AL HAJAR

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23rd edition

Mining Sector

Geological Heritage and Economic Future

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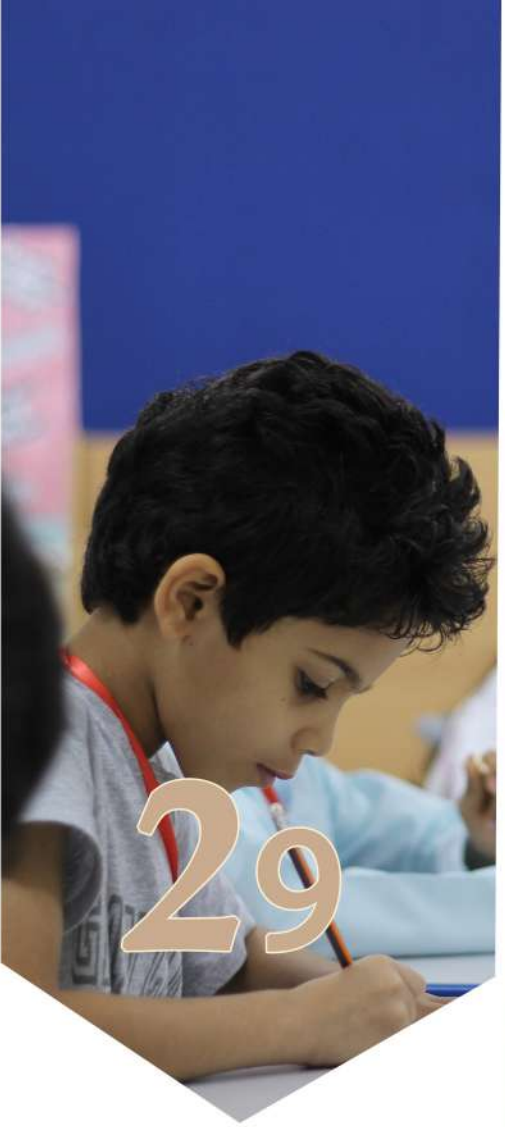

Editorial Board

President's Address

I am honored to be elected as the new GSO president . The new committee promises a vibrant active society. However, this requires your continuous support and we; therefore, invite you to lend us hand with ideas, initiative, active participation and support. Thank you and we look forward to active two years.

Dr. Ibrahim Al Isamili
GSO President

Dr. Ali Lazki
GSO President
(2015-2016)

The Geological Society of Oman was able to play a very effective role throughout 2016. This was demonstrated by the different activities that were organized by the GSO's members.

The GSO has committed a substantial effort to organize scientific events for university and schools' students. This includes running the 3rd consecutive version of the Geo-Challengers competition for university students, who were awarded in the GSO 2016 Annual General Meeting. At schools' level, the GSO organized the GeoKids-3 fun and learning event for students aged from 9-12 years under the title "The Land of Dinosaurs". Also, the GSO organized two workshops about "Oman's Rocks"; one for the Ministry of Education, as part of the Asian Conference of Innovation and Technology affiliated to the UNESCO, and the second workshop for the "3rd Students' Meeting for Innovation" that was held at the Training Center of the Ministry of Municipality and Environment. The GSO has worked to spread geological knowledge to the public, through talks, such as the talks delivered to Misfah Culture and Sports Club and the Rustaq Sports Club.

The GSO actively participates in the organization of international conferences, both in Oman and outside. The GSO was involved in the organization and participated in the second run of the Ta'deen (Mining) Oman Conference & Exhibition in Oman International Exhibition Center in January 2017.

Oman has unique geographic location and geology and famous with its mountains, beautiful long beaches, and vast desert areas, which makes it a favored destination for tourists and Geologists. Therefore, the GSO worked in collaboration with different private and governmental institutes to showcase the touristic potential of the geology of Oman. This included running a workshop for the Alila Hotel about the geology of Jabal Akhdar area. The GSO participated also in the International Show Caves Association Meeting, held in Oman and organized by The Ministry of Tourism and Umran Company in November 2016, by giving two talks entitled "Oman Geological evolution" and "Discovering Oman's Caves" by the Oman Caves' Team. The GSO, in collaboration with the Petroleum Development Oman, proposed a Geological-Ecological tourism project for the Al-Wusta region as part of "Tanfeedh" Tourism Projects proposed for investors.

We are so pleased to announce the joining of the Oman Caves Exploration's Team to the membership of the Geological Society of Oman. This collaboration is fueled by the common objectives and is aimed at joining efforts and resources to boost the exploration and documentation of Oman's Caves for tourism and scientific research.

Finally, I would like to thank the GSO executive members for the 2015-2016 term for their hard work and I would like to give the heartiest congratulations to Dr. Ibrahim Al-Ismaili for his new role as the new president of the Geological Society of Oman for the term 2017-2018.

Editor's Note

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Dear Readers,

Welcome to the 23rd edition of Al Hajar. In this edition, we share a recent interview with H.E Hilal bin Mohammed Al-Busaidi, the Chief Executive Officer of the General Authority for Mining, who took us through the objectives and responsibilities of the Authority, including its role in preserving the geological heritage of Oman.

Technology application also features with Full Tensor Gradiometry (FTG) in Block-55 (Petrogas Kahil) highlighting that despite challenging commodity prices, oil companies continue to invest in new technologies to evaluate the subsurface and enhance the chances of making a hydrocarbon discovery.

We also share the excitement and results around the recent discovery of two unique species of snail fossils from the Late Cretaceous fluvio-deltaic and marginal marine deposits at Al-Khodh, Oman.

In terms of the 'future', we share our progress of Geo-Kids and how GSO is interactively helping school students to understand the geoscience of Oman and the Earth.

We hope you have a joyful reading.

H.E Hilal Al- Busaidi (right) with Saif Al Azri (centre) and Mohammed Al Amri (left)

Mining Sector… Geological Heritage and Economic Future

By Mohammed Al Amri and Saif Al Azri

As part of a strategy for economic diversifation and sustainable growth, the Government of Oman is opening the door for investment in several different economic sectors including Mining.In line with its strategy, the Royal Decrees number 2014/49 declared on the 21st of September 2014 establishment of the General Authority for Mining. To understand more about the objectives and responsibilities of this authority, the GSO interviewed H.E Hilal bin Mohammed Al-Busaidi, the Chief Executive Officer of the General Authority for Mining.

Your Excellency, Can you please tell us more about the role and the objectives of the General Authority for Mining?

Of course the authority aims at developing and improving the mining sector in the Sultanate and to ensure best optimization of the minerals resources. It also works towards encouraging big investments in these resources, by improving laws and legislations that empower this sector, to ensure economic diversity in the Sultanate and bigger contribution of the mining sector to Oman's Gross Domestic Product (GDP).

The General Authority for Mining also strives to optimize the economic input of the geological heritage, making sure that there is a balance between the requirements of ecology preservation and mining activities.

The General Authority for Mining has several terms of reference. This includes setting comprehensive national strategies to manage the geological infrastructure of the Sultanate, as well as developing the mining sector, in coordination with other authorities. This can be done by proposing new projects oriented towards mining sector and revising old laws,

regulations and procedures that are related to this sector. The Authority also conducts and supports geological studies and research to discover new minerals resources or to optimize the commercial production of the existing ones. The Authority ensures that pre-feasibility studies for the projects related to minerals are conducted. Moreover, the Authority provides information, geological and mineralogical data, and make them accessible by all means. One of the Authority's specialties is to observe all activities related to discovering and extracting minerals to preserve Oman's geological heritage and to set proper regulations to protect it. In addition to that, the Authority issues approvals for mines and quarries' designs and quarrying plans and it also follows up with the execution of the processes. The Authority represents the Sultanate in the national and regional meetings that are related to the Authority's specialties to develop mutual cooperation ties with national authorities, regional and international organizations.

Giving the current status of Oman's economy, income diversification is one of the current top priorities. What is the role of the Authority to address this priority? And what are your expectations regarding the potential contribution of mining sector to the national income if all efforts are exerted to develop and improve this sector?

The increasing attention paid to mining sector is triggered by the need for national income diversification. Thus, there is a demand for regulating this sector to optimize value and to fulfill public interest.This sector can potentially contribute to income diversification by creating attractive investment opportunities and developing new methods to increase the direct revenues to the country.

In fact, there are some projects and plans that the Authority aims to achieve and in parallel meeting the national expectations of this sector. As long as the required capacities and plans exist to execute mining investment projects, the future of this sector will undoubtedly be promising. This is due to deeply rooted clear vision and common objectives of the sector cadre.

What is the limit of the investment opportunities provided by mining sector in the Sultanate? Do you think that the prolonged procedures to establish quarries and crushers are one of the barriers for investment in the sector?

Mining is one of the promising sectors in the Sultanate and it has already created many investment opportunities in a number of raw minerals sites in the country. For example, some factories in the Suhar Industrial Area have been producing Ferrochrome economically. As for raw cooper, some licensed areas are still in the primary exploration stages and economic assessment. The produced minerals and synthetic stones are diverse and they are largely distributed for consumers across the Sultanate. As an example, raw limestone brings about good opportunities to establish marble, cement and iron factories. The raw gypsum constitutes an opportunity to establish factories that produce gypsum boards, as well as cement manufacturing and building materials such as gabbro stones.In an attempt to stimulate and attract mining investments and to create working environment that encourages the projects sustainability, the Authority has started to apply policies and procedures to increase the benefit of such resources; for example, allocating new mining areas, for different mining activities, and offering them for competitive investment to interested parties through the principle of "competition in proposing investment". The Authority assesses the proposed applications by a specialized committee, and it approves the applications that meet the specified requirements. If the approval of other governmental authorities is required, the General Authority for Mining will accelerate the final approval in coordination with these authorities.

What are the main challenges facing the mining sector in the Sultanate?

One of the main challenges is the existence of some promising raw materials that can be utilized commercially which are located close to populated areas and the general lack of infrastructure that is required for operating mining locations, such as shortage or unavailability of access roads, in addition to the lack of ports specialized in exporting quarries products. Another significant challenge arises from the necessity to provide factories with enough power that is required for manufacturing the extracted raw materials.

His Majesty the Sultan Qaboos bin Said has reaffirmed in his royal speeches the significance of involving Omani Youth in different fields and encouraging them to compete in these fields. Could you shed light on the role of the Authority to encourage Omani Youth to work in mining sector?

There are many job opportunities that mining sector provides as it has a high percentage of Omanization and subject matter experts (SMEs) established in many fields, including quarries, crushers and quarry-related factories. These jobs can be directly or indirectly related to the mining business, including logistics support for the mining companies e.g. transportation, maintenance, water supply to crushers and exporting.

Is there any coordinated collaboration between the Authority and higher education institutions to create specializations that can improve the mining sector?

The Authority strives to expand investments in the mining sector in the coming years. Therefore, it works, along with the private sector organizations, to establish the educational and training policies in the Sultanate in a way that balances between educational outcomes and the job market. Hence, the Authority works in coordination with the Higher Education Council to determine how future educational specilaizations can cover the mining sector needs.

Mining Development Oman (MDO):

As you know, at the beginning of this year, the agreement of establishing MDO was signed. Can you give us an insight on the MDO's specialties and the role it will carry on?

Actually, the company is still in the making and it will be a partnership between different governmental bodies, along with Omani citizens through subscriptions. The company will focus on investments in minerals extraction and transformative industries that depend on raw minerals.

Protecting Oman's Geological Heritage:

It is well known that the Sultanate is rich with geological heritage and some people refer to the Sultanate as "the paradise of Geology." What is the role of the Authority to preserve this heritage?

The Authority plays a vital role in preserving Oman's geological heritage, because it is one of its essential expertise bodies that realizes the significance of this inheritance, which the Sultanate is rich with.

