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GEO ENeRGY

Promoting *R&D capability* in the service of European Industry

E&P - a diversity of opportunities and challenges

In this edition of Geo-Energy the diversity of opportunities and challenges facing the "geo-energy" supply industry in Europe are clearly revealed. Exploration and production of oil and gas in deepwater environments, from the Atlantic Margin to the eastern Mediterranean, are high among them. It is clear that the further development of European technical capability will not only win Europe valuable supplies of oil and gas from its indigenous reserves but also ensure that European firms are well placed to win in the increasingly important "deepwater" market world-wide.

However, with the emergence of new exploration and production opportunities comes new responsibility and challenges for industry with respect to the environment. Public perceptions, track record, achievements and the work still to be done by the exploration and production industry are explored, together with the role that the European RTD community can play.

The European Upstream Oil Industry and the Environment

The public has always perceived the oil industry as rich. However, with growing environmental awareness, it is increasingly being seen as both rich and dirty. This paper examines the environmental issues related to European oil and gas production followed by an account of the global warming issue.

Oil and gas production

Offshore production facilities, such as in the North Sea, are increasingly blamed for polluting the sea with oil and cuttings, while onshore production is blamed for polluting vast areas with oil from leaky pipes. Attention is also drawn to the wasteful flaring of large amounts of hydrocarbons while the decommissioning of old production facilities are presented as posing a large problem for the environment.

The facts of the matter are somewhat different. Offshore oil spills from production facilities are very rare. Even so, oil spills during drilling in the North Sea are only 15% of their level a decade ago. In addition, the use of oil-based drilling fluids has been dramatically reduced and when they are used the fluids and oil-bearing cuttings are increasingly re-injected into reservoirs in the sub-surface. Discharge of produced water in the North Sea continues to be reduced. The majority of produced water is now re-injected into reservoirs, and the minor amount of water discharged into the sea is cleaned to such high specifications that it poses no problems to the marine environment.

Most oil pollution occurring at sea is the result of illegal dumping of oil products from transport ships. The problem here - and it is a serious problem - is the lack of air/satellite surveillance (i.e. it is difficult to prove which ship was responsible for dumping oil, typically occurring at night) and international shipping legislation. Onshore pollution from oil spills while drilling and producing hydrocarbons onshore is very low in Europe. Drilling and production activities in EU countries are tightly regulated, both with respect to environmental and visual impact. The Wytch Farm oil field in southern England is a good example of successful hydrocarbon production in an environmentally sensitive area. Not only is the environmental impact extremely low, but the facilities have been located so as not to interfere with bird life. The visual impact has also been kept to a minimum by surrounding the installation with trees.
The Prinos oil field in northern Greece is another good example. Located less than 3 km offshore from Thasos Island, one of the best seaside resorts in Greece, the environmental impact of the oil field is minimal. The beach has been awarded the EU 'Blue Flag' of quality.

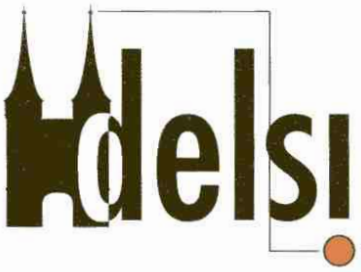
Flaring of gas does occur from offshore production facilities, but this too is being reduced. The main reason for this is the need to conserve reservoir drive energy, i.e. the majority of gas not piped to shore is re-injected into the reservoirs. As a result, flaring is only permitted for reasons of safety, and in a very limited number of cases where the gas is unsuitable for transport (e.g. H2S-rich gasses). Gas which was previously flared, is now put to good use providing on-site process energy. Europe has been particularly successful in reducing CO2 and methane emissions from oil and gas production. For instance, when producing a ton of oil or equivalent amounts of gas, European emissions are less than half of the emissions in the USA, and less than a quarter of the emissions in Russia.
Decommissioning of old offshore installations has received considerable media coverage over the last few years due to the Brent Spar. It is a fact that many North Sea installations in mature fields will become obsolete in the coming decade. The majority of these installations present no or very little environmental risk. These include most wellhead platforms as well as many production platforms without storage facilities.
The environmental problems associated with decommissioning these facilities are very similar to the scrapping of ordinary ships. However, a small number of facilities do present decommissioning problems: very large concrete structures (difficult to move) and facilities with storage capacity (e.g. Brent Spar). There is no doubt that the oil industry is seriously committed to solving these problems in an environmentally and socially acceptable manner. With respect to future production, much of this will take place using FPSOs (Floating Production, Storage,

