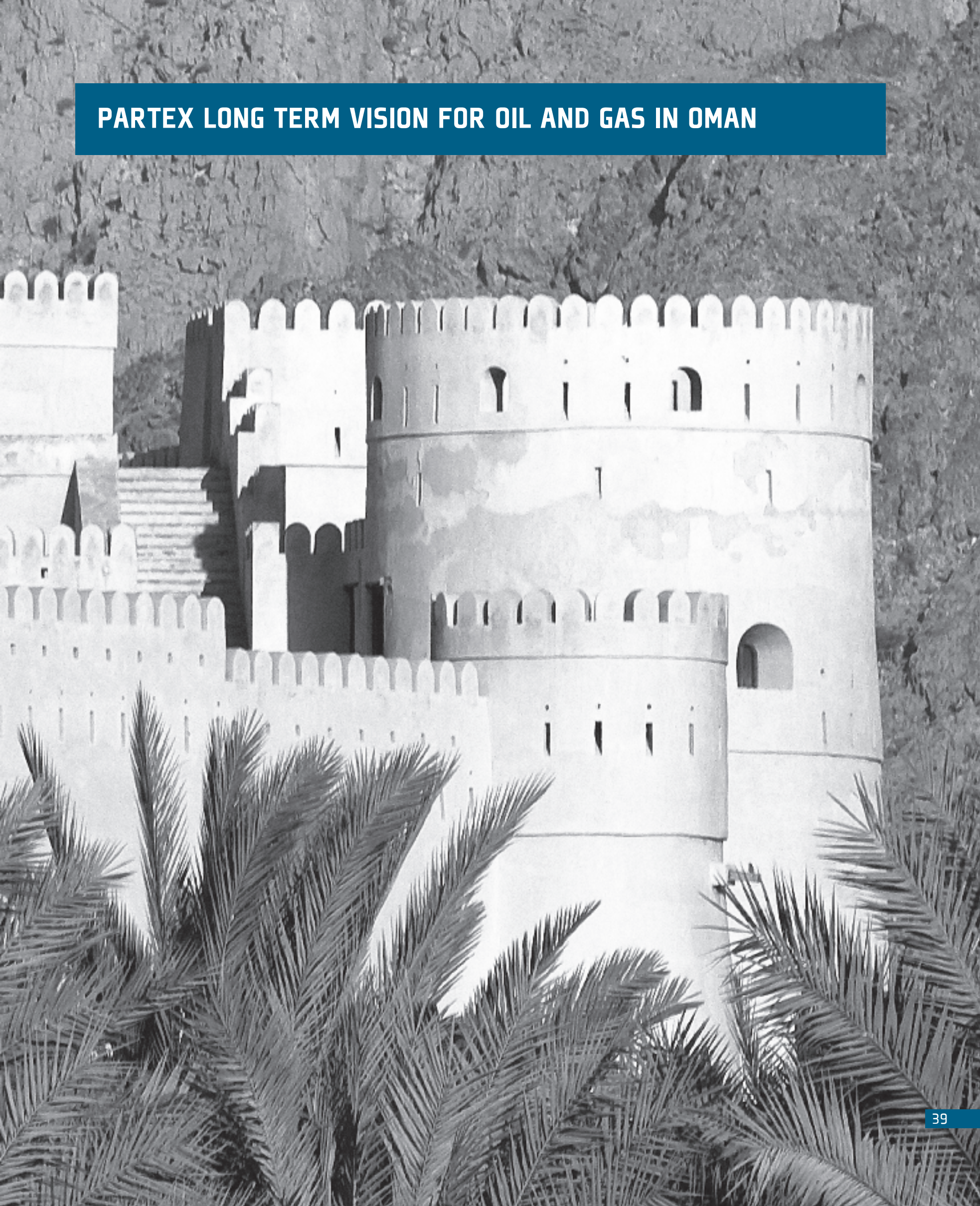
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### 2008

Gas plant commissioned in Kauther gas field.

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# PARTEX LONG TERM VISION FOR OIL AND GAS IN OMAN





#### PDO CONCESSION RENEWAL AND MUKHAIZNA CONCESSION AWARD

In 2004, the Omani government agreed to extend PDO's exploration and production concession and operating agreements for 40 years, until 2044.

In 2006, the government awarded the Mukhaizna heavy oil field to a consortium, in which Partex is present.

Both facts show the strong commitment of Partex to the development of the oil and gas industry in the country.

#### LONG TERM SUSTAINABILITY OF PDO PRODUCTION

Taking into consideration the knowledge of Partex about PDO reservoirs and the work conducted by Partex along the years on R&D projects related to Reservoir Characterization and Simulation Modelling of Carbonate Reservoirs, it is our belief that we can play a relevant role in achieving this goal. Partex can contribute to the improvement of oil recovery and the development of accurate and reliable Field Development Plans. This is critical to formulate options focused on the maximization of reserves, the increase of production and the sustainability of the target plateau rates.

