



"In the name of God"
Geological Map of Iran
1:100000 SERIES
SHEET SHIRGESHT
7358

Geography

The present map deals with the geology of the north-south trending mountain ranges along the eastern border of the Great salt Desert (Great Kavir). The limits of the sheet are given by longitudes 56°30'-57°00' E and latitude 34°00'-34°30' N. The area comprises of two different morphological and geological units:

1) The Pirhajat mountains in the west, which are the northern continuation of the Kalmard Ranges west of Tabas basin.

2) The Derenjal mountain, a solitary mountain group in the middle of the area. There is no big uniform mountain range, the hills and mountains of the area are split into more or less isolated groups. The Derenjal mountains are completely uninhabited, except for few families settlements of Derenjal. The settlements of course, are at places which are favoured by a good groundwater supply, on the western side of the Pirhajat mountains.

A system of water-bearing gravel fans in the centre of the area supplies water to the strange assemblage of villages at the border of the Great Kavir, northeast of the Derenjal mountains called Jolgeh (fertile, plain) and the villages around the sand-dunes of Del-e-Kuh.

The average annual precipitation is about 100 millimeters, so that the area can be considered as a semi-desert region.

Review Of Stratigraphy

The rock sequence exposed in the sheet area is nearly 15,000 meters thick. It comprises of rocks of nearly all ages from Cambrian to Recent. The main, lithostratigraphic units are as follows:

Paleozoic

Soltaniyeh Dolomite

South of Cheshmeh-e-Shorm a sombre looking precipitous mountain ridge called Kuh-e-Chesmeh Shorm rises up. It consists of cherty dolomite divided into two parts by a layer of greenish shale and siltstone. The dolomite resemble exactly with the Soltaniyeh dolomite, and the greenish sandy shales are easily recognized as the Chapoghlu Shale Member between the dolomite. the lower

dolomite unit is dark and cherty and the dolomite overlying the Chapoghlu Shale Member has a light grey to yellowish colour and contains chert bands.

Except Fucoid-like and some fossil-like traces in the shelly member, no fossils have yet been found in the carbonate members.

Here, the Soltaniyeh dolomite does not present a complete section of the Formation. The two lower members of the type locality (Lower Dolomite and Lower Shale Members) are missing here.

Barut Formation

The Soltaniyeh dolomite is overlain by a limestone which is partly dolomitic or siliceous, some shales and siltstones and a very characteristic layer of a black fetid limestone. These beds and the Barut Formation of northern Iran are quite different. For example, the intercalations of purple or green shales between the dolomite and limestone beds, otherwise so characteristic of the Barut Formation, are almost completely absent. Meanwhile, the typical Barut Formation consisting of an alternation of purple and green shales with dolomite layers, is exposed on the western flank of the anticline in the foothills south-southwest of Cheshmeh-Shorn, just above the Soltaniyeh dolomite.

Recently B. Hamdi reported small shelly fauna such as: *Hyalithellus* cf. *tenuis* Miss, *Turcutheca maxima* Jiang, *Orthotheca* sp., tube-like algae; which indicate a Lower Cambrian (Botomian) age.

Zaigun-Lalun Formations

Like everywhere, the Barut Formation is overlain by micaceous silty shales alternating with fine-grained thin-bedded sandstone, both being wine-red to purple-red in colour. The sequence continues upwards with a red quartzitic sandstone.

Compared to the Zaigun and Lalun Formation of the north Iran, the Zaigun Formation is more sandy in the Shirgesht area, and the boundary between the Zaigun and the Lalun Formation is less distinct. B. Hamdi and J. Jiang reported trace fossils: *Lachrymatichnus* cf. *inaidipingensis* Yang at Yin, *Flanolites* cf. *ammularis* Walcot indicating Lower Cambrian age.

On the western flank of the Derenjal mountain, Lalun Formation can be divided into two different members.

The Lower Sandstone Member is a typical Lalun Sandstone, it is purple, light-red to pink in colour, well-bedded with beds several centimeters to more than one meter thick, partly quartzitic and showing crossbedding. The upper part of the Lalun Formation consists of a red, thin to fine-bedded shale member alternating with several beds of red sandstone and layers of arenaceous dolomite which weather to light brown colour. Normally, there are only a few interbedded dolomite layers 1-2 meters in thickness. The sandstone layers are partly quartzitic and well bedded on a decimeter- to meter scale, partly thin bedded and intercalated with sandy shales. The colour of the shales and the sandstone beds is light wine-red to dark purple-red except for a few green coloured shale and sandstone layers.

Following trace fossils are reported by B. Hamdi *Rusophycus bilobatus* (Vanuxem, 1842) *Cruziana* ex: *plicata* Crimes et al, 1977 *Rusophycus* ex: *dydymus* (Salter, 1856) indicating Lower Cambrian (Toyonian) age.

