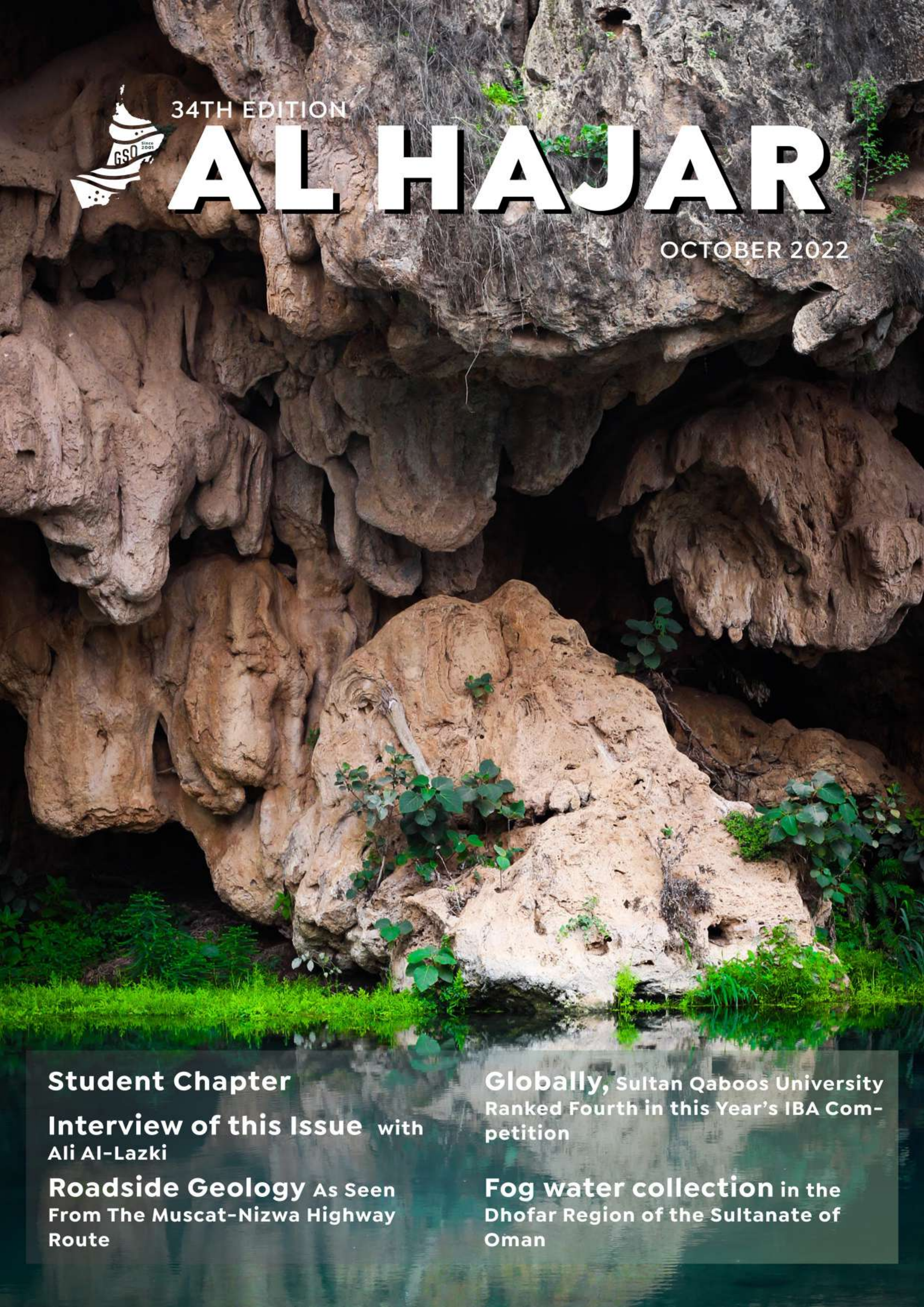

34TH EDITION

AL HAJAR

OCTOBER 2022

Student Chapter

Interview of this Issue with Ali Al-Lazki

Roadside Geology As Seen From The Muscat-Nizwa Highway Route

Globally, Sultan Qaboos University Ranked Fourth in this Year's IBA Competition

Fog water collection in the Dhofar Region of the Sultanate of Oman

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ABOUT GSO

The Geological Society of Oman GSO was established in April 2001 as a vocational non profit-able organization which aims to advance the geological science in Oman, the development of its members and to promote Oman's unique geological heritage.

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BY THE EDITOR

Dear readers,

The world is undergoing rapid changes as alternative energy solutions are introduced into many aspects of our lives. The intended outcome of course, is to enhance conservation of the surrounding environment by reducing the current impact of fuel emissions. One related research focus is the production and promotion of green hydrogen as an energy carrier that can be used in many everyday applications that currently rely on fossil fuels. Hydrogen is a lightweight and highly reactive fuel that can be produced through a chemical process known as electrolysis. This method uses an electric current to separate the hydrogen from oxygen which are bound together in water. If this electricity is obtained from renewable sources, then the hydrogen is considered to be 'green' as no carbon dioxide is released into the atmosphere. There are many amazing potential applications for this fuel, and well-directed research will help optimize its use in local transportation, electricity generation (including both combustion and fuel cells), household use, cargo ships, and other possible uses. Oman is well positioned to play a significant role in the hydrogen economy due to abundant sunlight for solar electricity generation, proximity to the sea as a source of water for hydrogen, and many depleted oil and gas wells which can be repurposed for underground hydrogen storage.

My message dear readers, is to highlight current global trends and the radical changes that require us to accelerate and diversify alternative and clean energy sources to avoid future problems and unwanted changes.

In this issue, you will find news related to the Geological Society of Oman as well as some interesting scientific articles shared with us by members. I hope you enjoy and discover something new about Oman and the geosciences. Please share your questions and any ideas you may have for future articles.

My Regards,
Yousuf Al Darai
Al Hajar Magazine Editor

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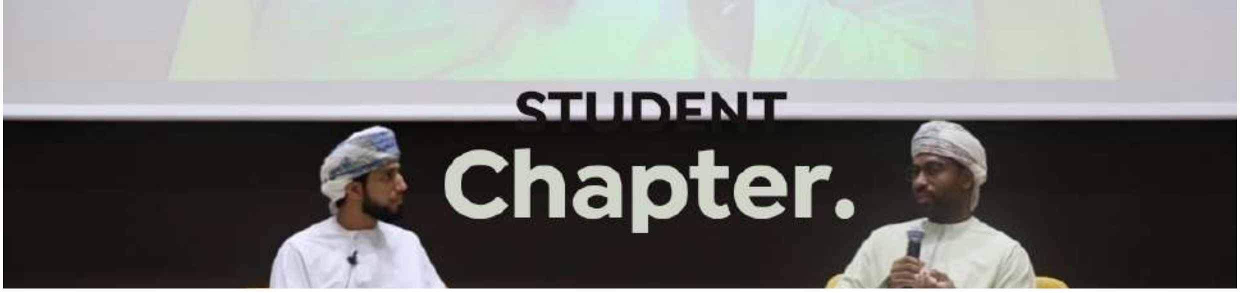

The Geological Society of Oman Affirms its Interest in the Advancement of Geological Knowledge for Students

Written by: ***Issa Al Shibli***

Since its establishment in 2001, the Geological Society of Oman continues to be the leading educational platform for supporting geoscientists, industry professionals, teachers, students, and all other persons who are interested in the earth sciences. Oman's reputation as a geological paradise, due to its fascinating and diverse landforms such as deserts, caves, mountains, and wadies, make it a popular destination for passionate research scientists from all over the world who wish to study unique geological features such as the complete geological succession of oceanic crust which is exposed in northern Oman.

