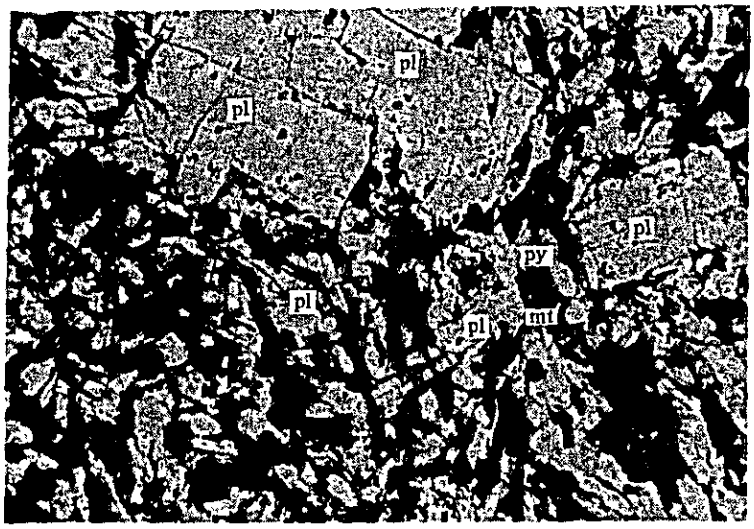
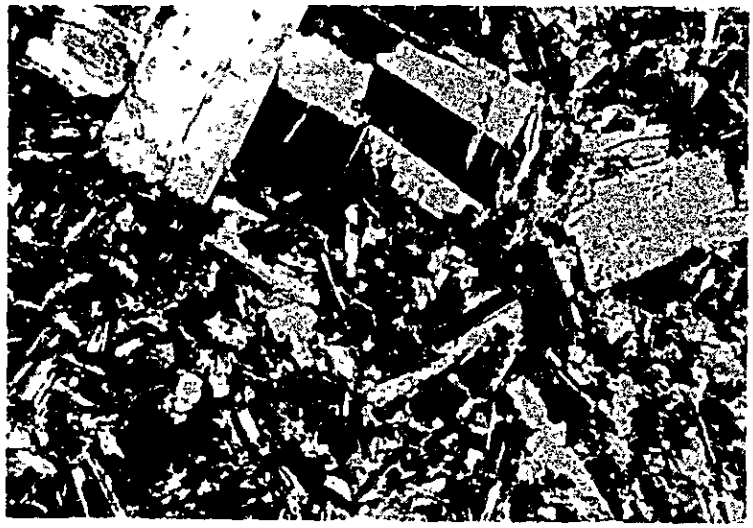
Photomicrograph 25




Only lower polar

Photomicrograph 26

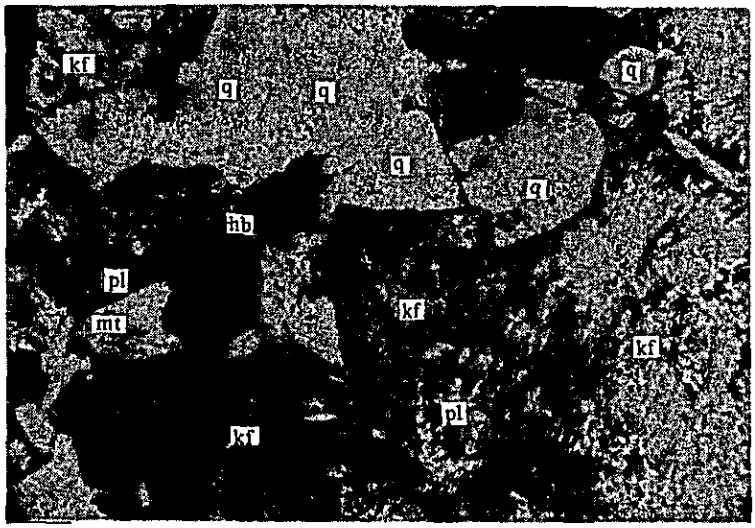


Crossed polars

0 1 mm

Sample No. : 26-B-102
Rock name : Biotite augite dolerite.
Locality : Wadi about 1.3 km east of Wadi Shaat camp, Salalah area.
Observation : The rock is holocrystalline and has porphyritic texture. Phenocryst is composed of plagioclase (maximum 2 mm) and augite (maximum 1 mm) and groundmass is composed of plagioclase lath, augite, biotite and magnetite, showing intergranular texture. Plagioclase is altered somewhat to sericite and carbonate, and some of augite are altered to montmorillonite and biotite.

Photomicrograph 27




Only lower polar

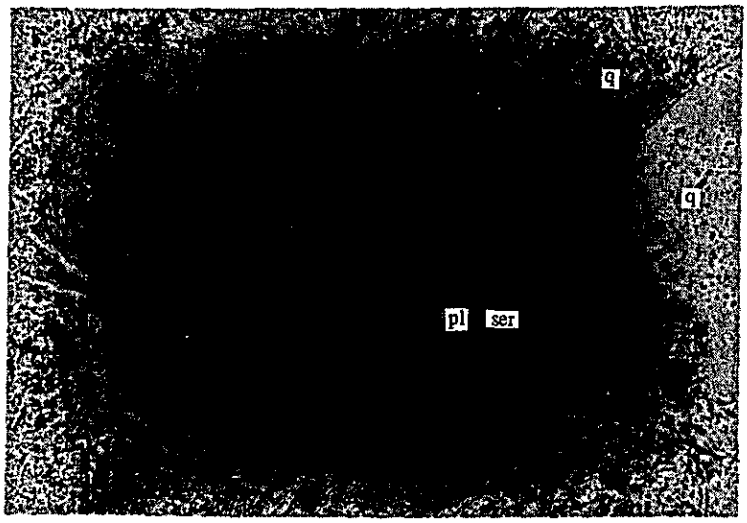
Photomicrograph 28

Crossed polars

0 1 mm

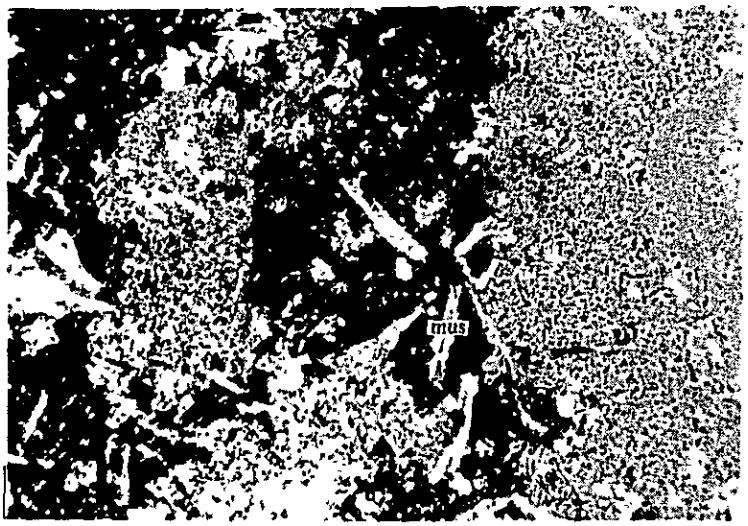
Sample No. : 22–2
Rock name : Hornblende adamellite.
Locality : Bottom of Central Jabal Samhan, Salalah area.
Observation : The rock is hollocrystalline, equigranular and composed of abundant K-feldspar, quartz and plagioclase, and a very small amount of hornblende, magnetite, sphene and apatite. It is altered weakly to sericite and chlorite.
K-fedlspar : Maximum 2.5 mm, hypidiomorphic ~ xenomorphic, carlsbad twinning and perthite structure.
Quarz : Maximum 2 mm, xenomorphic.
Plagioclase : Maximum 2.5 mm, hypidiomorphic ~ idiomorphic, somewhat sericitized.
Hornblende : Maximum 0.8 mm, hypidiomorphic ~ idiomorphic, somewhat chloritized.
Magnetite : Frequently including apatite and sphene.

Photomicrograph 29




Only lower polar

Photomicrograph 30

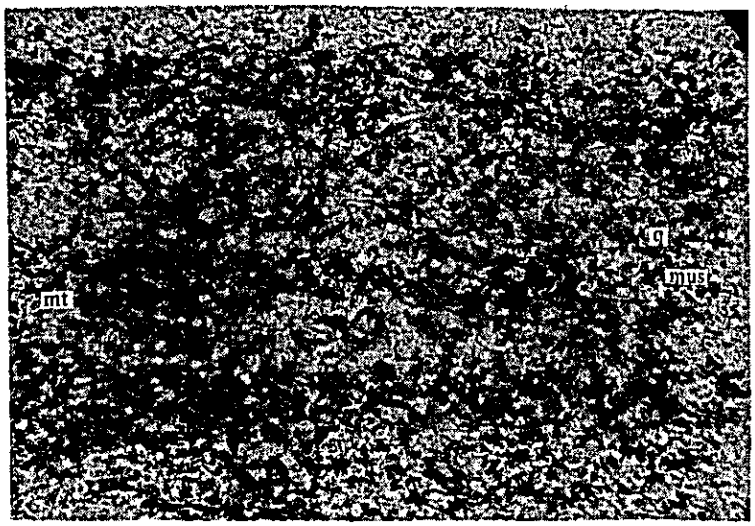



Crossed polar

0 1 mm

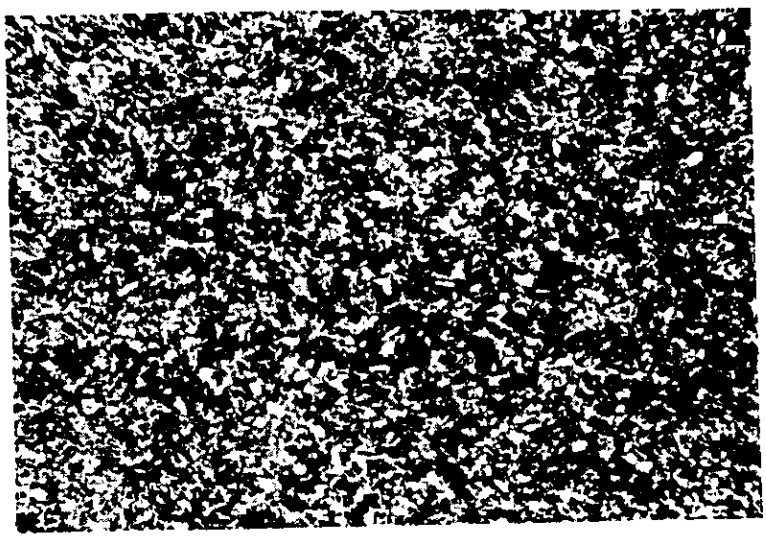
Sample No. : 25-3-1
Rock name : Quartz porphyry
Locality : Road northeast of the Wadi Shaat camp, Salalah area
Observation : The rock is holocrystalline and porphyritic and phenocryst is composed of quartz and groundmass is composed of strongly sericitized plagioclase and muscovite.
Quartz phenocryst: Maximum 3 mm, surrounded by mantles of secondary quartz.
Plagioclase : Maximum 0.5 mm, showing mossaic structure, strongly sericitized.
Muscovite : Maximum 1 mm.