#### IMPROVED OIL RECOVERY IN PRODUCING FIELDS

PDO reserves, given their characteristics, are good candidates for IOR projects, such as, among others, the optimization of water flood field development and the application of efficient infill drilling planning. However, in order to achieve success, a crucial issue is the understanding of reservoir behaviour and fluid dynamics. Partex can provide relevant insight on this area of petroleum knowledge, based on the work conducted in Reservoir Characterization and Reservoir Simulation, including studies on the understanding of complex reservoirs.









#### ENHANCED OIL RECOVERY PROJECTS

Many oil fields in Oman are either reaching a mature stage or are characterized by complex reservoir and fluid systems. In both cases, they cannot be efficiently developed through conventional techniques, requiring Enhanced Oil Recovery methods to ensure the maximization of reserves and viable production levels.

PDO has acknowledged the need for a greater focus on EOR technology to develop its oil reserves and some gas reservoirs.

Gas injection and steam injection projects are already in progress in Oman. In these cases, it is essential to establish very sound field development plans, based on rigorous reservoir and fluid characterization methodologies.

The experience of Partex with gas projects involving compositional simulation and equation of state studies, can play a relevant role for the future of oil production in Oman. In fact, Partex has already conducted gas injection studies for the Harweel and Budour fields, awarded by PDO.

Microbial EOR, an area in which Partex is sponsoring an R&D project with Portuguese Universities, has the potential to help facing some complexities of oil operations in Oman.

#### RESERVOIR MANAGEMENT

Partex involvement in areas of the world where ageing fields already required new approaches, can provide a useful support to PDO in terms of how the reservoir management process can accommodate these new challenges.

#### ASSET INTEGRITY AND HSE MANAGEMENT

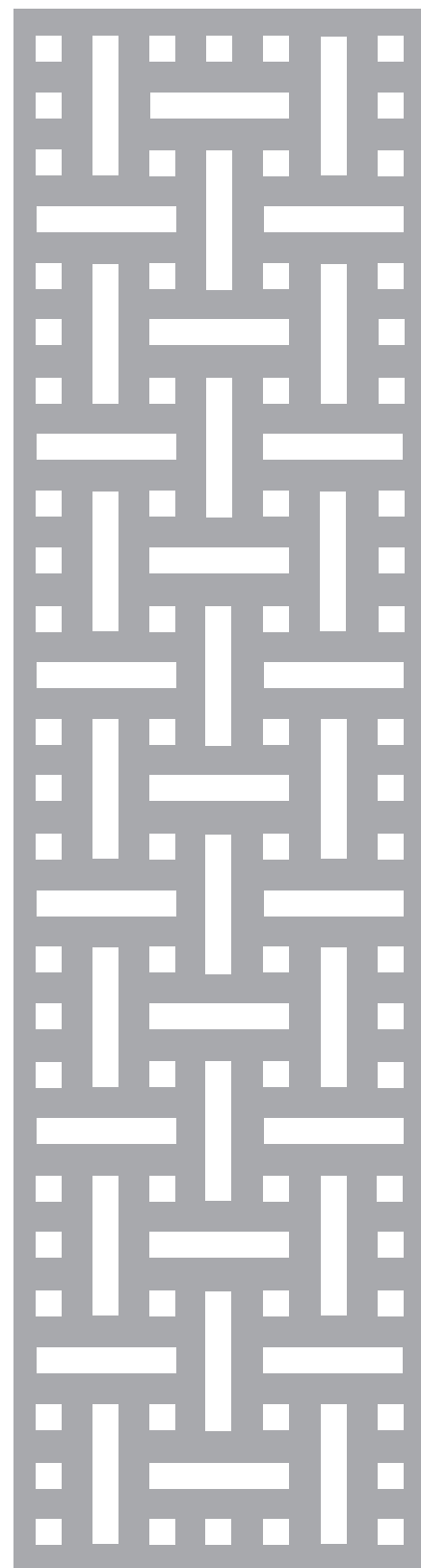
Asset Integrity continues to be the main focus of interest for PDO, in order to maintain the old facilities in optimum condition to last longer, as well as the implementation of Asset Integrity Management for the new plants to guarantee many years of good performance. Partex's contribution has been always present and will continue in this area, through the participation of highly skilled seconded professionals for special requirements (projects, audits, inspections, etc.).

Partex's contribution to HSE projects stands also in terms of providing Human Resources in order to support more difficult levels of operations.

#### WATER MANAGEMENT

Associated Water Production is increasing, its handling and treatment is becoming more complex, being vital for oil recovery optimization. Partex technology can contribute to the improvement and optimization of: (1) design philosophy and timely delivery of injection clusters; (2) water injection quality in low permeability reservoirs; (3) management of produced water, including prediction of rates and the treatment needed prior to injection and (4) evaluate the re-use of produced water for human and agricultural purposes.

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