

AL HAJAR

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Geological Society of Oman - Newsletter
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President's Message

My Fellow GSO Members,

It is my pleasure to bring to you the new Al Hajar edition that carries articles, news and society updates. The GSO continues to consolidate its steps as a prominent member of the scientific community regionally and internationally. Let me first shed some light on the latest local GSO activities. In addition to the normal GSO talks and field trips, the society is involved in three different projects.

The first and really of high significance is the preservation of geological heritage sites. Localities such as the silicified wood, rudists, coral garden and many others are at risk of disappearing due to abuse from geologists, tourists and the general public mainly because of negligence and lack of awareness of their importance. In this regard, the society is playing a major part in a committee setup by the Council of Ministers to draft legislation and methods to protect these sites.

The second project, which is moving in parallel to the first one, is the geological

section in the Natural History Museum. This project falls under the jurisdiction of the Ministry of Heritage and Culture. The society is involved in the initial setup, providing expert advice and some rock and fossil samples.

The third project which is also related to the GSO adopted theme "Geology is My Heritage" is the shooting of a documentary film about Oman's geology. The film is a joint effort between the Ministry of Information, the GSO, and some oil companies. Professor Ken Glennie is also participating in the making of the film.

You also may have notice by now the launching of the Geosciences Directory. This is a database for all GSO members in which members can update their contact details and search and contact other fellow members. We are also in the process of developing the system to handle membership payments, donations and executive committee election.

On another front, Al Hajar will bring you a series of articles themed 'Portrait of an Area'. Each article will focus on a geological area in Oman and give a

brief summary of its geological history and significance.

Further, in the context of Al Hajar, the executive committee addressing the cost of printing hard copies, has agreed to go digital. Many GSO members do not have a valid mail address and consequently many of the printed copies end up undistributed. This is wasteful and expensive, hence in future Al Hajar will be brought to you as a high quality PDF file that can be downloaded from GSO website and/or printed. This process is environmentally friendly and will enable us to increase the frequency of editions being more cost efficient.

I foresee a very bright and challenging future for the Society. GSO will need the support of each one of you.

Regards,

Dr. Mahmood Saif Al Mahrooqi
GSO – President

Note from the Editor

Welcome to the 13th edition of Al Hajar.

Firstly, my many thanks to John for a seamless and professional handover. I can only hope to build on the excellent example that precedes my involvement.

You will notice some changes! We are trialling a digital only delivery. This is for a number of reasons, namely: environmental, cost and speed of turnaround. In future we'll aim to issue a bi-monthly note – and as always your contributions are very welcome. Please contact me if you would like to submit an article or even to request coverage that interests you.

It's your publication!

In this edition, in addition to our standard Geologically Speaking and International News columns we also have a field trip report from the Wadi Daiqa & Amdeh trip run in November, a report from the Water Resources & Climate Change conference and an environmental article – there's no excuse for not knowing the name of that tree or bird from now on! Sadly, we also run an obituary for Hugh Wilson, one of the great fathers of Oman geology and an enthusiastic campaigner for his interpretations! Sincere thanks to all who have contributed.

I very much hope you enjoy this edition

and again, please contact me with any suggestions for articles (or improvement even), queries or comments.

Best regards,

Caroline
GSO- Editor

Geologically Speaking

Geodiversity



Permian Saiq Formation unconformably overlying Amdeh Formation, Wadi Amdeh. Photo: Juma Al-Belushi

In the last issue of AL HAJAR, I talked about conserving Oman's geological heritage and GSO's achievements within the topic. In this issue, I thought of introducing the reader to the concepts of geodiversity and geological conservation that are well practiced in the western part of the world. My objectives are two fold: to introduce the reader to the concept, improving his basic understanding, and then to encourage the readers to adopt some of these concepts in their daily practice.

Geodiversity can be defined simply as "the natural range (or diversity) of geological (rocks, minerals, fossils), geomorphological (land form, physical processes) and soil features. It includes their assemblages, relationships, properties, interpretations and systems" (Gray 2004).

With the spectacular and rich geology of Oman, geodiversity is about every thing we do in our daily lives. One can make an exhaustive list of threats facing many of the geological sites of special interest here in Oman. For this short summary, one cannot afford not to mention some of the imminent threats such as new road construction and associated cuttings, urban impacts both within or adjacent to these sites, excessive off-road driving and creation of new car tracks, inappropriate recreational activities, poaching and unauthorised fossil and mineral collecting. These human impacts may result in partial or total loss

of, or damage to, important rocks, minerals, or fossils, remodelling of natural topography, loss of access or visibility, interruption of natural processes, pollution, or visual impacts.

There are many ways in which we benefit from geodiversity. Appreciation of geological features is one that is obvious

and rock specimens whether in commercial or personal collections. Many natural processes, which as mentioned earlier are part of the geodiversity, can provide a number of essential services such as water supply.

Geodiversity is a wide topic and cannot be covered in this short column. I



The Jobah granodiorite basement outcrop, Al Jobah, Northern Huqf. Photo: Juma Al-Belushi

to the public, tourists and specialised visitors. Those who enjoy their weekends wadi bashing or visiting the many scenic sites of Jebel Akhdar will know what we mean by geological appreciation. The study of geological features enables the scientific community to understand the evolution and history of the planet hence improving our knowledge of our planet. In this regard, Oman meteorites have contributed to the understanding of the other planets around us. We also can benefit from the products associated with many of these geological features such as fossils, minerals

hope that in future, we can cover this in more detail as well as the conservation aims and objectives of the eight elements of geoconservation. I would like to leave the reader with a reminder to please appreciate nature as much as you enjoy it. Please be mindful of the many treasures of Oman's rich geological heritage. Adopt a conservation mindset and the next time you're on a fieldtrip, please practice your geoconservation skills!

Juma al Belushi
BG (Oman)

Obituary

H. Hugh Wilson (10 April 1925 – 14 October 2007)

Still Challenging Myths?

Hugh Wilson was Exploration Manager for Shell in Southeast Arabia when oil was discovered in Oman. I came across his obituary recently[1] and was prompted to share some of his memories, photographs and geological beliefs that he included in a long letter in 2006. Extracts from his letter are in italics below.

'In December 1961 I was called off my end (Guatemalan) contract vacation to report to The Hague to discuss my future assignment with the Group. Willy Leutenegger, the Group Chief Geologist, advised me that I was to be appointed Exploration Manager for Shell's operations in Kuwait, Qatar and Oman. Somewhat theatrically, Leutenegger concluded this interview by saying – "Wilson, the future of Shell's exploration rests on your shoulders!"

I arrived in Doha on 4th January 1962 and on the 5th February left for my first field trip to Oman in the company of Don (Ziad) Beydoun of PARTEX and Cliff Perriam, PDO's chief geologist. This trip took us along the dirt track from Muscat, through the Semail Gap and thence along the mountain front via Nizwa to Ibri. During the next five days we drove through the Umm as Samim sabkha and thence, across the desert, to the Haushi Huqf (Figure 1). From a purely geological point of view, I found the Semail and Hawasina outcrop fascinating, since I had been confronted with the problems of the Steinmann Trinity[2] during four years field mapping in SE Turkey and again in Guatemala in prior assignments for Shell.

In those days Sultan Said bin Taimur prohibited the establishment of a Shell exploration office in Oman, so all the exploration studies had to be confined to the small office in Doha, which also handled the supervision of Qatar and Kuwait activities (Figure 2). PDO's interface

with the Omani authorities was through its Chief Representative, Dick Clough, who resided in Muscat. Clough had to make a monthly visit to the Sultan's residence in Salalah and provide a synopsis of PDO's activities.

When the Iraq Petroleum Company (IPC) exploration of Oman failed in the 1950's with the drilling of Fahud, Ghaba, Haima and Afar dry holes, all partners in the consortium pulled out except Shell and PARTEX (Gulbenkian interest) who stayed to initiate the next phase of exploration with Shell as operator. PARTEX opted to stay on the advice of

tives, especially Mike Morton, and Brock Powers in ARAMCO.

At the same time we initiated a careful study of all cores, cutting and logs from IPC dry holes. Although the IPC seismic coverage did not reveal the buried fault at Fahud, work on cuttings and cores from Fahud-1 carried out by Jean Haremboure, detected strong slickensiding above the Fiqa-Natih contact that suggested faulting. IPC had interpreted that the thickened Fiqa section in Fahud-1 represented a facies change that accounted for the missing upper units of the Natih Formation.



(Figure 1) Hugh Wilson, with their driver Said, in the wadi Boy area of the Huqf, 9th February 1962.

Don Beydoun and Eric Tiratsoo both of whom recognised significant remaining prospectivity. [3]

At PDO in Doha I initiated a regional oil habitat study by gathering as much information as possible on producing fields in Qatar, Abu Dhabi and Saudi Arabia. This involved contacts with IPC representa-

[1] *Journal of Petroleum Geology*, 2008, 31, 327-328.

