Did the Ancient Mesopotamian Royal Stone Originate in Oman?

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Abstract
Royal statuary of the late third and early second millennia BC is often sculpted from „diorite“. But closer examination of the stone reveals that more correctly both diorite and gabbro are manifest. Royal records indicate a source for the „dark stone“ of the statues in Magan/Makkan. This is locatable in south-east Arabia, especially the present-day Sultanate of Oman but also in south-west Iran (Potts 1986: 271-285). Samples of „diorite“ statues are compared with petrological samples from the Sultanate. The stone of the royal statues need not be exclusively from here since sources closer to Sumer and Akkad exist in Iraq and Iran, although some correspondences are clear between the stone of certain statues and the samples available in the Sultanate.

Introduction
Traditional Oman, that is the United Arab Emirates and the Sultanate of Oman, 4000 years ago was known to the Sumerians as Magan and subsequently to Akkadian speakers as Makkan (Figure 1). Parts of south-western Iran once also belonged to this land. Cuneiform texts reveal the existence international exploitation and trade which began some time prior to 3500 BC (Englund 1983: 35).

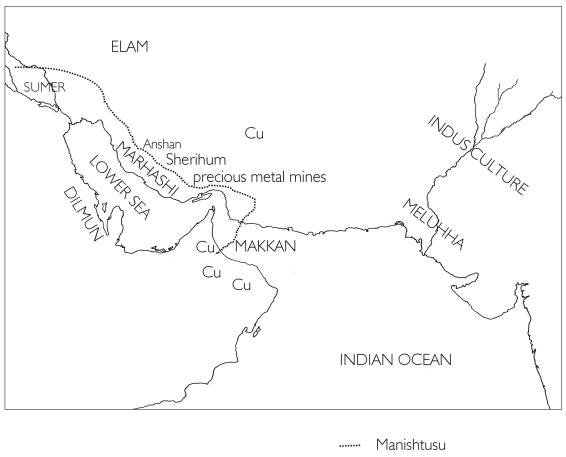

Fig. 1 The “Lower Sea” and route of Manitusu.

The ancient Mesopotamian traders and rulers were not interested solely in the copper for which Magan/Makkan at that time was preeminent. Various manufactured objects and raw materials were traded from there often by way of Dilmun before reaching Sumer and Akkad in southern Mesopotamia. Export items included livestock, furniture, and boats. The buyers were only partly aware of the ultimate points of origin of these goods to judge from the names they gave them, especially wooden objects and animals. The traders may have kept this information secret in order to discourage unwanted competition. Traders in spices and aromatics around the time of Christ similarly kept the sources of their wares secret. Historians differ as to whether the Mesopotamian traders themselves really mastered the trade or relied more on foreign ships and traders from distant ports.

[1] Yule contributed the archaeological part of the article and Guba the geological one. The names are written without diacritics. credit line: Figs. 1-3 (P. Yule); Fig. 4a=A01. 4b=Sb49. 4c=Sb20. 4d=A03. 4e=A05. 4f=A08. 4g=A020164. 4h=A03 from the Musée du Louvre (P. Yule). Figs. 5-18 (I. Guba). Published in Adumatu 4, 2001, 41-52.

Rulers from the time around 2300-2000 BC recount the procuring in Magan/Makkan in the „Lower Sea“ (Heimpel 1987a: 22-91) of a beautiful, obdurate, dark stone suited for the fashioning of their personal likenesses . This stone (^{na4}esi/usu) is usually translated by modern writers as "diorite", a much sought-after stone also in Egypt for pharaonic statues.

