



AL HAJAR

Geological Society of Oman
Quarterly Newsletter

**For Internal
Circulation Only**

President's Message

My fellow geologists, it gives me great pleasure to share with you some thoughts on our beloved society and the outlook for the rest of the 2007-2008 year. Since the start of this term, the Executive Committee has been trying to deliver an interesting and exciting program. This has meant working to organise the talks and fieldtrips and to issue the first Al-Hajar since December 2006. Success in delivering on these fundamental GSO activities should really be our performance indicator for this year. Looking at our performance over the last year and the first month of this year, it is becoming more and more apparent that we need to look beyond the executive committee in order to meet our targets. The recent workshop – The First Arabian Plate Geology Workshop – held in Muscat is a good example of this.

The outlook for the coming months is good. Geologically Speaking I can see a lot of energy in our members and a large scope to accommodate all the enthusiasm. The coming events include fieldtrips to Qarn Sahmah, the Salakh Arch and through the Jebel Akhdhar, our talks and participation in GEO2008 should provide ample opportunity to share and learn from the geoscience community.

In the coming months, we'll be forming the new executive committee for the 2008-2010 period. I would like to extend my invitation to all the members, who feel that they could add and contribute effectively in the executive committee to nominate themselves for positions fitting with their inspirations and skills.

Regards,
Dr. Mohammed Al-Mazrui

Note from the Editor

Welcome to the 11th edition of Al Hajar, appearing after a prolonged break, for which I apologise, especially to the contributors, some of whom have had a long wait to see their articles published.

In this edition we have several field trip reviews, including one from the Qatar Geological Society about a trip to the Oman Mountains, supported by GSO, a book review on the second edition of 'Oman's Geological Heritage' and two technical articles. The first concerns early oil exploration in Oman and the hunt for some of the sites used by the pioneers of the Omani oil industry, the second addresses a strange, and smelly, sample collected from Jebel Shams in the Hajar Mountains. In addition, there is a listing of Oman geoscience publications from 2006, and a description of the GSO's plans for more ambitious publications.

'Geologically Speaking' is a new, regular column that first appears in this edition. Juma Al-Belushi (BG Oman) has agreed to contribute the first four items to this column, which will feature topical aspects of the Sultanate's geology, particularly focussing on Geotoursim, geological conservation and heritage.

As some of you may have noticed we have changed publishers and I would like to thank Zawaia Advertising & Publishing for their assistance in issuing this edition of the Newsletter. We hope to have a long and fruitful relationship with them.

Thank you to the contributors to this edition. As always, any comments or articles for publication will be gratefully received.

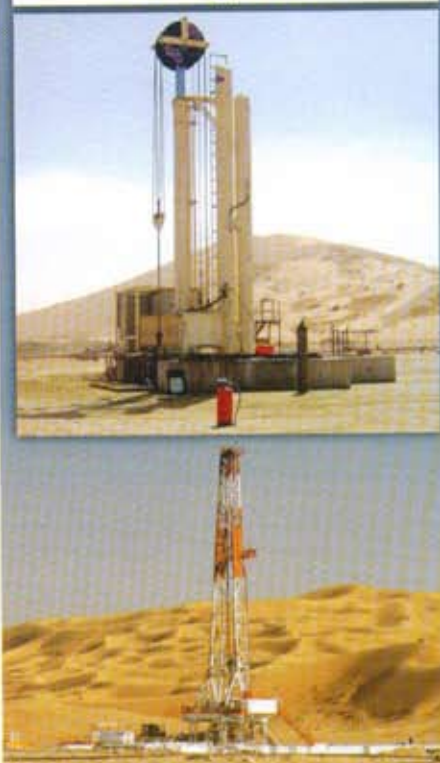
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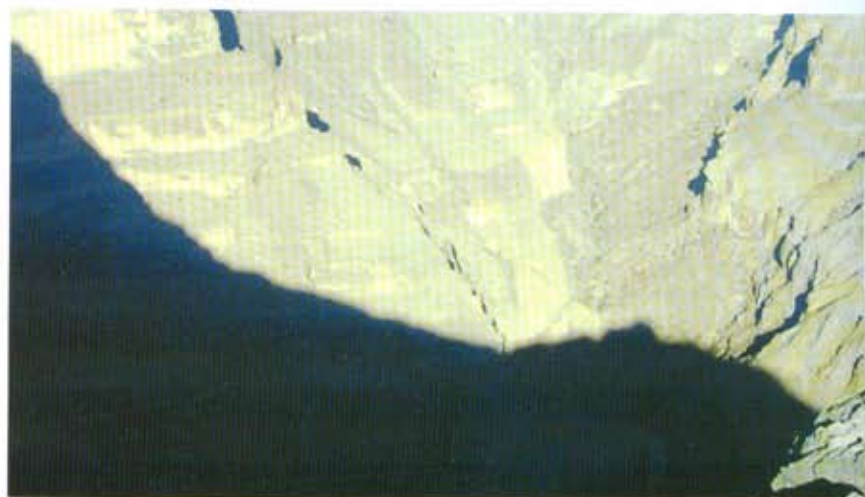
This issue sponsored by

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Geologically Speaking

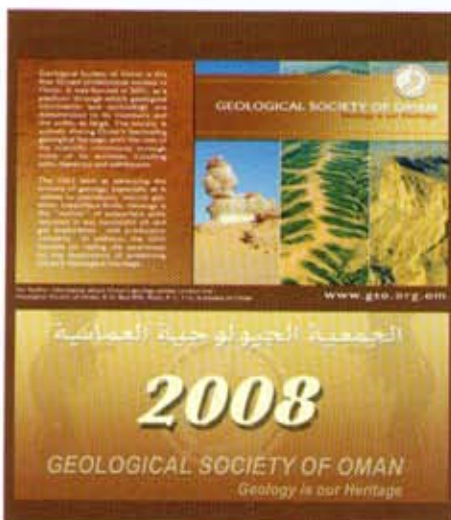
The tourism industry in Oman has grown tremendously in the last few years and it is very interesting see Oman's geology playing a key factor in such growth. Many of the natural and geological features rank high as tourist attractions. A quick sweep through the web pages of all tourist operators in the Sultanate shows a wide variety of tourist attractions that are nothing but geological features. To name a few examples; the Sharqiyah Sands (Wahiba Sands), the Jebel Akhdar which hosts Jebel Shams, the highest point in the Hajar Mountains, the Grand Canyon and the hottest of them all, the newly opened Al Hoota cave. A fantasy world of rock formations is hosted here in Oman and quite often Oman's geology provides the raw material, the rocks.



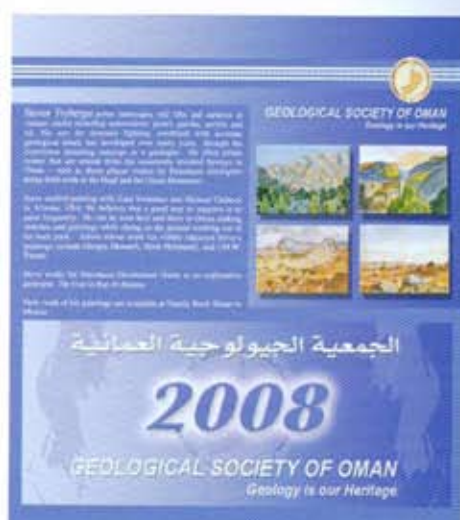
All of these are geological marvels that have provided endless fascination not only to professional geologists from all over the world, but also to amateurs and tourists. Oman's landscape has left an immense visual impression that is admired by many people who have been lucky enough to live in or visit Oman. God bless Oman and its geology!

Juma Al-Belushi
BG (Oman)

GSO 2008 Calendar



For the first time since its foundation, the GSO issued two calendars celebrating a theme of "Geology is My Heritage" with the same motto. The first calendar used the paintings of Dr Steven Fryberger, to capture the geological marvels of Oman while the second records Oman's geology through the camera lenses of the GSO members. 500 copies of each were printed, the later distributed free to GSO members while the former are available for sale to the public through the major book outlets in Oman. This marks the GSO's first product and a start in venturing to the wider population with geology orientated products.



GSO Publications

One of the key roles of the GSO is education and the dissemination of information and knowledge about the Sultanate's geosciences within the professional community and, perhaps more importantly, to the general public. To do this GSO must produce high quality publications above and beyond the Annual Report and the Al Hajar Newsletter.

