Geology of the Bitlis Metamorphic Belt

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ABSTRACT.— The Bitlis Metamorphic Belt forms apparently the uppermost tectonic unit of the Taurus orogenic belt. The belt is covered by the Tertiary age units of the Muş basin in the north and is underlain from north to south by the Baykan Complex of Eocene age, Çüngüş Complex of Eocene-Miocene age and the sediments of the northern margin of the Arabian Autochthon. The underlying units are in tectonic contact with one another.

The lowermost unit of the Bitlis Metamorphic Belt is the Hizan Group of pre-Middle Devonian age. The Hizan Group comprises bands and lenses of eclogite probably derived from basic magmatic rocks, in addition to gneiss and schists of sedimentary origin. Observations concerning the rocks of the Hizan Group suggest that they have undergone two different phases of metamorphism prior to the retrograde metamorphism that effected the cover rocks as well as the Hizan Group.

The Hizan Group is unconformably overlain by the rocks of the Mutki Group which are shelf sediments constituted by metaquartzite and recrystallised limestone of Middle Devonian to Middle-Upper Triassic ages. The volcanism during the Middle-Upper Triassic indicates a rifting in the north of the region and the deep-sea sediments overlying the volcanites point to the continuing development of the Bitlis Metamorphic Belt as a collapsed continental margin in the post-Triassic times. The Mutki Group of rocks including the granite of pre-Permian age has undergone a low grade metamorphism during the Upper Cretaceous (95 m.y.).

The Guleman Ophiolite and the metavolcanosediments (Campanian) lie over the Mutki Group with a tectonic contact. A seperate metamorphism of glaucophanic greenschist facies is observed in the metavolcanosediments and gabbros. Deformation and compression developed in the Bitlis Metamorphic Belt during Upper Cretaceous (75 m.y.) related to the obduction of the ophiolite flysch. Rocks of the Guleman Group were covered by a flysch of Upper Maastrichtian age. The filysch contains blocks of both the Guleman Ophiolite and the Bitlis metamorphites and is not metamorphosed.

Rocks of Paleocene-Middle Eocene age lie unconformably over the rocks that form the Bitlis Belt. The belt acquired its present imbricated structure following the post-Eocene overthrusting and it was thrust over the Baykan Basin which opened and closed during the Paleocene-Middle Eocene.

INTRODUCTION

The Bitlis Metamorphic Belt forms an arc in the eastern part of the Taurus Orogenic belt, approximately 300 km long and 60 km wide. The Belt is composed of numerous tectonic slices thrust over one another. The Tertiary sediments of the Muş basin overlie the Bitlis Metamorphic Belt beneath which, in the south, lie the sediments of the Arabian Autochthon and the Tertiary Ziyaret and Baykan Complexes which have tectonic contacts with one another. The first detailed local studies of the successions in the Bitlis Metamorphic Belt are those of Boray (1973), Hall (1974) and Yılmaz (1975). These workers stated that the metamorphites could be divided into a highly metamorphosed core and its cover rocks. One of the early interpretation of the geological evolution of the Belt is that of Tolun (1953) who suggested that the metamorphites form the basement of the region. Kellog (1960) proposed that the Bitlis metamorphites are composed of sedimentary rocks deposited in the time interval Devonian ?-Upper Cretaceous and that they are the metamorphic equivalents of the Arabian autochthonous succession. The first modern geodynamic interpretation of the Eastern Taurus Belt which included the study area was done by Horstink (1971). Sungurlu (1974, 1979) extended this interpretation and described the allochthonous units in the region. Şengör and Yılmaz (1981) tried in the light of available data to model the evolution of the whole of the Tethys belt. However, the present authors feel that the basic geological data used in the above interpretations is remarkably incomplete. An attempt is made in this study to present a succession which would be valid especially for the whole of the Bitlis Metamorphic Belt.

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It is hoped that the description of the succession will lead to healtier interpretations related to the geological evolution of the Bitlis Metamorphic Belt.

THE BITLIS METAMORPHIC BELT

The Bitlis Metamorphites are composed of a metamorphic basement of pre-Devonian age (the Hizan Group) overlain unconformably by metamorphic platform sediments of Palaeozoic-Lower Mesozoic age (the Mutki Group). They comprise numerous tectonic slices (Fig.1). Serpentinites or unmetamorphosed rocks of Upper Mesozoic and Tertiary ages crop out inbetween the tectonic slices. The Guleman Ophiolite of Upper Cretaceous age lies over the Bitlis Metamorphites with a tectonic contact (Fig. 2).

The Hizan Group

The Group which presents widespread exposures in the middle sectors of the Bitlis Metamorphites is composed of gneiss, schist and metabasic rocks which show vertical and lateral gradations with one another. The lower part of the unit contains biotite gneiss, garnet-biotite gneiss, muscovite-biotite gneiss, muscovite-garnet gneiss, albite-augen gneiss and hornblende-biotite-garnet gneiss in addition to the Andok Gneisses which contain scarce bands of metacarbonates. The metabasic rocks which occur as bands and lenses of various dimensions mostly in the Andok Gneisses are collected together under the name of the Ünaldı Formation. The Ünaldı Formation is composed of hornblende schist, amphibolite, garnetiferous amphibolite, eclogite, kyanite-eclogite and meta-pegmatitic gabbro. There are various transitional forms from eclogitic rocks to amphibolites. The upper part of the Hizan Group is represented by the Ohin Schists formed by biotite-garnet schist, biotite-muscovite schist, quartz-muscovite schist, biotite - amphibole schist, quartz - kyanite schist and biotite-hornblende-garnet schist.