Manishtusu‘s campaign and the „dark stone“

On his accession to the throne, one of the Akkadian kings, Manishtusu, mounted a military expeditionary force to put down a general insurrection especially in the outlying parts of the empire. First he successfully besieged Anshan (modern Tall-i Malyan), one of the traditional dual capitals of Elam, a feudal state in early Iran. He continued to a place called Sherihum, perhaps toward the south. It was in his interest to travel as much as possible by ship. Having crossed the „Lower Sea“ and awaiting him on the opposite side was a coalition of 32 Makkanite "cities" which he vanquished, capturing the king "Manitan". But there is a break in the clay tablet which contains this information, obscuring the sequence of events. A river is mentioned. Rivers are, however, atypical of the geography of southeastern Arabia. But between Bandar-i Bushire in the Fars and the straits of Hormuz several rivers, however, exist which Manishtusu may have been referring to.

He mentioned mines *(ḫu-rí kù)* in connection with his field campaign which usually are taken to refer to the copper mines of Makkan in south-eastern Arabia (Gelb/Kienast 1990: 176 line 29). But the signs of the inscription actually refer to mines for precious metal, especially silver, rather than to copper mines. While gold and silver occur only as trace elements in the northern part of the Sultanate, an occurrence in more massive form in the Fars and in Kerman in Iran is proven. On the other hand in today in Oman gold is extracted electrolitically from copper ore (for example at Raka): this is possible only by means of modern technology. With regard to gold, silver, and "diorite", it is clear that the mineralogy of south-western Iran differs from that of south-eastern Arabia, despite a common origin for the mountains of both areas. Manishtusu does not mention Makkan by name in connection with the mines. Instead the passage, "...as far as the mines of gleaming metal he seized", refers more probably to Fars than to Oman. Manishtusu is more clear about the source of the royal stone "diorite" beyond the „Lower Sea“ (line 32-36). But scholars require more definite information as to how and where the dark stone was procured.

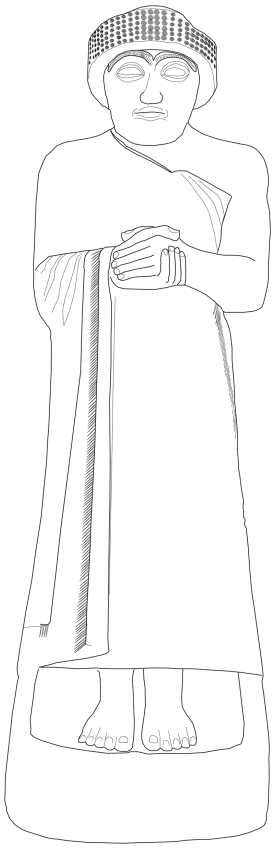

Fig. 2 “Diorite” sculpture of king Gudea, Musée du Louvre.

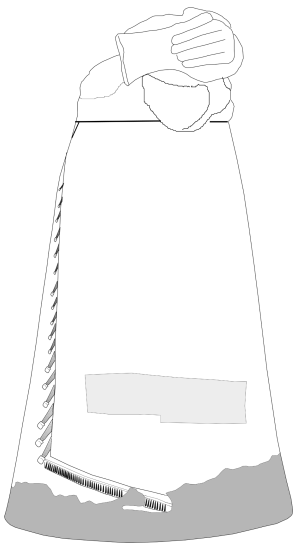

Fig. 3 “Diorite sculpture of king Manistusu, Musée du Louvre.

In order to source this stone, in 1982 Wilhelm Heimpel took samples of some of the statues in the Louvre of Gudea and other ancient Mesopotamian rulers (Figures 2 and 3) for mineralogical analysis (Heimpel 1982). These pieces were inscribed with the ancient name of the stone of which they were fashioned (in