[2] Close association of serpentinites, basalts and radiolarian cherts.

[3] Eric Tiratsoo went on to found and edit the *Journal of Petroleum Geology* and it was his son Christopher, the current editor, who put me in contact with Hugh Wilson.

Fieldwork at Natih also suggested control by deep faulting and its ovate structural form suggested the possible influence of Ara salt diapirism.

In 1962 a seismic survey was initiated using SSL as contractor. Geophysical interpretation was in the charge of Guus Magnée, our chief geophysicist. Survey work in the Fahud area gave further support for the presence of a buried normal fault (Figure 3). A rather nebulous anomaly was revealed in the Umm as Samim sabkha and 'Head Office' insisted on our drilling Umm as Samim-1 as a follow-up to Yibal.

My recommendation was that we should drill the Natih surface structure and if successful this should be followed up by a second test at Fahud. Both these surface structures were interpreted as reactivated fault blocks at depth, which could provide significant palaeostructural closures. Our studies of oil field structures in Abu Dhabi, Qatar, Kuwait and Saudi Arabia revealed, by isopach mapping, that oil accumulations were closely related to penecontemporaneous trap formation. This is, and still is, in my view the most important criteria in prospectivity rating.

On 2nd April 1962 I led J.J. Dosy, who had taken over from Willy Leutenegger as Group Chief Geologist, on a field trip to Oman (Figure 4). As we climbed about on the Fahud structure, I advised Dosy that my recommendation was that we should test Natih followed



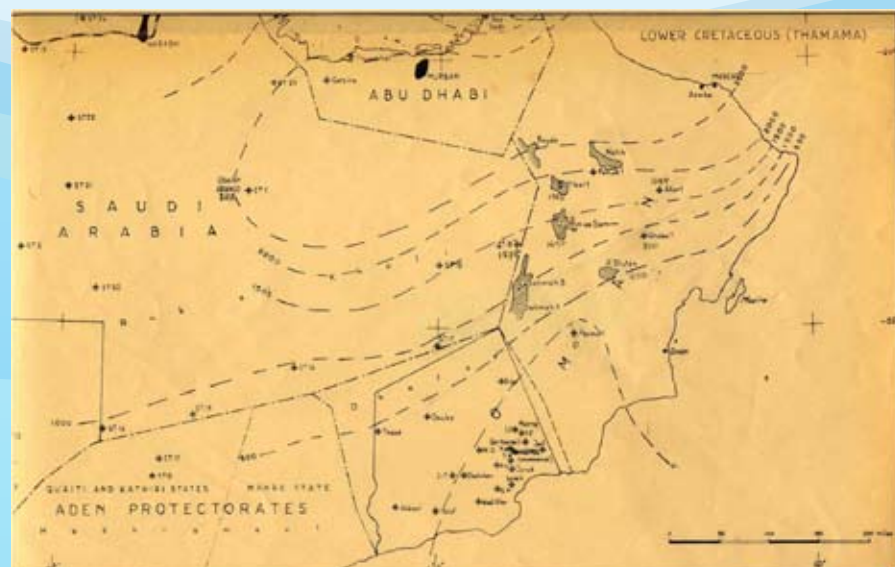
(Figure 2) Doha Bay, Qatar, 1962. The Shell Southeast Arabia Geological Department huts are indicated (and inset).

by a second test at Fahud if Natih was successful. I well remember Dosy's response which was "I don't think we should be drilling any more of these foothill structures after the failure of Fahud-1!" As you know my recommendation prevailed.

On 16th April 1963 a DST at Natih-1 produced 3bbls of oil from the Natih and on 9th July a production test produced 6,500bopd. Fahud-2, spudded on 24th December, had a show in the Natih on 8th January



(Figure 4) J.J. Dosy, Group Chief Geologist, on the UeR 'boulder beds' at Fahud, 2nd April 1962.



(Figure 3) Regional map of oil prospects in Oman by Wilson and colleagues in May 1962. Yibal-1 spudded late March and the Yibal-2 discovery came later in the year. A'Bluten became Al Ghubar, and Rayda, Lekhwair. Contours are gross isopachs of the Thamama Group (Rayda-Shuaiba) in feet.

1964 and in subsequent production testing produced 1500bopd.

After the discovery and appraisal of oil at Natih and Fahud, the decision was made to go into full-scale production. Plans had to be made for the main crude oil pipeline and the locations for the export terminal and PDO's permanent base camp. Planning for these major budget items was handled by the Chief Representative, Dick Clough, and subsequently, by Francis Hughes.

For a proper assessment of prospectivity in the Oman Mountains and foothills it was obvious that we needed better field control than that stemming from the earlier IPC mapping. The Hague provided Peter Llewellyn and Hans Kapp in 1963 to perform this survey. Peter's meticulous field and photo-geological

work resulted in an excellent map with stratigraphical and structural control from field observations. Hans Kapp provided petrological control for igneous rocks. When Peter Llewellyn showed me the surface section in Wadi Mi'aidin, I immediately realised that could provide the key to the stratigraphic relationship between Hawasina deep-water sediments and their foreland time equivalents. In addition to a fully exposed succession of Permian to Cenomanian carbonates, this section also exposed the Muti-Natih contact with the overlying Hawasina succession. The stratigraphic relationship between the Globotruncana bearing Muti clastics which we established by core hole drilling, and the overlying Guwayza clastics is critical to the interpretation of the Hawasina (Figures 5 and 6).

At the end of my four-year contract in Arabia I was transferred to Middle East coordination in Shell Centre, London. I worked for Tony Miller who was the Area Co-ordinator for Qatar and Oman. One of the problems that arose was the supply of fresh water to PDO's future base at Saih al Maleh. PDO's wa-



(Figure 5) Peter Kassler, Jean Haremboure and an Omani assistant above Birkat Al Mawz, January 1965. The road to Nizwa wanders off into the distance.

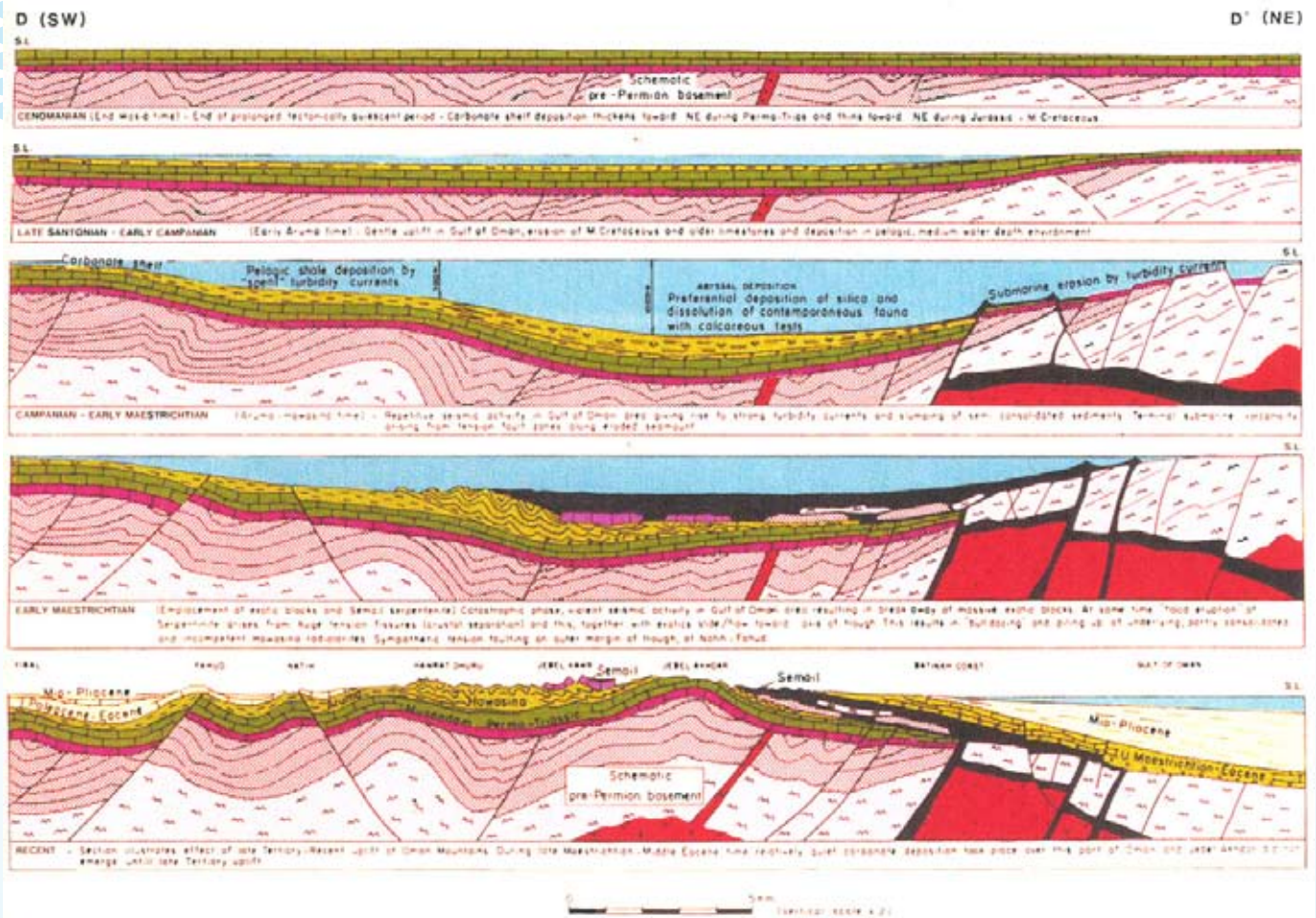
ter well drilling had been unsuccessful and David Barron, one of Shell's Managing Directors, recommended we employ a professional dowser friend of his named Colonel Merrylees. We invited the Colonel to Shell Centre and told him that we would provide a first-class round trip airfare to Muscat if he could do a hydrologic survey for PDO.

