A SKETCH OF POST-CRETACEOUS VOLCANISM IN CENTRAL IRAN

by

J. J. DOZY

(N. V. De Bataafsche Petroleum Maatschappij, The Hague)

Summary

The present article is a short description of field observations relative to the occurrence of rocks of a volcanic nature in the Tertiary and Quaternary of Central Iran.

Further study might perhaps reveal a genetic relationship.

Introduction

During a geological reconnaissance made in 1944, the author gained an insight into the geological history and main tectonic features of Central Iran. He was struck by the importance of volcanic deposits in the post-Cretaceous stratigraphical column in contrast to older formations. Rapid facies changes were caused by volcanic activity in marine, as well as terrestrial surroundings. Because these volcanic deposits, such as lava's, dykes or flows and coarse agglomerates are in general more resistant to weathering than the contemporaneous detrital sediments, the former form conspicuous elements in the morphology, whatever their relative age.

The following article should not be regarded as a final contribution. It has been written on the basis of field observations, so that petrographical names are "field names" only. It is hoped, however, that stating the problem of possibly interrelated volcanic activity in this tectogenic median zone — lying between two pronounced geosynclinal areas, will lead to further and more extensive studies.

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1. Palaeogene volcanic series

(Middle to Upper Eocene and Lower Oligocene)

The Lower Tertiary is marked by a transgressive sequence of sediments amongst which — in contrast to the sedimentary sequences of the late Mesozoic — eruptive rocks play an important, frequently even dominant rôle.

Most conspicuous are extrusive masses and flows of intermediate to basic dark grey andesitic rocks of Lower Tertiary age, with thier tuffaceous agglomerates, conglomerates, cineritic beds, volcanic breccia's, etc. Such formations outcrop in the mountains N of the plain of Saveh, in the Kuh-i-Tafrish Kuh-i-Busqush SSW of Saveh, in the Kush Kuh and Kuh-i-Sefid-Ab, E and NE of Kashan and other isolated mountains of the Siah Kuh (figs. 1 and 2), Kuh-i-Dowazdeh Imam, and Narakha Kuh.