In order that GSO publications are recognisable for what they contain and to provide a framework for publication it is desirable that GSO publications be organised into a number of 'Series' each with its own clear definition. The objective is to have a number of Series with a 'corporate identity' personified in these publications. Excluding the Annual Report and Al Hajar, the ExComm has agreed that the GSO will publish four Series.

1. **Special Publications.** Outstanding and original pieces of research or review of the Sultanate's geosciences or geological maps of areas of interest, possibly with explanatory notes/memoirs. All Special Publications will be 'hard' science aimed at the professional geoscientist and will be the 'flagship' publications of the GSO. GSO Special Publications will be published rarely and should be a significant contribution to Oman's geoscience. These publications will undergo full peer review in the same manner as journal articles and academic books.

2. **Occasional Publications.** 'Hard' science publications, not necessarily aimed at the general public, but published more regularly than Special Publications, with no fixed deadline for publication. They should be important contributions to the geosciences of Oman and will undergo peer review.

3. **Popular Geoscience Series.** These publications will be aimed at the general public/informed amateur but will also be of value to the professional geologist. The aim is to strike a balance that is meaningful to people with no/little formal geological training and yet still attract the interest of professional geologists. Some of these could be aimed specifically at children to stimulate their interest in geology, particularly the Geology of Oman and its geological heritage. It is proposed that they would, typically, be pamphlets and A5 booklets focused on a specific geographical or geological area, and some could be glossy posters. These may be published in English and Arabic.

4. **GSO Field Guides.** Specifically written guides to aspects of the geology of Oman. The Field Guides would be economically priced, 'pocket-size' volumes containing practical field information for individuals and groups visiting areas in Oman that provide excellent examples of the Sultanate's strata. The guides would be written to appeal to all levels, from keen amateurs, through undergraduates, to academics and other professional earth scientists. Individual localities and the features that they demonstrate will be clearly

described. Emphasis would be placed on the field aspects of geology, including geomorphology, clastic and carbonate facies, cycles and sequences, sedimentation, metamorphism, tectonics and basin development. Other related aspects of the regional geology such as basement history and mineral deposits may also be covered. The Field Guides should be essential purchases for new visitors to classical areas of geological significance in the Sultanate.

Publications Committee

As this ambitious programme will require a considerable amount of work to achieve its aims, it is necessary to establish a proactive GSO Publications sub-Committee, reporting, through the GSO editor, to the ExComm. If you are interested in serving the GSO, in terms of its publications, please contact the editor expressing your interest.

Proposals

The GSO Editor currently has several proposals under consideration for publication in all the above categories. However, if you are interested in submitting a proposal for a GSO publication please send this to the Editor. Proposals must contain a title for the publication, author's names, affiliations and contact details, a brief summary of what will be covered, a proposed contents list and the Series title under which you see your submission being published. Please be aware that although we are keen to establish publications, we have limited funds and are a voluntary organisation. Consequently, the number of publications that we can produce in any year is limited and we may have to delay publication for lack of time and funds. Some proposals may be rejected. The Editor, in consultation with the ExComm, will have final veto over any proposed publications and to which category they will be published under. The ExComm's decision will be final.

Sponsorship

GSO is a Society of limited funds; in order to undertake this ambitious publication programme sponsorship will be required. If you are interested in corporate or individual sponsorship of individual publications or contributing to a general GSO Publication fund, then please contact the editor. Your company logo will appear in the associated publications (on the cover if you are the sole sponsor), with an acknowledgment, as well as in the Annual Report.

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Book Review – Oman's Geological Heritage, 2nd Edition

Author (1st edition): Michael Hughes Clarke

Editor (2nd edition): Ken Glennie

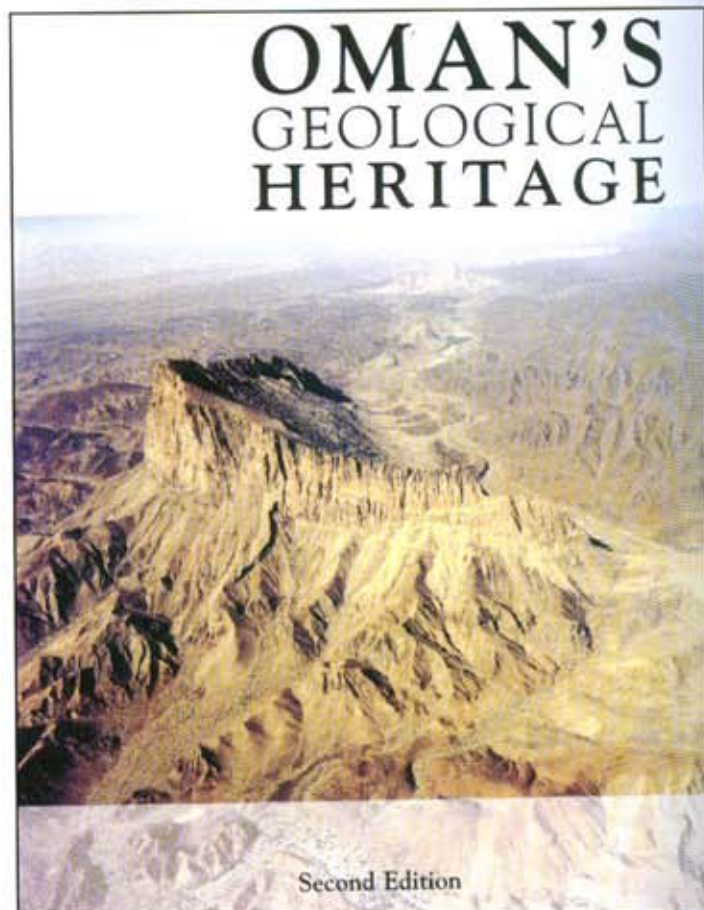
Published by Petroleum Development Oman

Oman's Geological Heritage was originally published, by PDO, in 1990 to commemorate Oman's 20th National Day and rapidly became the definitive non-specialist introduction to the geology of Oman. To commemorate the 36th National Day in 2006, PDO released a new and updated version of the book. As with the first edition the book is available in English and Arabic versions.

Most of the revision to the volume was undertaken by Ken Glennie (a retired Shell employee who undertook extensive fieldwork in the Oman Mountains in the 1960s and a GSO Honourary Member), with contributions from PDO staff and external experts. The new edition takes into account new geological discoveries and recent technological developments with a revised and expanded text and several new pictures. The book documents recent findings such as the first fossil pine cone from the Haushi Group in the outcrop area of the Huqf-Haushi High, the large number of new meteorites discovered since 1990 on the Jiddat Al-Harrassis and the dating of dune sands in the Sharqiya Sands. In terms of technological developments the book addresses recent advances in remote sensing, particularly from satellite images, and its applications to understanding the geology of Oman.

Generally the text has only undergone minor revisions for clarity and to eliminate errors that appeared in the 1990 edition. The most extensively updated section is Chapter 7: 'Delving the Deeps', which has been completely updated to reflect an improved understanding of the role of plate tectonics and the extensive research, since 1990, into ophiolite genesis and emplacement. The new text is supported by a new series of schematic diagrams that are a valuable addition.

Most of the illustrations in the second edition are identical to those in the original edition, this is particularly so of the photographs. However, many new schematic 'cartoons' have been included that are a great improvement on the original, adding clarity and greatly helping in explaining complex geological concepts. One criticism is with the photographs, which appear to have been scanned from original prints, and, despite clearly having been digitally touched-up, many of these are grainier and not as sharp as in the original version.



The second edition of Oman's Geological Heritage, as with the first edition, is certain to become the definitive introduction to the Sultanate's geology. However, it must be said that an opportunity has been missed in that the book could have been totally revised with completely new text, photographs and diagrams reflecting the considerable amount of research that has been undertaken on Oman's geology in the 16 years since the original publication. Nonetheless, the book is highly recommended to both professional and amateur geologists with an interest in Oman's geology. The book is available from major book shops and supermarkets throughout the country.

John F. Aitken
Petroleum Development Oman

Al Khlata and Gharif Formations (Permo-Carboniferous) Outcrops in the Southern Huqf

6th-8th February 2008

Excursion leaders: Juma Al-Belushi (BG (Oman)) & John F. Aitken (Petroleum Development Oman)



A cold Wednesday morning saw the assembly of a group of geologists in the Lulu Hypermarket car park at Ghubra. After a short HSE briefing from Juma, off we set south via the Sumail gap and Sinaw to Duqm. One car was delayed as a result of a minor accident, so the majority of the party set off into the Huqf through the rocky track behind Duqm, and John was abandoned to wait for the delayed car. Forty minutes later and two vehicles were safely negotiating the difficult sabkha at the end of Wadi Dungart. The two parties eventually met in Wadi Al Khlata South.