Colonel Merrylees said that he didn't need to go to Oman and if we had maps of the area he could do the survey right there in Miller's office. Francis Hughes produced large-scale maps of the Saih Al Maleh area and the Colonel set to work. Out of his briefcase he produced a wooden board with an elastic band across it, put this on his knee and proceeded to twang the rubber band with his left hand. He held a pencil in his right hand, which moved across the map in a series of 'survey' lines. Every so often the pencil jumped and he made a cross on the map. As we watched the performance we were hard pressed to contain our mirth but, for the sake of decorum, we did! After running a whole series of survey lines, Colonel Merrylees announced there were two locations where PDO could find fresh water and he marked these on a map for Francis Hughes. The Colonel said that since we might have some misgivings about his conclusions and since about one in ten people have dowsing ability, he recommended that Hughes should throw a party at the base camp, issue each guest with a dowsing rod, and let them wander about and see if anyone got a reaction.

At base camp, everyone set out and lo and behold someone shouted that his dowsing rod was twitching about. It so happened that this was over the spot that had been marked by Colonel Merrylees and a success-



(Figure 6) Water well rig drilling Core Hole 2 in Wadi Mi'aidin, November 1964. This well drilled and cored 64m of the Fiqa and topmost Natih. A detailed description of the section penetrated was never published and the cores have been lost. Peter Kassler in the blue shirt and Vic Colter in the white shorts.



(Figure 7) Summary diagram from Wilson's (1969) paper. The essence is a 10 km deep basin (geosyncline) formed by crustal extension to the south of the present mountains, catastrophic break away of exotic blocks and eruption of the Semail into the basin bulldozing and folding the poorly consolidated Hawasina towards the south.

Major differences are whether the Hawasina is deposited in 10 Ma of Late Cretaceous time with reworked faunas in it (Wilson) or spans 160 Ma of the Mesozoic (Glennie and others), the Semail as an eruptive flow or a predictably layered sequence of oceanic crust, and in-situ formation of the Hawasina and Semail rather than sequences displaced over hundreds of kilometres. Wilson observed that the major displacement surfaces are not prominent in the field and that he saw more evidence of extension than compression in the Oman Mountains. Glennie (2001) is a spirited critique of most of Wilson's arguments.

ful water well was drilled!

When I left Shell Centre for Australia in 1968 my connections with Oman were severed. However, during my spare time in London and later in Melbourne, I put together a paper on the evolution of the Oman Mountains that was published in the AAPG Bulletin in March 1969 [1] (Figure 7).

Some of his arguments were highlighted in a discussion of Glennie et al's work in 1973[2] and again in a later paper in 2000[3].

Hugh, whom I never met, tenaciously defended his beliefs in a geosynclinal origin for the Hawasina and Semail in Oman, earth expansion (crustal extension) rather than plate tectonics, early biogenic oil

generation rather than the normal geochemical ideas of maturity and expulsion with burial, and that contemporaneously-formed traps are a vital ingredient of petroleum prospectivity, amongst others. His last challenge to AAPG members, ahead of the Athens Conference, was in the letters page of the May 2007 Explorer. There he hoped 'that some of our imaginative members will come forward with serious challenges to the myths (dogma) that govern petroleum exploration interpretations today.'

The obituarist, writing in the JPG, accurately described Hugh as someone who 'steadfastly held minority positions.' But he was certainly right about Natih and Fahud!

Alan Heward
(Petrogas E & P)
alan.heward@petrogas.com.om

[1] Late Cretaceous eugeosynclinal sedimentation, gravity tectonics and ophiolite emplacement in Oman Mountains, Southeast Arabia. AAPG Bulletin, 1969, 53, 626-671

[2] Late Cretaceous nappes in the Oman Mountains and their geologic evolution: Discussion. AAPG Bulletin, 1973, 57, 2282-2298.

[3] The age of the Hawasina and other problems of Oman Mountain geology. Journal of Petroleum Geology, 2000, 23, 345-362 and discussion (by Glennie) 2001, 24, 477-484.

Field Trip Reports

Wadi Daiqa & Amdeh - 23rd October 2008

Leaders: Alan & Felicity Heward

They say that time and tide wait for no man and municipal developments are none too sympathetic either. The prospect of losing the ability to head off to the mountains fishing in the Ordovician and enjoying the elusive lakes of the late Carboniferous stimulated a huge turnout for the GSO's first field trip of the season. Despite the health warnings of long walks and steep climbs an enthusiastic group of 32 were collected en-route to the upper parts of Wadi Daiqa. The impressive dams currently being built above the village of Al Mazari will at some time soon start to collect waters and flood the upper part of this wadi.

Whilst Lake Daiqa is likely to providing a further attraction spot on Muscat's doorstep, it will hide from the geological community a collection of contrasting delights rarely to be seen in such close proximity. The first day of this two day trip concentrated on the upper reaches of Wadi Daiqa where the Amdeh 4 and 5 are well exposed in the base of the wadi and where recent work had demonstrated the presence of a small inlier of Al Khlata.

The trip started with a review of the sedimentology and ichnofabric of the Amdeh 4 quartzites which Rickards et al. (in press) have dem-



The Wadi Daiqa dam in preparation and in the foreground shallow marine sandstones of the Amdeh 4



Cross-stratified quartzites in the Amdeh 4



Skolithos escape burrows

Portrait of an Area – Wadi Daiqa

Geological History

Exposures of the Ordovician Amdeh and Permian-Carboniferous Al Khlata formations outcrop in Wadi Daiqa. Within the Amdeh Formation, preserved fragments of the armoured, jawless fish *Sacabambaspis* have been found. These finds greatly extend the palaeogeographic range of this genus around the margins of Gondwana. *Sacabambaspis* is heralded as 'the text book example of a primitive armoured fish and has an extremely important role in our understanding of early vertebrate evolution' (Sansom et al, in press). The Amdeh 4 and 5 exposed here are probably equivalents to the subsurface Ghudun and Saih Nihayda formations. A rich suite of traces, shelly fauna and sedimentary structures also enable palaeoenvironmental reconstructions that can be used to further understand the analogous subsurface reservoirs.

The Al Khlata in Wadi Daiqa comprises glacio-lacustrine diamictites, deltaic sandstones and pebbly sandstones and glacio-lacustrine shales. This is the most northerly locality known for Al Khlata in Oman and significantly extends the northern limit of Gondwanan glacial facies. Spores prepared from Wadi Daiqa samples include typical P9 markers.

Currently, a large dam construction project is underway in Wadi Daiqa. It is at present unclear to what extent these outcrops will be accessible once the dam is completed. Gratitude should be given to those local geoscientists who have tirelessly worked to investigate and describe the exposures and in so doing progress our understanding of these formations and of the deeper geological history of the area. Thanks are extended to Alan & Felicity Heward, Jan Schreurs, Graham Booth, Gordon Forbes and Randall Penney.

onstrated to be age equivalent to the Ghudun and Saih Nihayda formations in the subsurface of central Oman. The combination of *Skolithos* and occasional *Daedalus* trace fossils together with wave rippled sandstones and decimeter-to metre-scale cross-stratified beds were inferred to indicate shallow marine deposition. Palaeocurrent indicators suggest a predominance of north and eastward flow. The significant thickness of the Amdeh and the fact that it is predominantly shallow marine provide evidence for a prolonged period of shallow marine deposition and instigated debate on balance of



Orthocone carbonate in Amdeh 4/5



Alan Heward discusses the fauna of the Amdeh by the isoclinally folded orthocone carbonate

sediment supply and accommodation space generation and the basin forming mechanism. The rapid burial of the Amdeh sandstones is attested to by the presence of escape burrows, sand volcanoes and dewatering structures.