Recognizing that students are future leaders, GSO is moving forward to support students in building a confident, advanced mindset that helps them develop the required skills for accelerating research and responsible resource management and development across various disciplines. One way that GSO supports students is by allowing them to participate in all events, such as field trips and competitions, without paying the membership or other fees. This enables them to gain knowledge and learn from the discussions, as well as make connections with researchers and industry professionals at the same time.

Another way that GSO can support students is by establishing student chapters at various local and international universities. The idea of creating student platforms within the Geological Society of Oman, started when GSO conducted a survey among Omani geoscience students at universities all around the world to discover their ideas of what we can offer them in the future. From that, the GSO committee started building a strategy that targets university students in providing complementary support of what they are learning in their academic programs.

The GSO envisions that Student Chapter programs will raise student knowledge levels both technically and academically. These chapters also will give students a chance to develop leadership skills and to make vital contributions toward establishing programs that will benefit students from all the various earth sciences-related disciplines.

The Student Chapter initiative was launched at a student-related event on the 27th of July 2022 at the Oman Institute for Oil & Gas. Its clear mission is to enable and develop technical and personal skills for students during their undergraduate studies and before they enter the industry. This will empower them to adaptively and creatively embrace future challenges and opportunities in a rapidly growing and changing world.

The main objectives and vision of the Student Chapters are to:

- Enhance knowledge of the geology of Oman among Omani geoscience-related students at different universities within Oman and abroad.
- Bridge the knowledge gap between university academic programs and the ever-evolving requirements of the industry.
- Create a platform for communication between students within the Geological Society of Oman to share geological work and ideas.
- Gain new ideas and talents to support the activities of the Geological Society of Oman and to serve the geoscience industry in Oman.
- Build a sustainable future for the GSO and the Omani earth science community.
- Enable communication between Earth science student groups both inside and outside Oman.

Our visions will be achieved by organizing events, workshops, and field trips (technical and social) for the geoscience undergraduates within and outside Oman.

From left: Issa Al-Shibli (GSO) and Sami Al-Nofli (Petroleum Development Oman-PDO) discuss geoscience students' future and how PDO can support student events. They also discussed the skill sets required in today's industry and how best to prepare geoscience students to satisfy market requirements.

ROADSIDE GEOLOGY

as Seen From The Muscat-Nizwa Highway Route

Written by: *Almuathir Alkindi*

This article documents and explains many of the exposed rocks that are seen along the highway route that links Muscat with Nizwa and other regions of the central and south interior of Oman. The article gives general geological overviews for several significant outcrops, exposures and geological phenomena observed when commuting along this route.

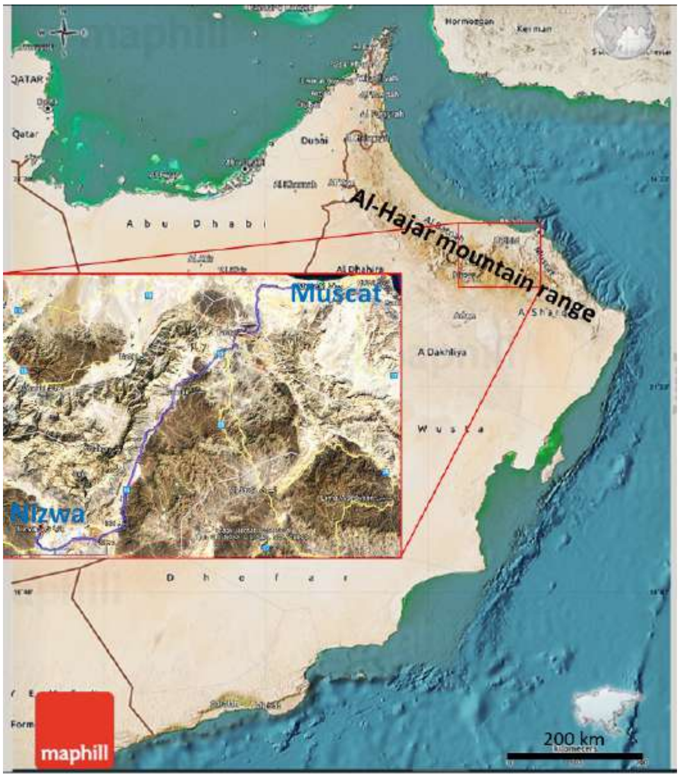

Figure 1: Map of the Muscat-Nizwa route within an overall satellite map of Oman.

LOCATION AND EXTENT:

The focus of this article is the highway extending from Oman's capital city of Muscat to the town of Nizwa in the interior (marked as route 15 in purple color in the satellite image, Figures 1 and 2). This route is one of the major strategic transportation corridors in Oman. It cuts through the Hajar mountain range to connect the Muscat metropolis and densely populated Al-Batinah coastal strip, with the interior of Oman including Ad-Dakhiliya, Ash-Sharqiyah North and Ad-Dhahirah governorates. From Muscat governorate, the route passes by the towns of Bidbid, Samail and Izki before reaching Nizwa.

Overhead geological view:

Figure 2: Overhead satellite map showing Muscat-Nizwa highway (purple line), running mainly between ophiolite (brown color) and Hajar mountains (greyish color), courtesy of Google Earth TM

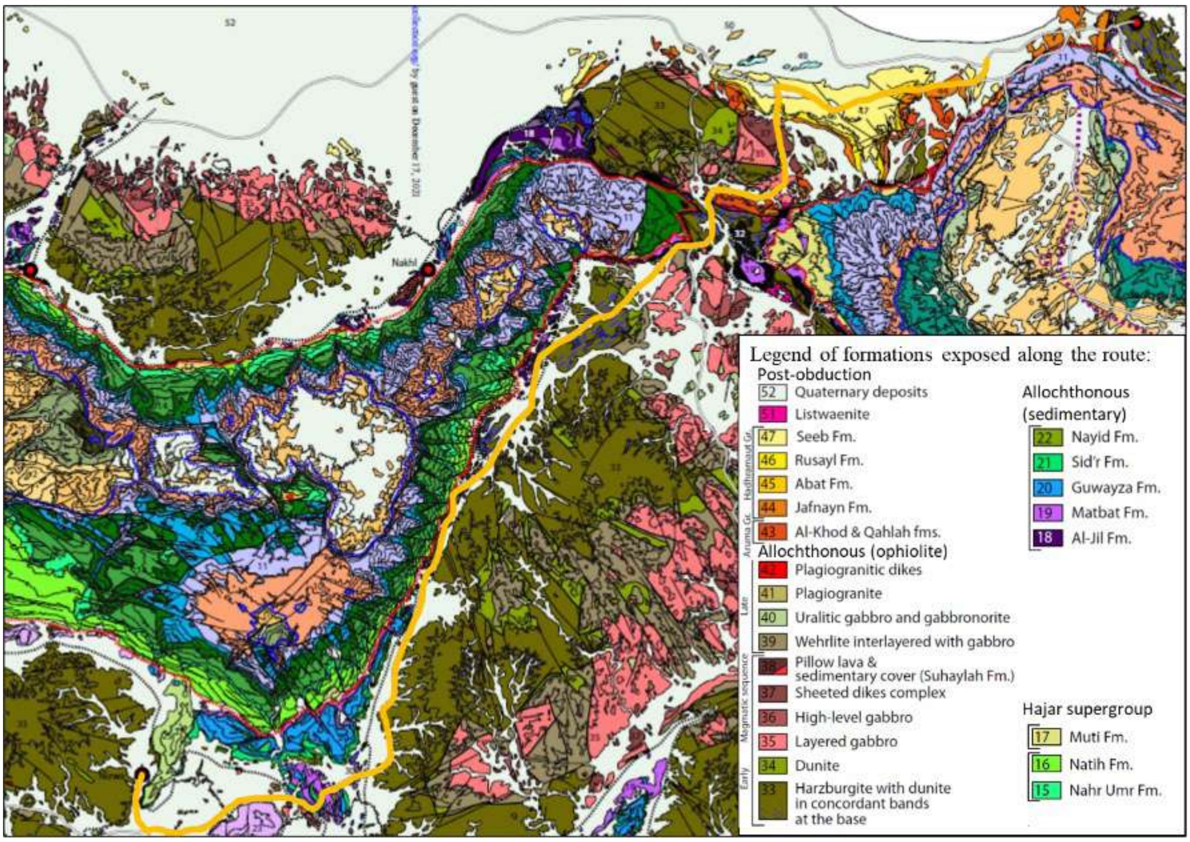

Figure 3: Geological map showing formations surrounding the Muscat-Nizwa highway (Scharf et al, 2021)