Photomicrograph 31




Only lower polar

Photomicrograph 32

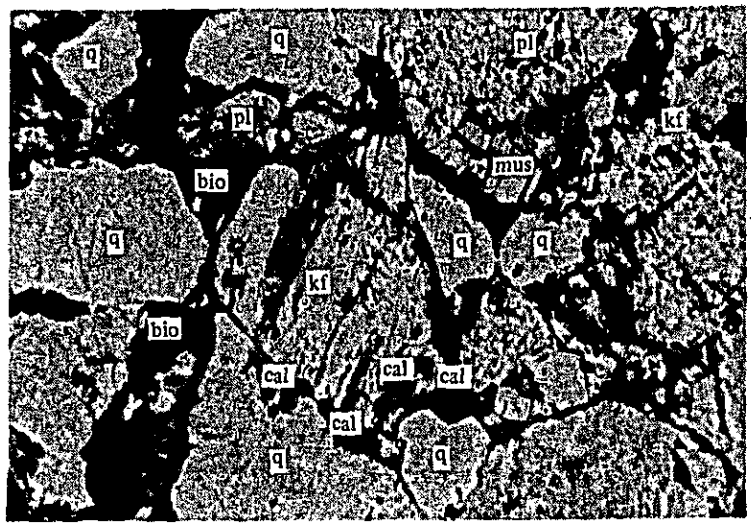


Crossed polars

0 1 mm

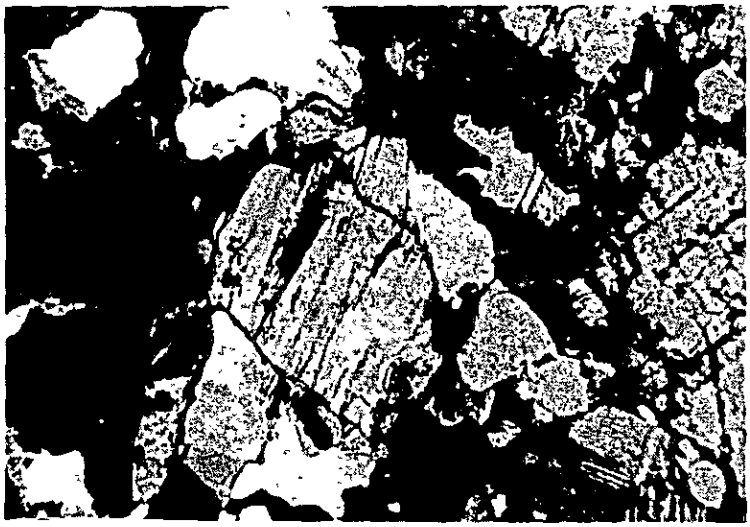
Sample No. : 22–9
Rock name : Siltstone, Mirbat sandstone formation.
Locality : Jabal Shereef, Salalah area.
Observation : The rock is composed of fine grains of quartz and magnetite, and muscovite flakes showing nearly parallel arrangement along bedding.

Photomicrograph 33




Only lower polar

Photomicrograph 34

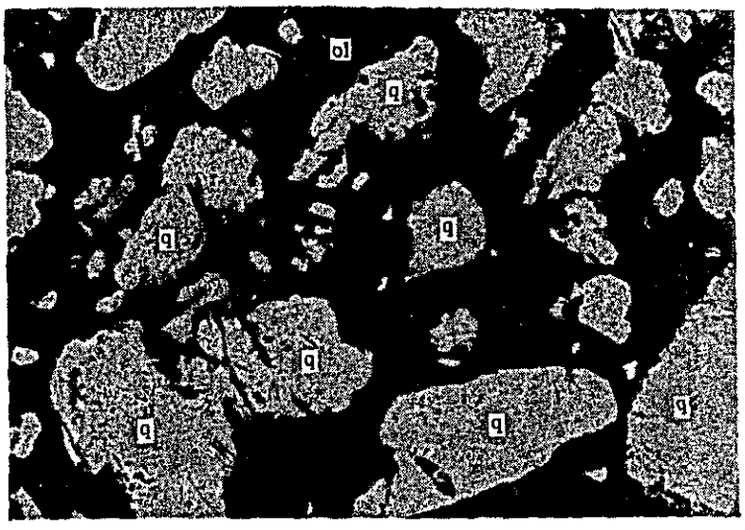


Crossed polars

0 1 mm

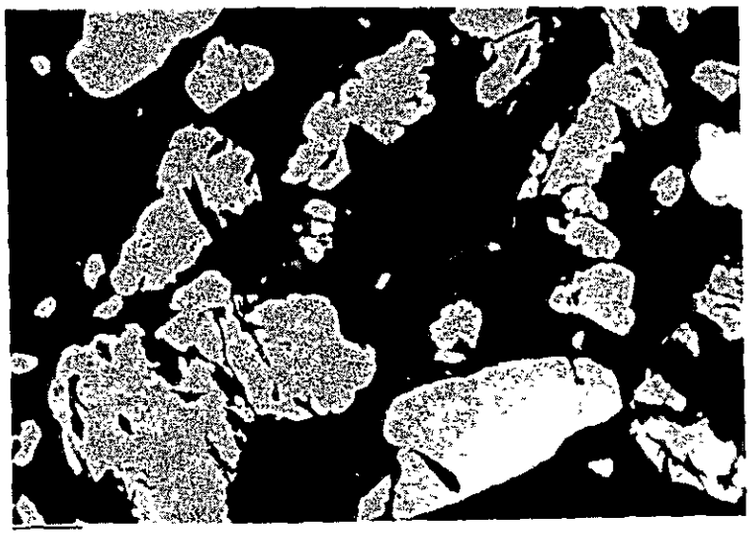
Sample No. : 22–10
Rock name : Coarse-grained arkose sandstone, Mirbat sandstone formation.
Locality : Near Wadi Marsham, Salalah area.
Observation : The angular ~ subangular sand grains of quartz (maximum 2 mm), K-feldspar (maximum 3.5 mm) and plagioclase (maximum 2 mm), and flakes of biotite (maximum 1 mm) and muscovite (maximum 1 mm) are cemented by carbonate.

Photomicrograph 35




Only lower polar

Photomicrograph 36

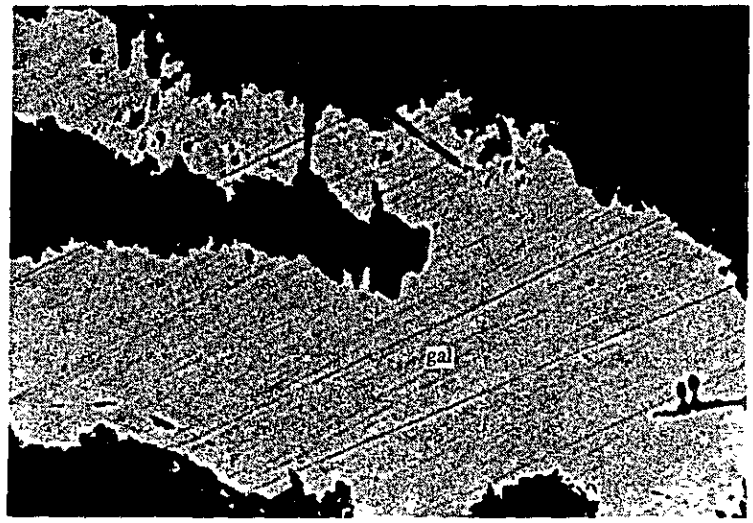


Crossed polars

0 1 mm

Sample No. : 22–3–3
Rock name : *Sandstone, Umm er* Radhuma formation.
Locality : The middle part of escarpment of eastern Jabal Samhan, Salalah area.
Observation : Quartz grains of various size are cemented by small spherical limonite and small grains of silicate with irregular shape.