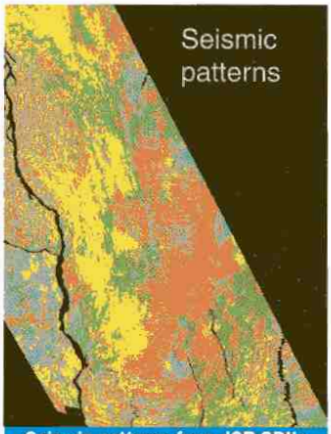
(Continued on page 2)

EUROPEAN UNION PUBLICATIONS

The European Commission has published four new flag brochures on innovative technologies supported by the THERMIE programme.

Brochure No. 200 describes DELSI, a state of the art software package for seismic inversion based on the innovative algorithms released by the laboratory of Seismics and Acoustics of Delft University of Technology. The software development was carried out at TNO following well established (IEEE) software engineering procedures. The DELSI software has been released in modules, each of which is part of a new generation of seismic processing methods: the DELPHI Scheme. These modules have been tested by TOTAL and successfully compared to conventional processing modules.





Seismic patterns from dGB-GDI's software modules

Brochure No. 201 describes dGB-GDI's software portfolio which comprises a set of object-oriented software modules for integrating, analysing and quantifying geoscientific information. The software is used for seismic applications such as lateral prediction and seismic pattern analysis, rock-physics analysis, and generally any type of quantitative interpretation. Project collaborators include TNO and SINTEF.

Fugro Engineer's EURIPIDES project, on the limits for the safe and economic design of offshore pile foundations in North Sea dense sands, is described in brochure No. 204. Life-size load tests and comprehensive instrumented pipe piles at Eemshaven in the Netherlands proved that short piles have a significantly higher bearing capacity than designs based on the API criteria.

Load tests in Eemshaven

Brochure No. 205 details AEA Technology's project on advances in downhole computer modelling. The project successfully demonstrated the ability of the MCBEND Monte Carlo Code to predict the response of commercial density tools in realistic downhole conditions. The primary aim of the project was to establish the accuracy of porosity determinations which are derived from density tool measurements in difficult environmental conditions. The method has been used to help in understanding better the causes for tool responses observed for different tools in the same or similar borehole conditions.

These publications can be obtained by faxing or e-mailing your request to Jonathan Shackleton at CMPT.
Fax: +44 (0) 1224 706601.
E-mail: j.shackleton@cmpt.co.uk

The Atlantic Margin
- challenges for deepwater exploration and production

In the oil industry's drive for new reserves, there is an increase in world-wide deep water field developments ranging from 90m - 120m of water to the ultra deep (over 2,700m of water) especially in the Campos Basin, offshore Brazil. In north-west Europe, deepwater activity has increased in the Atlantic Margin from west of Ireland to offshore Norway. Field developments in these harsh environments promise to pose a number of technological challenges. New deepwater prospects offshore the Faroe Islands are also on the horizon.

Of the technology challenges of the Atlantic Margin, four key areas are highlighted here:

- offshore structures and facilities;
- downhole technology;
- environmental issues;
- exploration technology.

The challenges posed by deep water are enormous. This calls for cohesive action through joint industry partnerships akin to those already in place for the Foinaven and Schiehallion field developments led by BP. In the UK a number of joint industry groups have been set up to address the challenges facing operating companies.