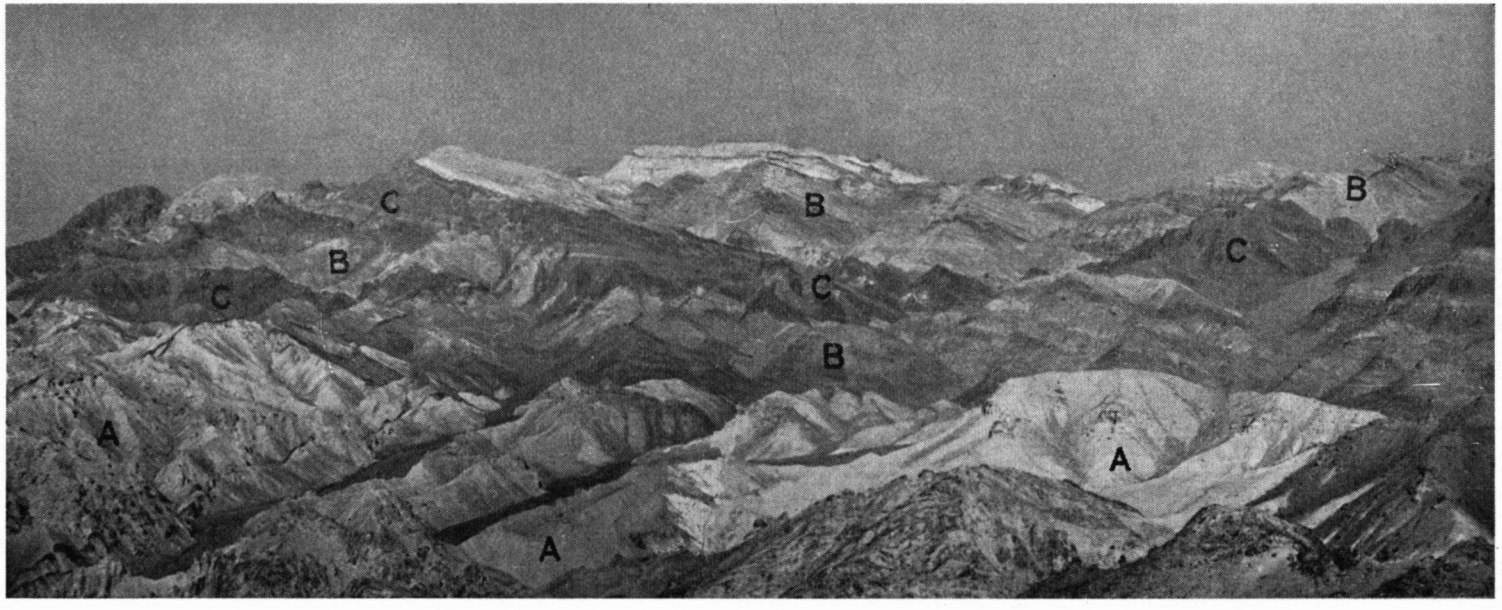


Fig. 1. Palaeogene Volcanic Series along the South side of the Siah Kuh range. North flank of an anticlinal uplift, exposing

A. white coloured quartz porphyry tuffs, vitric tuffs, etc.;
B. Eo-Oligocene sediments partly tuffaceous;
C. dark coloured lenticular masses and layers of eruptive rocks of andestic type.

At many places volcanic eruptions must have taken place below sea-level. Their tuffaceous deposits were mixed with normal marine sediments as is demonstrated by the occurrence of marine fossils and well bedded finely laminated sediments and limestones (e.g. fig. 2). From the Elburz mountains thick sequences of marine sediments with tuffaceous admixture have also been described by previous authors, such as RIVIÈRE and BAILEY as "couches vertes" or "green series".

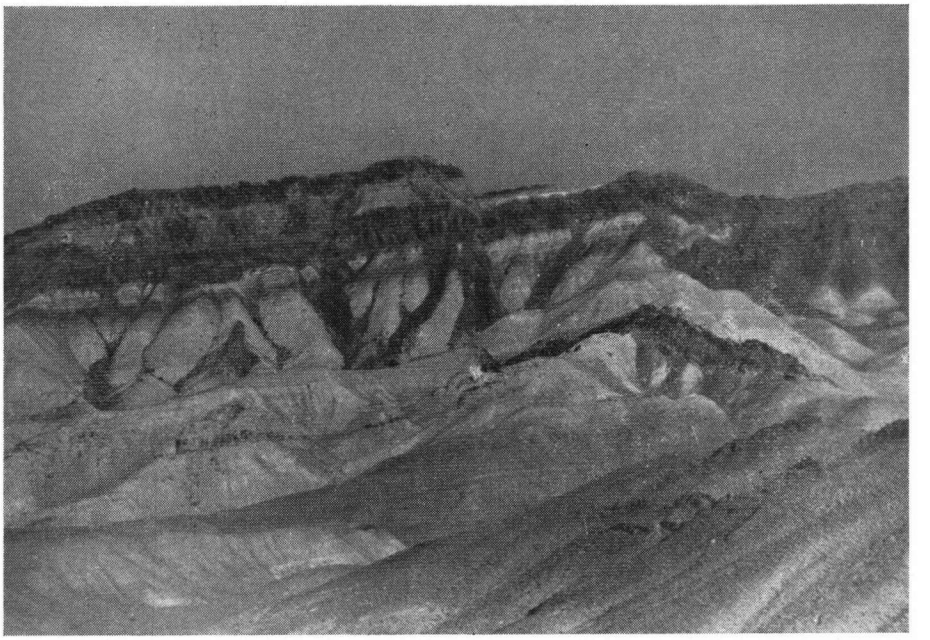


Fig. 2. Marine facies in the Siah Kuh. Palaeogene volcanic rocks overlying and intercalated into sequence of marine sediments, grading over into green tuffaceous sediments of "couches vertes" nature. NE flank of Siah Kuh.