Photomicrograph 37

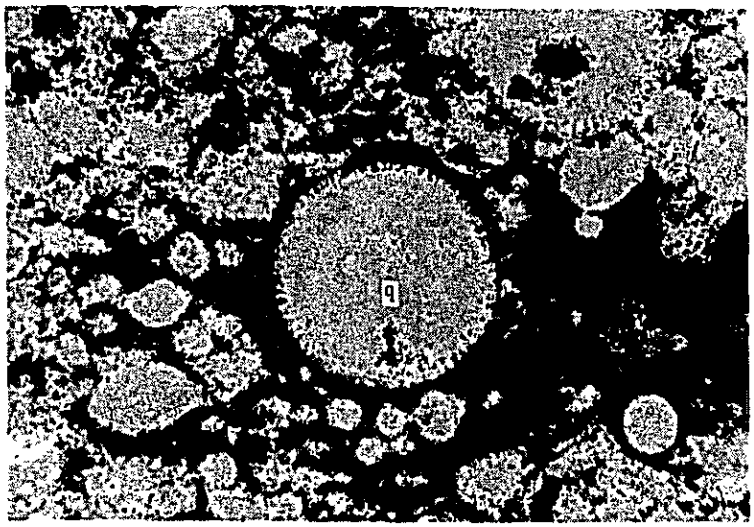



Reflected light
Only lower polar

0 0.5 mm

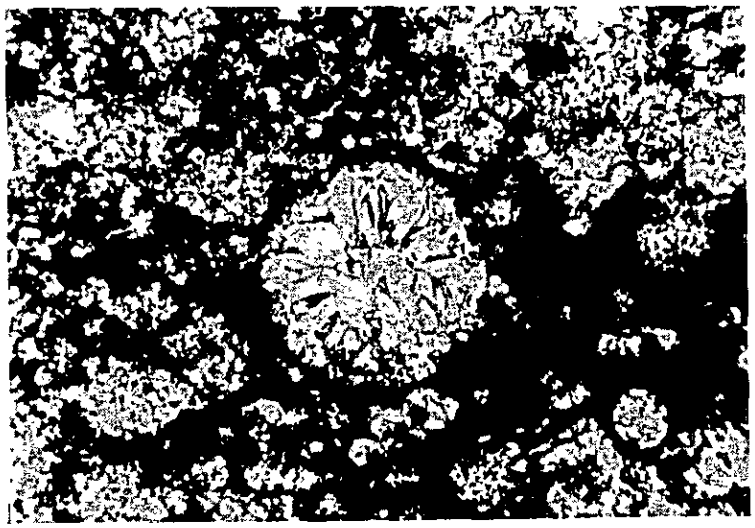
Sample No. : 25–5
Rock name : Galena ore.
Locality : Old lead pit, Salalah area.
Observation : The ore minerals other than galena are absent.

Photomicrograph 38



Only lower polar

Photomicrograph 39

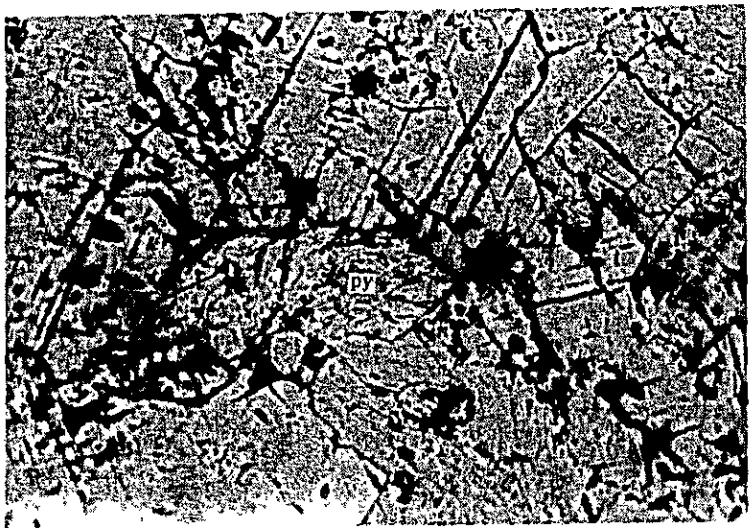


Crossed polars

0 0.5 mm

Sample No. : 8–A–112
Rock name : Radiolarian chert, Halfa formation.
Locality : Near western end of manganese ore zone, Eastern Sur area.
Observation : Abundant radiolarian mostly filled up by colorless radial quartz is cemented by cherty material composed of very fine-grained quartz and dusty reddish-brown iron mineral.

Photomicrograph 40




Reflected light
Only lower polar

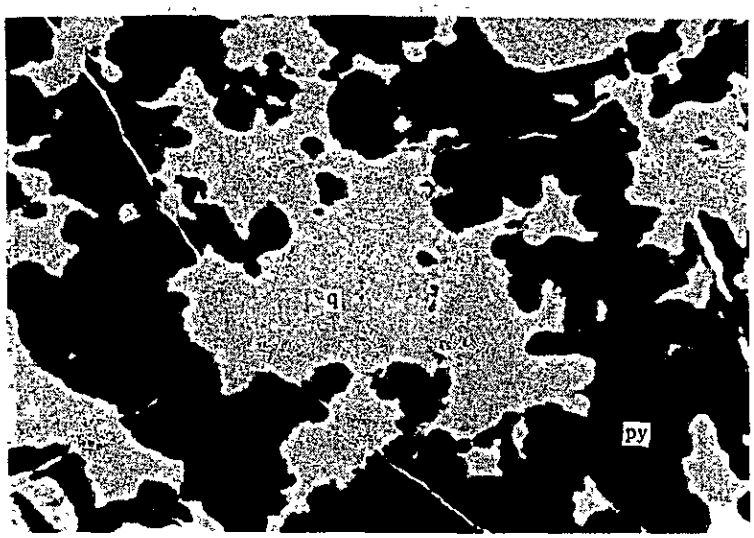
Photomicrograph 41

Crossed polars

0 0.3 mm

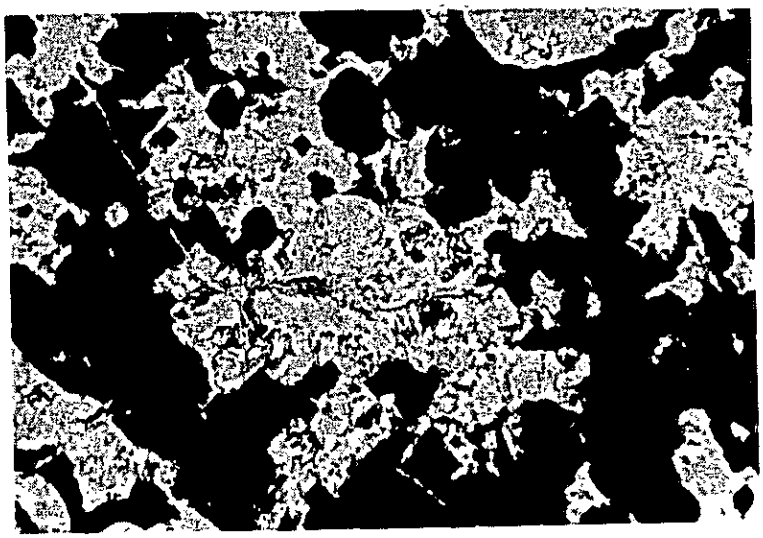
Sample No : 8-A-104
Rock name : High grade manganese ore, Halfa formation.
Locality : No.1 ore deposit, Eastern Sur area.
Observation : Pyrolusite has distinct cleavages, cream-white in color, distinct pleochroism and strong isotropism.

Photomicrograph 42




Transmitted light
Only lower polar

Photomicrograph 43

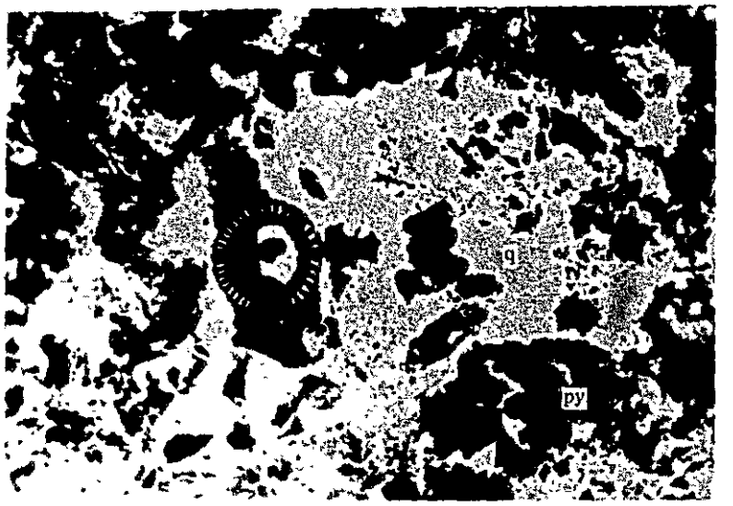


Crossed polars

0 0.3 mm

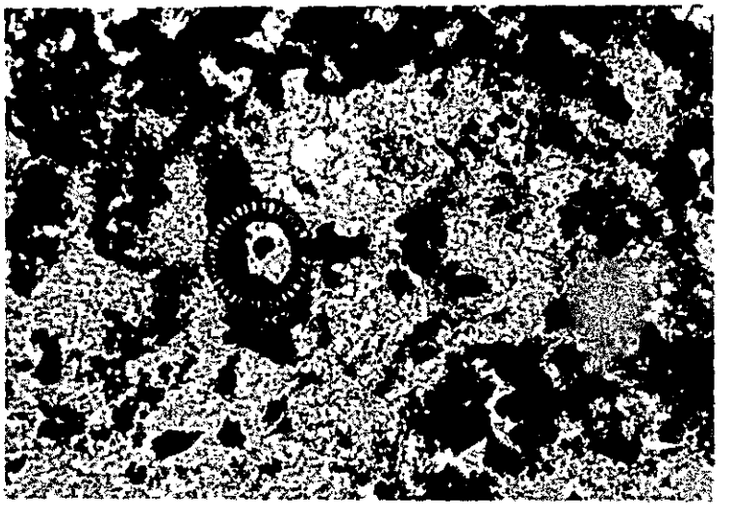
Sample No. : 8–A-103
Rock name : Low grade manganese ore, Halfa formation.
Locality : No.1 ore deposit, Eastern Sur area.
Observation : Pyrolusite occurs as interstices of chert composed of very fine-grained quartz. Feathery pyrolusite develops on the margin of pyrolusite and some parts of pyrolusite show spherulitic structure.