The common primary mineral assemblage of the gneisses is as follows:

Quartz + oligoclase + red-brown biotite + garnet + muscovite ∓ tourmaline

The minerals, chlorite + green biotite + albite + clinozoisite / epidote should belong to the retrograde phase that effected the gneiss.

The primary mineral assemblage of the eclogitic rocks is given by:

Omphacite + garnet + Ca-amphibole + rutile ∓ kyanite ∓ clinozoisite ∓ phengite ∓ quartz

Symplectic textured clinopyroxene (diopside) + plagioclase + light green amphibole + titanite and biotite are also developed in these rocks at a retrograde phase.

The assemblage Ca-amphibole + oligoclase + quartz + titanite ∓ garnet ∓ biotite is dominant in the amphibolites. The secondary minerals are represented by chlorite + clinozoisite / epidote + albite.

The ordinary mineral assemblage in the schists is quartz + albite/oligoslase + muscovite + red - brown biotite + garnet ∓ dark green amphibole ∓ tourmaline ∓ zircon. As in the gneisses, the minerals albite + chlorite + clinozoisite/epidote represent the retrograde phase.

The presence of eclogite in the Hizan Group of rocks indicates that the pressure and temperature conditions that caused the initial metamorphism of the unit reached those of the eclogite facies. It is likely that the eclogites were transformed into garnetiferous amphibolites through decreases in the pressure and temperature down to the amphibolite facies conditions at the final stage of the same metamorphic event whereupon the mineral assemblages common in the amphibolite facies became stable in the surrounding rocks. The Alpine events which effected the Hizan Group caused a retrograde metamorphism in the unit.

It is thought that most of the Hizan Group of rocks are produced by the metamorphism of psammitic and pelitic rocks. It is assumed that the infrequently exposed albite-augen gneisses are derived from acid/intermediate magmatic rocks and the amphibolites from basic magmatic rocks.

The Hizan Group of rocks are unconformably overlain by the Mutki Group of rocks. The Middle Devonian fossils found at the lower levels of this unit show that deposition and metamorphism of the Hizan Group were completed prior to Devonian. The Hizan Group of rocks are comparable to the units of pre-Cambrian age in northwest Iran (Stöcklin, 1974) and the Arabian Shield (Schürmann, 1966) as far as the rock types and the metamorphism are concerned.

The Mutki Group

The Group comprises platform type sediments that lie unconformably over the Hizan Group. The succession which generally starts with coarse grained clastics