However, many islands of a volcanic nature must have emerged from this Lower Tertiary sea as can be imagined in the area NE of Saveh and in certain ranges which are crossed by the Qum-Teheran road.

This state of affairs may also be concluded from the occurrence of rapid facies changes at relatively short distances, horizontally as well as vertically, whilst minor unconformities have been observed. Intercalations of detrital mostly fossiliferous limestones between volcanic sequences, may well represent reef-like deposits on shoals or around volcanic islands.

Marine fossils point to a Middle to Upper Eocene age, while also part of the Oligocene must be represented.

Mention should be made of a series of devitrified white quartz-porphyries with fluidal texture, porous ash-tuffs, white quartz-porphyry tuffs, vitric tuffs and tuffaceous agglomerates of an acid nature.

Sparse quartz crystals and rare decomposed phenocrysts of dark minerals may be present.

This acid sequence outcrops in the core of the Siah Kuh anticline on

the South side of the mountains bearing that name (fig. 1, foreground) in the Kuh-i-Arath South of Teheran (biotite and felspar phenocryste were observed). In the mountains N of km 90 of the road Teheran Qum, sometimes greenish, or light varicoloured thin-bedded arkose-like sandstones and quartz porphyry tuff agglomerates occur.

For the time being, we would also ascribe an Eocene age to these rocks, in which case the unconformity at the base of the darker more basic andesitic eruptive series would conform to an intra-formational break within the Eocene.

Since the base of this sequence was not observed by us, an older age is not excluded.

Concluding, we refer to figure 3, on which some columnar sections have been compiled. The irregular distribution of various types of sediments and rocks of a volcanic nature within the Palaeogene is clearly demonstrated.

2. Oligocene red series

(Lower to Middle Oligocene)

Towards the end of the Lower Tertiary, the sea must have regressed from central Iran. In certain depressions and basins subaqueous sedimentation still took place, but the deposits were more of a lagunal, terrigenous or terrestrial nature; chemical sedimentation also occurred.

Rock-salt and gypsum sometimes in combination with yellow soft marl occur locally and give rise to diapiric structures and salt-domes (Palangabad, Kuh-i-Namak). On the rock-salt of Kuh-i-Namak, blocks of vesicular andesite have been found to float; an indication again as to volcanic activity during this period.

Along the edges of lagunes or depressions, coarse and conglomeratic deposits marked the transition towards or the proximity of, larger or smaller land-masses or islands of frequently volcanic nature. Elsewhere siltstones and sandstones were deposited whilst the presence of green tuffs still betrays persistence of active volcanism on land.

NE of Do Barader mountain (S of Qum) an abrupt lateral transition between Oligocene Red Series and eruptive rocks can be observed.

3. Qum formation

(Uppermost Oligocene and Lower Miocene)

Towards the end of the Oligocene almost the entire area of Central Iran was flooded by a sea encroaching from the SW or W, depositing chiefly marls and limestones with many fossils. This light coloured limestone formation forms a conspicuous element in the landscape, and one is almost led to believe that during these stages volcanism was completely dormant. Although in general over large areas, no volcanic activity took place, we found at least one locality where a basaltic volcano probably emerged from the rather shallow sea. Near Khurabad, roughly 15 km SSE of Qum a lenticular shaped cross section through a basaltic volcano can be seen (fig. 4), its primary slopes being formed by basalt boulders, later taken up into the limestone ledges; to day these ledges appear to be interrupted by the volcanic rocks which are less resistant to weathering.

Intercalations of andesitic tuffs may occasionally be found elsewhere within the limestone and marl series.