Photomicrograph 44




Transmitted light
Only lower polar

Photomicrograph 45

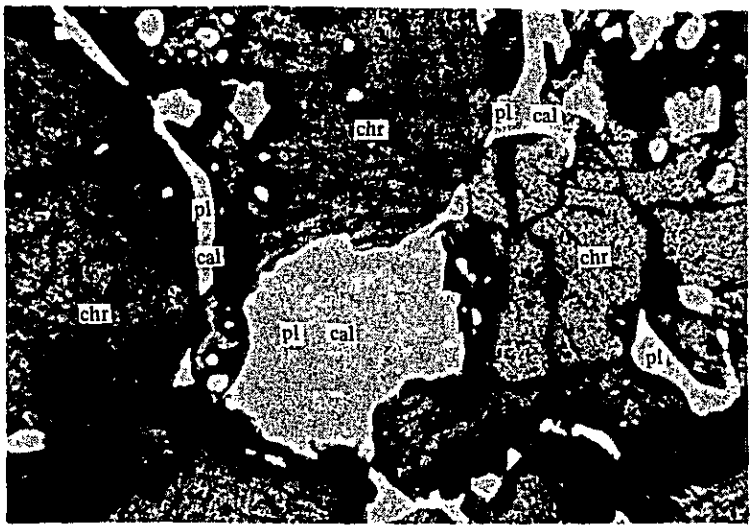


Crossed polars

0 0.3 *mm*

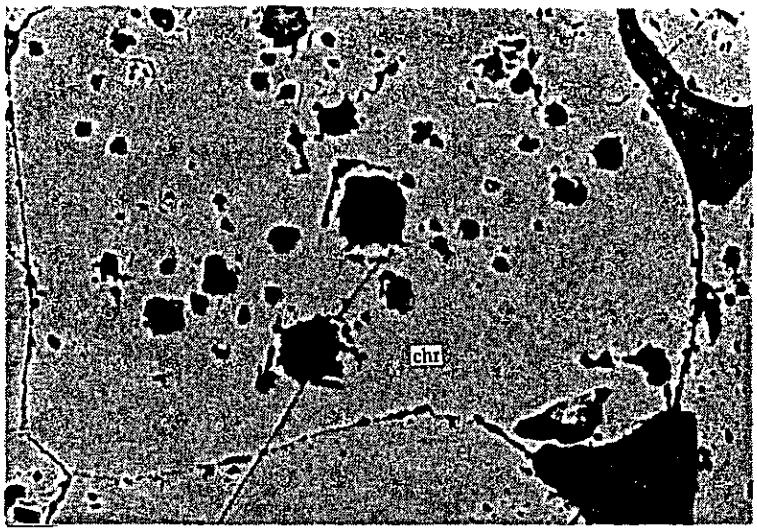
Sample No. : 8–A–103
Rock name : Low grade manganese ore, Halfa formation
Locality : No.1 ore deposit, Eastern Sur area.
*Observation* : The radiolarian inner part of which is replaced by quartz and pyrolusite is present.

Photomicrograph 46




Transmitted light
Only lower polar

Phomicrograph 47

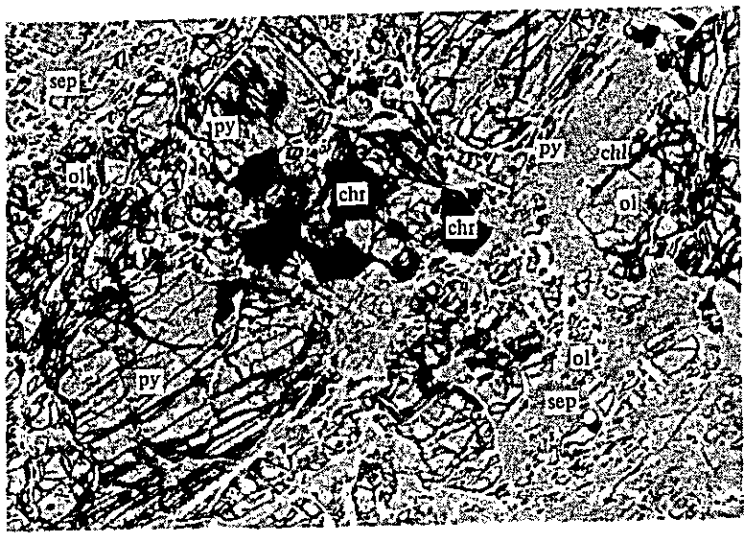



Reflected light
Only lower polar

0 0.5 mm

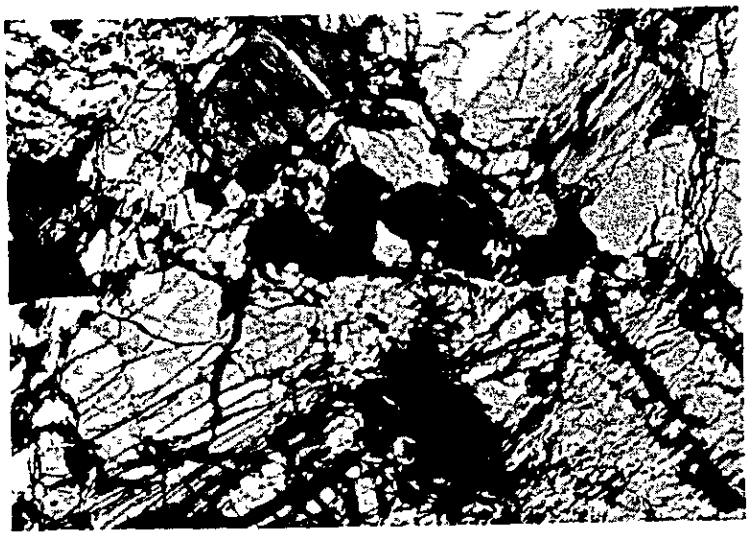
Sample No. : 5–A–101
Rock name : Chrome ore.
Locality : Wadi Jahfan, Batinah Coast area.
Observation : Under transmitted light chromite is brown in color with dark brown to opaque part along rim and crack. Under refelcted light is dark gray in color. Filling up the interstices of chromite and in chromite, feldspar is present, sometimes accompanying carbonate.

Photomicrograph 48




Only lower polar

Photomicrograph 49

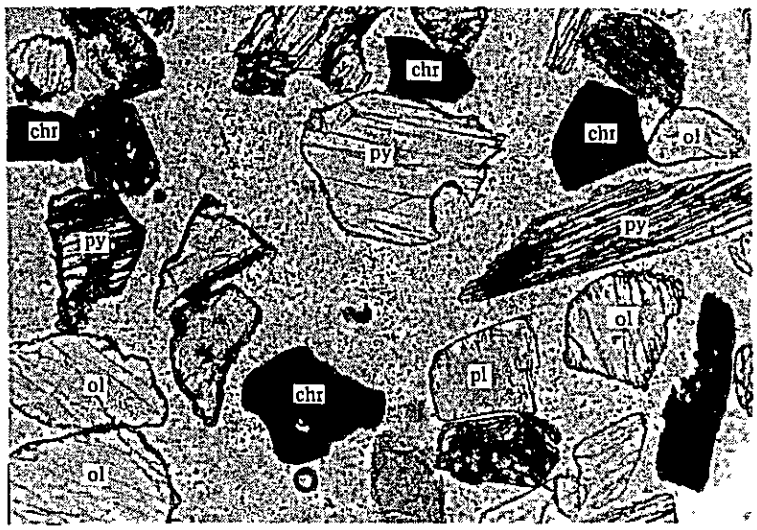


Crossed polars

0 1 mm

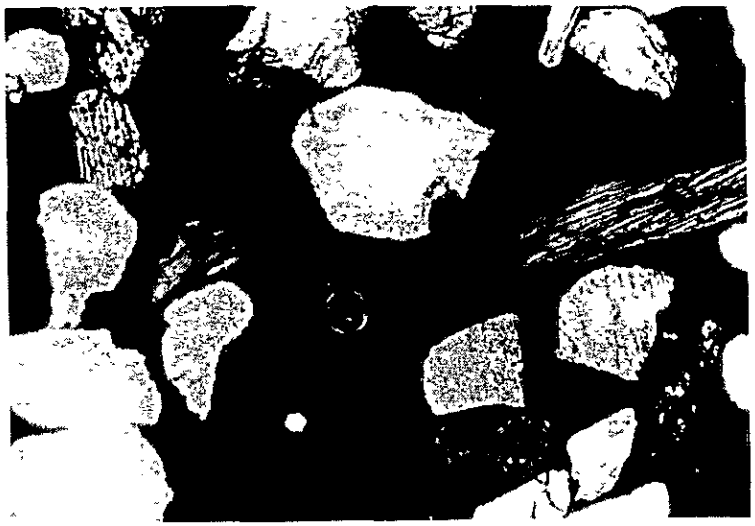
Sample No. : 6–A–101
Rock name : Olivine bearing serpentinized pyroxenite.
Locality : Al Bustan, Batinah Coast area.
Observation : The rock is hollocrystalline and composed of abundant serpentinized olivine and augite as well as a small amount of chromite
Chromite grans up to 0.5 mm, translucent, brown and isotropic, are embeded in the matrix of augite and olivine. Numerous network veinlets of serpentine cut the augite and olivine.