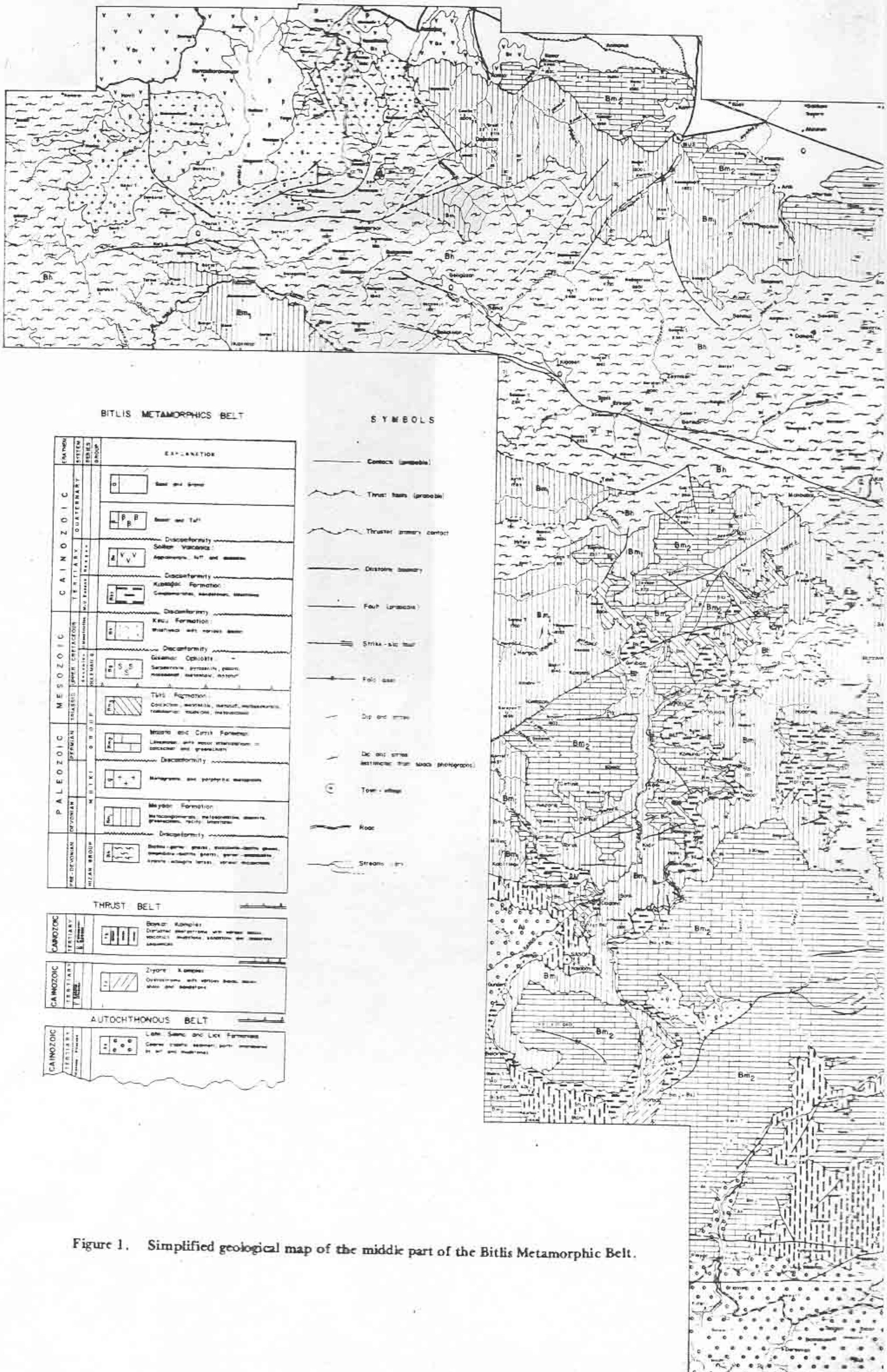
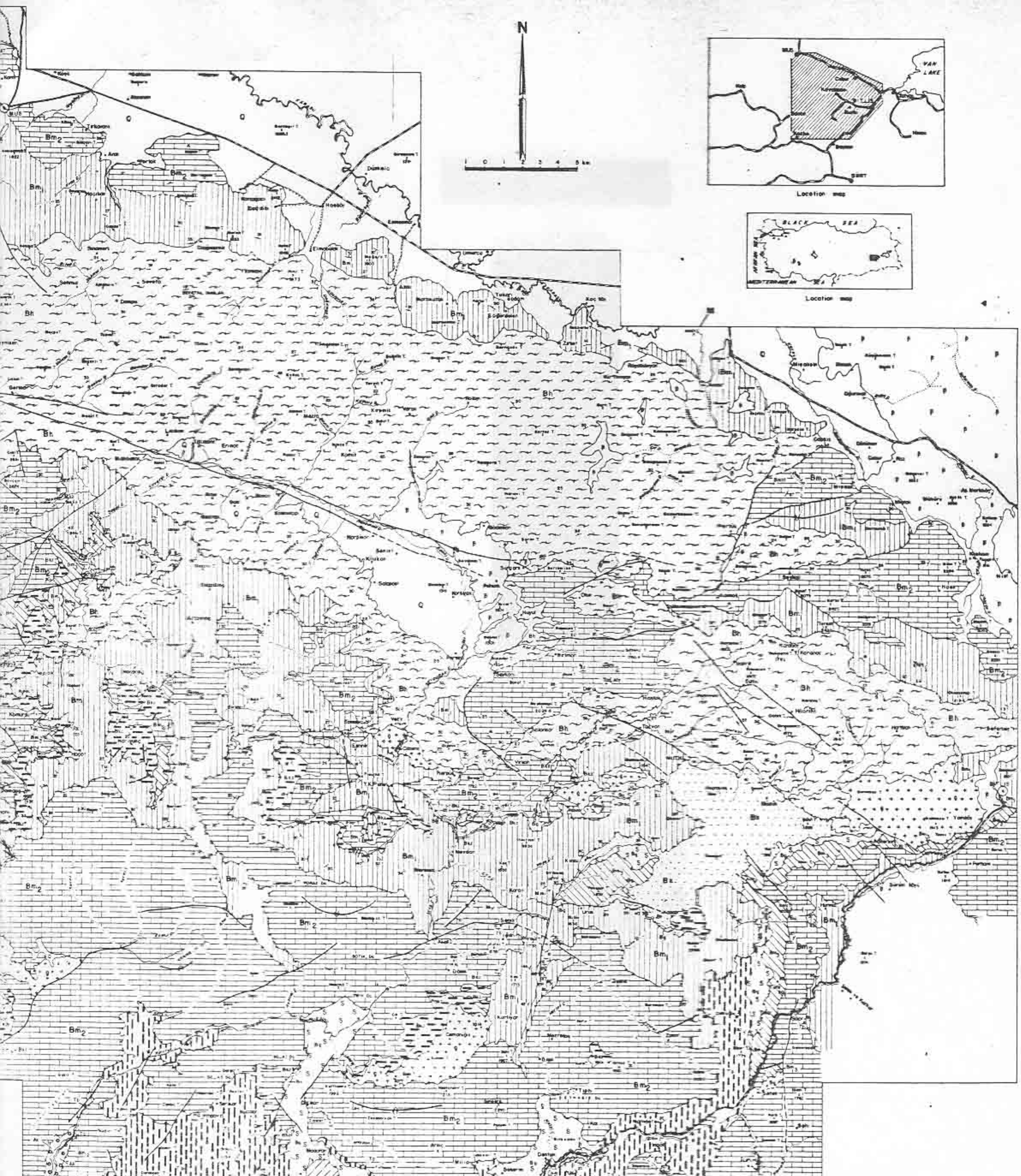


Figure 1. Simplified geological map of the middle part of the Bitlis Metamorphic Belt.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comprises intercalated pelitic rocks, reefoidal limestones and felsic and basic volcanites and passes upward into carbonate rocks. The differentiated units in the Mutki Group are the Meydan Formation of Middle Devonian age, Cırrık Limestone of Lower Permian age, Malato Limestone of Upper Permian age and the Tütü Formation of Triassic age.

