



AL HAJAR

Geological Society of Oman
Quarterly Newsletter

First Edition

January 2004

President's message

Dear GSO Member,

It gives me great pleasure to introduce the first edition of **AL HAJAR**, GSO's quarterly Newsletter (for the meaning of **AL HAJAR**, see next section). The publishing of **AL HAJAR** marks another milestone in GSO's relatively short history, and for that I would like to thank the Editorial Committee headed by Dr. Nadia Al Abry. The intent of this newsletter is to serve as another medium of communication through which you will know about various GSO related activities and events. Short articles on the geology of Oman are also part of the content. We intend to keep this newsletter a two communication medium, so your contributions and comments are not only welcomed but are also critical to the continuation and success of **AL HAJAR**. I hope that you will enjoy this first edition.

Best Regards,
Hisham. A. Al-Siyabi
GSO President

Welcome from the Editor

To achieve our vision of becoming the premier geoscience society in the region, GSO has the pleasure of launching its quarterly newsletter starting this January of 2004. The newsletter is titled **AL HAJAR** which its proposal by Mohamed Al-Harthy crowned all the other suggestions. The newsletter is planned to be crisp and light but still informative with a cutting edge. The newsletter will incorporate technical, business and leisure geoscience topics which amongst the proposed so far are:

- Geological sites from Oman and/or around the world.
- Profile of person or geological institute, centre...
- Review of geological publications (articles, books etc...).
- Review of GSO activities, talks and field trips.
- List of the latest publications on Oman geology (and maybe a review on one of them once a while).
- Latest news from GSO's principal sponsors, Oman exploration and/or production news: business and technical.
- Latest news from the different contractors and operators.
- Youngsters corner: Overview, review and simple explanation of the Oman stratigraphy, geological concepts, methods and techniques.
- Calendar and/or events list of the GSO (talks and fieldtrips) and other affiliated institutes such as SQU, EAGE, AAPG....
- Geo Fun, Earth Quiz, Jokes & Cartoons

For the first issue of **AL HAJAR**, some interesting topics are covered and the material submitted for the next issues looks very promising. The launch of **AL HAJAR** has been received with much enthusiasm and support from the GSO members and other various parties and we are looking forward to establishing the newsletter as a platform of leading geo-science news and knowledge in Oman and internationally. We therefore welcome your ideas and comments on the newsletter topics and presentation and your comments may feature in future issues of "**AL HAJAR**". The next issue will be a "Geo-Arabia Special Publication" where different topics relating to Geo-Arabia will be presented. These may include reviews on the papers presented, the participants, GSO activities in Geo-Arabia etc...

Nadia Al-Abry,
Acting GSO Editor

This issue is sponsored by the

Geological Society of Oman

E-mail: info@gso.org.om Internet: www.gso.org.om

AL HAJAR Explained

It is a great and real honour to propose the title for the GSO newsletter, which I have intended for it to be short, meaningful and reflecting the beauty of Oman geology. I therefore could not find a more suited title than "**AL HAJAR**" which is Arabic for the rock and strongly links with Oman and its cultural and geological values.

AL HAJAR is also often referred to the Oman "Rocky" Mountains located on the southeast corner of the Arabian Peninsula, where they form an arcuate range bordering the Gulf of Oman.

The majority of the rocks outcropping in the mountains belong to three main geological units. The lowest of these units consists principally of shallow marine carbonate limestones that, in the desert plains to the south and west of the mountains, contain the oil and gas reservoir rocks at Lekhwair, Natih, Fahud, Yibal and other fields. The middle unit (the Hawasinah) had turbidites, red cherts, large blocks of white Permian limestone "Exotics" and volcanic rocks. This section is commonly seen in quarries in the North of Oman where building materials are extracted. The highest unit (the Semail) comprises a suite of basic and ultra basic rocks (ophiolites) that consist of serpentinised peridotites, gabbros, diabases and pillow lavas. Copper and chromites are mined in Sohar from this unit.