Photomicrograph 50




Only lower polar

Photomicrograph 51



Crossed polars

0 0.5 mm

Sample No. : 6–A–11
Rock name : Beach sand (heavy part).
Locality : Wudam Alwa, Batinah Coast area
Observation : The heavy grains are composed of augite, chromite, olivine as well as a small amount of hornblende. Chromite grains are dark brown

# INTERIM REPORT

OF

# THE MINERAL RESOURCES DEVELOPMENT PLAN

OF

# THE SULTANATE OF OMAN

APRIL, 1979

JAPANESE SURVEY TEAM

JAPAN INTERNATIONAL COOPERATION AGENCY

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
P.O. BOX 216 MITSUI BLDG
2-1, NISHI-SHINJUKU, SHINJUKU-KU TOKYO
160 JAPAN

-:oOo:-

Mr. Mohammed H. Kassim
Director of Minerals
Ministry of Agriculture, Fisheries,
Petroleum and Minerals
The Sultanate of Oman

Dear Sir,

We have the pleasure of submitting our interim report at the end of our field survey programme in the Sultanate of Oman.

We surveyed three areas such as Dhofar area, Batinah Coast area and Eastern area of Sur as possible as we did in spite of terminated period, and we could finish survey very efficiently without any troubles.

JICA survey team expresses many thanks for you and your staff, and officers of Salalah office, who have organized heartful cooperation for us.

Yours faithfully,

S. Ikeda

Shusaku Ikeda
Leader of the team for
the Mineral Resources
Development Plan,
Sultanate of Oman.

CONTENTS

# I. INTRODUCTION

The survey team was dispatched by the Japan International Cooperation Agency to the Sultanate of Oman to carry out a preliminary geological and mineral resources survey in the three areas, that is, Dhofar, Bathinah Coast and Eastern area of Sur, on the basis of the result of negotiation between the Government of the Sultanate of Oman and JICA Mission in last December.

The survey has been carried out efficiently under the best arrangement of the Directorate General of Minerals though the three areas are isolately located.

As to the Dhofar area, we did not know any unpublished reports submitted to the Directorate General of Minerals by some foreign consultants firms until we had arrived in Muscat. These unpublished reports, especially the reports by Makay and Schnellmann (1977) and Tayler Woodrow-Towell Co. (1978), gave us many useful informations concerning geology, geological structure and geochemical exploration. We planned in Japan a similar but not so detailed field survey on the whole area as that of Tayler Woodrow-Towell Co. and we changed our initial plan and inspected the result of geology, geological structure and geochemical exploration data.

This interim report is the result of only field observation, and the nomenclature of some rocks and minerals will be changed after the laboratory work in Japan.

The Survey team member consists of five experts as shown below:

1. Shusaku Ikeda, Geologist, Team Leader
2. Kazunori Kano, Mining Engineer, Coordinator
3. Tadao Hamachi, Geologist
4. Tadao Aoyama, Geologist
5. Tsuyoshi Suzuki, Geologist

A list of visit and survey carried by the team during the stay in the Sultanate of Oman is shown in Annex 1.

After returning Japan, the team will continue laboratory works such as chemical analyses, microscopic observations, age determination and so on and come to report the result of the survey.

The estimated time schedule in the future is as follows:

| | |
|---|---|
| April to July, 1979 | Laboratory work |
| July, 1979 | Draft report making |
| August, 1979 | Final oral presentation in Muscat. |

## II. RESULTS

### 1. Dhofar area

We gave three points of priority in carring out field survey as follows:

(1) Geochemical exploration work

A. On the wadi near the lead and antimony showings reported by Taylor Woodrow-Towell Co., about 70 stream sediment samples were collected by 200-meter interval for studying whether the metallic components of stream sediment is reflected by mineralization or not.

B. On the Wadi Shiliyan and Wadi Shaat, seven and eight stream sediments were collected by about 20-meter interval across the wadi for studying the variation of metallic components across the wadi.

C. Ten and several samples were collected in some wadis with different geology for studying the background value of different geological conditions.

These stream sediments will be analyzed by Atomic Absorption method in Japan.

(2) Survey of geology and geological structure

Some places in the whole area, where different rock-types are distributed, are geologically surveyed for resolving the relation among different rock types and geological structure referring to the report by Taylor Woodrow-Towell Co.

As the result, a tentative sequence of geology is thought to be as follows from earlier to later.

A. Precambrian

1. Biotite schist

It is distributed in central area and characterized by thin, well-developed schistosity? and often seems to be intruded by lit-par-lit injection of acidic plutonics. Thin ultramatic rocks occur.

2. Amphibolite and amphibole gneiss

It is distributed enclosing the biotite schist zone and some seem to be assimilated by diorite. It is also intruded by ultra-mafics such as pyroxenite, serpentinite etc. On the left bank of Wadi Ain, amphiolite overlies biotite schist with gradual transition.

3. Leucocratic granite

It is distributed in the eastern part and intrudes both the schist and gneiss zones.

4. Pegmatite and quartz vein

Numerous pegmatite and quartz veins penetrate the schist and gneiss. In some places, pegmatites and quartz veins occupy a major part rather than the host rocks. Some are concordant with schistosity and gneissosity but others are discordant. The thickness is several meters in amsimum but generally is under several tens contimeters.

5. Dyke

Numerous dykes develop penetrating the above-mentioned rocks. These dykes are classified roughly to two types, that is, besic (basaltic-doleritic) and acidic (rhyo-dacitic) types, and the latter clearly cuts the former. The dyke swarms develop in the

whole area mainly with NW-SE direction and make narrow and long ridges. The thickness is under 20 meters and mostly under a few meters, but the length reaches up to several kilometers in some cases.

B. Mirbat sandstone

The Mirbat sandstone is obscure in age, but is thought to be Ordovician by Z.R.Beydoun (1964). It is also correlated with "Nubian Sandstone" which is thought to be continental or lagoonal sediments. It is composed Lower member of medium to coarse-grained arkose sandstone with basal conglomerate, Middle member of alternation of fine sandstone and siltstone, and Upper member of shaly siltstone and silty shale. It overlies unconformably the Precambrian basement in the western part of the area and wedges out to the east.

C. Cretaceous-Tertiary strata

It makes a cliff and occupies the upper part of escarpment of Jabal Samhan over 600-800 meters in altitude. It is also distributed on the tops of mountains as outliers along the coast.

(3) Survey of mineral showings

The already known mineral showings are scarce and the followings were surveyed:

A. Wadi Shaat area

Small quartz veinlets including a little galena are observed in the waste of old trench in dyke. The host rock seems to be microdiorite in the biotite schist.

B. Juffa camp

Samples collected by local people in this area did not include any metallic minerals.

C. Hadabin area

One gossan, which was found by a boy as float on the Wedi Hadabin, includes limonite and unidentified mineral, preudomorph after pyrite, in pegmatite (?).

D. West place to Wadi Khorhat, Sadah area

Malachite and pyrite showings are observed in pegmetite in amphibolite.

E. Ras Ain

A thin pyrrhotite and pyrite vein develops in epidotized amphibolite distributing on the hanging wall side of pegmatite of 20-30cm in thickness. The vein has 2-3 meters length with a "pool" of 10 x 15 centimeters.

F. Mirbat sandstone

From the result of study on literatures in Japan, the Mirbat sandstone was thought to be most favourable for uranium concentration in the area. Siltstone intercalation in sandstone of the Middle member showed three times radioactivity of background value as the result of radiometric survey carried out on the first day of helicopter survery. A part of the Lower member and a part of the Middle and Upper members were surveyed for making geological columns together with radioactive survey.

The radioactivity of siltstone-shale is higher than that of sandstone, that is, the former is as 2-3 times and the latter is 1-2 times as background radioactivity.

2. Batinah Coast area

The back mountainland consists of allochthonous Hawasina Group and Semail ophiolite covered with autochthonous Tertiary limestone, and Semail ophiolite includes some chromite deposits in peridotite zone.

For the purpose of examining the possibility of existence of chrome sand, ten beach sand samples were collected on the beach from Seeb ToBadaj Ud village, from pits dug with shovel upto one meter depth. Also, two samples were collected at Sidab and Al bustan east to Muscat where peridotite is distributed on the coastline.

Any black sand could not be observed to about 1 meter depth from the surface though the existence of magnetite was confirmed with magnet, but some samples will be examined for chromium in Japan.

One chromite deposit, which is located on the wadi near Tawiyah village about 30 kilometers south to Barka, was surveyed. The deposit occurs in peridotite and is composed of three ore bodies separated by faults. The bottom of each ore body seems to be cut by low angle faults, but quality of ore is rather uniform and is of high grade as lumpy ore ($Cr_2O_3$ may be over 46-48%). The mode of occurrence of this chromite deposit shows a typical "Alpine type" chromite deposit and its ore reserves is probably estimated under 2,000 tons.

## 3. Eastern area of Sur

The eastern and southeastern area consists mainly of Hawasina Group. The surveyed area is located in the south to Khawr Al Janamah, southwest to Ras Al Hadd, where a preliminary survey for manganese deposit has been carried out by Directorate of Minerals for ten days.

The surveyed area consists of the Hawasina Group composed of Lower Ibra formation and Upper Halfa formation unconformably covered with Maestrichtian to Oligocene-Miocene limestone.

The Ibra formation is Later Permian to Early Jurassic and composed of sandstone including locally abundant glauconite. The Halfa formation is Triassic to Early Cretaceous and composed of siltstone, shale and chert.

The manganese ore deposit occurs in chert zone of the Halfa formation and the ore zone is traced about 6 km along strike side though the ore body itself does not continue due to faults and/or thinning out.

As the result of observation on No.1 outcrop which is largest, geology is thought to be as follows:

From footwall side to hanging wall side:

1. Very thin-bedded brittle mudstone and siltstone with sometimes siliceous part in white partly reddish tint.

2. Alternation of white siliceous siltstone or chert and red mudstone with several centimeters thickness in average about 15 meters.