Mila Group

In the sheet area, the Lalun Formation is overlain by a succession of dolomite, limestone, shale, siltstone sandstone ranging in age from Middle-Upper Cambrian to Ordovician. This sequence comprises of the following three different formations, under the name Mila Group.

a. Kalshane Formation

This rock unit consists of an irregular and chaotic mixture of a number of different rocks as follows:

- 1) Dolomite, black, dark-grey or ash-grey. compact or finely crystalline, with well bedded chert at some places.
- 2) Limestone, black and fetid or bluish-grey and nodular, rarely with cherts or chert bands.
- 3) Dolomitic shales, scarlet or yellow, rarely greenish or grey coloured partly sandy. frequently containing gypsum and other evaporites.
- 4) Basic volcanic rocks.

On the whole, the Kalshaneh Formation is a volcanic breccia, or agglomerate of great dimension, The sediments which are broken up into large blocks correspond well with the beds forming Member I of the Mila Formation.

At its base, the Kalshaneh Formation rests everywhere on the "top quartzite" formerly attributed to the Lalun Formation. At the top there is a normal contact between the Kalshaneh Formation and the overlying Derenjal Formation.

b. Derenjal Formation

The characteristic rock of this formation is a thin-bedded "flaggy" limestone, being black when hammered but yellowish to light brown at its weathered surface. The limestone is distinctly bedded, containing marly and silty intercalations and lenticular layers of sparry or sandy limestone. A grey massive limestone full of brachiopods 20-30 meters in thickness ("Billingsella limestone") is an excellent marker horizon at the top of the formation. The total thickness of the Derenjal Formation is more than 800 meters. According to the brachiopods assemblage, the Derenjal Formation is of Late Middle Cambrian to Late Cambrian age, and comparable to the Members 2 and 3 of the Mila Formation, Member 4 of the Mila Formation might partly correspond to basal beds of the Shirgesht Formation.

The northwestern brink of the Derenjal Mountains, east and northeast of Cheshmeh-e-Shorm, is composed of a monotonous rock series, formerly described by the informal name "Shorm Beds". This consists of thin bedded (of cm-to m scale) slaty limestone alternating at some places with greenish slates or greenish or pinkish phyllitic shales and a pink siliceous dolomite the whole rock series has clearly undergone slight metamorphism. The bedding planes of the Slates and partly of the limestone, are covered by a sericitic film and the limestone shows excellent microfolding.

The Shorm beds has been previously considered as Precambrian basement rocks in the Shirgesht area.

Recently Cambrian age is suggested by Trilobite Pygidium (cf. Ptychaspidiids trilobite pygidium)

c. Shirgesht Formation

In the map area, the Shirgesht Formation represents the third formation of the Mila Group. The formation covers a relatively small area in the southern and southeastern part of the Derenjal mountains. The Shirgesht Formation consists mainly of marl, limestone, siltstone and sandstone and on the whole is brownish-green in colour.

The unit contains intercalations of red limestone. Generally, three divisions can be recognized within the Shirgesht Formation as follows:

- 1) a lower section with nodular limestone at the base and marls, at the top (570m).
- 2) a middle fossiliferous horizon, characterized by red sandy limestones and greenish marls (166m.) containing trilobites, brachiopods, gastropods and cephalopods of Middle Ordovician age.
- 3) a top member consisting of grey to greenish-grey marls, shales and siltstones (500m).

However, in other part of Iran, there is no lithological break between the Derenjal Formation (Cambrian) and the Shirgesht Formation (Ordovician). The Cambrian-Ordovician border lies most probably somewhere in the lower section of the Shirgesht Formation.

Niur Formation

In the Derenjal mountains, the Silurian System is represented by the Niur Formation which consists mainly of limestone and sandstone, the former being partly very rich in corals and brachiopods. Sandstone and quartzite being partly white and form a conspicuous and mappable member in the middle part of the formation. Diabase is an important rock, which intersperse the lower part of the formation and form stratum parallel to the bedding. The fauna assemblages indicate a Silurian age, possibly reaching Early Devonian.

Padeha Formation

In the mapped area, the Padeha formation (730m) consist of well bedded quartzitic sandstone with ripple marks and cross-bedding. reddish-brown in colour. alternating with layers of sandy dolomite. The dolomite intercalations occur mainly in the lower part of the formation. In the Kalut area. the reddish top sandstone contain thin gypsum layers only sporadically. No fossil has been found, an Early Devonian age is inferred from the stratigraphic position.

Sibzar Dolomite

In the map area, the Sibzar dolomite is about 100m thick. It consists predominantly of dark grey to black, finely crystalline, well bedded on a decimeter and meter scale, and partly fetid dolomite. The contact of the Sibzar dolomite with the reddish silty-shaly and partly gypsiferous top beds of the Padeha Formation is extremely sharp, marking a break in sedimentation. Its age is probably early Middle Devonian, since a late Middle Devonian (Givetian) age of the overlying Bahram limestone is assumed.