Mohamed Al-Harthy

What's inside

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The Roadside Geology of the Muscat Area

You're driving to Al-Bustan from the airport for a well-deserved weekend of relaxation; and at first, you don't really notice it. Then, a few kilometers along, you find yourself impulsively glancing off the road into the distance more often. At Qurum, you instinctively know something odd is going on. By the time you're rounding the curve into Ruwi, you're so transfixed by the galloping geology outside your window, you narrowly miss that cab merging from the shoulder.

"That's it!", your wife shouts. "Pull over and let me drive!"

Happens to me all the time. So, in order to become conversant on the unique geology of the capital area (and avoid future marital conflict) I dove into the literature; fully expecting to be simply drowned in information. Considering the extraordinary geology of Oman in general and the Muscat area in particular, I thought there must be literally (as well as figuratively) tons of information available detailing this unique natural geological laboratory.

Yes, there is a tremendous volume of literature. Yes, it ranges from Lees' influential paper in 1928 to studies ongoing today (e.g., Braun & Keleman, 2003). Yes, it confirms Oman's place as a first in unusual and exciting geology. However, it is virtually all regional, at a scale of 1:250 000 or greater. It does not really address nor explain site geology (save and except for a few learned field trip studies), and leaves all those incredible outcrops sitting there exposed and in a data vacuum.

As natura abhorret a vacua, I have embarked upon "The Roadside Geology of the Muscat Area", as an effort to both fill this unfortunate void and reduce geology-related road accidents in the capital area.

The book will be produced along the lines of the "Roadside Geology of [insert US state/park here]", and is intended for the professional geologist, interested amateur or curious layman. To address such a potentially large audience with varying degrees of geological acumen; the volume will include such items as: the international geological time scale, a new and revised Muscat area stratigraphic column, explanations of regional geology, stratigraphy, and tectonics, a detailed glossary, bibliography, and appendices explaining such things as SI units and other scientific minutiae.

However, the real meat of the volume will be the "stops". These will be those very outcrops causing all the traffic interference from Seeb Airport in the north to Al-Bustan hotel on the south; and covering a swath approximately 20 km wide parallel to the coast between these two endpoints.

The stops will be arranged travelogue-style; with odometer readings, directions, relevant signs and landmarks, as well as detailed site-specific (i.e., individual outcrop) descriptions.

In an endeavour to tie-in all available information and make the Muscat geological story as inclusive as possible, each outcrop will (where possible) be rendered as a photomontage, rather than single photo (Figure.1); complete with GPS coordinates, measured section, locale maps and sketches, occurrence in the stratigraphic column (Figure. 2), photogeologic interpretation and explanatory text (as noted in this partial example):

Figure. 1: Outcrop of Pleistocene cemented aeolianites ('fossil sand dunes'), Ras al-Hamra road (above the driving range) in PDO camp. Kilometer 21.5 from origin: Coordinates 23037'13.75"N, 58031'13.2"E. View is to the north-northwest.