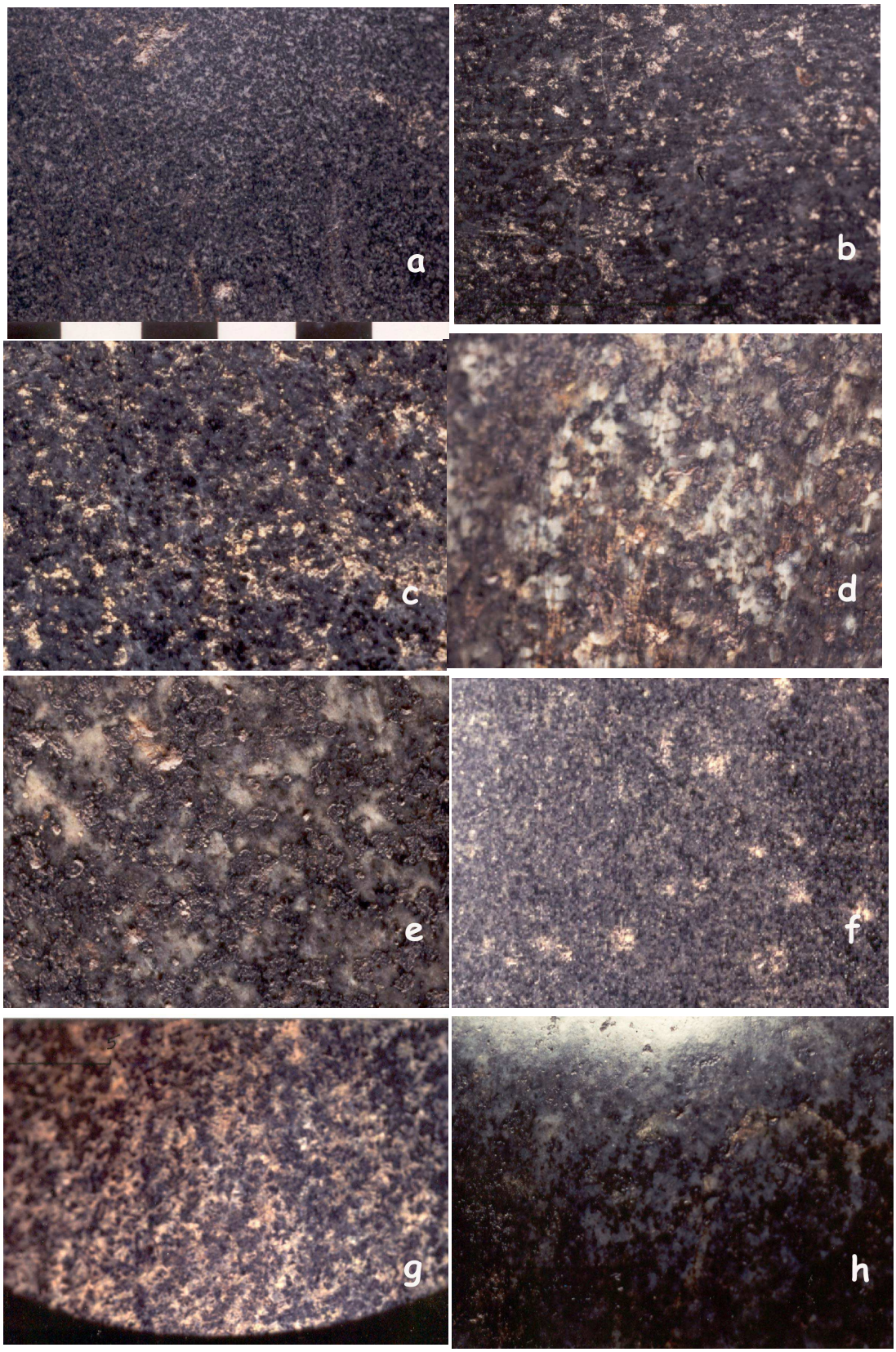

Fig. 4a-h Detail photos of “diorite” statues in the Musée du Louvre.

Akkadian ^{na4}*ushu*). As with most ancient names of stones, the name of this dark one derives primarily from its colour. But geologists point out that the exact identification with modern stones is difficult without turning to physical methods of measurement.

