SCANews

The SOCIETY of CORE ANALYSTS

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Message from the President

by ***Jos G. Maas***

I feel privileged to have been elected to serve as your President for the term 2001 - 2002. The Society of Core Analysts provides a great forum for core analysts world-wide to exchange experiences which advance our technology. Our organization is maturing very well, particularly with a growing attendance at our yearly Symposium, while we still see that members easily can further extend their network in an informal atmosphere.

We live in very troubled times and the tragic events of September 11th had also their immediate impact on the Symposium in Edinburgh less than a week later. Many registrants let us know they were not sure whether they could attend. The SCA Board faced a difficult decision whether the Symposium would have to be cancelled or postponed. After ample deliberation we decided that we would not want to disappoint members who still planned to join. Jake Rathmell, SCA President 2000 - 2001, opened the Symposium, expressing how Board and membership felt under the blow and requested moments of silence in commemoration of the victims of the brutal attack.

Some presenters and other registrants could not travel, but the Symposium was definitely another successful SCA event with more than 160 participants. I congratulate Xu-Dong Jing and Patrick Corbett and their co-workers on how they managed last minute changes and dealt with the problems behind the scenes. A review of the symposium is presented elsewhere on the website. At this place, I like to congratulate Dr Paul Worthington who was awarded the SCA's year 2001 Distinguished Technical Achievement Award during our Annual Meeting. In his acceptance speech, Dr Worthington dedicated the award to the people who lost their lives in the tragedy in the US. A high note was the presentation of the SCA 2000 Best Paper Award to Gerald Hamon and Clement Roy for their paper SCA 2000-23 "Influence of heterogeneity, wettability and core flood design on relative permeability curves".

About three weeks after the Symposium, the SCA Board and members were shocked at the news that our member and dear friend Carlo Venturini had died in the plane crash at Milan airport, Monday October 8th. Carlo was a great colleague, supporting the SCA in particular through his activities as member of the Technical Committee, reviewing for many years abstracts and papers for the Symposium. We will miss him dearly and our thoughts are with his wife and two children.

The present uncertain times impact on the economies of the world, but I will not speculate on how our industry may be affected. I would rather discuss how the SCA would advance. Personally, I get worried to see how many contributors at our Symposia just take it for granted that the business impact of their work is understood. This is a dangerous practice. It is really no wonder that the same core analysts observe with pain: "if only our management would understand the value of our data". As SCA we have here a role to play and I am very happy that the new VP Technology Dan Maloney has chosen as Symposium Theme **"Reducing Risk Through Core Analysis"**. Not only should this prompt us all to bring out explicitly in our papers the business impact of Special Core Analysis data, but also the Proceedings may serve to better explain to all powers that be what the value of our information is. Our future is to a large extent in our own hands!

I hope to see you all at our next Symposium in Monterey, California, USA, September 2002. Make sure to pre-register; the hotels promise to be crowded at that great place at that time of year. Checkout our website, www.scaweb.org, for the latest information!

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Publisher's corner
by ***Marios Ioannidis***

It is an honor and a privilege for me to have been selected to serve the SCA in the capacity of VP Publications. Lutz Riepe has done a tremendous job and he is indeed a tough act to follow!

The challenge of timely communication of our Society's activities is as pressing as ever. The unique value of the work of core analysts must be effectively communicated to wider audiences, if its business impact is to be fully understood, as noted by Jos Maas in his *Message from the President*. This sentiment is reflected in the theme of the forthcoming Symposium: **"Reducing Risk Through Core Analysis"**. Read more about the organization and the technical focus of this exciting Symposium in the *Note of the VP of Arrangements* and the *Call for Abstracts* in this issue of SCAN*ews*.

Also in this issue of SCAN*ews*, Patrick Corbett (VP Arrangements 2000-2001) presents a *Report of the SCA 2001 Symposium*, whereas Xu-Dong Jing (VP Technology 2000-2001) summarizes the presentations and related discussions of the Wettability Workshop in *Where we are on Wettability*.

On a different note, we are working to include the best three or four papers presented each year at the SCA Symposium in a special issue of *Petrophysics*. Stay tuned for papers from the Edinburgh Symposium in the May-June 2002 issue of this journal!

