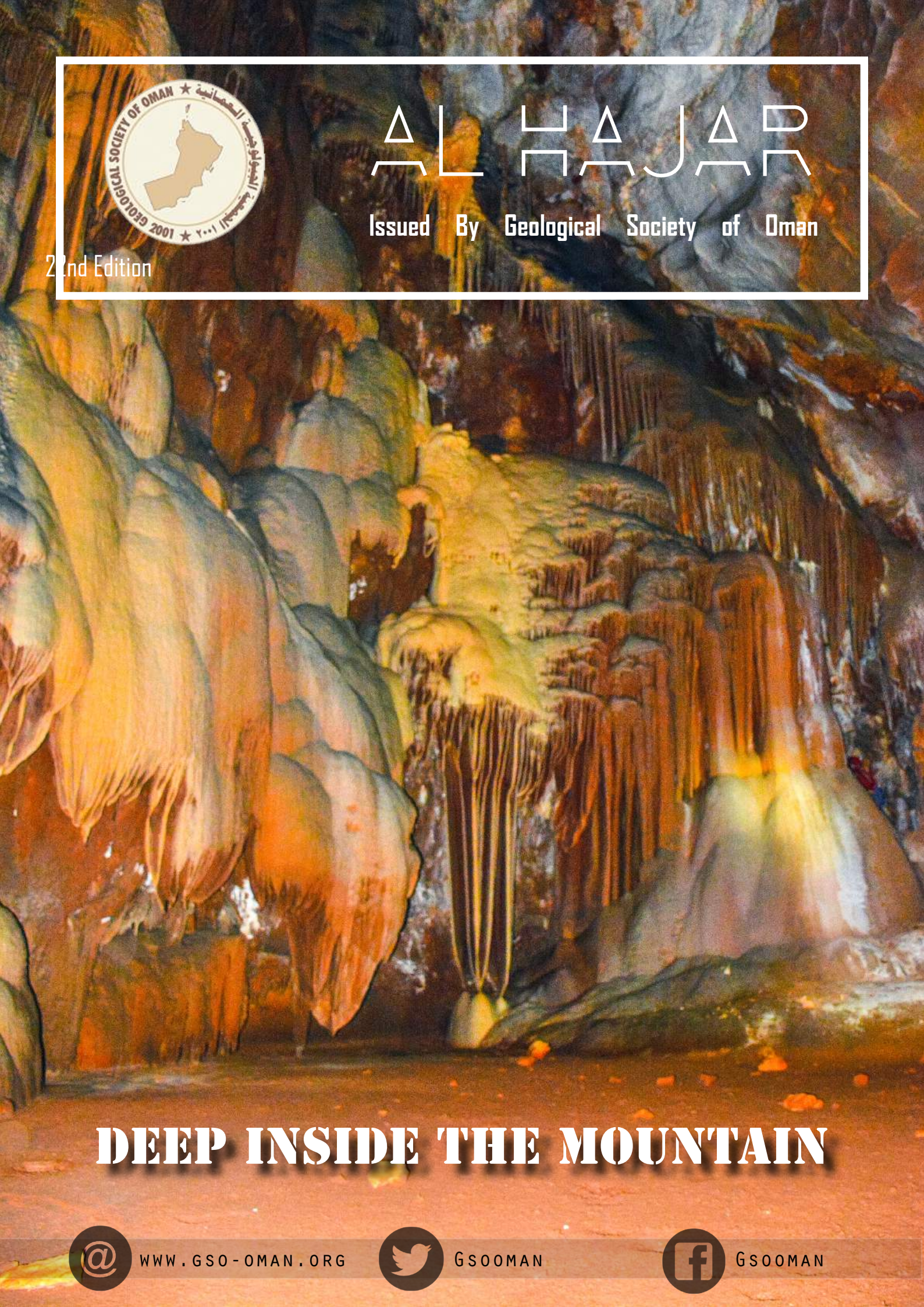
AL HAJAR

Issued By Geological Society of Oman

22nd Edition



DEEP INSIDE THE MOUNTAIN

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President's Address

It gives me a great pleasure to welcome you to the first Al Hajar issue for this year, 2016. The Geological Society of Oman (GSO) invests its time and effort to deliver the monthly talks and fieldtrips in the best way its members can benefit from. The GSO also strives to diversify its activities to include more programs which are directed towards the general public. From this prospective, the GSO has launched this year a campaign entitled "Geology around Oman" to deliver general geological talks in different Governorates of the Sultanate. Our first general geological talk took place in Al-Rustaq, in collaboration with Al-Misfah Culture and Sports Club and Al-Rustaq Sports Club, on March 4th, 2016.

On another note, the GSO hosted the first Arabian Gulf Geosciences Societies' Meeting, which was held in Muscat on May 27th, 2016. The organization of this meeting was done in collaboration with the Geosciences Societies from the Kingdom of Saudi Arabia, the United Arab Emirates, Qatar and Kuwait. The meeting was held under the auspices of His Excellency Honorable Dr. Al-Khattab Bin Ghalib Al-Hinai, the Deputy Chairman of the Oman State Council.

As part of its geology around Oman's campaign, the GSO will continue its endeavor to run the geological talks, for the public in the Governorates of Al-Dakhiliah, Al-Batinah, Musandam, Dhofar, Al-Sharqiyah, and Al-Dhahirah. Therefore, the GSO welcomes participation of its members who would like to be part of the teams organizing the talks, either for their own governorate or any other governorates of their interest. May Allah help us all to that which brings good and prosperity for our beloved Oman.

Dr. Ali Ibrahim Al-Lazki

President of the Geological Society of Oman

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Editor's Note

It is a great pleasure to introduce the 22nd edition of Al Hajar. In this edition, we have a wide range of interesting topics. You probably heard about the newly discovered caves in Al Jabal Al Akhdar. Well, the Al Hajar's team is bringing to you the full story, told by Dr. Mohammed Al Kindy, the man of the mission who led the group that made these discoveries. Alan Heward is also unfolding to you, in this edition, the untold story of a pioneering geologist in Oman known as "Abu'l jabal". A geologist who contributed significantly to understanding the geology of Oman, particularly the Hawasina sedimentary rocks and Semail ophiolite as thrust and allochthonous. Since the last edition of Al Hajar, the GSO ran a number of fieldtrips, talks, teaching activities, including Geo-Kids and Geo-challengers as well as the Annual General Meeting (AGM). All these events are summarised in this edition in the form of a photo gallery. The GSO was honoured to host the first GCC Geological Societies' Meeting, that was aimed to initiate collaboration among these societies, and the summary of the meeting is provided in this edition. One of the widely discussed issues in the recent years is the natural, technical and human risks that can evolve from working in the oil and gas sector. One of the major risks is the petroleum and chemical leakage in the oil fields that might cause severe impact for the environment in the long term. Therefore, the implications of modern geophysical techniques that can help creating safer environment are also discussed in this edition.

I hope you will enjoy reading through this edition

Have a great time

Dr. Aisha Al Hajri

GSO Editor

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Modern Geophysical Techniques in the Petroleum Industry

Towards Safer Environment

By Sultan Mohammed Al Habsi

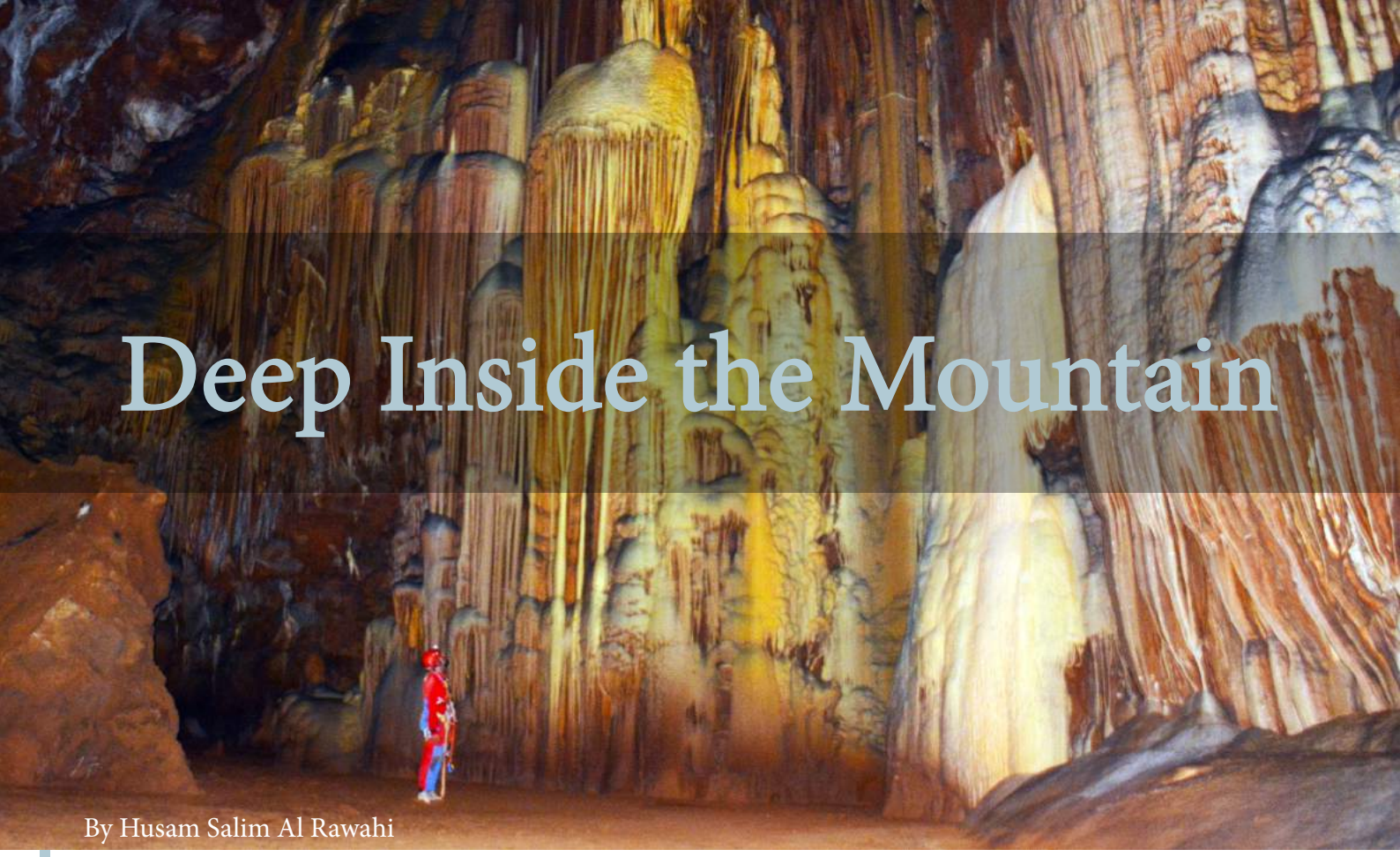
The nature of work in the oil and gas sector could involve natural, technical and human risks. One of the major risks in such sector is the petroleum and chemical leakage in the oil fields. Solving such problems might be trivial once the possible causes are identified. However, what about the subsequent effects of those leakages that might cause severe impact, in the long term, for the surrounding environment, the groundwater and the atmosphere?

Mixing one or more petroleum or chemical elements with the soil or underground layers, causes changes in the physical properties of that soil as oppose to the unaffected surrounding areas. Therefore, field studies are very important to determine the prevalence of those factors that negatively affect the soil and the underground layers in order to contain and prevent the spread of such elements. The procedure taken by many companies is to drill small wells in the suspected areas affected by pollution of this kind, so that a good understanding of the spread could be established. However, drilling wells costs a lot of money let alone the drilling hazards and the possible pollution caused by drilling equipment.

In addition, information collected from the wells is not sufficient to identify the extent of the spread of pollutants in the areas between the wells. On the other hand, modern geophysical techniques are more cost-effective and they can provide more information to study such problems.

Among modern geophysical methods used in Oman, which is provided by the National Rocks for Geophysical Exploration Company (NRGE), is the 2D electrical resistance technology. This method is primarily used to explore for water and metallic minerals as well as used in soil testing services. The method relies on the fact that different materials and elements vary in their electrical conductivity. In other words, some of the materials or elements are characterized by high resistance to electrical current, such as some types of rocks, while others have high potential to conduct electricity like water in general and salty water in particular. Along the same line comes the intermixing of rocks with depositions of petroleum or chemical elements, which in turn change the physical properties of the original rocks to become either more or less resistant to electrical current. One of the most important features of this 2D electrical resistance method is that it can read 360 points at 16 levels down to a depth of about 40 m. Those readings are taken continuously, making the extraction process of the data and their analysis more rational. A practical example of using this method was carried out during an investigation of a surface water leak in an industrial compound. The geophysical devices were able to detect low resistivity values caused by the water leak in the area. Such water leaks could otherwise affect the stability of the infrastructure of that industrial area, especially if limestone rocks are present in the area as this type of rocks can dissolve when reacting with water.

The technique has also been used to investigate the spread of a chemical substance beneath an oil field. On that investigation, the clean underground layers were found more conductive than those contaminated with chemicals. This electrical resistance technology can also be used as a time-laps method in which repeated measurements of electrical resistance are taken at different times. time-laps, 4D method could help in identifying how fast a spread of a leaked material can be or if a leak is still happening. The 2D electrical resistance technology can help oil and gas companies, as well as other sectors, to find effective and faster solutions to the petroleum and chemical leaks by identifying the places of the leaks, determining the size of affected areas, and assessing the current methods used to solve such problems.