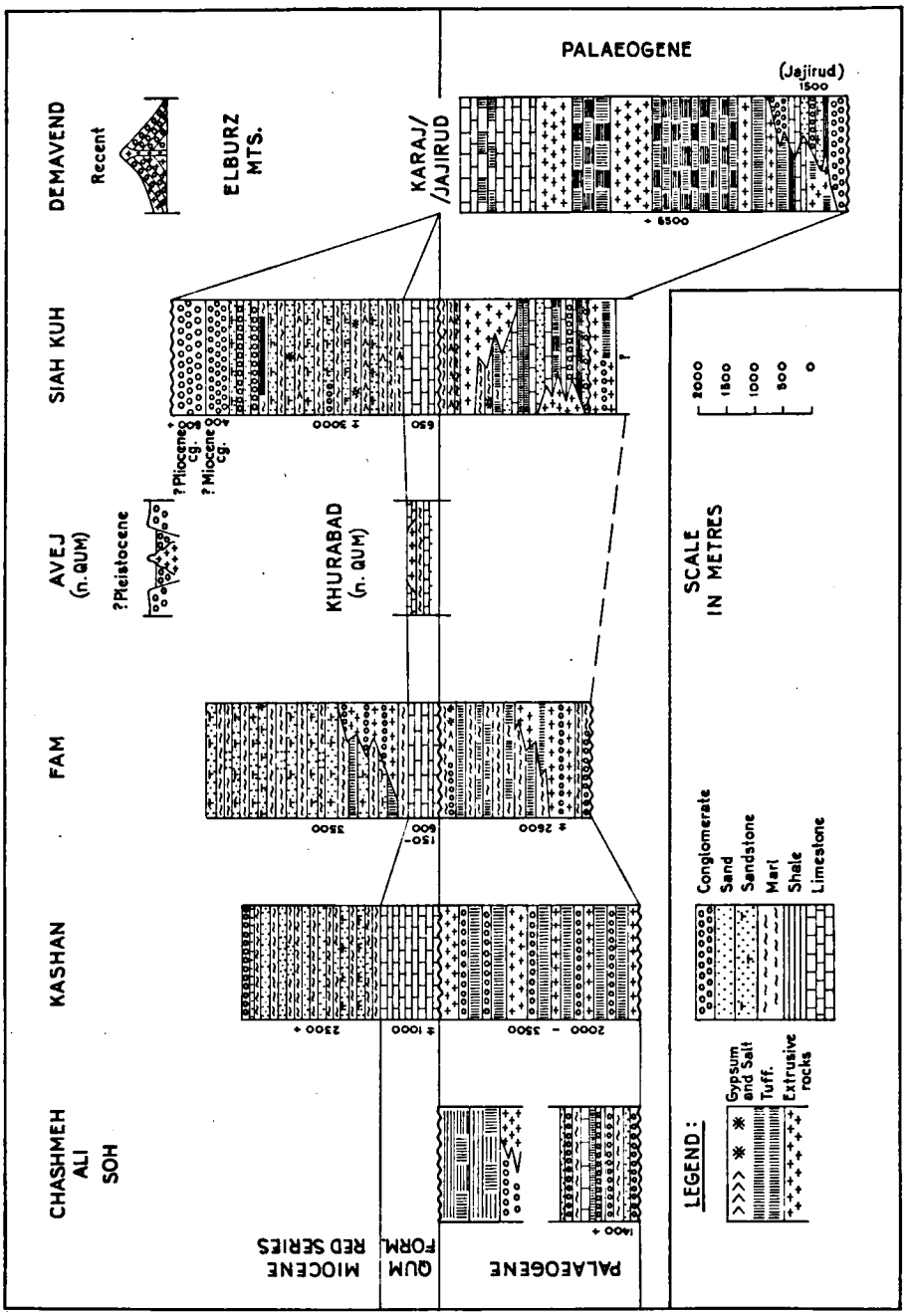


Fig. 3. Schematic columnar sections through Tertiary of Central Iran.

4. Miocene volcanic series

(Middle to Upper Miocene)

The Qum Limestone Formation is conformably covered by a thick sequence of terrestrial detrital deposits where red colours prevail again, the so called Miocene Red Series. However, at several localities, notably so in the area between Qum and Araq (Sultanabad), several high mountains appear to be composed of volcanic rocks, again of an andesitic nature with their tuffaceous and agglomeratic sequences. They are rather similar in appearance to the Palaeogene volcanic series but their age is clearly established by the fact that