Note of the VP of Arrangements
by ***Jorgen Yogi Vindum***

I am pleased to announce that a contract has been signed with the Best Western Beach Hotel in Monterey, California for our next annual meeting. The hotel is ideally suited for a meeting of our size. We have reserved space so that all attendees can stay at the hotel. The meeting will be from September 22nd (Sunday) to the 25th (Wednesday).

We will start the program with a get together mixer on Sunday night. If the weather cooperates we will have it on the beach. September is usually the best time of year to be in Monterey. However, if the fog rolls in, we will move the party indoors! Monday, Tuesday, and Wednesday have been set aside for the Workshop and Technical presentations. Thursday, September 26th, will be available for an optional field trip. Details of the trip are still to be worked out, but there is plenty of interesting geology to see in the area. We even have a few famous earthquake faults close by. (I can't promise that they will move while you visit, in fact I hope they don't)! The annual SCA dinner will be held at the Monterey Aquarium. No, a sushi buffet will not be on the menu!

The hotel is located right on the beach about 3 miles from Monterey. The San Francisco Airport is about an hour and a half away and the San Jose Airport is an hour away. The hotel can be reached by shuttle from either airport. More information regarding the transportation will be available later. The technical program and technical exhibition will be at the hotel. We will have space for about 20 booths in addition to posters.

For anyone planning to stay in the Monterey area any additional time, there are plenty of activities available. The weekend before has a Jazz festival and the Laguna Seca motorcycle race. There is also deep-sea fishing, whale watching, golf, shopping, nature trails and much more within a few miles. Seals, nesting sea birds, whales and the endangered sea otters can be seen from the Pt. Lobos State Park, a few miles from the hotel.

If you have any questions regarding the meeting arrangements, please do not hesitate to contact me. Additional details will be available in January.

I look forward to seeing you all in Monterey.

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Society of Core Analysts
2002 International Symposium
Monterey, California
22-25 September 2002

Theme: Reducing Risk Through Core Analysis

Call for Abstracts

We invite you to submit abstracts for the following sessions:

1 **Case Studies** - Papers that demonstrate how core analyses reduced uncertainty, avoided failure, captured opportunity (or could have…)
2 **Mechanistic Modeling** - Descriptions of core analyses that identified, predicted and/or resolved production issues
3 **Reservoir Condition Core Analyses** - Examples of when/why testing with live fluids makes a difference
4 **Wettability Determination/Restoration** - Practices and Recommendations
5 **Displacement Mechanisms** (Pc, kr methods and analyses)
6 **Residual Saturation/Resistivity/Log Calibration**
7 **Pore Scale Modeling**
8 **In-Situ Saturation Imaging and Advances in Core Analysis Technologies**
9 **Building upon the Foundation** - Knowledge gained from the SCA literature that made a difference

ABSTRACT DUE DATE IS 18 January, 2002.

Please note that **abstracts may only be submitted electronically** through the SCA website using the electronic ABSTRACT SUBMISSION form at **www.scaweb.org**.

For information, contact Dan Maloney, SCA VP Technology (drmalon@ppco.com).

2002 Society of Core Analysts Technical Committee

Dan Maloney, Phillips Petroleum Company
Xu-Dong Jing, Shell International E&P
Jill Buckley, New Mexico Tech
Patrick Corbett, Heriot Watt University
Louis Cuiec, Institut Francais du Petrole
Gerald Hamon, Total Fina Elf
Apostolos Kantzas, University of Calgary
Norm Morrow, University of Wyoming
Gene Spinler, Phillips Petroleum Company
Andrew Cable, AEA Technology
Ole Torsaeter, NTNU
Jos Maas, Shell International E&P
Ercan Ozer, Core Laboratories International
Doug Ruth, University of Manitoba
John Shafer, Reservoir Management Group
Colin Jones, Heriot Watt University
Iain Hillier, Baker Hughes INTEQ Sunbury
Gary Jerauld, BP
Bernie Baldwin, Green Country Petrophysics
Liviu Tomutsa, LBNL
Amy Chen, ExxonMobil Upstream Research
Edward DeZabala, Chevron Texaco
Arne Skauge, Norsk Hydro
Cliff Black, BP
Jon Knut Ringen, Statoil
Jaram Kamath, Chevron Texaco