Sourcing „Diorite“

Heimpel relies on D. Loftus for the mineralogy of Oman who suggests that Oman has no deposits of true "diorite" which could produce blocks large enough for the statues of Gudea (Heimpel 1982: 67 n. 24). Indeed, some of the royal statues are over lifesize. While there are deposits of diorite around Samad al Shan near the copper mines, their importance in the question to import is open to question (see below). I.S.E. Carmichael opined that the thin sections of the four statues from the Louvre which Heimpel tested revealed a stone which was from the "same geological intrusion or set of intrusions" (Heimpel 1982: 65). As an alternative to this source he mentions deposits of diorite and gabbro 50 miles north north-east of Bandar Abbas. Stone quarries which were used exclusively in the third millennium BC are not known. One reason is that they presumably were not very large. Their traces also can be obscured by later mining. Deposits of diorite occur in the Hajjar mountains from Ibra to Khor Fakkan. From here large blocks could be transported to the sea. Recently the dark hard stone has been commercially exploited in the latter area.

Lingering doubts about the validity of the identification of the source of the "diorite" of the royal statues impelled Yule some years later to visit the Louvre, which houses the largest collection of "diorite" statues. Photographs of 25 such statues show that the stone varies significantly from statue to statue (cf. Figure 4). The crystals may be large or small, hard or soft, or may show distinguishable impurities. Some pieces show a higher percentage of white crystals, some less. The same statue (cf. Figure 4d and 4h) can vary in darkness and crystal size. Some of the Statues which Heimpel tested show similarities and differences which (as he writes) for provenance purposes cannot be evaluated with the naked eye (especially the statues Sb49, Sb51, Sb15565). But marked differences in the stone suggest it was not quarried it from a single source but rather from a variety of places.

But the documentation of the stone of the statues reveals the problem to be more complicated than one might have assumed at first glance. Since several of the samples collected in the Sultanate in fact do resemble those of the statues in the Louvre, the dark stone of Oman is a possible source for some of them. Correspondences occur between certain of the stones used for the statues and samples collected in the Sultanate of Oman. Those from Khor Fakkan in fact resemble closely those of the material of certain of our samples from the Louvre[2]. While Khor Fakkan would be a more convenient place for the transport to the coast, in itself this is not a ground to exclude other more distant sources, such as those at the southern end of the the Wadi Samail. Although copper in quantity was exported from here to the coast, this cannot be used as an argument for the exposrt of large blocks of „dark stone“ (see below).

2 Fig. 4a cf. Fig. 7, 13, 18 right; Fig. 4e cf. Fig. 16; 4f cf. Fig. 14.

Inv. no.	Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Sb49	Manishtusu	●						●									
Sb51	Manishtusu	●										●					
Sb15565	Akkadian ruler, base																
Sb2	Akkadian victory stele	●							●		●						
Sb11387	Stele of Sargon													●			
AO26647	Gudea	●				●			●								
Sb47	Manishtusu standing		●					●		●							
AO2	Gudea, with Plan	●			●				●				●				
Sb52	Naram Sin, base														●		
Sb20	Manishtusu obelisk								●		●				●		
Sb3	Akk. victory stele			●		●	●		●		●						●
Sb1	Stele of Sargon														●		
AO3293	Gudea, Ningeszida		●		●			●									
AO3	Gudea, dedicated to Girsu			●			●										
AO7	Gudea, dedicated to Ningirsu		●			●	●										
AO4	Gudea, dedicated to Ba'u				●		●										
AO8	Gudea, dedicated to Ninhursag	●			●				●								
AO12	Gudea, shaved head			●		●	●						●				
AO13	Gudea, head	●				●			●		●						
AO6	Gudea, dedicated to Ba'u			●			●						●			●	
AO5	Gudea, dedicated to Inanna			●			●			●		●	●				
AO29155	Gudea, anepigraphic	●							●	●	●						
AO1	Gudea, colossal		●		●		●										
A09	Ur Ba'u														●		
AO20164	Gudea anepigraphic		●		●		●										

Description of the stone used for the royal statues

Key for the description of the stone

1 grain small
2 grain middle
3 grain large
4 grain precise
5 grain soft
6 much white
7 medium white
8 little white
9 irregular veins
10 very dark
11 rough surface
12 heterogeneous structure
13 sample taken
14 structure not visible
15 yellowish
16 brownish

