THE SIGNIFICANCE OF THE GEOLOGIC TIME FACTOR IN METALLOGENY AND PETROLOGY

Mehmed RAMOVIÇ

Natural Science Faculty, Sarajevo, Yugoslavia

INTRODUCTION

During the past decades metallogeny, as a new branch of geology, earned an important place in the industrial planning in many countries. Metallogeny treats the regularities of spatial distributions and temporal successions of origin of different types of mineral deposits and their relations to magmatic activities and orogenic stages.

To compose useful prognostical metallogenetic maps, the co-operation is needed of many specialists, such as stratigraphers, structural geologists, petrologists, metallogenists, geochemists, geophysicists and others. Here we will point out the urgent need for co-ordination of metallogenetic studies of geologists of different parts of the world. The problem that metallogenists are faced with, after analyses of numerous documents (facts), is how to predict suitable regions in which to plan prospection for distinct types of mineral deposits and to choose suitable methods for their discovery.

In this article we Will discuss the significance of the geologic time factor in metallogeny and petrology. Over the past ten years we have been gathering documents about different types of mineral deposits, their age, their relation to orogenic stages, the structures of the mining regions and metallogenetic belts, the character and quantitative relations between different types of accompanying magmatic rocks, about their absolute and relative geologic age determinations, and after analyses of numerous statistical data, we have established some regularities which are clearly evident in the Mediterranean countries. They could be summarized as follows :

a. The metallogenetic differentiation develops gradually, and is closely related to particular geologic periods as schematically represented in Fig.1.;

Fig. 1. shows H. Schneiderhohn's (1962) pegmatitic, pneumatolytic and hydrothermal ore formations (Erzformationen), geochronological scales after A. Holmes (1960), J. Kulp (1959), and J. Starik (1961), predominant types of magmatic rocks formed in distinct geologic interval, mining regions and metallogenetic zones, with special reference to the Mediterranean countries. Included in the schema are also the basic and ultrabasic rocks and related deposits of Cr, Pt, Ni.

b. It is clear, however, that according to the evolution of different types of magmatic rocks, we can trace gradual changes from acidic (granites) over intermediate (granodiorites, diorites and related effusives) toward basic and ultrabasic rocks, if we consider longer geologic time intervals.

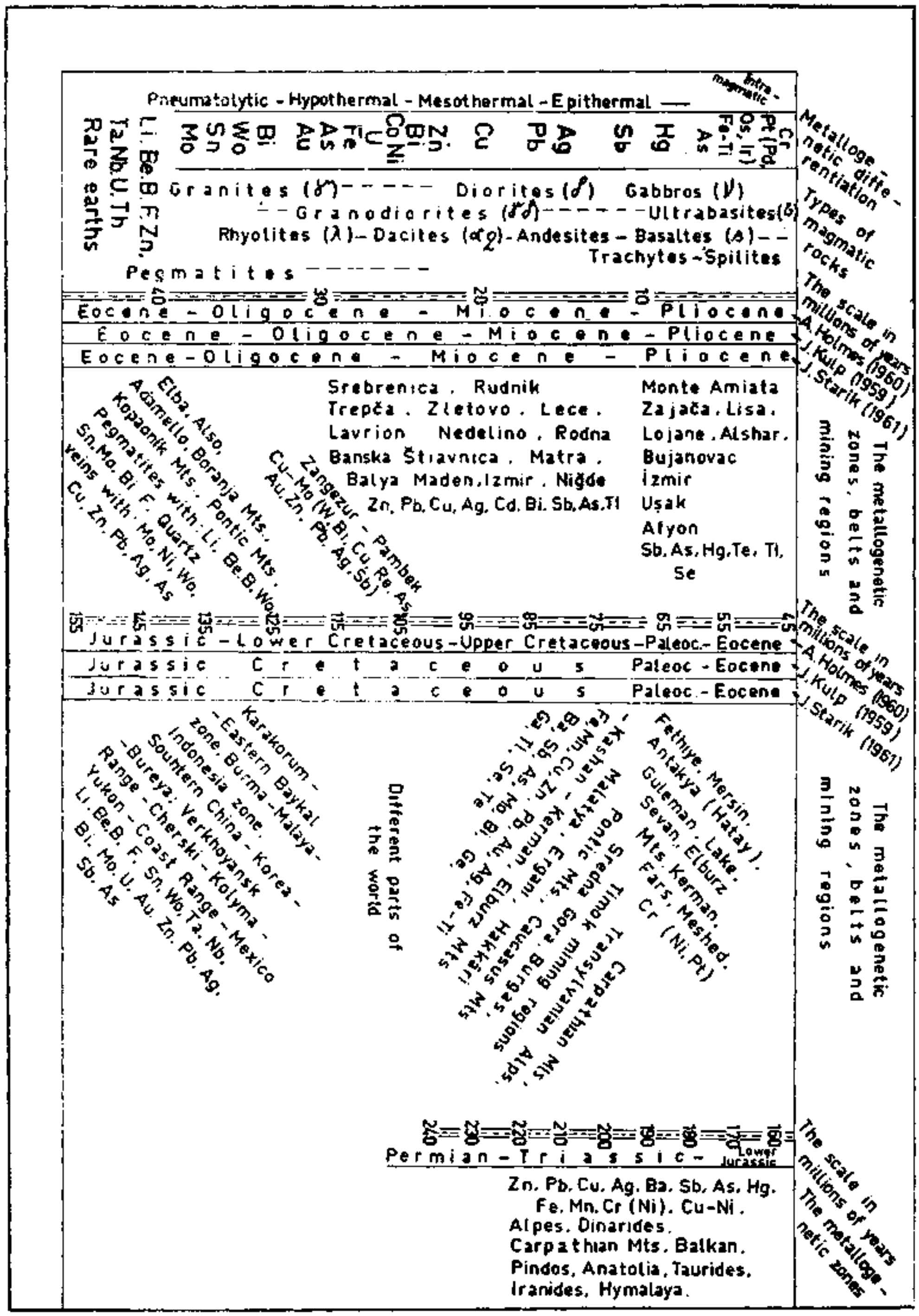
Pneumatolytic - Hypothermal - Mesothermal - Epithermal
Intra-magmatic
Metallogenetic differentiation
Granites
Diorites
Gabbros
Granodiorites
Ultrabasites
Rhyolites - Dacites - Andesites - Basaltes
Trachytes - Spilites
Pegmatites
Types of magmatic rocks
Eocene - Oligocene - Miocene - Pliocene
A. Holmes (1960)
J. Kulp (1959)
J. Starik (1961)
The scale in millions of years
Srebrenica, Rudnik
Trepča, Zletovo, Lece,
Lavrion Nedelino, Rodna
Banska Štiavnica, Matra,
Balya Maden, Izmir, Niğde
Zn, Pb, Cu, Ag, Cd, Bi, Sb, As, Tl
Monte Amiata
Zajača, Lisa,
Lojane, Alshar,
Bujanovac
İzmir
Uşak
Afyon
Sb, As, Hg, Te, Tl, Se
The metallogenetic zones, belts and mining regions
Jurassic - Lower Cretaceous - Upper Cretaceous - Paleoc. - Eocene
Jurassic Cretaceous Paleoc. - Eocene
Different parts of the world
Permian - Triassic - Lower Jurassic
Zn, Pb, Cu, Ag, Ba, Sb, As, Hg,
Fe, Mn, Cr (Ni), Cu-Ni,
Alpes, Dinarides,
Carpathian Mts, Balkan,
Pindos, Anatolia, Taurides,
Iranides, Hymalaya.
The metallogenetic zones