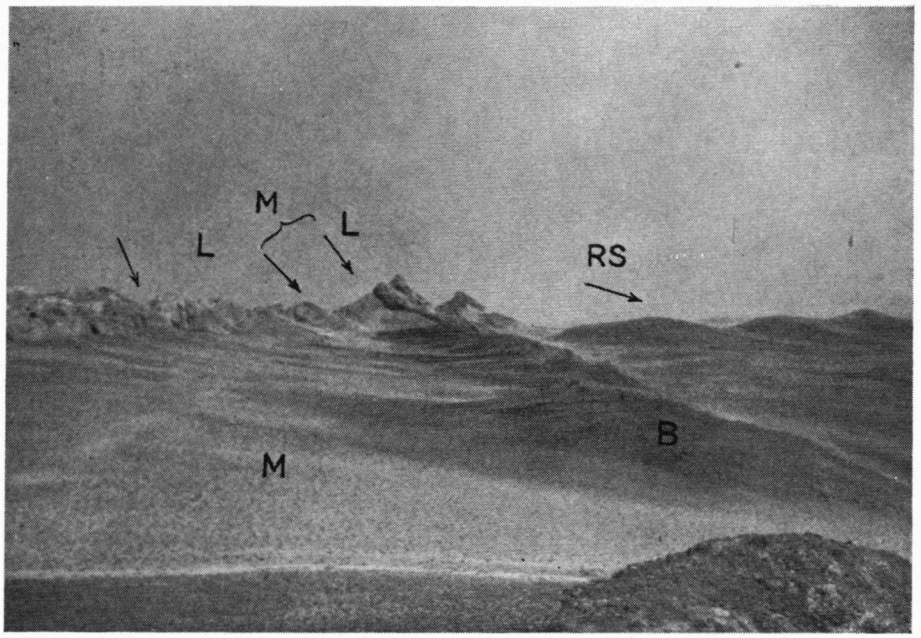


Fig. 4. Basalt in the Qum formation. Near Khurabad village ± 15 km SSE of Qum. Picture taken in direction of strike of uniformly to the right (SW) dipping sequence consisting of: (left) limestone ledges (L) then a marly layer (M) and again (background) a summit representing the outcrop of an uppermost limestone ledge (L) of the Qum Formation. Right foreground darker coloured basalt outcrop (B) which ends immediately behind the place where the foto was taken and where the limestone ridge (interrupted by the basalt) reappears. Right background Miocene Red Series (R. S.).

they overlie Qum Limestone Formation of Lower Miocene age, as is clearly the case in the Kuh-i-Zaghar S of Qum (fig. 5). At the Kuh-i-Raghird and Kuh-i-Ali Nazar some 400 metres of Miocene Red Series form the base of the volcanic deposits of these conspicious mountains. Elsewhere only tuffs are found intercalated into Miocene Red Series or volcanic intercalations may even be missing entirely (see fig. 3, Fam).

5. Plio-Pleistocene volcanism

The Miocene Red Series grades at several places into an overlying sequence of conglomerates of supposedly uppermost Miocene Age, which in