From the vicinity of the cars the group then walked up the wadi. Jean-Paul Breton described some of the structural styles of deformation in the Amdeh. The implications of the metamorphism described by Jean-Paul and his co-workers for the preservation of the palynomorphs that have enabled dating of the Amdeh in this area were pointed out. Graham Booth described the types of palynomorphs found in the Amdeh and the careful preparation required for identification of these highly altered organic

remnants. The group then looked at a tightly folded carbonate in the Amdeh4/5 with phosphate nodules and abundant orthocones carbonates and discussed its significance as a probable flooding surface. The view given was that while currently described as a single formation it is likely that the Amdeh contains a number of sequence boundaries and there is a need to further the work of Lovelock et al. (1981) by the detailed logging and correlation of Amdeh sections.

The Al Khlata outcrop in Wadi Daiqa is unimposing and was only made apparent by the erosion of wadi gravels



Sandstone-dominated and mixed sandstone-shale packages of the Amdeh overlain by diamictite and fluvial sandstones of Khlata



Granite cobble in the P9 Al Khlata diamictite



Alan Heward describing the difference in sandstone fabric of the Al Khlata from the underlying Amdeh



Amdeh 1 and Amdeh 2 Units in Wadi Amdeh



Al Khlata outcrop at the end of Wadi Amdeh



Fishing in the Ordovician



Close-up of Al Khlata Diamictite at Wadi Amdeh. Clasts are derived mainly from Amdeh

during Cyclone Gonu. However, the presence of exotic cobbles and pebbles, including granite clasts 'floating' in a muddy siltstone matrix and the characteristic compaction fabrics convinced the group that this was indeed a diamictite. Randall Penney described the palynological analysis of these deposits and the significance of the results. The biostratigraphy indicates a P9 age for this

On the southern side of the wadi where the diamictite is easily accessible the contact between the Amdeh and the Al Khlata is not exposed. Overlying the diamictite are porous, medium to coarse grained cross-stratified sandstones with pebble lags. The contrast in the sedimentological fabric of these sandstones and those of the tightly quartz cemented Amdeh sandstones was marked illustrating the impact of the vvmore prolonged diagenetic history of

the latter. diamictite. It therefore represents the most northerly proved development of the Al Khlata in Oman.

During lunch the view back across the wadi showed the unconformity between the Amdeh 4/5 and the Al Khlata and revealed the architecture of the Amdeh succession with a systematic pattern of mixed sandstone-shale intervals and amalgamated sandstone packages.

The afternoon took the group back across the wadi to climb the hill that we had been contemplated at lunch. The objective was to search for fish, trilobite trails and early crinoids. Alan and Felicity Heward directed the group to the location of fish prone beds in a more mixed shale and sand succession of the Amdeh 4/5 and the physiology of the strange early boneless fish *Sacabambaspis* sp. were described. The group found small fragments of dermal armour includ-

ing examples with oak-leaf shaped ornament as described by Giles Miller in his talk to the GSO earlier this year. The group also looked at the trilobite trails. It then proceeded up the hill to the orthocone carbonate noting the bivalve rich shell beds in the Amdeh.

By the top of the hill the heat and steepness of the climb was beginning to take its toll and the group was tiring. We re-

grouped just below the crest of the hill to review the superbly preserved eocrinoids with their distinctive curved stems that have been described by Jan Schreurs and Felicity Heward in the previous Al Hajar (12th Edition, June 2008).

This brought the day to a close as the sun was getting low on the horizon and the heat was leaving the day and we had a view across the waters of Lake Daiqa to the dams and back up the wadi to the mountains of Saiq carbonates. The decent back down to the wadi floor was undertaken with care and this together with the walk back to the vehicles drained the last of the energy for most of the group. But with the contemplation of a swim in the lake we collected to thank Alan Heward for an excellent and stimulating trip. The energetic agreed to meet the next day to look at the Amdeh and more possible Al Khlata in Wadi Amdeh and Wadi Kazah.

The remainder of us returned to Muscat.

Wadi Amdeh

The second day crowd headed to Wadi Amdeh and Wadi Kazah. The first stop was the Hijam dolomite outcrop a few kilometres into Wadi Amdeh. Hijam dolomites outcrops extensively in the area with an uncertain age and hence correlation with the subsurface nomenclature. The dolomites are light grey and honey coloured and contain stromatolites. Facing the dolomites are the Amdeh 1 and Amdeh 2 units.

The second stop was a quick one to site one on the Permian dykes that cuts through Amdeh. These dykes are present within wadis Amdeh and Kazah. The convoy then headed towards the upper end of Wadi Amdeh to walk the Al Khlata

section. The Al Khlata here comprises a muddy diamictite with much of the clasts are derived from Amdeh. No basement rocks were seen in this part of the Al Khlata. Samples were collected by the party to attempt to date the section palynologically.

The last stop of the day was the famous wave ripples locality in Wadi Kazah. These very shallow water wave ripples and common within the upper part of Amdeh 2. This was the end of the trip, thanks to Alan and Felicity for leading such an interesting and enjoyable trip.



Al Khlata diamictite in Wadi Amdeh



Wave ripples in the upper parts of Amdeh 2 at Wadi Kazah

References

Lovelock, P.E.R., Potter, T.L., Walsworth-Bell, E.B. and Wiemer, W.M. 1981. Ordovician rocks in the Oman Mountains: The Amdeh Formation. *Geologie en Mijnbouw*, 60, 487-495. Juma I Belushi & Ross Garden BG (Oman)

Field Trip Update

New Process

We are standardizing the procedure for field trip organization. This is to fairly allocate places and to improve communication. The points below will be followed unless stated otherwise. Please try to observe this procedure to avoid disappointment and unnecessary work for the organizers and trip leaders. May thanks in advance for your cooperation.

For all trips advertised, registration will open only once the e-mail notifier has been sent. Mail applications should be made to Caroline Hern at c.hern@shell.com. Places will be allocated on a first come first served basis unless there are vehicular considerations in which case the first registered vehicle owner will be selected. All candidates will be notified whether they have secured a place or are waitlisted. All candidates should indicate whether they can bring a vehicle. A full set of joining instructions and relevant trip details will be mailed approximately one week before the trip. At this point

participants should supply a contact name and telephone number of the person to contact in case of an emergency. For overnight trips, all participants are responsible for providing their own food, camping and washing equipment. A first aid kit will be taken by one GSO member but it is recommended to take your own personal kit or at least coordinate to have one per car. A journey manager will be nominated for each trip who will be fully briefed on the itinerary and will handle emergency coordination in Muscat should the need arise. For near-Muscat trips, full mobile coverage renders this unnecessary. In all cases, drivers go free and will have a contribution towards petrol made. The cost of each trip is dependent on the distance covered and expenditure associated with the organization (e.g. field guide printing or car hire). Excess monies are deposited in the GSO account to be used in support of other event expenses.

If you have any comments or additions to this suggested practice, please contact Caroline Hern or any ExCom member.

Kind regards,
Caroline

Environmental Concerns

Learnings from a stony desert

The Huqf area in central Oman stony desert is recognized worldwide as a haven for field geology because of its world-class rock outcrops. The terrain is arid and support diverse desert flora and fauna. The stony desert has three distinctive ecological zones : Hayla (sandy basin), Ghaba (desert woodland) and Jidat (stony plateau).

Hayla - Sandy basin

Hayla is a medium to mini sandy depression in a flat desert. The hayla supports vegetation cover all year round, making it the most important range land for domestic animals. The most common grasses of this area are *Stipagrostis* sp. Haylas also attract many gazelles. After some good rain, it is not uncommon to see gazelles in groups of 10 or so. The sand fox, desert hare and sand lizard are also common inhabitants of the area. The other main resident of the hayla is the desert monitor: a large lizard reaching up to 1 M in length. During the survey they were seen popping out of their burrows. The male monitors are known to be very territorial. In some spots where the shrub plants are rich the burrow density was very high; they were about 5-10 m apart.

Vegetation cover is dominated by a bush type *Acacia ehrenbergiana* (Salam). The Salam form a large sandy mounds offering an excellent and safe habitat for animals such as hare, fox and rodents. A typical bird frequently seen is the Sandgrouse. It's commonly seen resting under the shade of trees near water seepages. The birds have to take water twice a day and are known to fly as far as 40 KM to do so. After drinking water, the sandgrouse wet its feathers retaining moisture and transport it to its chicks. Other common birds are the black crown

finch, hoopoe and desert larks. In September the Hubara bustard appears.

The Jidat - Stony plateau

Jidat means a raised stony plateau averaging about 200 metres asl. Occasionally, the plateau is cut by shallow wadis or dotted by concentric depressions. Most of the time it is uniform and flat and expansive. Standing in the middle of the plateau, one may easily think that it continuous forever. The *Acacia* is the most widespread tree in the Jidat. Its height varies from 2 metres to 6 metres. It is considered a vital desert resource.

