

**GEOLOGICAL MAP OF IRAN**  
**1:100.000 SERIES**  
**SHEET 6958- MESR**

**GEOGRAPHY AND GEOMORPHOLOGY**

The Mesr sheet area occupies a salt desert and its surrounding mountains. It includes the S periphery of the Great Kavir Depression in the N and two medium-height mountain massifs in the SW and SE. Nameless mountains (1,245-1,345m) occur in the SW corner of the sheet area, and the Kuh-e Kalateh mountain chain (up to 1,432m) rises in the SE of the area. Piedmont plains (900-1,000m) adjoining these mountains in the N are cut by the valleys of temporary watercourses. A relatively flat relief developed within the Great Kavir Depression on the Miocene molasses and Quaternary cover includes salt flats, lake plains, eolian dunes and alluvial-pro-luvial dashts. Absolute elevations of the floor of the depression vary from 709 to 735m.

There are no perennial rivers in the area. Numerous valleys cutting the mountain massifs and piedmont plains are worked out by temporary watercourses resulting from snow melting and rainfall during the late winter and spring periods. Small settlements of Chah Zard, Mesr, Amirabad which are connected by automobile roads are situated in the extreme S of the area.

**REVIEW OF FORMATIONS**

The oldest rocks represented by the Upper Proterozoic metamorphites of the Jandaq complex are exposed in the S part of the sheet area. In the vicinity of Chah Zard the Jandaq complex is subdivided into three units whose stratigraphic succession is obscure and therefore determined tentatively. The lower unit (600-800m) is composed of quartzite and quartzitic muscovite schists ( $P_j^q$ ). The middle unit (about 1,600m) consists predominantly of mica and garnet schists, less frequently, quartzite, amphibole-biotite-epidote and chlorite schists, marble ( $P_j^s$ ). The upper unit (500m) is represented by amphibolite and amphibole schists gneiss, occasionally, garnet and mica schists, marble, quartzite ( $P_j^a$ ). In the northern spurs of Kuh-e Kalateh the Jandaq complex represented by a unit of mica and garnet schists ( $P_j^s$ ) and the overlying unit (300m) of metamorphosed ophiolitic rocks ( $P_j^{oph}$ ). The later is composed of amphibole schists, metagabbro, amphibolite, serpentinite, less frequently quartzite and marble.

The Chah Palang formation crops out in a small area in the SE of the sheet, in Kuh-e Kalateh. It consists of variegated micaceous sandstone and siltstone with interlayers of conglomerate, gravelstone and shale. The contact of the formation with the older Upper Proterozoic metamorphites is ubiquitously faulted. The total thickness is 300m. The Late Jurassic and Early Cretaceous age of the rocks is deduced from their stratigraphic position in the adjacent areas. The Chah Palang formation is, most probably, a stratigraphic equivalent of the Upper Jurassic Garedu red beds.

The Nogreh formation occurring at the base Cretaceous sequence is developed in the SE part of the area in Kuh-e Kalateh. Where the rest of the Cretaceous formations crop out as well. It is represented by conglomerate, gravelstone and sandstone which are red in the lower part and grey in the upper part. They occur on the subjacent Chah Palang formation with an angular unconformity. The thickness is 200m. In the uppermost part of the Noqreh formation, the calcareous sandstone beds occurring among conglomerates contain the Cretaceous foraminifers: *Orbitolina* sp., *Quinqueloculina* sp.

Upward, there occurs the Shah Kuh formation which is composed of grey, locally pinkish *Orbitolina* limestone and sharply subordinate interlayers of marl, clayey limestone, occasionally dolomitized limestone and calcareous sandstone. The thickness is 200-250m.

The following foraminifers have been collected in the *Orbitolina* limestone, mainly in the lower part of the formation: *Orbitolina* (*Palorbitolina*) *lenticularis* Blum., *Quinqueloculina* sp., *Gaudryina* sp., *Haplophragmoides* sp., *Lenticulina* sp. Ets: brachiopods: *Belbekella* cf. *aptiensis* Smith, *B. cf. barteloti* (Kilian), *Cylothyrus* aff. *latissima* (Sow).

*Burrirhynchia leightonesis* (Lamp), *Orbirhynchia* cf. *orbignyi* (Petitt) and rudists: *Toucasia carinata* (Mather), *Mono-pleura* ex gr. *urgonensis* Mather, *Radiolites* sp. The presence of the Aptian plankton foraminifers *Orbitolina lenticularis* (Blum) and Barremian-Aptian rudists *Toucasia* (Mather) suggests the Barremian-Aptian age of the formation. On the other hand, brachiopods *Orbirhynchia* cf. *orbignyi* (Petitt) found in the upper part of the formation point to Albian age of this part of the formation.