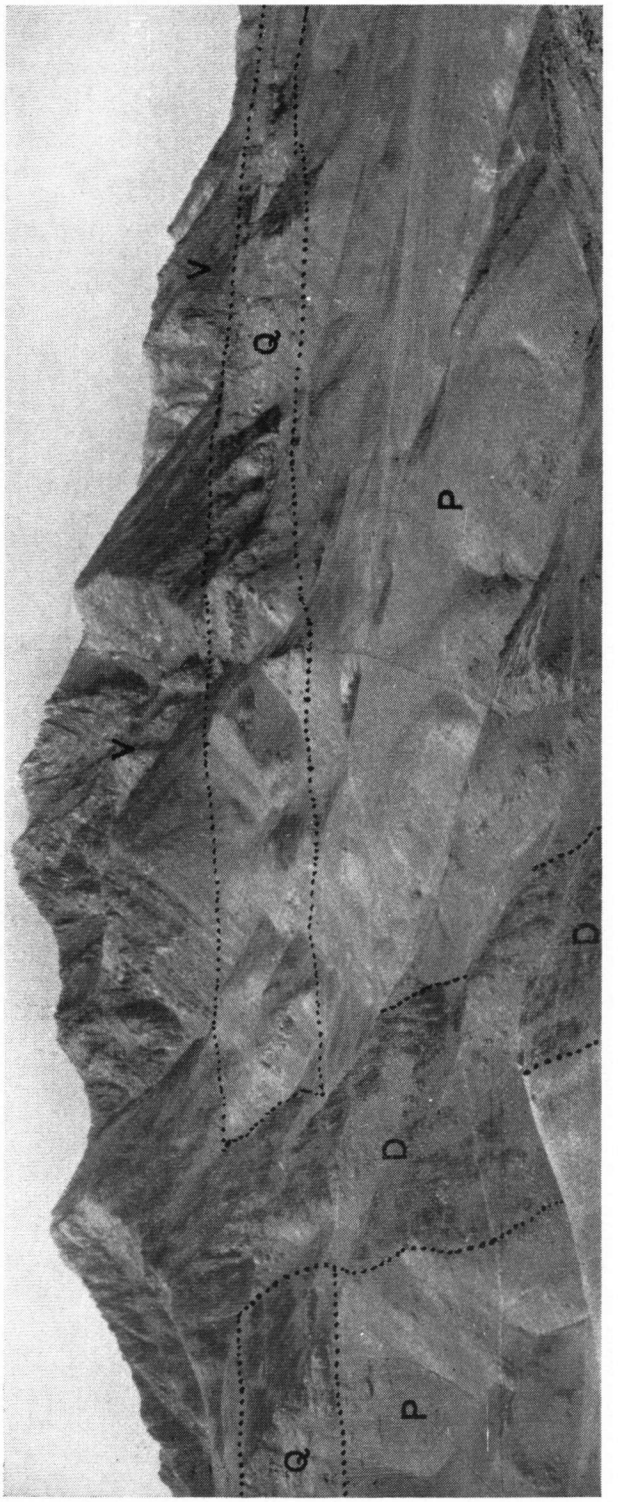


Fig. 5. Kuh-i-Zaghar. A Miocene volcanic sequence (V) with connected dike (D) overlying Qum limestone (Q) and a Palæogene marine sedimentary — tuffaceous sequence (P).

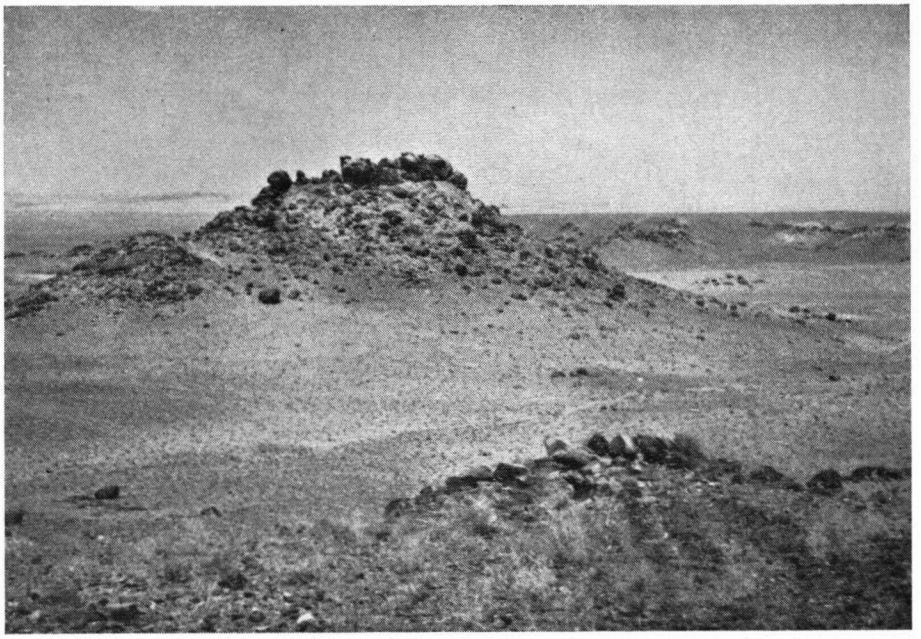


Fig. 6. Possible explosion crater and plug near Avej. Dioritic plug in circular craterlike depression.