Many legislations and laws have been established to help preserving this geological heritage, including:

1.Exporting any samples or stones shipments shall not be allowed without any permission from the Authority.

2.The Authority's staff shall inspect samples and shipments, before issuing exporting permission to ensure that the exporters are not violating the working regulations and laws.

3.The Authority shall not issue any permissions to extract or export fossils, except for special circumstances related to studies and researches for specific projects, and the exporter is obliged to return the exported fossils after the completion of the study.

4.For many years, the Authority has carried out an ambitious program to collect and classify meteorites in the Sultanate as an attempt to preserve this kind of inheritance and scientific wealth.

5.Exporting or circulating or selling or showcasing Omani meteorites shall be banned, except for governmental registered authorities.

6.In coordination with Royal Oman Police, transportation of any minerals, fossils and meteorites through the boards shall not be allowed, unless permission from the Authority is given.

7.There is a special committee assigned by the Authority to classify the main landmarks with geological inheritance called, "Geological Phenomena Classification Committee,"
which also regulates procedures to protect the landmarks from vandalization or smuggling, in addition to finding to finding possible ways to market the geological inheritance.

8. The inspectors and staff of the Authority shall monitor and record the geological inheritance during their field tours.

What is the message that you would like to convey to the Omani society to encourage its individuals to take their roles in developing the mining sector in the Sultanate?

The mining sector is a positive drive to develop society, because it provides basic services using raw materials, which in fact help in developing necessary infrastructure in society. This sector contributes in creating job opportunities. The Authority place an overriding emphasis to the safety of mining operations to ensure such operations will not harm the social and economic structure and help preserving the geology and ecology.

Companies which operate in this sector offer 5% of their profits to develop local community. Also, the mining sector offers many opportunities for individual SMEs and community companies by providing in-job training as well as providing the required means of transportation, maintenance and spare parts. The society; therefore, should seize such opportunities and give the chance to the working companies of this sector to grow and develop. It is important that partnership between the Authority and the community is maintained to provide the investment ground to find better ways to optimize the mineral resources in an endeavor to achieve goals intended to find diversified economy.

Kahil Air-FTG ® (Full Tensor Gradiometery) Survey, Case study of non-seismic advances.

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Abstract

Potential field technologies have witnessed significant advances in terms of resolving power and usability in recent years. One of those is Full Tensor Gradiometry (FTG). FTG is a multi-component and a multi accelerometer technology that measures variation in accelerations due to the Earth's Gravity Field. The measurements form a 3D depiction of the Gravity field as sourced by sub-surface density contrasts. Such density contrasts present themselves in the form of complex geological structures as exhibited by faults, contacts, folds and variable lithologies. The resultant FTG anomaly field is ideally suited to identifying and mapping such geological complexity.

This paper presents a case study describing the Kahil Air-FTG® and Magnetic Survey Data acquired over Block-55 (Kahil) in the Sultanate of Oman by Bell Geospace. As part of Petrogas Kahil effort to explore Block 55 for hydrocarbons, 8,000 Line KM of Air FTG and magnetic survey was acquired in December 2014.

The FTG unit used on this project is one of three owned by Bell Geospace. They have a history of performing well during several years of marine survey work and in airborne surveys since being upgraded in 2003.

The multi-component data was processed with the latest processing techniques to enhance signal-to-noise (S/N) ratios for better representation of subsurface geology, with Full Tensor Noise Reduction (FTNR) and contact lineament processing (CLP) to exploit the 3D nature of the data. Tensor Axis Realignment and Invariant Analysis techniques, uniquely suited
to evaluate 3D data, were used to map potential targets and structural contact information. The FTG data was used for basement depth estimation. The results are presented in Petrel, which allows mapping of potential targets and structural and stratigraphic boundaries. Correlation with existing 2D seismic data facilitates a more comprehensive interpretation. The acquisition data and the subsequent analysis have been used for better understanding of the block's prospectivity and to locate the newly planned seismic acquisition program.

Introduction

Kahil block 55 is located in the Al Wusta Governorate of Oman; in the eastern flank of the prolific South Oman Salt Basin (Fig.1a). Petrogas Kahil holds the right of 100 % interest of exploring hydrocarbons in Kahil Block. An extra complimentary scope agreed with the Ministry of Oil & Gas (MOG) was to acquire high quality gravity and magnetic data over the entire vicinity to determine main hydrocarbon potentials. The total areal coverage of the survey was ~ 7,564 km2, which represents nearly 8000 Km lines flown across the block. Three weeks (day time) was the flying time covering the entire surveyed area (Fig.1b)

The main objective of the Air-FTG® gravity data is to define a number of interesting areas possessing high and low density responses within the surveyed block. The FTG data will aid in imaging key geological targets such as top and depth-to basement, structural complexity and basinal fill. After processing and modelling of all anomalies, a clear picture of the basement can be generated and any potential hydrocarbon plays, related to mapping mini-basins or sags within the block, can be identified.

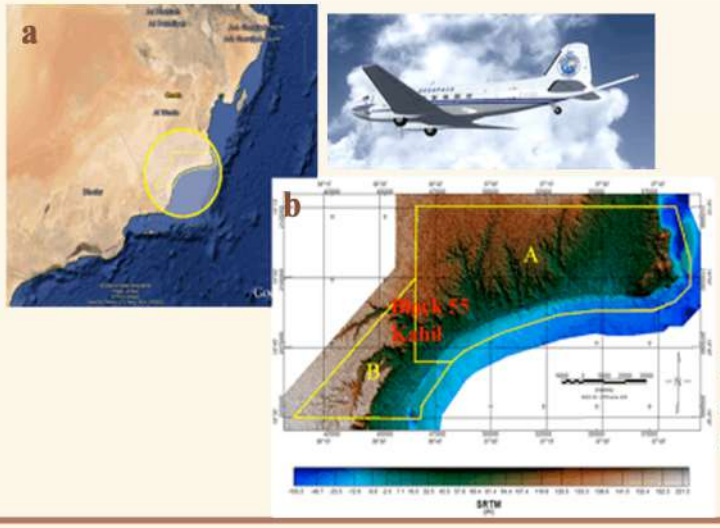
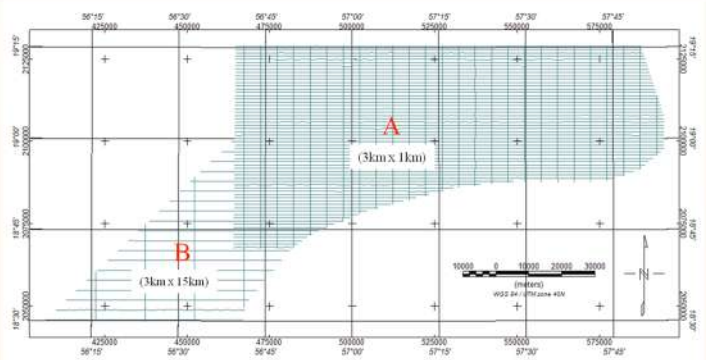


Figure 1: a) Location map showing Block 55 surveyed area (yellow polygon), in the SE side of Oman in Al Wusta governate; b) A & B represent segments of block 55 with different strategic drives.

Survey design

In the survey plan, the number of flown lines to cover the area of interest was considered based on nominal clearance for desired FTG detectability. In addition, line spacing, orientation, cost and time were also specified (Fig.2). Survey parameters were designed to ensure valuable data is acquired across the block, subsurface anomalies revealing some, if not most, of the opportunities and determining sensitivity to key geological targets (i.e. t structurally complex top Basement structural complexity and Base Cenozoic section).



b Survey Designation	Line-km: In-lines	Line-km: Tie-lines	Line-km: Total	Line Spacing (m)
Kahil A	6051.120	1199.640	7250.760	1000/5000
Kahil B	2581.752	533.532	3115.284	3000/15000

Figure 2: a) Survey plan showing A & B segments of block 55 with different strategic drive; b) Survey design parameters for both segments.

Methodologies

Magnetic fields generated in the Earth's Outer Core induce the field on susceptible geology. The Inner core has the highest density that decreases towards the crust and surface. What FTG surveying does is simply measuring variations in density caused by Earth's gravity. These variations are caused by subsurface geology that can be expressed as series of point masses per unit volume or density. Such variations tend to be much smaller than 9.8ms-1. Gravity is measured in units of milliGals (i.e. 1Gal=1cms-2). The value of gravity will vary depending on the number of point masses directly beneath the surface (i.e. subsurface geology). Where the magnetic field is measured from the Earth and also object to be detected (i.e. if object is susceptible), then its electrons are re-arranged as dipoles and becomes magnetized. In practice, the gravity and magnetic anomalies are expressed in wavelength and amplitude (Fig.3).

Full Tensor Gradiometry (FTG) is a multi-component gravity surveying technology that measures different components of the Gravity Gradient Tensor (Murphy, 2004).

The FTG measures simultaneously changes in the gravity field in all directions of the field (i.e. vertical and horizontal components). This is a fundamental difference to conventional gravity that measures only the vertical component of the gravity field vector.

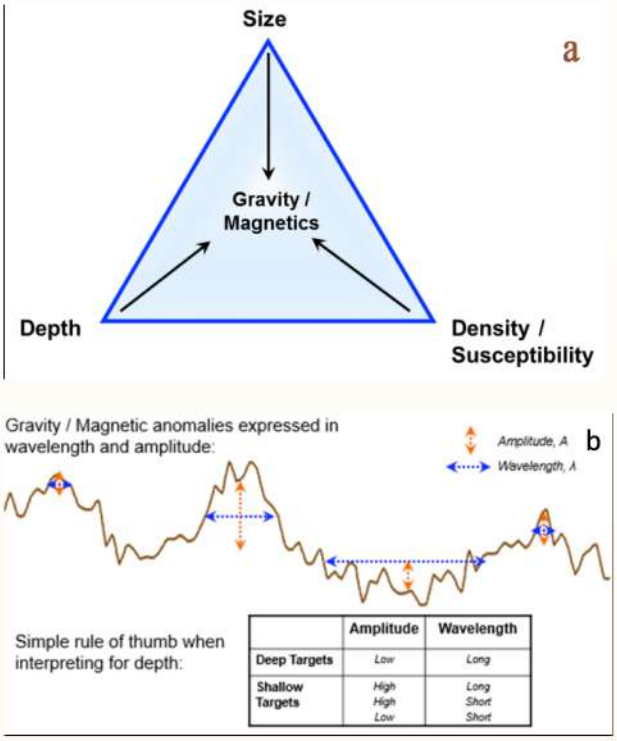


Figure 3: a) Controlling elements of Gravity and Magnetic data; b) the expression of their anomalies.

Workflow:

1. Start with a basement layer:

a.Define a long-wavelength gravity signal (i.e. Moho layer defines a very long-wavelength gravity and magnetic signal.

b. Describe the observed magnetic field

2. Meta sediment Layer:

a.Refine modelling for complex structural geology above basement, using the observed gradient data.

b. Facilitate investigation of density distribution within shallower layers:

3. Seismic constraint for modelling.

a.layer geometries are fixed in the model to converted pseudo-depth horizons.

4. Adjustments made to produce final model.

Results & Discussions

Comprehensive work has been done to interpret all recognised anomalies, using regional understanding (i.e. forward modelling) and by linking geology with some regional poor quality seismic lines. Some dominant, intermediate to long wavelength responses associated with basement or deep rocks succession have been mapped (Fig.4). Based on this data, new basins have been identified, including the already known 'Tertiary' Basin towards the eastern side of the block and other mini-basin in the SW direction (Fig.4). Also, major fault zones can be mapped clearly with confidence when compared to legacy seismic data. Both profile modelling and migration results revealed, in part, an estimate of the basement depth that varies considerably from 1 – 5 km referenced to mean sea level. This could be attributed to the complex structural history the basement subjected to. Also, the extreme high amplitude (pinkish colour; Fig.4) located to the east is associated with high density Masirah Ophiolite rocks.