Deep Inside the Mountain

By Husam Salim Al Rawahi

The Sultanate of Oman consists of unique geological heritage with hundreds of geological sites to visit and explore, making it a natural geological museum. Many of these geological sites are still hidden somewhere waiting for passionate explorers to bring them to light. Among these geological sites are two new caves which were discovered in Al Jabal Al Akhdar (i.e. the green mountain) area recently created a buzz in the media. These two caves are characterized by the presence of thick limestones that were deposited millions of years ago. These rocks were deposited in marine settings that covered this part of Oman during the Mesozoic time.

The quick trend of the news about the discovered caves in the media started via Twitter from geologist Dr. Mohammed Al Kindy, ex-president of the Geological Society of Oman and the CEO of Geological Consultancy Company, who challenged himself to descend to the two caves to explore and study them. Dr. Al Kindy didn't expect that the discovery of the caves will create this interest among the public, especially that caves do exist in many places in Oman. Examples of these caves are the famous cave of Majlis Al Jinn, which is located in Salma Plateau in the Wilayt of Quraiyat in Muscat Governorate, and Al Marneef and Taiq Caves in Dhofar Governorate. Caves are cavities that can be formed in different ways and usually occur in limestones, which are made of calcium carbonates. The calcium carbonates can be subjected to dissolution when they react with rain/ground water that flows through the cracks and vertical fissures within the limestones, resulting in the formation of caves as time passes.

The names that were given to the discovered caves are “Khaslat Hail Al Diyar” and “Khaslat Hail Al Ruwais”, based on the nearest two villages to these caves. I asked Dr. Al Kindy about the meaning of the word “Khaslat” and its origin. “It is a local word from the language spoken by residences of Al Jabal Al Akhdar,” he explained. It means a cavity in the rocks or the long tube with unseen bottom. The word is derivated from the Arabic word “Khashla” which is a concave area that looks like an egg. Similar to many countries in the world, these ancient pits have been used to get rid of unwanted items, including old clothes and dead animals. “The presence of Al Alila Jabal Akhdar Hotel in the mountain, helped to encourage the search of new touristic places to inlcude them into the tourist attraction list,” said Al Kindy. The management of Al Alila Hotel called one of the famous English cave explorers named Steve Jones. People of the Jabal led Steve to the location of one of the holes in which Steve descended to discover that it leads to a new cave. When Al Kindy heard about the new cave, he decided to go inside the cave to study it and to take high resolution photos of it. He asked two other persons to join him in this adventure; Andreas Woolf, a professional cave excavator, and Matthias Korya who is an adventurer, a geologist, and a lecturer at GUtech. The three of them had an initial plan to explore “Al Kaadi” cave in Yiti in Muscat Governorate, but the plan changed when they heard about the new cave.

“Khaslat” It is a local word from the language spoken by residences of Al Jabal Al Akhdar that means a cavity in rocks

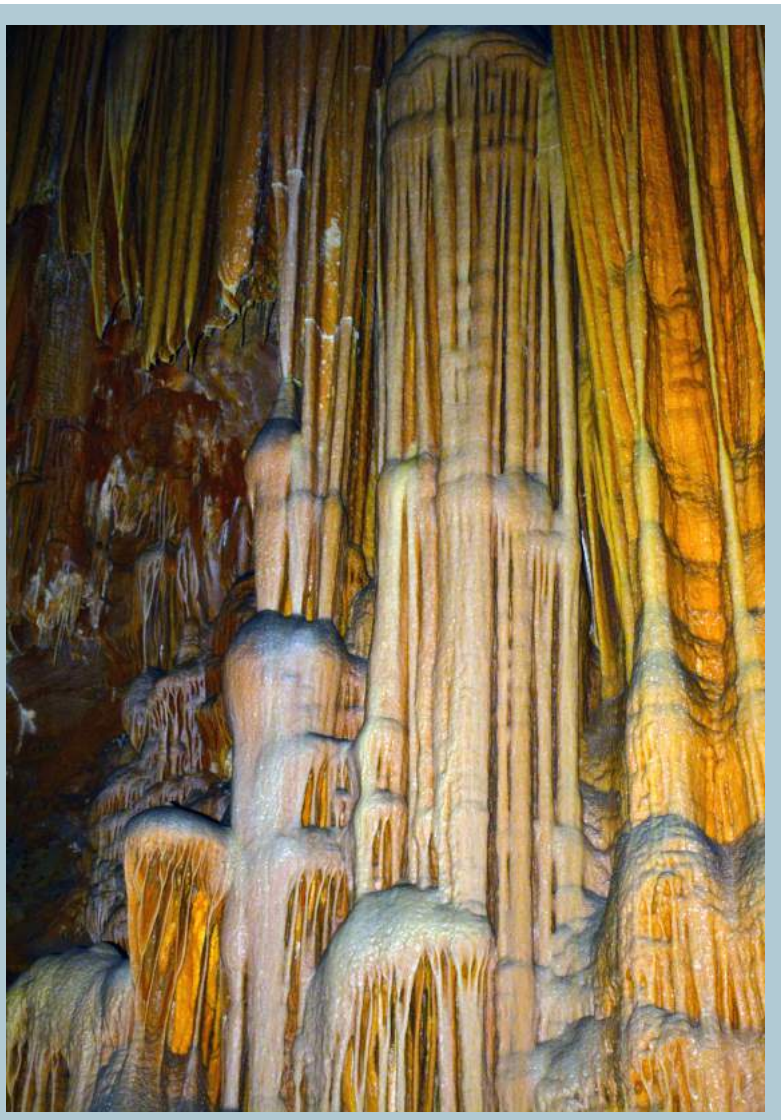
Khaslat Hail Al Diyar cave can be divided into four main areas, according to Al Kindy: the outside chamber, the upper corridor leading to the cave which is the only section that links the cave to the surface, the small chamber, the upper corridor leading to the big chamber, and the big chamber. The overall length of the cave is about 100 meters (m), while the height to the ceiling may be more than 15 m. To access the big chamber and its corridor, the person must bend crawling for five meters to see the beautiful sculptures surrounding the roof and walls of the big chamber.

The descent into the cave started on Friday, from 11 am to 4 pm. "The adventure requires fitness and strong will to survive the unknown and also crawling on bats' leftovers which can cause sensitivity when inhaled by humans," said Al Kindy.

The diameter of the top entry point of the cave is around 1 m, and it is in thick solid limestones, which gives it a stability not to collapse. Whereas, the vertical to oblique corridor that leads to the cave is about 50 m long and it fits only one person at a time.

At the bottom of the corridor, a 10 m x 5 m flat area is located besides the two cave chambers (i.e. the big chamber and the small chamber). The area of the small chamber is about 60 m² and it contains simple sculptures, but it is not the main feature of the cave.

The corridor towards the large chamber contains two sections: external and internal sections separated by low area that requires 5 m of crawling through it. The internal section has various cave deposits in its wall.



The big chamber of Khaslat Hail Al Diyar is the main feature of the cave, which is decorated by a mix of amazing textures and formations on the walls and the ceiling of the chamber. The chamber is circular to square in shape. The total area of the big chamber is 400 m², while the maximum height is up to 15 m. The chamber contains different shapes of stalagmites and stalactites that show remarkably different colors when illuminated with different sources of light. The chamber contains small corridors that exhibit metallic, tiny, needle-like formations as well. The chamber seems to have only one passage and the presence of other entries is unlikely due to the absence of light or air currents in the cave. The chamber is isolated from the upper corridor, thus, isolated from noise too.

The floor of the cave still retains its natural origin that has not been exposed to human intervention yet. Thus, it maintains the scientific details that will help to study how the cave and its sculptures formed. The floor contains dripped down hole, which may have formed by falling stalactites that fell from the top of the cave, and this shows the necessity of wearing a helmet when visiting the cave. The floor is composed of mud deposits, which were probably deposited by the seasonal heavy rains on Al Jabal Al Akdhar that formed small pools inside the cave. "With no doubts this will increase the chances to develop the cave as tourists attraction," said Al Kindy.

Neither Mohammed Al Kindy nor his team encountered any attacks from snakes or scorpions when they stepped into the cave, but he said that a small spider passed under his feet. He also saw a skull of a donkey and skeletons of two dogs, at a distance from the main entry, which indicate that these dogs didn't die immediately when they fell down the cave, but had the chance to walk inside the cave before they died. In addition, boxes of old clothes were found inside the cave that were thrown by people.

Al Kindy described the clothes as beautiful clothes and continued his words before I got the chance to ask him by saying "I didn't take any of these cloths. I wanted to keep the cave as it is, until a comprehensive study is initiated later".

Mohammed Al Kindy used Nikon DSLR camera to capture photos of the cave, using a long exposure, and he used illuminations from different sources such as helmets lamps, hand torch and phones. "The pictures are the reason why the news about the cave went viral," said al Kindy. He added "The magnificent and beautiful limestones formations and the sculptures are attractive to anyone, not only geologists".

After the first day of exploring Khaslat Hail Al Diyar, Mohammed Al Kindy posted the photos on Twitter, which went viral and reached to the newspapers. Dr. Mohammed Al Kindy decided to explore another hole discovered by a young Omani student in the twelfth grade from Al Jabal Al Akhdar (Aqabt al Boyoot), named Asaad Al Jamodi. Asaad was looking after his sheeps and stumbled on the entry of the Khaslat Hayl Al Ruwais cave.

Asaad told his teachers who in return told Mohammed Al Kindy about it. “The distinguished teachers of Abu Zaid Al Riyami School of Al Jabal Al Akhdar communicated with me and told me about this cave and other caves. I knew them from the lecture I presented in the school few months ago. Here comes the benefit of building relationships between scientists and the public, which spreads the benefit of exploration. Those teachers were great examples of those who care to discover the elements of the nature with curiosity and enthusiasm,” explained Al Kindy. The descent to Khaslat Hayl Al Ruwais cave is not as difficult as the Khaslat Hayl Al Diyar cave as Mohammed Al Kindy told me. The height of the former is 20 m and it contains calcite formations similar to those in Khaslat Hayl Al Diyar cave, but less elegant.

The team that Al Kindy has formed, which is made of geologists, cave explorers,experts, as well as the teachers of Abu Zaid Al Riyami School, are searching for new slots in Al Jabal Al Akhdar. After few days of discovering the two caves mentioned in the article, a new cave called Khaslat Hayl Al Hadb was discovered. There are many signs that more caves can be found in the area.

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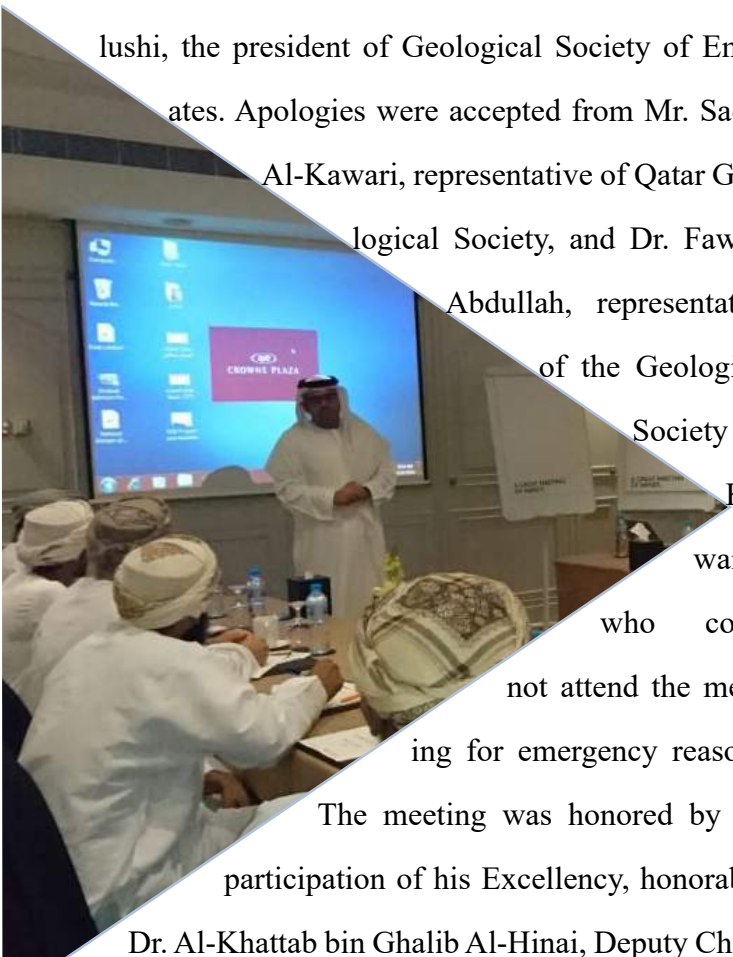
The First Meeting of the Gulf Geosciences Societies

By Dr. Ali Ibrahim Al Lazki

The Geological Society of Oman sought to join hand and collaborate with its sisters in the Gulf Cooperation Council (GCC) in order to increase the number of people who can benefit from the services and activities provided by these societies. With Allah's help this effort culminated with the first meeting of Gulf Geosciences Societies held in Muscat on Friday 27th of July, 2016.

This meeting was coordinated with the heads of the geological societies in the Kingdom of Saudi Arabia, the United Arab Emirates, Qatar, and Kuwait. The meeting was attended by Dr. Mohammed Husein, representing Dhahran Geoscience Society in the Kingdom of Saudi Arabia, and Dr. Khaled Al-Belushi, the president of Geological Society of Emirates. Apologies were accepted from Mr. Saeed Al-Kawari, representative of Qatar Geological Society, and Dr. Fawzia Abdullah, representative of the Geological Society of Kuwait, who could not attend the meeting for emergency reasons. The meeting was honored by the participation of his Excellency, honorable, Dr. Al-Khattab bin Ghalib Al-Hinai, Deputy Chairman of State Council of the Sultanate of Oman.



