METALLIC MINERAL DEPOSITS IN TURKEY

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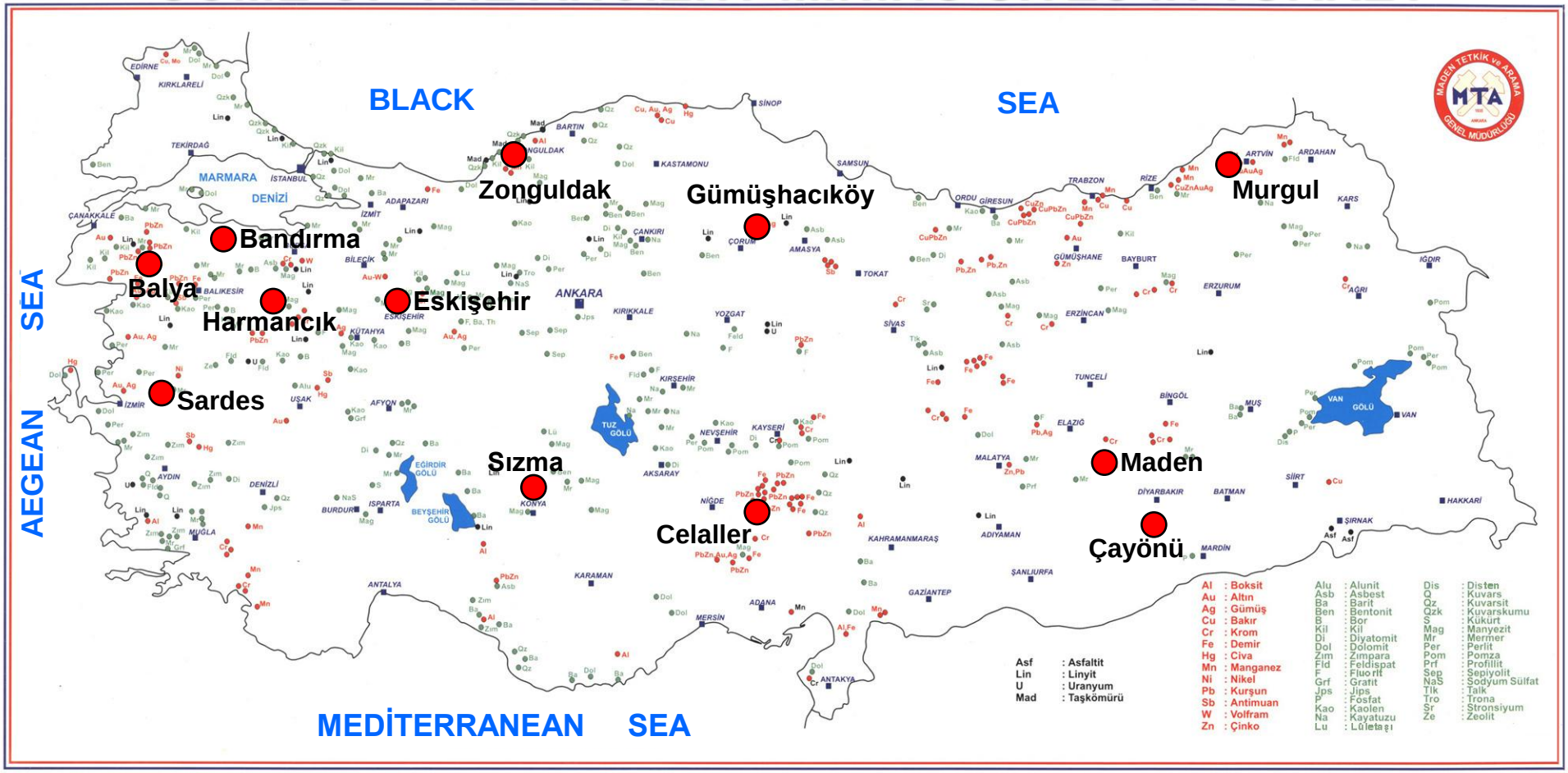
- **Archaeological studies show that history of mining in Anatolia goes back to 8800BC.**
- **Mining appears to have played an important part in the developments of ancient civilizations in Anatolia such as; Phoenicians, Hitites, Phrygians, Lidyans, Romans, Ottomans**