In some areas the *Acacia* often provides the only available shelter from the sun, and bedu commonly set up camp under its shade. Besides providing shade and foliage, its seed pods have a very high nutritional value. Its profuse leaflets provide not only a large surface area for casting shade but also forage for the herds. During the flowering season, bees are attracted to the tree's yellow flowers. The nectar from the *Acacia* produces one of the best honeys. In addition, the tree is also important as source firewood. Other products that are harvested from the tree include lichens and resins.

In this area fog is main source of moisture, given the plateau's proximity to the sea. The fog brought by the southwest monsoon winds revives new pastures and plants. Evidence of fog can be seen in *Acacia* trees branches, where *Ramalina duriaei* lichens form a thick growth. Other plants identified is the dwarf palm, *Nannorhops ritchiana*. The bedu use it for rope making.

Indigenous wisdom

For hundreds of years the bedu have learned to harvest products from trees in a region that most of

us think of as a wasteland. During field surveys, I have been frequently asked by to stop at their "homes" for coffee. Home was always under a shade of a tree — a ghaf or a sumr. During those coffee breaks, I was regaled with a lot of stories about man and his environment and how they can co-exist in harmony. The Harsusi tribe inhabits most of this part of the desert. Their bedu settlements are near the hayla. Their camels are allowed to roam freely in the desert in search for food, returning to home every couple of days. True to their reputation as the most well-adapted domesticated desert animal, camels not only can graze what grows on the ground but also browse the twigs and leaves on trees that are too high for other animals. Unlike goats, the camels can survive without drinking water for two weeks. The goats are led every day to the hayla for grazing and brought back before sunset so that they can drink.

The conservation of the Omani desert woodlands by the bedu is a classical example of a sustainable life. In order to sustain the meager desert productivity, the people have to understand, respect and appreciate their environment. Tribal laws forbids the damaging or cutting of trees in any way whatsoever. Touring around the woodland, the bedu are willing to explain the medicinal or other uses of each plant.

At such times, I find it ironic how we can learn about sustainability from the wisdom passed from generation to generation by the bedu since time immemorial.

Faisal Al Lamki
PDO



The Ghaf woodland (*Prosopis*), is another dominant tree species on the sandier parts of the Huqf.



Arabian Gazelle. The most common wild mammal on the stony plain.



The Ghaf woodland (*Prosopis*), is another dominant tree species on the sandier parts of the Huqf.



The desert lizard (*dhub*) lives in burrows. Unfortunately recent development has disturbed its habitats.



Oryx



Nubian Ibex. Mainly on the Huqf cliffs, but can be sighted on the wadis in early morning and late afternoon.



The Sandgrouse is the most common bird in the area. It wets its feathers and carries the water to chicks.



The fog in the Huqf is the main source of moisture for plants and animal.



The desert information center, donated by PDO is located in Jaluni, headquarters of the Arabian Oryx project. Visitors are encouraged at the center to learn more about desert ecology.

Conference Round-Up

Water Resources & Climate Change in the MENA Region

The first International Conference on Water Resources & Climate Change in the MENA Region was held between 2nd and 4th November at the Crowne Plaza hotel Muscat.

A synopsis of the conference proceedings is presented by Mohamed Al Lamki, Hydrogeologist with Petroleum Development Oman.

Climate change is proving to be a hot topic worldwide and its effects impinge on everyone around the globe. Recently GONU in Oman, excessive flooding in Bihar in India and in the Caribbean countries as well as severe drought in Australia may all be the results of recent climatic changes. In this context the Ministry of Regional Municipalities and Water Resources (MRM & WR) together with the Ministry of Environment and Climatic Affairs (MECA) hosted a conference at the Crowne Plaza from 2nd to 4th of November 2008 to discuss climatic issues and their water resources impact in the Middle East and North Africa (MENA) region. H.H. Sayyid Asaad bin Tariq bin Taimur, H.M.'s special representative opened the conference. He thanked the organizers and wished the participants a successful gathering.

The conference got under way with presentations from keynote speakers who stressed the fact that the MENA region is known to be one of the arid regions of the earth. At best the region receives rain very intermittently and some areas may go for years without rain. Coupled with unprecedented growth in population this results in an overall water deficit that plays havoc with the economic development of the countries concerned. The urgency it was noted, is to first understand the situation the countries are in, and thereafter find common strategies to combat the chronic water shortages. Water storage uncertainty related to

current climatic change is now an established fact among readers of hydrogeology, hydrology and the environment. Research into the effects of an increase in surface temperatures on hydrological cycle pattern changes is absolutely crucial among nations, as it is expected that probable excessive snow melt in temperate regions will result in excessive flooding leading to economic chaos whilst sub-tropical regions may be subjected to increased drought and desiccation. At present it is unclear how the changes will affect the hydrological cycle on the whole, and specifically river flows, run-offs and groundwater levels. One thing is certain however, that fresh water ecosystems including lakes, streams and non-coastal wetlands will be affected.

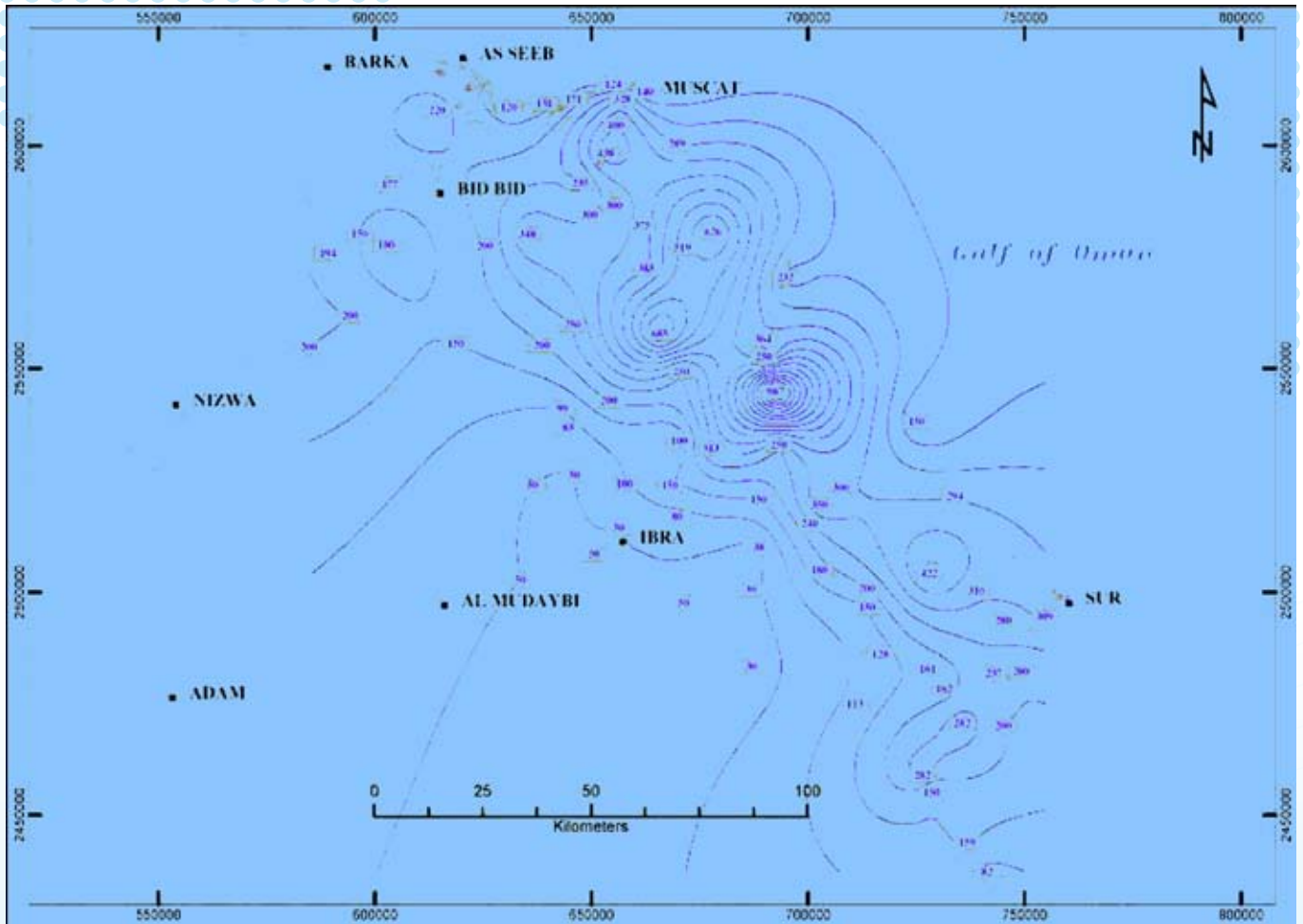
Notable among the local presentations was a presentation by AlKhatry Aysha et al. on "The Effect of GONU on Recharging Groundwater Aquifer in the Sultanate of Oman". The presentation outlined that the rainfall in northern Oman on average is about 100mm/yr and rates of evaporation exceed 1700 mm/yr. In June 2007, Oman was hit by tropical cyclone GONU that resulted in much devastation of the infrastructure. The positive groundwater recharge effects of the cyclone were measured in the numerous recording stations in the eastern coast and the Sharqiyah region. What emerged in the final analysis was the fact that more than 700mm of rain fell in a single day, exceeding anything that has been seen since records began at the turn of 20th Century. The spin-off effect was seen in the form of groundwater recharge, which increased dramatically. The calculated recharge for the shallow alluvium and fractured limestone aquifers was 1,686 MMm³ which is five times the long term annual average recharge for the study area (325 MMm³) and approximately 1.5 times the annual average recharge for the entire Sultanate.