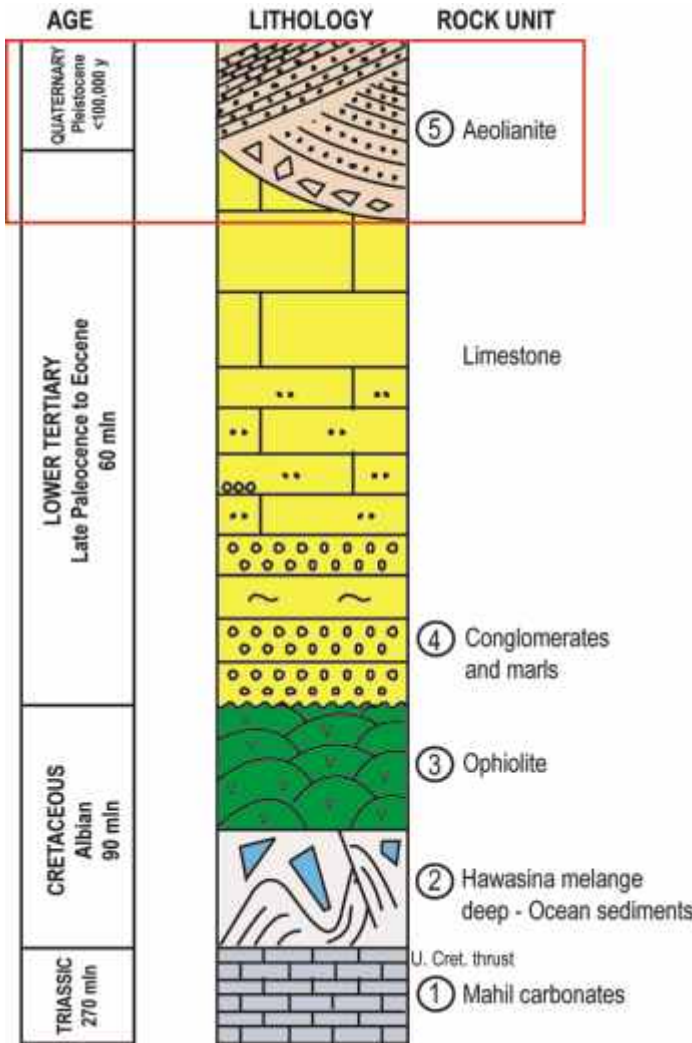


Figure. 2: Muscat stratigraphic column. Box indicates interval covered in Figure 1.

These cream-colored well-cemented Pleistocene deposits fill most depressions and paleokarst features in the Ras Al Hamra area. These are clearly unconformable on the generally steeply-dipping limestone beneath. They are aeolian sand dunes, composed primarily of bioclastic lime grains with subordinate siliciclastic and ophiolitic particles (Glennie and Gökdag, 1998), wind-blown in origin and commonly banked-up steeply and thickly against ridges of older rock. The material is soft and porous, comprising mainly calcareous grains. Sharp internal cross-beds, with dips of up to 350°, support a wind-blown origin. These deposits are not accumulating at present, indicating a change in depositional environments and conditions since the Pleistocene. This could be due to a decrease in availability of sediment, changes in climate and wind directions, or combinations of these factors. In the sea cliffs east of Ras Al-Hamra bay, the wind-blown deposits dip below present sea level, indicating a lower sea level at the time of their deposition.

It is probable that during the last glacial pulse in the late Pleistocene, large areas of unconsolidated sediment on the continental shelf would have been exposed and subjected to windblown transport, providing the source of material in the ancient dunes. Also, this lower sea level lowered the local water table. When sea level rose after the last glacial period, these dunes were inundated by both a rising water table and frequent rainfalls; to be cemented by calcite and celestite derived from calcium and strontium-rich ground and surface waters.

This is truly a “work in progress” and though I have endeavoured to include all available information; if you have any information, published or unpublished, that you think would pertain to this study and enhance the final product, please Email me at Martin.R.Leipzig@PDO.CO.OM or Rocknocker@australia.edu. Indeed; questions, comments, criticism, and large sums of cash will be gratefully received.

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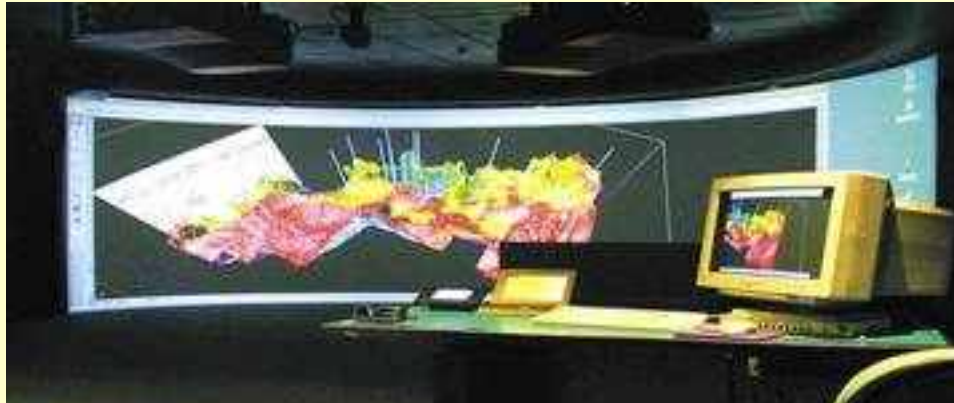
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Stratigraphic column adapted from: J. Marshall, 1994, BPZ Geological Excursion, Capital Area, PDO Note.