3. Manganese ore body, 3 meters

   A. Partly massive dark gray chert with segregation of white quartz veinlets, 50 centimeters.

   B. Siliceous manganese ore body of partly very high grade.

4. Gray thin-bedded chert including several manganese beds or nodules of 10 centimeters in maximum thickness, 5 meters.

5. Red brittle siltstone, 5-10 meters.

The manganese ore generally consists of chert fragment and black manganese minerals (pyrolusite?) which sometimes show long prismatic of radial aggregates and partly form high grade part with concernt-ration of black manganese minerals.

The manganese ore zone continues about 500 meters along strike side of N 55° E with about 40° SW dip, though each ore body seems to have N 10° W strike, 35° W dip generally and about 30 meters strike length due to step faults and/or foldings.

The above-mentioned geology near the ore body is one of the typical rock sequence, and the massive dark gray chert of the footwall side of ore body always exists in the bedded manganese ore deposit in the paleozoic formation, thermally, regionally metamorphosed or unmetamorphosed, in Japan, and such type of deposit is thought to be formed by submarine exhalation. But lack of such massive chert in almost whole area may suggest that most of manganese might be supplied by sea water without any relations to volcanism.

The thickness of manganese seems to be rather thin and most of the managemese bed are under 30-50 centimenters, but, the strike length is long comparing with its thickness, and this means that dip length may be long. The thickness of ore body is most important factor of such type deposit, and if the ore body becomes thicker due to folding, it is economically worked, because many flow foldings are observed in the chert zone of Halfa formation.

## III. CONCLUSION

As the result of the preliminary geological field survey, the followings are led to conclusion.

1) Dhofar area

The Precambrian basement complex is composed of biotite schist, amphibolite and amphibole gneiss, leucocratic granite, pegmatite and quartz vein, a few stocks of felsite (quartz-monzonite?) and dyke swarms, and several mineral showings are known up to present. But, the informations are based on an insufficient geological survey, and mainly from photogeological interpretation. The absence of volcanism in the schist and gneiss complex may suggest the absence of lead, zinc and copper deposit related to volcanism such as that of Saudi Arabia. But, later acidic dykes and stocks together with a part of leucocratic granite, all of which have never been surveyed in detail up to present, could supply basemetal vein-type deposits. As to uranium, if radioactivity showing several times of background value especially in the basal conglomerate part associated with carbonaceous matter, is found in the Mirbat sandstone, potentiality of uramium deposit becomes higher.

2) Batinah Coast area

The chrome sand is not expected within 1 meter from the surface of beach samd. The beach close to peridotite is necessary to be surveyed.

3) Eastern area of Sur

Only th information on the area south to Khaer Al Jaramah is known. The remnant wide area of Hawashina Group is interest from geological point of view.

From the above-mentioned facts, at first, Dhofar area has to be taken into consideration for further geological survey, and, it is necessary that a topographic map and aerial photo of at least 1:50,000 in scale, 1:20,000 in some cases, will be prepared at the time of fur ther geological survey.

ANNEX 1

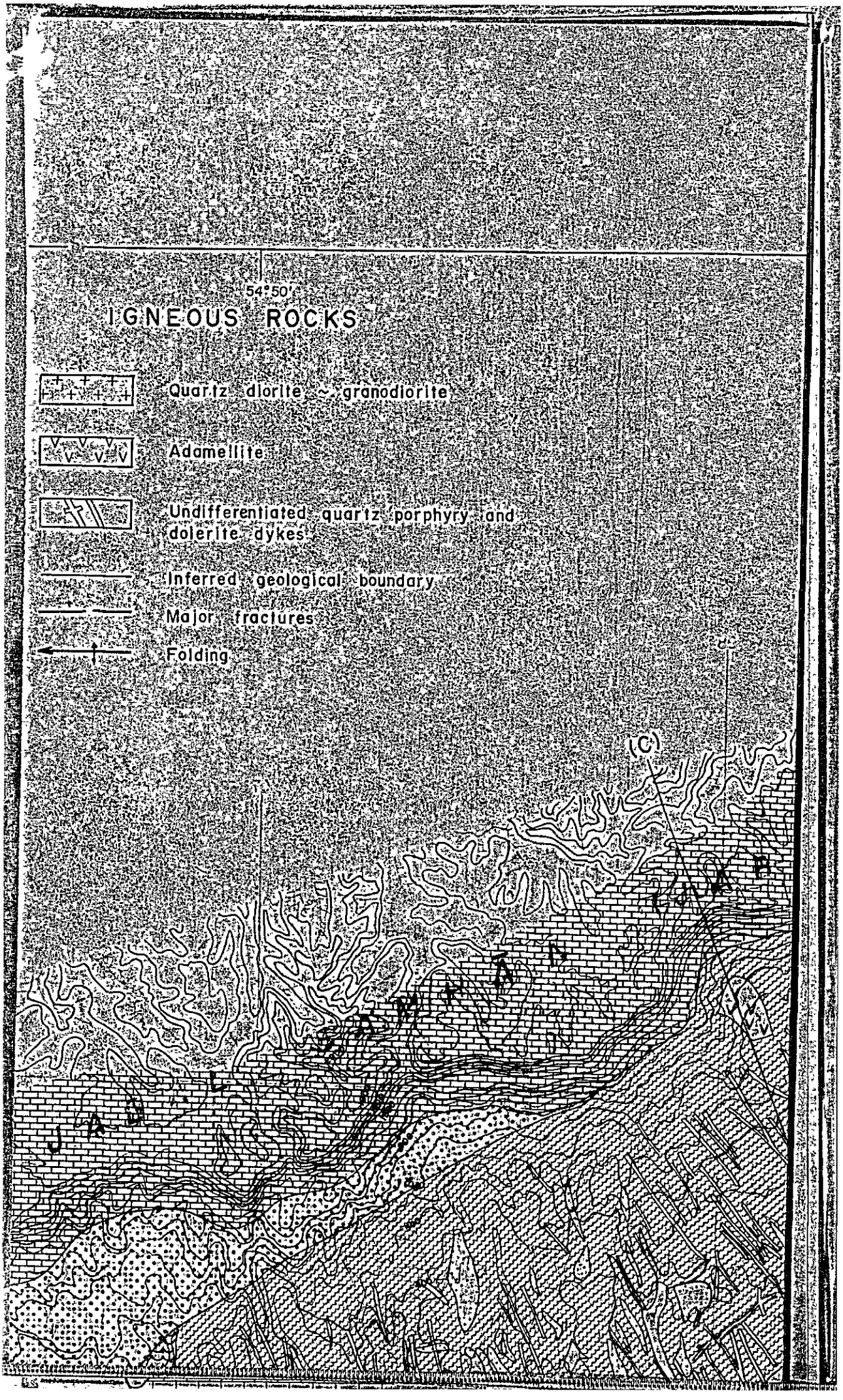
SURVEY ITINERARY

| Date | Time | Place of visit, persons interviewed |
|---|---|---|
| Mar. 18 (Sun) | 09:30 | Ar. Seeb |
| Mar. 19 (Mon) | 09:00 | Ministry of Agriculture, Fisheries, Petroleum & Minerals.<br>Mr. M.H. Kassim (Director)<br>Dr. Leif Carlson (Geologist)<br>Mr. Omar Al Amin (Geologist) |
| | 12:00 | Mr. Fida Karim (General affairs) |
| Mar. 20 (Tue) | 09:00 | H.A.F.P. & M<br>Dr. Leif Carlson<br>Mr. Omar Al Amin<br>Mr. M.H. Kassim |
| | 12:00 | Muscat Area (geological survey) |
| Mar. 21 (Wed) | 11:10 | Lv. Seeb |
| | 12:40 | Ar. Salalah |
| | 13:30 | Ministry of A.F.P. & M (Salalah)<br>Mr. Omer Abdul Aziz (Manager) |
| Mar. 22 (Thu) | | Trip to eastern area of Dhofar (Helicopter)<br>Salalah |
| | | Typical geological locality (gneiss, schist, granite, pegmatite, dyke rock, limestone, sandstone etc.) |
| | 17:30 | Ar. Salalah |
| Mar. 23 (Fri) | | Trip to Kuria-Muria Islands (Helicopter) |
| | 08:00 | Lv. Salalah |

| Date | Time | Place of visit, persons interviewed |
|---|---|---|
| Mar. 23 (Fri) | 08:30 | Ar. Al-Hasik |
| | 08:45 | Lv. Al-Hasik |
| | 09:15 | Ar. Al-Qibliyah Island |
| | 10:35 | Lv. Al-Qibliyah Island |
| | 10:55 | Ar. Al-Hallaniyah Island |
| | 13:15 | Lv. Al-Hallaniyah Island |
| | 13:35 | Ar. As Sawda Island |
| | 14:20 | Lv. As Sawda Island |
| | 14:30 | Ar. Al Hashikiyah Island |
| | 15:10 | Lv. Al Hashikiyah Island |
| | 15:50 | Ar. Sadah |
| | | Mr. Mohammed Said (Manager of Sadah) |
| | 16:40 | Lv. Sadah |
| | 17:20 | Ar. Salalah |
| Mar. 24 (Sat) | 11:00 | H.A.F.P. & M (Salalah) |
| | | Dr. Leif Carlson |
| | | Mr. Omer Abdul Aziz |
| Mar. 25 (Sun) | 09:05 | Taquh |
| | 10:00 | Mirbat |
| | | Mr. Amer Ali (Manager of Mirbat) |
| | 15:20 | Gneiss, schist, galena mineral ore sampling |
| | 18:30 | Wadi Shaat |
| Mar. 26 (Mon) | 08:00 to 18:00 | Wadi stream sediments sampling |
| Mar. 27 (Tue) | 08:20 | Juffa |
| | 12:30 | Wadi Hadbin |
| | 16:00 | Wadi Morir |