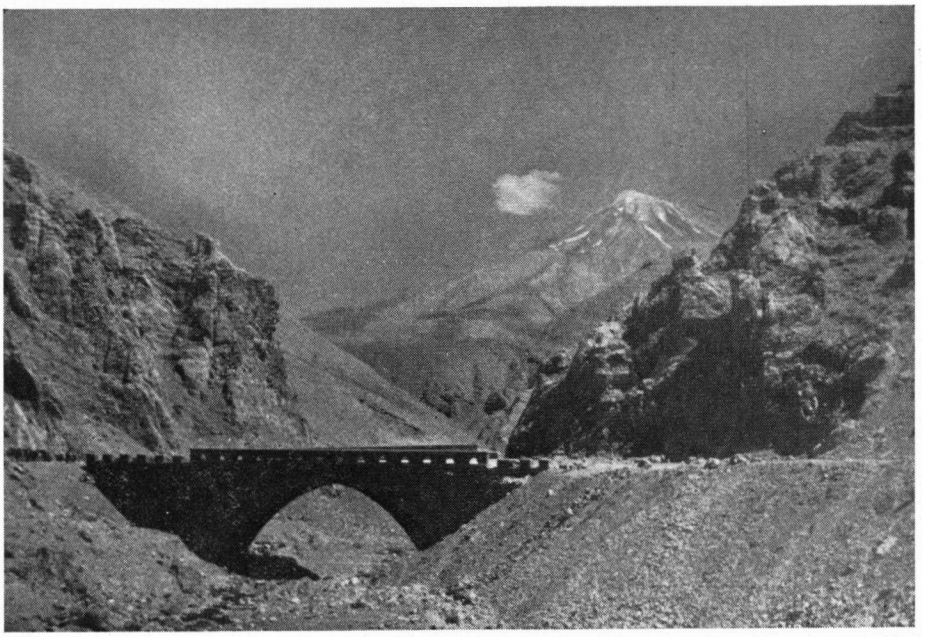
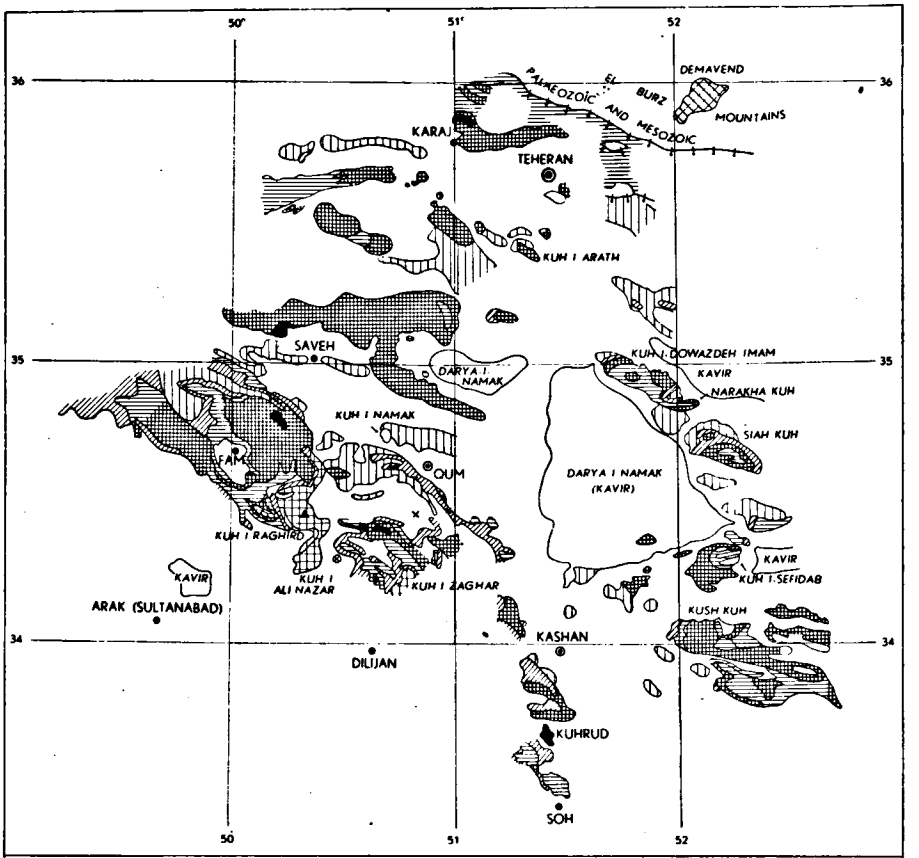