The Bazyab formation is of a limited distribution and crops out chiefly in the SE of the area. It occurs conformably on the Shah Kuh formation and consists of marl, clayey limestone, limestone with

siltstone and mudstone interbeds. No organic remains have been found in these rocks within the sheet area. The thickness is 20-40 m. The Aptian – Albian (mainly Albian) age of the formation is confirmed by the findings of the Lower Cretaceous brachiopods made in the adjacent territory of sheet 7058.

The Debarsu formation crops out in Kuh-e Kalateh and ESE of Amirabad. It is represented by limestone, sandstone with interlayers of marl and gravelstone. The sandstone contains glauconite. The rocks occur either without any noticeable unconformity on the limestone of the Shah Kuh formation or have a faulted contact with the subjacent Bazyab formation. The thickness is 150m. The Cenomanian-Turonian age of the formation is confirmed by the findings of stromatoporoid: *Actinostromaria stellata* Dehorne and *Tosastroma karassuense* Savorsky.

The Haftoman formation occurs also in the SE of the sheet area, E of Amirabad. It rests transgressively on the underlying Debarsu formation and is composed mainly of rudist limestone with basal conglomerate and gravelstone. The thickness is 50m. The Lower Senonian age of the formation is assumed tentatively according to correlation with the type section measured southward. On the sheet area the Haftoman formation is found to contain Santonian brachiopods: *Cretirhynchia* cf. *laevistriata* Katz, *Orbirhynchia* cf. *pisi-formis* (Petitt); Senonian echinoids: *Echinocorys* sp. *Conulus* sp. Pelecypods: *Lima* cf. *marrotiana* Orbin; also recognized in the Upper Turonian and Coniacian of the Central Asia; and Albian-Maestrichtian rudists *Durania* sp.

The Farrokhi formation is most widespread among the Cretaceous rocks. In the SE part of the sheet area, in Kuh-e Kalateh, it is observed to rest conformably on the Haftoman formation. The formation is characterized by a three-member pattern. The lower member (200m) consists of marl with a few interlayers of calcareous siltstone and clayey limestone ( $K_f^m$ ). The middle member (500m) is represented by limestone with characteristic chert concretions and nodules ( $K_f^{ll}$ ). The upper member (300m) is distinguished by an irregular alternation of limestone and marl ( $K_f^{l2}$ ). The Upper Senonian-Danian age of the formation is assumed on the basis of the fauna collections made chiefly in the easterly and south-easterly adjacent areas (sheets 7058,7057). On the territory of sheet 6958 the formation contains: *Echinocorys* aff. *oblique* Raven, *Hemiaster* sp., *Brissopneustes* sp. And other echinoids typical mainly of the Danian stage.

The Pis Kuh formation is common in the extreme SW of the area. It is represented by an alternation of brown and light marl with intercalations of greenish-Grey and brown sandstone, gravelstone and conglomerate. The lower contact is transgressive. The thickness is 1,000m. Based on the stratigraphic position and nummulites collected on the territory of sheet 6858 the age of the formation is taken as Middle-Late Eocene.

The Upper red formation is most common in the sheet area and crops out in its central and northern parts. It consists of gypsiferous and salt-bearing light to brownish-red marl and clay with interlayers of gypsum, sandstone and conglomerate. The lower contact of the formation is transgressive. The thickness is 2,000-2,500m. The Miocene age of the formation is determined by its correlation with similar paleontologically characterized rocks of the adjacent areas.

The rocks of supposedly Pliocene age are exposed mainly in the SW part of the sheet. They consist predominantly of light brown boulder and boulder-pebble conglomerate, cemented by sandy-gypsum or carbonate material. The thickness is 50m.

Quaternary sediments are ubiquitous. They are classified on the basis of geomorphological data and relative age into oldest, old, young and recent, and by their genetic types-into alluvial (pebble gravel, sand, conglomerate, gravelly sandstone), proluvial (pebble gravel, sand), lake and eolian sand, sediments of clay and salt flats (takyr and kavir) represented by clayey sand, Salinized clayey sand, sandy clay and clayey salt.

Marble of the unknown age crops out in extreme SW and SE of the area as small (less than 1 sq. km) nappes, which consist of homogenous banded marble with small patches of secondary dolomitization and sideritization. The thickness is 200m.