There was a presentation on "Climate Change Mitigation in Morocco: Setting an Indicator for an Early Drought Warning" by Dr. Chafai Elalaoui Ali et al. The presentation outlined that in Morocco, meteorological records have shown that over the last twenty years, there is a trend toward increasing air temperatures. Average precipitation is also decreasing with much variability within and between years. As a consequence, Morocco has experienced more frequent droughts, with negative effects on agriculture and the national economy. The researchers have developed an indicator for an early drought warning, based on prediction of the three main cereal yields at any time of the growing season for a given province. By comparison of the predicted yield with the statistical yield series, it is possible to determine the drought severity at any time during the growing cycle and issue an early drought warning when the predicted yield falls in the moderate or severe drought classes. Setting such indicators for early warning allows decision makers to take appropriate measures to reduce drought impact and alleviate its adverse effects on crop production and on populations whose main income come from agriculture.

Further afield from Australia there was a presentation on "Rainfall Trends on the Continent of Australia - Evaluating the Evidence from the Past Century" by Professor Peter Schwerdtfeger,

Emeritus Professor of Meteorology, Flinders University, Adelaide. Australia is currently experiencing drought which is causing havoc among farming and dairy farming communities. If the situation continues it will result in closure of many dairy farms with devastating economic consequences.

In the words of the professor "Australia is fortunate in having an excellent climatic data base, thanks to an enduring national Bureau of Meteorology



GONU rainfall contour map for 5th June, 2007 (Source: Al Khatry, Aysha et al)

which was constitutionally conceived in 1900".

While the number of monitoring stations and their data quality has steadily increased, interpolation by GIS techniques has also resulted in a geographically more continuous and reliable overview of the continent. Although Australia is historically associated with the problems of regional droughts, it is less than two decades since a public realisation of a potential shortage of water for agriculture, industry as well as domestic consumption emerged.

GIS presentations of decadal means of both Australia's annual and growing season rainfall for the period 1900 to 2007 were presented in map form. While intrinsically interesting, in searching for trends, it is more informative to graphically represent data to reveal departures in each decade from the century mean. The consequent revelation of the connection between significant historic events such as wars and depressions with major climatic aberrations is striking.

tions is striking.

More regionally specific analyses were shown for the S.W. and S.E. of Australia, respectively vital areas for grain production and irrigation-based horticulture. For the former, major anthropological impacts on regional vegetation are explored with an implied warning that climate cannot be solely ascribed to the "demon" CO₂. For the latter, the S.E. of Australia, there is some persuasive visual evidence that particulate atmospheric pollution from combustion may also be contributing to the current serious dearth of precipitation.

Because the total rainfall, averaged over the continent of Australia has remained relatively stable, current trends in the East, S.E. and S.W. have caught most of the population, which is increasingly concentrated in large cities in these areas, by surprise, particularly when agricultural productivity, conducted by a tiny rural minority, is viewed on an integrating large scale rather than in

a localised manner. GIS methods are presented which show how a dangerous threshold may be approached with unwitting confidence. Myopic focusing on a too restricted range of factors which influence climate may result in "chaos".

While it is not possible to outline all the proceedings in this brief note, for those interested GSO members it is possible to obtain comprehensive full-paper copies of the proceedings from Eng. Suleiman Al Obeidani at the Ministry of Regional Municipality and Water Resource (MRM & WR). The details of how to contact Eng. Suleiman can be obtained from

Mohamed Al Lamki

Mohamed.mss.lamki@pdo.co.om

International News

Kindly supplied by IHS



BAHRAIN

Bahrain has launched an international licensing round for exploration of onshore natural gas in the Awali field at depths of up to 6,096m below sea level. The official announcement of the licensing round was made by the Minister of Oil and Gas Affairs and National Oil and Gas Authority (Noga) chairman, Abdulhussain Mirza at a meeting at Noga headquarters. According to Mirza, "gas consumption has increased from 250 MMcf/d in 1972 to an average of 1,300 MMcf/d last and it is expected to grow, over the long term, even further to more than 2 Bcf/d, if it becomes available." The Awali field is currently producing gas from the Permian-Triassic Khuff Formation. However, the aim of the licensing round is to attract international oil companies to explore for additional gas resources within pre-Khuff formations.

INDIA

Gas flowed at the rate of 7.83 MMcf/d at an onshore discovery made by ONGC in the Krishna Godavari Basin. The Vygreswaram 1 (VGAA) wildcat was drilled to a total depth of 3,635m (3,607m, true vertical depth) on the Block 1B. It was tested on a 7mm choke from perforations in the Object-II (3,387.5-3,385.5m, 3,371-3,369m, 3,365-3,361m, 3,355-3,350m and 3,337-3,335m) in the Cretaceous Raghavapuram Shale Formation; flowing tubing head pressure was 5,030 psi. Flow rates on other choke sizes were: 6.17 MMcf/d through 6mm choke with a flowing tubing head pressure of 5,390 psi, and 4.35 MMcf/d through 5mm choke at a flowing tubing head pressure of 5,790 psi.

BP has drawn up plans to commence exploration drilling on its BB-CBM-2005/III (Bengal Basin) block by the end of 2008 or early 2009. The supermajor is negotiating with Australia's Mitchell Drilling to drill eight core-hole commitment wells. The 248 sq km block was awarded to BP as a result of the Third Licensing Round for Coal Bed Methane (CBM III) that was

held in November 2006. The Petroleum Exploration License (PEL), however, was not awarded until a year later. It is understood that the block has a gas resource potential of 2 Tcf.

After making the SPF-1 discovery on its Rajasthan acreage during the July 2008, Focus Energy Ltd is running two rigs in the RJ-ON-6 block. The SSG-1 well was drilled by the ZJ-70-1 rig to a total depth of 3,500m on the SFT-7/L prospect. Targeting the Cretaceous Pariwar Formation, it encountered a number of clean, gas-charged sand horizons; a test program is to be undertaken shortly. Meanwhile, Focus has spudded the OMM-1 with the ZJ-40 rig. This well, which is 1km north-east of the company's SGL-1 gas discovery and 1.4km south-west of the SGL-2 appraisal, is targeting the Palaeocene Sanu Formation (D2 Sandstone). The SPF-1 wildcat flowed gas and water during initial testing of three zones, with gas flared continuously for 48 hours. It is the latest gas discovery out of the 11 wells Focus has drilled on the acreage during the current license term. Among the earlier discoveries is SGL-1, which has 2P reserves of 192 Bcf, and SSF-2, which has been assigned a contingent resource of 369 Bcf. IRAN

IHS Global Insight reports that Iran's Oil Minister, Gholamhossein Nozari, has refuted widely believed notions that Iran will suffer economically while oil prices are below the US\$ 90-per-barrel mark. The minister is optimistic that oil prices will eventually rebound following OPEC's 1.5 MMb/d production cut, although he maintained that Iran—as it had proved in the 1980s and through much of the 1990s—is able to survive long periods of low oil export revenues if it has to. Government finances would not be too burdened, he maintained, because Iran's largest projects were by and large, nearing completion. He did however caution that a longer period of reduced oil prices could result in significantly lower global investments in new production capacity, creating a situ-

ation where future shortages were likely. Deutsche Bank recently estimated that Iran will run a budget deficit when oil falls below US\$ 97/bbl, while CERA, an IHS company, has put the Islamic republic's break-even point closer to US\$ 83/bbl, with most other analysts placing themselves somewhere in between. Iranian President Mahmoud Ahmedinajad's expansionist economic policies have led his government to tie up most of the estimated high oil export revenues in large infrastructural projects formulated to create jobs and spread wealth through the country. The 1980s and 1990s were decades in which Iran was plagued by economic crises and hardly demonstrated ebullient growth. Also casting doubt on the oil minister's optimism is that new strategies preparing for a change in energy sector focus and planning, as well as making cuts in certain projects' funding, have already been mooted. Ahmadinejad announced his current policy for economic reconstruction back in June when oil prices were at an all time high and about to peak. The essence of this new plan was the elimination of the majority of government subsidies, particularly on the provision of cheap fuel, in favor of a new targeted welfare program. However, the dramatic drop in oil prices can be seen to correlate to a popular increase in opposition to the president.