SOME OF THE ANCIENT MINING SITES IN TURKEY



Çayönü 8800 B.C.
Maden (Elazığ) Cu Deposit 2000 B.C.
Gümüşhacıköy (Çorum) Pb-Zn Deposit 2000 BC.Hitites
Sızma (Konya) Hg Deposit 1500 B.C. Phrygians
Sardes (Manisa) Au Deposit 600 B.C. Lydians
Celaller (Niğde) Sn Deposit

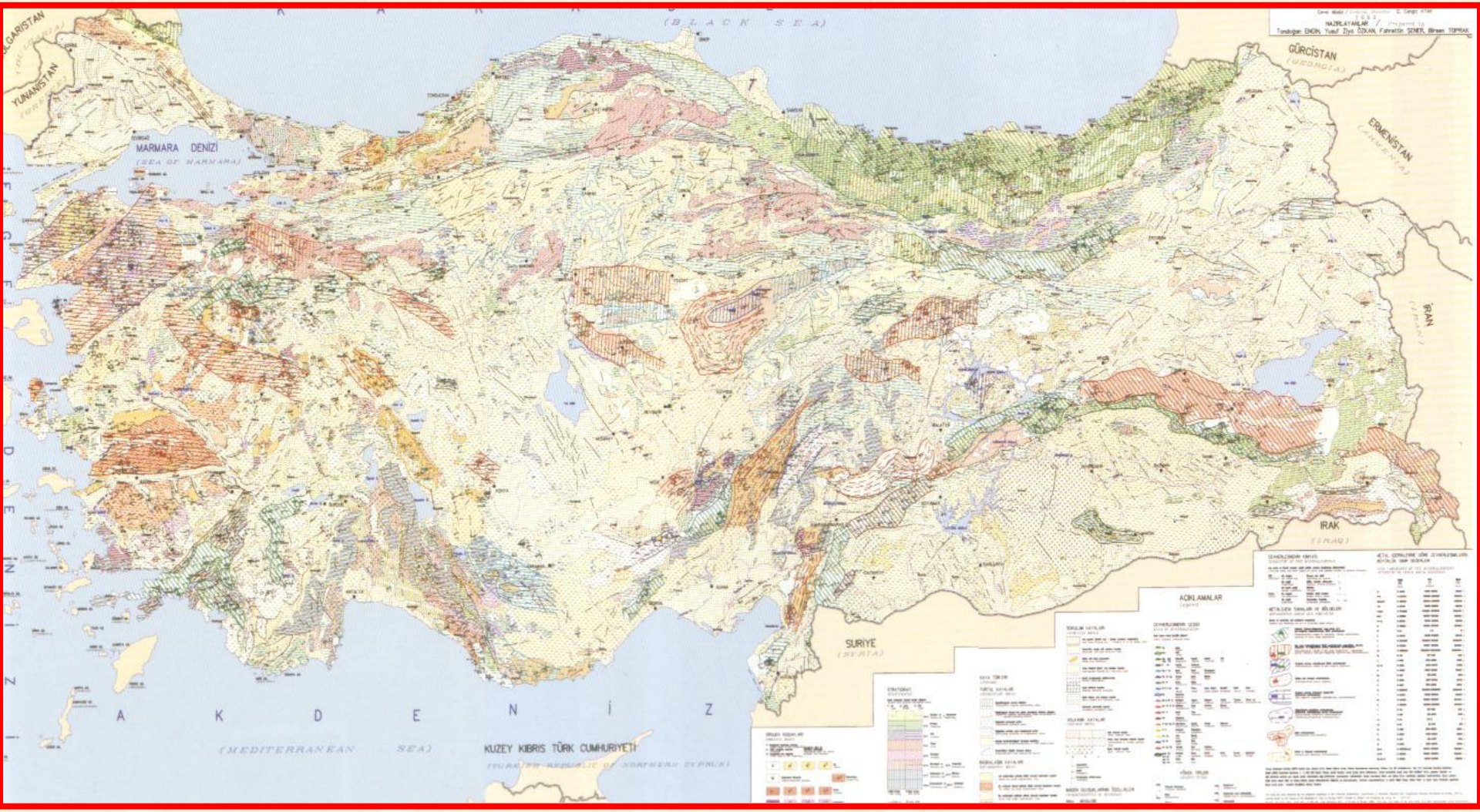
Balya (Balıkesir) Pb-Zn; Murgul (Artvin) Cu Deposits 500 B.C.
Eskişehir Meerschaum Deposits, Romans
Bandırma (Balıkesir) B Depsits 1815;
Zolguldak Coal Deposits 1822;
Harmancık (Bursa) Cr Deposit 1848
} Ottomans