The First Gulf Geosciences Societies (GGS) meeting aimed initially to agree on joint activities that can be carried out by these societies together. The meeting was planned to run for the whole day. The morning session included three introductory presentations from the societies of the Kingdom of Saudi Arabia, the United Arab Emirates, and the Sultanate of Oman. The remaining part of the morning and the afternoon were dedicated for the discussion sessions, which focused on potential joint activities that can be carried out by the participating societies in the remainder of 2016 and the near years to come. Many proposals were discussed in these sessions, including a proposal of "Exploration fieldtrips in the Arabian Peninsula", which was adopted by the Geological Society of Oman. Dhahran Geoscience Society adopted the "Distinguished Lecturer" proposal, through which a number of distinguished lecturers will be selected to give a series of technical talks in different GCC countries throughout the year. The Geological Society of Emirates adopted the "Geophysics Winter Field Camp" proposal, which will be organized for undergraduate students from different universities in the region. Complete preparation and documentation of these proposals will be carried out in the second meeting of the (GGS), which will be held in the United Arab Emirates in September, 2016.

G.M. LEES (ABU'L JABAL): A PIONEERING GEOLOGIST IN OMAN

paper by :Alan Heward (alan@midfarm.demon.co.uk)

Malvern, U.K.

George Martin Lees came to Oman in the winter of 1925-1926 looking for oil. His contributions to Oman's geology, geography and archaeology are not well known apart from, perhaps, his early geological map, that he undertook the first Ph.D. on Oman's geology, and that he correctly interpreted the Hawasina sedimentary rocks and Semail ophiolite as thrust and allochthonous and continued to argue this even though at the time their origins were far from understood.

Prelude

Lees did not have a traditional university education in geology. His background was in the military and, after the World War I, the political administration of Iraq. In his early 20s, he established a reputation among the tribes on the borders of Iraq, Turkey and Iran for his fair administration, humour and physical fitness. Flying with the Royal Air Corps and the scenery of Kurdistan sparked an interest in geology. In 1921 he disagreed with the direction of the British administration of Iraq and resigned from the Political Service. A few months later, he took a job as an assistant geologist with the oil company, Anglo-Persian (APOC). He followed a number of courses at Imperial College, London (IC), but much of his geology was learnt accompanying others, particularly Professor Hugo de Böckh, a larger-than-life Hungarian adviser to APOC's explorers and management. De Böckh was energetic and enthusiastic and brought experience, a broad approach, and knowledge of Tethyan faunas, stratigraphy and tectonics. He recognised zones in the Zagros similar to those known from the Alps (foreland, foreland folded belt, nappe and thrust belt, median mass; Fig. 1 ,[1,2]). This concept found support from an early regional gravity profile, a geophysical technique he introduced to APOC. Whilst attending a course at IC, Lees was encouraged to join a Geologists' Association (GA) field trip to the Alps held in Switzerland in August 1926 [3]. All this provided the background to Lees' confident recognition of thrusts, nappes and klippe in the Oman Mountains, and a foreland setting in Dhofar.

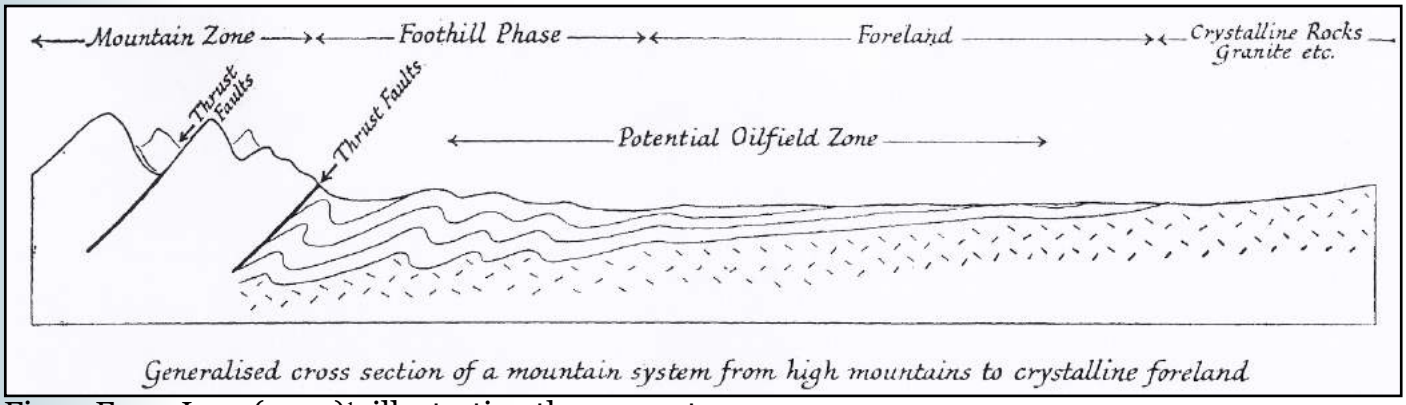


Fig. 1. From Lees (1940)[1], illustrating the concept.

Lees took part in the winter 1924-1925 tour of Persia with De Böckh, Lister James (the Chief Geologist of APOC), and Richardson. It was during this tour that Lees found the first trilobites (*Ptychoparia sp.*) in shaley dolomites brought up by the Al Buza salt dome that indicated the Hormuz (Ara) Salt was older than Middle Cambrian in age (Al Buza, now known as Moallem, near Bandar Lengeh; Fig. 2)[2].

The D'Arcy Expedition to Oman

In Oman there were regular rumours of oil seeps near Masirah Bay and another possibly at Raisut. Oil slicks had also been reported near Halul Island, offshore Qatar [4]. On 18th May 1925, the D'Arcy Exploration Company, the exploration arm of APOC, signed an oil concession for Muscat and Oman that had a two-year exploratory phase and a 55-year mining lease for up to ten selected blocks. Not that APOC really needed more oil with what they had already discovered in Iran, but a rival company was busy in Bahrain seeking an oil concession and they did not want to lose out to a competitor without having had a look first. In the winter of 1925-1926, De Böckh was part of the group due to examine the prospects of Kurdistan for the Turkish Petroleum Company (TPC, later the Iraq Petroleum Company, IPC)[5] . Lees was also intended to be part of this group, made up of participants from the shareholder companies of TPC. However, Sir John Cadman, the MD of APOC, decided that Lees would instead make a geological reconnaissance of Oman and Qatar. Another geologist, K. Washington Gray, who was based in Persia, would accompany him. There was lots of preparation to do ahead of the visit to try to ensure areas of interest in Oman were accessible, to contact people with influence who might accompany and facilitate the visits and to arrange supplies and transport. There was a request for surveyors from the Government of India as there were no detailed topographic maps of Oman outside the Muscat area.

1. G.M. Lees, 1940. The search for Oil. Geographical Journal, v. 95, p. 1-18.

2. H. De Böckh, G.M. Lees and F.D.S. Richardson, 1929. Contribution to the stratigraphy and tectonics of the Iranian ranges. In: J.W. Gregory (Ed.), The Structure of Asia, Methuen, p. 58-176, (incl. Oman section by Lees).

3. R.W. Ferrier, 1973. Makers of BP, No. 7: Dr G. M. Lees. BP Shield International, April 1973, p. 18-21.

4. G.E. Pilgrim, 1908. The geology of the Persian Gulf and the adjoining portions of Persia and Arabia. Mems Geol. Surv. India, v. 34, pt. 4, 177p.

5. E.W. Owen, 1975. The Trek of the Oil Finders: A History of Exploration for Petroleum. Chapter 18, pt. 1. The Iran story. American Assoc. Pet. Geol. (AAPG) Mem. 6, p. 1252-77

Lees, Gray and Haji Abdullah Williamson (an Arabic-speaking facilitator with a good reputation through the region) set out from Abadan on 10th October 1925 on an APOC oil-product carrier S.S. Khuzistan . They called at Bushire (Persia) to discuss their plans with the Political Resident for the Gulf and then headed for Bahrain. In Bahrain, they did some tourism and some covert geology, but their guide could not locate the bitumen seepage described by Pilgrim[4]. They then sailed to Sharjah to pick up a local political agent (Khan Bahadur Isa), before heading to Ras al Khaimah (Fig. 2).

Lees and Gray managed about five days in the field in Ras al Khaimah and Musandam, around Shamal, Khasab and Khor ash Sham, making observations, recording general sections and collecting what fossils they could collect to help them determine the ages of the rocks. They encountered difficulties with some of the tribes limiting what they could achieve. Lees noted that none of the igneous and sedimentary rocks that occurred in rafts in the salt domes in southern Iran and the Gulf islands were present, suggesting that the sequences in Musandam were younger. They then sailed on via Khor Habalayn (Malcolm Inlet) to Muscat, where Lees and Gray examined the geology of the Muscat - Ruwi area while Haji was finalising political arrangements of where they could visit along the Batinah and in the mountains.

The geologists hoped to visit al Jabal al Akdhar, but to do so required the consent of Sheikh Isa bin Salih and the Imam.

They were joined at this stage by a botanist, Joseph Fernandez, who was taken-on by APOC for three months to record and make collections of Oman's flora and fauna[7] .

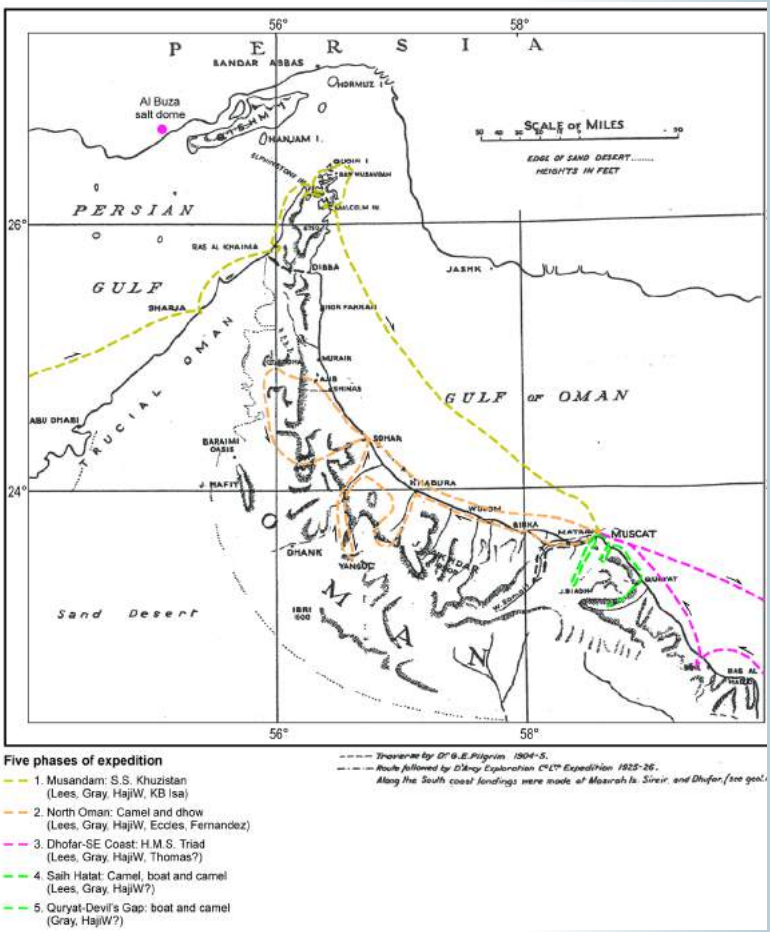


Fig. 2. Map showing the route followed by the D'Arcy's expedition to Oman[9] , with added detail.Does not include the landings made in Dhofar, Sireir (near Duqm) and on Masirah Island.

Six crossings of the Oman Mountains

Capt. G.J. Eccles, the Commanding Officer of the Muscat Levies, based at Bait al Falaj, also joined the party for the next two months of travels in the northern Oman Mountains. He wrote a 'social and political' account of the journey and gave an illustrated talk about it to the Royal Central Asian Society in London a few months later[8] . Photos from four of his lantern slides are reproduced in figure 4. The party left Bait al Falaj on 4th November 1925. They journeyed by camel to Bausher, Barka, Ras Suwadi and up the Batinah to Khaburah, making direct geological observations where they could and also recording distant views of e.g. the wave-cut platform along the mountain front north of Wattayah (850' terrace) and the structure of Jabal Nakhl. From Khaburah, they went inland up Wadi Hawasina. The request for surveyors from the Indian Survey had been lost in the system and Lees and Gray set-to making a topographic and geological map of the area through which they travelled. The topographic map was made by plane table and prismatic compass; a survey technique Lees had used to effect in Kurdistan mapped the Shahr-i-Zur valley.

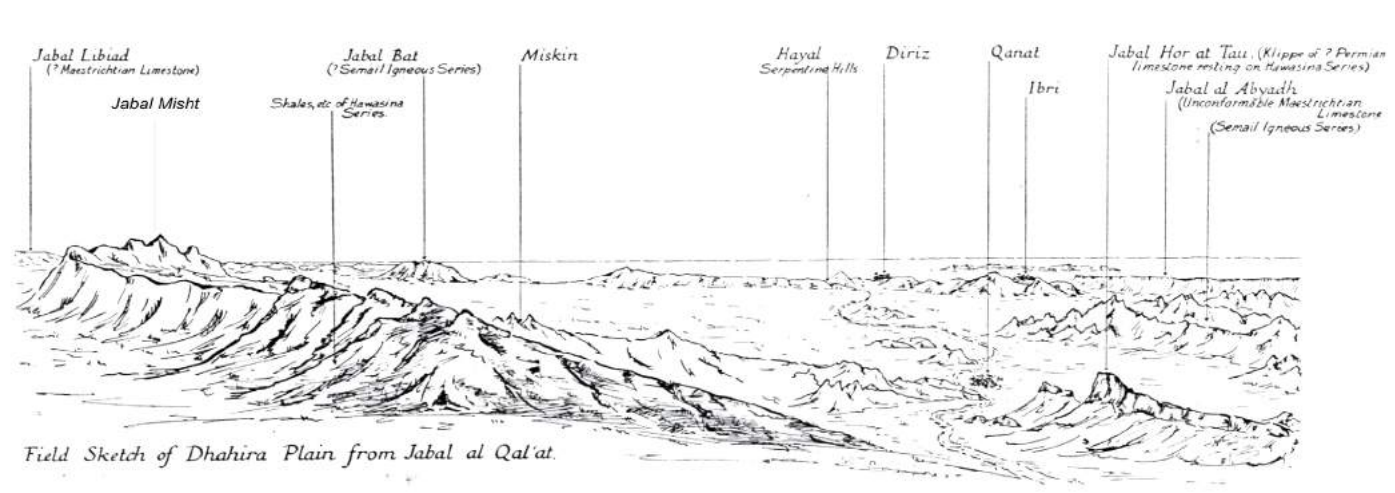


Fig. 3. Sketch from Lees (1928)[9] (with Jabal Misht also obvious). Some details he added later and after the identification of fossils they had collected. From the view sketched, Jabal al Qal'at seems to be a peak south-east of Jabal Rais.

