

『アラビア半島を旅する』第2章 高橋俊二

**2 アラビア楕状地と厚い堆積層の形成**

**2 Formation of Arabian Shield and Thick Sedimentary Layers**



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| 1. アラビア楕状地の形成 | 1. Formation of Arabian Shield |
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| 画像は、小笠原諸島の西之島火山活動のビデオの一部 | Image is part of a video of Nishinoshima volcanic activity in Ogasawara Islands |
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(<https://www.youtube.com/watch?v=G2k6XH8O8is>)

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| 10 億年前に沙漠の半島がアフリカ北東に並ぶ火山性の群島として初めて水面に顔を現すまでは、アフリカの北東には数百キロメートルにわたって陸地がありませんでした。これらの群島は、小さな 2 つのプレートが衝突して出来た火山性のアシール島弧でした。9 億年前頃までには、最初に現れた陸地の塊としてアシール島弧が合成された均一の陸地と成りました。その頃、さらに北では、ヒジャーズ(حجاز)島弧を形成した第二次衝突が始まりました。 | Until a billion years ago, when Arabian Peninsula first appeared on Earth surface as a volcanic archipelago in Northeastern Africa, there was no land there for hundreds of kilometers. These archipelago were Volcanic Asir arcs formed by two small plates collision. By about 900 million years ago, Asir Island arc was synthesized as the first land mass to appear. Around that time, further north, the second clash began, which formed Hijaz (حجاز) Island arc. |
| 現在のビーシャ(بيشة)やターイフ(الطائف)がある場所まで部分的には連なっていた最初の                                                                                                                                                                     | The first volcanic series, which partially led to the sites of present-day Bisha (بيشة) and                                                                                                                                                                                                                                                                                                                                                                              |

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| <p>火山列は、侵食によって、その山頂を削られ、すり減らされました。侵食によって出来た瓦礫は、雨水で流され火山列の前後の堆積盆は、その瓦礫で埋められました。その堆積した瓦礫が時間と共に一体となり、幾種類かの堆積岩を作りました。岩の種類も交互に層を重ねて形成され、深い層のものは上部の地層の圧力で潰され、変成されました。</p> | <p>Taif (الطائف), was carved and worn away by erosion. The debris created by erosion was washed away by rainwater, and the sedimentary basins before and after the volcanic column were filled with the rubble. The accumulated debris became one over time to form several types of sedimentary rocks. The types of rocks were also formed by alternating layers, and those in the deep layers were crushed and metamorphosed by the upper strata pressure.</p> |
| <p>火山活動が次第に収まるに連れて、地中の深い場所で冷えて固まった深成岩は、花崗岩、閃緑岩、その他色々の岩石の地域となって地上に露出しています。最終的には比較的新しい堆積岩を突き抜けて古い火成岩の露頭がある概ね平らな景観を作り出しました。</p>                                        | <p>As volcanic activity gradually subsides, plutonic rocks that have cooled and solidified deep in the ground have become areas of granite, diorite, and various other rocks that are exposed to the ground. Eventually, it broke through relatively new sedimentary rocks to create a largely flat landscape with outcrops of old igneous rocks.</p>                                                                                                            |