SAMAIL GAP:

A large (70 km long) portion of this route was built along a NNE-SSW trending fault lineament which is known as the Samail/Semail gap. Unlike the typical expression of geological gaps, defined as unconformities or periods of non-deposition, the Samail gap is a geomorphological feature located between the eastern flank of the Jebel Akhdar dome and the Samail ophiolite massif. The major wadis running through this gap (Wadi Samail and Wadi Halfeen) mark the geographical boundary between the two major subdivisions of the Hajar mountain range in Oman (Western Hajar mountains and Eastern Hajar mountains). The tectonic sliding motion of the hanging-wall ophiolite block likely influenced the orientation of the Semail Gap Fault Zone and adjacent faults, with an imprint that influences the fault zone's surficial expression.

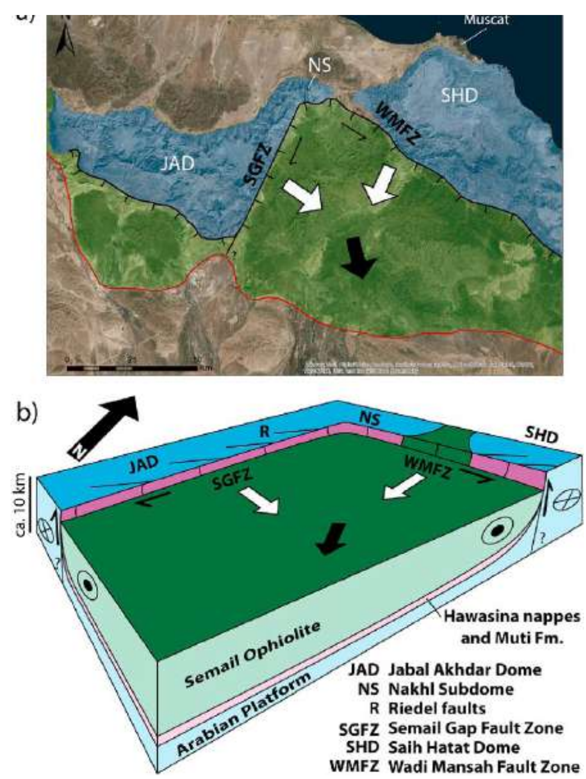

Figure 4:(a) Schematic map shows the sliding/downthrown direction of the hanging wall block. b) Schematic block diagram depicting the motion of the Semail Ophiolite block away from the JAD and NS/SHD. (Scharf, et al, 2019)

ONSET FROM MUSCAT:

We begin our tour at the Geological Society of Oman (GSO) office in Muscat. This metropolitan area is largely built upon an alluvial plain which lies between the coast of the Sea of Oman, and the northern mountain piedmonts of Saih Hatat dome. This alluvial plain is occasionally crosscut by Pleistocene sand dunes such as the Bousher sands.

CENOZOIC CARBONATE OUTCROPS:

As we head west via the Muscat Expressway, the most notable outcrops seen in the roadcuts, are bright Eocene carbonate-dominated formations such as the Jafnayn, Rusayl and Seeb. Between Al-Ansab bridge and the Muscat International Airport bridge, the predominant exposed rock is from the Jafnayn formation, which is largely composed of Eocene limestone marls (carbonate mudstone) and limestone that is rich in alveolinid foraminifera (Özcan et al, 2015).

The road then passes through a 10 km long series of outcrops representing the Seeb Formation, which is a 600 m thick succession of transgressive carbonates (Hersi & Al Harthi, 2010). Throughout the outcrops of this limestone, we observe a strong karst porosity represented as pores and cavities within the limestone strata, indicating its potential to host aquifers or hydrocarbon reservoirs in the subsurface.

Turning off the Muscat expressway and heading south toward the Muscat-Nizwa highway, the first outcrop we encounter reveals a section of the Rusayl Formation. This is a thin formation dominated by dark shales and containing occasional limestone subordinate interbeds, with red paleosols. Stratigraphically, it is located above the Jafnayn and below the Seeb formations.

This shale-dominated outcrop near the village of Rusayl was typically encased in cement for road safety due to its fragility caused by the presence of gypsum. However, there is currently a viewing opportunity, as recent road expansion works have removed the cement cover and further excavated into the outcrop.

Image 1: Outcrop near Muscat airport heights, showing bright limestone from Seeb formation by Muscat expressway, showing significant pore space

Image 2: Outcrop near Rusayl showing Rusayl Formation dominated by dark shales, overlying bright limestone of Jafnayn formation

As we head further south, the village of Al-Jafnayn is located within ophiolite exposures of a basalt sheeted dyke complex (rather than the Jafnayn limestone). To the southeast, Jafnayn carbonate cliffs are seen to unconformably overly the ophiolite. These cliffs host the popular hiking destination of Saal stairs. The highway cuts through and exposes a layered Gabbro sequence of the ophiolite. Also visible is a mountain with notable carbonate cliffs and a flat table-top shape, which marks part of the synclinal saddle between the Jebel Akhdar and Saih Hatat anticlinal domes.

Near the town of Fanja, the road continues westward passing through Saih Al-Ahmar, which translates as "Red alluvial plain", and is located on the flanks of reddish mountains composed of the Al-Khoudh Conglomerate. Dating back to the upper Cretaceous, this formation is a post-obduction deposit that overlies the ophiolite below. The dominant red color is from a fluvial conglomerate that is largely derived from the Hawasina group (Mattern et al, 2015).

Image 3: Syncline resembling a tabletop, with bright Eocene limestone overlying upper Cretaceous conglomerate

The road briefly bends towards the southeast, where we see an outcrop marking the contact between the Al-Khod Conglomerate and a rock type known as Listwaenite. The town, plantations, and wadi Fanja are seen on one side of the road while the Listwaenite exposure is visible on the other. Listwaenite is a hydrothermally altered metamorphosed ophiolitic peridotite that is cross-cut by calcite or quartz veins (Nasir et al, 2007). Wadi Fanja is one of the major wadis in Oman, and its tributaries form a catchment area of about 1720 km2 (AL-Hashmi et al, 2020).

This catchment covers a semi-triangular region between the northeastern piedmont of the Jebel Akhdar anticline, the southwestern piedmont of Saih Hatat dome and the ophiolite nappes in between. The course of the wadi is parallel to the "Samail gap" which plays an important role in the facilitation of the route.

Going south from the bridge and bending to the west, the road cuts through peridotite hills which contain a notable density of calcite and magnesite-filled fracture veins as seen between the town of Bidbid and the intersection with the Ibra-Sur highway.