6.William Richard Williamson converted to Islam in Aden and took the names Abdullah Fadhil. His biography 'Arabian Adventurer: The story of Haji Williamson' was written, based in interviews, by W.E. Stanton Hope in 1951. Chapter 31, Through the Oman Wilds, p. 303-9 is an account of the first parts of the D'Arcy Exploration Company expedition to Oman. (A report of photos by A.F. Williamson, file 127428, BP archive, Warwick Univ. suggests Haji was present in later parts also).

7. Fernandez, through no fault of his own, was out of work from the Agriculture Dept. of Iraq. His temporary employment as a clerk and collector for the expedition was as a personal favour by Sir Arnold Wilson (Director of D'Arcy Exploration Company) to a friend in a Basra trading company (file 70452, BP archive).

8. G.J. Eccles, 1927. The Sultanate of Muscat and 'Oman: With a description of a journey into the interior undertaken in 1925. J. Central Asian Soc. v. 14, p. 19-42. (35 prints from B&W lantern slides are present in file RSAA/L/6 of the Royal Central Asian Society, and in file 13086 of the BP archive there is a more comprehensive account of the journey that contains more of the problems and illnesses they faced, some gems like the Abu'l jabal incident, and an appendix by Fernandez of plants they encountered and crops being cultivated).

9. G.M. Lees, 1928. The geology and tectonics of Oman and parts of south-eastern Arabia. Quart. J. Geol. Soc. Lond. (QJGS), v. 84, p. 585-670.

Their topographic map of the Batinah and northern Al Hajar is included in Eccles' paper[8] and forms the base for their 1 inch to 4 mile (1:250,000) geological map of the Wadi Hawasina to Wadi Hatta area (plate IV of their company report)[10] . Mapping meant climbing jabals to observe the lay-of-the-land and to take bearings on other jabals and features in view. It appears that Lees took few field photographs and liked to sketch instead and, by doing so, to understand the geology (Fig. 3).

They were guided along the northern flank of Jabal Rais and down the Al Naqs gorge leading to Wadi Bani Umar. On a tricky descent in the gorge, most of the party followed the advice of the local guides and used the chain that had been provided by a benevolent sheikh some years previously (often referred to today as Lees' chain). Eccles chose to do otherwise and had to be rescued (Fig. 4c)[6'8]. On a day of several disasters, Gray spilt ink over the plane table map, potentially ruining a fortnight's work. Fortunately, when the ink dried it could be scraped off and the detail could be traced onto a new clean sheet. The party then progressively worked their way back towards the Batinah.

They were then invited by Sheikh Muhammad bin Hilal of the Bani Ali to visit his brother Khalifah, the paramount sheikh, in Yanqul and made their way there by Wadi Ahin. The geologists found what appeared to be films of oil on pools of water emerging from the ophiolite and Lees surmised that there must be a shale series beneath the ophiolite. An elderly woodcutter tried to stop Lees climbing a jabal and threw stones at him, only to be chased by a tall and athletic Lees waving his geological hammer and later jailed in Yanqul for discourtesy to the sheikh's guests[8]. Above Wuqbah, the geologists first encountered magnetic disturbance of their compass needles due to the presence of iron minerals in the ophiolite. '*This magnetic effect is a sad thorn in the flesh of the wearied topographer who, having clambered up several thousand feet to a commanding view point, is apt to find himself deprived of the fruits of his toil by an apparently inebriated compass needle'*[10]. '*These effects are often so local that we have found a difference of 45° between sights taken standing and lying*' .

They established camp for several days at Al Rowdhah, near Yanqul and after a courtesy visit to Sheikh Khalifah, Lees and Gray began examining the geology and extending their maps. The geologists noted the commanding peak of Jabal Yanqul and must have also been impressed by the contortions of the Hawasina lithologies. They climbed, made a substantial collection of Cretaceous fossils and mapped from Jabal Abyad, above their campsite (Fig. 4d). Haji and Eccles spent much time in Yanqul, discussing local politics, the advance of Sheikh Isa bin Salih's forces along the Dahirah and the recent fall of Ibri to his supporters.

This polarisation of tribal allegiances, in response to a heightened Wahhabi threat to Buraimi, prevented the geologists from visiting some of the areas they would like to have done. On the return journey to the Batinah, Lees collected samples of copper ore from diorites near the village of Maydan in Wadi Ahin that were used by a committee of the British Association to identify Oman as the probable source for the copper (with a high nickel and arsenic content) used by early civilisations in Mesopotamia[12] . Lees and Gray re-examined the iridescent films on pools of water in the ophiolites and concluded that these were probably due to carbonate rather than oil.

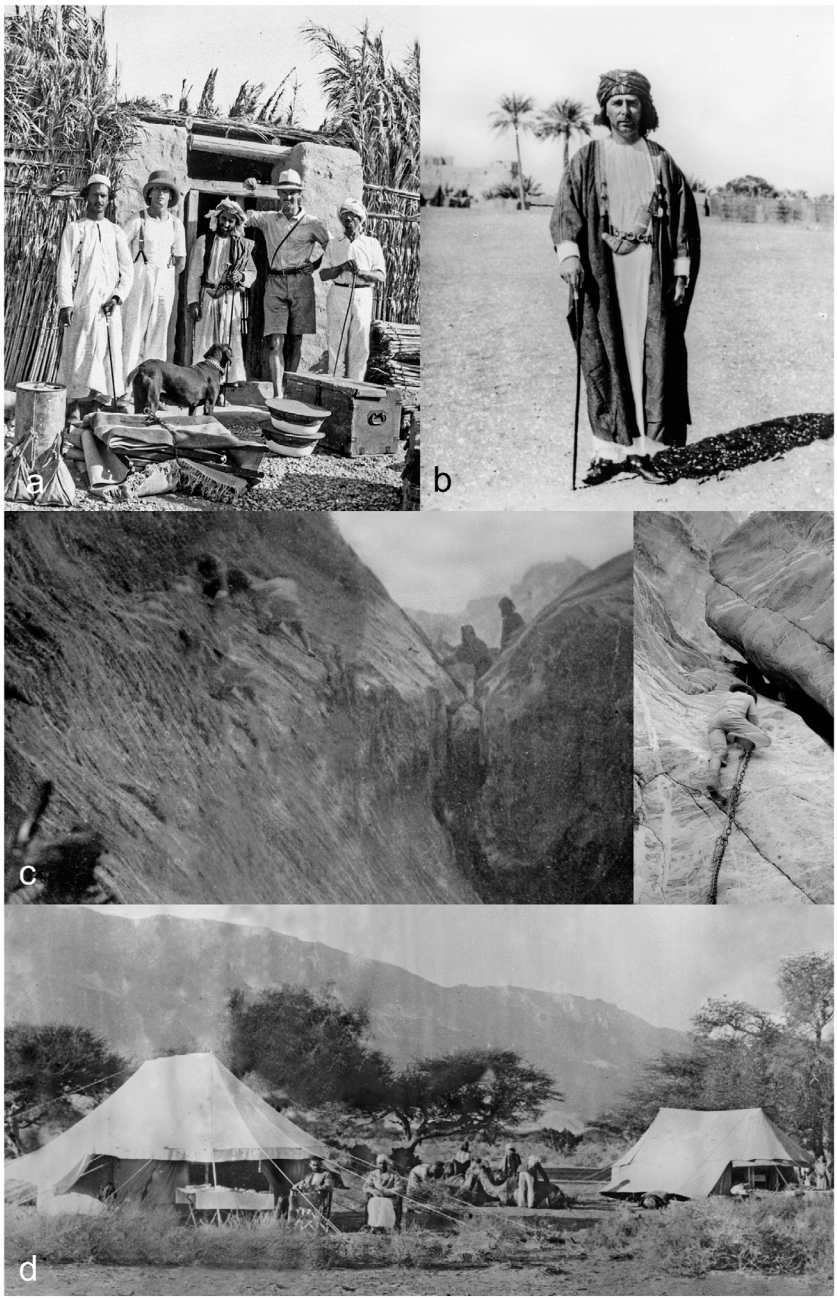
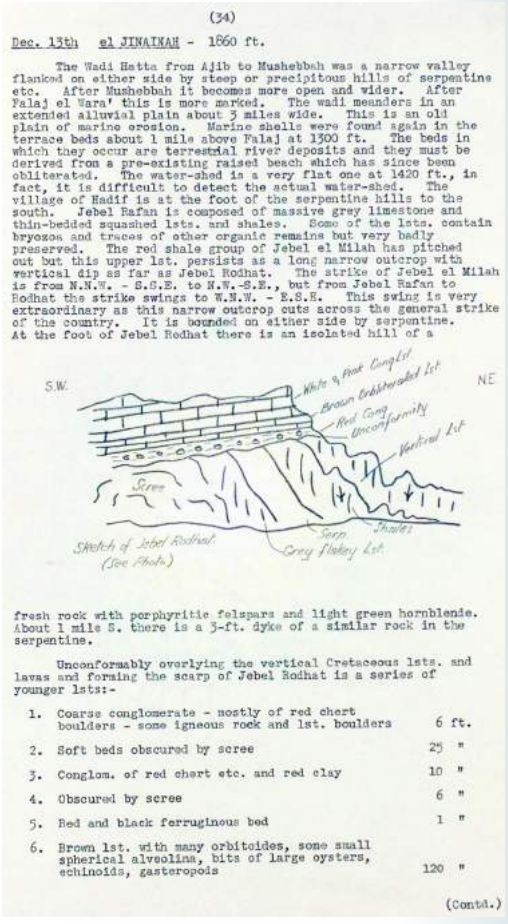


Fig. 4. Slides from the October 1926 lecture by Eccles[8]. a) A well-known photograph of the party, location unrecorded, L-R, Haji Williamson, in Arab dress, Washington Gray, un-named sheikh, Lees, tall, in shorts and with a battered panama hat, and Fernandez. The dog is identified as Skinny Liz. b) Capt. Eccles in Arab dress, location unrecorded. c) Al Naqs gorge, the chain location? Eccles, who did not follow advice and used the chain, being rescued by local people[6]. Inset, the chain from below in the 1980s from a PDO News article, 1985 (1), p. 11-13. d) The expedition campsite at Al Rowdhah, 10 km west northwest of Yanqul and at the foot of the scarp face of Jabal Abyad. Lees? in shorts and Eccles? seated.

A chance meeting, over lunch near Sohar, provided an opportunity for the party to travel to Mahadah, via Wadi Hatta. Gray was sick with fever and toothache for several days during this part of the journey. A page from Lees' typed up field-notes shows the detail of his notes and field sketches (Fig. 5)[13] . On 14th December 1925, Lees decided on the name Hawasina for the strongly deformed unfossiliferous sequence they kept finding that included radiolarites. '*This group deserves a name as it looks as if its exact age limits can never be determined. I propose to call it the Hawasina series since we first met it in that wadi*'[13]. Lees made a large collection of fossils, 'in only about an hour', from a prolific outcrop of Simsima Formation in Wadi Sharm (Jabal Malih[14] , 51 species of which 14 were new species or variants)[9]. He also made a small archaeological collection of worked flints from the desert plain nearby[11]. Lees wondered about the source of the red sand for the dunes he encountered here at the edge of the desert, was it re-worked from outcrops of Palaeozoic sandstones that they had not yet encountered (like the red Cambro-Ordovician sandstones of Jordan)[9]. From the top of Jabal Mahadah he obtained good views and bearings on the villages of Buraimi, and Jabal Hafit that he estimated to rise 4000 feet above the desert plain (possibly using techniques he learned in training for the Royal Artillery). A local guide challenged Lees to a race from the top of Jabal Mahadah back to the majlis at Bait al Nad. Lees won, arriving a full 30 minutes before the guide. As a consequence of this feat, Sheikh Salim bin Diyan Al-Kaabi gave Lees the title Abu'l jabal[8]. The party received an invitation to visit Buraimi, but due to lack of time, they decided to head back, via Wadi al Jizi, and arrived in Sohar on 22nd December. By this time, they had been in the field for seven weeks and had crossed the Oman Mountains six times by five different routes (Fig. 2). Most of the group then took a dhow to Muscat and the mail boat on to India for some rest and recuperation. Eccles returned by camel along the Batinah to Bait al Falaj.



(34)

Dec. 13th el JINAINAH - 1860 ft.