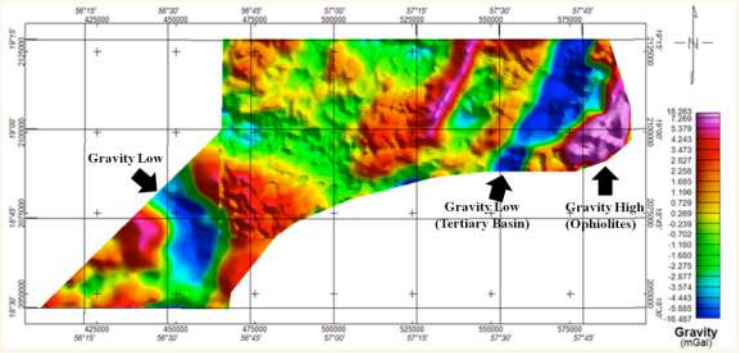


Figure 4: A final residual gravity map covering the entire block 55.

Low amplitude and negative FTG anomalies are interpreted to be associated with basins (e.g. mini-basins), which is typically occupied with thick sediments (Fig.5).

Attribute analysis of the Tensor data facilitates lineament mapping by delineating contacts separating areas of high and low densities. Figure 6 shows lineament anomalies mapping boundaries and possibly major NE-SW-trending structures (i.e. faults) that may reach the surface, which are evident on the Eastern side of the block trending. These observed structures correlate well with troughs and normal faults mapped by seismic.

A simplified depth conversion and a 2-density layer model provide some insights to the topography of the top basement (Fig.7). Depth-converted seismic and formation density constraints can improve the 2D basement models, highlighting subtle variations in density and structural style of the top basement surface. This subtle density contrast is suspected, as well as more complex structures line modelled (line 930403). Aeromagnetic data shows deep magnetic basement. A deep mafic magnetic basement is suspected to fit the aeromagnetic data of this line and other lines used in this study.

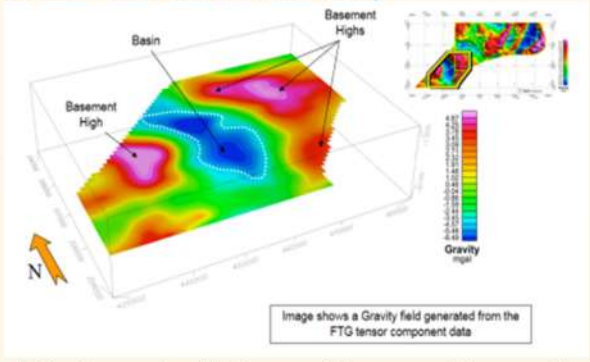


Figure 5: Gravity anomaly reflecting a possible accommodation space (basin) in the basement.

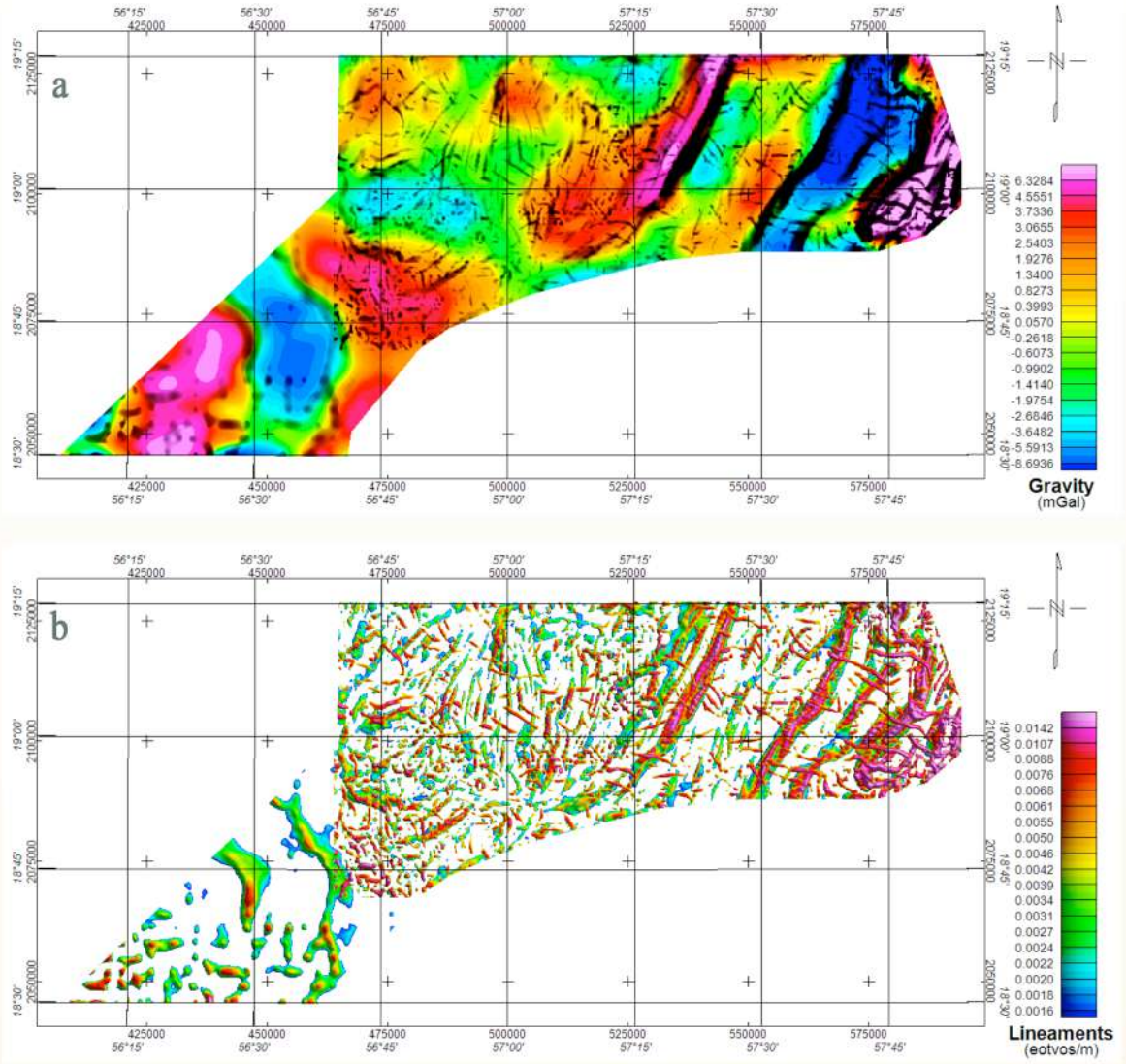


Figure 6: a) Gravity residual map after mapping of possible faults, trough anomalies ,current mini -basins and structurations that reach the surface; b) Lineament, anomalous-amplitude analysis attribute, which provides an insight to depth and / or density contrast of causative geology and help in allocating edges of shallow r, small-scale geologic features (e.g. troughs, major faults).

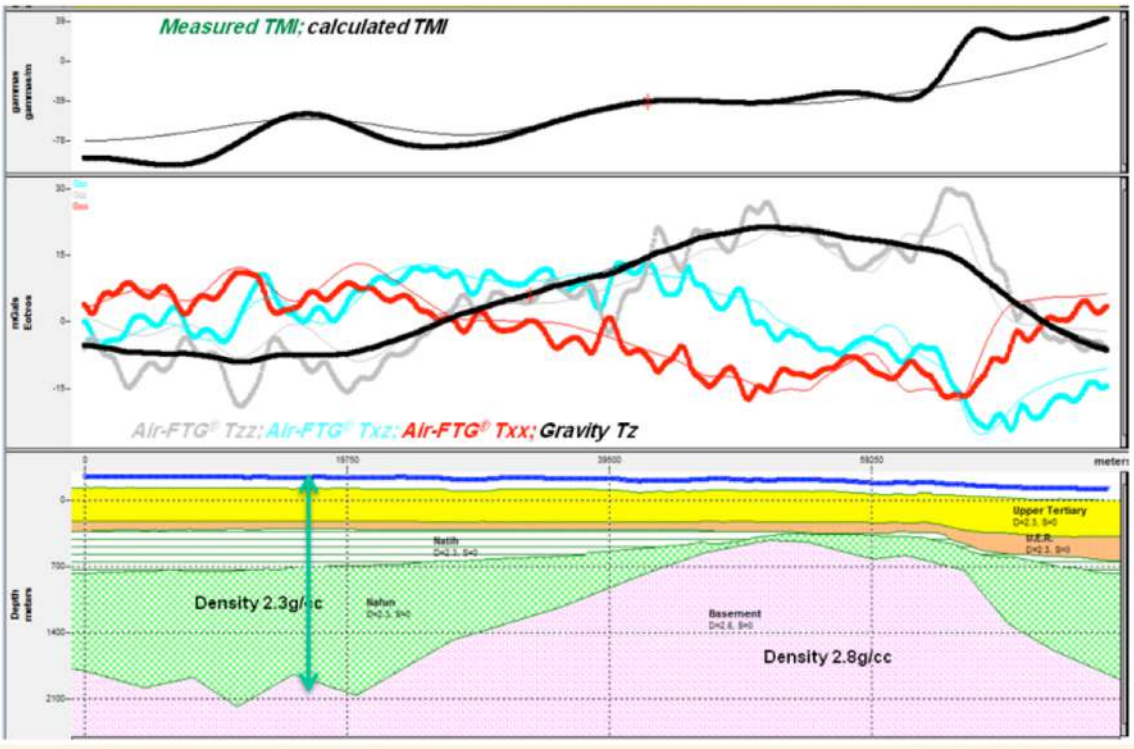


Figure 7: Depth converted seismic line running from NW to SE across block 55 showing subtle changes of gravity response.

Conclusion

-Air-FTG data has allowed extracting Depth-Density cube through full tensor migration for Kahil, block 55.

- Enhanced subsurface anomalies have been identified and structural geological trend has been mapped. This aided allocating the possible potentials with good definition (i.e. mini basins).

- FTG gravity helped estimating depths of possible potential anomalies, utilizing depth maps resulted from the comparison of FTG & magnetics.

- Generated lineament maps provided insights of mapping major faults and mapping the trends of troughs by allocating the edges of shallow basement geology.

- High amplitude gravity anomaly, bounded by NE-SW trending anomaly pattern, is observed in the eastern side of the block. This is associated with the Masirah Ophiolite.

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Acknowledgment

I would like to thank Petrogas Kahil and Sultanate of Oman Ministry of Oil and Gas for permission to present this work. Extended thanks go to Bell Geospace Limited, Edinburgh, United Kingdom for acquiring & interpreting the data.

Late Cretaceous Lanistes (Mollusca, Gastropoda) from Al-Khodh, Oman

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Abstract

The Late Cretaceous fluviodeltaic and marginal marine deposits at Al-Khodh, Oman, have yielded a diverse flora and fauna, including freshwater, brackish water and fully marine taxa. Among the freshwater molluscs there are two species of snails with sinistral shells. The overall morphology of the specimens indicates appurtenance to the genus Lanistes, which is confirmed by details of the fine structure of the shells. The presence of two species of this genus in the Late Cretaceous will help in defining a chronological base line for the ampullariid molecular clock.

Key Words
Ampullariidae, Gastropoda, Cretaceous, Lanistes, Oman

Introduction

Field surveys in the Al-Khodh Formation 10 km west of Muscat Airport, Oman, have led to the recovery of diverse plant and animal fossils of Late Cretaceous age. The Al-Khod fluviodeltaic-marine series (Nolan, 1990) overlies and is in faulted contact with the Semail Ophiolite of Campanian age. At Al-Khodh the sediments are ca 860 metres thick. It is overlain by the fully marine Palaeogene Jafnayn Formation.