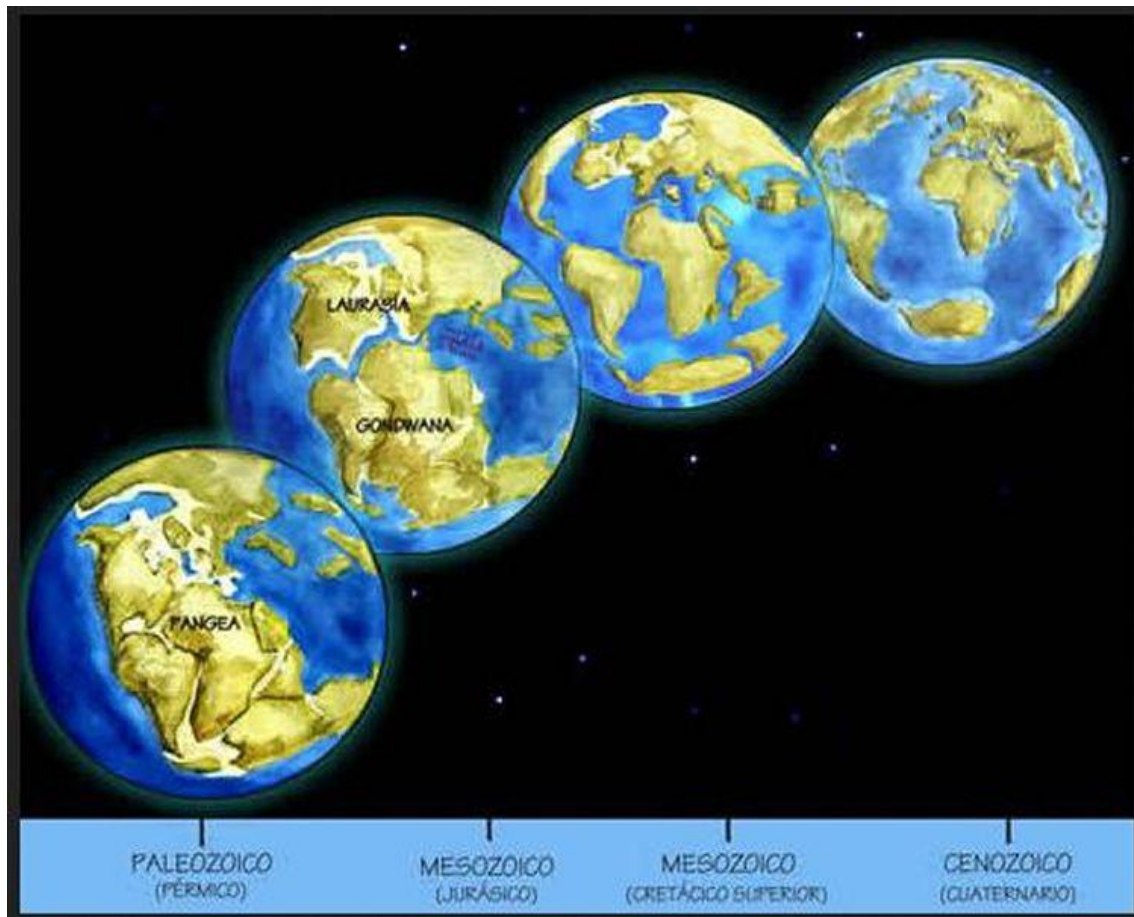


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| リヤード州北部の古生層露頭 （撮影：高橋） | Paleozoic outcrops in Northern Riyadh province<br>(Photo: Takahashi) |
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| <p>同じような必然の過程が各火山列に起きて来ました。ヒジャーズ火山列が北へ、東へと連続して小さなプレートと衝突し、同じ様な地層、地形の進化を繰り返しました。その結果として、その都度、種々雑多な異なる岩石が雑然と混入したメランジュと呼ばれる地層（岩体）を形成しています。小さなプレートが次々と付着し、一つのプレートを形成する過程は、約 6 億 4 千万年前で終了しました。</p>                                                                                           | <p>A similar inevitable process occurred in each volcanic column. Hijaz volcanic array collided with small plates in succession to North and East, repeating the evolution of similar strata and topography. As a result, various different rocks are mixed together to form a stratum (rock body) called a melange. The process of forming a single plate with small plates attaching one after another ended about 640 million years ago.</p>                                                                                                                                                                                                                                              |
| <p>今でもこの小さなプレートは、この新しいプレートと構造的に単一体ですが、地殻変動が収まるまでその地殻変動の影響を受けていました。非常に大きなマグマがその地表の下に入り込み、ゆっくりと冷やされ花崗岩の塊なるに連れて引っ張りと圧縮の力が新しい大地に割れ目や断層をたくさん作り、多量の火山性熔岩が地表に流れ出し、最初の山脈が侵食され破碎されて出来た堆積岩と混じりあいました。5 億 5 千万年までに第一過程でのアラビアプレートの形成は終わりました。その後は、6 千万年前に紅海を作り出した地殻変動が始るまで、沙漠の半島での地殻変動は殆どありませんでした。</p> | <p>Even now, this small plate is structurally monolithic to this new plate, but it was affected by tectonic movements until they subsided. Very large magma entered the surface and slowly cooled down to form a mass of granite, causing many cracks and faults in New Earth, and a large amount of volcanic lava flowed out to its surface, mixing with the sedimentary rocks formed by the erosion and crushing of the first mountain range. By 550 million years ago, Arabian Plate Formation in the first process ended. After that, there were almost no tectonic movements on Arabian Peninsula until another tectonic formation that created Red Sea began 60 million years ago.</p> |
| <p>この小さなプレートが幾つも付着して出来た新しいプレートを今日ではアラビア楕状地と呼ばれています。その基盤となる岩石</p>                                                                                                                                                                                                                         | <p>The new plate, formed by many small plates attached to it, is today called Arabic shield. The rocks that form its foundation</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