Image 4: Outcrop near Fanja, showing Listwaenite with mineral bands

After the junction, we can see exposures of the southern flank of an east-west trending part of the Jebel Nakhal sub-dome and adjacent listwaenite exotics to the right-hand (west) side of the road and rounded gabbro hills on the other side by the village of Al-Farfarah.

As we head southwest of the junction, the route passes through a wide alluvial plain which separates gabbros to the southeast and the Nakhal subdome with adjacent listwaenite to the northwest.

After the alluvial plain, the road penetrates a group of ophiolite hills transitioning from crustal gabbros to mantle-sequence peridotites. A notable view is of the green village of Al-Jaylah beside which the road follows the course of a wadi. The tributaries of this wadi descend from the high-relief piedmont of the Hajar supergroup carbonate and converge to the southeast in a funnel-like alluvial plain before cutting through the ophiolite hills and flowing northeast.

As we head towards the outskirts of Samail, colorful outcrops are found close to the junctions that lead towards the town. These meta-sedimentary layers belong to the Al-Jil (upper Permian to mid-Triassic) and Matbat (Upper Triassic to lower Jurassic) formations that were later obducted as part of the Hawasina sequence. The obduction processes caused the metamorphism and various styles of folding seen in these rocks.

Beyond Samail, the road follows an elongated alluvial plain named Saih Al-Rasiyat (meaning "plain of firm mountains") and is oriented along a major wadi located between the Hajar supergroup anticlinal piedmonts and the ophiolite hills. In a manner similar to Wadi Al-Jaylah, the alluvial plain narrows between the ophiolite hills and funnel downstream through the ophiolite to Samail oasis. The alluvial plain's hydrogeological storage capacity and orientation also provide an abundance of water for the oases further downstream.

Figure 5: Tilted satellite image showing topography relative to wadi Al-Jaylah, Samail, with convergence and NE flow of wadi, courtesy of Google Earth TM.

Image 5: Outcrop near Samail, showing colorful layers of Permian to Triassic meta-sediments

One of the most prominent uphill ascents on the route is past the village of Sayja, which is known for its warm-water foothill springs. These springs emerge from the thrust contact between the ophiolite and Hajar supergroup where breathtaking steeply dipping strata of thick resistant cretaceous autochthonous carbonates are observed. Further uphill, another roadcut exposes various meta-sedimentary Hawasina layers, and it is located where the road runs through a saddle between the autochthonous anticline flank and the allochthonous Oman Exotics nappe.

In Wadi Bani Rawaha, both the road and the wadi follow the elongated geomorphological gap. Along the wadi is seen a thread of mountainside oasis and villages where water is supplied by tributaries from the steep anticlinal flanks of the Jebel Akhdar dome to the west and the gently sloping wadis from the peridotite massif to the east, before flowing northward towards Samail. Through this section, the route takes a gradual uphill trend towards the south/southwest up to an obvious elevated alluvial terrace known as Al-Najd (translated as the plateau). This is likely an example of a recent wadi incision of its own alluvium due to change in relief or uplift.

After passing the high point that defines the drainage divide between wadis that flow northward to the Sea of Oman and those that flow south towards the Arabian sea, the road gradually descends southward through the alluvial plain of Wadi Halfeen. This wadi cascades steeply down a canyon from Jebel Akhdar and its waterfall is visible from the highway during and after rainstorms. The wadi descends into an alluvial fan with a minor distributary that runs to the northeast while the main stream turns south and flows towards the town of Izki and adjacent villages.

Approaching the oases of Imti and Qaroot, we see the eastern side of Jebel Akhdar as a high-relief piedmont that rises to an elevated plateau of over 2000 m elevation. Near the foothills of the Jebel, there are exposures of allochthonous formations such as the Sidr and Nayid (seen as brownish-orange inclined strata), which are inclined similar to that of the autochthonous Hajar supergroup carbonates (particularly Natih and Shuaiba formations) which are exposed at the elevated piedmont of the Jebel.

One of the best exposures of harzburgite peridotite is seen near the northeast outskirts of the town of Izki. Here, the road cut reveals an outcrop of freshly exposed grey harzburgite, which sharply contrasts with the dark brown color of naturally exposed and weathered surfaces of the same lithology. The discoloration is due to oxidation and other processes that naturally alter ophiolite minerals such as peridotite. This weathering from prolonged exposure to oxygen and humidity, demonstrates the chemically instability of mafic rocks compared to the majority of sedimentary/metamorphic groups in Oman mountains. The structural instability of these rocks, due to fractures and weathering, is evidenced by their tendency to manifest as lower elevation hills compared to the more resistant carbonates of Hajar supergroup and others similar rocks in the Jebel Akhdar/Saih Hatat domes.

Image 6: Distantly captured image of Imti oasis, with an autochthonous ridge displaying brown shales of Sidr/Nayid, and the elevated autochthonous piedmont of Jebel Akhdar displaying greyish color behind

Image 7: Outcrop near Izki showing artificially exposed peridotite outcrop (right side) in contrast with brown weathered peridotire (upper left side)

As the route approaches the bridge of Izki, we observe cemented conglomerates overtopping the ophiolite bedrock. The present-day channel of the wadi, which hosts alluvial transportation and deposition, is about 10 m below road level as observed from the bridge that overlooks the wadi (Wadi Halfeen).

The town center of Izki also is seen from the bridge and is largely built on either side of the southward-running wadi channel that flows between plains of ophiolite alluvium from the east and Hajar supergroup/Hawasina alluvium from the west.

Image 8: Outcrop near Izki showing cemented recent alluvial conglomerate overlying ophiolite

Between Izki and Birkat-Al Mouz, the road runs across a 4.5 km section showing a series of spectacular exposures that often attract attention of specialists and non-specialists alike, and are worthy of further detailed studies. There is notable diversity within the scale of thin bedding intervals, that alternate between red chert and mudstone and brighter carbonates and channel sandstones.

This variability is characteristic of the deep-marine turbidite series within the Hamrat Duru group of the Hawasina nappes. We also observe structural complexity in this section represented by faulting and folding of those strata, and this is a result of the processes of obduction and emplacement of this group.

Image 9: Outcrop near Birkat Al-mouz, showing turbidite sequences displayed in a variety of colors and lithology

After exiting this section, the route runs through an alluvial plain on the outskirts of Nizwa, with occasional gabbro hills exposed in some places, giving an impression of the subsurface beneath the alluvium. This plain largely hosts the alluvial fan of Wadi Al-Muaydin, one of the prominent high-relief canyons draining southward from Jebel Akhdar.

Near Birkat Al-Mouz, we can see from a distance the southern foothills and piedmont on which was constructed the automobile route that goes up to the Jebel. It is notable that the wadi exits the mountain and enters the plain at a point where the strike direction of the anticlinal dome changes to NW-SE as seen at the piedmont that overlooks Nizwa.

The anticline strike orientation by Nizwa and the interior plains is perpendicular to the typical strike of the piedmont that overlooks Izki/Semail gap.

As we head towards the final destination of Nizwa, we get closer to Al-Hawra, a mountain that is topped by metamorphosed carbonates and belongs to the Oman Exotics allochthonous island arc (Aridh and Kawr groups).

This mountain forms a ridge that separates the previously mentioned alluvial fan and the oasis of Nizwa proper. The route eventually turns northward through the metropolitan extension of Nizwa, and gradually ascends from Farq at the southern tip of Al-Hawra ridge, towards the town center of Nizwa. Here the town sits in a north- south elongated valley bounded by Al-Hawra Mountain on the east, the ophiolite massif of Nizwa-Bahla on the west and the SSW-dipping piedmont of Jebel Akhdar on the north.