- **Turkey is located within the alpine orogenic zone and has been subjected to intensive tectonic movements.**
- **Turkey has been divided into numbers of tectonic plates, intensive igneous activities developed, ophiolite emplacements took place.**
- **This complicated geology is the cause of rich variety of Turkey's minerals wealth.**
- **Copper, lead, zinc, iron, chromite, borate, sepiolite, mercury are the tradational minerals mined in Turkey.**

- **90 commodities are traded in the world mineral market. Out of this 90, 73 commodities are mined in Turkey**

- **Metallogenic map of Turkey shows that there are numbers of different age and origin, structure and rock type controlled metallogenic provinces in the country.**

METALLOGENIC MAP OF TURKEY



Some of the metallogenic provinces in Turkey

- **Mineral provinces related to ophiolites: They include *chromite, magnesite, asbestos, copper deposits and mineralizations.***
- **Volcano-sedimentary mineral provinces related to felsic volcanics: They include *copper, copper-lead-zinc, manganese deposits and mineralizations***

- **Mineral provinces related to acid-neutral magmatisms: They include *copper, copper-lead-iron, porphyry copper-iron skarns, hydrothermal copper-lead-zinc, copper-lead, lead-zinc, copper-zinc-lead, wolfram, antimony, antimony-gold, iron-wolfram-molybdenum, iron, fluorite, mercury, mercury-antimony, antimony-mercury, barite, iron-phosphate deposits and mineralizations***

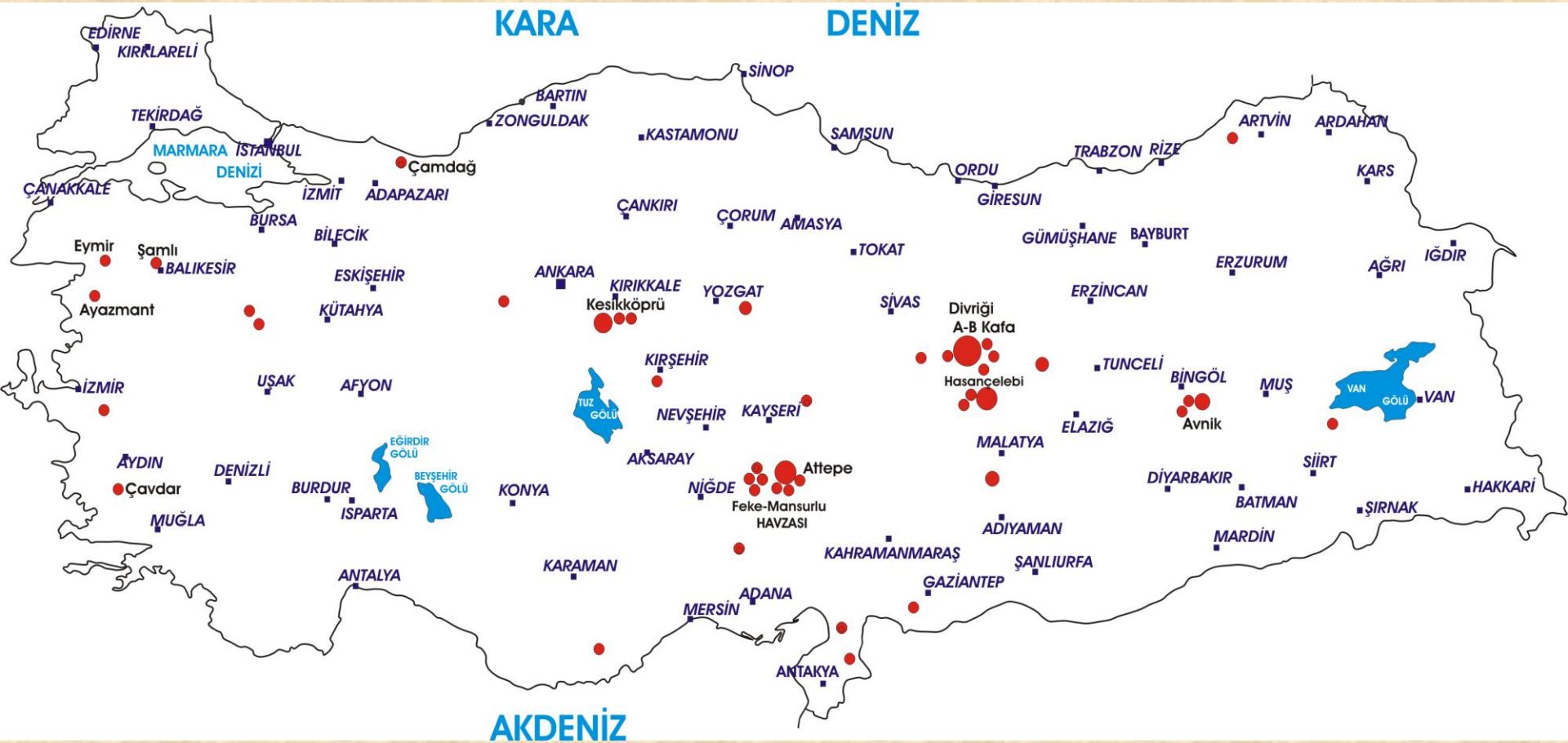
- **Sedimentary mineral provinces: They include *manganese, iron, red bed type iron-copper, phosphate, stratabound barite-lead, zinc-lead deposits and mineralizations.***