By Martin Leipzig

Joint Virtual Reality Centre for Carbonate Studies



INTRODUCTION

The Joint Virtual Reality Centre for Carbonate Studies (JVRCSS), is a joint venture between Sultan Qaboos University (SQU), Muscat, and Shell International. Housed in the Department of Earth Sciences at SQU, the Centre has a powerful graphics computer system and a state-of-the-art Virtual Reality Room. The Centre also has access to all the facilities in the Department of Earth Sciences, including lecture theatres, lab rooms, microscopes, thin section fabrication, XRD, XRF, and SEM equipment.

The Joint Virtual Reality Centre for Carbonate Studies was presented to His Majesty Sultan Qaboos bin Said by the Shell international Group of Companies as a gift to the nation on the 30th Renaissance Day.

FUNCTIONS & DUTIES

Linked to the Earth Sciences Department in Sultan Qaboos University, the Centre's functions are:

Education

We provide undergraduate studies as well as higher studies opportunities. Our main contributions are to Sedimentology, Stratigraphy, Seismic Interpretation, Petroleum Geology, Reservoir Engineering and Hydrogeology in the form of lectures, field trips and seminars. Higher education is provided as an MSc by Research in Carbonate/Petroleum Geology or a PhD program, which offers joint projects with foreign institutions and awaits candidates.

We provide an experienced and qualified teaching resource for undergraduates and graduate students. Belonging to an independent unit, our professionals, who come from both Geo-science and Engineering backgrounds are well-placed to provide cross-discipline courses for Science and Engineering students, which focus on topics related to the oil and gas industry.

Research

The Centre aims to achieve recognition as a world-class unit providing high quality research. Our research interests cover the full spectrum of carbonate rocks and related industrial aspects, particularly with regards to hydrocarbons and water resources. We promote understanding, analysis and solution of complex geological and engineering problems encountered in the exploration for oil and gas in carbonate systems, in reservoir characterization and modeling, and in the simulation of oil and

gas reservoir behavior. We are working in close collaboration with several academic research centres of international repute such as Aberdeen University, MIT-ERL, University of Miami-CSL, Free University of Amsterdam, BEG/University of Texas at Austin, Colorado School of Mines, Delft Technical University, Rennes University and Zurich Polytechnic.

Commercial Services

With expertise in the geo-science and engineering aspects of exploration and development of carbonate reservoirs, we act as consultants for the industry. Our advisory technical and research based services are available not only to Shell, but also to other companies and to non-profit organizations. The centre offers a range of set short courses as well as Tailor-made one-two day specialist courses. Mentoring and supervision may also be employed in directly solving specific problems with your own data to ensure effective technology transfer, skills development, product enhancement and project audit.

With our Virtual Reality Room and SUN workstations to visualise and interpret seismic datasets, we offer a range of services for the oil and gas industry, with ranges starting from acreage assessment, through prospect identification and appraisal to reservoir characterisation and ending with reserves evaluation. We also carry out petrographic and diagenetic studies and have access to the expertise of our Carbonate Technology & Skills Network.

Staff

Professor Peter Homewood
Director of Joint Virtual Reality
Centre for Carbonate Studies
E-Mail: homewood@squ.edu.om

Dr Omar Al-jaaidi
Assitant Director of JVRCSS,
E-Mail: aljaaidi@squ.edu.om

Wim.J.A.M Swinkels M.Sc.,
Petroleum Engineer,
E-Mail: Wim.Swinkels@Shell.Com

Henk Droste
M.Sc., Geologist
E-Mail: Henk.Droste@Shell.Com

Steve Farmer
IT Manager
E-Mail: STEVE.SM.FARMER@pdo.co.om

Asma Al-Saidi
IT assistant
E-Mail: amsaidi@squ.edu.om

By Omar Al-jaaidi

Contact Details JVRCSS

P.O. Box 36, Al Khod, Postal Code 123, Sultanate of Oman
E-mail: jvrccs@squ.edu.om
Web: www.squ.edu.om/sci/centres/VR/index.htm