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| <p>は、西半分では地上に露出しています。中央部の殆どと東部の全て地域では楕状地の基盤岩は、堆積岩起源の若い岩石に被われているので基盤となる岩石は、を見る事は、出来ませんが、地下深く埋まっています。</p> | <p>are exposed to the ground in Western Arabian Peninsula. In most of its Central part and all areas in its eastern part, the bedrock covered by young rocks of sedimentary origin, therefore its underlying rocks cannot be seen, but they are buried deep underground.</p> |
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| 2 堆積層の形成                                                                                                                                                                                                 | 2. Formation of sedimentary layers                                                                                                                                                                                                                                                                                                                                                                                                                                      |
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| <p>この時代のアラビア楕状地は、殆ど生物の住まない広大な不毛の平らな陸地であり、早期に出来た山や丘陵は、大きく侵食されていました。その侵食を受けた大地は、新しく多様な生物の営みで活気付いていた海中にゆっくりと沈んで行きました。およそ5億5千年前から7千年の間、地球上の全ての海面が切れ目無く上昇し続けました。</p>                                          | <p>Arabian Shield of this era was a vast barren flat land with almost no living organisms, and the mountains and hills that were formed early were greatly eroded. The eroded earth slowly sank into the sea, which was alive with new and diverse organisms. For about 550 million to 7,000 years, all sea levels on Earth continued to rise uninterruptedly.</p>                                                                                                      |
| <p>海面が上昇するに連れて、タブーク(تبوك)周辺の沙漠の半島（アラビア半島）西北部とイエメンを含む半島南西部の何ヶ所かの陸地を残すだけになるまで海面がアラビア楕状地の中へ中へと侵入して来ました。4億7千年前までにその浅い海は、数百メートルもの厚い層の砂と泥の混ざった堆積物を残して後退して行きました。アラビア楕状地は、この新しい堆積層に覆われ、その特徴は、地表では見られなくなりました。</p> | <p>As the sea level rose, the sea level penetrated into Arabian Shield until only a few pieces of land were left in Northwestern and Southwestern Arabian Peninsula, including Tabuk (تبوك) and Yemen. By 470 million years ago, this shallow sea had receded, leaving behind hundreds of meters of thick layers of sand and mud mixed sediments. Arabian Shield was covered by this new sedimentary layer, and its features were no longer visible on its surface.</p> |



(<https://www.scribd.com/presentation/356041706/Eras-Geologicas>)

アラビア楕状地が陸地として海面上に現れて間もなく、その西側の半分は厚い氷の層に覆われ、その為に地表に残された堆積物の多くは、その氷の浸食を受けました。地球規模の大陸移動がアラビア楕状地をかってないほど南へと運びました。カシム地方(منطقة القصيم)では氷河地帯の特徴であるティル(氷河によって運ばれ、堆積した未分級の堆積物)と言う古い堆積性の岩がそれを物語っています。氷河は、大地を削り、地表を覆っていた堆積物を岩屑、巨礫岩の河原やその他の氷河特有の残存物に変えてしまいました。

Shortly after Arabian Shield appeared on sea surface as a landmass, its western half was covered with a thick layer of ice, and much of its sediment left on its surface was eroded by this ice. Global continental drift has moved south beyond Arabian Shield. In Qasim region (منطقة القصيم), this glacial zone characteristic is tir (till) (ungraded sediments carried and deposited by glaciers). Its old sedimentary rocks speak for themselves. Glaciers have carved away earth and turned sediments that covered its surface into rock debris, boulder-