Fig. 1

The successions acidic-intermediate-basic-ultrabasic rocks, could also be traced from Middle Carboniferous period up to present time, as follows :

1. Middle Carboniferous- Lower Jurassic
2. Middle Jurassic - Eocene, and
3. Upper Eocene - Anthropogene

We will now outline the metallogenetic regional differentiation and occurrences of magmatic associations from Upper Mesozoic up to present time, specially in the Mediterranean countries. We will start our considerations from youngest geologic periods and will go up till Upper Mesozoic.

UPPER PLIOCENE - QUATERNARY - ANTHROPOGENE

In many Mediterranean provinces great volumes of basalts have been erupted with little or no accompanying andesites, dacites or rhyolites, trachytes and other rocks.

In western and central parts of Anatolia the Pliocene and Quaternary andesites, andesito-basalts and basalts are found. In regions of Erzine and Bozcaada in NW Turkey, olivine basalts and older andesites by A. Kalafatçıoğlu (1963) are described. A. Akartuna (1962) observed that basalts have cut through Cretaceous and Miocene beds in İzmir district. T. Ayan and C. Bulut (1964) in their studies of Malatya district have discovered that alkaline basalts rich in olivine, found in the Göktepe region, overlie the Miocene marls and limestones. Neogene, Quaternary and active volcanoes in historic time, were marked in various regions of Asia Minor by İhsan Ketin (1960) in his tectonic map of Turkey. Neogene and Quaternary basalts are widespread in Syria and Lebanon (L. Dubertret, 1954).

Detailed descriptions of Neogene and Anthropogene volcanism on Lesser and Great Caucasus were made by E. Malinovski (1956), A. Aslanyan and V. Amaryan (1962), N. Koronovskiy (1962), İ. Magakyan (1959) and others. On Lesser Caucasus, during Upper Pliocene and Quaternary, basalts, andesito-basalts some dacites and subordinately liparites have erupted. On Elbrus and Kazbek are found Neogene andesites, dacites, dellenites and liparites and Quaternary andesites, andesito-basalts, basalts and some acidic effusives (Y. Polovinkina, 1960). H. Walter (1960) described volcanic activities in Persia including active volcanoes in historic time: Kuh-i-Bazman and Kuh-i-Taftan.