Figure 6: Tilted satellite image showing major geological features around Nizwa, courtesy of Google Earth TM

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SULTAN QABOOS UNIVERSITY RANKED *Fourth* IN THIS YEAR'S IBA COMPETITION

AAPG | Imperial Barrel Award

A Joint Program of AAPG and the AAPG Foundation

Written by: ***Mohammed Farfour***

The Imperial Barrel Award (IBA) is an annual geoscience competition organized by the American Association of Petroleum Geologists (AAPG). IBA was initially an M.Sc. course unit at the Imperial College London, however, AAPG adopted the program in 2007 as an annual prospective basin evaluation competition between universities. Since then, graduate geoscience departments worldwide have participated in IBA where they can win funds for their department and gain international recognition for placing in the top three. The program consists of two stages. In stage one, universities compete on a regional scale. Winning regional teams qualify for the finals (stage two) and compete against other universities worldwide.

A team of five students from Sultan Qaboos University (SQU) Earth Sciences Department recently participated in the 2022 IBA and were successful in securing a fourth-place finish overall against top universities globally. During the Middle East regional competition, SQU competed against German University of Technology (Oman), King Abdullah University (KSA), King Abdul Aziz University (KSA), University of Taiba (KSA), Khalifah University (UAE), and Kuwait University (Kuwait). After taking first-place honors in stage one, SQU then went on to represent the Middle East region in the final competition stage against winning universities from all around the world.

These included the University of Louisiana representing North America, the University of UniLaSalle representing Europe, Colombia University representing Latin America, Bandung Institute of Technology representing Asia and Australia, and Lagos University representing Africa.

The competition consisted of each team using provided data to explore for potential petroleum prospects. The SQU team was assigned a challenging dataset from Offshore Australia for their project. The students worked for over eight weeks evaluating seismic data, well data, and reports in order to identify the best prospects with the lowest risks. The various tasks completed by the students included: reviewing published literature, researching the geological history of the area, integrating and interpreting well and seismic data, analyzing petrophysical data, understanding petroleum systems, and de-risking all identified prospects. The students presented their findings in front of panel of oil industry judges including representatives from PDO, ARAMCO, and Schlumberger.

Congratulations to SQU team members Khadija Al-Maimani, Aalaa Al-Naabi, Al-Rayan Al-Mahdhouri, Amrou Al-Alawi and Fatima Al-Lawati for their 4th place finish worldwide! The team was mentored and supervised by Dr. Mohammed Farfour, Associate Professor of Geophysics from the department of Earth Sciences.

It is worth noting that Sultan Qaboos University has made significant achievements in the IBA competition over the past years. The table below summarizes various achievements accomplished by SQU teams in this competitive and prestigious program.

2010
2nd place winner in the Middle East

2011
3rd place winner globally

2013
3rd place winner globally

2014
1st place winner in the Middle East

2015
2nd place winner in the Middle East

2016, 2017, 2018, 2019
1st place winner in the Middle East

2019
Teamwork excellence award winner globally

2020
2nd place winner in the Middle East

2021
2nd place winner globally

2022
4th place winner globally

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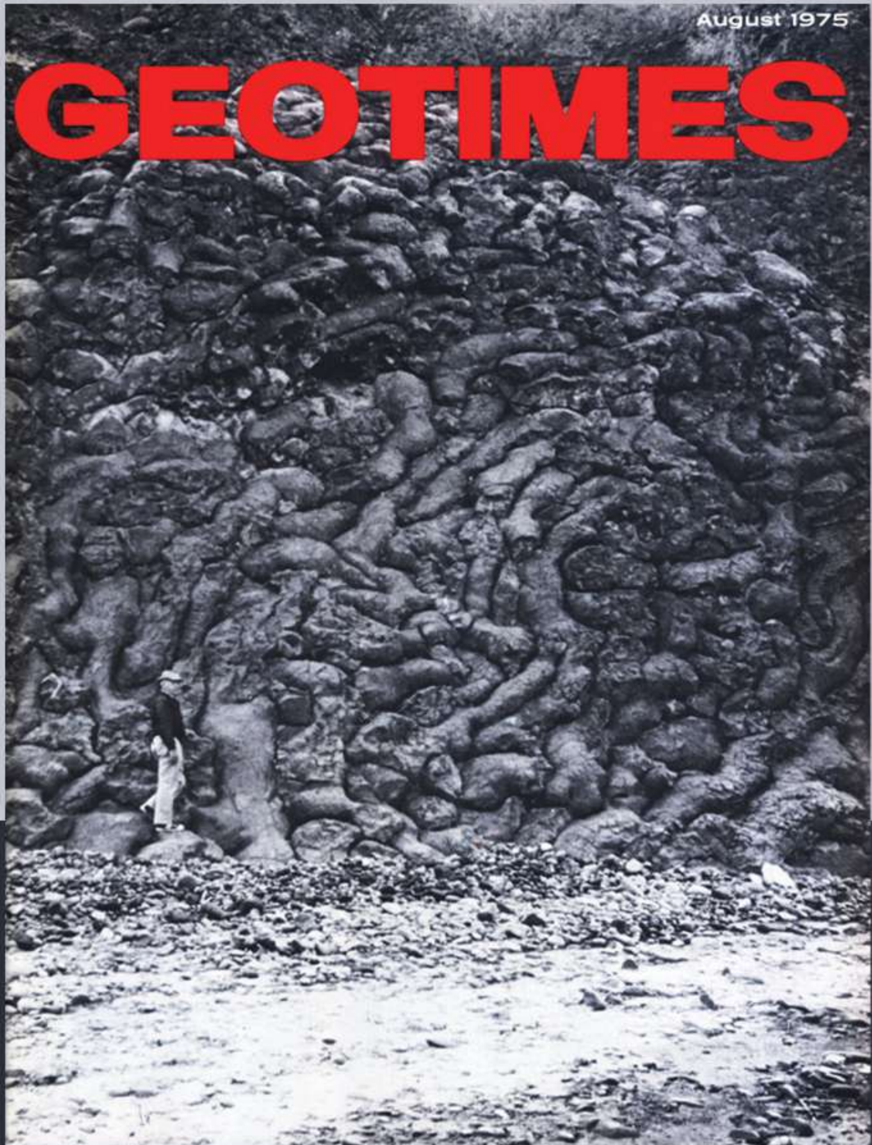


The pillow lavas pictured here on the cover of the August 1975 issue of Geotimes magazine were later named the Geotimes unit after the magazine. (https:/shortest.link/4PwA)