Wadi Al Jizzi Field Trip Review

Oman had been an obsession of mine for years. As an undergrad, I had read about Ophiolite outcrops in Oman; the largest, best-exposed and least-deformed fragments of oceanic lithosphere preserved on land. After completing my PhD, I worked for a company contracted to Intec Engineering to assess the subsea geohazards along the Oman to India Pipeline route. Unfortunately, I started too late to take part in the surveys. Finally, my chance came, when after some correspondence with Jan Schreurs regarding the sediment transport along the Al Batinah coastline, I was invited on the Geological Excursion to Wadi Jizzi.

The field trip was to cover the Al Batinah coastal plain region from the coastal town of Sohar inland approximately 40 kilometers to the Zabyah region in Wadi Jizzi. After dropping off our gear at the Sohar Beach Hotel, we drove out to visit the first stop of the trip, the ruins of Hawra Burghah, a medieval fortress, which sits high above Wadi Jizzi with spectacular and commanding view of Sohar peak and the wadi below. I was electrified to stand along the walls of this ancient fortress and look through doorways out on a scene that has not changed for millennia. It was hard to leave this spot, but we had to head to Fort Sohar where Talib Al-Ajmi had arranged a private tour for us. While the Fort had many displays on the archeology and geology of the region we were to visit the next day, what awaited us on the watchtowers rooftop was truly spectacular, watching the sun set over the Western Hajar.

That evening we all were treated to a nice dinner and an introduction to the geology of Wadi Jizzi by Jan. I have to add, I was relieved to find so much background on the extrusives in the guidebook prepared by Jan, for my enthusiasm alone could not help me recall my mineralogy and petrology from undergrad! Randall Penney after dinner provided a tour of the skies to most of the group, making this a truly interdisciplinary field trip: Geology, Archeology, and Astronomy.

On Day 2, we headed back to Wadi Jizzi to see the spectacular outcrop at the Geotimes Pillow Lava locality (Figure.1). Jan led us through the stratigraphic section, showing us the geology and archeology of the Lasail Mine, with its ancient arch left by the miners for good luck. We lunched under palm trees below the Zabyah Sheeted Dykes (Figure.2), complete with comfortable chairs, a close-up view of sunspots and solar astronomy courtesy of Randall, and three donkeys eyeing our leftovers from terraces above. After lunch, we stopped to see the copper deposit at Bayda and then onto the Aarja "Ziggurat" Platform and its causeway. Again, it was overwhelming for someone who had come from the States, where a place like Jamestown, Virginia (settled in 1607) is considered "old", to stand on a site constructed millennia ago and have it so connected to the geology around it. Directly adjacent to the Ziggurat platform are the remains of Sumerian copper mining smelting. Jan pointed out to us, that the most likely spots for the ancient smelters, were the circular regions devoid of the slagheaps. Afterwards, we headed to the last stop, and the highest stratigraphically, where we looked at red chert, a deep-

sea silicious ooze.

Jan Schreurs did a magnificent job preparing and leading this trip which provided us not only with a trip showing us in detail the outcrops of the ophiolites and explaining the dynamics of them, but also giving us some insight to the ancient inhabitants of this region and their close connection to the geology which helped shape their early society.

By Brian Parsons



Figure. 1: A close-up on a pillow lava, notice chilled margin with radial fractures. Photo courtesy of Jan Schreurs.



Figure. 2 : Sheeted dyke at Zabyat. Photo courtesy of Jan Schreurs.

Terminal Proterozoic Glaciations: The Omani Connection

The Neoproterozoic is a period in Earth's history that lasted from 1000 to 543 million years ago. Among other things, the Neoproterozoic witnessed the evolution of the first calcifying organisms and probably the most severe climatic fluctuations in Earth history. These climatic fluctuations are represented by the occurrence of a number of glaciations events. While the exact number of these glaciations is debated, three events are now widely acknowledged. These are: Sturtian (?-746Ma), Marinoan (601-657Ma), and the Varanger (565-595) [1].