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|                                                                                                                                                                                                                                                                            | covered riverbeds, and other glacier-specific remnants.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 氷河が融けた後、大地は、以前とは全く様相が変わっていました。以前の平らな景観は、氷河で削られ、巨礫岩が雑然と転がり、谷底を砂利でおおわれた谷で引き裂かれていました。氷河から流れ出る水は、地球上で唯一の海洋であったテチス海へと河川を通じて排出されました。氷河地帯の東側に位置し、テチス海に至る地域では、河川の流れによって堆積物が浸食されました。沙漠の半島（アラビア半島）最南東部にあるオマーンのアフダル山塊(الجبيل الأخضر)の古い堆積岩は、昔の氷河作用を示すティルや縞模様のある巨礫岩等の氷河活動による特徴を持っています。 | After glaciers melted, earth was completely different from before. Its previously flat landscape was carved by glaciers, boulders rolled in a mess, and valley floor was torn apart by valleys covered with gravel. Glacial meltwater flowed into Tethys Sea, Earth's only ocean at that time, via river systems. In region east of glacial zone, leading toward Tethys Sea, sediments were eroded by flowing water. Old sedimentary rocks of Akhdar massif (الجبيل الأخضر) in Oman, located in Southeastern Arabian Peninsula, are characterized by glacial activity, such as till (tir) and striped boulders, which indicate ancient glaciation. |



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| アフダル山塊 | Akhdar Massif |
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(<https://que-faire.voyage/jebel-akhdar/>)

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| <p>時間と共にアラビア楕状地を含むゴンドワナ大陸は、極地からもっと暖かい緯度へ移動しました。氷河は、後退し、再び海面が北西部を除いてアラビア楕状地を覆いました。この第二回目の海水の浸入も厚い堆積層を跡に残しました。今度の堆積層は筆石類の化石をたくさん含む頁岩でした。今日では絶滅している筆石類は、5億5千年前から3億5千年前の海中で最も多く栄えた生物の一つでした。沙漠の半島が再び陸上に現れた時にはこの頁岩の層で地表が覆われていました。陸上に現れた時の一度目との違いは、湖、河川、海岸の近傍に緑が生えて来たことでした。シルル紀（408 - 438 百万年前）の植物生は浜辺地帯に先ずその生を適応しました。動物生がすぐにそれに続いて浜辺地帯に上陸しました。</p> | <p>Over time, Gondwana Continent, including Arabian Shield, moved from the poles to warmer latitudes. The glacier retreated, and again the sea level covered Arabian Shield except for the northwest. This second infiltration of seawater also left a thick sedimentary layer in its wake. This time the sedimentary layer was shale containing many fossils of brush stones. Graptolites, which are extinct today, were one of the most prolific creatures in the sea between 550 million and 350 million years ago. When Arabian Peninsula reappeared on land, the surface was covered with this layer of shale. The difference from the first time it appeared on land was that greenery grew near lakes, rivers, and coasts. Plant life in Silurian period (408 - 438 million years ago) first adapted to the beach area. Animals soon followed suit and landed on the beach.</p> |
| <p>沙漠の半島（アラビア半島）は、12回以上も海中に没し、そしてしばしば海上に現れ出てはいましたが、沙漠の半島は、陸上に現れている期間の二倍の長い期間に渡って、海中に没していました。陸地の塊は、海水面や構造地質とは無関係に、地中深いマントルの中の動きによって隆起したり沈下したりします。これは、プレートの変形でも造山運動でもなく陸地が大きな塊として静かに隆起する現象です。沙漠の半島は、この様にして隆起と沈下を何度も繰り返しました。</p>                                                                                                                | <p>Arabian Peninsula was submerged in the sea more than a dozen times, and often appeared at sea, but Arabian Peninsula was submerged in the sea for a period of twice as long as the period it appeared on land. Land masses are uplifted and subsided by movement in the deep mantle of the earth, independent of the sea surface and tectonic geology. This is not a plate deformation or orogeny, but a phenomenon in which the land quietly rises as a large mass. Arabian Peninsula repeatedly rose and sank in this way.</p>                                                                                                                                                                                                                                                                                                                                                    |