What is ”diorite”? What is ”gabbro” ?
The stones used for the Mesopotamian statues are often classified as ”diorite” according to their mineral constituents. A diorite is a member of the family of „igneous” rocks – those deriving from fire. Igneous rocks crystallized from a silicate melt, known as a magma. The high temperatures (900 to 1000 degrees C) needed to generate liquid rock suggest that the source of magmas lies tens of kilometres below the earth’s surface. A magma is principally made up of oxygen, silica, aluminum, iron, calcium, magnesium, natrium and kalium, together with gaseous components. There are two major groups within the igneous rock family: Extrusive or volcanic rocks, and intrusive or plutonic rocks. The first group includes those the magma of which reached the earth’s surface in a molten or semi-molten state. It cooled rapidly with the result that the size of the crystal components is generally small. The rocks of the second group are the result of crystallization of a magma that did not reach the earth’s surface, so it cooled slowly, and resultingly the mineral crystals are larger in size.

If the original magma is fairly low in silica dioxide, the resulting rocks contain mainly minerals such as olivine, pyroxene, hornblend, or biotite, with little or no free quartz. These rocks tend to be dark because of their high percentage of ferromagnesian minerals. On the other hand, crystallization of a melt high in silica dioxide results in rocks with abundant quartz and alkali feldspars. They are lighter in overall colour. Between these two extremes – dark and light rocks – there are wide variations of igneous rocks in colour, mineralogy, and texture.

There is a complete gradation from one rock type into another, so the names of igneous rocks and the boundaries between types, are largely arbitrary!
So where do ”diorite” and ”gabbro” fit into this classification? Both are plutonic granular rocks characterized by plagioclase feldspar of whitish or greyish tone, but lacking quartz. The dark minerals are either hornblends or pyroxenes. If the plagioclase feldspar is more calcic in composition (but still white in colour), then the rock is called a gabbro. Although the distinction between diorite and gabbro is based on this criterion alone, most gabbros contain olivine.

Are ”diorite” and ”gabbro” present in Oman?
The Hajar Mountains, stretching in an arc-shaped parallel to the coast all over northern Oman, are famous for their ”Oman ophiolite” or ”Samail ophiolite nappe”. These are huge masses of igneous rock which were thrust from a northern sea-floor-spreading centre onto the continental margin of Oman 65 million years ago. In the field, ophiolite is easily identified by its massive unlayered appearance and the dark, sombre tone.

Gabbro, with or without olivine, makes up a very large part of the ophiolite. This rock is found in many varieties: It can be quite dark, with only a few white feldspar minerals; it may contain 50% black and 50% white minerals; it may consist of a high percentage of large white minerals, so that the entire rock appears whitish in colour (”pegmatitic” gabbro). Also, black and white minerals might be equaIly distributed (”isotropic” gabbro), or arranged in stripes and zones (”layered” gabbro).

”Diorite” also occurs within the ophiolite, that means the feldspar tends to be oligoclase to andesine. The outcrops of diorite from Wadi Andam to Ibra and on Masirah Island are well known.

As ”diorite” and ”gabbro” grade into each other and differ only very little in the chemical composition of their minerals, they may resemble each other in colour, texture and overall appearance.
The rock ”granodiorite” or ”quartz diorite” contains visible grains of whitish-grey quartz, but in terms of colour and texture these rocks closely resemble a gabbro or diorite. Granodiorite occurs in small amounts within the nappes in Masirah; but major outcrops of geologically different age and origin are found in Jebel Ja’alan as well as at Mirbat in the south province Dhofar.

Are the Mesopotamian statues made from rock from Oman?
To be really certain whether the Mesopotamian statues are made from real ”diorite” or from the look-alike gabbro, one would need to remove samples from the statues and analyse them chemically, petrologically and mineralogically. But this cannot be done, because it would mean injuring these works of art. Thus the only other way to determine the type of rock of the statues is by visual examination and some physical tests, for example hardness tests of the minerals, which can be carried out without violation of the sculptured surfaces.