Unlike Phanerozoic glaciations, a rock record of Terminal Proterozoic glaciations exists in almost every present-day continent. Paleomagnetic work on some of these deposits confirmed the occurrence of these glaciations at low latitudes, and in some cases reaching as low as the equator. In addition, most of these glacial deposits are paradoxically capped by extensive carbonate units that range in thickness from meters to hundreds of meters. A number of models have been presented to explain the occurrence of these glacial deposits and the associated cap carbonates, but the most "popular and controversial" is the Snowball Earth Model**.

In Oman, Neoproterozoic glacial deposits occur both in outcrop and in the subsurface. In the Oman Mountains, glacial deposits are found in the Ghubrah Formation and in the overlying Fiq member of the Ghadir Manqil Formation. The Fiq glacials are overlain by the Hadash cap carbonate. The age of these glacials is only constrained in the Ghubrah formation where a radiometric age date from an interlayered ash bed yielded a zircon U-Pb age of $723 \pm 16/-10$ [2]. The age of the Fiq member is not yet known. Thick glacial diamictites also occur in the Lower Mirbat Formation in the Dhofar region. While no radiometric date has been attained from this unit, the underlying Ledger granite has yielded a U-Pb age of 723 ± 2 Ma.

In the subsurface, only a limited number of wells penetrate this part of the stratigraphy. Interestingly, a recent well drilled by Petroleum Development Oman in the South Oman Salt Basin encountered more than 1000 meters of diamictites. Interlayered with this section was a relatively thin volcanic ash bed that yielded a radiometric age date that is much younger than the Ghubrah glacial deposits. The date, which is still being refined, makes this glacial section in this well Marinoan in age. If that age date stands, Oman would be one of the very few places where the Sturtian and Marinoan glaciations have been constrained radiometrically.

* Further reading on the snowball earth

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By Hisham Al Siyabi

'Omani Geologists as superb as the Omani Geology'

Hi there, Omani teenagers!

Looking for something new and really really ROCKY COOL??... G-E-O-L-O-G-Y is here for you, right at your doorstep. And it can turn your life into an exciting adventure!

- **What is geology?**
- **What makes Oman a geological paradise?**
- **What can be done for Oman with the Omani geology?**

Geology means 'Study of the Earth'. The word is derived from the Greek Geo (earth) and Logia (study). Geologists learn to understand how the earth's crust is organised, how it changed through geological time, and where to find minerals, oil and gas, building stones and... water. All this information is contained in the ROCKS, both the ones outcropping at the surface and the ones in the subsurface (below the ground).

The geology of Oman is spectacular! Geologists from all over the world know that Oman is a geological paradise! Oman's geological variety and beauty is exposed at the surface, in what geologists call 'outcrops'. Rock types and structures of all kinds can be admired by anybody who is interested, as there is no vegetation to hide it. Photos of 'text-book examples' of geological features are shown in lectures all over the world. Unique geological events are studied in Oman by the world's greatest specialists. In addition, a huge amount of information contained in the subsurface is obtained through oil and gas exploration and drilling.

The oldest rocks in Oman are some 800 million years old (Figure. 1) and the youngest ones are still being formed today. The Oman's earth crust has experienced many changes through geologic time, in terms of composition, shape and climate.

- Mountains were formed. Sea became land, as witnessed by marine life that can now be found as fossils high in the Oman mountains, in Oman's Huqf area (Figure. 2), in Al Khod (Figure. 3), and in many other places in Oman.
- Land became sea, as evidenced by fossilised desert dunes of 130,000 year old, which occur not only on land, close to the shore but also below present sea level.
- Polar landscapes with glaciers changed into deserts, as witnessed for example by the 300 million year old glacier marks, which occur in the Huqf desert.
- World-class examples of 'pillow lavas', representing deep-sea volcanic eruptions can be admired in Wadi Jizzi (Figure. 4).