Molluscs are found at intervals throughout the Al-Khodh Formation, but freshwater taxa appear to be confined to the lower half of the succession, being replaced upwards by brackish water taxa, then by fully marine faunas, with some overlap of shallow water marine types, such as oysters and Turritella- like snails associated with brackish water snails.

The two kinds of Lanistes described in this paper occur in different parts of the Al-Khodh stratigraphic sequence, the large carinate form near the base, and the smaller non-carinate form with a sunken spire in the middle of the succession associated with brackish water snails and oysters.

Materials and methods

The fossils described herein are curated at the Oman Natural History Museum, Muscat (ONHM). The specimens were measured with sliding calipers to the nearest 0.1 mm using the method outlined by Van Damme & Pickford (1995).

Images were taken with an 18.2 megapixel Sony Cybershot Camera and treated with Photoshop Elements 03 to enhance contrast and balance.

Geological setting and age of the Al-Khod Formation

Previous work.

Nolan et al. (1990) defined the "Al-Khawd" Formation and correlated it to the Campanian-Maastrichtian. They observed the unconformable (and faulted) relationship between the Semail Ophiolite below and the faulted contact with the overlying Jafnayn Formation of Late Palaeocene age above. The authors interpreted the deposits as a fan-delta complex. The age was reported to be imprecisely known.

Fournier et al. (2006) interpreted the geology of northern Oman in a broad geotectonic framework. They included the Al-Khodh deposits in the Qahlah Formation. We here treat the Al-Khodh deposits as a distinct unit which probably accumulated in a localised basin, although they could well be lateral chronological equivalents of the succession at Qahlah.

Dinosaur remains and a crocodile from the Al Khodh Formation were described by Schulp et al. (2000, 2008) and Buscalioni et al. (2004) but nothing has been published about the molluscs and plants.

Figure 1. Location map showing the location of the Al-Khodh Formation outcrops at Al-Khodh, Fanjah and Al Taiyyim.

Geological Mapping:

In the type area of the Al-Khod Formation, outcrops occur as cuestas dipping generally northeast at various angles from 30° to vertical. Much of the area is obscured under a Miocene terrace deposit about 100 metres above extant sea level, and parts of the area have been eroded down to the local wadi base level. Individual beds of the Al-Khod Formation can seldom be followed laterally for more than a hundred metres. The overall impression is that the cuestas represent lenses of resistant rocks (conglomerates, sandstones) intercalated between softer silts and clays, giving rise to classic scarp- and dip-slopes. In the basal layers claystone and siltstone comprise about 30-40% of the succession, but at the top they comprise up to 80% of the succession. Mapping of the cuestas suggests that the system comprises fluvial deposits laid down in fans, braided streams and deltas, with greater or lesser marine influences depending on the position within the succession.

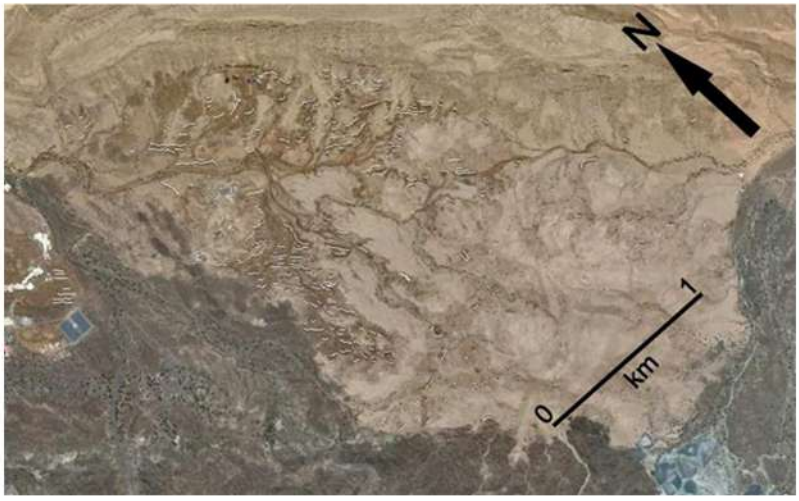

Figure 2. Cuestas in the Al Khod Formation (white lines on dark brown ground) comprise the major part of the outcrops in the type area (image modified from Google Earth).

Tectonic setting:

The Al-Khod Formation accumulated in a fault-bounded basin, northeast of the Semail Ophiolite (Fournier et al. 2006). The floor of the basin was subsiding during deposition of the formation, but sedimentation rates were so high that the basin was infilled as it deepened, meaning that throughout its 860 metre thickness, the deposits accumulated near sea-level. There is a deepening upwards sedimentation trend (fan to braided river at the base, to coastal deposits in the middle, to delta deposits at the top).

Outcrops of sediments at Fanjah and Al Taiyyim (Fig. 1) have been correlated to the Al-Khod Formation, but they occur in tectonically controlled valleys eroded into the Semail Ophiolites. Those at Fanjah preserve marine molluscs, so were deposited near sea-level, but those at Al Taiyyim appear to be freshwater deposits which infilled a 2 km broad valley incised into the ophiolite.

The overlying Palaeocene Jafnayn Formation comprises a great thickness of shelf carbonates intercalated with siltstones and mudstones, indicating that subsidence eventually exceeded sedimentation rates in the Al-Khod – Fanjah sector of Oman.

Stratigraphy:

The stratigraphy of the Al-Khod Formation was published by Nolan et al. (1990) and some details were added by Buscalioni et al. (2004). Examination of the deposits indicate that they may be subdivided informally into

three members, a basal predominantly freshwater facies yielding freshwater bivalves, gastropods and dinosaurs, a middle section rich in brackish water gastropods associated with shallow water marine taxa (oysters), and an upper part which yields mainly fully marine, but still shallow water molluscs (bivalves and gastropods).

The basal member corresponds to braided river deposits at the toe of a large fan emanating from a valley in the Semail Ophiolites. The middle member shows abundant marine and brackish water influence but some freshwater fossils indicate deposition in a coastal zone close to the ancient shoreline of the Palaeo-Oman Sea. This member has some sandy limestone, limey sandstone, and lenses of almost pure limestone rich in fossils.

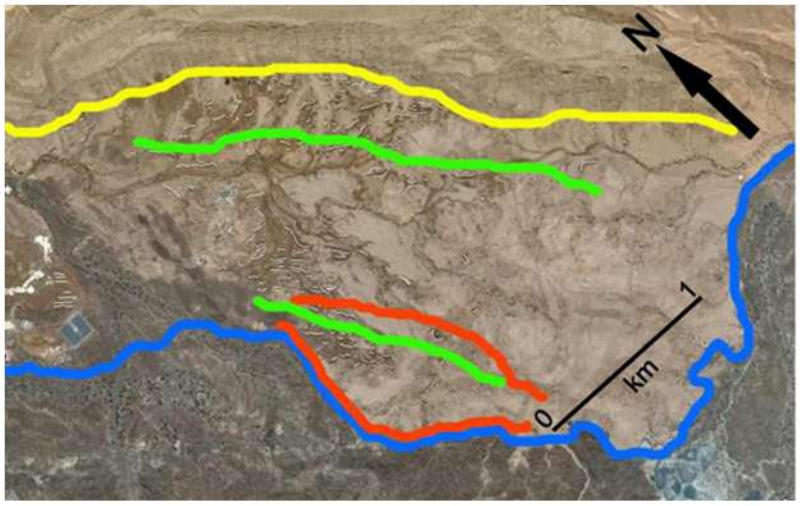

Figure 3. Simplified geological sketch map of the Al-Khod area, showing the Semail Ophiolite (below the blue line), the three informal members of the Al-Khodh Formation (the lower freshwater facies between the red lines, the middle coastal facies withTurritella, whelks and oysters between the green lines, and the upper delta facies between the upper green and yellow lines) and the overlying Palaeogene marine Jafnayn Formation above the yellow line. The overlap between the lower and middle members represents an overlap in the distribution of freshwater and marine molluscs (image modified from Google Earth).

There are many marine and brackish water bivalves and gastropods (Turritella, whelks) in this member, and dinosaur fossils are well represented. Many of the fossils in this member occur in conglomerates which likely represent ancient gravel beaches, passing laterally and vertically into sandy beaches which often contain oyster shells. The upper member comprises predominantly siltstone and mudstone with lenses of sandstone and conglomerate. In this uppermost member, many of the indurated sediment lenses show a coarsening upwards succession, starting with silt, overlain by cross-bedded sandstone, followed by conglomerate, all overlain discordantly by siltstone. This member comprises delta deposits intercalated with inter-distributory siltstones. There are abundant marine bivalves in some of the sandstone levels, but thus far no dinosaur remains have been recovered from this member.

Depositional Environments:

Nolan et al. (1990) considered that the depositional environment of the Al-Khod Formation consisted of a fan and delta complex. It is likely that this is close to the mark, because the basal deposits comprise lenses of conglomerate, sand and siltstone deposited in a dominantly freshwater setting which are laterally discontinuous and which show rapid vertical changes in facies, much in the style of braided river deposits extending distally from the toe of a fan. The middle part of the succession shows greater marine influence with abundant brackish water and marine

bivalves (oysters, corbiculoids) and gastropods (Turritella, whelks) deposited in beach gravels and sands, with thin beds of calcareous sands and sandy limestones. The top third of the succession is dominated by claystone and siltstone

Biostratigraphy:

Little study has been done on the biostratigraphy of the Al-Khod Formation. Its age is currently considered to lie sometime between Campanian and Late Maastrichtian, on the grounds that it post- dates the Semail Ophiolite, it contains dinosaurs, and it underlies Late Palaeocene marine shelf carbonates of the Jafnayn Formation (Nolan et al. 1990).

Marine, brackish water and freshwater molluscs were collected from many localities in the Al-Khod Formation, and it is clear that there are changes in the fauna from the base of the unit upwards. The basal deposits at Al-Khod yield a few freshwater bivalves and gastropods, among which there are two species of the sinistral genus Lanistes, which is known elsewhere throughout the Cainozoic (Abbass, 1966, 1967; Van Damme & Pickford, 1995). Bandel (1993) wrote that "Lanistes appears near the Cretaceous-Tertiary boundary in freshwater deposits of Pakistan and Sudan" but without providing details of the fossils or references to them. I have been unable to find any reference in support of the Pakistan

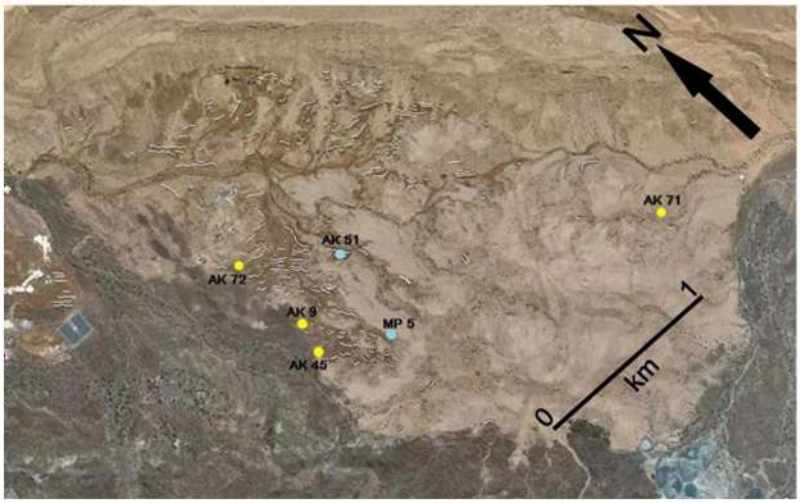

Figure 4. Distribution of Lanistes in the Al-Khod Formation (yellow points large globose carinate species, blue points small planispiral species) (image modified from Google Earth).

record of the genus (which could well be erroneous), but the Sudan one is based on material from the Hudi Chert which is either early Eocene or Oligocene depending on the author (Gautier, 1973; Ibrahim, 2003). The Al-Khod specimens are thus probably the earliest known representatives of this genus, and they will help to refine estimates of the timing of origin of the group after it diverged from Pila. Some molecular biologists tend to support a Tertiary origin for Lanistes (Schultheiss et al., 2009) but the fossil data suggests an earlier, possibly Early Maastrichtian or even Campanian origin.