- **Mineral provinces related to evaporites: They include *borate, trona, salt, gypsum, celestite deposits and mineralizations***

- **Mineral deposits related to laterites and placers: They include *bauxitic iron, bauxite, nickel, gold deposits and mineralizations***

METALLIC MINERAL DEPOSITS IN TURKEY

IRON ORE DEPOSITS IN TURKEY



- **Iron ore deposits in Turkey are mainly small and medium size. They are genetically 6 types.**
- **1-Contact metasomatic deposits. Divriği A and B bodies (Sıvas, C.Turkey), Karamadazı (Erzincan), Bızmişen, Hasançelebi (E.Turkey).**
- **2-Hydrothermal metasomatic deposits. Attepe, Mansurlu (Adana, S.Turkey).**
- **3-Volcano-sedimentary deposits. Hekimhan (Malatya, E.Turkey), Büyük Eymir (Balıkesir, W.Turkey).**

- **4-Marine sedimentary deposits. Çamdağ (Sakarya, NW.Turkey).**
- **5-Lateritic deposits. Avşarören (Sıvas, C.Turkey), Karaçam (Eskişehir, W.Turkey).**
- **6-Placer deposits. C placer (Divriği, C.Turkey), Eastern Black sea coastal sands.**

- **Important iron ore deposits are mainly of contact metasomatic type and are mainly located in Central Turkey.**
- **Minable ore reserves with 55%Fe grade is estimated to be 150 million tons(proven+possible).**

Divriği (Sıvas, C. Turkey) body (A) iron ore deposit

MANGANESE DEPOSITS IN TURKEY

- **Manganese mining in Turkey was first carried out in the Peronit manganese deposit (NE. Black Sea region) during 1900-1911.**
- **During the 1st. World War Gökçeovacık (Fethiye, SW. Turkey) manganese deposit was mined.**

- **There are numerous manganese occurences in Turkey.**
- **Apart from the sedimentary Binkılıç (Çatalca, NW.Turkey) deposit all other deposits are volcano-sedimentary type.**
- **Ulukent deposit with 2.5 million tons reserves is the biggest in the country**