There is no doubt, that the ”diorite” of the Mesopotamian statues, which looks like gabbro, might be identical with gabbro in terms of petrology and mineralogy, and therefore might originate from the Samail Ophiolite in the Hajjar Mountains.

But another very important factor plays a ro1e: to produce life-size statues, which, until present times, show not a single crack, fissure or wear-and- tear caused by weathering, one must extract a massive, fresh, unfractured and unweathered huge block of rock from the mountains.

By virtue of their origin as rocks of a thrust sheet, all the ”diorites” and ”gabbros” of the Oman ophiolite are highly tectonized, that means they suffered enormous stress of millions of years, which left them fractured, sheared and shattered. In addition to that, they were exposed to intensive chemical alteration (serpentinization) caused by thermal waters penetrating the rock. That means, it might have been quite difficult in ancient times (and still is difficult today) to find fresh, solid, massive, unweathered as well as unfractured big blocks of rocks in the ophiolite mountains.

To be able to extract a big block of fresh rock from the mountains, one would need to apply sophisticated mining and quarrying methods: First the weathered and fractured overburden waste material must be removed. Having reached the more or less fresh rock, extracting methods must be applied to separate the block from the rest of the rock mass. This would leave a large hole in the surface of the mountain. Then, the block must be transported to the coast and loaded on a ship.

For both quarrying and transporting activities no evidences have been found yet in Oman. Though mining and processing of copper ore have been going on in Oman for many thousand years, the extraction methods of the two materials, copper and big blocks, are different and require different approaches and skills.

But nonetheless, the problem of the transport of big blocks could have been diminished, if the rock were taken from a cliff near the sea. There are several places in ancient Oman, where this could have taken place; In the area of Khor Fakkan, where the gabhro cliffs are close to the sea, on Masirah, where the southern part of the island exposes c1iffs of relatively fresh rock, in Mirbat, where the quartz diorite and the granodiorite form a more than 60 km 1ong coastline, and on the Hallaniyah Is1ands, which consist to a great extent of suitable igneous rocks.

Do ”diorites” and ”gabbros” exist in neighbouring countries’?

The Zagros-Taurus Mountains, which stretch along the Gu1f coast from the SE to the NW from Iran through northern Iraq and on into Turkey, contain igneous rocks of all variations. Diorites are well known from northern Iraq. The rocks there are less fractured than the ones in Oman, because they suffered less from tectonic movements. The *locus typicus* of ”diorite” lies

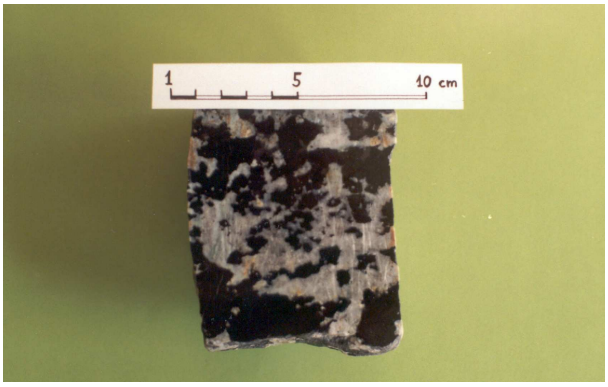

Fig. 5. ”Pegmatitic” gabbro with very large crystals of black iron-rich minerals and white feldspars. This cut and polished piece is from the area of Sinsilah/Sharqiyah.

Fig. 6. This rock looks almost like a granite, but the chemical composition of the minerals shows that it belongs to the gabbro family. Besides the white and black minerals it also contains pink crystals of zoisite (thulite), which is a valuable gemstone. This piece, cut and polished, derives from the Wadi Andam.

in southern Egypt near a place cal1ed ”Diorita”. From here all of the fresh rock used for pharaonic buildings was quarried.