- The Atlantic Margin Joint Industry Group (AMJIG) for Facilities and Infrastructure, co-ordinated by CMPT.
- AMJIG for Well Technology, co-ordinated by the DEA (Drilling Engineering Association)
- AMJIG for Exploration.
- Atlantic Frontier Environmental Network (AFEN).

The main issues today are in meeting the challenges of reducing the total CAPEX and OPEX through advanced and innovative technologies, improving performance and reducing rig time in the harsh environment of the Atlantic Margin.

Data available to date show that UK oil reserves West of Shetland are about 48% of the country's total; the equivalent for gas reserves is over 44%. These reserves will have an enormous impact on the European market far beyond the millennium.

Currently about 40% - 60% of deepwater development costs are attributable to the drilling and completion programmes. Advanced drilling and completion strategies are therefore required to improve performance and reduce rig time. The challenges posed include the problems of:

- High pressure and high temperature. - This type of environment will stretch the limit of current technology in terms of drilling/completion fluids technology, downhole tools/materials technology especially packers, safety valves etc., well control, etc.
- Reduction in the number of wells drilled through the possible use of multilaterals and trilaterals and possible quadlaterals. These will optimise the time spent on development work and reservoir depletion.
- The drive towards intelligent completions.

Enormous challenges will be posed by the advanced completion and well intervention techniques required for such special wells, especially for subsea completions.

Production systems are key to successful field developments. In deeper waters, the challenges posed by the use of floating, production, storage and offloading vessels (FPSOs) and tension leg platforms (TLPs) will have to be reviewed in line with specific local experience in terms of water depths and reservoir performance requirements. The potential use of riserless systems coupled with subsea separation facilities are proving to be an attractive alternative and are likely to require more detailed study.

The need for the application of advanced technology in locating hydrocarbon deposits in deepwater areas is more urgent. Over much of the area the explorationist has the difficult task of imaging, using seismic technology, beneath thick piles of volcanic rocks. The latest developments on 3-D and 4-D seismic exploration and other 'smart' techniques will need to be extended and upgraded.

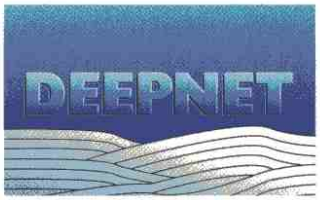
Experiences to date show that there is now a more urgent need for the development of a strategic approach to RTD in tackling the special problems of the deepwater environments. A proposal to establish a knowledge network known as DEEPNET (see below) to be co-ordinated by The Centre for Marine and Petroleum Technology (CMPT) is therefore welcomed. Other global initiatives include DEEPSTAR (USA, Gulf of Mexico), PROCAP 2000 (Brazil), HOST 2500 (Norway), and WADO (West Africa).

For further information contact Dr M Babs Oyeneyin, Robert Gordon University.
Tel: +44 (0) 1224 262327.
Fax: +44 (0) 1224 262333.

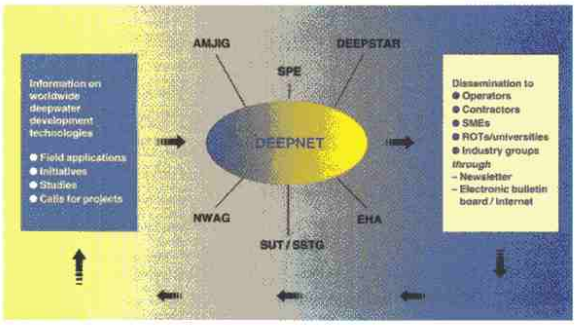
DEEPNET - a new network for deepwater technology

The Centre for Marine and Petroleum Technology (CMPT) recently hosted a meeting to discuss the establishment of DEEPNET, a global network of deepwater and hostile environment knowledge.

Increasing exploration and development in deepwater and hostile environments has put significant pressure on technology to overcome the many challenges that these environments present. The oil and gas industry has generated several initiatives (associations, programmes, projects, etc.) to address the needs of specific interest groups, but many of these have concentrated on a specific technology or geographical areas.
CMPT believes that significant benefits will be gained by exchanging knowledge and resources between these, and other initiatives.