The Wadi Hatta from Ajib to Mushebbah was a narrow valley flanked on either side by steep or precipitous hills of serpentine etc. After Mushebbah it becomes more open and wider. After Falaj el Wara' this is more marked. The wadi meanders in an extended alluvial plain about 3 miles wide. This is an old plain of marine erosion. Marine shells were found again in the terrace beds about 1 mile above Falaj at 1300 ft. The beds in which they occur are terrestrial river deposits and they must be derived from a pre-existing raised beach which has since been obliterated. The water-shed is a very flat one at 1420 ft., in fact, it is difficult to detect the actual water-shed. The village of Hadif is at the foot of the serpentine hills to the south. Jebel Rafan is composed of massive grey limestone and thin-bedded squashed lsts. and shales. Some of the lsts. contain bryozoa and traces of other organic remains but very badly preserved. The red shale group of Jebel el Milah has pitched out but this upper lst. persists as a long narrow outcrop with vertical dip as far as Jebel Rodhat. The strike of Jebel el Milah is from N.N.W. - S.S.E. to N.W.-S.E., but from Jebel Rafan to Rodhat the strike swings to W.N.W. - E.S.E. This swing is very extraordinary as this narrow outcrop cuts across the general strike of the country. It is bounded on either side by serpentine. At the foot of Jebel Rodhat there is an isolated hill of a

fresh rock with porphyritic felspars and light green hornblende. About 1 mile S. there is a 3-ft. dyke of a similar rock in the serpentine.

Unconformably overlying the vertical Cretaceous lsts. and lavas and forming the scarp of Jebel Rodhat is a series of younger lsts:-

1.	Coarse conglomerate - mostly of red chert boulders - some igneous rock and lst. boulders	6 ft.
2.	Soft beds obscured by scree	25 "
3.	Conglom. of red chert etc. and red clay	10 "
4.	Obscured by scree	6 "
5.	Red and black ferruginous bed	1 "
6.	Brown lst. with many orbitoides, some small spherical alveolina, bits of large oysters, echinoids, gasteropods	120 "

(Contd.)

Fig. 5. Typical page from Lees' typed up field notes with a field sketch of Jabal Rawdah and a rare mention of a photo[13]. Reproduced with permission of the BP Archive.

Dhofar, the South-eastern coast and Saih Hatat

The next phase of their exploration of Oman was from on-board a naval yacht, H.M.S. Triad (Fig. 6a). The yacht sailed from Bombay on 15th January 1926 with members of the party. Some of the details of this phase of their travels are sketchy, but they appear to have sailed back to Muscat and picked up Bertram Thomas (Financial Adviser to the Sultan) who joined them for the journey down the coast to Dhofar (Fig. 2) and helped in liaison with the leaders of the tribes[15].

It is not clear how many days the group spent in Dhofar as the details of the visit are not recorded in the typed field notes or papers by Lees or Thomas. We can reconstruct that they visited Mirbat and observed dikes cutting the basement and climbed Jabal Samhan with a barometer to estimate its height[16]. They probably sought evidence of the oil seep rumoured to be near Raisut. Lees made another small collection of archaeological flints between Al Balad and Taqah[11], and one of freshwater gastropods from an unknown Dhofar locality[17]. The sketch section of figure 7 demonstrates Lees' ability to simplify and pick out the important elements (when compared with similar sketches by Carter 1852 and Fox 1947). The overall thinness of succession in Dhofar and the absence of the Jurassic Arab reservoir would be considered condemning by the later IPC explorers in the area. On the journey back up the coast, Lees made observations of Ras Madrakah from the sea and the party made a landing at Serier (Nafun), opposite to Nafun Island, on 27th January. They were hoping to investigate the oil seepage reported in the vicinity. In Lees' words '*The natives of this delectable coast-line are so jealous of their independence, and so fearful of the possibility of our peaceful penetration, that no amount of persuasion or argument could elicit any information whatsoever from them regarding the natural features of the country, or even place-names*.

Fig. 6. a) Photo from Haji Williamson's report of the expedition[6]. Reproduced with permission of the BP Archive. b) The echinoid *Conulus triadis* (Lees 1928), from the Samhan Fm, Serier (Nafun, near Duqm). '*I have named this species after the flagship of the British Persian Gulf Squadron, H.M.S. Triad. Without the cordial co-operation of Capt. Leir and the officers of that ship, a visit to this inhospitable coast would have been quite impossible*' [9].

10. G.M. Lees and K. Washington Gray, 1926. The geology of Oman and adjoining portions of south-eastern Arabia. D'Arcy Exploration Company Report GML21, KWG10, September 1926 (file 13086, BP archive, Warwick Univ.).

11. G.M. Lees, 1928. The physical geography of south-eastern Arabia. Geographical Journal, v. 71, p. 441-70. 12. H. Peake, 1928. The copper mountain of Magan. Antiquity, v. 8, 452-7. Sir Arnold Wilson (Director of D'Arcy Exploration Company) obtained samples of copper from various parts of the Middle East for analysis by the committee of the British Association examining the possible sources of copper used by the Sumerians in Mesopotamia. Lees would have been aware of this effort, hence probably his sampling.

13. File 13086/1 BP Archive, Warwick Univ. contains Lees' typed up field notes of localities in Oman, but not the 2 or 3 days they spent in Dhofar. They don't include any field notes by Washington Gray either. This seemed a little strange, until coming across correspondence in file 44065 that suggests they were typed up in 1949, to assist IPC geologists who were beginning their exploration field work in Oman. The Dhofar localities were probably omitted as IPC, of which Anglo-Iranian (formerly Anglo-Persian) was a shareholder, was already planning to relinquish Dhofar as unpromising.

Mr. Thomas had made previous arrangements for our landing here, and we were met on arrival by Shaikh Mansur and about 150 wild and gaunt Jannabah tribesmen'[11]. Thomas, when describing a later journey, adds '*Here at the bottom lay the plain opposite the island of Hamar Nafur, where oil seepages had once been reported, and where I recalled that two years before a geological party had landed and was greeted by a hail of stones*'[18]. Whilst they failed in their primary objective of investigating the reported oil seep, they climbed up onto the Nafun dolomites (500' terrace) and could see no higher hills inland, they measured a section through the Upper Cretaceous Samhan and Fiqa Formations collecting a number of echinoid species, and they observed pebbles in the wadi of purple and greenish shaly sandstone '*with an older appearance*'[13] It is clear they did not travel many kilometres inland as there the purple and greenish sediments of the Shuram Formation outcrop and Lees could not have failed to notice the numerous trilith monuments that line the edge of the wadi.

Two days later, they landed on Masirah Island to investigate the ophiolites, lavas, radiolarites and overlying Tertiary. They also made a landing at Qalhat, to follow up visits and faunas recorded by earlier geologists von Krafft and Pilgrim. They examined the basement and the overlying Upper Cretaceous sequence containing the large benthic foraminifera *Loftusia* which they were familiar with from Persia. Lees correctly interpreted the 30 m basalt lava flow, with its chilled base, was unrelated to the Semail and more comparable with the lava flows of Sind[9]. They arrived back in Muscat on 3rd February and were accommodated at Bait al Falaj for the final phase of their geological investigations of Oman (Fig. 2).

Lees and Gray managed a number of short visits to the Saih Hatat area interspersed with bouts of sickness. They visited Bandar Al Jissa, Yiti, Wadi Maih, Wadi Aday, Saih Hatat and up through the Amdeh Quartzites of Wadi Qahza to the watershed (Jabal Biadh). They made a geological sketch map of the Muscat-Qurayat area using a 1906 base from the Indian Topographic Survey (Plate V in Lees and Washington Gray, 1926)[10]. Lees left Oman on 17th February on the mail boat S.S. Barpeta to make a reconnaissance of the oil prospects of Qatar. Gray remained behind in Oman in the hope that they might still receive permission to visit Jabal al Akdhar. When that hope proved futile, and having missed the weekly mail boat, Lees suggested Gray examine the Wadi Daiqa section inland from Qurayat. In Bahrain, Lees hired a small launch from APOC's agent and was almost shipwrecked trying to reach the reported oil seep off Halul Island. However, with Haji's assistance, Lees managed to obtain an 18-month oil exploration concession for Qatar. Lees, Gray, Haji Williamson and Eccles (who was going on leave to the U.K.) all arrived back in Abadan around 20th March 1926.

Reporting, Ph.D. and Publications

Lees wrote up their 1926 report in London over the summer months[10]. He concluded that rumours of oil seepages in Oman, with one exception that could not be checked, were without foundation and that with the nature of the geology there was no hope of oil in Muscat. To extend their work to the Sharqiyah would possibly require another concession to be negotiated (with Sheikh Isa bin Salih). The Muscat and Oman concession had another year to run and it was retained pending an investigation of the coast of Gwadar where gas seepages were known to occur. There is no evidence that a visit to Gwadar took place in that year and the D'Arcy concession for Muscat and Oman lapsed in May 1927. Lees spent much of 1927 on study leave at the University of Vienna where he attended lectures by prominent European geologists of the time (Suess, Kober and others), described and identified fossils collected in Oman at the Natural History Museum (NHM) in Vienna and others at the NHM in London. He wrote up his Oman work in a 58-page thesis, in German, for which he was awarded a Ph.D. During 1927 Lees also prepared two scientific papers which he presented in January and March 1928 and which were published later that year[9'11].

Lees' 1928 geological work on Oman is the best known of these papers and includes a map of the geology of the known areas of Oman, Qatar and Bahrain (Fig. 8). It also includes five structural sections across the mountains (three of which are included in Fig. 8b). There are many interesting observations and deductions in the paper, such as, the probable deep-water origins of the Hawasina radiolarites and the possible sea-level implications of inter-beds of shallower-water carbonates and clastics (this was before any understanding of turbidity currents). He never lost sight of trying to discover the age of the Hawasina radiolarites, as we will see later.

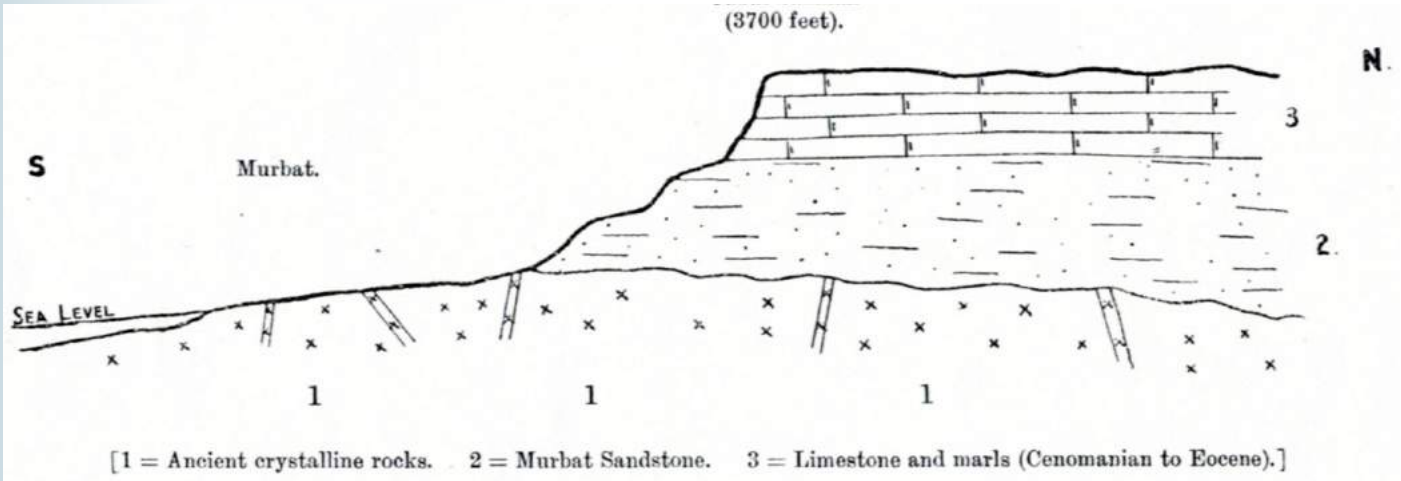


Fig. 7. Lees sketch-section of the thin 'foreland' succession in Dhofar[9].

14. Lees mentions in his field notes that the name refers to a thin bed of salt, but his local guide did not know where it was. Lees suggests it might be the gypsiferous cement in the basal conglomerate of the U. Cretaceous.

15. Payments totalling 2000 rupees were made by Thomas (funded by APOC) to the Amir of Ja'allan and Sheikh of Masirah to enable access to their territories. Correspondence in file 70454, B.P. Archive. This was a substantial sum of money. By comparison, a present worth about 1000 rupees secured an 18-month exploration option for an oil concession in Qatar. See discussion about '*having to pay your way*' by Sir Percy Cox in Lees[11].

The second part of his 1928 paper is palaeontological and is easy to overlook[9]. Listing out his fossil finds provides several interesting insights. There were eight locations where they collected significant faunas; four from the Late Cretaceous (J. Malih, J. Abyad, Sirier and Qalhat). Lees described and identified the bivalves, gastropods and echinoids himself, while brachiopods, corals, rudists and foraminifera were passed to others to work on[9,19], . Of the more than 100 different species collected, 20 were new species or new variants of species. Members or aspects of the expedition are recorded in the names of several of the new species (*Praeradiolites? leesi, Trochus grayi, Conulus triadis, 'Echinanthus' pumilus var. abiadensis*).

Chief Geologist of APOC/AIOC

Lees was clearly an excellent geologist, good communicator, an independent broad thinker and an energetic leader and in November 1930, aged only 32 years, he was appointed Chief Geologist of Anglo-Persian. These were the depression years, and the number of staff was small, but as activity picked up Lees guided the worldwide exploration efforts of Anglo-Iranian (AIOC), the forerunner of BP, for more than 20 years[3].

Lees' last paper on Oman is a short note from 1937 highlighting the discovery of source rock conditions on the modern continental shelves[20]. In 1944 Lees accompanied De Golyer on the Iranian leg of his fact-finding tour of oilfields in the Middle East that predicted the importance of the region to the future supply of the world's oil.