The geological aspects of the trip began with a walk through the Al Khlata reservoir in Wadi Al Khlata South, starting with the glacially grooved Khufai Formation pavement overlain by diamictite, in turn overlain by gravelly sandstones. We traced the sediments down the Wadi viewing their variability in thickness and facies. These facies changes, over a few hundred metres, are similar to the variability observed in the field, we were told. With the light fading fast, it was back to the campsite and settling down for the night.

After an appropriately glacially cold night it was back into Wadi Al Khlata South to trace the sediments farther down the wadi, with new facies appearing (particularly deformed argillaceous sandstones) and others disappearing. Then into the cars and off to Wadi Al Khlata North where there is a stratified, glaciolacustrine diamictite, an enormous granite erratic and incised sands and gravels. The two sides of the wadi, perhaps 50m apart, cannot be correlated! Shab Nakhad South was the next site visited where a laterally extensive and thick succession of climbing rippled sandstones are exposed, then we ventured north to see the glacial step that appears to indicate a south-westerly ice flow direction. Lunch was at Point Lookout, sitting on the lithic boulders of a weathered diamictite, followed by a brief stop at the Haushi Limestone nearby. Then across the sabkha to Wadi Gharif and a beautifully exposed upper Gharif Formation coarse-grained channel sandstone with inclined heterolithic strata. John explained that these inclined heterolithic strata could represent lateral accretion surfaces on a point bar in a meandering river, or alternatively, they could represent side bar accretion in a braided system. The evi-

dence is equivocal with the outcrops of the Gharif having features of both braided and meandering systems. With the afternoon drawing on it was time to head north to Ain Hindel.



A difficult drive through lots of soft sand, but only one car became stuck and had to be dug out. At Ain Hindel camp was established and we settled down for another cold night.

The morning saw us wandering over the grooved glacial pavement at Ain Hindel where at least three direction of ice movement can be discerned. Then it was time to leave, with an attempt to return to the blacktop via Wadi Shuram, which did not materialise as a wrong turn was taken that took us into a southerly directed Wadi bringing us back to Wadi Dungart. The party partially split up at the blacktop, with two cars remaining in the southern Huqf, whilst the remainder headed north to Mahout after which point we all made our separate ways back to Muscat.

Diamictite, glacially grooved pavements, boulders, channels, limestone one lost mobile phone, one car stuck in sand and one minor traffic accident made a great weekend.

Thanks to Juma and John for arranging this field trip – it was excellent.

On the track of Oman's oil pioneers-

A visit to Duqm, a lost seepage?,

Al Ajaiz, Point 'X', Ghaba-1 and salt mining at Qarat al Milh

Over the weekend of 2-4 November 2006 we journeyed to Duqm with Quentin and Gill Morton, in search of what remains of the Iraq Petroleum Company (PD(O)) camp that stood there. The Duqm camp was an active supply base for PD(O)'s activities from February 1954 until it was closed in 1960. There are plans to construct a major ship repair and dry dock complex on the site and we wanted to see what was there before the landscape is changed forever. We had a few photographs taken by Quentin's father Mike¹ and others from various archives, newsletters and books. The most notorious happening at the camp was an attempt to steal the safe in April 1960, but that is a story for another occasion.

We arrived at about 4pm in the vicinity of Ras Duqm and Stinking Fish Rock; Ras Hamar to a local Wahiba family we talked with. We found two stone-built buildings and were surprised to see wood from labelled packing cases used in the lintels above the windows. It is clear that these are parts of the camp that have stood the test of time.

There were piles of rubble suggesting several other stone buildings had been bulldozed. We soon located a photo point on the top of Stinking Fish Rock (SFR), an apt description even today, not from drying fish but

from the multitude of fishing activities that go on around it. I used to think there was dust on many of the old photographs, now those specs seem just as likely to be seabirds.



View from the top of Stinking Fish Rock looking south towards Ras Duqm. Equipment and materials were shipped in by landing craft and drums of fuel floated ashore. Mina Al Fahal was latterly used as an all season transshipment point en-route to Duqm. Photo courtesy of PDO's digital archive.



As dusk approached we retreated inland a few kilometres to escape the humidity and the smell of fish and camped amongst a weird world of concretionary characters (weathering from the Eocene Dammam Fm). Ones resembling 'Snoopy' and 'E.T.' were our favourites, but there was Picasso's reclining lady, a rocket launcher and many more.

The next morning we returned to SFR and amidst the dissected ground on its landward side came across the same broken glass bottles and blue-rimmed porcelain as occurs near the I.P.C. campsite south of Fahud. There was plenty more evidence of buildings and it did not take us long to locate the site from where George Laurance probably took the best view of the camp that we have come across thus far. As one might expect, it was from the top of the nearest prominent hill. For George, a mechanical engineer, his time in Oman was the most interesting period of his life².

Looking north along the coast is the treacherous beach /sabkha where Don Sheridan got stuck taking a short cut just as he thought he had made the fastest ever journey from Fahud to Duqm³. As we left Duqm, sure enough, one of the fish lorries had tried a short cut and was well and truly embedded in the sabkha.

The edge of SFR to the left, Nafun Island out to sea and the beach extending right towards Ras Duqm. Upper photo by George Laurance, courtesy the IPC Society Newsletter, showing the camp was quite extensive. Nafun Island, in the lower photo, was obscured by the early morning mist.

Our next stop was a water seepage in wadi Jurf at

3. D. Sheridan, 2000. Fahud the Leopard Mountain. Vico Press, pp. 115-116, pp. 39-40.

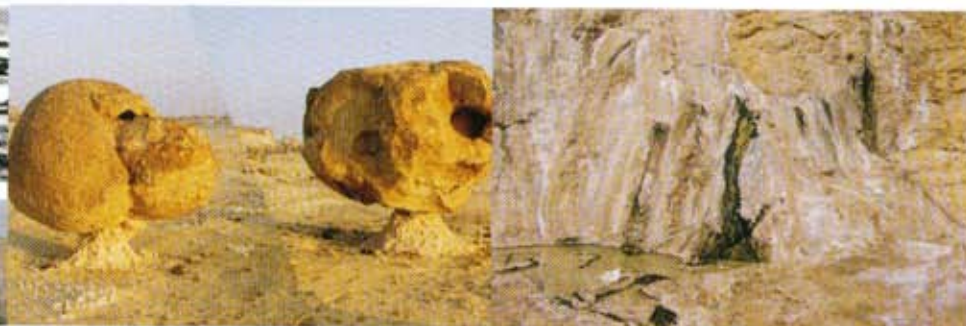
If footnotes are not practical simple please place above text in brackets at the relevant point

557730E, 2182375N. I have driven past this spring many times on the way to Al Khlata and noticed the glistening salty waters trickling over the surface of the Khufai dolomites. The reason for stopping and taking a closer look is that this seems a likely site for the reported oil seepage that was part of the reason that

aquifer. From there we followed the narrow graded road made by IPC in due north and northwest sections across the Jiddat to the salt domes and then Fahud. Along this road many lorries must have passed carrying materials to Fahud, Ghaba and servicing the several geophysical crews that were operating in the area.



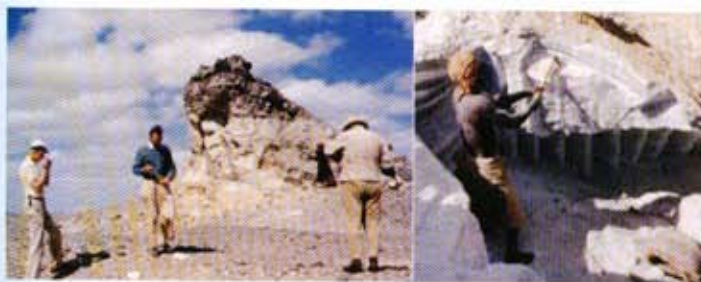
Duqm Camp then and now



Anglo-Persian took a Concession in Oman in 1925-7. There were repeated verbal reports in the early 1920s of a seep a few miles inland from the coast opposite Nafun Island. G.M. Lees and his party landed there on 27 January 1926 and the 'natives proved sullenly hostile.... No information could be extracted from them, not even the names of topographical features. They professed complete ignorance of any oil seepage or bitumen deposit.' Bertram Thomas is more forthcoming in remarking that the 'geological party was greeted by a hail of stones.' It is intriguing to see ribbons of black algae fringing the streams of water and quite possibly these were taken to be oil by tribes-people who knew no better.