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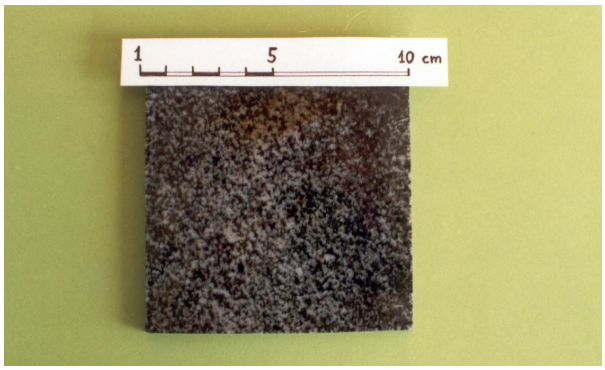

Fig. 7 Gabbro is the classic textbook type. All over the world it is used for decorative floor – and wall tiles. Oman has enormous deposits of this ”isotropic” gabbro, but it is not yet mined. This cut and polished tile from the Samail ophiolite was tested at the Department of Petroleum, Mining Engineering, College of Engineering/Sultan Qabus University, and was found to be of excellent quality, and suitable for sculpting purposes.

Fig. 8. ”Layered” gabbro shows black and white minerals arranged in zones or along lines. This cut and polished piece comes from Wadi Mansah.

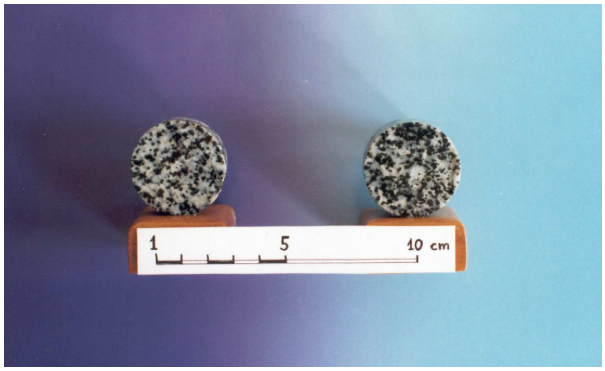

Fig. 9. Gabbro, when mined as fresh rock from the mountains, is a beautiful stone to which sculptors have been attracted since ancient times. These lovely pieces occurred at Khor Fakkan, where the ophiolite cliffs are close to the sea.

Fig. 10. The gabbro of Oman was, by virtue of its origin, affected by hydrothermal waters, which led in some parts of the rock to an alteration of its original minerals. The light brown minerals in this gabbro from Samail result from ”rusting”, that means the oxidation of iron-rich minerals.

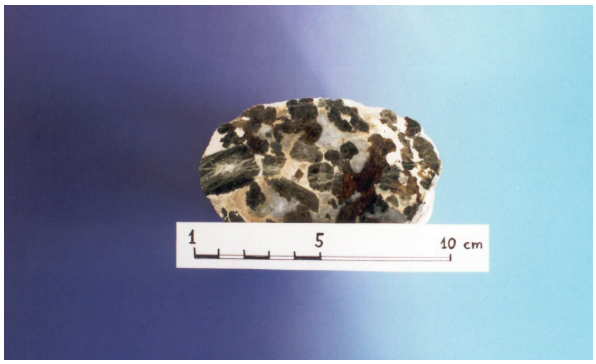

Fig. 11. This ”pegmatitic” gabbro appears to be illuminated from the inside. It derives from the ophiolite mountains near the Wadi Andam where it occurs in zones within the medium-grained gabbro.