| Date | Time | Place of visit, persons interviewed |
|---|---|---|
| Mar. 28 (Wed) | 09:10 | Wadi Jish-Jesh |
| | 10:30 | Sadah |
| | | Mr. Mohammed Said |
| Mar. 23 (Fri) | 12:20 | Wadi Kohrhant |
| | 14:45 | Wadi Ain |
| | 16:00 | Ras Ain |
| | 17:55 | Mirbat |
| Mar. 29 (Thu) | 08:00 to 14:00 | Geological and radiometric survey of the Lower member of Mirbat sandstone |
| Mar. 30 (Fri) | 08:00 to 14:00 | Geological and radiometric survey of the Middle and Upper member of Mirbat sandstone |
| Mar. 31 (Sat) | 15:00 | Raysut |
| Apr. 1 (Sun) | 09:00 | M.A.F.P. & M (Salalah) |
| | | Dr. Leif Carlson |
| | | Mr. Omer Abdul Aziz |
| Apr. 2 (Mon) | 18:00 | Lv. Salalah |
| | 19:15 | Ar. Seeb |
| Apr. 3 (Tue) | 12:00 | Ministry of Foreign Affairs |
| | | Mr. Mohammed Hassan Ali (Director of Technical Cooperation) |
| | | Mr. Itusaa Alimussah (Temporary Japan Resident Ambassador) |

| Date | Time | Place of visit, persons interviewed |
|---|---|---|
| Apr. 3 (Tue) | 12:30 | M.A.F.P. & M |
| | | Dr. Leif Carlson |
| | | Dr. El Boushi (Chief Geologist) |
| Apr. 4 (Wed) | 12:00 | M.A.F.P. & M |
| | | Mr. M.H. Kassim |
| | | Dr. El Boushi |
| | | Dr. Leif Carlson |
| Apr. 5 (Thu) | 10:00 | M.A.F.P. & M |
| | | Mr. M.H. Kassim |
| | | Mr. Cherian Zacharia (Geologist) |
| | 11:00 | Barka |
| | 11:20 | Jubra |
| | 12:10 | Wadi Jafhan (Chromite outcrop) |
| Apr. 6 (Fri) | 08:00 | Batinah Coast (chromite sand deposits) |
| | to | Sidab, Al Bustan, Sib, Barka, |
| | 17:00 | Musanua, Wadan Alwa, Badaj Ud. |
| Apr. 7 (Sat) | 10:30 | |
| | to | |
| | 18:00 | Eastern area of Sur (Khawr Al Jaramah) |
| Apr. 8 (Sun) | 07:40 | |
| | to | |
| | 17:10 | Khawr Al Jaramah (Manganese deposits) |
| Apr. 9 (Mon) | 08:05 | Basement (diorite) |
| | 13:00 | Western Ibra (Layer type gabbro) |
| | 14:35 | Eastern Biddid (pillow lava) |


54°50'
IGNEOUS ROCKS
Quartz diorite ~ granodiorite
Adamellite
Undifferentiated quartz porphyry and dolerite dykes
Inferred geological boundary
Major fractures
Folding
(C)

## L E G E N D

| | | |
|---|---|---|
| Quaternary | | Sand gravel |
| Cretaceous to Tertiary | | Umm er Radhuma Formation |
| Ordovician | | Mirbat Sandstone Formation |
| Precambrian | | Sadh Gneiss |
| | | Juffa Gneiss |

## IGNEOUS ROCKS

| | |
|---|---|
| | Quartz diorite ~ granodiorite |
| | Adamellite |
| | Undifferentiated quartz porphyry and dolerite dykes |
| | Inferred geological boundary |
| | Major fractures |
| | Folding |

54°50'

55°00'

17°10'N

17°00

(A)

(C)

(E)

(G)

(D)

SADH

MIRBĀT

54°50'

55°00'

US ROCKS

·tz diorite ~ granodiorite

mellite

lfferentiated quartz porphyry and
:rite dykes

rred geological boundary

or fractures

ding

(E)

(I)

(C)

(F)

(D)

HADARIN

SADH

SEA

To Muscat

D H O F A R

0 50km

Hasik

Kuria Muria Is

Salalah

Taqah

Sadh

Mirbat

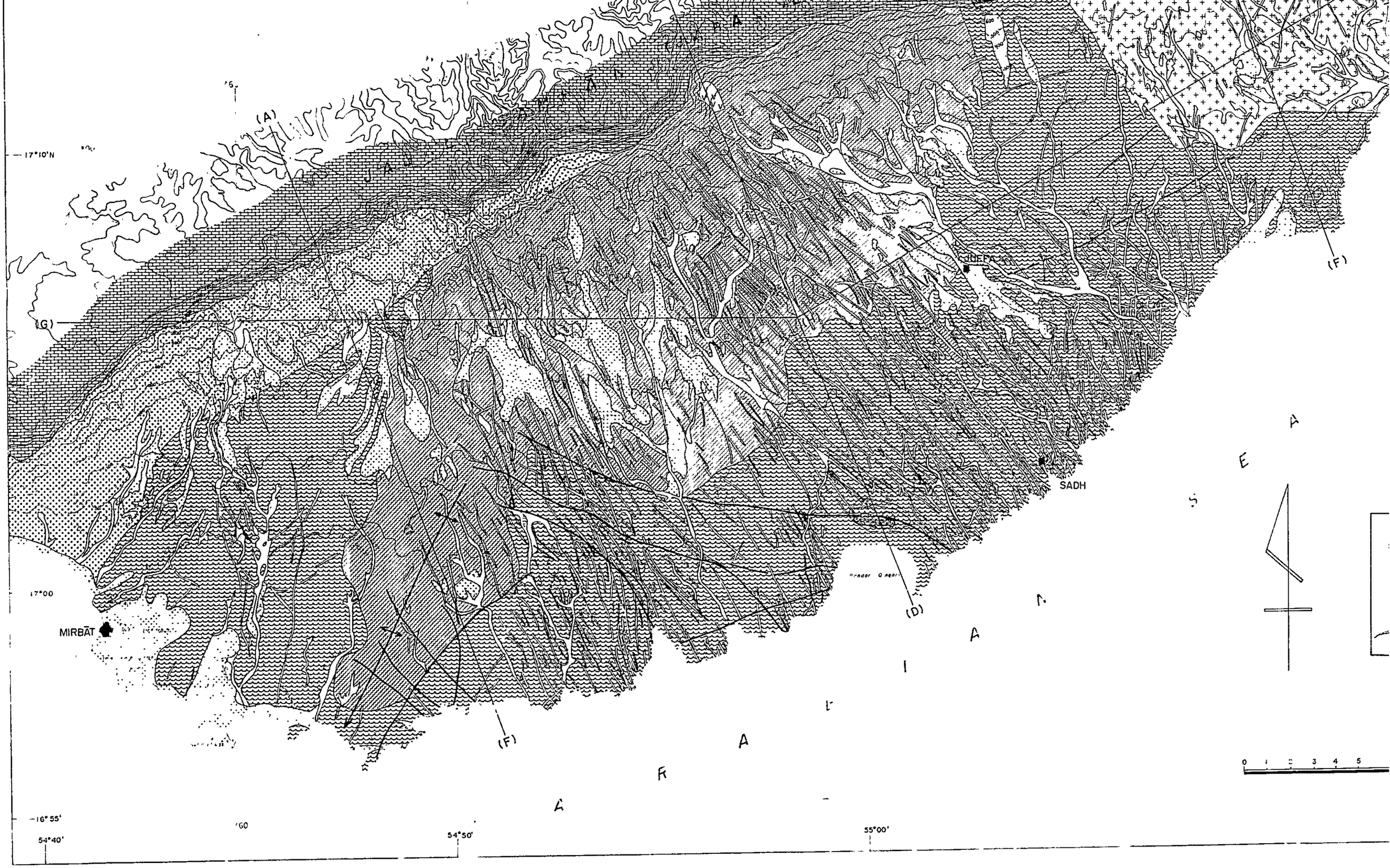



Fig. 12 Geologic map of Salalah area.