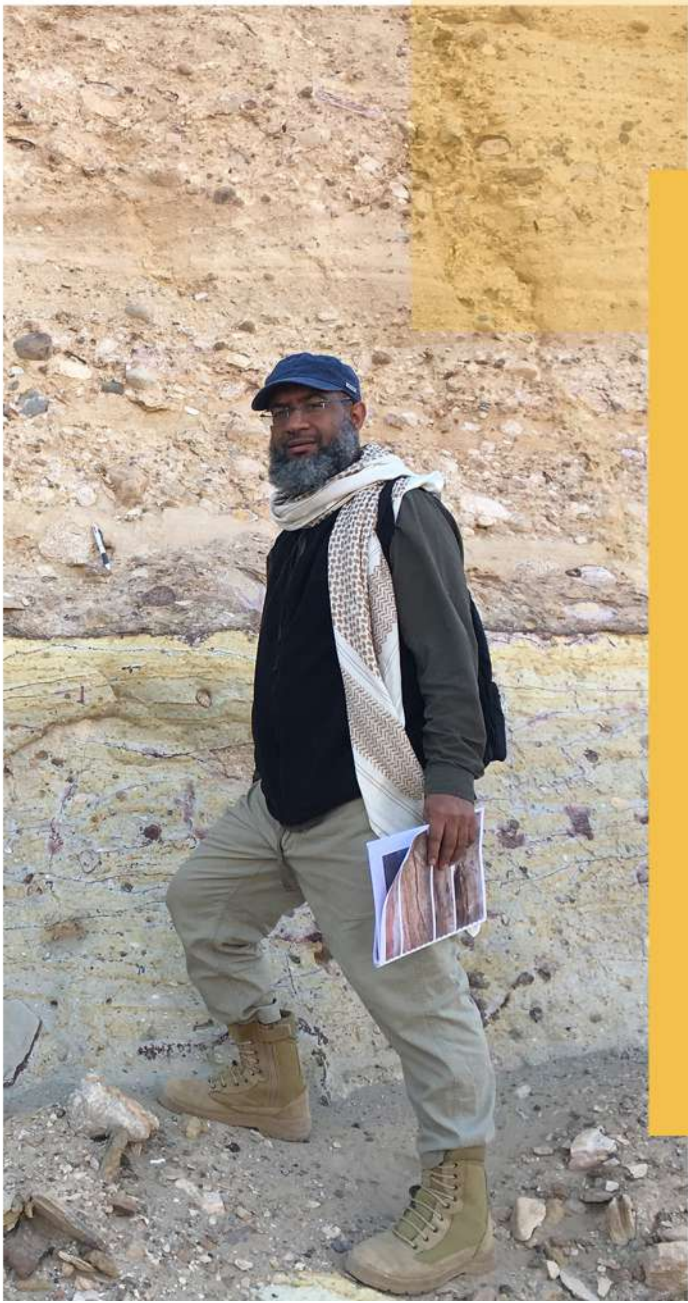
Geotimes Pillow Lava- Wadi Al-Jizi, Oman

Pillow lava is the upper part of the ophiolite sequence. This photo shows the Geotimes unit lava (it is called that because it appears on the cover of the Geotimes magazine in August 1975). It directly overlies a sheeted dyke complex; the thickness is about 1.5 km, the pillows are tilted to NW, and it is typically large and elongate (2-3 m) and have a tube shape; the margin of it is glassy during the fast cooling, but it is significantly affected by weathering; as well as there are several dikes that cut the pillows.

Interview of this Issue

Geoscience has become a much broader science that requires knowledge and skill from various fields

Our interview for this edition of Al Hajar is with one of the most prominent and active members of the Geological Society of Oman who has done much to promote the geosciences in Oman. Dr. Ali Al-Lazki is one of the past presidents of GSO (2014 - 2015), and he is currently a Subsurface Instructor at Petroleum development Oman.



Dr. ALI AL-LAZKI

1. First of all, Dr. Ali, tell us about the early stages of your interest in geology and the educational path you followed?

My first introduction to geology was while selecting a major within the college of science. I learned that Earth Science is an applied science that uses all basics sciences from biology to Maths. This made me choose Earth sciences as a major in my undergraduate B.Sc. at Sultan Qaboos University. I also took Physics as a minor which later helped me become a geophysicist!

2. We are keen to know more about your career and research highlights?

While earning my degree in geology and physics, I got the opportunity to further my studies through a scholarship program at Sultan Qaboos University. Following that, I continued to pursue my dream and completed an MSc in geophysics at the University of Tulsa, Oklahoma, USA from 1993-1995. In Tulsa I attended my first seismic processing course, in Seismic Unix! My research was to study the effect of porosity and clay content on Amplitude Variation with Offset (AVO). For my PhD, I changed focus from reservoir scale AVO to regional scale research seismology and geophysics. My PhD research was carried out in two areas: Oman and Eastern Turkey. In Oman we performed regional scale structural integration of surface geology maps, seismological Receiver Function, 2D seismic reflection data, and well data and this was complemented by gravity modeling of the NE Arabia Crust. In this study we proposed a new interpretation of the Jabal Akhdar structure and we provided the first Moho depths below Jabal Akhdar and the mountain foreland area.

"Goal one: deliver geology of Oman talks to public"

The Eastern Turkey regional study focused on determining the rheological status (hot or cool) of the upper mantle-lithospheric mantle beneath Eastern Turkey. We used a Tomography methodology to estimate the velocity of the upper mantle using Pn phase. This meant picking manually the arrival time of thousands of Pn seismic phase arrival times. Pn phase dominantly propagates just below the Moho sampling the upper most parts of the Mantle or lithospheric mantle. Estimated slower than average (8km/sec) Pn velocities were indicative of a hot upper mantle, while faster than average Pn velocities were indicative of cold upper mantle lithosphere. Unstable areas were identified in Eastern Turkey and parts of Iran. Since 2012, I have worked on other interesting topics such seismic inversion, micro-gravity, magnetic & gravity modeling and micro-seismic.

3. Since you are one of the Ex-presidents of the Geological Society of Oman, what did the Geological Society add to you?

I gained more passion to learn more about Oman geology. I realized better my responsibility towards the geoscience community and public.

4. What challenges did you face during that period during your presidency?

Limited resources, both people and financial, to complete the very ambitious goals that I wanted to achieve!

5. Which of your contributions to the Geological Society of Oman do you value the most?

Goal one: deliver geology of Oman talks to public. We started with a public talk delivered in Rustaq and hosted by the local sports club. Goal two: establish a permanent compound (office & small exhibition) for the geological society of Oman. Unfortunately, this goal did not materialize! Goal three: establish collaboration agreements with GCC geological societies to deliver geological events jointly, e.g. fieldtrips, talks, workshops, etc. The initial steps were taken and GSO hosted a one-day meeting attended by presidents of Dhahran Geological Society, Qatar Geological Society, Kuwait Geological Society and UAE geological society.

6. What topics in geology are of the most interest to you and why?

I have always had some kind of bond with the Oman Ophiolites. This may be because I studied it during my undergraduate thesis and during my PhD. I have always been fascinated to learn new aspects of the unique Oman Ophioilites.

Perhaps because of my PhD training, I am always interested to learn more about the tectonic evolution of Arabia plate and the region. Hence, I tend to focus more on the bigger picture of the geology of Oman.

7. What are the skills that are most important for a position in geology?

Sedimentology and structural geology are key components for a geologist in the hydrocarbon industry. If these skills are complemented by a basic understanding of seismic interpretation, then that should enable a candidate to meet most job challenges. However, as our industry transitions, candidates with numerate skills and software & programming literacy will better be able to meet new position challenges.