DEEPNET will seek to be an independent and complementary information exchange network for industry representatives focused on improving communication on deepwater technology. The network will be open to oil and gas companies, manufacturing and supply companies, government departments, research and technology organisations and university departments world-wide. The ultimate goal is the faster development of new technology solutions for the oil and gas industry.



CMPT has been encouraged by Shell, BP, Texaco, Conoco, Petrobras and NPD to proceed with establishing the basis for the network and approaching companies to join. The joining fee has been provisionally set at £1000.

Interested organisations should contact Irene Hepburn, CMPT Aberdeen.
Tel: +44 (0) 1224 853400.
E-mail: i.hepburn@cmpt.co.uk.

The Greater Eastern Mediterranean Region
-a new frontier area for hydrocarbon exploration

The 250 km wide accretionary mass of the Mediterranean Ridge marks the convergent boundary between the African and European plates, which have been converging at a rate of 10 mm/yr for the last 80 my. Sediments were scraped off the subducting African plate and piled up in front of the Aegean region forming a thick prism of deformed sedimentary rocks.

There is strong debate between geoscientists about the geological character of the region and extensive geological research has been carried out during the last two decades. DEP-EKY, the Greek state owned oil company, in collaboration with European universities and institutes, conducted two relevant geophysical projects partly financed by the EU (STREAMERS and IMERSE). The data they acquired gave constructive ideas about the evolution, the stratigraphy and the tectonism of the area.

As a result the offshore area of the Mediterranean Ridge has been identified as a new frontier for hydrocarbon exploration in the near future, although the water depth (2000-4000 m) will make development and production challenging. Nevertheless the expected hydrocarbon potential is a factor which will attract exploration in the area and subsequent investment in the new technologies for the difficult development and production which lie ahead.

The exploration work undertaken till now by DEP - EKY in the external Hellenides, has revealed numerous structural and stratigraphic trapping possibilities with good source rocks, reservoirs and seals. Recently DEP - EKY announced the awarding of four exploration and production licenses for onshore and offshore exploration in W. Greece. Two areas were awarded to the consortium of Enterprise Oil and Union Texas and the other two to Triton Resources.

The expected traps in the licensed areas include stratigraphic features in Miocene sands, Mesozoic or Eocene carbonates covered by flysch or Neogene clastics, and salt diapirs. Potential for structural trapping is expected in the folded thrust belt area. Deep structures in the prism of deformed strata below the main detachment level of Triassic evaporites, have not yet been explored but are also considered to have promising hydrocarbon potential.

For further information contact Yannis Grigoriou, DEP-EKY. Tel: +301 8095146. Fax: +301 8095306.

The EC Re-launches the OPET Network

JOULE-THERMIE

The OPET network (Organisations for the Promotion of Energy Technology) has been re-launched as a collaboration between the INNOVATION Programme (DG XIII) and the demonstration component of the JOULE-THERMIE Programme (DG XVII). This co-operation between two Directorates-General of the European Commission ensures that the activities undertaken in the Network remain at the technological state-of-the-art whilst also focusing on innovation technology transfer, the exploitation of results and closer collaboration with the market. This focus on working with market actors, such as industry utilities, financiers and public authorities is another key feature of the new Network. The activities of the OPET Network will help its clients make decisions about reducing energy consumption of non-sustainable energies by identifying appropriate technologies which conform to their needs for energy services.

OPETs are now working directly with market actors in their country region or locality to address their needs directly by providing the services they require. In addition to general awareness raising, the focus for the future is to utilise the experience of all the Network through the individual OPETs to help work with local industry commerce etc. to meet their needs for energy services. OPETs will also work as part of a Network throughout the EU to help share experience and transfer expertise and knowledge. In this way the EC expects to achieve some very real and concrete results from this initiative.