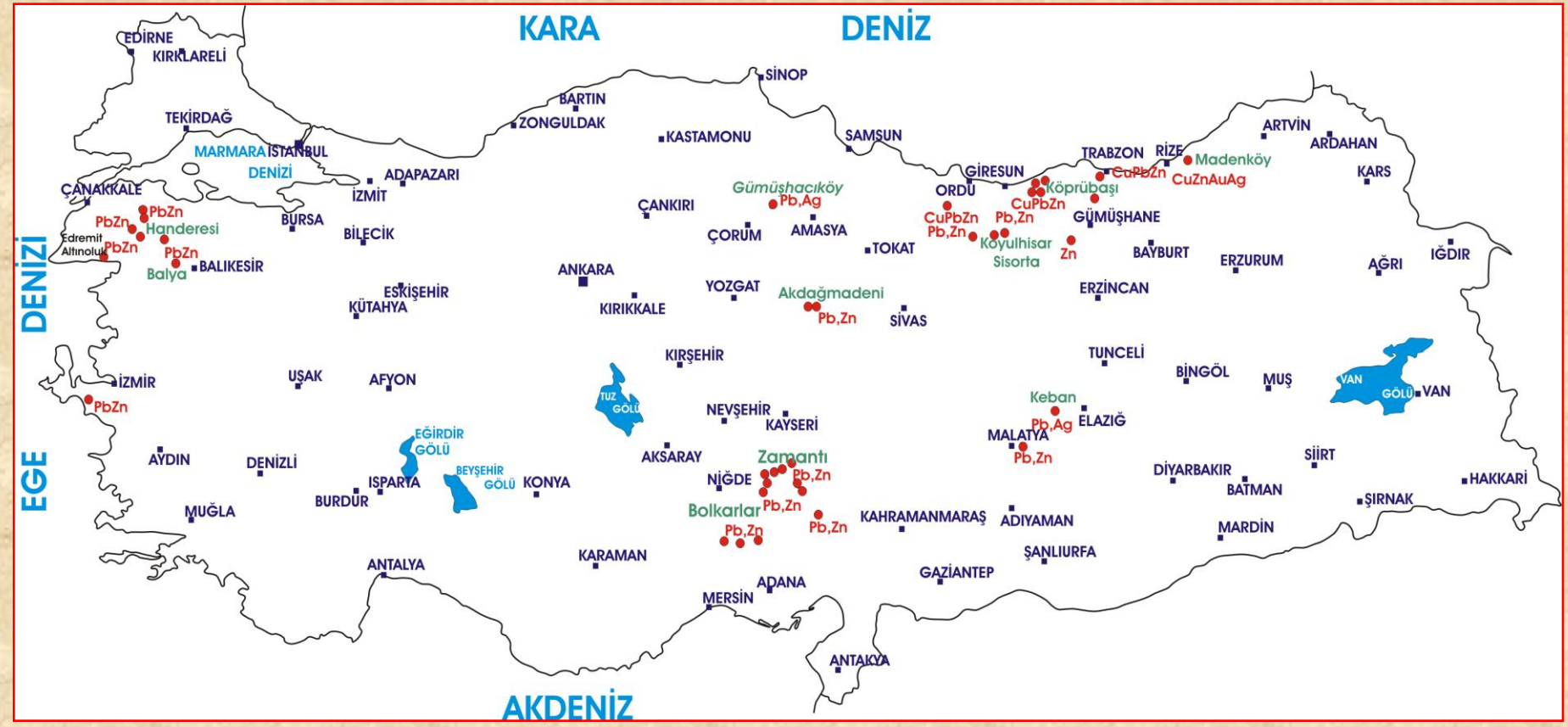
Manganese mine,
Ulukent, Tavas, Denizli

COPPER DEPOSITS IN TURKEY

Copper-lead-zinc deposits

- They are genetically 5 types:
- 1-Deposits related to ophiolites (Cyprus type).
- 2-Volcano-sedimentary deposits related to andesite-dacite volcanisms (Kuroko type).
- 3-Skarn and vein types.
- 4-Porphyry types.
- 5-Stratabound types.

LEAD-ZINC DEPOSITS IN TURKEY



- **Archeological data show that first lead mining in Anatolia was carried out in Gümüşhacıköy, Amasya, N. Turkey during the Hitite era (1750-1200 B.C.).**