We were a bit unsure where Point 'X' was on the track, where a petrol dump had been built-up in 1954 in preparation for a dash for Fahud. Whilst we could see no obvious evidence of abandoned drums, it was almost certainly at Haylat Harashif (a junction on the modern blacktop to Salalah). Sultan Said had prohibited travel north of 21° earlier in the year and Haylat Harashif lies just within that limit.

We called in at the Ghaba-1 wellsite where the Ideal-100 derrick that had previously been used for Fahud-1 lies rusting in the desert. Many of the girders near ground level are stamped with the name Skinningrove and part numbers that allowed this large derrick to be assembled and dis-assembled like a meccano kit. Skinningrove is a town on the North Yorkshire coast near Teeside and still sports a specialist steel works and the Cleveland Ironstone Mining Museum. I bet they don't realise where some of their steel ended up!



Geologists visiting Qarat Al Milh February 1957; IPC Chief Geologist F.E. Wellings with the straw boater and polished brown shoes. A Duru tribesman mining salt at the time of the visit. The pockmarked topography inside the dome is probably not due to dissolution, as I had previously thought, but to the sand covered remnants of shallow pits like the one being dug above.

We also stopped at the small Qarat Al Milh salt dome and saw evidence of continuing small scale salt working. Back home in the UK, Quentin went through some of his father's photographs again and found some of a visit to Qarat Al Milh in 1957. These showed much more active salt mining 50 years ago.

We ascended the Huqf escarpment via the rugged Akaba Boi, just to give Quentin the experience of what it must have been like for his father and the geological party scouting the first drivable routes onto the Jiddat Al Harasis. We drove on to Al Ajaiz to view the water well located by Mike in 1954 that taps a brackish Fars

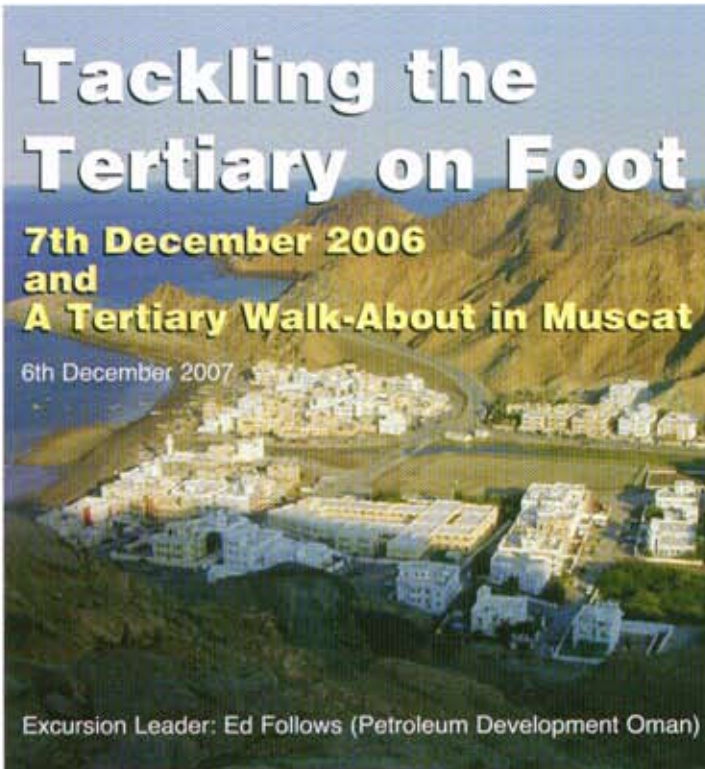
Alan Heward
Petrogas E&P LLC

Acknowledgement Thanks to Quentin for permission to use photos of the Duqm concretions and his father's photos of Qarat Al Milh.

Tackling the Tertiary on Foot

7th December 2006
and
A Tertiary Walk-About in Muscat

6th December 2007



Excursion Leader: Ed Follows (Petroleum Development Oman)

On a fine Thursday morning in December 14 GSO members attended a field trip looking at Ophiolite and Tertiary outcrops in the Muscat area particularly at Ras al-Hamra, Jassah beach & Darsait village. The field trip was led by Edward Follows a PDO geologist. Various ages and disciplines were present. Among attendants were two teenagers and a mathematician.

The field trip mainly focused on Tertiary formations. Fossils, stratigraphy and structures ensured a reasonable geological discussion which was also supported by experienced members. Other issues that found a link to the field trip were civil engineering, hydrogeology, history and archaeology.

The morning session began at a chert-replaced coral, around the Ras al-Hamra golf course and then moved to the unconformity between the ophiolite and the conglomerates at the road cut toward Qantab. Plenty of quartzites from the Amdeh were noted as well as mysterious pale green pebbles thought to be Muti equivalent. The group walked through the old village ruins to the Jassah beach section, hunting corals and red algae.

A lunch-loaded table, carried 1km along the rocks, was



brought to Darsait beach. The absence of quartzite in limestone conglomerates was noted compared to Jassah. It was debated that present day river runoff from Wadi Aday and Wadi Mayh might reflect a similar drainage pattern to that of the early Tertiary during the doming Saih Hatat, infilling irregularities in the unconformity surface, prior to the main phase of shallow marine limestone deposition.

The afternoon featured a challenging climb to a mountain plateau. Personally, the motivation behind this climb was getting closer to a dark bed within the light coloured Tertiary mountains that I see every morning. At this few hundred metres altitude, beside a bird's eye view of my home, a nice overview of the Muscat area can also be seen.

As a geophysicist, I have often shown companions the Ophiolites and Tertiary outcrops however I was not able to point to the Tertiary formations neither was I aware of the fossil content resting next to me at the Jassah beach on a fine weekend rest. It is also unexpected to realize that your neighbourhood is another location where Ophiolites and Tertiary meet up.

For non-geo related folks, the best remark I heard was from my accompanying teenage brother who described being on top of Darsait mountain as being in the Fear Factor show. Perhaps geologists are used to this feeling, perhaps he will get used to this feeling not necessarily on top of a mountain though.

Hussain Najwani
Petroleum Development Oman

Editor's Note: This review, provided by Hussain, particularly refers to the first of the two trips that Ed Follows led to the Tertiary of the Muscat area. The second trip had a different itinerary.



Joint Qatar Geological Society Qatar Society of Petroelum Engineers Field Trip to Oman



The Qatar Geological Society joined forces with the Qatar Society of Petroleum Engineers (QSPE) last November to conduct the first out-of-country field excursion for either organization. The venue of choice was, of course, Oman, where many of the reservoirs that produce oil and gas in Qatar are exposed on the surface for close inspection. Frans Van Buchem took the lead along with support from Henk Droste, Mia Van Steenwenkel, and Adil Al-Kiyumi (GSO VP), our Geological Society of Oman host. Dave Puls, Field Trip Chairman assisted with safety and logistics.

Three full days were spent in and around the mountains and wadis surrounding Nizwa and the coastal access points near the village of Nakhl. On the first day we were introduced to the complexities of obduction and observed the products of oceanic crust formation in the dark brown ophiolite successions. Classic exposures of Jurassic and Cretaceous strata were observed in Wadi Mu'aydin where a several complete cycles of shelfal carbonate systems can be examined. Further to the east, Wadi Bani Kharus offered the chance to see late Precambrian sediments that indicate the presence of glacial conditions and an opportunity to stand on an unconformity representing over 300 million years of geologic time! On the last day we were able to observe the edge of the Cretaceous platform where shelf margin sediments transition into deeper water calci-turbidite deposits. In just a few days we traversed over 500 million years of geologic history! Along the way the group was treated to superb Omani hospitality, culture and the deli-

cious local halwa. This is a trip that must be repeated again and we are already in the planning stages for another excursion.