> *"Its Oman's responsibility at current to look for alternative sources of energy that it can supply to the world in the future. This energy can be Hydrogen, Solar, Wind, and others!"*

8. WHAT ABILITIES OR PERSONAL QUALITIES DO YOU BELIEVE CONTRIBUTE MOST TO SUCCESS IN GEOSCIENTIFIC LIFE?

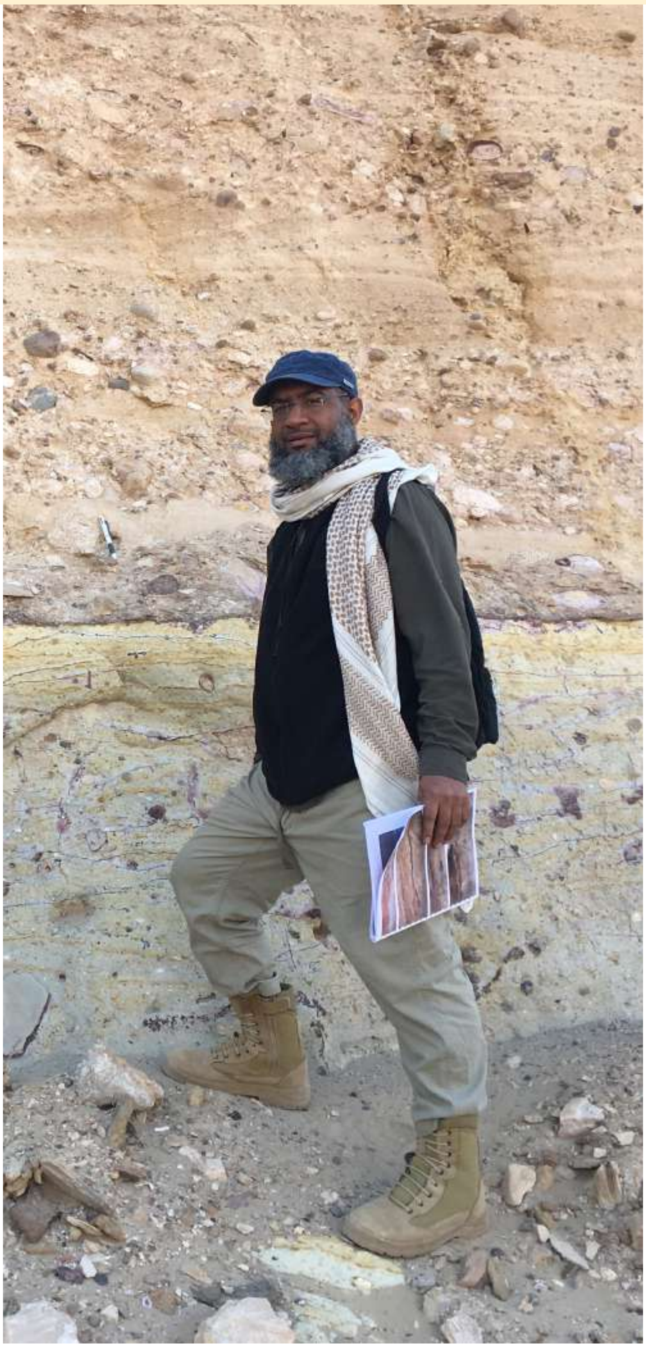
Passion and hard work.

9. Given your current experience in the field of oil exploration, how do you see the future of Omani oil, and to which alternatives should the Sultanate turn to reduce dependence on oil resources?

All business undergo change with time as dictated by supply and demand. Hydrocarbons have no problem on the supply side, but demand is certainly shifting towards other alternatives, slowly but surely. Its Oman's responsibility at current to look for alternative sources of energy that it can supply to the world in the future. This energy can be Hydrogen, Solar, Wind, and others! Oman also has the potential to provide international services in Carbon Capture and Sequestration (CCS). Key to Oman at this stage, is to take serious steps to explore and evaluate every available alternative opportunity within Oman's unique setup. A secure future based on current resources and income may be at risk! It is likely that out of the 3-5 options explored, some may prove to be commercial and further developed.

10. WHAT SPECIAL ADVICE DO YOU HAVE FOR A STUDENT SEEKING TO QUALIFY FOR A POSITION IN THE GEOSCIENCES FIELD?

Geoscience has become a much broader science that requires knowledge and skill from various fields. In the past you were either a geologist or geophysicist. Now a geologist is required to master geophysicist skills and knowledge also. Future geologists will not only require skills in geophysics, but also programing and data analysis.



We are so glad to talk with you Dr. Ali Al-Lazki. Thank you very much for giving us some of your time and your experiences. We hope the best of luck to you in your practical and scientific journey.

FOG WATER COLLECTION in the Dhofar Region of the Sultanate of Oman

Written by: Yousuf Ali Al-Darai

PREFACE

The Dhofar Region, in the south of Oman, is located about 650 miles (1,040 km) from Muscat (Fig. 1) ("A most refined reserve," 2009). This paper explains the fog collection technique used in the Dhofar Region during monsoon season, and how this technique reduces the dependence on groundwater by creating a clean additional water source.

Figure. 1: Location map of the Dhofar Region in the southern part of Oman (Fanack, 2016).

FOG WATER COLLECTION TECHNIQUES

The fog water collection technique is a simple and sustainable way to ensure fresh water for multi-uses such as afforestation, farming, and as a drinking water source for human and animal consumption (Klemm, 2012).

Normally, precipitation is the main water source that supplies an aquifer. However, there are some areas in world located in upland regions, where the collection of fog droplets by vegetation not only supports the vegetation but also contributes to aquifers. These regions are called cloud forests, because the fog source is from clouds moving over these regions (Schemenauer, 1994b).

In the Dhofar Region, the main water source is the groundwater system. However, as fresh groundwater is extracted due to high demand for irrigation and other uses, salinity contamination occurs as salt water naturally flows in from the coastal plain. For this reason, people increasingly extract water directly from mountain drainages, but this fresh water source is not enough to cover the high and growing demand for water to different sectors.

The Dhofar Region, especially coastal areas like Salalah (the administrative capital of Dhofar), is affected by an annual monsoon season each summer between June and September. This phenomenon is caused by moist air from the Indian Ocean (Figure. 2). This presents an excellent opportunity to supply water using the non-conventional alternative technique of fog water collection and thereby reduce dependence on conventional water sources like the groundwater.

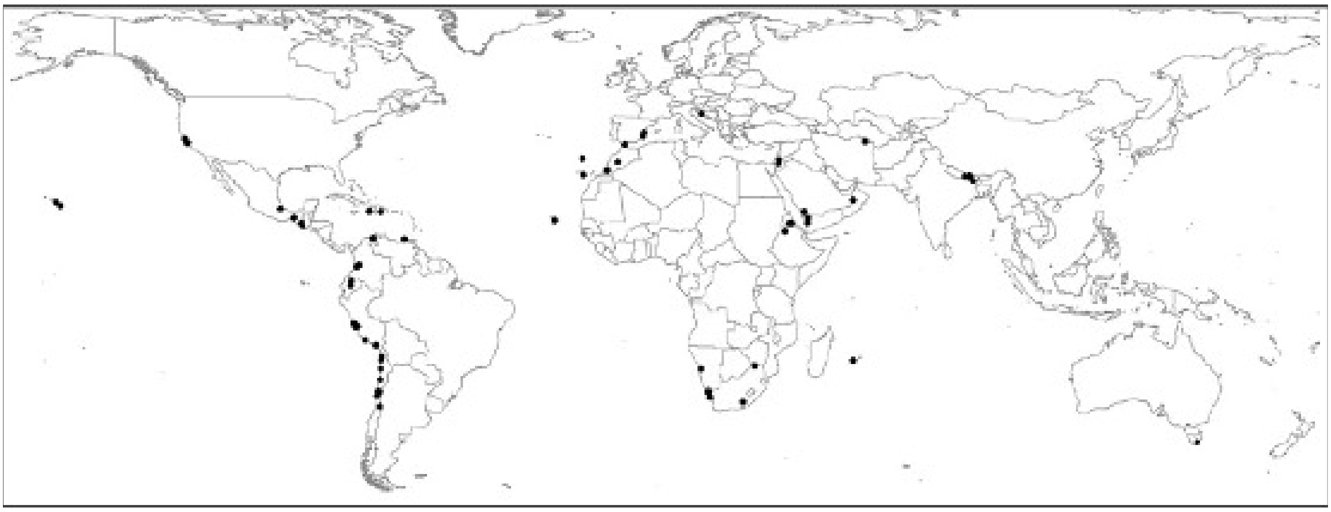


Figure. 2: Map with locations marked that have potential for successful fog collecting to produce fresh water in arid or seasonally arid regions. The South of Oman is one of the important regions for this technique due to its location overlooking the Indian Ocean (Klemm, 2012).