S. Dimitrov (1946), Y. Yovtchev (1965) and others reported some Neogene and Quaternary trachytoid volcanic rocks and series of small basaltic bodies in the vicinity of Svishtov, Suhindol, Tryavna, Kazanlık, etc. In prolongation of Bulgarian small basaltic bodies of Quaternary age, which are arranged in a meridional line, the Herghitei Caliman andesito-basaltic zone in Rumania is situated. These rocks were formed during younger Neogene and Quaternery periods (N. Oncescu, 1959). In West -Carpathian Mts., basalts and basanitoids in the regions of Lubina-Niederschlesien and in Filakovo-Salgotarjan and in some parts of Slovakia and Hungary were formed (A. Mihalikova and M. Simova, 1965 and E. Vadasz, 1961).

From the Aegean regions in Greece, and along the Vardar River region up to the zinc-lead mine Rudnik in Serbia, could be traced the occurrences of Neogene and Quaternary basalts, leucitites, trachytes and some other rocks.

In NW Africa, Spain, Auvergne in France, Eifel and Vogelsberg and in Czechoslovakia (Central Europe) basaltic rocks of Neogene and Quaternary age have been in detail described by C. Burri and P. Niggli (1945), L. Glangeaud (1948) and others. We can list here the well-known younger basaltic (subordinately acidic) volcanic rocks in Italy (Fig. 2).

Some investigators hold that quicksilver deposits of Monte Amiata in Tuscany and in Western Anatolia, and then antimony and arsenic deposits are of Upper Pliocene and Quaternary age. In craters of young volcanoes, especially in Italy, native sulphur deposits are found. In all above-mentioned regions the thermal springs are widespread.

The quicksilver deposits connnected with Pliocene-Quaternary basalts and andesito-basalts in California, Japan, Caucasus regions (Kağızman, Erivan, Araks), as well as some arsenic and gold deposits are found.

MIOCENE (MIDDLE AND UPPER MIOCENE) - LOWER PLIOCENE PERIODS

Bulky volumes of andesites, dacites and rhyolites have been erupted over large areas with little or no accompanying basalts in many Mediterranean petrographic provinces. For such cases F. Turner and J. Verhoogen (1960) remarked that on quantitative grounds alone, it would seem unlikely that basalt could be the parent and andesites and dacites the derivative magma.

In the Mediterranean countries we can distinguish the following metallogenetic (magmatic) Middle Tertiary zones and belts:

The Nevada metallogenetic belt in Spain

The Zn-Pb (Ag) veins in Mazarron mining region near Cartagena as well as the occurences of Cu, Sb, As and other minerals, are connected with the Middle Tertiary andesito-dacites.

Tuscany in Italy

Ore bodies with Cu, Zn, Pb, Bi, Sn, Sb, As and other minerals are found near Massa Marittima and some other places, closely related to andesito-dacitic volcanic rocks. The veins cut Eocene limestones (W. Lindgren, 1933).

The metallogenetic zone of Carpathian Mts.

With Tertiary andesites, dacites and rhyolites are associated the mineralizations of: Bi, Wo, Mo, Cu, Zn, Pb, Au, Ag, Sb, Ga, Ge, As, Se, Te and others. We will describe in brief the mining regions, related magmatic rocks and types of deposits in Table 1.

The types of mineral deposits as well as the accompanying volcanic and intrusive rocks are very similar to some Tertiary mining regions in western parts of U.S.A., Japan, Indonesia, New Zealand, etc.