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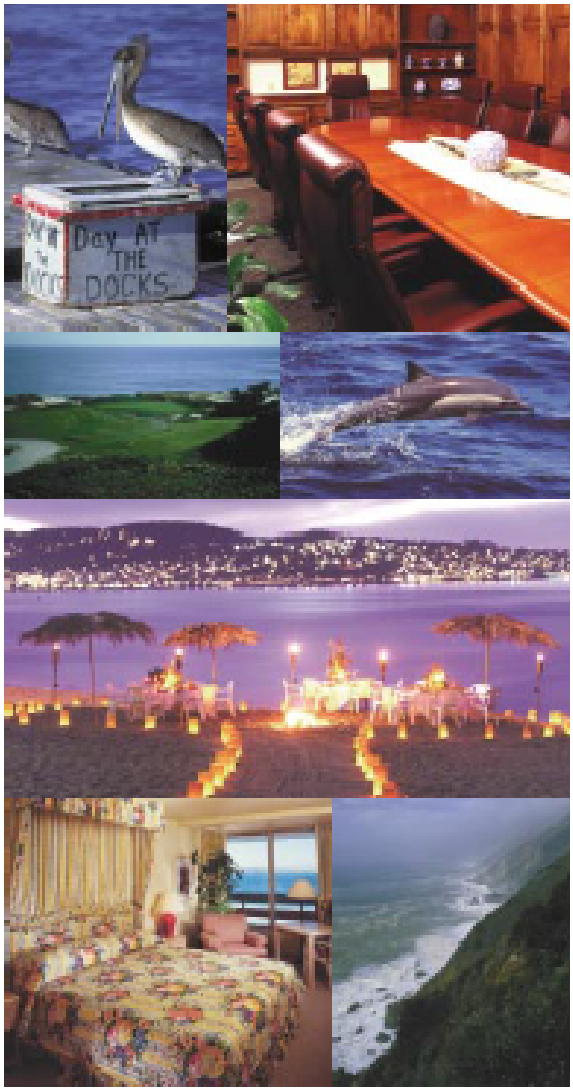
Monterey, California, USA



Dates

Sunday, 22 September through Thursday, 26 September

(An optional field trip is planned for Thursday, 26 September)

Location

Best Western Beach Hotel, Monterey, California (near San Francisco. Shuttles are available from the San Francisco and San Jose airports) the hotel is located on the each about 2 miles northeast of Monterey.

Events Planned

- ✓ Evening mixer on the beach
- ✓ Awards Dinner at the Beautiful Monterey Bay Aquarium

Keep watching the SCA web site for additional details. If your company would like to sponsor a portion of this event please contact us:

Phone: +1.925.275.0633, Fax: +1.925.275.9697, E-Mail: events@Vindum.com

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Report of the 2001 SCA Symposium

by ***Patrick Corbett***

The 2001 SCA International Conference started on a somber note with a period of silence in memory of the tragic events in the US the week before. The disruption to travel arrangements impacted the run up to the conference with many cancellations, however, the Board were determined to continue with the meeting.

Early registrations were stronger than expected reaching 190. However, 49 had to subsequently cancel, but late registrations rallied numbers to a final total of 162 delegates.

The preceding Sunday saw a workshop on Wettability and a Field Trip to the nearby Scottish Coast. These technical icebreakers made sure that the meeting got off to a good start. Murrayfield Stadium proved to be a good choice the intimate atmosphere created by adjacent lecture room and exhibition/poster area proved popular. The historical review of Relative Permeability by Prof. John Archer and the current context by Prof. Martin Blunt, Prof Mike Christie and Dr Gary Jerauld provided a very thought provoking keynote session once the technical sessions got underway. Dr Paul Worthington was awarded the SCA's Distinguished Technical Achievement Award dedicating it to the people who lost their lives in the tragedy in the US. The main technical programme included 30 oral presentations and 25 posters covering fundamentals of flow in porous media, core analysis data acquisition and integration for field studies.

By way of light entertainment – a visit to Dynamic Earth helped the delegates appreciate the wider significance of an interest in cores of rocks – Dr Stuart Monroe spoke with enthusiasm of the importance of science (and particularly Geoscience) to Scotland's past and future.