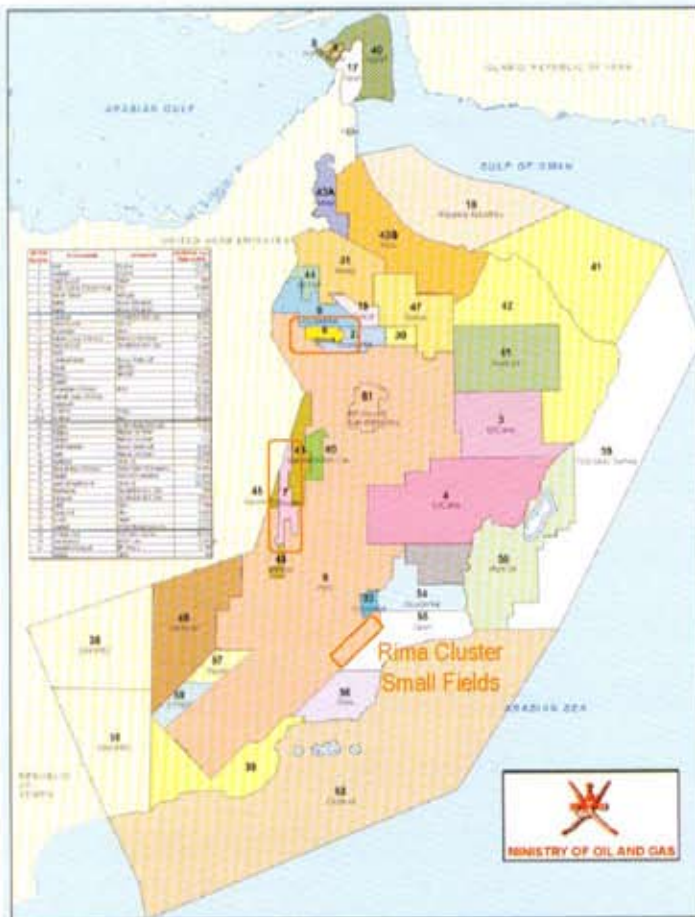
Participants from Qatar included Ali Trabelsi, Fahad Al Halabi, Nayef Al-Mansouri, Ebrahim Al-Khulaifi, Tamer Abdo, Tausif Ahmed, Megha Mohan, Joe Huck, Joe Moser, Jens Ole-Koch, Cathy Fuseller, Otilia Manela Militaru, Georgeta Popa, Sonny Lim, Walid Diab, Jannes Kloos, and Blandine Klein. Supporting companies include QP, Maersk, ExxonMobil, and RasGas, who provided the means for two Texas A&M students to join the trip. Special thanks go to Shk. Faisal Al-Thani and Jassim Al-Mohammadi (QSPE) and Saeed Al-Kuwari (QGS Vice President) for their vision and planning support. Lastly, Kay Montero (QSPE) made it all come together with her organization of participants, payments, and coordination of the tour contractor. Thanks also goes out to the Geological Society of Oman and Adil Kiyumi for accompanying us along the way and providing so much information about the outcrops and local history and culture.

David Puls
Qatar Geological Society

This article was originally published in the Newsletter of the Qatar Geological Society and is reprinted here with permission.



استكشاف وإنتاج النفط والغاز Petrogas E&P



Petrogas E&P is an Omani company wholly owned by MB Holding Company. It is actively engaged in acquisition, operation and management of oil and gas properties. Petrogas currently employs some 70 staff directly in Oman and India of whom 85% are Omani. It has the following subsidiaries-

Petrogas LLC has a 100% interest and is operator of Block 7, Butabul, Oman. This was Petrogas' first E&P asset, acquired in 1999. Light 44°API oil is produced in the Sahmah, Ramlat and Rija fields at depths of 3100-3700 m, representing some of the deepest oil production in Oman. The reservoirs are mainly in the Lower Gharif Basal Sands and Haushi Limestone of Permian age. The leached oolitic dolomite and sandstone reservoirs of the Haushi Limestone are unique in the Sultanate. The oil is of 'B' type, sourced from Silurian Sahmah source rocks. Ongoing exploration activities are targeting a Haushi prospect near Sahmah, Shuaiba closures in the Aydan area and the deep gas and condensate potential of the block.

Mazoon Petrogas SAOC has a 50% interest in Daleel Petroleum, which operates Block 5, Wadi Aswad, Oman. Petrogas was awarded this concession in 2001 and farmed-out a 50% interest to CNODC. Light 30-39°API oil is produced in the Daleel, Mezoon and Bushra cluster fields from Cretaceous Upper Shuaiba and Natih A-D reservoirs. The Upper Shuaiba Daleel accumulation is stratigraphically trapped on the flank of the Lekhwair High. The Natih reservoirs occur both in truncation traps on the eastern flank of Daleel and as fault-dip closures in the Bushra cluster fields. Both the Upper Shuaiba and Natih reservoirs have tilted oil-water contacts due to Plio-Pleistocene regional deformation. Oils are typed to North Oman Huqf and Natih source rocks. Ongoing exploration activities are focussed on Natih and Shuaiba prospects to the east and west of Daleel.

Petrogas Rima LLC has recently been awarded a service contract by PDO to manage and further develop 18 small oilfields in the Rima area of southern Oman (within Block 6). There it will be partnered by Oman Oil Company who will have a 25% interest. Reservoirs in this area are in the Permian Gharif and Al Khlata, and the Cambrian Haima. The oils in the 9 currently producing fields vary in quality from 20-27°API.

Petrogas E&P has 20% interests in three NELP VI Exploration Blocks in India, two offshore in the Mumbai Basin and one onshore in the Krishna-Godavari Basin. These licenses are with local partners GAIL India Limited, Gujarat State Petroleum Corporation, India Oil Corporation Limited and Hindustan Petroleum Corporation Limited. Petrogas is operator in MB-OSB-2004/2, which has Tertiary carbonate reservoirs and is considered oil prone. 3D seismic is planned after the monsoon season in 2008, with exploration drilling to follow in 2009+.

Recently, Petrogas E&P acquired a 30% interest in onshore Area 'A' in Egypt. The Area comprises two exploration concessions and four development leases along the western side of the Gulf of Suez. The operator of these concessions is Oil Search (a company registered in Papua New Guinea). Reservoirs in these Egyptian producing fields are mainly in the Tertiary, whilst ongoing exploration is largely targeted at deeper Cretaceous objectives.



Sahmah field, Al Wusta region, Oman

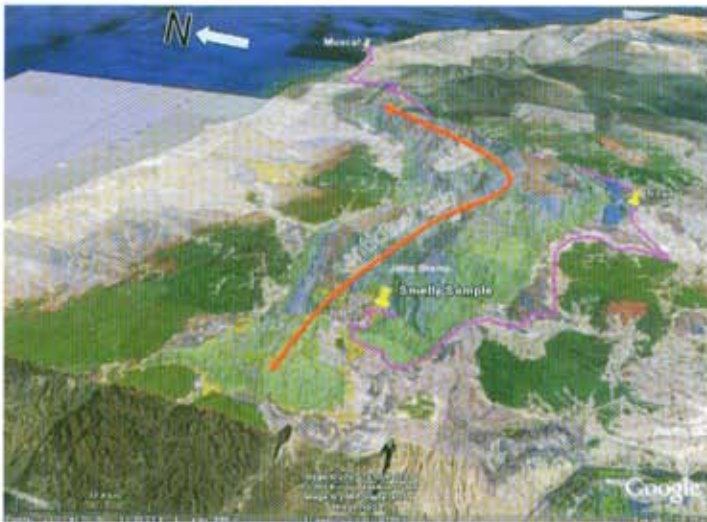
Petrogas is an Omani E&P Company, part of the MB Group. It was founded in 1999, focusing initially on extracting more oil from mature fields in Oman. It now has exploration and production interests in Oman, India and Egypt.

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The smelly sample



Google Earth map draped with the geological map of Oman (BRGM), showing the anticlinal axis of the Jabal Al Akhdar range, the largest anticline in Oman, essentially consisting of Mesozoic carbonates (light greens and blues) draped by the ophiolites (dark greens that have been eroded from the crest). For reference the motorway from Muscat to Nizwa and from there the road up to Jabal Shams.

Our campsite was close to a deep ravine cutting more or less east-west into the western flank of the Oman Mountains. The geological map shows east-west running faults near our campsite and if the geologists that mapped the area would have had satellite imagery on their PC's they would have probably drawn faults through the ravine next to our campsite as well.