The Meydan Formation: This formation which is the lowermost unit of the Mutki Group starts at the base with metaconglomerate having carbonate matrix. This level which in places crops out between thrust planes contains clastics which belong to the Hizan Group and grades upward into quartzites. The quartzite is well sorted and graded showing cross-bedding. It contains medium to thin bedded bands and is of yellow, purple and whitish colours. More than 90 % of the rock is composed of extended quartz grains exhibiting wavy extinctions. Grains of muscovite, tourmaline, albite and opaque minerals are uncommon. The quartzite unit in the upper parts passes into quartz-albite-sericite schist, albite-sericite-chlorite schist and calcschist, the last of which is intercalated with chlorite schist, albite-epidote-chlorite schist, albite-epidote-calcite schist and metadiabase. In this part, dolomite bands and lenses are found in places. The following fossils have been determined in these dolomite lenses to the east of Bitlis: *Actinostroma allathratum*, *Actirostroma* sp., *Thamnopora* sp., *Favosites* sp., and remains of crinoids. According to these fossils the unit should be of Givetian-Frasnian (Middle Devonian) age (Göncüoğlu and Turhan, 1983).

Albite-actinolite schist, albite-psilomelane-chlorite schist, graphite schist and albite-chlorotoid-sericite schist dominate the upper levels of the interbedded section which is thought to have originated from clayey sandstone, clayey limestone and volcanic rocks.

The Çeşme Formation: This unit which is constituted by felsic metavolcanics and metatuffs is vertically gradational with the Meydan Formation. Blocks and bands of fine grained recrystallized limestone, calcschist and greenschist are found in the Çeşme Formation. The massive parts of the unit is composed of quartz + albite + phengite + clinochlore ∓ zircon ∓ apatite ∓ tourmaline. The fine grained metatuffs contain albite + quartz + chlorite + phengite + clinozoisite. Relict porphyritic textures are found in both the rock types. Post-metamorphic tectonism heavily mylonitized the unit. It is considered that the Çeşme Formation is a product of the magmatism that brought about the Muş Granite.

The Cırrık Limestone: The limestone is medium to

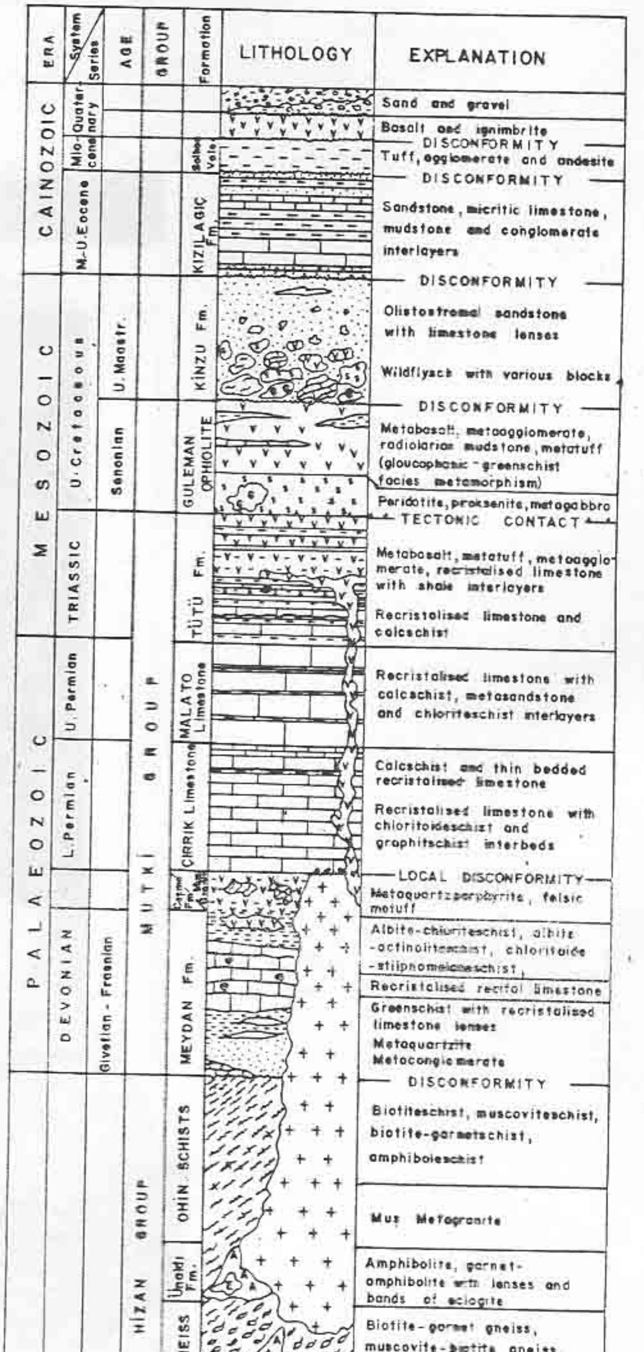

Figure 2. Generalized stratigraphic section of the Bitlis Metamorphic Belt.

coarsely bedded, grey-black coloured, recrystallized and bituminous containing fossils of gastropoda, corals and foraminifera. It generally lies conformably over the underlying units. A basal metaconglomerate with carbonate matrix and pebbles of granite and quartz-porphyry is apparent though not common. Interlayers of graphite schist, quartzite, albite-chloritoid schist and calcschist are observed in the upper parts of the Cırrık Limestone. The fossils, *Yatsengia ibuhensis* and *Parafusulina* sp. have been identified from samples taken at various localities in the Bitlis Metamorphic Belt, which assign the unit with the age of Lower Permian. The fossil content and the lithology of the Cırrık Limestone suggest that the unit was deposited in a shelf environment.