The significance of the location was clear to all when the Scottish Rugby Team appeared to practice. In case anyone is wondering – Scotland produced one of their finest performances in recent times on the Saturday after the conference to trounce the Irish! That means the SCA should have no problems being invited back.

The organising committee would like to take this opportunity to thank everyone involved in making the meeting a success. The Holiday Inn's understanding of and sensitivity to the International situation was particularly appreciated. Our meeting sponsors: Baker Hughes Inteq, Enterprise Oil, Ergotech, ExxonMobil, Hays IMS and Shell are also thanked for their support.

Where We Are on Wettability

by ***Xu Dong Jing***

One of the technical highlights of the SCA 2001 Symposium was the highly successful workshop on the study of reservoir wettability and its related field applications. On behalf of the symposium organizing committee, I would especially like to thank Prof. Ken Sorbie of Heriot-Watt University for putting together such a strong, balanced and interesting workshop programme, and for chairing the day's presentations and discussions. I would also like to thank Dr. Gary Jerauld of BP for summarizing the main technical points of the workshop and presenting them to the main conference during the keynote session. This report is an extract from the presentation slides from the workshop. Interested readers are encouraged to contact the authors directly for more technical details.

The workshop featured six presentations:

- Wettability and the Efficiency of Oil Recovery by Waterflooding – Norman Morrow, University of Wyoming
- Crude Oil/Brine/Rock Interactions that Alter Wettability - Jill Buckley, PRRC
- Wettability as a Major Factor in Special Core Analysis - Jos G. Maas and X.D. Jing, Shell Intl. E&P

- Wettability And Spreading: Upscaling Of Microscopic To Core Scale Properties - Michel Robin, IFP

- Analysis of Unsteady-State Water Injection at Different Wetting Conditions – Arne Skauge, Norsk Hydro

- Wettability Effects in Three-Phase Systems - Ken Sorbie, Heriot-Watt University

Jill Buckley presented the first two talks one of which on behalf of Norman Morrow who could not make it to the meeting in time due to the travel restrictions following the events of September 11. Norman Morrow highlighted that wettability is fundamentally important to waterflood performance, but it has long been misunderstood resulting in poor reservoir engineering. Steady progress has been made over the years in understanding reservoir wettability. It's now generally recognized that extreme cases of strongly water wet and strongly oil wet do not bracket all other possible wetting conditions, which depend on rock, crude oil, brine, Swi, aging temperature, aging time, and displacement temperature conditions. The behavior of continuous films of the wetting phase is important in understanding oil recovery in mixed–wet systems. The rate of imbibition is found to be a better measure of wettability than the traditional Amott index, which is often not sensitive enough in complex wetting situations. Dimensionless scaling groups have been proposed to correlate imbibition rate to rock and fluid properties. An interesting example of using low salinity brine to increase waterflood oil recovery was presented, and a pore scale wettability mechanism was proposed.

Jill Buckley focused on the understanding of the physics and chemistry of crude-oil brine interactions and their control on the wetting state of crude oil/brine/rock systems. The role of asphaltenes was highlighted as key to wettability alterations. An overview was given of state-of-the-art experimental techniques for characterizing complex wetting systems: measuring hysteresis between receding and advancing contact angles by Wilhelmy plate techniques and Atomic Force Microscopy (AFM) for measuring the thickness of adsorbed organic layers and their distributions on selected mineral surfaces as a function of pH, salinity and crude oil type. Salinity and pH are fundamental controls on wettability according to DLVO analysis. Acid and base numbers were found to be uncorrelated but both are important factors influencing reservoir wettability. Asphaltene stability can be correlated with RI/Solubility parameter and is important to wettability. Studying these fundamental properties has lead to steady improvements in experimental procedures and in building effective analogues to aid further investigation.

Michel Robin presented IFP research developments on using microscopic visualisation techniques on model systems to uncover the physics necessary to derive pore-level models that could ultimately predict core-floods. He covered cryo-SEM, ESEM and Wilhelmy plate techniques. An example was shown to indicate that kaolinite becomes oil-wet (after exposure to crude oil). With the aid of detailed microscopic visualization, the distribution of apparent contact angles, contact angle hysteresis and possible correlation between wettability and pore-size have been studied. He also discussed upscaling issues from pore, to core and then to reservoir scales showing the importance of taking wettability into account through the process.