The middle section of the Al-Khod Formation has yielded immense quantities of corbiculoid bivalves, as well as oysters, Turritella and brackish water gastropods. These levels also yielded Lanistes, but a smaller more anisotrophic planispiral species than the globose hyperstrophic form which occurs in the basal layers.

The upper third of the Al-Khod Formation yields abundant thick-shelled bivalves indicating fully marine but shallow water conditions, but no freshwater or brackish water taxa. At the moment, the biostratigraphic meaning of these bivalves is not known.

Some of the fossil groups found at Al-Khod managed to survive the KT boundary crisis (massive extinction of, among other fossil groups, rudists, ammonites and dinosaurs). Among the survivors are palms, turtles, freshwater molluscs (mutelids and Lanistes) and several marine molluscs (Turritella, corbiculoids).

Mollusca:

By far the most common macrofossils preserved in the Al-Khod Formation comprise molluscs, freshwater, brackish and marine. Many of the bivalves are preserved as couplets, indicating that post- mortem transport is minimal. Some specimens are still in their life position, but many are lying parallel to the bedding planes of the sandstones and carbonates suggesting that gentle winnowing of sediment occurred, leaving the coarser grains and shells behind, more or less in their original life positions.

The basal deposits of the formation yield specimens of large freshwater bivalves (mutelids) and gastropods (Lanistes) with rarer brackish water and marine specimens (Table 1). The middle deposits yield abundant corbiculoid specimens, but also many oysters in their growth position, and reworked specimens in gravel, and there are many Turritella and brackish water gastropods. The upper third of the formation, comprising the delta deposits, yield a monotonous series of thick-shelled bivalves, most of which are found as isolated valves, but many of which comprise couplets.

Table 1. List of localities and their co-ordinates at Al-Khod which yielded two species of Lanistes.

Abbreviation	Locality n°	Taxon	Latitude	Longitude	Google Earth altitude
AK	9	Large globose	23°33'01.9"N	58°08'30.4"E	109 m
AK	45	Large globose	23°32'54.9"N	58°08'30.4"E	110 m
AK	71	Large globose	23°32'37.7"N	58°09'36.2"E	113 m
AK	72	Large globose	23°33'18.3"N	58°08'26.0"E	112 m
MP	5	Small planispiral	23°32'50.9"N	58°08'39.7"E	126 m
AK	51	Small planispiral	23°33'05.5"N	58°08'42.6"E	106 m

Systematic Palaeontology:

Family Ampullariidae Gray, 1824
Genus Lanistes Denys de Montfort, 1810

Type species: Lanistes olivierii Montfort, 1810 [= Lanistes boltenianus (Röding, 1798) = syn. Lanistes carinatus (Olivier, 1804)] original designation [Lee (2013) discussed the nomenclatorial history of this species].

Type locality and age : Egypt, Recent

Species Lanistes large globose carinate sp.

Stratigraphy and Age: Al-Khod Formation, Maastrichtian.

Material: ONHM AK 9, single shell; ONHM AK 45, single shell; ONHM AK 71, single shell; ONHM AK 72, single shell.

Description: The Al-Khod shells are sinistral, globose, with five whorls, spire slightly raised with rounded whorl profile except last whorl which shows a distinct carina high on the shoulder of the whorl. The apical suture is narrow and sharp, but shallow. The umbilicus is wide basally narrowing upwards like a funnel. It has an angular margin which is scored by prominent growth lines which become finer inside the funnel and apart from the broadest ones, they fade out on the outside of the body whorl.

The preservation is not good enough to reveal fine details of spiral sculpture or protoconch morphology, although it seems clear that the protoconch grades into the teleoconch without a major change in gross morphology. None of the apertures is well preserved, but its shape can be estimated in AK 45. No operculum is known for this taxon.

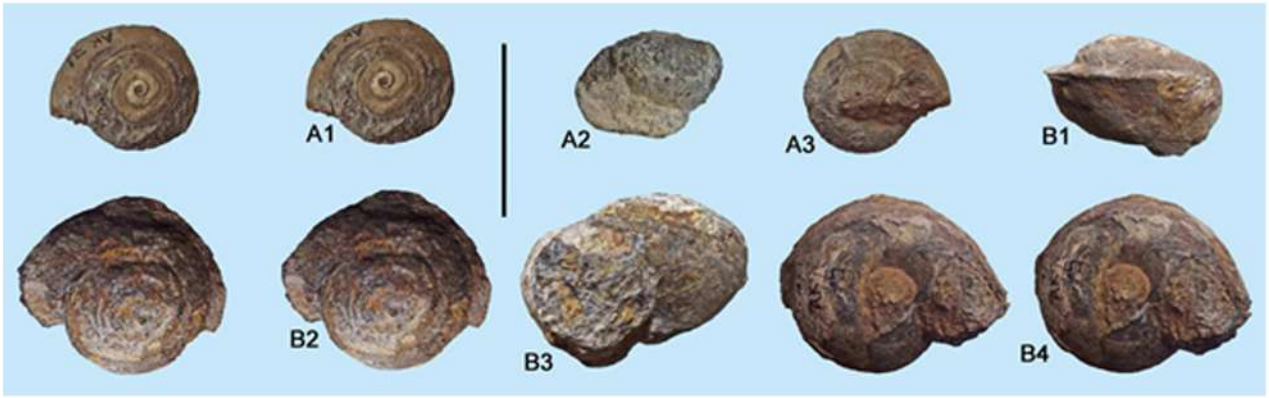

Figure 5. Large globose, carinate sinistral gastropods from the Al-Khod Formation, Oman (Cretaceous) attributed to Lanistes. A) specimen from locality AK 71, A1 – stereo apical view, A2 – apertural view, A3 – umbilical view, B) specimen from locality AK 45, B1) lateral view to show carena, B2) stereo apical view, B3) apertural view, B4) stereo umbilical view (scale : 5 cm).

Discussion: The dimensions (Table 2) and overall morphology of the large globose form of Lanistes from Al-Khod recall to some extent the extant species Lanistes carinatus. Eo-Oligocene specimens of Lanistes from Egypt and Sudan (Cox, 1932, 1933) are also somewhat carinatus-like, as are some specimens from the Miocene of Uganda and Kenya (Verdcourt, 1963; Van Damme & Pickford, 1995).

Species Lanistes small planispiral sp.

Stratigraphy and Age: Al-Khod Formation, Maastrichtian.

Material: ONHM AK 51, single shell; ONHM MP 5 single shell.

Description: The shells from Al-Khod are sinistral, almost planispiral (anisostrophic planispiral, Peel & Horny, 1996) with a slightly sunken spire and a broad and deep, funnel-shaped umbilicus. The larger of the two available shells has five whorls, and the spiral suture is narrow and shallow. The protoconch grades into the teleoconch without any evident interruption in gross morphology.

The protoconch grades into the teleoconch without any evident interruption in gross morphology. The umbilical margin is angular and spirals upwards into the funnel. Inside the umbilicus, fine growth lines are evident. No operculum is known for this taxon, neither is the aperture preserved, but its outline can be estimated in specimen AK 51.

Figure 6: Small planispiral sinistral shells from the Al-Khod Formation, Oman (Cretaceous) attributed to Lanistes. A) specimen from locality MP 5, A1) stereo umbilical view, A2) apertural view, A3) stereo apical view, B) specimen from locality AK 51, B1) stereo umbilical view, B2) apertural view, B3) stereo apical view (scale : 10 mm).

Table 2. Dimensions (in mm) of shells from Al-Khod (Cretaceous) attributed to Lanistes.

Specimen	Form	Diameter	Height
AK 45	Globose	60	37
AK 71	Globose	43.6	33
AK 51	Planispiral	25	11.6
MP 5	Planispiral	16.8	8.2

Discussion: The planispiral sinistral shells from Al-Khod superficially resemble the flat topped species, Lanistes thaytinitiensis, from the Eo-Oligocene of Oman described by Neubert & Van Damme (2012) but the spire is not as planar as in that species, the peripheral keel is not as well developed and the shells are not as large (Table 2). In addition, the protoconch is sunken slightly beneath the outer whorls, and not raised slightly. The umbilicus is wide basally and has an angular margin that spirals into the umbilicus as in L. thaytinitiensis, which might indicate a relationship between these snails.

Malacological Discussion:

Had these shells from Al-Khod been found in Tertiary deposits there is little doubt that they would be classified in Lanistes or a genus close to Lanistes. The sinistral shell, the broad, open, funnel-shaped umbilicus with inward spiralling angle, the shallow but sharp and narrow spiral suture, and the overall aspect of the shells agrees with this genus. What little that is preserved of the surface sculpture, such as the growth lines entering the umbilicus, also agrees with Lanistes.

Extant Lanistes species that live in rivers and shallow lakes tend to have rather monotonous shell shapes, corresponding broadly to Lanistes carinatus and Lanistes ovum. Basically similar shells occur as far back as the Early Oligocene of Oman and Egypt. This suggests that such shapes represent good adaptations for slow flowing rivers and shallow lakes, which tend to be unstable over geological time spans. In contrast, as was pointed out by Van Damme & Pickford, (1995) when the genus Lanistes colonises deep graben lakes such as extant Lake Malawi or Miocene Palaeolake Obweruka (Uganda), then extreme modifications of shell shape can occur in abbreviated time spans, giving rise to planispiral taxa with spines such a Lanistes senuti from Palaeolake Obweruka, or taxa with raised superior shoulders such as Lanistes nasutus of Lake Malawi or Lanistes asellus of Palaeolake Obweruka.

In terms of ecological adaptations, the larger of the two Al-Khod species of Lanistes corresponds to the carinatus type, typical of slow flowing rivers and shallow lakes, but the smaller, planispiral species does not correspond either to the carinatus or to the ovum type. However, the latter species is not markedly different from a planispiral taxon from the Eo-Oligocene of Oman, where it is found in large quantities in marls that accumulated in low lying depressions close to the sea. The ame deposits yield a taxon not very different in shell properties from the carinatus form. Thus the Cretaceous Al-Khod Formation, which accumulated close to the sea, contains two shell morphotypes whose ecomorphology resembles that of two species found in much younger, Eo-Oligocene, deposits in the Dhofar, Oman.

General Discussion

There is overall agreement among malacologists that the Ampullariidae is a Gondwanan family of molluscs with deep Mesozoic origins (Fischer, 1963; Jørgensen et al., 2008, Hayes et al., 2009; Schultheiss et al., 2009). There is less agreement concerning the time of origin of the various genera that comprise the family, although three broad biogeographic groups are consistently discussed, comprising 1) strictly African genera Afropomus, Saulea and Lanistes, (Brown, 1994; Berthold, 1989, 1990a, 1990b, 1991; Bieler, 1993), 2) the Afro-Asian genus Pila (Brown, 1994; Kase, 1984) and 3) a more varied South American group consisting of Pomacea, Marisa, Asolene, Felippones and Pomella. Molecular approaches have generated interesting data concerning phylogenetic relationships of genera and species within the family, but there is debate concerning the timing of the various dichotomies, which raises questions about the accuracy of the so-called molecular clock and the ages of the palaeontological anchor points used to calibrate the clock. As Hayes et al. (2009) commented concerning the hypothesis that "diversification of New World ampullariids probably occurred in South America some time after its separation from Africa, approximately 130 Mya (Jokat et al., 2003), without a calibrated molecular clock and additional fossil data, this remains untestable ».