Fig. 7. Demavend volcano in the Elburz mountains.



LEGEND

PRETERTIARY, QUATERNARY AND UNSURVEYED	UNCOLOURED
RECENT VOLCANIC DEPOSITS (DEMAVEND)	
PLEISTOCENE-RECENT EXPLOSION CRATER	
UPPER TERTIARY SEDIMENTS	
MIO-PLIOCENE VOLCANIC SERIES	
QUM FORMATION WITH OBSERVED ERUPTIVES	
PALAEOGENE SEDIMENTS	
PALAEOGENE VOLCANIC SERIES WITH INTRUSIVES	

Fig. 8. Geological sketchmap of the Tertiary in Central Iran.

turn are overlain, sometimes unconformably, by a series of conglomerates of possibly Pliocene age. Again a younger formation of conglomerates — lithologically, mostly idential with the older ones — can be discerned on general geological and morphological grounds. It comprises remnants of old terraces and scree fans and may therefore be ascribed tentatively to a Pleistocene age.

There are indications that at least during the last mentioned period, volcanic activity still occurred. Near the village of Avej roughly 20 km SSW of Qum, we found what looked like an explosion crater with a plug of dioritic rock in its center. This crater relic occurs in a possibly Pleistocene terrace landscape (fig. 6). A similar age may perhaps be ascribed to a large plug-like hill SW of Chashmeh Ali on the road from Qum to Dilijan and Isphahan.

6. Recent volcanic activity

In the region under discussion, phenomena pertaining to recent volcanic activity have not been met.

For completeness sake, however, mention should be made of the fact that volcanic activity in the general neighbourhood is still persisting to-day. The cone of Mount Demavend rides high on the Elburz mountain chains and is still in a solfataric stage (fig. 7). However, it is situated in a rather different tectonic setting, superimposed as it is on the folds and upthrusted masses of Paleozoic and Mesozoic sediments.

7. Intrusive rocks

Intrusive rocks connected with the above-described volcanic activity have also been observed. They are mostly holocrystalline rocks with a granitic texture. Fine textured granites NW and SSW of Saveh may be connected with the Palaeogene Volcanics amongst which they are intruded.

Probably of a younger age — perhaps connected with a Miocene volcanic phase or younger — some rather leucocrate rocks of a more dioritic type occur. They form conspicuous mountains close to the Qum — Chashmeh Ali road and are chiefly intruded into Palaeogene volcanic rocks. However, in the same neighbourhood intrusions into steeply dipping Qum limestones and marls occur, giving rise to interesting skarn-like contact phenomena. It is therefore not excluded that these intrusions are even younger than Lower Miocene and may be related to a Pliocene folding phase.

Mention should also be made of a large intrusive mass of granite or granodiorite S of Kashan, near the village of Kuhrud. Haematite and some other ores are found at the contact with limestones. The rock occur in Liassic shales and quartzites, but may well be linked with a Tertiary volcanic phase.

Addendum

Since the above article was written, two important publications regarding the area in question have appeared. Reference is made to:

GANSSER, A., 1955. New aspects of the geology in Central Iran. Proceedings Fourth World Petroleum Congress, Section I/A/5, p. 279—300.

FURRER, M. A. and SODER, P. A., 1955. The Oligo-Miocene Marine Formation in the Qum Region (Central Iran). Proceedings Fourth World Petroleum Congress, Section I/A/5, p. 267—277.