Bahram Limestone

In the northern part of the Derenjal mountains, the core of the syncline southwest of Chah-e-Baba Ali is composed of bluish-grey limestone and light grey marl containing corals, brachiopods and the typical small tentaculites of the Bahram limestone formation. The facies of the Bahram Formation is somewhat different in

the southern part of the Derenjal mountains, where marls are more abundant, Fossil collection refer to Givetian to a Late Devonian, mainly Frasnian age.

Shishtu Formation

No Shishtu Formation is exposed in the Derenjal mountains except for a thin-bedded gray limestone with shaly intercalations exposed in the northern-most part of these mountains-which, may belong to Shishtu 1.

Sardar Formation

The Sardar Formation, having a hilly landscape, is made up of an alternation of dark greenish shale and brown-weathered sandstone the later being partly quartzitic. This sequence contains beds of brownish grey sandy limestone bearing echinoderms, bryozoans, brachiopods and cephalopods at some places. The sandy-shaly facies of the Sardar Formation is rather unique for the Carboniferous of Iran with a Late Visean to Early Nammurian age.

Jamal Formation

In the mapped area, the Permian deposits are represented by the upper part of the Jamal Formation. The uppermost part of the Jamal formation is exposed just beyond (west of) the major fault of Chah-e-Sorb. Here the formation consists of light grey limestone and ash-grey dolomite. Oolitic or sandy parts of the limestone show cross-bedding. The limestone contains small foraminifera, a few corals and brachiopods have also been collected there.

Mesozoic

Sorkh Shale Formation

It is a colourful formation consisting of calcareous and argillaceous shales with a characteristic tile-red to wine red colour. A few thin, harder beds of yellow to pink limestone are intercalated.

Poorly preserved lamellibranchs, small gastropods and serpula-like worm tracks, as well as the stratigraphic position and regional correlation indicate Early Triassic age.

Shotori Formation

In the map sheet area the Shotori Formation is well exposed in the Pirhajat mountains. Here, the lower part of the formation consists of well-bedded dark grey dolomitic limestone and dolomite alternating with light grey dolomite. Light yellowish coloured, well-bedded dolomite forms the upper part of the formation. This subdivision of the Shotori Formation, is mainly based on colour than lithology.

Only a few poorly preserved brachiopods and pelecipods are found here. The age of the formation is probably Middle Triassic

Shemshak Formation

in the map sheet area, the Shemshak Formation lies unconformably on various Triassic and Permian beds. It consist mainly of sandstones and shales, this formation is rather uniform throughout the area, although the thickness varies from more than 1000 meters to almost nil. Conglomerates exposed at the base of the formation at a few places rebresents basal unconformity. The basal beds of the formation consist predominantly of shales (140-200m) which are dark

olive-green to black in colour. Shaly units also appear, locally, in the middle part of the formation.

Badamu Formation

In the Pirhajat mountains, the Badamu limestone is dark grey to black in colour. It is fetid in parts, brown on weathering; sandy-oolitic and cross-bedded, with ripple marks on bedding planes.

The limestone is up to 50 meters thick and contain poorly preserved pelecypods, as pecten and oysters, pointing to a Toarcian age.

Hojedk Formation

This formation is exposed in the eastern part of the Pirhajat mountain, and it dominates in a 2 kilometer-wide strip along the major fault, west of the Chah-e-Sorb mine. Here, the Badamu Formation is overlain by a brownish-grey to reddish sandstone, containing intercalations of shales, marls and thin limestone layers. The total thickness is estimated to be almost 700 meters.

Parvade Limestone

It is a persistent ammonite-bearing limestone unit upto 40 meters in thickness. Here, the limestone overlies unconformably over various older rocks, and marks a new marine transgression during Middle-Upper Bathonian times. Generally, the limestone is gray to dark grey in colour, oolitic or detrital, well-bedded in the decimeter range, nodular and partly conglomeratic. Sponges, corals, spines of cidaris, belemnites and ammonites can be found in the limestone.

Baghamshah Formation

It is a rather uniform formation consisting of pale green marly shales and marls; conformably overlies the Parvadeh limestone. The light green marls form a friendly landscape with low hills and smooth slopes. Small contents of gypsum already noted from many places. Some paleontological evidence indicate a Late Bathonian to Early Kimmeridgian age.

Qaleh Dokhtar Formation

In the map sheet area, the Qaleh Dokhtar Formation is separated into two main rock units. The limestone (unit 1) occurs in form of elongated lenticular-shaped bodies of variable dimensions, either at the top or within or at the base of unit 2. This unit is mostly light bluish-grey in colour, frequently elastic; the limestone is well bedded and rather fossiliferous. The alternation of limestone, marl and shale (unit 2) at places represents zone of transition between the Baghamshah marls and the reef limestone of the Esfandiar Formation, the thickness of this unit range from about 200 to nearly 1000 meters. The unit interfingers with the Esfandiar limestone as well as with the Baghamshah marls.