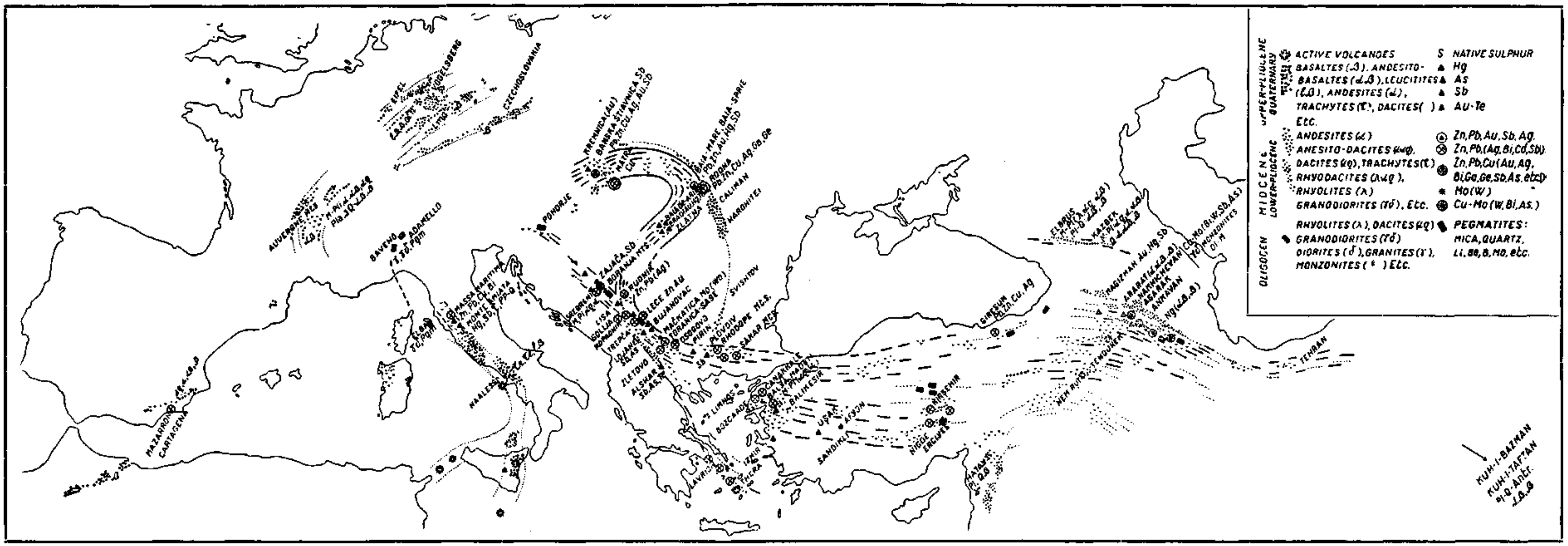

Fig. 2 - Oligocene - Miocene - Pliocene - Quaternary magmatic (metallogenetic) zones, belts and mining regions in Mediterranean countries.

Table - 1

Mines and mining regions (Authors)	*Magmatic rocks and their age*	*Metallization*
Banská Stiavnica (M. Kodéra, 1965)	Tertiary andesites, dacites and granodiorites	Upper zones of ore systems have Au and Ag, the middle ones Pb and Zn and the lower (deeper) ones have Cu, Pb, Zn, Bi minerals and scheelite
Kremnica	Rhyolites, dacites andesites	Au-Ag quartz veins
Matra	Rhyolites, dacites and andesites	Cu, Zn, Pb, Ag, Sb and other minerals
Baia Mare (N. Oncescu, 1959; J. Urdya & S. Radulesku, 1965)	Tortonian rhyolites, and their tuffs and Sarmatian dacites and andesites	In central part of the mining region the Au-Ag veins, in eastern and western parts Pb, Zn, Cu, Ag, Au, Sb, As ore bodies are to be found.
Rodna (Óradna) (C. Lazar, G. Udubaşa, 1965)	Miocene-Pliocene andesites	Pb, Zn (Cu, Ag, Ga, Ge, Sb)
Shuior and Baia Sprie	Andesites and dacites	Upper parts of the vein systems contain Au-Ag (small amounts of Pb and Zn) and lower parts have Zn, Pb and Cu
Baia-de Aries, Brád, Zlatna, Roshia and others. Named «Golden Quadrangle» by N. Oncescu (1959). Detailed description by C. Lazar and G. Udubaşa (1965)	Miocene and Lower Pliocene andesites and dacites	Au-Ag veins with Zn, Pb, Cu and other minerals

Dinarides - Aegean regions - Asia Minor - Persia (Iranides Mts.) metallogenetic zone and belts

Some mineralizations with Tertiary andesites and dacites in Slovenia have been observed. From Bosnia over Serbia, Macedonia, Rhodope Mts., Aegean Islands, Asia Minor towards Persia, many metallogenetic belts with: Zn, Pb, Ag, Bi, Mo, Cu, Sb, As, Cd, and other mineralizations are found, closely related to the Middle Tertiary volcanic rocks, associated with some intrusives. Ore bodies of meso- and epithermal character (Fig. 1 and 2 and Table 2) are encountered in numerous mining regions.

The realgar, auripigment and stibnite with native As and minerals of Tl, Hg, Te, Ba, Pb, Cu are found in the form of veins or irregular replacement deposits in a broad area from Central Bosnia (Teslic, Srebrenik, Maglaj) over Podrinja mining district (Zajaca, Cumavici, Stolice, Krupanj), and then Lisa, Bujanovac, Lojane and still further in Vardar and Osogovo-Pirin belts (Alsar, Pirin) towards the Aegean regions, Asia Minor (Balıkesir, İzmir, Manisa, Bilecik, Kütahya). Similar types of ore deposits connected with Neogene volcanic.- activities are found in the regions of Darri-Dağ, Kağızman, Amasya, Karaiman (Lesser Caucasus) and possibly in the mining district on Elburz Range.