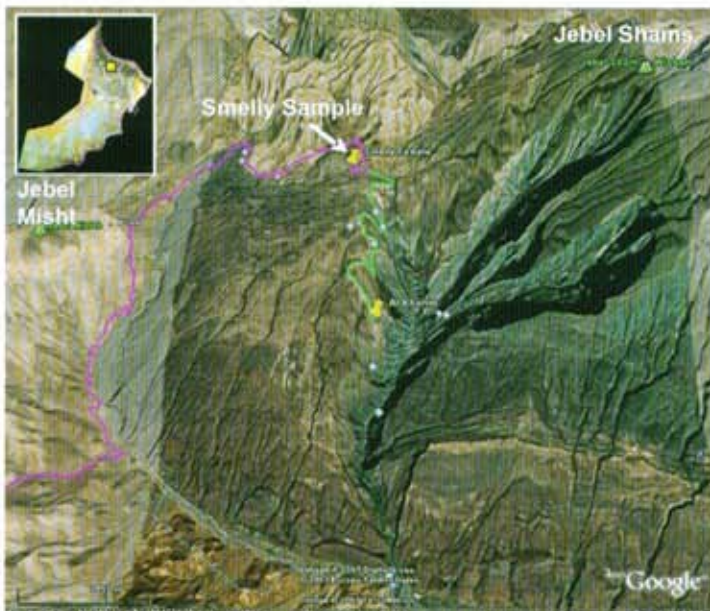
The same satellite images clearly show the darker colours of the Mesozoic carbonates (Natih, Kahmah) contrasting with the sediments of the Hawasina Group just to the north and west (respectively the greens/yellow and the greys on the geological map). These were emplaced on the Mesozoic carbonates at the end of the Cretaceous together with the black ophiolite that now drapes the mountains. The road up Jabal Shams essentially follows the contact between these different carbonates, between what is generally known as the autochthonous and allochthonous rocks of the mountains.

Roaming around we soon stumbled on the idyllic mini-terraced garden carved into the head of the ravine, well hidden from the beaten tourist area just above it. In the shade of the steep rock-faces surrounding the ravine there were even small crystal-clear pools of water. Every niche below the overhanging rocks seemed to have been used by people for simple homes and shelters for their animals. A small oasis in the surrounding barren mountains. People must have lived there for hundred and perhaps even thousands of years. Nobody was living there now, but the gardens were still well maintained. We were closely watched by many curious goats clambering along the rocks.

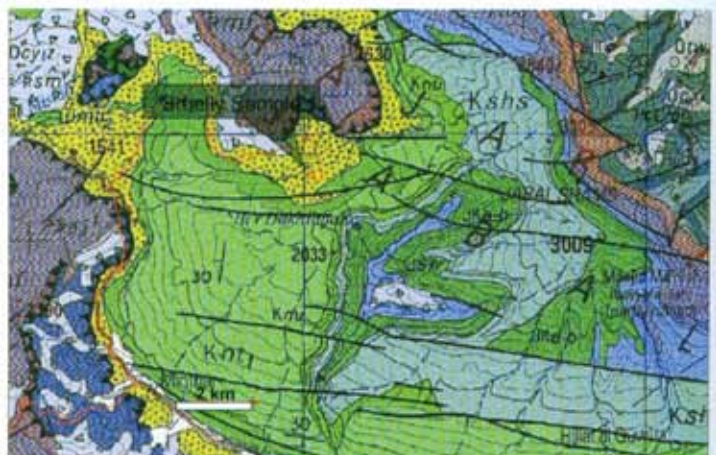
Not surprising therefore to see and smell the droppings of the same goats all over. Droppings, yes, but what about the black stuff that seemed to ooze out of rocks. Normal tourists would not have bothered, but with three geologists a lively discussion started.

Ken Glennie, whose team of geologists mapped the Oman Mountains in the 1960's, concluded that there was no oil to be found there. So here we have the largest structure in Oman that comprises the core of the Oman Mountains culminating at Jabal Shams and Jabal Akhdar, still undrilled. These massive carbonates are bent and broken, deeply eroded, down to underlying rocks dating back to the Neoproterozoic, some 700 million years old.

None of us was thinking of oil when we were camping on the western flank of Jabal Shams during Eid holidays in October 2006. Just enjoying the impressive views.



Satellite view of Wadi Ghul, Jabal Shams area, Oman Mountains, known as Oman's Grand Canyon



Geological map (BRGM) Dotted yellow is Muti Formation, the green colours comprise the Natih Formation and the older Kahmah carbonates. The grey colours comprise sediments of the overthrust Hawasina Group.



A secluded terraced garden and next to it the deep ravine where we found our smelly stuff on the cliff face (the left side of the picture)



Close-up of the black material on the rock surface, at first sight soft and bubbly, but in reality hard and tough.



The black stuff apparently coming out of fractures in the rock.

The stuff seemed to come out of fractures – or was it going in there? But what about seeing it in places too steep and even overhanging. Not places where you would expect goats to empty their bowels unless their ancestors would have had spider-man powers. The material had solidified in the baking sun as hard, black, amorphous material, but with a bubbly surface, almost like frozen while flowing. We needed hammers to get some pieces.

Strange material but with the unmistakable smell of what is generally known as shit. Geologists, used to explaining the unknown, are never shy of a possible answer and in this case stuff oozing out of rocks could of course mix with goat-stuff, explaining the smell. Back at the campsite we tried to burn the material, concluding that it was almost fire-proof, now smelling even more. Not the tell-tale characteristics of hydrocarbons seeping from rocks. How to explain that it seemed to come from the rocks? Rocks not far from a faulted zone and not far from big thrusts. That's why we decided to take some samples home. Well packed to avoid the penetrative smell.

Once home, the bag with the smelly samples was hastily put out of nose-range back in the shed. That's where it remained hidden for many months. Courageous plans to analyse the material were discussed around the campfire on Jabal Shams, but back home realism favoured a more careful approach as most evidence indicated something to do with goats.



Remnant of a partly walled rock dwelling where dung can accumulate over many years, decomposing and impregnating the rocks.

Goat-stuff, albeit weird looking, to be analysed in a sophisticated geochemical laboratory? The bag remained where it was ... until Cyclone Gonu hit Oman.

Clearing the mess

after the storm we also needed to empty the shed behind the house. There was the bag, still smelling. No more excuses.

After consultation with our geochemist, explaining its strange origin, we decided to give it a try and send a bit for analysis. To understand this, one has to realize that in a country relatively rich in oil it is perhaps surprising that there is only one known place where oil naturally seeps to the sur-

face. This seepage was found by Don Sheridan in the 1950's while mapping in the Haushi area in Central Oman, almost by accident, at the edge of a sabkha. To get hydrocarbons to surface one also needs water to carry it there and that is of course the problem in a desert country. No more true seepages have since been found, yet geologists have always been on the look-out for oil indications. Where better than in the mountains where rocks have been eroded deeply and where perhaps even oil was trapped once before. After all the location is below the sealing Muti (Fiqa) in carbonates of the Natih Formation, a combination that houses some big oil fields in the interior of Oman.

Back to our smelly sample.

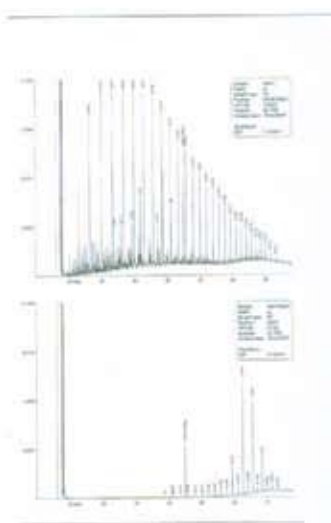
Gas chromatography, an analytical method commonly used to characterise hydrocarbons, shows what we already expected: no hydrocarbons. Peaks in the C30 range (molecules with chains of 30 carbons strung together) indicate plant-material. Very supportive of the smelly interpretation as likely goat excreta, as the scientist would say.

So how can we explain all of this?

Walled dwellings may have faced many areas below the overhanging rocks. Some still remain. Dwellings that filled over time with goat droppings, accumulating and decomposing, partly into organic liquid material, soaking into the rocks. The dwellings have long since disappeared and the material now oozes out of the rock, solidifying in the sun.

No oil, no big anticline to drill.

Still one never knows as the saying goes: "oil is where you find it".



Gas chromatograms of a typical Oman oil (above) and the smelly sample (below). Notice that most C-peaks of the smelly sample are only in the C-30 range indicating complex higher organic compounds.