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| <p>約 3 億 7 千 5 百年前にも同じ様な現象が起きました。海面の高さが一定であるのにアラビア半島が乾いた陸地として一度に海中から隆起しました。次に続く時代から残っている顕著な地質学的特徴としては、トゥワイク山脈がルブア・ハーリー沙漠(الربع الخالي)の砂丘に没するその最南端に広がる多くの花崗岩の巨礫岩地層があります。この巨礫岩の大きさは様々で大きいのは径が 1.5m に達します。それらの巨礫岩が出来た源となったと思われる最も近い花崗岩の露頭まで数百キロメートルも離れていて、それは、現在のイエメン領内になります。</p> | <p>Similar phenomenon occurred around 375 million years ago. Despite stable sea level, Arabian Peninsula suddenly rose from ocean as dry landmass. Prominent geological feature from following period is extensive granite boulder formation at southernmost tip of Tuwayq Mountains, where range sinks into sand dunes of Rub' al Khali Desert (الربع الخالي). Boulder sizes vary, largest reaching diameter of 1.5 meters. Nearest granite outcrop, considered origin of these boulders, lies several hundred kilometers away, within present-day Yemen.</p> |
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| <p>ムンダファン(المندفن)の北部<br/>(トゥワイク山脈南端のビデオの切り抜き)</p> | <p>Northern part of Mundafan (المندفن)<br/>(southern end of Tuwayq Mountains)</p> |
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(<https://www.tiktok.com/@.g5p5/video/7289123954210458887?language=en>)

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| <p>アラビア半島は、この過程の最終段階で、再び南の低緯度地域へと運ばれ、極地の氷河が半島南部に広がりました。この地域で発見された花崗岩の巨岩には、氷河の運搬中に通常形成される典型的な条線や溝が欠けています。これらの巨岩は、氷河の北進中に運ばれたか、落下石として堆積したと考えられています。落下石とは、氷河の氷床に凍り付いた、または氷河に埋め込まれた岩片で、氷が溶けるにつれて地面に落下します。オマーンでは、涸れ谷ダイカなどの涸れ谷床に活発な氷河作用の証拠が残っており、氷河に埋め込まれた巨岩が平らな岩盤に最大 1 メートルの深さの平行な溝を刻み、涸れ谷の谷底で見ることができます。</p> | <p>Arabian Peninsula, in final phase of this process, was again transported southward to lower latitudes, where polar glaciers extended over southern part of peninsula. Granite boulders found in region lack typical striations or grooves usually formed during glacial transport. These boulders are thought to have been carried during northward advance of glacier or deposited as dropstones. Dropstones are clasts frozen into glacial ice sheet or embedded within glacier, which fall to ground as ice melts. In Oman, evidence of active glaciation remains in wadi beds such as Wadi Daiqa, where boulders embedded in glacier carved parallel grooves up to one meter deep into flat bedrock, visible on wadi floor.</p> |
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| <p>涸れ谷ダイカ(وادي ضيقة)の河原 (オマーン山脈 (ハジャール山脈(خبال الحجر)) のカラタ氷河堆積物等)</p> | <p>Wadi Daiqa (وادي ضيقة) riverbed (Al Khlata glacier deposits in Oman Mountains (Hajar Mountains (خبال الحجر)), etc.)</p> |
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(<https://www.lyellcollection.org/doi/full/10.1144/sp392.15>)