Table - 2

Mines and mining regions (Authors)	*Magmatic rocks and their ages*	*Metallizations*
Teslic, Maglaj and Srebrenik in Bosnia	Miocene - Lower Pliocene dacites and andesites	Realgar (As) veins
Srebrenica in eastern Bosnia (M. Ramoviç)	Miocene - Lower Pliocene dacites, andesito-dacites and andesites	The systems of veins, Zn, Pb (Ag, Bi, Cd, Sb, As), and some minerals of Wo, Mo, U, Te, and others
Rudnik, Serbia (S. Rakic, 1959)	The Middle Tertiary andesito-dacites and granodiorites and younger basalts	Pb, Zn (Ag, Bi, Ni, Sb, As, and others)
Trepca, Belo Brdo, Novo Brdo, Janjevo, Ajvalija, Kiznica, Golija (A. Cissarz, 1956)	Tertiary andesites and dacites, and intrusions of granodiorites	Replacement ore bodies with contact-metamorphism, and hydrothermal deposits of: Zn and Pb (with Wo, Bi, Ag, As, Sb, Cd and other minerals)
Lece, Serbia (D. Pesut, 1957)	Neogene andesites	Zn, Pb (Au, Ag) ore bodies
Zletovo-Dobrevo and Sase-Toranica and surrounding regions (A. Cissarz, 1956; S. Jankovic, 1965)	Miocene and Lower Pliocene andesites and dacites and Upper Pliocene and Quaternary basalts	The systems of veins with Zn, Pb, Ag, Cd, Bi, U, Ni, Ba, Sb, As and other minerals
Lavrion, Greece and Aegean Islands: Ios Melos, Siphnos, Lesbos, Samos and eastern regions of Thessalonika (H. Putzer, 1948; G. Marinos, 1948; E. Davis 1960 and others)	Middle Tertiary granodiorites, diorites and andesito-dacites and younger basalts	Pb, Zn, Ag, Sb, As and other minerals
Osogovo-Pirin and Rhodope Mts., mining regions with deposits: Madjarevo, Gabrovo, Spakhyevo, Lozen, Davidkovo, The Maden - Nedelino and others (Y. Yovtchev, 1965)	Dacites, rhyolites, andesites and small intrusives of Miocene age (diorites). Ore veins cut Upper Oligocene effusive-sedimentary complex and are not found in the Pliocene sediments	Contact-metamorphic, replacement ore deposits and ore veins with: Zn, Pb, Cu, Ag, Sb, As, Mo, U, F, Ba and other minerals
Sakar districts, Ustrem mining region (Y. Yovtchev, 1965)	Ore deposits are found in tectonic fault zones, similar to the Lece mining region in Serbia	Pb, Zn, Ag, As, Ba, F
Balya mining regions, Turkey (C. Ryan, 1960)	Miocene and Lower Pliocene rhyolites, dacites and andesites, with rhytmic repetition of dacites and andesites, ended by final extrusion of basalts	Zn, Pb, Cu, Ag, Sb, As, Bi, Te, F, Hg and other minerals
Edremit regions, Turkey	Neogene andesites and dacites	Pb, Zn, Ag, Au, Sb, As and others
Çanakkale and Balıkesir in Turkey (C. Ryan, 1960)	The ore veins in Tertiary dacites and their tuffs	Pb, Zn, Cu, Ag, Sb, As, Au, Ba and sedimentary hematites
Kırşehir (Mucur) mining region, Turkey (C. Ryan, 1960)	Oligocene gypsiferous-saline formation and beds of continental origin have been intruded by andesites	Pb, Zn, Ag, Sb, etc.
İzmir district, Turkey (M. Akartuna, 1962; and C. Ryan, 1960)	Rhyodacites, rhyolites, dacites and andesites with sanidine phenocrysts cut the lower strata of Miocene	Zn, Pb, Ag, Sb, As, Cu and other minerals

UPPER EOCENE - OLIGOCENE - LOWER MIOCENE METALLOGENETIC BELTS AND MINING REGIONS

Granites and granodiorites of Upper Eocene, Oligocene and Miocene ages have been reported to occur in Tuscany, Elba, Alpes, Mts. Boranja and Mts. Kopaonik in Serbia, in Osogovo - Pirin district and Rhodopes Mts. in Bulgaria, and in Greece (in Lavrion and on Aegean Islands), and similar rocks are found in Asia Minor and Persia (L. Glangeaud, 1954; H. Schneiderhohn, 1961; D. di Colbertaldo, 1958; H. Putzer, 1948; I. Magakyan and S. Mkrtchyan, 1960; Y. Yovtchev, 1965 and other authors).

In western parts of the Elba Island and in the Alpes near Baveno, Adamello and Alzo, granites, granodiorites and the pegmatites are found with: lithium minerals, tourmaline, beryl, cassiterite, feldspars, quartz, apatite, fluorite, molybdenite, axinite, pyrrhotite, magnetite and some other minerals.

Oligo-Miocene granodiorites of Mts. Boranja in western Serbia, and andesito-dacites in the surroundings of the mining region of Srebrenica, have been investigated for absolute ages determination with the following results :

	In million of years
Granodiorite of Mts. Boranja near the mouth of the Desivojski Brook into the Duboki Brook............	**27 ± 2**
Granodiorite of Mts. Boranja, Desivojski Brook.....	**29 ± 2**
Biotite dacite, near village of Potocari in the surroundings of Srebrenica........................	**30 ± 2**
Hypersthene-hornblende andesite, Potocari..........	**27 ± 2**
Minette (lamprophyre) near Gradina-Sase in the mining region of Srebrenica............................	**26 ± 2**

The author has collected fresh samples of biotite which were investigated in H. M. Government's Age Determination Unit of the Overseas Geological Survey, Department of Geology and Mineralogy in London.