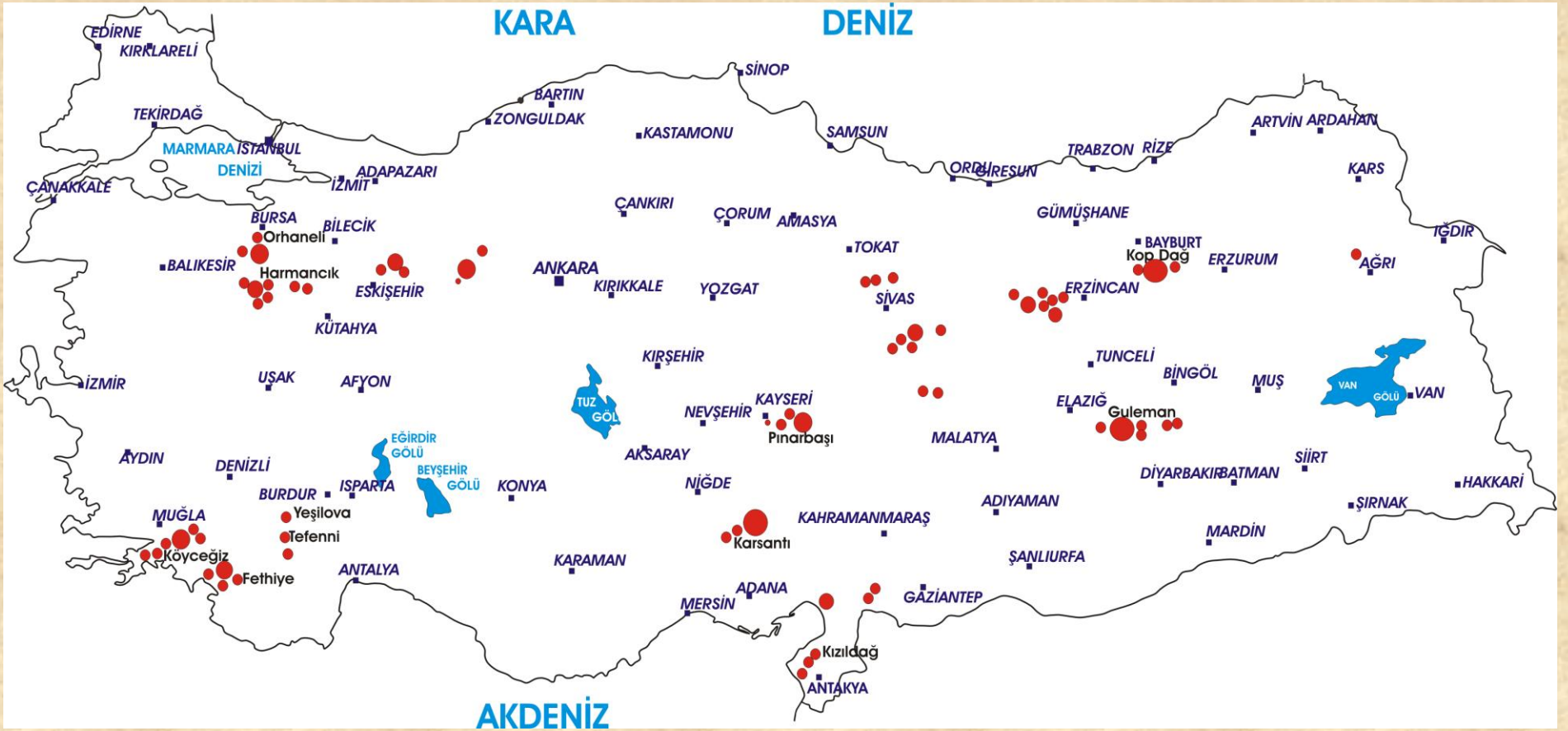
- **Skarn mineralizations related to granitic and dacitic rocks are important for lead-zinc mineralizations.**
- **They are mainly located in Balıkesir, Çanakkale areas (NW. Turkey), in Yozgat(C. Turkey), in Giresun (N.Turkey)**

- **Stratabound carbonate type lead-zinc deposits are located at certain levels of Paleozoic-Lower Mesozoic limestones in the Taurus mountains along S. Turkey.**

- **Estimated sulphur type lead-zinc reserves are 68700000 tons(p+p+p) at 5.18% Zn, 1.66% Pb, 3% Cu grades.**
- **Oxide type lead-zinc reserves are estimated to be 860000 tons(p+p+p) at 17.3% Zn, 6.7%Pb grades.**


Lead-zinc mine, Balya, Balıkesir

CHROMITE DEPOSITS IN TURKEY



- **Chromite mining in Turkey started in 1850, since then Turkey played an important role in the world chromite market.**
- **It is estimated that so far Turkey has produced about 45 million tons chrome ore.**
- **Chromite production is mainly export oriented.**
- **Turkey has 2 ferrochrome and 1 chrome chemical plants. Their annual ore need is about 530000 tons.**

Chromite Deposits

Chromite deposits in Turkey are alpine type. They are comparatively smaller in size but are higher grade than stratiform types.

- **They are located in the tectonite as well as ultrabasic sections of the cumulates of the ophiolite assemblages.**