For further information on the OPET network contact OPET-CU in Brussels.
Fax: +32 2 743 8931.
email: opet_cu@ecotec.com

GEO-ENERGY is produced by the ENeRG network.
For further information please contact:

Jonathan Shackleton, CMPT, Offshore Technology Park, Exploration Drive, Aberdeen AB23 8GX, UK.
Tel: +44 (0) 1224 853400. Fax: +44 (0) 1224 706601.
E-mail: j.shackleton@cmpt.co.uk

Requests to be put on the mailing list should be sent to the Editor.
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The ENeRG Network

ARMINES, France.
Tel: +33 1 40 51 90 50. Mr T Retsin.

BRITISH GEOLOGICAL SURVEY,
Tel: +44 131 667 1000. Dr C Browitt.

THE CENTRE FOR MARINE AND PETROLEUM TECHNOLOGY, UK*
Tel: +44 131 451 5231. Dr S Brown

CHALMERS UNIVERSITY OF TECHNOLOGY, Sweden.
Tel: +46 31 772 2040.
Prof M Middleton.

GEUS GEOLOGICAL SURVEY OF DENMARK AND GREENLAND *.
Tel: +45 31 10 66 00.
Mr N P Christensen.

ENIRICERCHE, Italy.
Tel: +39 2 520 54 88. Prof F Forlani.

FEDERAL INSTITUTE FOR GEOSCIENCES & NATURAL RESOURCES, Germany.
Prof Hamman.

FORBAIRT, Ireland.
Tel: +353 1 837 0101. Mr G Keane.

GERMAN PETROLEUM INSTITUTE, Germany.
Tel: +49 53 23 71 10. Prof D Kessel.

IKU PETROLEUM RESEARCH SINTEF GROUP, Norway.
Tel: +47 73 59 11 00.

INSTITUT FRANÇAIS DU PÉTROLE, France.
Tel: +33 147 52 66 71.
Mr P Simandoux.

MINING UNIVERSITY OF LEOBEN, Austria*.
Tel: +43 140440 3670.
Dr G Ruthammer.

NATIONAL TECHNICAL UNIVERSITY, Greece.
Tel: +30 17485057. Prof Panagopoulos.

NETHERLANDS INSTITUTE OF APPLIED GEOSCIENCE TNO, The Netherlands.
Tel: +31 152 697 197. Ir M H Mulder.

NETHERLANDS RESEARCH SCHOOL OF SEDIMENTARY GEOLOGY, The Netherlands.
Tel: +31 20 444 7375. Prof S Cloetingh.

ØDEGAARD & DANNESKIOLD-SAMSØE, Denmark.
Tel: +45 35 26 60 11. Mr J M Petersen.

OSSERVATORIO GEOFISICO SPERIMENTALE, Italy.
Tel: +39 40 21 401. Mr S Persoglia

PETIUM, Denmark.
Tel: +45 45254169. Prof J Reffstrup.

PUBLIC PETROLEUM CORPORATION OF GREECE,
Tel: +30 1 80 95213. Mr Y Grigoriou.

ROBERT GORDON UNIVERSITY, SCHOOL OF MECHANICAL & OFFSHORE ENGINEERING, UK.
Tel: +44 1224 262300.
Dr L J Power.

ROGALAND RESEARCH, Norway.
Tel: +47 51 87 53 00. Mr E Bergsager.

UNIVERSITY OF ABERDEEN, OIL & GAS INSTITUTE, UK.
Tel: +44 1224 212336.

UNIVERSITY OF DURHAM, UK.
Tel: +44 191 374 2520.
Dr R Swarbrick.

UNIVERSITY OF LIVERPOOL, UK.
Tel: +44 151 794 5153.
Prof J Watterson.

UNIVERSITY OF PATRAS, Greece.
Tel: +30 61 99 75 74. Prof A Payatakes.

UNIVERSITY OF PORTO, Portugal.
Tel: +351 2 310 290.
Prof M J Lemos de Sousa.

* Member of the Geo-Energy editorial committee