With Mts. Boranja granodiorites are found some pegmatites, chalcopyrite-pyrrhotite skarn ore bodies with scheelite, quartz-molybdenite veins (stockworks), and Bi, Zn, Pb, Sb, As minerals, magnetite ore bodies and some other. The silver-bearing ore veins of Srebrenica were formed after genesis of dacito-andesites and above-mentioned minette.

Similar magmatic rocks and metallization are found on Mts. Kopaonik in Serbia.

In the Osogovo-Pirin district (metallogenetic belt) and Rhodope Mts. Oligocene and Miocene rhyolites, dacites, trachyandesites, granite-porphyries and small bodies of monzonitoid granites occur together with: Zn, Pb, Mo, Cu, Fe, Sb minerals. .

Tertiary granites, granodiorites, monzonites are known to occur in Lavrion and the Aegean Islands in Asia Minor and Persia. In the regions of Zangezur, Karadağ, Akhtinski, Daralagez and other are found the Cu-Mo mines with occurrences of Wo, Bi, Zn, Pb, Fe, As, Sb, Ag, Tl, Se and other minerals. The granodiorites cut the Eocene beds. In the literature these regions are knowp under the name of «Pambek - Zangezur Metallogenetic Copper-Molibdenum Belt». The average ore composition is 0.5 to 1%

Cu, 0.05 to 0.1 Mo. In the copper concentrates Bi, Ag and Au are found, and in the concentrates of Mo, is Re found (I. Magakyan and S. Mkrtchyan, 1960).

In the Oligocene and Miocene periods rhyolites, rhyodacites, dacites were to be found in the Carpathian Mts.

When we summarize the regional metallogenetic differentiation sequences and maginatic evolution occurring in the form of numerous phases in wide areas in the Mediterranean countries, starting from Upper Eocene-Oligocene until Anthropogene, we can reach the following conclusions :

a. The geological time factor (periods of the ore and rocks formation), must be considered in the study of regional metallogenetic differentiations as represented schematically in Fig.l. From pegmatites, over pneumathopytic, cata- meso- and epithermal mineral deposits we can trace gradual changes from Upper Eocene-Oligocene period with occurrences of Li, Be, B, Sn, Wo, Mo, Bi minerals over Miocene-Lower Pliocene with Mo, Cu, Bi, Zn, Pb, Ag, Au, Sb towards comparatively young Pliocene-Quaternary mineralizations with Au, Te, Ag, Sb, As, Hg and native sulphur deposits.

b. Concerning temporal successions of granites, granodiorites with accompanying rhyolites, dacites and andesito-dacites and younger andesito-basalts, basalts, we can assume that, after the acidic rocks can be traced intermediate and finally basic and alkaline basaltic rocks, since Upper Eocene until the present time. Similar quantitative and qualitative relations during above-mentioned geologic intervals, can be traced in the Pacific regions, Eastern Asia and in western parts of North and South America.

The range and trend of chemical variation is not precisely the same in all provinces and even varies both in time and place from one mining region to another within a given metallogenetic zone; but if we consider numerous magmatic phases in vast areas, the afore-mentioned regularities and trends of magmatic evolution and metallogenetic differentiation could be established.

Extensive development of granitic batholithes and mineralisations of : Li, Be, B, F, Sn, Wo, Bi, Mo. Ta, Nb, U, Th, formed during Middle and Upper Jurassic, Lower Cretaceous periods in Burma, Malaya, southern China, eastern Baykal districts and in Alaska are well known in geologic literature. Granodiorites and related effusives and deposits of Sn with sulphides, scheelite, Cu, Mo, Zn, Pb, Ag, Au, Sb and others are known in many parts of the world, such as : Rocky Mts., Andes, Verkhoyansk Range, Sikhote-Alin, Japan, etc.

The Upper Cretaceous - Paleogene metallogenetic zones, which will be discussed below, could be treated as a part of geomagmatic (metallogenetic) succession following Middle and Lower Cretaceous and Middle and Upper Jurassic periods.