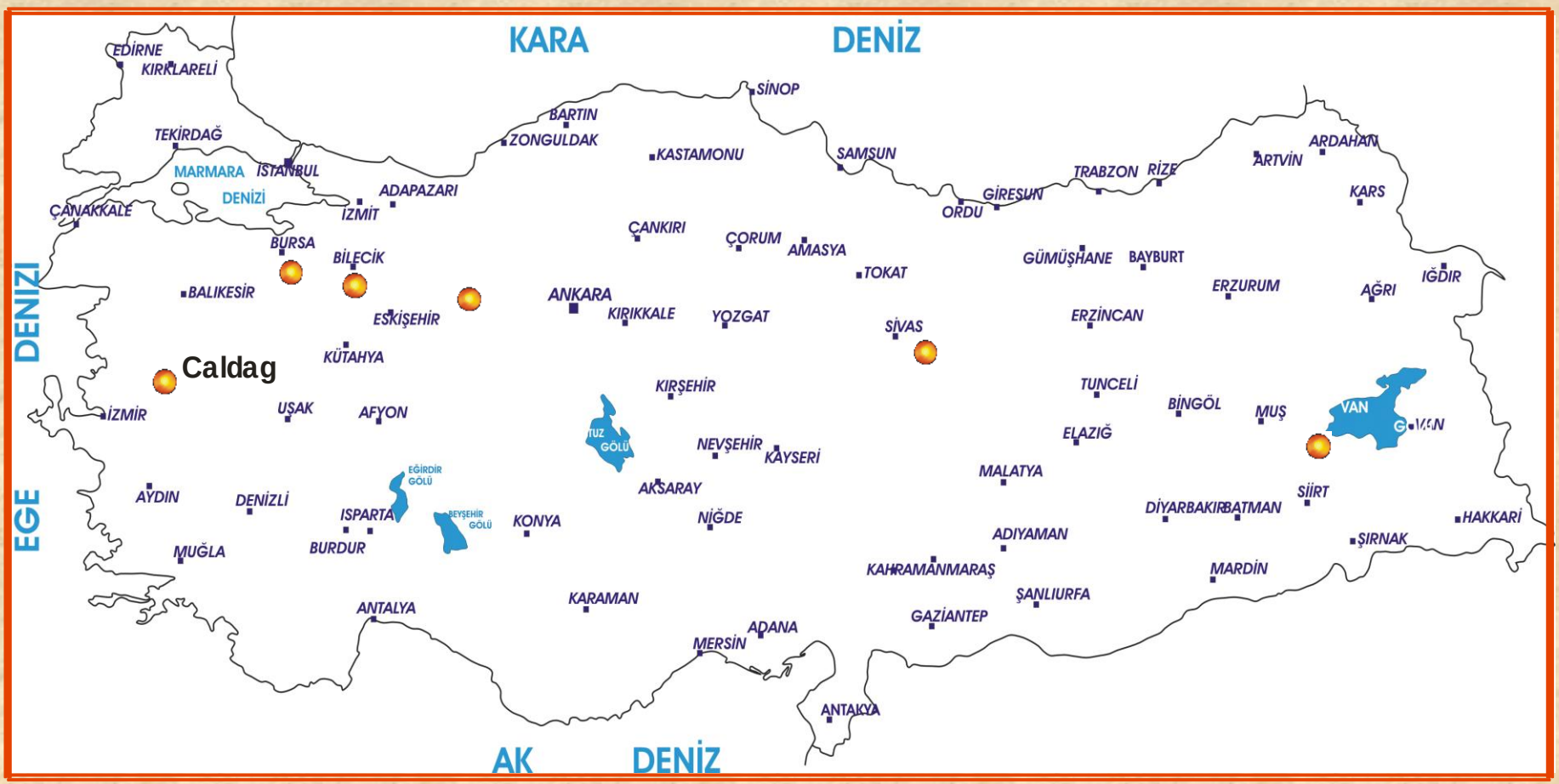
- Geographically chromite deposits are located in six major areas. Relative order of importance, they are:
- Guleman region(Elazığ, E. Turkey).
- Kopdağ region(Erzincan-Erzurum, E.Turkey).
- Fethiye-Köyceğiz-Denizli region(SW. Turkey).
- Bursa-Kütahya-Eskişehir region(NW.Turkey).
- Mersin-Aladağ-Pınarbaşı region(S. Turkey).
- İskenderun-K.Maraş region(S.Turkey).

Chromite deposits are made of various size chromitite bodies. Their relation with the host peridotite is complicated.

- Chromitite reserves of Turkey is estimated to be about 26 million tons.
- In Aladağ(Adana, S. Turkey) a low grade chromite deposit (5.42%Cr_2O_3 grade) with 200 million tons reserve is yet to be exploited