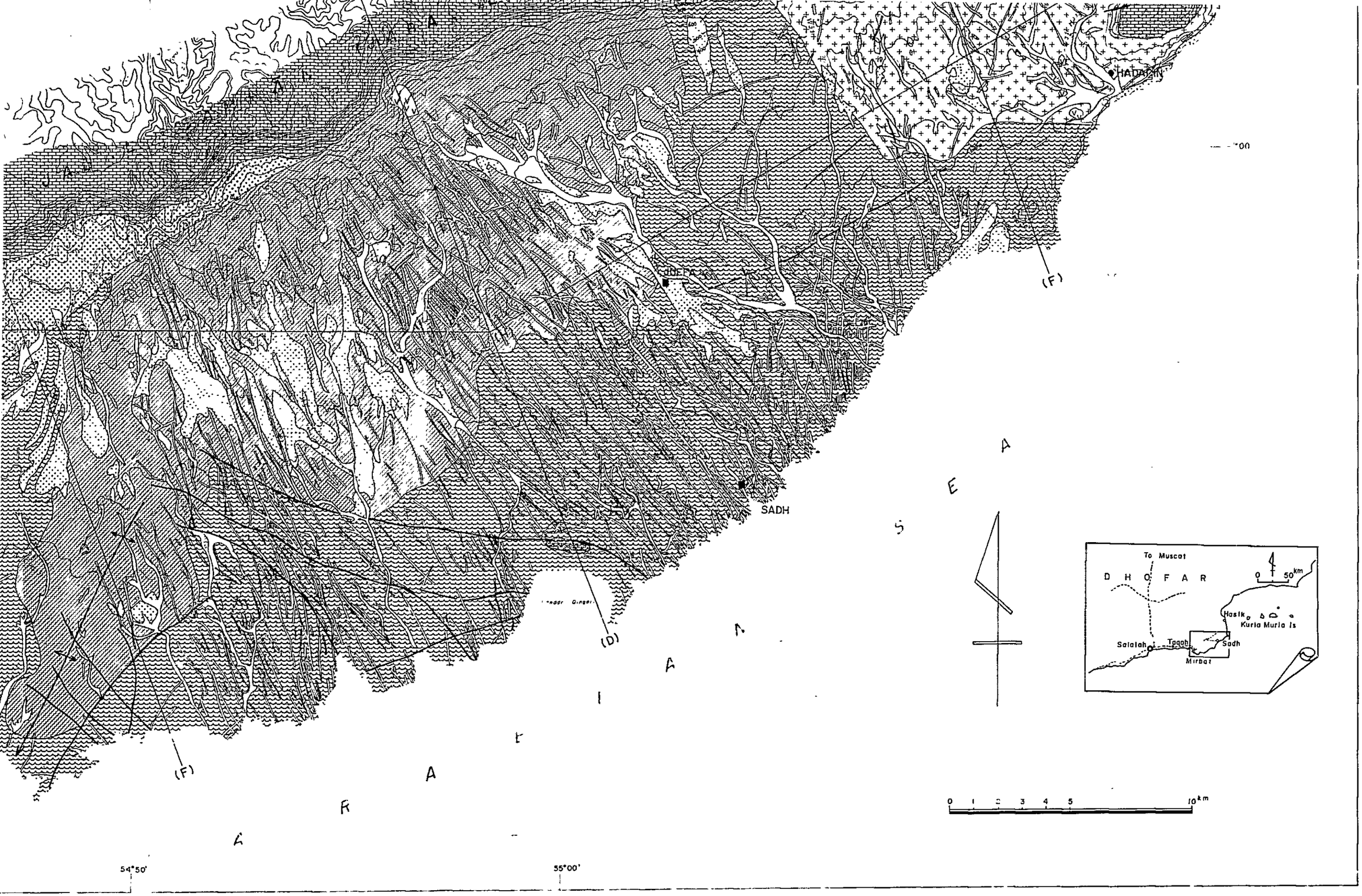



Fig. 12 Geologic map of Salalah area.

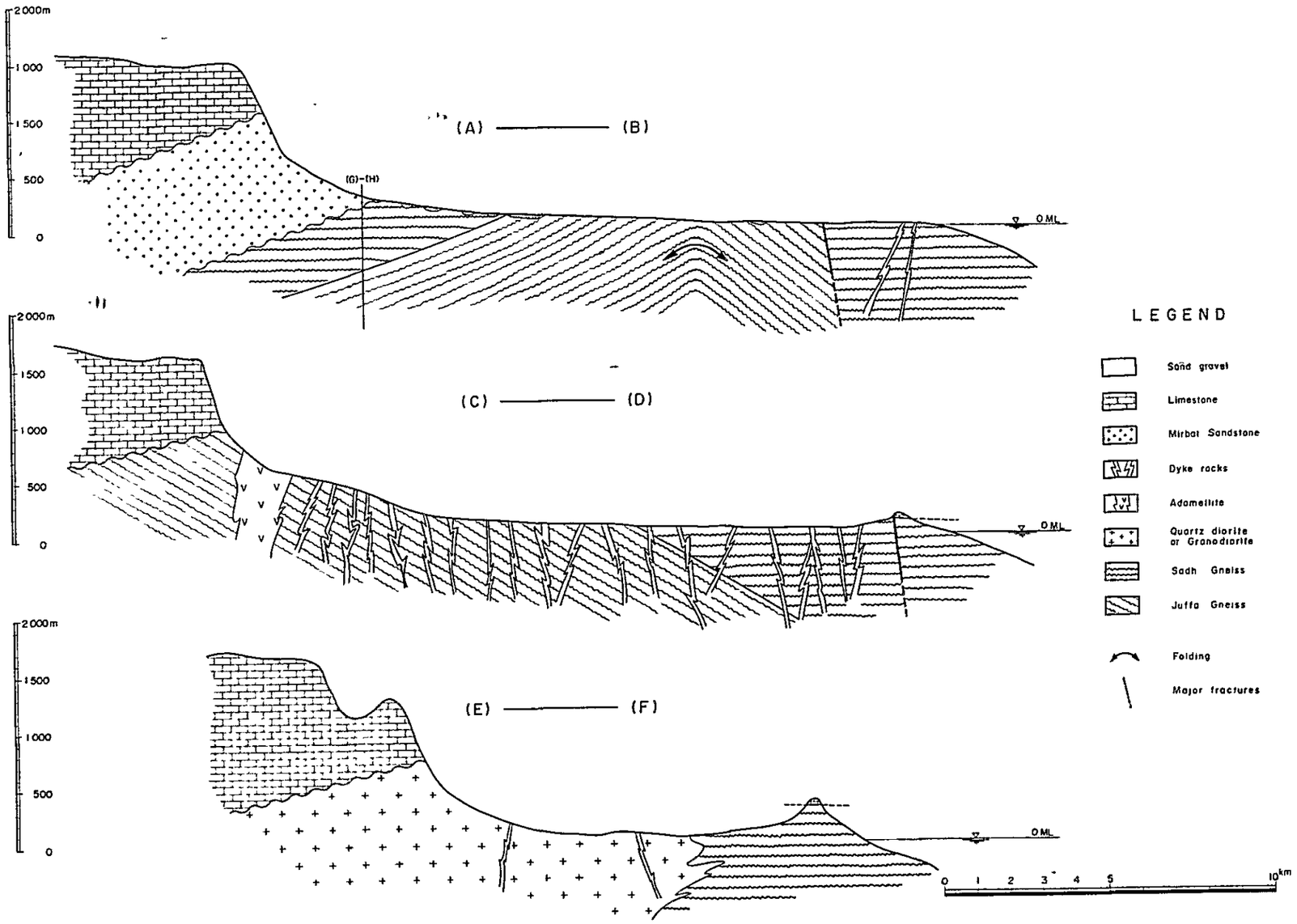



Fig. 13 Geological cross sections of Salalah area (1)

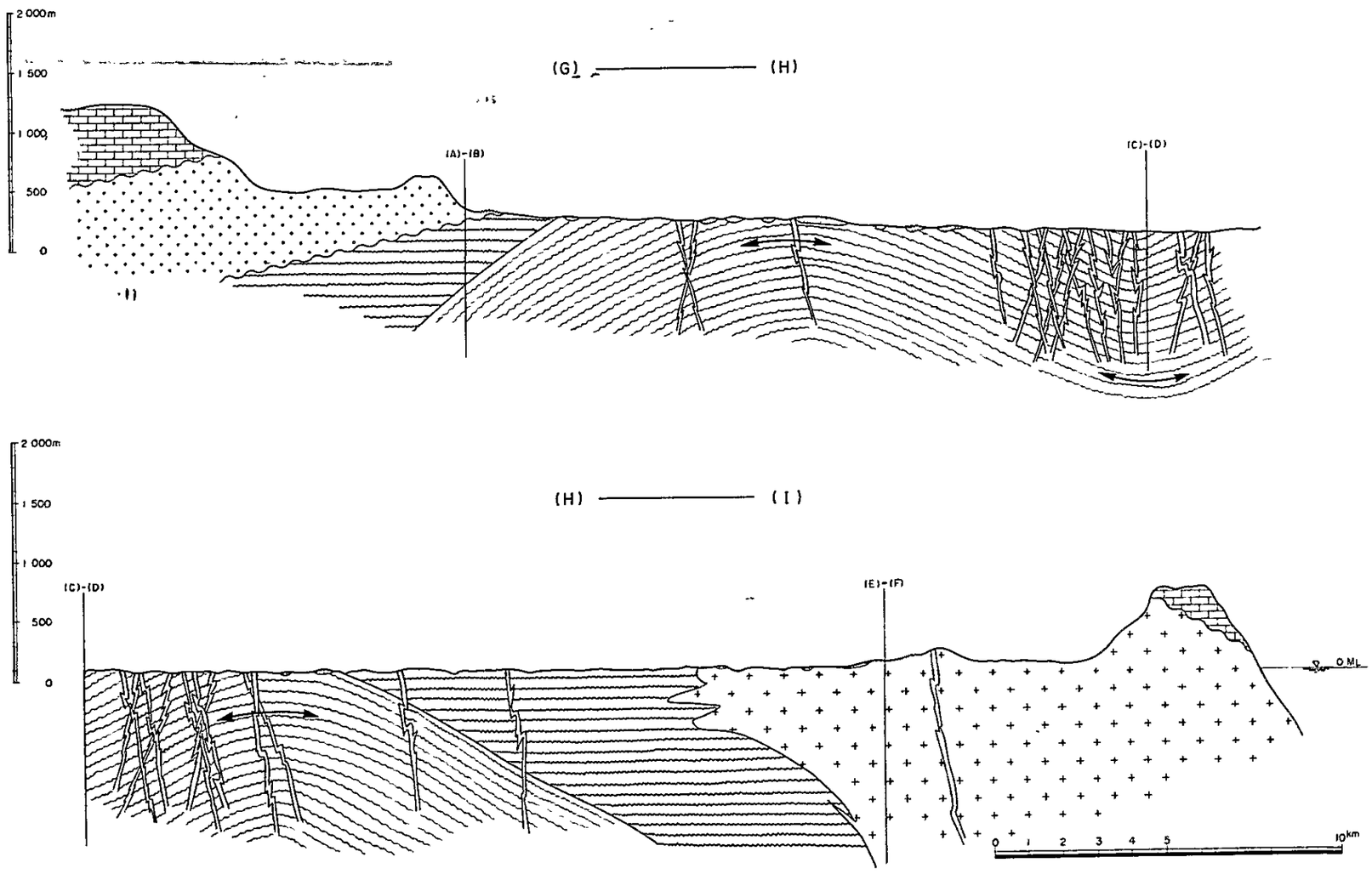



Fig. 14 Geological cross sections of Salalah area (2)