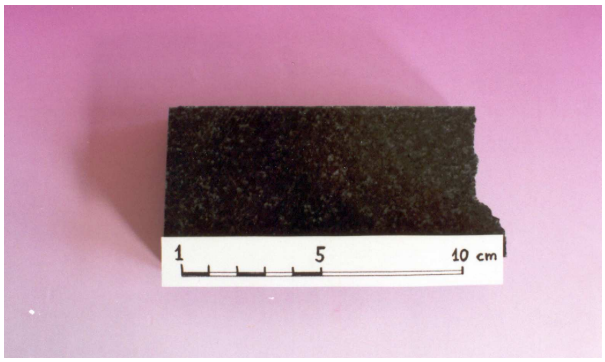

Fig.12. The percentage of white feldspars in a gabbro may be rather small, so that the stone is almost black. This cut and polished slab heralds from the Samail ophiolite near Fanja.

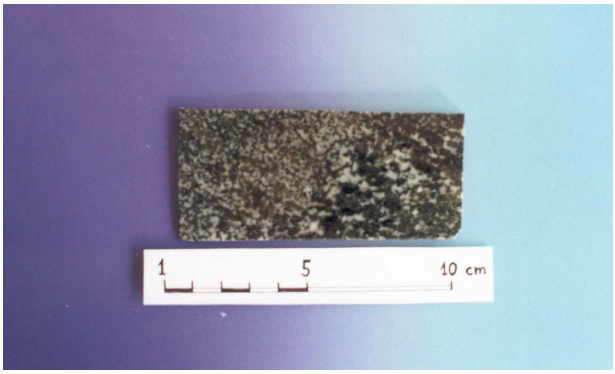

Fig. 13. The grain size of the white feldspars and the black pyroxenes may change locally. This cut and polished tile from Khor Fakkan shows small crystals in the left part and medium to coarse grains in the right part.

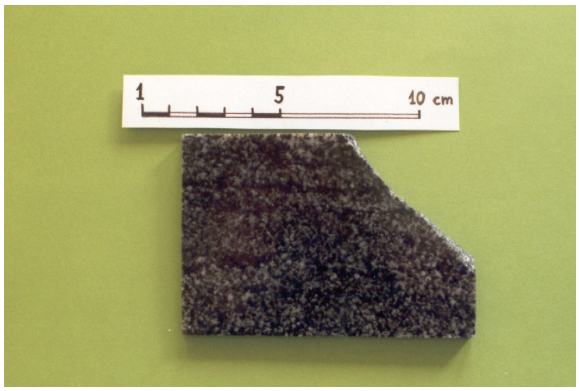

Fig. 14. Cut and polished slab from Khor Fakkan which shows a slight ”layering” of the black minerals.

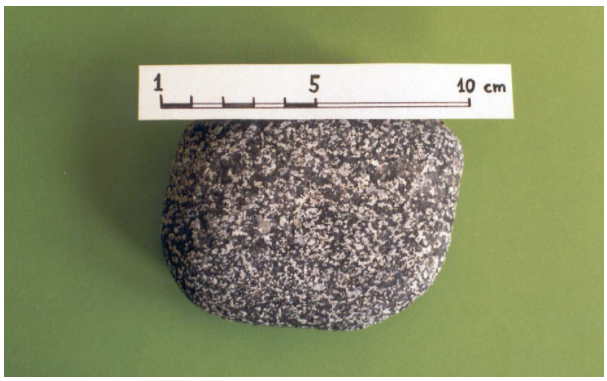

Fig. 15. Classical textbook gabbro from the Samail ophiolite. Black and white minerals have about the same size and are distributed equally (”isotropic” gabbro) throughout the rock.

Fig. 16. Though this rock resembles granite, it belongs to the gabbro family, because the white minerals are not quartz, but calcic plagioclase feldspars. The originally black iron-rich minerals have ”rusted”, that is have oxidized. This specimen is a water-worn pebble from the Wadi al Khod.

Fig. 17. Very dark and fine-grained gabbro can change to coarse-grained ”pegmatitic” light-coloured gabbro locally. This phenomenon results from peculiarities of cooling and variations of gas pressure in the magma.

Fig. 18. These two pieces of gabbro show great variations in the percentage of black and white minerals, Though they differ completely, both belong to same type of gabbro rock within the Samail ophiolite.

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