I gave the talk on behalf of Jos Maas who arrived at the conference venue *only* two-hours too late after a tortuous journey of more than two days to finally succeed in finding the flight connections from Houston to Edinburgh. An overview was presented on why and how wettability affects relative permeability, residual oil saturation and capillary pressure. It is clear that changes in wettability can bring about changes in relative permeability of an order of magnitude or more. We then discussed laboratory procedures that should bring about a wettability state that is representative of the field. Although no consensus exists in the industry on how to prepare samples at the correct wettability, a pragmatic way forward is suggested to deal with the lack of detailed information on in-situ wettability.

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The procedure of restored core analysis involves drilling, shipping and handling core materials as if preserved cores are required. Following the appropriate cleaning (often multiple solvents needed) and aging at reservoir temperature (using CAPRICI – simultaneous measurement of Pc, Kr, resistivity over time to assess the aging process), a combination of experiments, typically steady-state and centrifuge to Kro ~ 10^{-5}-10^{-6} range, is always recommended. Multiple pressure taps along the core length and accurate in-situ saturation monitoring using X-rays should be used in coreflood experiments. History matching of centrifuge and coreflood experiments using a numerical simulator to unravel the effects of capillary pressure and relative permeability has become a routine procedure at Shell Rijswijk.

Arne Skauge highlighted the importance of considering uncertainty bounds on Kr, Pc measurements. The effect of flow rate on water-oil relative permeability has been analyzed from unsteady-state displacements performed on intermediate-wet sandstone reservoir cores. Several methods, both analytical and numerical have been applied in order to derive relative permeability. They have generated an extensive high-quality data set which demonstrates a number of features: with in situ saturation monitoring simultaneous Kr and Pc can be determined, 80% of the time dynamic Pc is different from static Pc; and rate dependence clear in mixed-wet cores. It is still unclear which dimensionless groups or criteria can be used to properly scale relative permeability to reservoir conditions. The results show that the derived relative permeability is influenced by capillary pressure even at rather high flow rates. He recommended low rate displacement analyzed by simulation and including capillary pressure as the best method to estimate relative permeability for intermediate-wet cores

Ken Sorbie presented the current state-of-the–art in using pore network models for understanding dependencies of Kr and Pc on saturation in three-phase flow. Most existing three-phase models focus mainly on strongly water-wet or oil-wet systems. His group at Heriot-Watt has been developing a network simulator for capillary-dominated three-phase flow in porous media where the wettability varies from pore to pore. Reduction of phase continuity in weakly wetted pores has required incorporation of double and multiple displacements for mobilization of disconnected phase clusters. Many important conclusions can be drawn from simple models, e.g, gas can be more wetting than water in many practical situations. Their model predicts that all three Kr and Pc curves depend on two saturations and hysteresis effects exist in all three Kr curves. A WAG injection cycle is simulated for which the saturation path is recorded along with the statistics of the corresponding phase occupancies and displacement mechanisms.

In summary, many advances have recently been made in the area of understanding reservoir wettability. For example, it is now generally accepted that most oil reservoirs are not strongly water wet and mixed wetting can lead to drastically different displacement mechanisms and hence recovery factors. However, the industry as a whole is still facing many technical challenges in characterizing reservoir wettability (both its spatial variation at initial reservoir conditions and its possible dynamic or temporal variation during production as a result of changes in P&T and fluid conditions) and its impact on hydrocarbon recovery. There is an urgent need to reduce wettability information to simple, measurable pore-level wettability rules, and to establish reliable procedures (core or log based) to determine reservoir wettability rapidly and know when and how close we have reproduced it in laboratory SCAL experiments.

As highlighted in Norman Morrow's presentation, a continuing industry research effort is needed in core recovery, cleaning, and test procedures – this can accompany specific reservoir studies. The reservoir wettability problem will probably never be completely solved - individual reservoirs will usually present specific cases. A combination of experimental and theoretical studies is needed to identify the mechanisms that control oil recovery. Continued industry collaboration, particularly through provision of rock and crude oil samples, is essential.