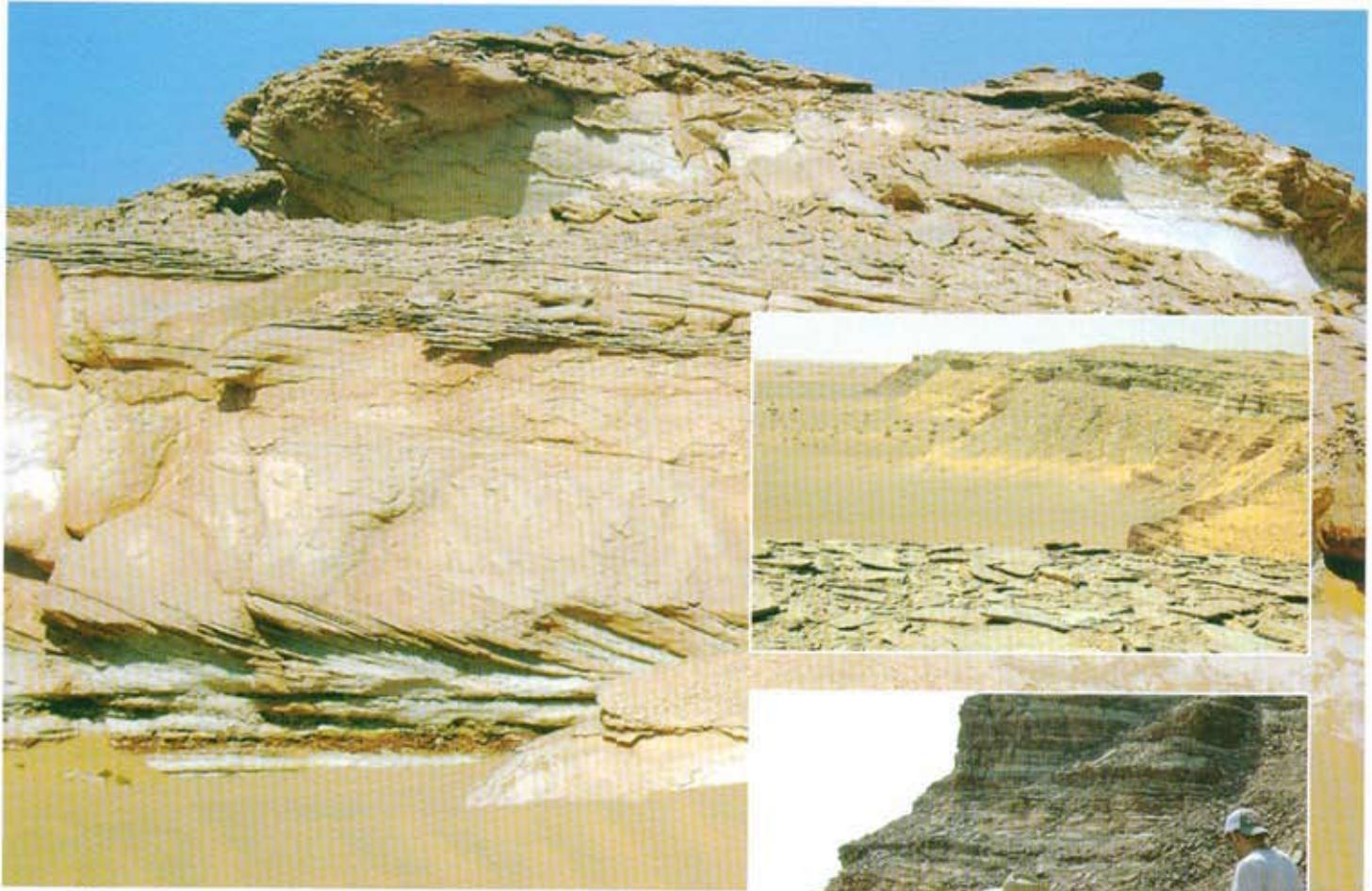
Sultanate of Oman **Geoscience Publications, 2006**

A list of peer reviewed Oman geoscience publications from 2006 is provided here. This bibliography covers geology, palaeontology, petrology, geophysics, hydrogeology and geomorphology. Omitted are annual reviews, papers dealing with the entire Arabian Peninsula, regional summaries and articles in trade publications. Also excluded are conference abstracts (even if published in respected Journals; e.g. American Association of Petroleum Geologists Bulletin and GeoArabia) and papers that do not undergo peer review (e.g. Society of Petroleum Engineers Papers), although these may contain valuable contributions to the understanding of the Sultanate's geosciences.

This bibliography has been compiled using internet search engines and the browsing of Journals available to the compiler. It is believed that this is a complete listing for 2006, however if anyone notices any omissions, please contact the editor (editor@gso.org.om) and these will be published in the next edition.

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The Cambro-Ordovician Lower Haima Supergroup. Amin, Miqrat and Lower Andam Formations

15th February 2007

Core Workshop Leaders: John F. Aitken, John A. Millson & Raimond van der Pal (Petroleum Development Oman) and

Cambro-Ordovician Haima Supergroup: Miqrat Formation, Al Bashair and Barik Sandstone Members (Andam Formation), Qarn Mahatta Humaid, Haushi-Huqf High

28th February-2nd March, 2007

Excursion Leaders: John F. Aitken, John A. Millson, Raimond van der Pal (Petroleum Development Oman) & Salmeen Al-Marjibi (University of Aberdeen)

Four days split across two weekends looking at lower Haima deposits in the subsurface and at outcrop might be some people's idea of a nightmare, but to several enthusiastic geologists it was a delight!

The Haima extravaganza began on Thursday 15th February in PDOs core storage facility where some 25 people gathered to view Amin, Miqrat and Andam Formation cores. This was the first core workshop organised by GSO and it was greatly appreciated by the participants with a suggestion that at least one such workshop should be held each year. Thanks are extended to the Ministry of Oil and Gas and the management of Petroleum Development Oman for permission to show these cores.



Two weeks later and a group of 30 gathered to continue the journey through the lower Haima by visiting the outcrops at Qarn Mahatta Humaid. The trip did not start auspiciously when one of the trip leaders (John A) missed the turn for Sinaw and ended up in Adam! However, once in the Huqf, sheetflood and playa deposits of the Miqrat Formation were viewed and discussed, the upward transition into the Al Bashair viewed and the amazing trace fossils in the Al Bashair debated. Then on to the fluvial sandstones of the Barik Sandstone Member.

John, John, Rai and Salmeen must be congratulated on running such a good trip and for the initiative of the core workshop.

Geology of the Jebel Sumeini Area

11-12th January 2007

Excursion Leader: John Hurst (Indago)



The second 'overseas' GSO field trip, a drive to Hatta, one passport forgotten and one person returning to Muscat. The party met with John Hurst at the Hatta Palace Hotel, collected packed lunch and off into the field.

The first stop was an overview where John explained the setting of Jebel Sumeini lying between the Hawasina to the east and the carbonates of the Margham Field to the west, thrust-bounded on both sides. The next stop was north-west of Wadi Wasa where John further explained the setting. Here a complete section is exposed from the Permian, through the Triassic and Jurassic into the Cretaceous, possibly all riding on top of salt with thrusting to the west. To the south of Wadi Wasa we walked to the mountain to examine a few patches of dark grey sediments in the midst of lighter grey deposits. The light grey sediments are Triassic-Jurassic aged carbonates, but the dark grey sediments are clastics with patches of gypsum. These are out of place, but biostratigraphically barren and so they cannot be dated. A theory to explain this juxtaposition is that salt movement brought these clastics up from deeper stratigraphic levels and they were then subsequently moved by thrust faulting. At the entrance to Wadi Wasa, Carnian reefal deposits are exposed overlying Jurassic extensional faults. This site is due to disappear as it will be quarried for building materials for Dubai. This is a great shame as this is one of only two sites that expose these sediments. Within

Wadi Wasa, dark Permian sediments are thrust westwards onto the Jurassic with Carnian age deposits wrapping around.

Following an excellent buffet breakfast we set off for Jebel Makram where slope carbonates of the Hanifa are exposed with a chert marker bed in the Rayda Formation. Next on to Wadi Mayha where there are interbeds of turbiditic and cherty carbonates, which locally are very conglomeratic. This is the equivalent to the Nahr Umr Formation! To the north, the Hawasina is thrust onto carbonates and overlain by the Guwaisah Formation. The final location was just off the main road leading to the Margham field. Here there is an exposure of Natih E carbonate boulder beds. Underlying these Natih deposits, some 100m to the south, are sediments of the Fiqa, younging upwards, which were probably shed off an exposed carbonate shelf. Finally John showed us some cross-sections of the Margham Field. Margham-1 was drilled on a thrust-related dome of Maudud. To the south Mirdiff-1 was drilled on a structure that was thought to be Maudud boulder beds, but this interpretation proved to be incorrect.