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| <p>二畳紀（245 - 290 百万年前）には厚い幾重もの砂岩層が形成されました。今日ではその殆どが浸食を受けて残っていません。僅かに今でも残っている場所では、これらの砂岩層には大きな化石が殆ど見つかってはいませんが、地層の岩石見本に含まれる孢子の化石を顕微鏡で分析し、時代を考証できます。</p>                                                                      | <p>During Permian period (245 – 290 million years ago), thick layers of sandstone were formed. Today, most of them have been eroded and have not remained. Although few large fossils have been found in these sandstone formations in the few places that still remain, the fossils of spores contained in the rock samples of the strata can be analyzed under a microscope to verify the age.</p>                                                                                                                                                                 |
| <p>二畳紀の最後に沙漠の半島が再び海中から隆起するに連れて植生と動物生の大規模な絶滅の時が訪れました。この隆起の時には沙漠の半島は、白い石灰岩でおおわれていました。二畳紀の絶滅は、古生代（245 - 570 百万年前）の終わりの区切りとなりました。この時に多くの種が除去され、地球上の生態系が回復した時には随分と異なった生物が生息していました。それまで海中では圧倒的に多かった三葉虫は僅かな残存種を残すのみと成ってしまいました。</p> | <p>At the end of Permian, the time came for a large-scale extinction of vegetation and fauna as Arabian Peninsula rose out of the sea again. At the time of this uplift, Arabian Peninsula was covered with white limestone. Permian extinction marked the end of Paleozoic era (245 – 570 million years ago). At this time, many species were removed, and when Earth's ecosystem was restored, there were very different organisms living there. Until then, trilobites, which had been overwhelmingly abundant in the sea, left only a few remaining species.</p> |
| <p>中生代（65 - 245 百万年前）を通じて地球上の海面は、上昇し、白亜紀（65 - 145 百万年前）の終わりには、もっとも海面が高くなり、この時代の殆どの間、沙漠の半島は、浅い熱帯性気候の海に沈んでいました。最初に砂岩と頁岩の間に薄い石灰岩の層が挟み込まれたが、やがて非常に厚い石灰岩の層が形成されました。それらが今日トゥワイク崖地(جبال طويق)の石灰石の露</p>                            | <p>Sea levels on Earth rose throughout Mesozoic era (65 – 245 million years ago) and reached their highest level at the end of Cretaceous period (65 – 145 million years ago), and for most of this era was submerged in the sea with a shallow tropical climate. Initially, a thin layer of limestone was sandwiched between sandstone and shale, but over time a very thick layer of limestone was formed. They</p>                                                                                                                                                |

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| 頭に良くみられる岩礁の特徴を持つ熟成した多くの化石です。 | are the many mature fossils with the reef features commonly found in the limestone outcrops of Tuwaiq Cliffs (جبال طويق) today. |
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| リヤードの西、トゥワイク山脈の石灰岩の露頭に現れている白亜紀のアンモナイトの化石、人物は、当時のサウジ人運転手です。（撮影：高橋） | A fossil of a Cretaceous ammonite appearing on a limestone outcrop in Tuwaiq Mountains, west of Riyadh, is my Saudi driver of the time. (Photo: Takahashi) |
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| 最も初期の海進は、一般的にアラビア半島西部の最深部まで達したと考えられています。カンブリア紀（510 - 570 百万年前）およびその他の古生代堆積層は、アラビア半島の南部と北部の両方で紅海に最も近い位置にあります。これらの古生代堆積層の痕跡は、その後の多くの地質時代における継続的な侵食により、アラビア楕状地中央部では確認されていません。後期古生代および中生代堆積層は、アラビア半島中央部を 1000 キロメートル以上にわたって弧状に広がり、おそらく北部と南部の露頭を結 | Earliest marine transgression is generally believed to have reached deepest into western part of Arabian Peninsula. Cambrian (510–570 million years ago) and other Paleozoic sedimentary layers are closest to Red Sea in both northern and southern parts of Arabian Peninsula. No traces of these Paleozoic layers are found in central Arabian Shield, due to continuous erosion through many subsequent geological periods. Late Paleozoic and Mesozoic sedimentary |
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| <p>ぶ線よりも西に広がっています。アフイフ (عفيف) 近郊、リヤド(رياض)・メッカ(مكة)間の旧道路沿いでは、これらの層は最も近い中生代海成堆積物から西に 200 キロメートルの位置にあります。</p>                                                                                                                   | <p>layers form arc stretching over 1,000 kilometers across central Arabian Peninsula, likely extending farther west than line connecting northern and southern outcrops. Near Afif (عفيف), along old Riyadh (رياض) –Mecca (مكة) road, these layers lie 200 kilometers west of nearest Mesozoic marine deposits.</p>                                                                                                                                                                                                                              |
| <p>トゥワイク崖地から、陸地は徐々に東に向かって傾斜しています。崖地とダフナー砂丘帯(الدنهء)の間に露出した岩石は、時折見られる海成起源の薄い砂岩層を除けば、ほぼ全てが石灰岩で構成されています。この石灰岩層は、ジュラ紀（145 - 208 百万年前）から白亜紀にかけて連続的に堆積した 10 の明確な層で構成されています。東向きの地形傾斜と侵食作用により、各層は短い距離であっても、より若い地層に覆われる前に地表に露出します。</p> | <p>From Tuwayq escarpment, land gradually slopes eastward. Except for occasional thin sandstone beds of marine origin, exposed rocks between escarpment and Dahna dune belt (الدنهء) consist almost entirely of limestone. This limestone sequence comprises ten distinct layers deposited successively from Jurassic (145–208 million years ago) into Cretaceous. Eastward tilt of terrain, combined with erosional effects, causes each layer to be exposed at surface before being overlain by younger strata, even over short distances.</p> |