The Malato Limestone: The Cırrık Limestone is conformably overlain by the Malato Limestone which is medium to thinly bedded, yellow-grey coloured and recrystallised. There are frequent bands of metasandstone, calcschist and quartz-albite-chlorite schist within the unit. The fossils *Pachyploia* cf. *Schwageri*, *Waagenophyllum* sp., *Hemigordius* sp., *Schwagerina* sp., and *Mizzia* sp. have been determined from the parts where recrystallization is not intense showing that the age of the Malato Limestone is Upper Permian. The rock types and the fossil content of the unit indicate that the shelf environment was persisting.

The Tütü Formation: The Tütü Formation which is the uppermost unit of the Mutki Group is conformable over the Malato Limestone and transitional with it. A coarsely bedded, grey-coloured recrystallized limestone of approximalety 110 m. thickness occurs at the base of the unit. The succession continues upward with interbedded recrystallized limestones and calcschists and contains levels of metashale, metatuff, metadiabase and metabasalt in the middle parts. Metaagglomerate, metamudstone, metabasalt, recrystallized micritic limestone and shales are exposed at the upper sections of the unit. The parageneses, pumpellyite + zoisite + chlorite and muscovite + chlorite have developed in the volcanites of this part. The fossils, *Involutina* sp., *Trocholina* sp., *Trochammina* sp. and *Duostomminidae* have been identified from the recrystallized limestones at the level where the volcanic bands start in the middle part of the Tütü Formation. These fossils indicate that deposition of the lower part of the Tütü Formation continued until the Upper Triassic (Sevci et al., 1980). However, the lithological changes and the volcanic sedimentary interlayers in the Tütü Formation symbolize a sudden change in the shelf environment conditions that had been prevailing at least since Middle Devonian (Göncüoğlu and Turhan, 1983). This change signified the start of the dominance of a deep-sea environment, rather than the neritic environment, characterized by radiolarian mudstone, agglomerate, tuff, micritic limestone and shale represented by the upper part of the unit in the whole of the Belt (Fig. 3). The authors attribute this change to a Triassic rifting of the Bitlis Metamorphic Belt which stayed as a collapsed continental margin until the Upper Campanian-Lower Maastrichtian when the ophiolite emplacement was realized in the region. Perinçek (1980 a) presents the Triassic units containing volcanites in the western sector of the Bitlis Metamorphic Belt as evidence for an oceanic spreading between the Anatolian Plate and the Arabian Plate and puts forward that the Bitlis Belt forms the southern margin of the Anatolian Plate.

The Guleman Ophiolitic slice sits tectonically over the Tütü Formation. Intense deformation and mylonitization in the Tütü Formation are related to the emplacement of the ophiolitic slice.

The Muş Metagranite

The acid intrusive rocks which are widespread in the Bitlis Metamorphic Belt are collectively known as the Muş Metagranite (Göncüoğlu, 1983, in print). The Muş Metagranite is of light colour, medium grained and distinctly foliated. The primary texture and the mineralogical composition of the metagranite are in places obliterated by the post-crystallization deformation and it has been transformed into quartz-feldspar-phengite gneiss. It contains quartz, alkali-feldspar, plagioclase, phengite and biotite as the major phases. Phengite + clinozoisite + garnet represent the metamorphic phase. It is thought that the metamorphism developed at low/medium temperature and medium pressure conditions. The Muş metagranite intruded into the rocks of the Hizan Group and the Meydan Formation at the contacts of which contact metamorphism developed. Pebbles which are derived from the metagranite are found at the base of the Cırrık Limestone. Therefore, the intrusion age of the metagranite must be post-Middle Devonian and pre-Lower Permian. Geochronological studies carried out on the western part of the Bitlis Metamorphic Belt (Helvacı, 1983) support the above conclusion.

Geochronological work on the phengites of the Muş Metagranite produced 95 ∓ 3.8 m.y. with the Rb/Sr method and 75 ∓ 1 m.y. with the K/Ar method. The former age is considered to be the crystallization age of the phengites. Therefore, it is plausible to suggest that the Muş Metagranite and the host Bitlis Metamorphic Belt experienced a second metamorphism during the Lower Turonian (Göncüoğlu, 1983, in print). The second determined age (Upper Campanian) represents a reheating stage of the metagranite due to events to be described later.

The Guleman Ophiolite

The term, Guleman Ophiolite was used by Özkaya (1978) to describe the ultramafic and the related volcanic rocks of Upper Jurassic-Lower Cretaceous age, obducted upon continental crust during the Upper Cretaceous and