The Senonian - Paleogene volcanic activities with andesites basalts, spilites and intrusives: granodiorites (banatites), syenites, gabbros, pyroxenites and periodotites with deposits of: Fe, Mn, Cu, Pb, Zn, Ag, As, Ge, Cr (Ni, Pt) and others

We will outline the Upper Cretaceous - Paleogene metallogenetic zones (belts) in the Mediterranean countries in the following manner:

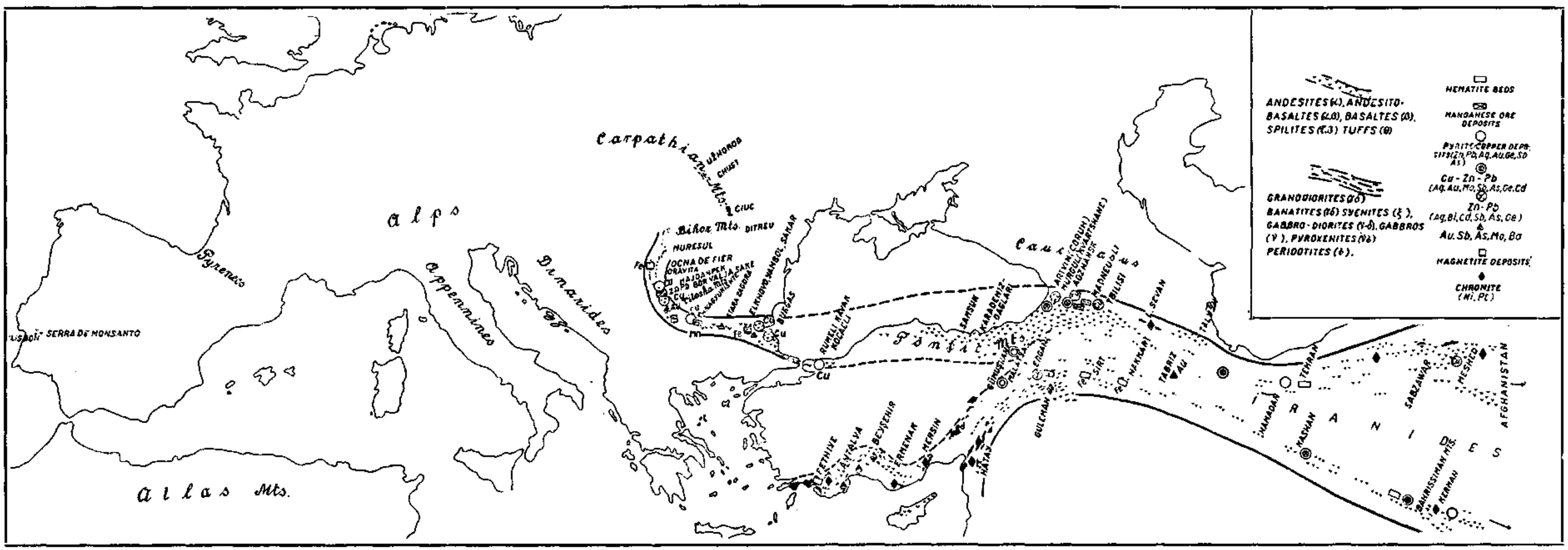

Fig. 3 - Upper Cretaceous - Paleogene magmatic (metallogenetic) zones, belts and mining regions in Mediterranean countries.

The Carpathian Mts. - Timok - Bulgarian Middle Mountains (Sredna Gora) Burgas metallogenetic zone

Table - 3

Mines and mining regions (Authors)	*Magmatic rocks and their ages*	*Metallization*
South Carpathian Mts., Eastern Carpathian Mts., Oravita, Dognocea, Bihor Mts., Muresul River	Early Tertiary intrusives: granodiorites, monzonites, syenites, gabbros and hornblendites	Magnetite deposits and occurrences of Cu, Mo, Bi, Zn, Pb, As and other minerals
Timok mining regions: Valja Sake, Bor (F. Drovenik and M. Drovenik, 1957; A. Cissarz, 1956; V. Majer, 1960; R. Milojevic, 1959; W. E. Petraschek, 1963)	Senonian and early Paleogene: andesites and andesito-basalts, intruded by granodiorites diorites and monzonites	Magnetite deposits, Cu and Cu-Zn-Pb and pyrite-Au deposits with minerals of: Mo, Bi, Au, As, Sb, Ge, Ba
Sredna Gora district Viskiar Mts., - Panagyurishte-Burgas (S. Dimitrov, 1946; Y. Yovtchev, 1965; G. Terziev, 1965; S. Belev; 1960; S. Stojnova, 1960 and other authors)	Senonian and early Paleogene: andesites, andesito-basalts, basalts, spilites, their tuffs, then trachytes, tholeiites and granodiorites, monzonites, syenites, diorites, gabbros and lamprophyres	Magnetite deposits, Fe-Ti-V deposits, pyrite-Cu deposits, hematite deposits, manganese deposits with hornfels, barite deposits and occurrences of Zn, Pb, Ag, Au, Sb, Ge, Te, Se, Tl, Mo, and other minerals

Metallogenetic zone Pontic Mts. - Caucasus - Elburz Range

This zone could be considered as continuation of the abovementioned metallogenetic zone. In the Cretaceous period, the eruptions began during the Cenomanian times and were renewed during the Senonian. The dominant lavas are andesites, andesito-basalts accompanied by tuffs. During Paleogene the intrusives occurred.