## INTRUSIVE AND SUBVOLCANIC ROCKS

The intrusive complex represented by the Qanbar massif on the northern slope of Kuh-e Kalateh near the Chah Qanbar water well is supposedly of the Late Proterozoic age. The massif is composed of granite-gneiss, granite (an intrusive phase itself), and aplite, granite porphyry, lamprophyre (a vein phase). Both the intrusive rocks and the rocks of the Jandaq complex have undergone metamorphism in the epidote-amphibolite facies.

Another intrusive complex supposedly of the Mesozoic (pre- Upper Jurassic) age crops out on the SE of the sheet area as an elongated rather narrow body confined to a sublatitudinal fault that separates the Upper Proterozoic metamorphites and Jurassic rocks.

The complex consists mostly of granodiorite and granite; less frequent are gabbro, diorite and quartz diorite which, unlike the Late Proterozoic intrusive complex, have not been subjected to metamorphism. All the above rocks are found in the conglomerate pebble and in sandstone grains of the Upper Jurassic-Lower Cretaceous Chah Palang formation. The absolute age determinations of the rocks of the complex in sheet 7058 (158 and 147 m.y.) confirm the Jurassic age of the granitoids.

The Eocene subvolcanic rocks observed as single dykes composed of andesite and andesite-basalt crop out in the SE of the sheet area, in the vicinity of the Chah Qanbar well.

## STRUCTURAL FEATURES

The sheet area is characterized by a fold- block structural pattern with resulted from the Alpine and earlier tectonic movements. It includes the N periphery of the Anarak-Khur massif and the S part of the Great Kavir Depression.

The Anarak-Khur massif occupies the S part of the area. The Great Kavir Fault which is masked by young sediments within the sheet area serves as its northern termination. The fault is traceable in the central part of the area in the NE direction as zones of slight plicative dislocations and fractures in the Miocene rocks. The basement of the Anarak-Khur massif exposed in the SW and SE parts of the area is composed of intensely deformed Upper Proterozoic metamorphites and granite-gneiss. The metamorphic rocks are notable for tight folds of the NE and sublatitudinal trends. Less frequent are brachyfold or nearly dome- like structures.

The latter can be exemplified by a fragment of the dome-like structure occurring in the N spurs of Kuh-e Kalateh where outcrops of granite-gneiss are surrounded by schists of the Jandaq complex with distinct periclinal dips of 50-70°. The coincidence of the foliation trends, as well as a similar degree of metamorphism of the intrusive and enclosing rocks of the Jandaq complex at the level of the epidote-amphibolite facies point to the fact that they were metamorphosed simultaneously, most probably during the Baikalian epoch. The desimentary cover of the massif is developed only in the SE of the area. It is represented by the Upper Jurassic-Lower Cretaceous and Cretaceous rocks attributed to the platform structural stage. The Upper Jurassic-Lower Cretaceous terrigenous rocks (Chah Palang formation) are crumpled into asymmetric conjugate anticlinal and synclinal folds with a span of limbs attaining several tens to hundreds of meters. The Cretaceous essentially carbonate sediments are deformed into gentle brachy folds or are cut into separate blocks, showing a monoclinial dip of beds. Complexes of the tectono-magmatic reactivation are represented by Mesozoic granitoids intrusions and Eocene grey molasses. The former are restricted to the sublatitudinal fault zone separating the cover of the massif from its basement. The Eocene molasse sediments are common in the marginal part of the massif. Where they are deformed into gentle brachyfolds.

The Late Alpine Great Kavir Depression occupies the major northern part of the sheet area. This superimposed type structure which result from the Late Alpine orogeny is constituted by Miocene and Pliocene Quaternary deposits. The Miocene red molasse is crumpled into simple brachyfolds with a span of limbs attaining 3-5 km and more. The dip angles of beds on the limbs are usually gentle (10-30°) and only near the fault zones they reach 50-70°. The Pliocene-Quaternary coarse-fragmentary rocks form an almost horizontal undisturbed cover.

## MINERAL INDICATIONS

In the S part of the area there are minor ore occurrences of copper. Mica (muscovite) and talc. The mazre eh-Ostahan copper ore occurrence located in Kuh-e Kalateh is represented by thin quartz-sulfide veins which occur in the crush zones in the metamorphic rocks of the Jandaq complex. The muscovite occurrences known from several localities in the SW of the area and N of Chah Zard are associated with pegmatite veins occurring in the Upper Proterozoic schists. In the same area there is also an occurrence of falc forming lenticular bodies in the same schists. Besides, weakly contrast geochemical anomalies of copper, zinc, nickel, molybdenum and heavy concentrate haloes of tungsten and gold of low concentration have been identified in the S of the area.