There has been a tendency to accept identifications of sinistral fossil ampullariid shells from Tertiary deposits as Lanistes, even if they are poorly preserved, as for example much of the material from the Oligocene of

Egypt (Abbass, 1966, 1967; Mayer-Eymar, 1893) or the Hudi Chert, Sudan (Cox, 1933; Gautier, 1973) (Table 3), whereas material from the Cretaceous is usually treated with doubt, even if well preserved. There thus seems to exist a bias in the way that palaeomalacologists have approached the ampullariid fossil record.

The Omani fossil shells from the Cretaceous Al-Khod Formation are so similar to Lanistes in overall shape, size, and what details of the shell sculpture is preserved, that this is where they should be classified. Whatever the eventual outcome, the presence of two distinct species of Lanistes in the Maastrichtian of Oman indicates that the genus originated some time earlier than the period of deposition of the Al-Khod Formation, possibly in the Early Maastrichtian or even the Campanian. This interpretation provides a minimum age base line for calibrating the molecular clock, but it is probably an underestimate. The well preserved fossil samples from the Eo-Oligocene of Oman (Neubert & Van Damme, 2012) contain two species of Lanistes, L. thaytinitiensis and L. tricarinatus.

Table 3. Cretaceous and Eo-Oligocene fossils attributed to Lanistes.

Species	Author, Year	Age	Country	Other references
L. grabhami	Cox, 1933	Early Eocene, Oligocene	Sudan	Cox, 1932; Gautier, 1973; Ibrahim, 2003
L. antiquus	Blanckenhorn, 1901	Lutetian	Egypt	Bellardi, 1855; Mayer-Eymar 1901; Blanckenhorn 1900; Newton 1912
L. tricarinatus	Neubert & Van Damme, 2012	Eo-Oligocene	Oman	
L. bartonimus	Blanckenhorn, 1901	Middle Eocene	Egypt	
L. sodaensis	Abbass, 1967	Eocene	Egypt	Abbass, 1966
Lanistes globose, carinate	This paper	Cretaceous	Oman	This paper
Lanistes planispiral	This paper	Cretaceous	Oman	This paper

Conclusion

The main conclusion of this paper is that the Late Cretaceous Al-Khod Formation of Oman has yielded two species of the sinistral freshwater ampullariid gastropod, Lanistes, a large globose form with a peripheral carina recalling extant Lanistes carinatus, and a smaller planispiral form with rounded periphery, resembling in some ways the recently described species Lanistes thaytinitiensis from the Eo-Oligocene of Oman. Several inferences flow from this discovery. One is that the genus may well have originated during the Middle Cretaceous or even earlier and that by the Maastrichtian it had had time to diverge into two quite distinct shell morphotypes. A second is that the genus traversed the K-T crisis.

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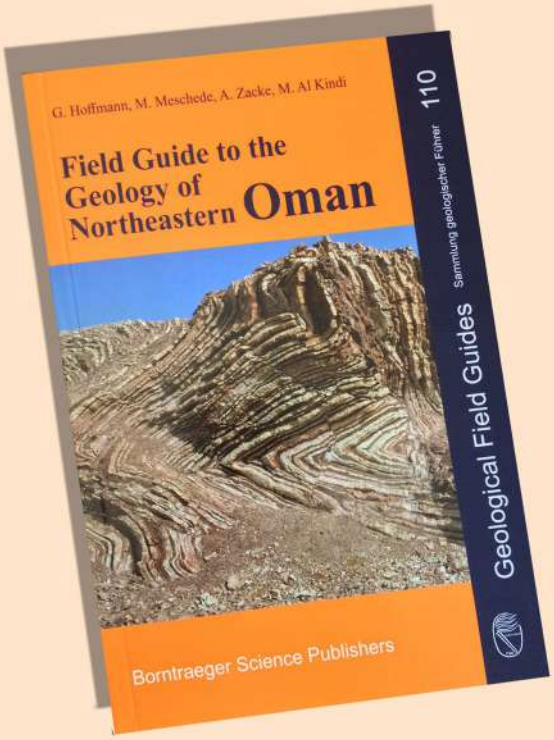

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Description:

This publication is a joint effort of members of the Geological Society of Oman (GSO), lecturers in the German University of Technology in Oman (GUtech) and members in the German Geologcial Society (Deutsche Gesell-schaft- Geologische Vereinigung e.V.DGGV). The Fascinating geology of Oman is obvious, not only to the expert. Visitors to the country are immediately enchanted by the variety of landforms and rocks. This book aims to serve as a general introduction and guide to the geology of Oman for the laymen, students, and geologists alike. It contains comprehensive descriptions of the main geological sites in northeastern Oman and the routes to reach the described sites, including detailed maps and coordinates for the stops. The authors of the book aim to help the reader putting the variety of Oman's beautiful landscape into a scientific context and to understand the processes that led to its formation.

Content:

Geo-Kids

Fun and Learning Activities with School Students

By **Abeer Al Saifi**

Geo-Kids is one of the successful GSO events, for school students, to educate them about the geology of the Earth and Oman in an interactive way. The event was initiated in 2014, and has been organized for 3 times since then. The theme of the first edition of Geo-Kids was "Tour in Rock World", which targeted 30 students whose ages were between 9 and 13 years. The second edition of Geo-Kids was in 2015 and aimed to increase the number of students, thus, two programmes were organized. The theme of the first programme was "Tour in the Petroleum Geology World". This programme targeted

programme was "Tour in the Earthquakes World", which targeted 36 students whose ages are between 10 and 14 years.

This year's event was completely different and the theme was "Dinosaurs Land". Around 150 students attended and were divided into two groups, based on their ages; (15-11) & (10-7) years old, respectively. The event included workshops and groups' activities and competitions for the kids to interact and learn about dinosaurs' origin, life, and extinction, worldwide and in Oman.

Throughout the last 3 years, the Geo-Kids event went smoothly and successfully, with an outstanding acknowledgment from the students and their parents.

الجيولوجيين الصغار

فعالية ترفيهية تعليمية لطلاب المدارس

كتبته: عبير السيفي

فعالية الجيولوجيين الصغار هي إحدى الفعاليات الناجحة التي تنظمها الجمعية الجيولوجية العمانية لطلاب المدارس؛ لغرض رفع محصلتهم المعرفية عن جيولوجية الأرض وعمان بطريقة تفاعلية. بداية الفعالية كانت في عام ٢٠١٤ ، والتي كانت تحت عنوان "رحلة في عالم الصخور" ، والتي شارك فيها ٣٠ طالب وطالبة تتراوح أعمارهم بين ٩ و ١٠ سنوات. في عام ٢٠١٥ ، سعت الجمعية إلى زيادة عدد المشتركين في الفعالية ، لذلك تم تقسيم الفعالية إلى برنامجين على مدى يومين. البرنامج الأول كان تحت عنوان " رحلة في عالم الجيولوجيا النفطية" وإشترك فيه ٣٦ طالباً وطالبة من الفئة العمرية ١٥-١٧ سنة. أما البرنامج الثاني فكان تحت عنوان "رحلة في عالم الزلازل" وكان موجها للطلاب من عمر ١٠ سنوات إلى ١٤ سنة.

في عام ٢٠١٦ ، تم تنظيم الفعالية بشكل مختلف وتحت عنوان " أرض الديناصورات" حيث تم تقسيم الطلاب ، والبالغ عددهم ١٥٠ ، إلى مجموعتين حسب أعمارهم: فئة ٧-١٠ سنوات وفئة ١١-١٥ سنة. تضمنت الفعالية عدة ورش عمل ، وأنشطة تنافسية تعليمية بين المجموعات ، والتي تركزت حول أصل الديناصورات ، وبداية تواجدها و إنقراضها حول العالم وفي عمان. هذا وقد لاقت فعالية الجيولوجيين الصغار نجاحا كبيراً وإشادة من قبل الطلاب المشاركين وأهاليهم على مدى السنوات الثلاث من عمر الفعالية.



الحفاظ على التراث الجيولوجي

سعادتكم لا يخفى عليكم أن السلطنة تزخر بتراث جيولوجي، وهي كما يطلق عليها البعض بـ "فردوس الجيولوجيا". فما هو دور الهيئة في الحفاظ على هذا التراث؟

دور الهيئة في الحفاظ على التراث الجيولوجي دور فاعل ومهم وهو أحد إختصاصاتها؛ وذلك إدراكا من الهيئة للأهمية التراثية التي تحملها جيولوجية السلطنة. فقد تم سن العديد من التشريعات والقوانين التي تعمل على الحفاظ على هذا التراث تتمثل في ما يلي:

أولا: يمنع تصدير أية عينات أو شحنات صخرية بدون تصريح مسبق من الهيئة.

ثانيا: يقوم موظفو الهيئة بتفتيش العينات والشحنات المصدرة قبل إصدار تصريح التصدير؛ للتأكد من عدم مخالفة المصدرين للأنظمة والقوانين المتبعة.

ثالثا: تمنع الهيئة إعطاء تصاريح لإخراج أو تصدير الحفريات إلا تحت ظروف خاصة تتعلق بأعمال البحث والدراسة لمشاريع محددة على أن يقوم المصدر بإعادة هذه الحفريات بعد إنتهاء الدراسة.

رابعا: تنفذ الهيئة منذ سنوات برنامجا طموحا لدراسة وتجميع وتصنيف النيازك العمانية بهدف الحفاظ على هذه الثروة التراثية والعلمية.

خامسا: يمنع تصدير أو تداول أو بيع أو عرض النيازك العمانية إلا للجهات الحكومية المرخص لها.

سادسا: تم التنسيق مع شرطة عمان السلطانية بعدم السماح بعبور أي نوع من المعادن والحفريات والنيازك عبر كل المنافذ الحدودية، مالم يكن مصرحا لها من الهيئة.

سابعا: هناك لجنة مكلفة من قبل الهيئة لحصر أهم معالم هذا التراث (لجنة تحديد الظواهر الجيولوجية) وتحديد كيفية حمايته من العبث به أو تهريبه والطرق الممكنة للترويج لهذا التراث الجيولوجي.

ثامنا: يقوم مفتشو وموظفو الهيئة برصد وتسجيل هذا التراث أثناء جولاتهم الميدانية.

سعادة المهندس: ما هي الرسالة التي تودون إرسالها إلى المجتمع لحثه على القيام بدوره في تنمية قطاع التعدين بالسلطنة ؟

يعد قطاع المعادن محركا إيجابيا نحو تنمية المجتمعات بما يقدمه من خدمات أساسية ترتكز على مواد الخام المعدنية ، والتي تعمل على تطوير البنى الأساسية في المجتمعات. وهو يعمل على توفير فرص العمل في مناطق تواجد الخامات المعدنية. وتولي الهيئة أهمية كبيرة لسلامة العمليات التعدينية؛ للتأكد من أنها لا تضر بالبنية الاجتماعية والاقتصادية وسلامة البيئة. وتقدم الشركات العاملة في هذا القطاع ما نسبته ٥٪ من أرباحها لتنمية المجتمع المحلي. كما أن القطاع يقدم العديد من الفرص للأفراد والمؤسسات الصغيرة والمتوسطة والشركات الأهلية من خلال التدريب على رأس العمل، وكذلك ما يحتاجه من عمليات النقل والصيانة وقطع الغيار وغيرها. وعلى المجتمع إستغلال هذه الفرص وإتاحة الفرصة للشركات العاملة بهذا القطاع للنمو والتطور؛ لينعم الجميع بخيرات هذا الوطن كل من موقعه. ولذا فإنه من المهم تحقيق الشراكة الحقيقية بين الهيئة وبين المجتمع في توفير المناخ الإستثماري؛ إ ستغلال هذه الثروة الإستغلال الأمثل وتحقيق الأهداف المرجوة في التنويع الاقتصادي.