Table - 4

Mines and mining regions (Authors)	*Magmatic rocks and their ages*	*Metallization*
Giresun, Artvin, Sivrikaya, Sarigyukh, Sevkar, Kevul, Kuvarshan, Adzhar-Trialet, Lake Sevan, Tehran regions, Shahrud, Meshed (A. Kraëff, 1963; C. Ryan, 1960; E. Diehl, 1944; H. Walter, D. Nalivkin, 1960; G. Dzotşenidze & G. Tvalschrelidze, 1960; T. Ivanitsky, 1965; W. E. Petraschek, 1963)	Turonian, Senonian and Paleogene: andesites, andesito-dacites, albitophyres, basalts, spilites, teschenites, trachybasalts, diorites, monzonites, syenites, gabbro-diorites, gabbros, periodotites and serpentinites	Hematite sedimentary deposits with andesito-basaltic lavas. Manganese beds with hornfels, tuffs and other volcanic-sedimentary formations. Pyrite-Cu deposits: Gümüşane, Çoruh, Madneuli, Shamlug, Akhtala, Kedabek and others with Zn, Pb, Sb, As, Cd, Ga, Bi, Se, Te, barite, etc. Magnetite (skarn) deposits. Chromite deposits with some Pt, Ni, Co minerals

Metallogenetic zone; Toros (Taurus) - Ergani - Hakkari - Hamadan - Bahrassimman Mts.

In the mining regions of Antalya, Beyşehir, Ermenak, Mersin, Antakya, Malatya, Ergani, Hakkari, Hamadan, Kashan, Kerman.(Fig. 3) are widespread magmatic associations and types of ore deposits as in the metallagenetic Pontic Mts. - Caucasus - Elburz zone mentioned earlier. If we use the data published by H. Borchert (1957, 1958),

A. Kalafatçıoğlu (1963), T. Ayan and C. Bulut (1964), K. Nebert (1964), L. Dubertret (1954), C. Ryan (1960) and many other-investigators of these regions, we could produce the sizeable book about Upper Cretaceous and Paleogene magmatism, tectonic activities, volcanic-sedimentary formations and mineralizations. We can mention here the well-known basaltic rocks from Deecan Plateau in India, which were formed mostly during Paleogene.

In many parts of the world it can be observed that the basic and ultrabasic intrusives (gabbros, serpentinites, peridotites) tend to be associated geographically with spilitic (basaltic) rocks, but the period of their intrusions is in many cases distinctly later after that of effusives.

CONCLUSIONS

The types of magmatic rocks and mineral deposits that have been formed at a definite geologic interval including numerous metallogenetic zones (belts) in the world tend to exhibit similarities of chemical and mineral composition. The metallogenetic isotypism is clearly discernible in the Mediterranean countries in the following relatively younger geologic periods :

1. The deposits of Hg, As, native sulphur and probably Au-Te occurrences are found closely related to the andesito-basalts, basalts, trachytes (subordinately dacites and rhyolites) of the Pliocene, Quaternary and Anthropogene age.

2. During Middle and Upper Miocene and Lower Pliocene periods, large quantities of andesites, dacites, and rhyolites have been erupted, with some accompanying diorites and granodiorites. Numerous mining regions with deposits of Zn, Pb, Ag, Au, Sb, As, Bi, Hg, Se, Te are known. Besides the mineralization of: Zn, Pb (Cu, Ag, Sb, Bi, Te, F, Hg, As), which occur in the mining regions in Çanakkale, Edremit, Balya Maden, İzmir, Kırşehir (Mucur) etc., we can suppose that in Anatolia the Au (Ag) veins of the Carpathian type are to be found. Upper parts of the veins may have been intensively exploited by ancient miners.

3. The rhyolites, dacites, granites, granodiorites with pegmatites Cu-Mo, Bi, Pb, Zn, Ag, U, Sb, As, Au, Fe and other deposits occurred during Upper Eocene, Oligocene and Lower Miocene in the Mediterranean regions. In we prove that the granodiorites of Pontic Mts. and some other parts of Turkey were formed during these intervals, we can search for deposits of Wo (scheelite), Bi, Mo, Cu, Zn, Pb, Sb, U, Au, As and some other which were encountered in Boranja Mts., Kopaonik Mts., etc.

4. Upper Cretaceous - Paleogene magmatic activities are accompanied by Fe, Mn, Cu, Zn, Pb, Au, As, Ag, then Cr (Ni, Pt) occurrences. In prolongation of Ergani mining regions towards Hakkari regions and Zagros Mts., we can search for deposits such as: magnetite, hematites, pyrite with Au, barite, Zn, Pb, Mo, manganese and others encountered in isotypic metallogenetic zone South Carpathian Mts.-Timok-Sredna Gora-Burgas.

I would like to emphasize that we have not yet solved fundamental problem in geology, i.e. why particular geologic periods yield particular types of magmatic rocks and mineral deposits. I hope that I have sufficiently pointed out the significance of geologic time factor in domains of mineral deposits, in metallogeny and petrology.

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