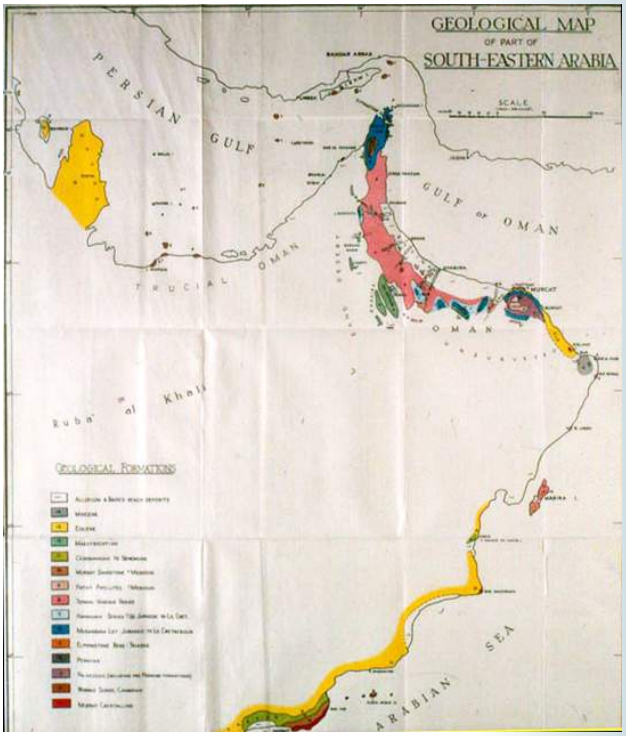


Fig. 8a. Geological map of Oman, Qatar and Bahrain[9].

16. Jabal Samhan is actually 5974 feet (1821 m). Their barometer can't have been accurate at this stage or else there is an error in the figure and should have been 5700 feet.

17. M.P. Pallary, 1928. Mollusques continentaux du Sud de l'Arabie collectés en 1926 par M. Lees. Proc. Malacol. Soc. Lond., v. 18, p. 39-42. Describes collections of gastropods made in Dhofar (including a new species *Euryptyxis leesi*) and at Kalhat.

18. B. Thomas, 1929. The south-eastern borderlands of Rub' Al Khali. Geographical Journal, v. 73, p. 193-215. Includes a few paragraphs on the geology of Oman (based on Lees) and mentions the discovery of red and purple slates at Jabal Hamr, near Sereir. See also Lees[9], p. 615. (Probably also Shuram Fm).

19. O. Kuhn, 1929. Beiträge zur palaeontologie und stratigraphie von Oman (Ost-Arabien). Ann. Naturhist. Museum, Wien, v. 43, p. 13-33.

G.M. Lees, 1937. "Black Sea" conditions in the Arabian Sea. AAPG Bull., v. 21, p. 1579-82.

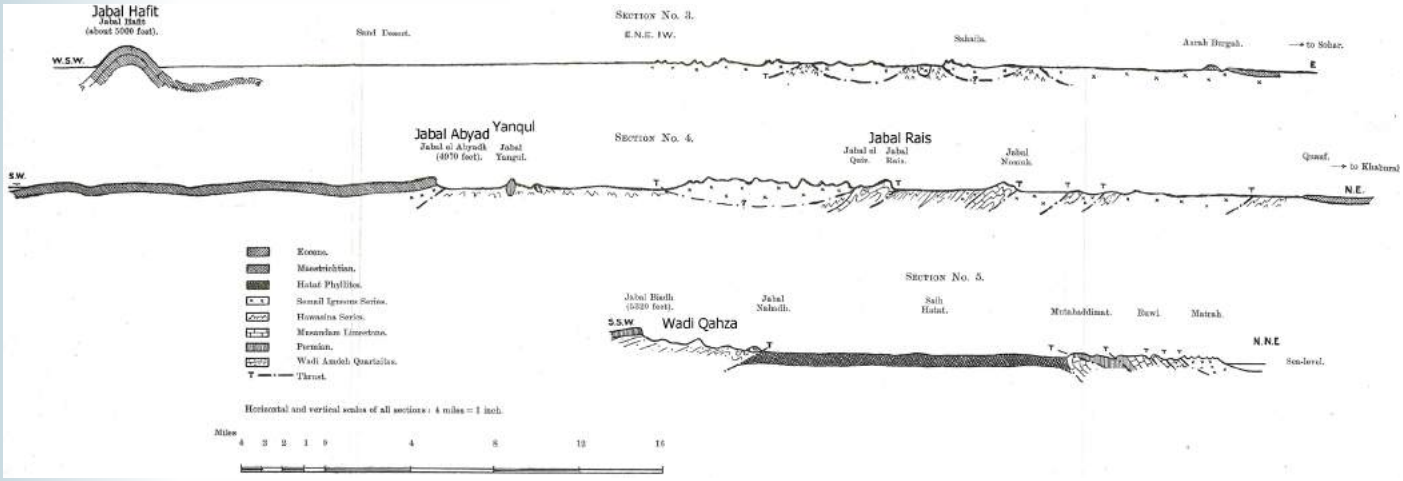


Fig. 8b. Three of Lees' sections across the Oman Mountains: Jabal Hafit to Sohar, SW of Yanqul to Khaburah, Jabal Biadh to Muttrah[9].

In 1943 Lees was awarded the Bigsby medal of the Geological Society of London for his pioneering efforts in worldwide geological exploration. '*His work in the forbidding mountains of Oman was a test of endurance as well as a demonstration of skilful mapping and sound deduction*'. In 1948 he was the first geologist from the oil industry to be elected to the prestigious Royal Society, and in 1951-1952 he became President of the Geological Society of London, again the first from industry to be so appointed[3].

He continued to be active regarding Oman providing partner input to the exploration activities of IPC, though there was rivalry between IPC and AIOC, and IPC's geological experts did not agree with Lees' conclusions on the Hawasina and Semail. '*It is an extremely difficult problem, and I am quite aware of the difficulty of accepting the consequences of my ideas, but I think there are even greater difficulties in any alternative explanation*'[21]. Lees initiated work on radiolarites in AIOC, including the investigation of samples of Hawasina from near Bait al Falaj in Ruwi, which yielded a probable Late Jurassic-Early Cretaceous age[22] . Lees noted that '*this result fitted his ideas but would cause discomfort to IPC colleagues*'[21]. He was active in the discussions of lectures in London by Wilfred Thesiger on his 1949-1950 journeys in Oman (where his dry sense of humour is in evidence), and IPC's R.G.S. Hudson on the geology of the Jabals Hagab and Qamar areas of the northern Oman Mountains[23] .

20. G.M. Lees, 1937. "Black Sea" conditions in the Arabian Sea. AAPG Bull., v. 21, p. 1579-82.

21. Correspondence Lees to Kitchen (IPC) and Davis 16 and 18 March 1949, file 44065 BP Archive, Warwick Univ.

22. A.G. Davis, 1950. The radiolarian of the Hawasina series of Oman. Proc. Geol. Assoc., v. 61, p. 206-17.

23. Discussions of Thesiger, 1950, Geographical Journal, v. 114, p. 170-71; Hudson et al., 1953 (publ. 1954), J. Hagab, QJGS, v. 110, p. 146-152; Hudson et al., 1954, J. Qamar, Proc. Geol. Soc. Lond., no. 1513, p. ci-civ.

24. Dauka-1 would show a greatly expanded section compared to the 'foreland' sequence at Jabal Samhan in Dhofar, just as several of Lees' exploration wells in the U.K. showed away from the outcrops (Dauka-1 preceded Fahud-1 by several months).

Unfortunately, the demanding and sometimes unhealthy conditions of fieldwork in his earlier years and hard work throughout his career took its toll. Ill health forced him to retire from AIOC in 1953 and he died in 1955 (aged 56), just a few months before Dauka-1, the first exploration well seeking oil in Oman, was spudded by Cities Service [24].

Fig. 9. Dr. George Martin Lees, M.C., D.F.C., F.R.S. Reproduced with permission of the BP Archive.

Lees believed in observation and deduction rather than speculation. He was sufficiently confident in his observations to defend his ideas against the general tide of geological thinking, like the allochthonous origin of the Hawasina and Semail and the likelihood of oil being found in the U.K. He continued to be intrigued by the geological world around him, by fold-belts and particularly by mountain chains and what happened to them when they reached the sea (this was the era before plate tectonics). He believed in publishing oil industry findings for the benefit of the geological community at large. His work showed '*the essentially unity of pure and applied science*'[25] . Lees' legacy and example, shaped by the inspirational geology of Oman, can live on.

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25. Geology Division of the Anglo-Iranian Oil Co., Ltd., 1954. Dr G.M. Lees, F.R.S., Nature, No. 4403, March 20th 1954, p. 523.

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إجتماع جمعيات علوم الأرض الخليجية الأول

كتبه: الدكتور علي بن إبراهيم اللزكي

سعت الجمعية الجيولوجية العمانية للتعاون المشترك مع شقيقاتها في مجلس التعاون الخليجي؛ من أجل توسيع دائرة المستفيدين من الأنشطة والخدمات التي توفرها هذه الجمعيات لتشمل جميع المهتمين بالعلوم الجيولوجية في دول الخليج العربية. وبعون الله تكلل هذا الجهد بإنعقاد الإجتماع الأول لجمعيات علوم الأرض الخليجية في مسقط يوم الجمعة ٢٧ مايو لعام ٢٠١٦ ميلادية.

لقد تم التنسيق لهذا الإجتماع بالتعاون مع رؤساء الجمعيات الجيولوجية في المملكة العربية السعودية ودولة الإمارات العربية المتحدة ودولة قطر ودولة الكويت، وحضر الإجتماع كل من د. محمد الحسين ممثل جمعية الظهران لعلوم الأرض في المملكة العربية السعودية، و د. خالد البلوشي رئيس الجمعية الجيولوجية الإماراتية بالإمارات العربية المتحدة، كما إعتذر عن الحضور كل من الفاضل سعيد الكواري ممثل الجمعية الجيولوجية في دولة قطر، والدكتورة فوزية عبدالله ممثلة الجمعية الجيولوجية في د و لة ا لكو يت الشقيقة؛ وذلك لظروف طارئة. ولقد تشرف المجتمعون بحضور ومشاركة سعادة المكرم الدكتور الخطاب بن غالب الهنائي نائب رئيس مجلس الدولة.

تمثل الهدف الأساسي للإجتماع في الإتفاق على نشاطات مشتركة تقوم بها الجمعيات الجيولوجية الخليجية مجتمعة. شملت الفترة الصباحية للإجتماع ثلاثة عروض تعريفية لجمعيات المملكة العربية السعودية ودولة الإمارات العربية المتحدة وسلطنة عمان. بعد ذلك خصص الجزء المتبقي من الفترة الصباحية والفترة المسائية لجلسات نقاشية، والتي ركز فيها المجتمعون على تحديد النشاطات المشتركة التي يمكن للجمعيات الجيولوجية الخمس مشتركة القيام بها في ما تبقى من عام ٢٠١٦، و الأعوام القريبة القادمة. وقد أثمر النقاش عن عدة مقترحات منها مقترح "رحلات إستكشافية لجيولوجيا الجزيرة العربية" والذي تبنته الجمعية الجيولوجية العمانية، كما تبنت جمعية الظهران لعلوم الأرض مقترح "المحاضر المتميز" والذي سيتم من خلاله اختيار مجموعة من المحاضريين المتميزيين في علوم الأرض، والذين سيقومون بتقديم سلسلة محاضرات في دول الخليج المختلفة على مدار العام. وتبنت الجمعية الجيولوجية الإماراتية مقترح "المخيم الجيوفيزيائي الشتوي" لطلاب علوم الأرض من مختلف جامعات دول الخليج العربية. واتفق الجميع على أن يتم الإعداد والتجهيز لهذه المقترحات بشكل كامل في الإجتماع الثاني لجمعيات علوم الأرض الخليجية، والذي سيقام في دولة الإمارات العربية المتحدة في شهر سبتمبر ٢٠١٦.

رحلة إلى عالم النفط

Trip to Oil World

رحلة إلى عالم الزلازل

Trip to earthquakes wo

المتحدّيين الجيولوجيين

GeoChallengers

الرحلات الميدانية

Fieldtrips

معرض صور الجمعية الجيولوجية العمانية

Geological Society of Oman Photo Gallery

المؤتمرات

Conferences

الجيولوجيا حول عمان

Geology around Oman

المحاضرات

Talks

بعد اليوم الأول من المغامرة في خسلة حيل الديار ، قام الكندي بنشر الخبر في التويتر و تم تداول التغريدات ، التغريدة بعد الاخرى ، ليصل في اليوم الثاني إلى الجرائد و الصحف. لم يكتفِ الكندي بهذه الحفرة فقط ، بل قرر النزول إلى حفرة أخرى إكتشفها شاب عماني من الجبل الأخضر في الصف الثاني عشر إسمه أسعد الجامودي من قرية عقبة البيوت خلال رعيه للغنم بعد ما كاد أن يتعثر عليها. قام أسعد بإخبار معلميه و هم بدورهم أخبروا الكندي عن الحفرة. يقول الكندي: "المعلمون الأفاضل من الجبل الأخضر وبالتحديد من مدرسة أبو زيد الريامي تواصلوا مشكورين معي لإخباري عن هذه الحفرة وحفر أخرى. كنت قد تعرفت عليهم بسبب محاضرة أقمتها في المدرسة قبل عدة أشهر، وهنا تأتي فائدة بناء العلاقات ومد جسور التواصل مع الناس، ونشر ثقافة الإستكشاف. لقد كان هؤلاء المعلمون مثالا رائعا حقا لمن يهتم بإستكشاف مقومات أرضه الطبيعية بكل جهد ونشاط". نزول خسلة الرويس ليس بصعوبة الحفرة الاولى كما قال الكندي لي. فهي بإرتفاع ٢٠ مترا، و نزولها أسهل بكثير من خسلة حيل الديار، وتتكون من تشكيلات كلسية مماثلة في الشكل مع خسلة حيل الديار لكنها أقل رونقا.