ما هي أبرز التحديات التي تواجه قطاع التعدين في السلطنة؟

من أهم التحديات التي تواجه القطاع وجود بعض الخامات المبشرة، والتي يمكن استغلالها تجاريا، بالقرب من المواقع البيئية. وكذلك الزحف السكاني باتجاه العديد من المواقع التعدينية، ووجود العديد من الاعتراضات من قبل المواطنين لاستثمار المواقع، ومنها مواقع عامة للكسّارات والمحاجر لنقل الكسّارات، المتأثرة بالزحف العمراني عليها. وأيضا قلة البنية التحتية اللازمة لإنشاء المواقع التعدينية من حيث قلة أو عدم توفر الطرق إلى تلك المواقع وعدم توفر الموانئ المخصصة لتصدير منتجات المحاجر. كما يشكل عدم توفرالطاقة اللازمة لإنشاء مصانع للخامات المستخرجة أحد أهم التحديات.

أكد حضرة صاحب الجلالة السلطان قابوس بن سعيد المعظم -حفظه الله ورعاه- في خطاباته السامية على أهمية عمل الشباب العُماني في المجالات المختلفة، وتشجيعه للمنافسة فيها. فهل يمكن لسعادتكم أن تلقوا الضوء على دور الهيئة في تشجيع الشباب العماني للعمل في قطاع التعدين؟

إن فرص العمل التي يوفرها قطاع التعدين كثيرة؛ حيث أن هذا القطاع يحظى بنسبة كبيرة من التعمين في مجالات المحاجر والكسّارات والمصانع المرتبطة بتلك المحاجر. كما يوفر القطاع العديد من فرص الاستثمار للمؤسسات الصغيرة والمتوسطة من حيث إتاحة المجال لتأسيس شركات مساهمة محلية قادرة على بدء وإدارة المشاريع المتعلقة بالمحاجر والكسّارات.

كما أن فرص العمل تتمثل في الحصول على أعمال مباشرة في شركات التعدين، وفرص غير مباشرة تتمثل في الدعم اللوجستي للشركات العاملة في مجال التعدين مثل: خدمات النقل والصيانة وتوصيل المياه للمحاجر والتصدير. وكذلك قيام مؤسسات صغيرة ومتوسطة يعتمد عملها على الخامات المعدنية والتي تنتجها الشركات المرخصة كمؤسسات تقطيع وتلميع الرخام.

إذا إنتقلنا إلى الناحية الأكاديمية، فهل هناك تنسيق وتعاون بين الهيئة ومؤسسات التعليم العالي في إنشاء تخصصات ترفد القطاع؟

إن سعي الهيئة إلى توسيع الإستثمارات في قطاع التعدين خلال السنوات القادمة يبرز أهمية مشاركة الهيئة مع مؤسسات القطاع الخاص العاملة في قطاع التعدين في وضع السياسات التعليمية والتدريبية في السلطنة بحيث تواءم المخرجات التعليمية مع سوق العمل. وعليه فإن الهيئة تعمل على التنسيق مع مجلس التعليم لتحديد التوجهات العامة باحتياجات قطاع التعدين من التخصصات الدراسية المستقبلية.

شركة تنمية معادن عمان

سعادتكم في مطلع العام الجاري تم التوقيع على اتفاقية تأسيس شركة تنمية معادن عُمان. فهل يمكنكم التعريف بصورة أكثر عن إختصاصات الشركة والدور الذي ستقوم به؟

الشركة حاليا هي قيد التأسيس، وستكون شراكة بين الحكومة، من خلال أذرع الاستثمار الحكومية، وكذلك المواطنين من خلال الإكتتاب. والشركة ستركز على الإستثمار في الشق العلوي من التعدين، وهو استخراج المعادن، وكذلك في الشق السفلي، وهو إقامة صناعات تحويلية قائمة على الخامات المعدنية.

التعديـن في إطـار الاسـتراتيجية الوطنيـة الشـاملة للتنميـة، والعمـل عـلى توفـير البنيـة التنظيميـة المشـجعة لنمـو وتطـور قطـاع التعديـن بالتنسـيق مـع الجهـات المعنيـة. يتـم ذلـك مـن خـلال اقـتراح مشـاريع ذات صلـة بقطـاع التعديـن، ومراجعـة القوانـين والنظـم والإجـراءات المعمـول بهـا في هـذا الشـأن، كذلـك إعـداد الدراسـات والبحـوث الجيولوجيـة والتعدينيـة لأغـراض الكشـف والتنقيـب عـن الـثروات المعدنيـة، وتنفيـذ دراسـات لتقييـم الجـدوى الاقتصاديـة للمشـاريع المتعلقـة باسـتغلال المعـادن، ونـشر المعلومـات والبيانـات الجيولوجيـة والتعدينيـة وتوفيرهـا بكافـة الطـرق المتاحـة وتسـهيل الحصـول عليها. كـما تقـوم الهيئـة بـالإشراف عـلى كافـة الأنشـطة المتعلقـة بالكشـف والتنقيـب عـن المعـادن وتنميـة الـثروات المعدنيـة المكتشـفة. ويناط بهـا أيضـا الحفـاظ عـلى الـتراث الجيولوجـي، ووضـع الضوابـط اللازمـة لحمايتـه، والعمـل عـلى الترويـج لاسـتغلال الخامـات المعدنيـة المتوفـرة بكميـات تجاريـة. كـما تقـدم الموافقـة عـلى تصاميـم المناجـم والمحاجـر وخطـط التحجـير ومتابعـة تنفيذهـا.

وتعمـل عـلى تطويـر علاقـات التعـاون المشـترك مـع الجهـات الوطنيـة المعنيـة والمنظـمات الإقليميـة والدوليـة ذات الصلـة باختصاصـات الهيئـة، وتمثيـل السـلطنة في الاجتماعـات الدوليـة والإقليميـة ذات الصلـة بإختصاصـات الهيئـة.

من المسـلم بـه سـعادتكم أن تنويـع مصـادر الدخـل مـن الأولويـات الاقتصاديـة الحاليـة للسـلطنة. فـما هـو دور الهيئـة في ذلـك؟ ومـا توقعكـم في مـدى مسـاهمة قطـاع التعديـن في الدخـل الوطنـي إذا تمـت مضاعفـة الجهـود في تنميـة وتحسـين هـذا القطـاع؟

إن تزايـد الاهـتمام بالتعديـن تولـد نتيجـة الحاجـة لتنويـع مصـادر الدخـل للاقتصـاد الوطنـي. الأمـر الـذي يسـتوجب تنظيـم القطـاع بمـا يحقـق الاسـتغلال الأمثـل لـه، وبمـا يخـدم الصالـح العـام. ونتطلـع في الهيئـة العامـة للتعديـن أن يسـاهم قطـاع التعديـن في تحقيـق هـذا التنـوع الاقتصـادي للسـلطنة، مـن خـلال إيجـاد فـرص اسـتثمار جاذبة للـشركات المهتمـة بهـذا القطـاع، وكذلـك اسـتحداث آليـات جديـدة لمضاعفـة الإيـرادات المبـاشرة لصناعـات التعديـن في صنـدوق الدولـة. فهنـاك مشـاريع وخطـط تسـعى الهيئـة إلى تحقيقهـا، والتي ستسـاهم في تحقيـق هـذا المطلـب الوطنـي مـن القطـاع. إن المسـتقبل واعـد -بـإذن اللـه- في هـذا القطـاع؛ لأن الرؤيـة واضحـة، والهـدف مشـترك لا يختلـف عليـه إثنـان مـع الإحسـاس بالمسـؤولية لـدى القائمـين عـلى هـذا القطـاع.

مـا هـو حجـم الفـرص الاسـتثمارية التـي يوفرهـا قطـاع التعديـن في السـلطنة؟

يعتـبر قطـاع التعديـن أحـد القطاعـات الواعـدة في السـلطنة، والـذي يوفـر العديـد مـن الفـرص الاسـتثمارية في جميـع الخامـات المعدنيـة المكتشـفة في السـلطنة. فعـلى سـبيل المثـال، تقـوم عـدة مصانـع في منطقـة صحـار الصناعيـة بإنتـاج الفيروكـروم. وفيـما يتعلـق بخـام النحـاس، فـإن بعـض مواقـع التراخيـص مازالـت في مراحـل التنقيـب والتقييـم الإقتصـادي. أمـا المعـادن والصخـور الصناعيـة ، فـإن فـرص الاسـتثمار فيهـا واعـدة؛ نتيجـة لتنـوع هـذه الخامـات وتوزعهـا عـلى أرجـاء السـلطنة بكميـات كبـيرة، بالإضافـة إلى وقـوع العديـد منهـا بالقـرب مـن موانـئ التصديـر. فعـلى سـبيل المثـال، تمثـل خامـات الحجـر الجـيري فـرص جيـدة لإقامـة مصانـع للرخـام، كذلـك الجـير المطفـئ، والإسـمنت، والحديـد. كـما يشـكل خـام الجبـس فرصـا لإقامـة مصانـع لإنتـاج ألـواح الجبـس، بالإضافـة إلى مـواد البنـاء كالإسـمنت وصخـور الجابـرو. وفي سـبيل تشـجيع وجـذب المسـتثمرين، وخلـق بيئـة عمـل تكفـل اسـتمرار المشـاريع، فقـد بـدأت الهيئـة في تنفيـذ الإجـراءات التـي تضاعـف الفائـدة مـن هـذه الـثروات، كتحديـد مناطـق جديـدة للتعديـن في مختلـف الأنشـطة التعدينيـة؛ لطرحهـا للاسـتثمارالجاد ومـن خـلال مبـدأ التنافـس في تقديـم عـروض الاسـتثمار وذلـك لزيـادة المـردود مـن هـذه الاسـتثمارات.

هـل تعتقـدون سـعادتكم أن طـول الإجـراءات المطلوبـة لإنشـاء المحاجـر والكسـارات أحـد الأسـباب المعيقـة لزيـادة الاسـتثمار في القطـاع؟

إن الهيئـة تقيـم الطلبـات عـن طريـق لجنـة متخصصـة في ذلك، بعـد إسـتيفاء هـذه الطلبـات للـشروط المنصـوص عليهـا. عنـد اسـتلام الهيئـة للطلبـات الجديـدة، يتـم تحويـل هـذه الطلبـات إلى الجهـات المعنيـة؛ والتـي بدورهـا تنظـر في هـذه الطلبـات وتحـرر الموافقـة عليهـا. قـد يتطلـب ذلـك بعـض الوقـت، ولكـن تسـعى الهيئـة إلى تطويـر وتبسـيط هـذه الإجـراءات؛ لتوائـم متطلبـات الاسـتثمار مـن خـلال مـشروع تحديـد مواقـع تعدينيـة جاهـزة للاستثمار، وتتولى التنسيق مع الجهات المعنية لأخذ موافقاتها.

قطاع التعدين...
موروث جيولوجي.. ومستقبل اقتصادي

إعداد: محمد العامري وسيف العزري.

تولي السلطنة اهتماما كبيرا بالصناعات غير نفطية؛ لتنويع مصادر الدخل ولفتح باب الاستثمار في القطاعات الاقتصادية المختلفة. ويعتبر قطاع التعدين أحد أهم القطاعات التي تركز عليها سياسة الحكومة الاقتصادية، والتي تهدف إلى تحقيق نمو ثابت للاقتصاد في السلطنة لا يعتمد كليا على الصناعات النفطية فقط. لذلك تم إنشاء الهيئة العامة للتعدين بموجب المرسوم السلطاني السامي رقم ٢٠١٤/٤٩ بتاريخ ٢١ سبتمبر ٢٠١٤م. لنعرف أكثر عن اختصاصات وأهمية هذه الهيئة، أجرينا هذه المقابلة مع سعادة المهندس هلال بن محمد البوسعيدي الرئيس التنفيذي للهيئة العامة للتعدين.