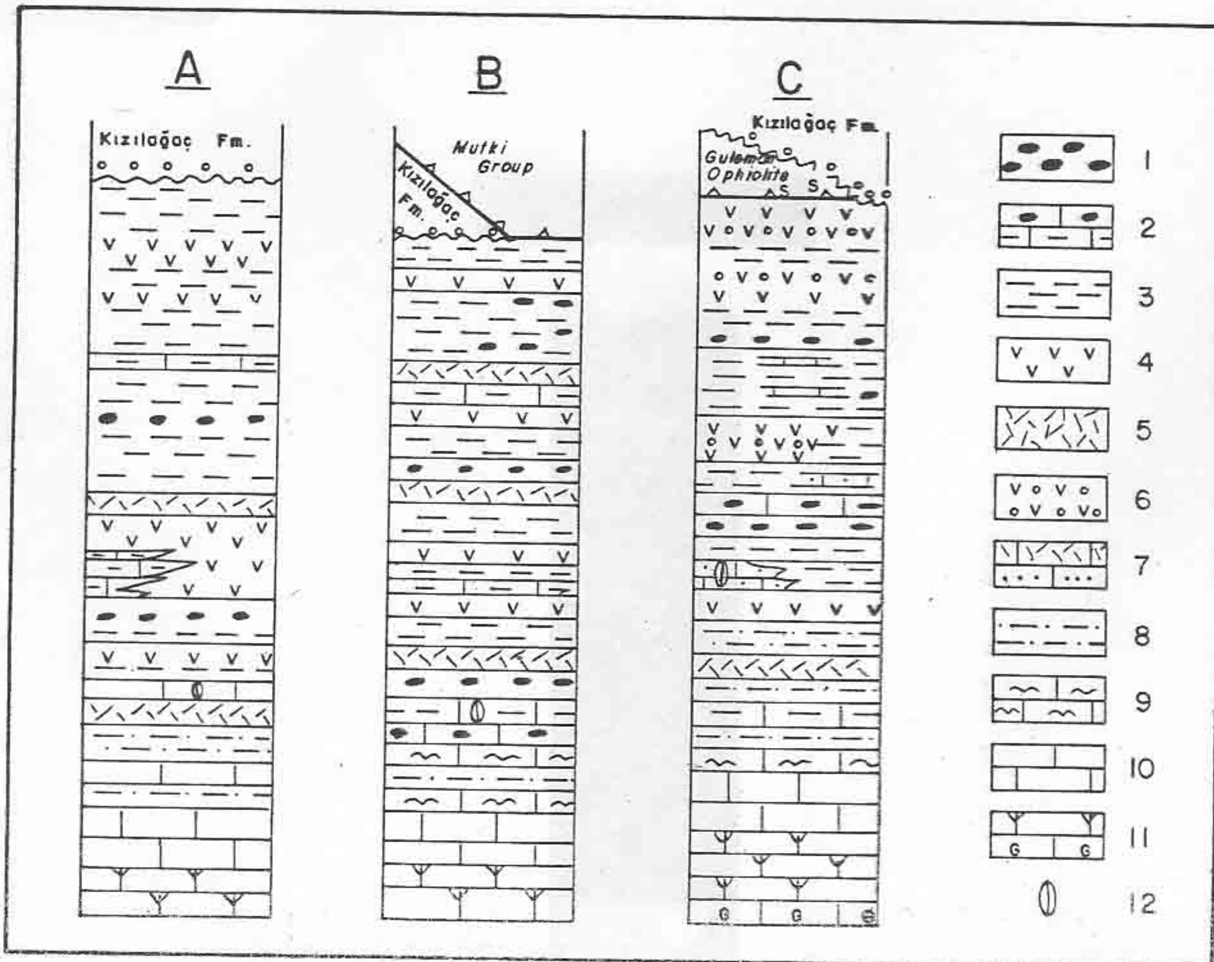

Figure 3. Vertical columns of the Tütü Formation, A: Han Mahallesi (ca 95 m), B: Tingis Köyü (ca 70 m), C: Hıdırnebi/Kambos Dağı (ca 200 m). 1- radiolarite/radiolarian chert, 2- cherty limestone/micrite, 3- radiolarian calcareous mudstone, 4- basic volcanics, 5- tuff, 6- crystalline limestone, 7- tuff banded calcarenite, 8- shale, 9- calcschist, 10- crystalline limestone, 11- Cırrık and Malato Limestone, 12- Triassic foraminifera.

located to the west of the Bitlis Metamorphic Belt. In this study the term has also been adapted for the ultramafic rocks exposed inbetween the tectonic slices in the Bitlis Metamorphic Belt.

The Guleman Ophiolite is found as tectonically overlying the Tütü Formation i.e. the uppermost unit of the Bitlis Metamorphic Belt. Intense mylonitization is observed at the contact zone.

The first unit that has been overthrust is generally composed of serpentinized ultramafic rocks (harzburgite and pyroxenite) and gabbro. Less frequently, the basic volcanic rocks and the related sedimentary rocks which are considered to be part of the Guleman Ophiolite form the first overthrust tectonic slice. This unit, termed the volcanosedimentary slice, comprises pillowed metabasalts, metatuffs, metaaglomerates, radiolarian mudstones, microgabbros and micritic limestones. It is highly folded. The presence of the paragenesis albite + glaucophane + phengite + epidote/clinozoisite + chlorite + hydromuscovite in the microgabbros and basalts indicate that the volcanosedimentary unit of the Guleman Ophiolite has undergone glaucophanic greenschist metamorphism prior to emplacement (Hall, 1974) Quartz-albite-muscovite-clinozoisite schists and hornblende-schists occur in the contact of this unit with the ultramafic slice. These rocks which are known with their different metamorphism are mistakenly taken by Yılmaz et al. (1981) as platform sediments which experienced contact metamorphism during the emplacement of the ophiolite.

The following fossils have been identified from the micritic interlayers in the volcanosedimentary slice: *Hedbergella* sp., *Ticinella* sp. and *Globotruncana* sp. These indicate that the deposition on the floor of the ocean that produced the Guleman Ophiolite took place during the Senonian (Campanian ?). Therefore, the ophiolite obduction upon the Bitlis Metamorphic Belt must have come about after the Campanian. Furthermore, an event around 75 m.y. (Upper Campanian) determined by the K/Ar method from the phengites of the Muş Metagranite is apparent. The event with all the likeliness corresponds to the reheating of the rocks of the Bitlis Metamorphic Belt related to the obduction of the Guleman Ophiolite.