All this and much much more can be found and enjoyed in Oman. Many aspects of the extraordinary geology of Oman are illustrated in the book 'Oman's Geological Heritage', which was published by PDO as a tribute to His Majesty Sultan Qaboos bin

Said on the occasion of Oman's 20th National day. The video 'Tracts of Time' is a follow-up of the book. 'A Field Guide to the Geology of Oman' by Prof. Hanna is another great guide for starting (and more experienced) geologists, more particularly for the geology of the Oman Mountains. And of course, don't forget the GSO website: www.gso.org.om

And you know what? By knowing the geology of your country, you can shape your country's future! Because geologists find and produce oil and gas, they know which rocks to use for cement industry, they know where the ground is strong enough for large buildings, and... they know where to find aquifers of potable WATER.

No doubt that Oman could be a breeding ground for superb geologists! Omani youngsters, grab this opportunity!! And make it your mission to be

'Omani Geologists as superb as the Omani Geology'

By Mia Van Steenwinkel



Figure. 2: Another example of ancient sea beds. Nummulites, coin-shaped creatures of ca. 1 cm wide, covered the sea floor some 40 million years ago. The sea retreated and the area became land (Sultan Qaboos University area, Al Khod). These rocks occur also in Egypt, where they were used to build the pyramids.



Figure. 1: The oldest rocks found in Oman: granite basement of at least 800 million years old, Al Jobah (Huqf area, Oman).



Figure. 3: Fossil shells, called Rudists, lived 80 million years ago and became extinct together with the dinosaurs. They occur in the Saiwan area (northern Huqf), showing that this area was once a tropical sea.



Figure. 4: The most beautiful 'Pillow lavas' in the world can be seen in Wadi Jizzi (near Sohar). They represent deep-sea volcanic eruptions.

GSO Event Calendar

January 2004	February 2004	March 2004
06 5th GSO Talk Paul Hoffman Snowball Earth	24 7th GSO Talk Alan Heward Permocarboniferous stratigraph	16 8th GSO Talk Andy Kwarteng
20 6th GSO Talk Philip Allen Neoproterozoic stratigraphy	18 to 20 4th GSO Field trip Alan Heward Huqf (Permocarboniferous)	2 to 5 GEO Arabia GSO Field Trip Alan Heward & Omar Al Ja'aidi Huqf (Permocarboniferous)
08 3rd GSO Field trip Joachim Amthor Oman Mountains	April 2004	11 GEO Arabia GSO Shuaiba Workshop
GSO Public Exhibit Venue: TBA Date: TBA	9th GSO Talk AAPG Distinguished Lecturer Date: TBA	May 2004
Teachers Workshop Date: TBA	5th GSO Field Trip Gorden Coy Saiq Plateau Date: TBA	25 10th GSO Talk GSO Annual Meeting Date: TBA
	GSO Elections Date: TBA	

TBA: To Be Announced

AL-HAJAR Editorial committee:

Nadia Al Abry (Petroleum Development Oman)
Nadia.SN.Abry@pdo.co.om

Ali Al Lazki (Sultan Qaboos University)
lazki@squ.edu.om

Saleh Al Anboori (Ministry of Oil and Gas)
s.alanboori@mog.gov.om

Jan Schureurs (Petroleum Development Oman)
Jan.M.Schreurs@pdo.co.om

Bader Al Kalbani (Occidental)
Bader_Al_Kalbani@oxy.com

Glen W. Mah (EnCana Inc.)
glen.mah@encana.com

John Willoughby (Petroleum Development Oman)
John.Willoughby@pdo.co.om

Somkiat Chaithed (PTTEP ME)
SomkiatC@pttep.com

Salim Al Busaidi (Ministry of Commerce & Industry)
d.gs@mocioman.gov.om



**IAS 2005
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Contact Details
AL HAJAR
Geological Society of Oman
PO. Box 993, Ruwi
Postal Code 112
Sultanate of Oman
E-mail: info@gso.org.om
www.gso.org.om