Thanks are extended to John Hurst for running this field trip.

Ibrahim Al-Ismaili
Petroleum Development Oman

The Sharqiyah Aeolian System: Processes, Products and Implications for Hydrocarbon Prospectivity & Production

29th November – 1st December 2006

Excursion Leaders: Steve Fryberger & Caroline Hern (Petroelum Development Oman)



Figure 1 Small barchan dunes migrating across well sands and gravels on the southern margin of Wadi Batha. Larger barchanoid dunes are visible in the background migrating up the eastern side of a linear dune.

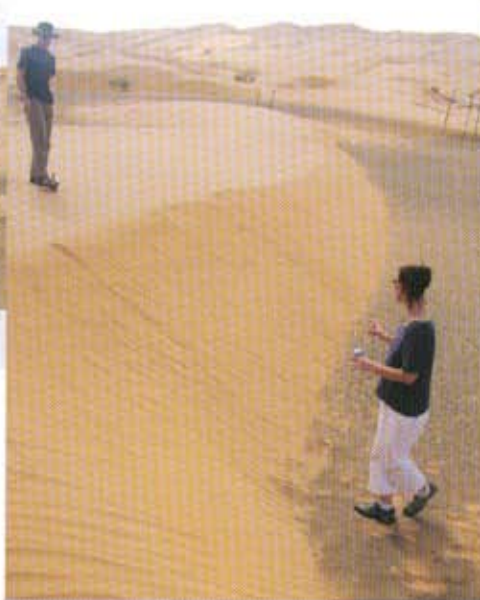


Figure 2 Caroline explaining sedimentation processes on a small linear dune in Wadi Batha.



Figure 3 Trenching in Wadi Batha.

The Geological Society of Oman trip to the Sharqiyah Sands run by Steve Fryberger and Caroline Hern provided an excellent insight into modern aeolian sedimentary processes and their controls in this unique area of Oman. The trip progressed from the examination of small-scale fluvial and aeolian sedimentary processes to evaluation of the current and historical aeolian processes active on the large-scale bedforms in the interior of the Sharqiyah Sands. As is fitting for one of the key gas plays in the Sultanate, the participants were reminded of the implications for subsurface exploration and exploitation at various stages of the trip.

While and coordinated by Steve Fryberger and Caroline Hern, the trip brought together the additional expertise of Ken Glennie and Chris Heine. On the evening prior to the first day Ken Glennie placed the study of the Sharqiyah

Sands in a historical context but more significantly provided a regional overview of the processes controlling aeolian sedimentation of the Sharqiyah Sands. He explained how the tectonic evolution of northern Oman and the uplift and erosion of the Oman Mountains coupled with glacial-induced climatic changes impacted the seasonal variation on wind strength and aridity. Chris Heine re-iterated his lecture of the previous night demonstrating how the understanding of the global setting of ancient aeolian systems allowed an improved understanding of variations seen in the subsurface reservoirs.

The field trip started with the selection of a number of locations in Wadi Batha that superficially comprised a small linear dune and a small barchan dune and wadi gravels (Figures 1 and 2). The group were set to work under the sun to open up trenches exposing the internal architecture

of the deposits (Figure 3). The surface processes were then related to the internal stratification styles and the sediment calibre. The participants were made aware of sediment segregation and sorting in aeolian systems by the combined effects of sediment saltation and suspension and sediment transportation by wind-ripple and bedform migration were explained.



Figure 5 Grain flow avalanche on a wind-rippled slipface to a barchanoid dune on the crest of a linear dune.



Figure 4 Wadi gravel overlying de-stratified well sorted sand of aeolian origin.



Figure 5 PDO sand trap near Al Raha camp situated on a small dune in the interdune area between two linear dunes Sharqiyah Sands.



Figure 6 Late evening on the Sharqiyah Sands looking over the steeper western margin to a linear dune across the interdune area to the west.

Discussion was also had on the differentiation of aeolian and fluvial sands. In this example the wadi gravels derived principally from the Oman Mountains to the north were poorly sorted and lithic rich whereas the aeolian sands are well sorted and quartz rich. The difficulty arises when fluvial processes rework aeolian sands (Figure 4).

From Wadi Batha the trip progressed into the interior of the Sharqiyah Sands where the architecture of the linear dunes was examined. Here the compression of the trade wind belts during glacial episodes resulted in an increase in the velocity of the monsoonal winds which impinge onto Oman in this area. Sediment was transported northwards and segregated into linear dunes with the interdune areas being largely swept of sand. While the linear dunes were formed during the last ice age, current processes are modifying these massive structures with preferential migration of sand to the north-west. This results in the development of superficial barchanoid dunes on the eastern sides of the linear dunes and slip faces on the western sides (Figure 5).

An introduction to the ongoing research being conducted by the PDO trip leaders was provided by a visit to a sand trap near the Al Raha Desert camp. This ingenious device comprises a partitioned container buried below the surface. The container is capped and has a small, hollow wind vein that orientates parallel to the prevailing wind and captures saltating sand grains (Figure 6). The grains drop into the container and the amount and calibre of sediment being transported in different directions can be measured.

The first day finished on the crest of a linear dune north of the Al Raha desert camp. The group considered the internal architecture of the dunes considering the original formation during the last glacial period and the subsequent modi-

fication by the current wind system (Figure 6). We then returned to the camp for the night.

Another research initiative was described on the evening of the first night by Colin McBeth and his co-workers from Heriot-Watt University, Edinburgh, Scotland. The UK-based team have been undertaking ground penetrating radar surveys (GPR) in the Sharqiyah Sands to evaluate the internal architecture of the linear dunes. While revealing only limited information from the core of the dunes, the GPR did indicate the possible presence of dense cemented intervals a short depth beneath the surface.

The second day of the trip saw a shift to concentrate on the processes allowing stabilisation of the dune and the interdune areas. Scrub vegetation is a feature of most of the locations in Sharqiyah Sands visited and examples of rhizonecretions and pedoturbation of dune sands were examined (Figure 7).

The presence of more extensive cementation was evident in the interdune areas where dm to metre thick limestones are developed locally. These indicate the presence of a higher high water table at some point in the past and emphasised the importance of changing climate as a control on the formation and preservation of these sands.

In the early afternoon at the close of the trip, thanks were given to Steve and Caroline for well co-ordinated and safely run trip. The participants were then directed back to the highway for quick refreshments before the return drive to Muscat.

Ross Garden
BG (Oman)



Figure 9 The flat interdune area between two linear dune complexes. The interdune floor comprises a 2m-thick limestone with pedoturbation.



Figure 7 Pedoturbation of Aeolian sands on the northern margin of the Sharqiyah Sands and Wadi Batha.



Wind-ripple migration across the top of a linear dune.

GSO Calendar 2008

February

26th February

How strong is the Glue? Crack-Seal processes in the Jebel Shams High fluid Pressure cell: New Insights from high resolution field studies and microstructural modelling

Prof. Janos L. Urai, Mr. Marc Holland & Dr. Christoph Hilgers

Oman - German University of Technology (OGTech), Muscat and RWTH Aachen, Germany.

March

3rd-5th March

Geo2008

Manama, Bahrain

11th March

Stratigraphic Framework of the Mafrq Formation, North Oman

Mr. Hamad Al-Shuaily

Petroleum Development Oman

13-14th March

Qarn Sahmah Salt Dome, Evaporites, Ara Stringers and Volcanics, Al-Khlata Glacial Deposits and Salt Mining by PD(O) and the Durru.

Dr. Alan Heward (Petrogas LLC)

Ms. Zuwena Rawahi (PDO)

20th-21st March

Structural evolution and fracture pattern of the Salakh Arch (foothills of the Natih Formation)

Dr. Mohammad Al-Kindy

Petroleum Development Oman

25th March

The Geological Evolution of the Laurentian Passive Margin: Late Cambrian-Early Ordovician of Eastern Ontario and SW Quebec, Canada

Dr. Osman Salad Hersi

Sultan Qaboos University

April

7th April (Joint GSO-SPE Special Talk)

Block 7: Butabal and Fields

Dr. Alan Heward

Petrogas LLC

3rd-4th April

Evolution of Jebel Akhdar

Dr. Mohammed Al-Wardi

Sultan Qaboos University

May

29th May

GSO Annual Meeting

Copy deadline for future issues

Spring 2008	Wednesday 12th March 2008
Summer 2008	Wednesday 4th June 2008
Autumn 2008	Wednesday 3rd September 2008

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