The Guleman Ophiolite is unconformably overlain by the Kinzu Formation of Upper Maastrichtian age. This shows that the emplacement of the ophiolite was completed before the Upper Maastrichtian.

THE UNMETAMORPHOSED COVER ROCKS

The unmetamorphosed cover rocks are exposed inbetween the tectonic-slices of the Bitlis Metamorphic Belt. These rocks form two separate units.

The Kinzu Formation: The lower part of the unit is of wildflysch character, which passes upward into a regular flysch. Blocks of dunite, gabbro, metabasalt, radiolarite and metatuff belonging to the Guleman Ophiolite and of marble, quartzite and schist derived from the Bitlis Metamorphic Belt are found in the wildflysch. The size of the blocks varies from a few m. to a few km. At the lower sections of the unit, the matrix of the blocks (sandstone and mudstone derived from serpentinite) in places thins out and cannot be seen. The wildflysch passes upward into the regular flysch composed of interbedded sandstone-mudstone-siltstone through a decrease in the size of the blocks and increase in the proportion of the matrix. The fossils *Inoceramus* sp., *Actaeonella* sp. and *Cyclolites* sp. have been determined from the clayey sandstone levels of the regular flysch and *Globotruncana arca*, *Globotruncana* sp., *Siderolites calcitropoides*, *Orbitoides media*, *Rotalia* sp., *Calcisphaerula* sp., *Pseudosiderolites* sp. and *Textularidae* sp. from the carbonate levels. According to these fossils, the age of the flysch is Upper Maastrichtian as pointed out by Meriç (1973).

The Kızılağıç Formation: The Kızılağıç Formation is the youngest unit that covers the rocks of the Bitlis Metamorphic Belt. The unit starts with coarse clastics and upward in the succession contains mudstone, micritic limestone, clayey limestone and shale. There are sandstone and conglomerate levels in the upper levels derived from andesite. It has been differentiated from the sediments of the Maden Group occurring in the Eastern Taurus (Perinçek, 1979) by its rock types and age. Samples taken from various localities in the Kızılağıç Formation contains the following fossils of Lutetian-Upper Eocene age: *Nummulites* sp., *Discocyclina* sp., *Assilina* cf *spira*, *Globigerina* sp., *Alveolina* sp., *Orbitolites* sp., *Truncono taloides topilensis* and *Globigerapsis* cf. *Kugleri*.

The upper contacts of the rocks of the Kızılağıç Formation are generally tectonically defined. This indicate that the Bitlis Metamorphic Belt acquired its present imbricated structure following the Upper Eocene.

THE THRUST BELT

Rocks of two complex assemblages are exposed in a belt 20 km wide and occurring inbetween the Bitlis Metamorphic Belt and the Arabian Autochthon all along the whole of the Eastern Taurus. The first assemblage of rocks that underlies the Bitlis Metamorphic Belt is known as the Baykan Complex (Sungurlu, 1974). It comprises limestone, flysch and basic volcanics of Upper Paleocene-Middle Eocene age and olistostromes of the Bitlis Metamorphic Belt and the Guleman Ophiolite. The Baykan Complex is underlain by the Çüngüş Complex of Upper Paleocene ? - Miocene age. The Çüngüş Complex is a chaotic unit with intercalated shale and sandstone and blocks of the Baykan Complex amongst others. Baştuğ (1980) points out that the unit has formed with gravity slides.

THE AUTOCHTHONOUS BELT

The lowermost structural unit in the region comprises the shelf sediments of the Arabian Platform whose age ranges from the Infracambrian to the Upper Miocene (Perinçek, 1980 b). It has been correlated with the Bitlis Metamorphic Belt by Baştuğ (1976).

CONCLUSIONS

— In the studied section of the Eastern Taurus, the Thrust Belt comprising the Tertiary Complexes is overthrust upon the Arabian Autochthon and is itself thrust upon by the Bitlis Metamorphic Belt.

— The Bitlis Metamorphic Belt is allochthonous and composed of numerous tectonic slices.

— The base of the Bitlis Metamorphic belt is formed of an old core exhibiting polyphase metamorphism and deformation which can be correlated with the base of the Arabian Autochthon.

— Lower Devonian-Upper Triassic sediments of a shelf environment are widely exposed in the metamorphic cover of the Bitlis Metamorphic Belt. These units can be correlated with the units of corresponding ages in the Arabian Autochthon.

— There are rocks in the Bitlis Metamorphic Belt which point to a rifting during the Upper Triassic. Deep-sea sediments, reflecting a collapsed continental margin environment rather than a shelf environment, come to the scene in the period from the Upper Triassic to Upper Senonian when the ophiolite emplacement took place.

— The setting of the volcanosedimentary units of Triassic and probably younger (Lower Cretaceous ?) ages can be taken as evidence to show that the opening of southern arm of Neotethys took place inbetween the Pütürge-Bitlis Belt and the Arabian Platform (Perinçek, 1980 a; Şengör and Yılmaz, 1981) as well as to show that it took place to the north of the Bitlis Metamorphic Belt. The authors prefer the latter speculation.

— The major event that led to the cataclastic metamorphism of the Bitlis Metamorphic Belt was realized during the Lower Turonian (95 ∓ 4 m.y.). The metamorphism was caused by compressions in the continental crust and developed under low temperature and medium pressure conditions.

— Emplacement of the GulemanOphiolite upon the Bitlis Metamorphic Belt took place during the Upper Campanian (75 ∓ 1 m.y.). This event caused reheating in the Bitlis Metamorphic Belt.