IRAQ

According to Dow Jones Newswires, the Iraqi parliament's oil and gas committee has rejected a new draft of the legislation on oil and natural gas. The head of the committee, Ali Hussein Balou, told Dow Jones that the Iraqi Cabinet had submitted a modified version of the February 2007 draft of the legislation and, although it was the closest to being accepted thus far, it nonetheless was rejected by the committee. According to Balou, the Iraqi parliament is expected to start debating the draft legislation in November 2008. Earlier in 2008,

Iraqi oil minister Hussein Al-Shahristani said that the Iraqi Government hoped to endorse the draft legislation by the end of 2008. Iraq is targeting an oil production rate of 6 MMb/d by 2015. Current Iraqi oil production is approximately 2.3 MMb/d. There is some indication the oil ministry may go ahead with plans to issue contracts using the old law, which dates back to the regime of Saddam Hussein.

In proceeding with plans to open the country's major producing oil fields to foreign oil companies, the Iraqi oil ministry has signaled the end of total state control over half of Iraq's proven oil reserves and some 40% of non associated gas reserves. At a presentation in London, Iraq's oil minister Hussein al-Shahristani presented details on the country's first licensing round to pre-qualified oil companies in which Iraqi state-run entities will have a 51% interest in the fee-based service contracts and the international companies 49%. Bids for the contracts, which are expected to run for 20 years, are to be submitted by April 2009 and are expected to be awarded in mid-2009. Media reports suggest the successful oil companies will have to pay signature bonuses of US\$ 10 million for production up to 100,000 b/d and US\$ 50/barrel for every incremental barrel based on the incremental and plateau targets submitted in the bids. They must also commit to achieving 10% of their production target within two years. Apparently there is no provision for force majeure because the companies are aware of the risks of working in Iraq.

The contracts are controversial for the country has long been suspicious of foreign investment in its oil sector. In the absence of a federal oil law, all contracts, according to al-Shahristani, would be sent to the cabinet for approval. This could cause some delays in awarding the contracts. The Rumaila North and South, Zubair, West Qurna, Kirkuk and Bai Hassan oil fields are included in the tender as is the "Misan" field (the Misan Province contains a number of producing fields including Jabal Fauqi, Abu Ghirab and Buzurgan). The Akkas and Mansuriyah gas fields were also included.

The government is hoping to add significant production capacity within a relatively short time, targeting an increase from today's official production capacity of 2.5

MMb/d to 4.5 MMb/d by 2012–13, 500,000 b/d of which is hoped to come within a year of the contracts being awarded.

Targeting a large sub-thrust anticline with primary objectives in both Tertiary and Cretaceous reservoirs, Oil Search is now drilling its Shakal 1 wildcat. The well is located on the block of the same name and has a planned total depth of 3,350m. It has been suggested that the nearby Pulkhana structure, which holds the 300 MMb Pulkhana field, could extend into the block and pre-drilling estimates by the companies suggest there could be potential for the block to contain unrisked recoverable reserves of some 250 MMb. The Shakal license is one of several that are progressing to the exploration stage in the coming months, leading to a surge in activity in the region. It also puts pressure on the Kurdistan Regional Government (KRG) to come to a solution with the central government about getting access to crude export routes, as the companies will need to know that their oil can be monetized before they invest in any development.

SYRIA

Gulfsands (50%) and equal partner Emerald Energy have Spudded exploration well Yousefieh 1 in Block 26. This wildcat has a planned total depth of 2,300m, and will target Cretaceous aged reservoirs identified within a structure located immediately adjacent to the Khurbet East oil field. The well is designed to evaluate the potential of a newly identified play type within the Cretaceous reservoir system. In August 2007, the partnership commenced the first three-year extension period of the license, a renewal that required an obligation to acquire 250 sq km of 3D seismic and the drilling of two exploration wells; Yousefieh 1 is the first of these. Gulfsands' Production Sharing Contract in Block 26 includes oil and gas rights to Paleozoic age reservoirs beneath all of the existing fields within the block and oil and gas rights to all depths in areas outside of the existing producing fields.

With maturing fields and no significant recent reserves additions, productive capacity has been declining steadily since peaking at 610,000 b/d in 1995. In September 2008, Syrian Oil Minister Soufian Allao an-

nounced that oil production is expected to average 385,000 b/d in 2008 and that the country expects to maintain oil production levels above 320,000 b/d till 2020. The prospect of any significant additional capacity looks limited based on the estimated volumes found and remaining to be found in the country, and poor recent success with no major new oil reserves being discovered since 1992. However, the Ministry of Petroleum and Mineral Resources (MOPMR) has been proactive in attracting international investment by holding five bid rounds for exploration blocks between 2001 and 2005, and making changes to fiscal terms. Over the longer term, the county is optimistic about its deepwater potential in the eastern Mediterranean, and its first ever offshore bid round was launched in May 2007, with four new blocks offered. However, interest in the offshore round was disappointing with only one block being negotiated by the partnership of Dove Energy and Larsen Oil & Gas. It is understood the MOPMR is planning to relaunch the other blocks under improved contract terms in the near future.

UNITED ARAB EMIRATES

Looking at a total capital investment of around US\$ 500 million over the next three to four years, Occidental has signed preliminary agreements with Abu Dhabi National Oil Company (ADNOC) to appraise and develop the Jam Yaphour and Ramhan oil and gas fields. Oxy will operate both fields and hold a 100% interest. Development activities at the onshore Jam Yaphour field will commence immediately and first production is expected in 2009 and peak at around 10,000 boe/d. The shallow water Ramhan discovery, in close proximity to the Abu Dhabi refinery, was tested in 1992 at a combined rate of 1,750 bo/d and 14 MMcfg/d. Appraisal activities will commence immediately and, if commerciality is proved, the field could be onstream in 2011 with production also expected to be in the 10,000 boe/d range.

Abu Dhabi National Oil Company (ADNOC) and Shell have signed an Memorandum of Understanding (MoU) under which both companies will jointly evaluate, explore, develop and produce deep pre-Khuff offshore gas prospects in

Abu Dhabi. Upon completion of the evaluation phase, Shell hopes to move forward rapidly with final agreements in order to quickly begin joint exploration and development activities.

YEMEN

Enhancing its position as the country's leading foreign investor, Total has signed agreements to farm into the 1,367 sq km onshore Block 70 (Atiq), located in the south-eastern Marib-Al Jawf-Hajar Basin, taking a 30.875% from operator Korea National Oil Corporation (KNOC). KNOC acquired 410km of 2D seismic within Block 70 between February and April 2007, with processing and interpretation of the data completed in August 2007. The company is currently drilling the Al Raed 1X exploration well at a location in the north of the block. This well has a planned total depth of 3,665m and seeks a Basement objective. Block 70 contains the Nakaa 1 wildcat abandoned by SPPE (Soviet Petroleum

Exploration & Expedition) as a minor non-commercial oil discovery after a drill-stem test yielded 3.5 bo/d from Tithonian Naifa Formation limestones. Subject to the necessary approvals, new interests in Block 70 will be; KNOC (30.875%, operator), Total (30.875%), Samsung (19%), Daesung Industrial (14.25%) and Yemen General Corporation for Oil & Gas (5%).

CERA, an IHS company, makes clear there are concerns within Yemen on the sustainability of the country's current production level. Yemen's recoverable proven crude oil reserves stand at around 4 billion barrels, and it is generally felt that Yemen has now reached a plateau rate of production and it will be hard to significantly exceed current levels of output. As a consequence, the government is thought to be considering a relaxation of its PSA terms in order to stimulate exploration. After reaching a plateau around of 450,000 bo/d in 2001 and 2002, Yemen's production capacity has begun a steady decline with its major fields in a mature

phase of production. Liquids capacity is expected to decline from current levels of 360,000 b/d to 240,000 b/d by 2020. In an effort to stem the decline, Yemen has stepped up its exploration activity with four international bid rounds since 2004, and is considering a fifth round in late 2008. Further oil and condensate growth in the next 10 years seems unlikely. Exploration potential in the main producing regions is considered fair, with only the likelihood of small discoveries. The forecast assumes no contribution from Yemen's offshore areas, where success has been elusive.

With thanks to



For further information please contact

Ken White or Stuart Lewis

e-mail : ken.white@ihsenergy.com

e-mail : stuart.lewis@ihsenergy.com

web site : www.ihsenergy.com

Learning Curve

Overland visit to Oman in 1965

More than 40 years since my first visit to Oman, I have been reflecting on what little I know and the vastly greater amount that I will never know about the geology of Oman.