On average, fog occurs during 20-25% of the days annually, and it mostly happens during the monsoon season. This presents an ideal condition for fog water collection in Dhofar (Figure. 3). The first study of fog water collection techniques at Jabal Dhofar was published by Fallon (1978). He used wire netting to intercept water and increase precipitation. Stanley Price, et al. (1988) started new investigations of fog collection and demonstrated that up to 50 L/d could be collected by a 1 m2 screen of aluminum wire mesh.

Barros and Whitcombe (1989) did additional experiments during the 1989 monsoon season. Their study concentrated on the possible applications and benefits of fog water collection techniques.They concluded that the Dhofar coastal mountain region had potential to produce 30 to 40 L/d, over a two-month period, at 900 to 1000 m elevation, using 1 m2 standard collectors (Barros and Whitcombe, 1989).

Figure. 3: Shows the fog water collection in the Dhofar Region during the monsoon season (June to September) (Al-Sulaiman, 2015).

Later, Abdul-Wahab et al. (2009) also worked in Jabal Dhofar during monsoon season to develop residential-type fog collectors to directly meet the needs of mountain residents, and thereby decrease the extraction of groundwater. The collected fog water was directed into storage tanks for later use by people, animals, and agriculture.

Barros and Whitcombe (1989) also carried out experiments to determine the ability of trees to collect fog water for later use. In 2009 Abdul-Wahab et al. did similar experiments to measure the potentiality of specific trees to condense fog depending on leaf shapes, size, and cross-sectional area of the tree canopy.

The study concentrated on three types of trees including Figure, lemon, and tamarind. Fog collection from the Figure tree over a 47-day period during the monsoons was 140.5 L/m2, or an average of 2.7 L/m2/d. Fog collection from the lemon tree was 243.0 L/m2, or an average of 4.4 L/m2/d. The tamarind tree produced 218.9 L/m2, or an average of 4.3 L/m2/d over the same period (Abdul-Wahab et al. 2009).

METHODS OF THE FOG WATER COLLECTION

There two types of fog collectors which have been used during the last 20-30 years. The first one is called a standard fog collector (SFC). This is a 1 m2 collector used to evaluate potential fog collection sites. The second type is called a large fog collector (LFC) and is 4×10 m in size. Both collectors use 2 layers of 35% raschel mesh shade cloth. The water is collected as fog droplets condense on the mesh surface and then drip into a gutter pipe which drains into a storage tank (Figure. 4) (''Fog Collection Basics,'' 2014).

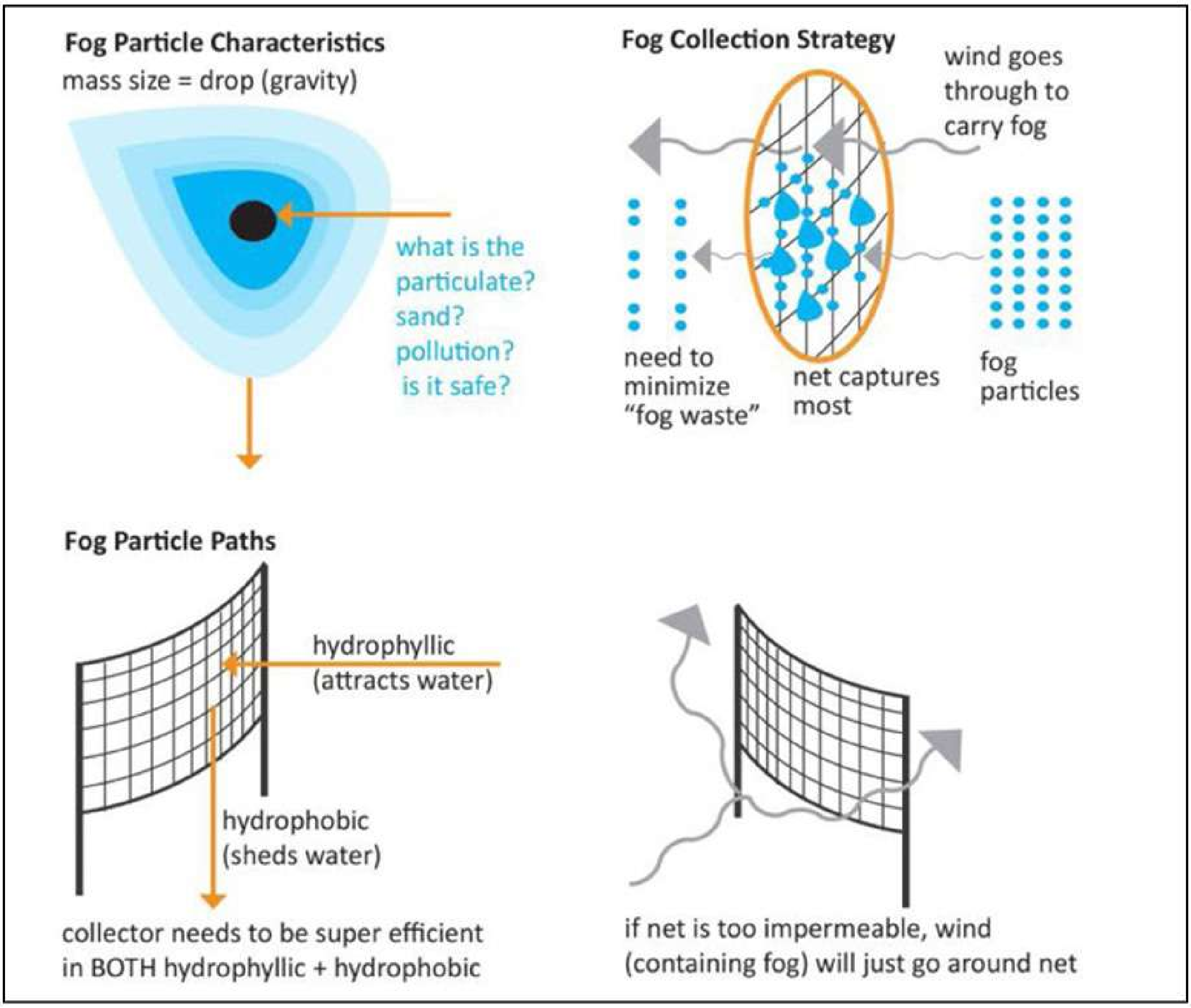


Figure. 4: Shows the fog collection Basics, and how the droplet of the fog moves through the mesh due to wind power ("Fog Collection Basics," 2014).

EXPANDED APPLICATIONS MADE IN THE DHOFAR REGION

In 2019, the Shabiba media channel released a video that documents some of Oman's government efforts to harvest fog water on a large scale during the monsoon season in Dhofar. A project was implemented to collect this water from an area covering 931,260 square meters. Project sites were selected based on the amount of fog available, wind speed and direction, elevation, and soil fertility in these locations.

The project was designed so that prevailing winds pushed fog through an array of nets. The condensed moisture dripped from the nets into collecting pipes where it then flowed into special storage tanks for use after the monsoon season. As a result, the project collected a total of 350,000 gallons (1,324,894 Liters) of water.

This project successfully demonstrated a working model for the sustainable management of natural resources. If scaled up, there is potential for this project to preserve the environment from desertification, reduce the loss of vegetation that covers the Dhofar Mountains, provide fresh water to communities across the Salalah Plain and irrigate local crops.

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View from Hayawt village during the monsoon season, Dhofar.

Long: 53.973888°

Lat: 17.123383°

Photo by: Shahad Al Siyabia

Instagram: @joodax_18


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