Esfandiar Limestone Formation

This is a reefal limestone, built up mainly by algae; is massive to coarse bedded, yellowish-white in colour; forming steep cliffs and pale yellowish rock faces. Locally a detrital member is at the top of the formation. The reef facies overlies and/or substitutes for the Qaleh Dokhtar Formation. The main Esfandiar limestone is of late Jurassic age.

Garedu Red Beds

A Red-Bed facies joins the varied facies development of the Upper Jurassic. It consists of conglomerate, greyish-red to dark purple calcareous sandstone, dark red siltstone and shale and layers of bluish-grey limestone.

Cretaceous

in the region of Chah-e-Sorb, the Jurassic beds are unconformably overlain by a dark grey, well bedded limestone. The limestone is tentatively compared with Middle Cretaceous Orbitolina limestone, known in other parts of Central Iran. Light gray marl, marly limestone and greenish sandstone are exposed at the eastern corner of the Derenjal mountains. Some poorly preserved fossils suggest a Cretaceous age.

Cenozoic

Kerman Conglomerate

It consists of poorly sorted and scarcely rounded pebbles of dolomite, platy limestone and some grey sandstone. The Conglomerate rests unconformably on various older formations. The age of the Kerman conglomerate is problematic, a Latest Cretaceous or Early Tertiary age is possible.

Paleogene Dacite

It is a layer of dacitic tuff. 4 meters in thickness accompanied by 4-6 meters of tuffaceous sandstone. These volcanic rocks are interbedded with a thick complex of conglomerate, which forms the hills west of Kal-e-Gaz. The tuff contains angular fragments of plagioclase, hornblende, biotite and quartz; the groundmass consists of glass exhibiting a vitroclastic texture.

Neogene

The common features of the Neogene beds are conglomerates underlain by or interfingering with beds consisting of white gypsum and a small amount of salt with a few pebbles. sand-or silt-layers in between.

Quaternary

The map sheet area is largely covered by extensive gravel fans which consist of unsorted material derived from neighbouring mountain ranges. The dasht-cover may be divided into, the Recent gravel fans; the gravel fans of the actual dasht; old gravel cones at the foot of the mountains.

Sand dunes north of Pirhajat mountains represent the northeastern edge of an extensive sand belt which runs along this southeastern shore of the Great Kavir. Northern part of the map area is situated between two extensive Kavir-filled basins, the Great Kavir and Kavir-c-Namak. They consist mainly of yellow-brown salt-bearing silt and clay; salt and salt lake.

Structural History

As no rocks older than Cambrian are exposed in the mapped area, the Pre-Cambrian history of the area is not revealed. No angular unconformity has been found during the Paleozoic up to Middle Triassic, but several breaks in sedimentation are observed. An unconformity occurs at the base of the Shemshak Formation referring to Late

Middle Triassic tectonism. Parvadeh limestone, with a basal conglomerate, rests directly on Middle Triassic and Carboniferous beds, with a sharp angular unconformity, referring to a tectonic unrest during Bathonian time. Uninterrupted sedimentation lasted until latest Jurassic. An Early Cretaceous orogeny, can be conjectured. Late Cretaceous Paleocene movements are documented by a sharp unconformity between the Kerman conglomerate and Late Jurassic beds. The main orogeny of the Alpine diastrophic cycle was in Late Eocene-Early Oligocene times. Traces of Pliocene and Pleistocene movements have been found at many places, such movements occurred until sub-Recent times.

Economic Geology

There are indications of widespread mineralization in the Shirgesht area, This mineralization has affected equally Permian, Triassic, and Jurassic rocks. Generally, the mineralization appears in the form of carbonate or carbonate-quartz-veins, here and there containing lead and zinc ore; they all proved to be very poor. However, in the Chah-e-Sorb area, limestone of the Qaleh-Dokhtar Formation is comparatively mineralized. The abundant Chah-e-Sorb mine is at and around a hill which is an anticline formed by bluish-grey well bedded Qaleh Dokhtar limestone. The limestone is intersected by joints and minor faults some of which are mineralized, thus becoming veins. The filling of the veins consist mainly of calcite and varying amount of galena and barite.

Small lead ore deposits were explored in a similar Jurassic limestone south (Kuh.e-Mari) and north of the Chah-e-Sorb mine.

In the Pirhajat mountain, all lead deposits are located along faulted boundaries between the Shotori dolomite and the Shemshak Formation. The main lead occurrences in the Pirhajat mountains are Ma'aden-e-Kolor and Cheshmeh Bozu. None of which are presently in operation.