هل يمكن لسعادتكم أن توضحوا للقارئ الكريم اختصاصات الهيئة وأهدافها؟

تهدف الهيئة إلى تطوير وتنمية قطاع التعدين، وتحقيق الاستغلال الأمثل للثروات المعدنية، واستثمارها بما يخدم أهداف التنمية والتنويع الاقتصادي في السلطنة عن طريق وضع خطط ومشاريع تنهض بهذا القطاع. لتحقيق ذلك سعت الهيئة إلى تطوير القوانين والتشريعات التي ستبنى عليها استراتيجية التعدين بما يتناسب مع متطلبات المرحلة.

كما عمدت الهيئة إلى إيجاد آليات الاستثمار الأمثل، وجذب المستثمرين، وكذلك رفع نسبة وكفاءة الكوادر المحلية في القطاع.

كما تعمل الهيئة جاهدة لتطوير واستغلال التراث الجيولوجي، والموائمة بين متطلبات الحفاظ على البيئة والأنشطة التعدينية، وتحسين موارد الهيئة المالية ، ومتابعة مدى نمو ومساهمة قطاع التعدين في الناتج المحلي. أما عن الاختصاصات المنوطة بالهيئة، فإنها تتمثل في إعداد استراتيجية تتضمن الخطط والسياسات الخاصة بالبنية الجيولوجية الأساسية للسلطنة،وتنمية قطاع

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أعزائي القراء،،،

مرحبا بكم في العدد الثالث والعشرين من مجلة الحجر. في هذا العدد الجديد، سنحت لنا الفرصة بالإلتقاء بسعادة المهندس هلال بن محمد البوسعيدي الرئيس التنفيذي للهيئة العامة للتعدين، حيث وضح لنا من خلال حوارنا معه أهداف ومهام الهيئة، بما في ذلك الدور الفاعل الذي تبذله الهيئة لحماية الموروث الجيولوجي العماني.

في إطار آخر، فإن شركات النفط تسعى دائما للاستثمار في التقنيات الحديثة التي من شأنها توفير المعلومات اللازمة لفهم الجيولوجيا تحت سطح الأرض; وذلك لتعزيز فرص نجاح عمليات استكشاف المنتجات النفطية الموجودة في باطن الأرض. أحد هذه التقنيات تقنية (FTG) والتي أثبتت نجاحها في توفير المعلومات اللازمة للتعرف على جيولوجية المنطقة في منطقة امتياز شركة بيتروجاز (PETROGAS) في سلطنة عمان. ونحن نعرض لكم في هذا العدد نتائج هذه الدراسة باللغة الإنجليزية، بحكم أن الدراسة تمت بهذه اللغة. قام مؤخرًا مجموعة من الباحثين بدراسة صخور نهاية العصر الطباشيري في منطقة الخوض. في هذا العدد تجدون أهم مخرجات هذه الدراسة باللغة الإنجليزية كما قدمها المؤلفون، بما في ذلك أيضا عرض لدراسة اكتشاف نوعين من الحفريات الحلزونية. نعتذر عن عدم توفر الدراستين باللغة العربية; لكونهما دراستين تخصصيتين لدارسي علوم الأرض. لمن يرغب بالتعرف أكثر على محتوى الدراستين بأسلوب مبسط يرجى التواصل معنا.

أخيرًا، تعتبر فعالية الأطفال الجيولوجيين إحدى الفعاليات الناجحة التي تنظمها الجمعية سنويا لطلاب المدارس، ونحن في هذا العدد نسلط الضوء على أهمية هذه الفعالية في تعريف الطلاب بعلم الجيولوجيا بشكل عام وجيولوجية عمان بشكل خاص.

أتمنى لكم قراءة ممتعة ومفيدة.

كلمة رئيس الجمعية

يشرفني أن حضيت بثقتكم بأن إنتخبتموني كرئيس للجمعية وسأسعى بإذن الله بأن أرد جميل ثقتكم بالعمل لما فيه صلاح الجمعية. الإدارة الجديدة تعدكم بجمعية ذات نشاط وحيوية، ولكن هذا لا يتحصل بدون دعمكم المستمر. ومن هذا المنبر ندعوكم لمساندتنا بالأفكار والمبادرة والمشاركة والدعم المادي والمعنوي، وأختم بشكركم وترقب عامين حافلين بالنشاط بإذنه تعالى.

د.ابراهيم الاسماعيلي
رئيس الجمعية الجيولوجية العُمانية

د. علي اللزكي
رئيس الجمعية الجيولوجية العُمانية (٢٠١٥-٢٠١٦)

يسرني ويسعدني أن أرحب بكم في هذا العدد الجديد من مجلة الحجر. استطاعت الجمعية الجيولوجية العمانية بعون الله القيام بدور فاعل وبناء خلال العام ٢٠١٦ ميلادي. تمثل بالقيام بنشاطات ومشاركات مختلفة قام بها أعضاء الجمعية.

سعت الجمعية الجيولوجية العمانية للقيام ببرامج علمية ومسابقات تثقيفية لطلبة المستوى الجامعي ومستويا المدارس المختلفة، بما في ذلك مسابقة المتحدي الجيولوجي لطلبة المستوى الجامعي في نسختها الثالثة والتي أعلنت نتائجها في الحفل السنوي لعام ٢٠١٦ ميلادية، وعلى المستوى المدرسي نظمت الجمعية ورشة عمل للأطفال «الجيولوجيين الصغار-٣» لأعمار ٩-١٢ سنة، بعنوان أرض الديناصورات. كما قامت الجمعية بتقديم ورشتي عمل لأنواع صخور السلطنة المختلفة بالتعاون مع وزارة التربية والتعليم؛ حيث قدمت الجمعية الورشة الأولى في مؤتمر الابتكار والتقنية الأسيوي والتابع لمنظمة اليونسكو. وتم تقديم الورشة الثانية في ملتقى الابتكار الثالث والذي أقيم مؤخرًا في مركز التدريب التابع لوزارة البلديات الإقليمية والبيئة في شهر يناير للعام ٢٠١٦ ميلادية.

وعلى الصعيد العام، فقد سعت الجمعية الجيولوجية العمانية إلى نشر الثقافة الجيولوجية للعامة من خلال تقديم محاضرات عامة مثل المحاضرتان اللتان قدمتا لنادي الرستاق الرياضي وفريق المسفاة الرياضي الثقافي.

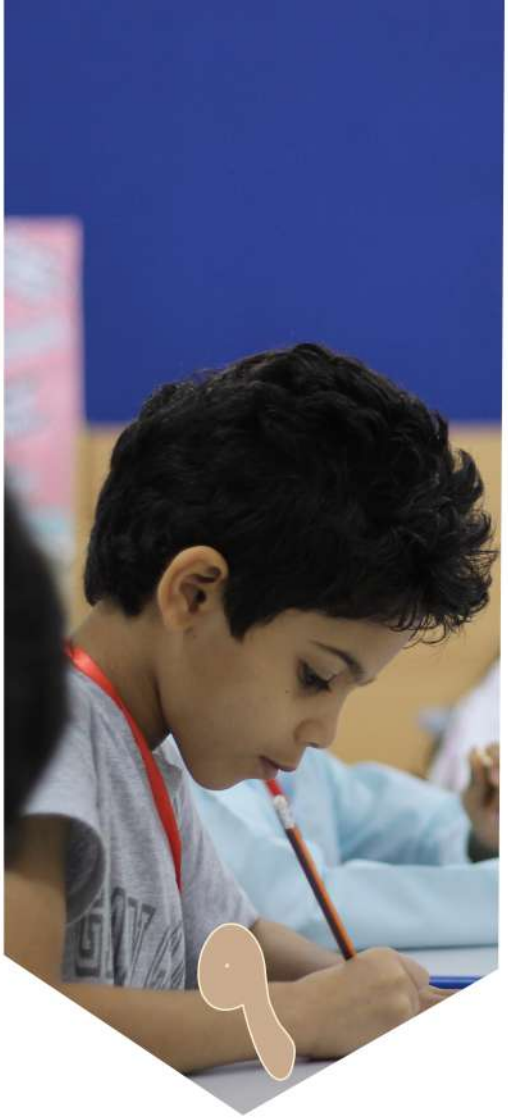
وكما أن الجمعية الجيولوجية العمانية مشارك فاعل في تنظيم المؤتمرات العلمية المتخصصة الداخلية والخارجية. حيث شاركت الجمعية الجيولوجية العمانية في تنظيم مؤتمر التعدين في نسخته الثانية، والذي أقيم مؤخرا في مركزعمان الدولي للمعارض في يناير ٢٠١٧م.

تتمتع السلطنة بموقع جغرافي مميز، وتشتهر بجبال وصخور فريدة زينت السواحل البحرية ممتدة والصحاري الشاسعة الجميلة. مما جعل عمان وجهة ومزارًا مفضلا للسائح والجيولوجي المتخصص. ومن هذا المنطلق، قامت الجمعية خلال ٢٠١٦ بعدة مشاريع تضمنت ورشة خاصة لمنتجع عليلة بالجبل الأخضر؛ للتعريف بالسياحة الجيولوجية في الجبل الأخضر. وشاركت الجمعية بمحاضرتين في مؤتمر الكهوف، والذي أقيم برعاية من وزارة السياحة وشركة عمران في السادس من نوفمبر لعام ٢٠١٦ ميلادية، بعنوان "التطور الجيولوجي لعمان" و "الكهوف المكتشفة من قبل فريق الكهوف العماني". وبالتعاون مع شركة تنمية نفط عمان، ساهمت الجمعية الجيولوجية العمانية بطرح مشروع سياحة جيولوجية بيئية متكاملة لمحافظتي الشرقية والوسطى، والذي تم طرحة ضمن مشاريع تنفيذ للاستثمار السياحي.

وإنه ليسرني إعلان انضمام الفريق العماني لاكتشاف الكهوف ليكون تحت مظلة الجمعية الجيولوجية العمانية. حيث يمثل هذا الانضمام توافق الأهداف وتكاتف الجهود للقيام بإبراز مكنونات الكهوف العمانية، وما تحويه من بعد سياحي وعلمي داخليًا ودوليًا.

وفي الختام، أتوجه بجزيل الشكر لأعضاء مجلس إدارة الجمعية الجيولوجية العمانية للفترة ٢٠١٥-٢٠١٦ لما بذلوه من مجهود للقيام بأعباء الجمعية المختلفة. كما أود أن أبارك لأخي الدكتور إبراهيم الإسماعيلي رئاسته للجمعية الجيولوجية العمانية للفترة القادمة ٢٠١٧-٢٠١٨ ميلادية متمنياً له التوفيق.

الفهرس



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تنبيه

إن المقالات والمنشورات الواردة في المجلة هي مساهمات فردية تعبر عن رأي كاتبها ولا تعبر بالضرورة عن رأي الجمعية الجيولوجية العمانية. كما أن ماورد في المقالات أو المنشورات من توصيات ونصائح لا يجب اعتبارها توصيات ونصائح مرفوعة بواسطة الجمعية الجيولوجية العمانية، كما لايجب الإعتماد عليها في إتخاذ قرارات سواء كانت إستثمارية أو غير ذلك. وعليه فإن الجمعية الجيولوجية العمانية لا تتحمل أي أضرار، مباشرة أو غير مباشرة، ناتجة عن معلومات تم نشرها في مجلة الحجر بما في ذلك أضرار ناتجة عن خسائر في الأرباح أو الإيرادات أو العقود.

الحجر

تصدر عن : الجمعية الجيولوجية العُمانية

العدد ٢٣

قطاع التعدين

موروث جيولوجي ومستقبل إقتصادي

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