— The Upper Maastrichtian flysch unconformably overlies the Bitlis Metamorphic Belt. It was probably at this time that the Baykan marginal basin in which the Baykan Complex was deposited opened in the south of the Bitlis Metamorphic Belt and started filling by gravity slides during the Upper Paleocene-Middle Eocene. There was intense volcanism in the Baykan basin during this period. It is thought that the basin was not on a base of oceanic crust. The Çüngüş Complex developed with the closing of the basin in the Middle Eocene and migration of the sedimentation towards south.

— There was no deposition taking place over the Bitlis Metamorphic Belt after the Middle Eocene. The Belt started being imbricated at this period which continued through the Upper Tertiary, acquiring its present structure.

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REFERENCES

Bağtuğ, C., 1976, Bitlis napının stratigrafisi ve Güneydoğu Anadolu Sütur zonunun evrimi: Yeryuvarı ve İnsan, 1/3, 55-61.

Baştuğ, C., 1980, The nature of the interface between the Arabian autochthon and the Eastern Taurides in SE Turkey 26 th Internat. Geol. Congress, Paris, Abstracts, 315.

Boray, A., 1973, The structure and metamorphism of the Bitlis area, Southeast Turkey: Ph. D. Thesis, University of London, 223 p. (unpublished).

Göncüoğlu, M.C., 1983, Metamorphism and age of Muş-Kızılağıç Metagranite: MTA Bulletin, 99-100 (In press).

Göncüoğlu, M.C., and Turhan, N., 1983, New results on the age of Bitlis Metamorphics: MTA Bulletin, 95/96, 44-48.

Hall, R., 1974, The structure and petrology of an ophiolitic melange near Mutki, Bitlis province, Turkey: Ph. D. Thesis, University of London, 351 p. (unpublished).

Helvacı, C., 1983, Avnik (Bingöl) bölgesi Bitlis Masifi metamorfik kayalarının Rb/Sr jeokronolojisi: Türkiye Jeoloji Kurumu 37. Bilimsel ve Teknik Kurultayı Bildiri Özleri, 111.

Horstink, J. 1971. The Late-Crateceous and Tertiary geological evolution of Eastern Turkey: Türkiye Birinci Petrol Kongresi Tebliğleri, 21-45.

Kellog, H.E., 1960, Stratigraphic report; Bitlis-Siirt Area, Petroleum District V., Southeast Turkey: Petrol İşleri Genel Müdürlüğü Arşivi, Report (unpublished).

Meriç, E., 1973, Sur la presence d'un affleurement du Maastrichtien Superieur an S de Mutki (Bitlis-Turquie): Rev. Fac. Sci. Univ. İstanbul, B, Tome, 38, Fasc. 1-4, 49-51.

Özkaya, İ., 1978, Ergani-Maden yöresi stratigrafisi: Türkiye Jeoloji Kurumu Bült. 21, 129-139.

Perinçek, D., 1979, Interrelation of the Arabian and Anatolian plates Guidebook for Excursion B: First Geological Congress on the Geology of Middle East, Ankara, 34p.

Perinçek, D., 1980a, Bitlis Metamorfitlerinde volkanitli Triyas: Türkiye Jeoloji Kurumu Bült., 19, 65-78.

Perinçek, D., 1980b, Arabistan kıtası kuzeyindeki tektonik evrimin kıta üzerinde çökelen istife etkileri: Türkiye Beşinci Petrol Kongresi Bildirileri, 77-93.

Savcı, H., Yöndem, F., Göncüoğlu, M.C., and Turhan, N., 1979, Bitlis-Mutki dolayının jeotektonik evrimi: Türkiye Jeoloji Kurumu 33. Bilimsel Teknik Kurultayı Bildiri Özleri, 113-114.

Schürmann, H.M.E., 1966, The Pre-Cambrian along the Gulf of Suez and the northern part of the Red Sea: Leiden, E.S. Brill, 404p.

Stöcklin, J., 1974, Possible ancient continental margins in Iran, In The Geology of Continental Margins, C.A. Burke and C.L. Drake (Editors), 873-887.

Sungurlu, O., 1974, VI Bölge kuzeyinin jeolojisi ve Petrol imkanları: Türkiye İkinci Petrol Kongresi Tebliğleri, 85-107.

Sungurlu, O., 1979, Güneydoğu Anadolu Sürüklenim Kuşağı Kretase sürüklenimleri: Türkiye Jeoloji Kurumu 33. Bilimsel ve Teknik Kongresi, Bildiri Özleri, 117-118.

Şengör, A.M.C., and Yılmaz, Y., 1981, Tethyan evolution of Turkey; a plate tectonic approach: Tectonophysics, 75, 181-241.

Tolun, N., 1953, Contribution a'la etude geologique des environs du S et SE du Lac de Van: MTA Bulletin, 44/45, 77-112.

Yılmaz, O., 1975, Cacas Bölgesi (Bitlis Masifi) kayaçlarının petrografik ve stratigrafik incelenmesi: Türkiye Jeoloji Kurumu Bült., 18, 33-40.

Yılmaz, Y., Dilek, Y., and Işık, H. 1981, Gevaş (Van) ofiyolitinin jeolojisi ve sinkinematik bir makaslama zonu: Türkiye Jeoloji Kurumu Bült, 24, 37-44.

Göncüoğlu, M.C, and Turhan, N., 1984, Geology of the Bitlis Metamorphic Belt. In Tekeli, O., and Göncüoğlu, M.C. (Editors), Int.Symp.on the Geology of the Taurus Belt, Proceedings, 237-244.