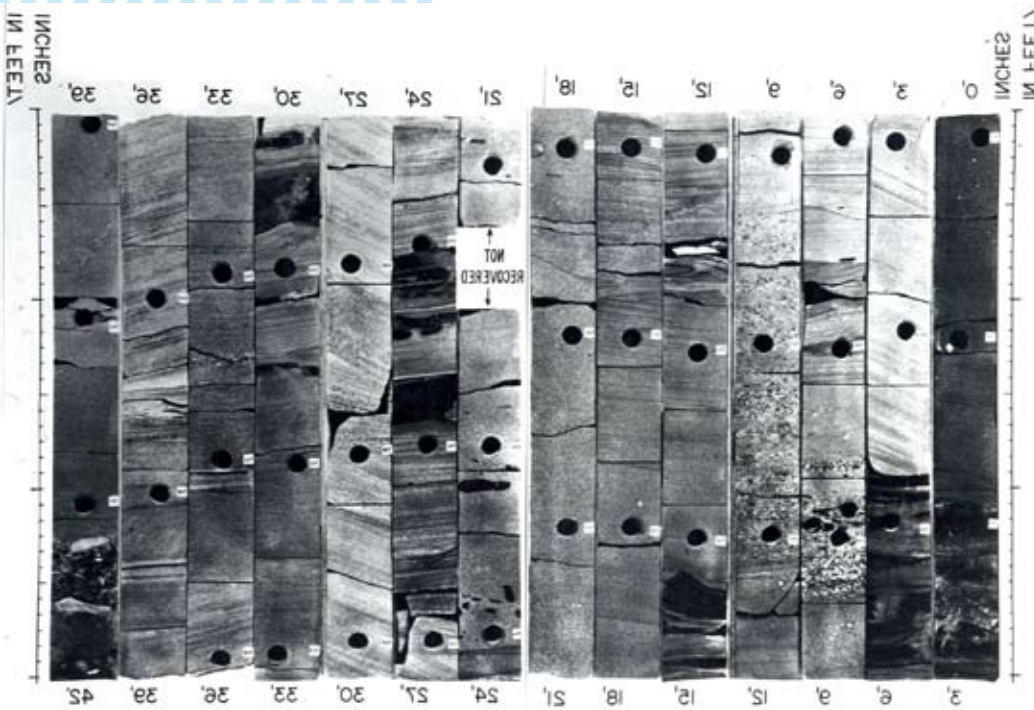
It all began in The Netherlands in 1963, where the size of the giant Groningen gas field had just been recognised. Its Permian Rotliegend (red layers) reservoir was of probable desert origin, but as no one in Shell knew anything about deserts, I was told to find out 'what made them tick'. Field work in Libya, the Thar Desert and Ranns of Kutch in India, was now being extended in the spring of 1965 by further studies along the "Trucial Coast" (modern UAE) into Oman. On this visit I was accompanied by Brian Evamy who had recently joined Shell. We had travelled overland from Sharjah, entering Oman via the Buraimi oasis.

Arriving at the border we were met by Irishman Eamon Conboy, a former manager of the Bank of the Middle East in either Kuwait or Qatar, who had joined PDO on a higher salary for duty as an Arabic-speaking liaison officer with the local Omanis. After three days of rough travel driving one Landrover stationwagon and a 1 ton Forward-control Landrover (for carrying our camping kit - soon taken out of service as they were too top-heavy for travel over rough ground when loaded) we desperately needed a bath before meeting the local Wali and being entertained by him to lunch. Espying a falaj, Brian and I knew exactly where to bathe, only to leave in a hurry when we espied a man a little upstream washing down his donkey.

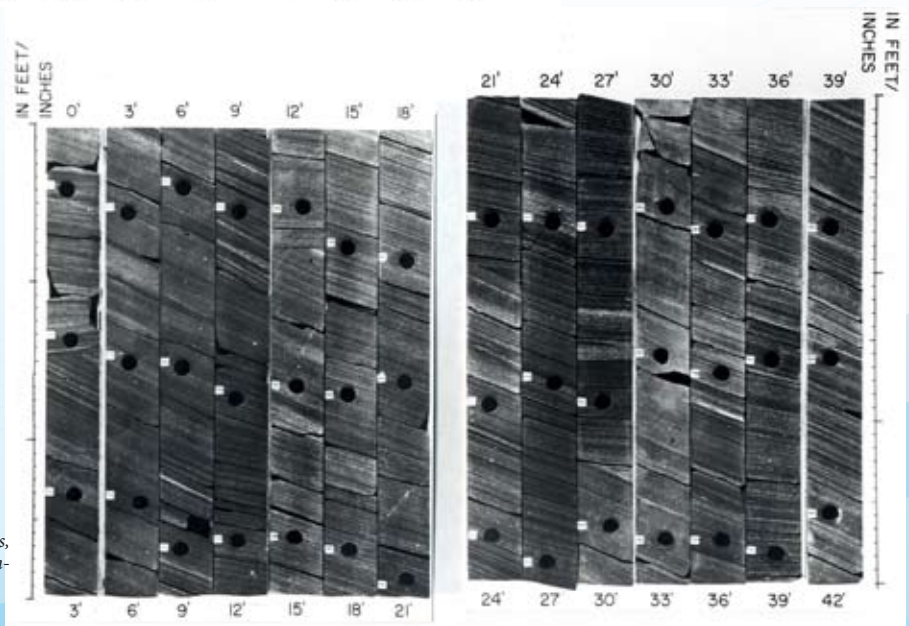
Before leaving Sharjah we had been warned by the Trucial Oman Scouts not to follow the route along the edge of the mountains because a BP petrol tanker had been blown up there the previous week.

Instead, we drove almost to Abu Dhabi Island before turning back towards Al Ain. We need not have bothered. The tanker, now minus one wheel, was no more than 100 metres from the Wali's fort; we would have had to pass it no matter which route we followed. At that time, Oman was still suffering occasional disturbances of a similar nature even some ten years after its civil war had ended.

I knew virtually nothing about the country apart from what could be gleaned from a simple atlas but did know how to recognise various aspects of desert sedimentation. Although I had vaguely heard of the Wahiba Sands, I had no real idea just where they were and could not anticipate the vast improvement in our understanding of their origins that would follow: first from the Royal Geographical Society's expedition in 1985/86, and then from many week-end studies by Steve Fryberger and Caroline Hern of PDO/Shell over the past ten years



42 Feet (c. 13m) of mixed fluvio-aeolian cores, Rotliegend Formation, Leman Bank Field, UK North Sea.



42 Feet (c.13m) of laminated aeolian sands, Rotliegend Formation, Groningen area, Netherlands.

or so. The nearest we got to the Wahiba in 1965 lay far to the SW at Barik, I think, where we found a camp that had obviously been abandoned very rapidly (dirty coffee cups still on the table five years later and three Landrovers half engulfed by a migrating sand dune – the PDO medical doctor rescued a windscreen wiper motor from there a couple of years later); the former IPC staff of PDO had been pulled out of the country at short notice in 1960 when three of its five major shareholders (BP, Esso, Total) decided that oil was unlikely to be found in Oman. Of the two remaining, Shell now held 85% and Partex or Mr 5%

(Gulbenkian) 15%. Total later acquired 10 of Gulbenkian's 15% of shares so that he could revert to his preferred shareholding status. The Government now holds 60 % of PDO's shares.

Several times while travelling over the almost flat desert floor, we disturbed small herds of gazelle. Of the local Bedouin, however, we saw nothing. Well, almost! Occasionally when making camp at sunset and preparing an evening meal we found ourselves offering traditional hospitality to a Bedouin man. Our lamps and cooking stove acted like a magnet to distant travellers who appeared when our eve-

ning meal was almost ready for serving. Although we knew barely a word of Arabic, Eamon was able to tell our visitor (never more than one) that we were studying the 'Ramlat'. What stupid people these westerners must be!

We returned to the Trucial States via Buraimi to continue our studies there for another month. On that trip we neither visited Muscat nor even got close to the mountains. I was later told that Western visitors to Oman rarely arrived and departed by the overland route.

Ken Glennie

Upcoming Events

Talks

- | | |
|-----------------|---|
| 10 March | Of cuttings and landslides in Muscat
<i>Jean-Paul Breton</i> |
| tbc May | Diagenesis of the Upper Shuaiba reservoir in the Malaan Field
<i>Suleiman al- Furqani</i> |
| 25 May | GSO Annual Meeting |

Field Trips

- | | |
|------------------|---|
| tbc March | Structural evolution and fracture pattern of the Salakh Arch
<i>Mohammed al-Kindy</i> |
| tbc March | Shuaiba and Nahr Umr equivalents along the Nakhl transect
<i>Zuwena al-Ruwahi</i> |
| tbc April | Evolution of Jebel al-Akhdar
<i>Mohammed al-Wardi</i> |

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Geological Society of Oman

Post Box 993, Ruwi 112, Sultanate of Oman

E-Mail - Info@gso.org.om

www.gso.org.om