وما زال الفريق الذي شكله الكندي من خبراء إستكشاف الكهوف ومعلمي مدرسة أبو زيد الريامي في الجبل الأخضر يبحثون بجهد لإستكشاف فتحات كهفية أخرى في الجبل الأخضر. وقد عثر الكندي بعد أيام قليلة من إكتشاف الكهفين المذكورين في المقال على فتحة جديدة أسمها خسلة حيل الحدب، وهناك مؤشرات إيجابية للعثور على المزيد من الكهوف.

تعد الغرفة الكبيرة لكهف خسلة حيل الديار أبرز مقومات الكهف، وهي مزينة بمزيج باهر من التشكيلات والترسبات الكهفية الرائعة على جدرانها الجانبية وفي سقفها، والغرفة دائرية إلى مربعة الشكل. وتبلغ مساحتها الإجمالية في حدود ٤٠٠ متر مربع تقريبا، في حين أن أقصى إرتفاع لها قد يصل إلى نحو ٢٠ مترا. وهي تحتوي على مجموعة مختلفة من الصواعد والهوابط يُمكن إنارتها بطرق مختلفة; لإبراز ألوانها المختلفة بطرق باهرة. وفي الغرفة أيضا مجموعة من المداخل الصغيرة التي تحتوي على تشكيلات دقيقة وخيوط معدنية صغيرة. وللغرفة فيما يبدو مدخل واحد فحسب، ولا يُعلم على وجه الدقة إن كانت لها مداخل أخرى من جهة السقف، وهذا أمر مستبعد; لعدم وجود أي ضوء أو تيارات هوائية بها. كما أن الغرفة تمتاز بإنعزالها تماما عن الممر العلوي المؤدي للكهف وهي بذلك معزولة عن الضوضاء أيضا. بالنسبة لأرضية خسلة حيل الديار فإنها تحتفظ بطبيعتها الأصلية التي لم تتعرض حتى الآن لتدخل الإنسان، وهي تحتفظ بذلك بتفاصيل علمية يمكن من خلالها التعرف على طريقة تكون الكهف والترسبات المختلفة فيه. كما تحتوي على حفر صغيرة ربما تكون آثارا لبعض الهوابط التي سقطت من أعلى الكهف، وهذا يبين ضرورة لبس خوذة الرأس عند زيارة الغرفة. وأرضية الكهف طينية بسبب الأمطار الغزيرة التي سقطت على شمال عمان عموما والجبل الأخضر خصوصا في الأيام الماضية، وهذا ربما يشير إلى أن الماء يشكل بركا صغيرة وغير عميقة داخل الكهف. لم يتعرض الكندي ولا فريقه لأي هجمات من أي ثعابين أو عقارب عند نزولهم إلى الكهف، لكنه ذكر أنه رأى عنكبوتا واحدا يمر من تحت قدميه، ورأى جمجمة حمار وهياكل عظمية لكلبين على مسافة من الفتحة العلوية، دلالة على أنهما لم يلقيا حتفهما إلا بعد تجول بسيط قاما به في أنحاء الكهف. وبالإضافة إلى ذلك رأى الكندي مجموعة من الصناديق الملئية بالملابس القديمة، والتي رُميت من الأعلى للتخلص منها، ووصفها بالملابس الجميلة جدا، وتابع كلامه قبل أن أساله أنه لما يأخذ أي شي منها، وأبقاها في مكانها مثلها مثل بقية الأشياء الأخرى؛ للحفاظ على الكهف بنفس الهيئة التي عُثر عليها فيه، حتى تقام دراسة شاملة للكهف فيما بعد.

إستخدم الكندي كاميرات نيكون بتعريض طويل لإلتقاط الصور الرائعة للكهف، وإستخدموا إضاءات من مصادر مختلفة مثل مصابيح الخوذ والكشافات والهواتف. "الصور هي ما أكسب هذه الكهوف سرعة تداول خبرها" مثل ما قال الكندي، وتابع قائلا : "التشكلات الكلسية الرائعة والتكوينات ذات ألوان جميلة ومختلفة جذابة لأي شخص سواء كان جيولوجيا أو غيره".

يمكن تقسيم كهف خسلة حيل الديار إلى أربعة أقسام أساسية على حسب ما ذكره محمد الكندي: الفتحة الخارجية والممر العلوي المؤدي للكهف، وهي الفتحة الوحيدة التي توصل إلى السطح الخارجي، ومنطقة النزول والغرفة الصغيرة، والممر المؤدي إلى الغرفة الكبيرة، والغرفة الكبيرة. ويبلغ طول الكهف إجمالا نحو ١٠٠ متر، في حين أن إرتفاع سقف الغرفة الكبيرة قد يصل إلى أكثر من ١٥ متر في أقصى إرتفاع له. وللدخول إلى الغرفة الكبيرة والممر المؤدي لها ، لا بد للإنسان أن ينحني زاحفا لمسافة خمسة أمتار تقريبا، ثم ينفتح الكهف بعدها على تكوينات جميلة جدا تحيط بسقفه وجدرانه الجانبية.

بدأت رحلة النزول إلى خسلة حيل الديار في الساعة ١١ صباحا من يوم الجمعة إلى الساعة الرابعة عصرا من نفس اليوم. يتطلب لعمل مثل هذه المغامرة لياقة بدنية عالية ، وقوة تحمل كبيرة ; نظرا لما يواجهه المستكشف من التوغل إلى المجهول ومخلفات الخفافيش، التي قد تسبب حساسية قوية بسبب كمية الغبار التي قد يستنشقها الإنسان.

يصل قطر الفتحة الخارجية للكهف إلى متر تقريبا، وهي موجودة في طبقاتٍ صلبةٍ وسميكة من الصخور الجيرية، ولذلك فإنها تبدو آمنة من الإنهيار. ويمكن تطوير المنطقة المحيطة بها، ويصل طول الممر المؤدي إلى الكهف إلى ٤٠ متر تقريبا أو أقل، وهو يتسع لشخص واحد. كما أن الممر يتميز بأن له جدران صلبة، وهو عمودي إلى شبه عمودي في أغلب أجزاءه.

في أسفل ممر النزول توجد منطقة منبسطة يبلغ طولها ١٠ أمتار تقريبا وعرضها ٥ أمتار، وعلى جانبي هذه المنطقة توجد غرفتا الكهف الصغيرة والكبيرة. وتحتوي الغرفة الصغيرة ، والتي تبلغ مساحتها نحو ٦٠ مترا مربعا، على تشكيلات كهفية بسيطة . وهي وإن كانت جميلة لكنها لا تشكل المكون الأساسي للكهف.

يحتوي الممر المؤدي إلى الغرفة الكبيرة على قسمين: خارجي وداخلي، تفصل بينهما منطقة منخفضة تتطلب الزحف لمسافة خمسة أمتار تقريبا للمرور خلالها. ويحتوي القسم الداخلي للممر الواقع بعد منطقة الزحف على ترسبات كهفية رائعة ومتنوعة.

"خسلة حيل الديار" و "خسلة الرويس"، هما الإسمان اللذان أُطلقا على هذين الكهفين، و قد سُمّيَ خسلة حيل الديار بهذا الإسم نسبة إلى قربه من قرية حيل الديار بالجبل الأخضر كما هو الحال بالنسبة إلى خسلة الرويس والذي سمي بإسم المنطقة التي يقع بها الكهف. بسبب تكرار كلمة خسلة سألت الكندي عن معنى هذه الكلمة و مصدرها، وهنا بدأ الكندي بشرح الكلمة ومعناها، شرح معلم اللغة العربية لطلابه، إذ ذكر أن كلمة خسلة في لهجة أهل الجبل تعني الهوة في الصخر أو الأنبوب المغلق الذي لا يُرى قعره، ولها أصل عربي مستوحاً من كلمة خشلة (بالشين)، وهي عبارة عن المنطقة المقعرة التي تشبه البيضة. وكما هو الحال في كثير من بلدان العالم، كانت الحفرتان تستخدمان للتخلص من بعض الأغراض الغير المرغوب فيها، وأحيانا للتخلص من الحيوانات الميتة أو الملابس القديمة. ذكر الكندي أن وجود فندق العليلة في الجبل ساهم بشكل كبير في تشجيع البحث عن أماكن سياحية جديدة لإدراجها في قائمة الأماكن السياحية بالمنطقة. وحتى يتسنى أخذ السائحيين إليها ليستمتعوا بها، استعانت إدارة فندق العليلة بمسكتشف كهوف معروف هو الإنجليزي ستيف جونز. وقد قاد سكانُ المنطقة ستيف إلى أحد هذه الفتحات، و الذي قام بدوره بالنزول إلى هذه الفتحة، وأثمر ذلك عن إكتشافه كهفا جديدا. عند سماعه خبر إكتشاف الكهف الجديد، قرر الكندي النزول الى هذه الحفرة و دراستها و مسحها بمعدات التصوير، فأخبر شخصين آخرين شاركاه في المغامرة، وهما أندرياس وولف ، مستكشف كهوف ألماني خبير، والآخر ماتياس كوريًّا، وهو جيولوجي محب للمغامرة يعمل كمحاضر في الجامعة الألمانية للتكنولوجيا. كان لهؤلاء الثلاثة خطة أولية وهي إستكشاف "كهف الكعدي" في يتي بمحافظة مسقط. لكن الخطة تغيرت عند سماعهم عن الكهف الجديد.

> "خسلة:في لهجة أهل الجبل الهوة في الصخر أو الأنبوب المغلق الذي لا يرى قعره"

التوغل إلى باطن الجبل

خسلة حيل الديار وخسلة الرويس

كتبه: حسام بن سالم الرواحي

تتمتع سلطنة عمان بطبيعة جيولوجية فريدة من نوعها مما جعلها بحق متحفا جيولوجيا طبيعيا يحتوي على مئات المواقع الجيولوجية التي تستحق الزيارة والإستكشاف. كثير من هذه الموروثات الطبيعية ما زالت قابعة في مكان ما تنتظر رفع اللثام عنها. وليس أدل على هذا من الإكتشاف الرائع الذي أحدث ضجة في وسائل التواصل الإجتماعي وانتشر بسرعة كبيرة في مختلف وسائل الإعلام. كان الإكتشاف هو العثور على كهفين جديدين في منطقة الجبل الاخضر الذي يتميز بوجود طبقات سميكة من الصخور الجيرية التي ترسبت قبل ملايين عديدة من السنين. هذه الصخور ترسب أغلبها في بحار ضحلة غمرت هذا الجانب من عمان في تلك الفترة.

يعود الفضل لإنتشار هذا الخبر في وسائل الإعلام إلى الجيولوجي الدكتور محمد الكندي الرئيس السابق للجمعية الجيولوجية العمانية و الرئيس التنفيذي لشركة الإستشارات الجيولوجية الذي قبل التحدي مع نفسه وقررالنزول إلى الكهفين و إكتشافهما و دراستهما. لم يكن لدى الكندي أدنى فكرة بأن هذا الإكتشاف سيلقى صداً قويا بين الناس لاسيما أن الكهوف منتشرة كثيرا في الصخور الجيرية العمانية. من هذه الكهوف الكهف المشهور كهف "مجلس الجن" الذي يقع في هضبة سلماه بولاية قريات بمحافظة مسقط والكهوف الأخرى في محافظة ظفار مثل "كهف المرنيف" و "طيق". تعرف الكهوف بأنها عبارة عن تجويفات صخرية تتكون بطرق مختلفة، وعادة تنشأ في الصخور الجيرية التي تتكون من مركبات كربونات الكالسيوم. هذه المركبات تتعرض للإذابة عند تفاعلها مع مياه الأمطار والمياه الجوفية; إذ تجري هذه المياه في التشققات والصدوع العمودية لتُكَوِّن مع مرور الوقت غرفا كهفية تتسع تدريجيا بمرور الوقت.