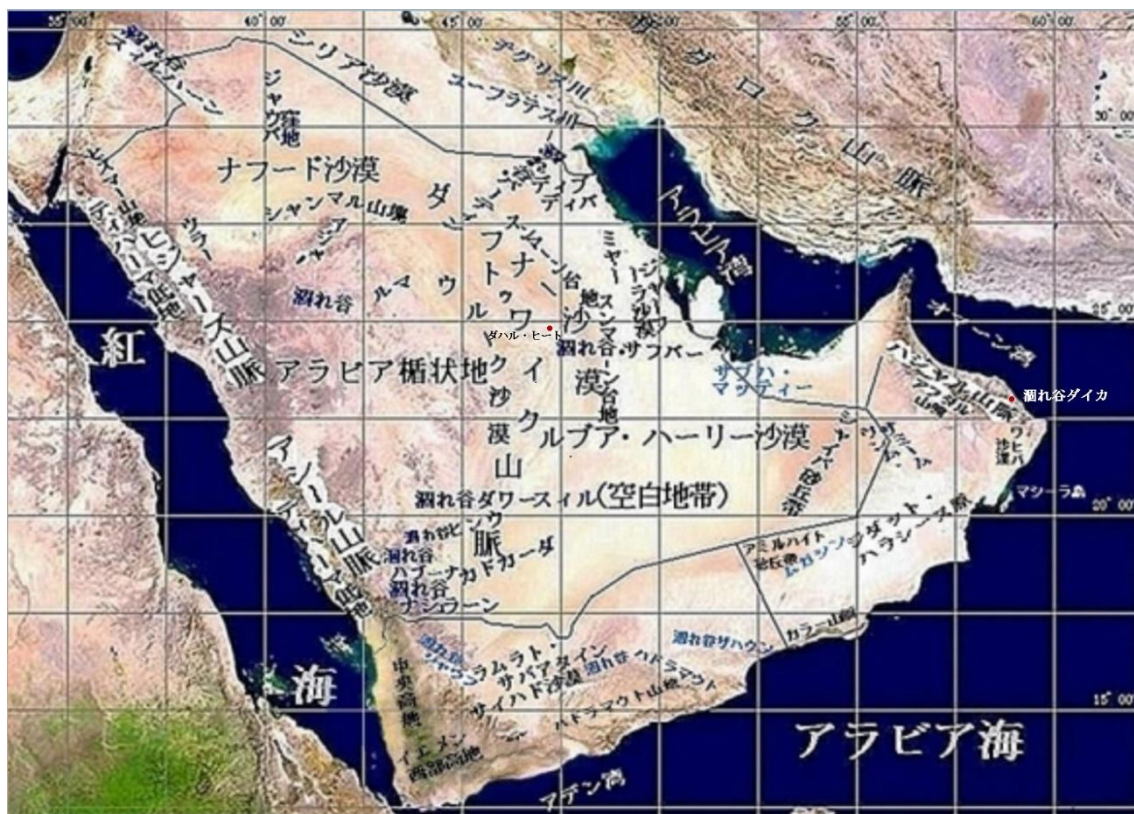
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| 鍾乳洞ダハル・ヒートの入り口（撮影：高橋） | Entrance to Dahl Hit (a limestone cave)<br>(Photo: Takahashi) |
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| <p>石灰岩の著しい例外は、ハルジュ(خرج)からリヤード(رياض)への途中の鍾乳洞ダハル・ヒート(دحل هيت)で、ここでは、地表に無水岩と呼ばれる蒸発岩が見られます。</p> <p>(注：ダハル・ヒートは、ハルジュ南80km 付近にもありますが、そちらではありません。) この真珠のような灰色の岩には少し暗いシミが付いています。このシミが 1938 年に ARAMCO の地質学者がタールのシミとして沙漠の半島で始めて発見した油兆であり、半島東部の油層を解読する為の重要な鍵と成りました。東部州でこの層を掘り下げて、この国の莫大な原油埋蔵の最初の出油がありました。</p> | <p>A notable exception to limestone is Dahl Hit (دحل هيت) (a limestone cave) between Kharj (خرج) and Riyadh (رياض), where evaporites called anhydrous rocks can be found on surface. (Note: The another Dahl Hit is also located near 80 km south of Kharj, but not subject one, here.) This pearly gray rock has a slightly dark stain. This stain was the first oil sign discovered by ARAMCO geologists in 1938 as tar stains on Arabian Peninsula, and became an important key to deciphering the oil reservoir in Eastern Arabian Peninsula. Digging into this layer in Eastern Province,</p> |
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|                                                                                                                                                                                                                                                                                   | there was the first oil release of this country's huge crude oil reserves.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| アラビアの多くの油田がジュラ紀地層に含まれ、トゥワイク崖地とリヤードの間に露出している石灰岩は、この無水岩より少し古い。地層が東に行くに連れて深く埋まり、増大した圧力と温度がゆっくりと石灰岩を変化させ、油を析出させました。この油は、後に沙漠の半島（アラビア半島）がアジア大陸とぶつかり圧縮されて岩が褶曲した背斜構造の下部に貯留しました。イラク南部やイラン南部の油田も同じ時代の似たような褶曲に存在しています。このアジア大陸が沙漠の半島と衝突して出来た褶曲に世界の原油資源の半分近くが埋蔵されています。                        | Many of Arabia's oil fields are included in Jurassic Formation, and Limestone that is exposed between Tuwaiq Cliffs and Riyadh is a little older than this anhydrous rock. As these strata moved eastward, they were buried deeper, and increase their pressure and temperature slowly changed limestone and precipitated oil. This oil was later stored in lower of anticlinal structures, where Arabian Peninsula collided with Asian Continent and compressed, causing rocks to fold. Oil fields in Southern Iraq and Southern Iran are also present in similar folds of same era. Nearly half of world's crude oil resources are buried in folds formed by collision of Asian Continent with Arabian Peninsula. |
| 中生代の終わりが近づくに連れて、デボン紀（360 - 408 百万年前）と同じ様に半島中央は、隆起してきました。海岸線は、陸地が隆起する前に後退し東へと移って行きました。それ以来、海岸線が内陸奥深くまで進入することは、ありませんでした。海岸線は、これ以降も上昇下降を繰り返し、その連続的な動きの中で現在の沙漠の半島東部の土地が何度も水没する事がありましたが、海岸線が現在のダフナー砂丘帯を越えて、更に、西に侵入することは、ありませんでした。沙漠の半島の中央部および西部は、これ以後も浸食作用と削剥作用を受けてはいませんが、海生の堆積層は、無く、古 | As Mesozoic era approached to its end, Central Arabian Peninsula was uplifted, just like Devonian period (360 - 408 million years ago). Its coastline receded and moved eastward before its land mass was uplifted. Since then, its coastline has never penetrated deep inland. This coastline continued to rise and fall repeatedly after this, and in continuous land movement in Eastern Arabian Peninsula in present-day desert was submerged many times, but its coastline did not cross current Dahna dune belt and invade further west. Central and western Arabian Peninsula have been subjected to erosion and erosion since                                                                               |

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| い岩層から陸生の堆積層が形成された特異な地域と成っています。 | then, but there are no marine sedimentary layers, and it is a unique area where terrestrial sedimentary layers have formed from old rock layers. |
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| 付属資料（第 2 章関連する地勢図） | Attached materials (Topographic map related to Chapter 2) |
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第 2 章関連地勢図