روائع عمان الجيولوجية
Oman's Enchanting Geology

أول كتاب عماني يبرز جمال جيولوجية عمان الساحرة من الشمال إلى الجنوب

First Omani book shows the beauty of the geology of Oman charming from north to south

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الجمعية الجيولوجية العمانية
Geological Society of Oman

لذا تعتبر التقنيات الجيوفيزيائية الحديثة من أكثر الطرق فعالية في تتبع مثل هذه المشكلات، حيث أنها لا تزيد من كمية البيانات المستخرجة فحسب بل توفر الكثير من المال والجهد والوقت. من ضمن التقنيات الجيوفيزيائية الحديثة المستخدمة حاليا في سلطنة عمان، والتي تستخدمها شركة الصخور الوطنية للإستكشاف الجيوفيزيائي، هي تقنية المقاومة الكهربائية ثنائية الأبعاد (٢D) والتي تستخدم في التنقيب عن المياة والمعادن الفلزية وخدمات فحص التربة لإستكشاف التسريبات البترولية والكيميائية ومعرفة مدى إنتشارها. تعتمد هذه التقنية على حقيقة أن المواد والعناصر المختلفة تتفاوت في قدرتها على التوصيل الكهربائي؛ بمعنى آخر فإن بعض المواد أو العناصر تتميز بمقاومة عالية للتيار الكهربائي مثل بعض أنواع الصخور في حين أن البعض الآخر له قدرة عالية على توصيل الكهرباء مثل الماء بما فيه من أملاح ذائبة. كما أن إختلاط الصخور بالترسيبات البترولية أو الكيميائية يغير من الخصائص الفيزيائية للصخور الأصلية فتصبح أكثر أو أقل مقاومة للكهرباء. وعليه يمكن التفريق بين العناصر والمواد المختلفة على حسب تباين قدرتها على المقاومة أو التوصيل الكهربائي. إن أهم ما يميز تقنية المقاومة الكهربائية ثنائية الأبعاد التي تستخدمها شركة الصخور الوطنية للإستكشاف الجيوفيزيائي هو أنها تقوم بقراءة ٣٦٠ نقطة على ١٦ مرحلة متوزعة على أعماق مختلفة تصل إلى ٤٠ متر. يتم تسجيل هذه القراءات بشكل متواصل وفي خط ثابت مما يجعل عملية إستخلاص التحليلات ومن ثم الإستنتاجات من هذه القراءات عملية أكثر منطقية. ومن الأمثلة على ذلك قامت الشركة بإستخدام هذه التقنية للبحث عن مكان تسريب الماء من حوض مائي فوق سطح الأرض في إحدى المرفقات الصناعية لأحدى الشركات، حيث إستطاعت الأجهزة الجيوفيزيائية رصد قراءات ذات مقاومة منخفظة حول الحوض ناتجة عن وجود الماء المتسرب الموصل للكهرباء في المنطقة التي حدث فيها التسرب المائي. مثل هذه التسربات المائية من شأنها التأثير على ثبات البنية التحتية للمرفقات الصناعية خاصة في المناطق التي تتواجد فيها الصخور الجيرية القابلة للذوبان عند تفاعلها مع المياة. وكمثال آخر تم إستخدام هذه التقنية لتقصي مدى إنتشار مادة كيميائية تحت سطح الأرض في إحدى الحقول النفطية، حيث أن طبقات الأرض النظيفة كانت أكثر توصيلا للكهرباء من تلك الملوثة بالمواد الكيميائية. كما يمكن إستخدام تقنية المقاومة الكهربائية في أربعة أبعاد (٤D) ، والتي هي عبارة عن تكرار لقياس المقاومة الكهربائية ثنائية الأبعاد في أوقات مختلفة لمعرفة مدى سرعة الإنتشار للمواد المتسربة أو إذا ما زال التسريب مستمر عبر فترات زمنية متباعدة.

إن تقنية المقاومة الكهربائية ثنائية الأبعاد سوف تساعد الكثير من شركات النفط والغاز وغيرها في إيجاد حلول لمشاكل التسريبات البترولية والكيميائية في حقول النفط وذلك من خلال معرفة أماكن التسريب وتحديد مدى إنتشار المواد المتسربة وأيضا من خلال تقييم الطرق المتبعة حاليا لعلاج هذه المشاكل.



تقنيات جيوفيزيائية حديثة في قطاعنا النفطي:
نحو بيئة أكثر أمانا

كتبه: سلطان بن محمد الحبسي

إن طبيعة العمل في حقول النفط لا تخلو من أخطاء بشرية أو تقنية أو طبيعية، وتعتبر التسريبات البترولية والكيميائية في حقول النفط من أهم المشكلات الناتجة عن هذه الأخطاء، وقد تبدو حلول هذه المشكلات بسيطة عند إكتشافها ولكن ماذا عن التأثيرات التي قد تظهر على المدى البعيد على كل من البيئة والمياة الجوفية والغلاف الجوي ؟

يؤدي إختلاط عنصر من العناصر البترولية أو الكيميائية بمساحة معينة من التربة أو الطبقات الأرضية إلى تغير خواصها الفيزيائية مقارنة بطبيعة الارض من حولها وإن كانت على تجانس مع بقية المكونات. ولذلك تعتبر الدراسات الميدانية مهمة جدا لمعرفة مدى إنتشار العناصر المؤثرة سلبا على خصائص التربة والطبقات الأرضية؛ حتى يتم وضع الخطط المناسبة لإحتوائها والحد من إنتشارها. تقوم معظم المؤسسات بإنشاء العديد من الحفر في المناطق التي يشتبه تأثرها بتلوث من هذا النوع؛ لرسم خارطة تقريبية توضح مدى إنتشار هذه الملوثات وهذا بدوره يكلف الكثير من الأموال. كما أن آلات الحفر نفسها قد تسبب تلوثا آخر للمنطقة سواء كان عن طريق أنابيب الحفر أو الإنبعاثات المنطلقة في الجو أو غيرها، ناهيك عن عدم توفر معلومات كافية عن مدى إنتشار الملوثات في المساحات الواقعة بين الآبار المحفورة.

رسالة المحررة

إنه لمن دواعي سروري أن أقدم لكم نبذة عن محتوى العدد الثاني والعشرين من مجلة الحجر، والذي يتضمن العديد من المواضيع المتنوعة والمفيدة بإذن الله. لربما تكونوا قد سمعتم بالأخبار المتداولة في الفترة الأخيرة عن سلسلة من الإستكشافات لكهوف في الجبل الأخضر، ونحن هنا في مجلة الحجر أرتأينا أن نسرد القصة الكاملة عن هذه الإستكشافات المثيرة كما أخبرنا بها الدكتور محمد الكندي والذي قاد رحلة الإستكشافات. كما نظمت الجمعية الجيولوجية العمانية العديد من الرحلات الميدانية، والمحاضرات العلمية، والأنشطة التعليمية للطلاب بما فيها مسابقتي المتحديين الجيولوجيين والجيولوجيين الصغار، والإجتماع السنوي العام لأعضاء الجمعية، ونحن في هذا العدد نعرض لكم ملخصا مصورا لجميع هذه الفعاليات. لقد تشرفت الجمعية بإستضافة الإجتماع الأول للجمعيات الجيولوجية بدول مجلس التعاون الخليجية، والذي هدف إلى مناقشة سبل التعاون المشترك بين الجمعيات. تجدون في هذا العدد ملخصا لهذا الإجتماع ومخرجاته. أحد أهم المواضيع التي تستقطب إهتمام العامة، خصوصا في السنوات الأخيرة، هي الأخطار البيئية الناتجة عن العوامل الطبيعية، والأخطاء التقنية والبشرية الحاصلة في قطاع النفط والغاز. من أهم هذه الأخطار تسريبات المنتجات البترولية والكيميائية في حقول النفط، والتي قد ينشأ عنها أضرار بيئية جسيمة على المدى البعيد. في هذا العدد نسلط الضوء على دور التقنيات الجيوفيزيائية الحديثة في التقليل من هذه الأخطار وخلق بيئة أكثر أمانا. أخيرا أتمنى لكم قراءة ممتعة، و إن كان لديكم أي تعليقات أو كنتم تودون المشاركة في الأعداد القادمة من مجلة الحجر، وذلك بنشر أي موضوع علمي، نرجوا منكم عدم التردد في التواصل معي عن طريق بريدي الإلكتروني.

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كلمة رئيس الجمعية

يسرني ويسعدني أن أرحب بكم في عدد الحجر الأول لهذا العام ٢٠١٦ ميلادية. تبذل الجمعية الجيولوجية العمانية جهدا ملموسا لتقديم نشاطاتها الشهرية من محاضرات ورحلات ميدانية تعليمية لأعضائها الكرام على أكمل وجه، وبالإضافة الى ذلك دأبت الجمعية الجيولوجية العمانية إلى تنويع نشاطاتها؛ وذلك حتى توسع من دائرة المستفيدين من المعرفة التي توفرها الجمعية لتشمل العامة من المواطنين والمقيمين في أرض السلطنة، ومن هذا المنطلق، أطلقت الجمعية الجيولوجية العمانية حملة الجيولوجيا حول عمان والتي تهدف إلى تقديم المحاضرات الجيولوجية التوعوية للعامة في مختلف ولايات السلطنة، حيث بدأت أولى هذة المحاضرات في ولاية الرستاق، والتي تم تنظيمها بالتعاون مع فريق المسفاة الرياضي الثقافي، ونادي الرستاق الرياضي في الرابع من مارس لهذا العام ٢٠١٦ ميلادية.

وإنه لمن دواعي سروري إعلامكم بخبر إجتماع الجمعيات الجيولوجية الخليجية الأول، والذي أقيم في مسقط بتاريخ ٢٧ مايو لهذا العام ٢٠١٦ ميلادية. تم التنظيم لهذا الإجتماع بالتعاون مع رؤساء الجمعيات الجيولوجية في المملكة العربية السعودية ودولة الإمارات العربية المتحدة ودولة قطر ودولة الكويت، وتشرف المجتمعون بحضورالمكرم الدكتور الخطاب بن غالب الهنائي نائب رئيس مجلس الدولة. المزيد من تفاصيل عن هذا الإجتماع ستجدونه في هذا العدد من مجلة الحجر.

وإذ تسعى الجمعية الجيولوجية العمانية إلى نشر الثقافة الجيولوجية في المجتمع العماني عامة، ستواصل الجمعية تنظيم المحاضرات للعامة ضمن حملة الجيولوجيا حول عمان في عدد من ولايات السلطنة بحيث تشمل في هذه السنة بإذن الله محافظات الداخلية والباطنة ومسندم وظفار والشرقية والظاهرة، على أن يتم التنسيق لهذه المحاضرات مع ممثلي الشورى والمجالس البلدية في الولاية المزمع عقد المحاضرة فيها. ومن هذا المنطلق تفتح الجمعية الجيولوجية العمانية باب المشاركة لأعضائها الكرام للمساهمة في التنظيم كل في ولايته أو لمن أراد المشاركة في ولاية أخرى.

وفقنا الله وأياكم لما فية الخير والنماء لعماننا الحبيبة.

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تحرير

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الدكتور علي بن إبراهيم اللزكي – تنمية نفط عمان

تدقيق المقالات باللغة العربية

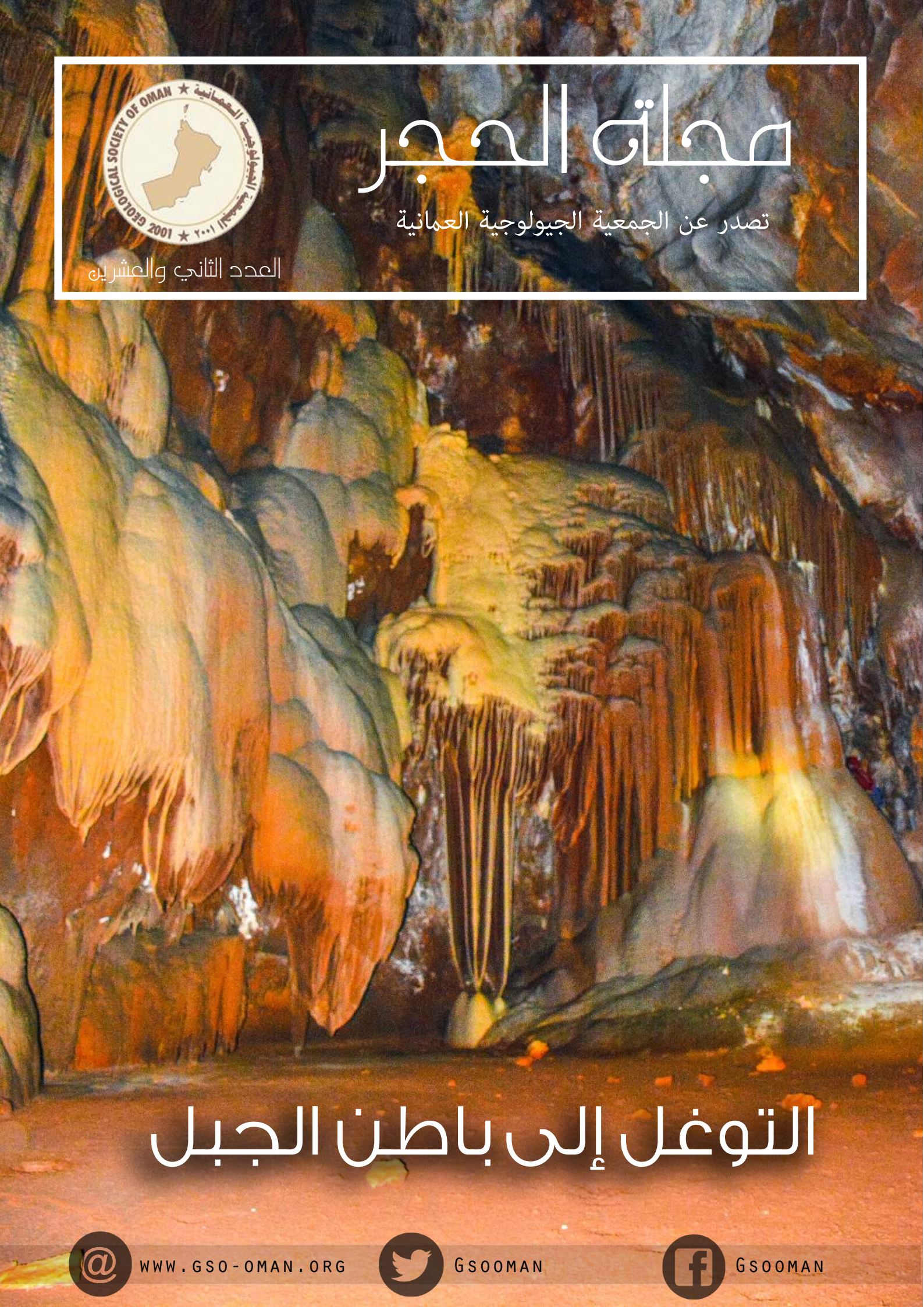
الدكتور إبراهيم بن يحيى الإسماعيلي – الرؤية للحلول النفطية المتقدمة

تدقيق المقالات باللغة الإنجليزية

أحمد بن إبراهيم الحضرمي – شركة النفط العمانية للمصافي والصناعات البترولية
محمد بن حمد العامري – تنمية نفط عمان

تصميم

بشرى بنت محمد الطوقي – أوكسيدنتال عمان



مجلة الحجر

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