Folded chromitite
Biticealan, Fethiye, Muğla

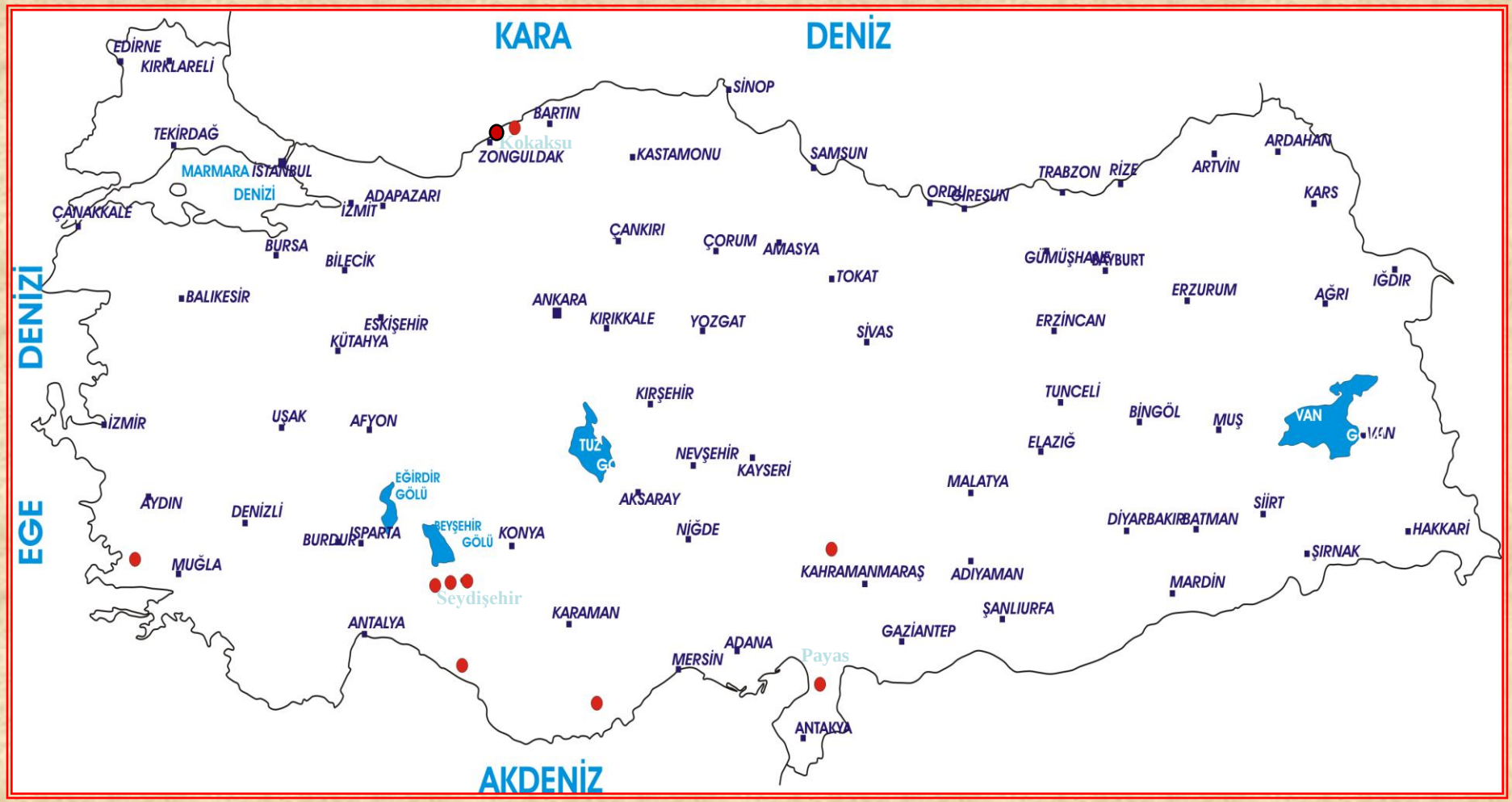
NICKEL MINERALIZATIONS IN TURKEY



- **Çaldağ (Manisa, W. Turkey) nickel deposit with 49 million tons reserve at 1.37%Ni grade is the only lateritic nickel deposit.**
- **Pancarlı (Bitlis, E. Turkey) nickel sulphide mineralization with 4%Ni, 2%Cu grades is yet to be explored**


Lateritic nickel deposit
Çaldağ, Turgutlu, Manisa

ALUMINIUM DEPOSITS IN TURKEY



- **History of aluminium mining in Turkey is rather new.**
- **Aluminium explorations started in Turkey in 1930ies.**
- **Aluminum mining started in 1970ies in the Seydişehir bauxite deposits, Konya, C. Turkey**

- **Aluminium deposits in Turkey are mainly three types; böhmitic, iron and diasporitic bauxites.**
- **Seydişehir (Konya), Akseki (Antalya), Silifke (Mersin), Kokaksu (Zonguldak) deposits are böhmitic.**
- **Payas (Hatay),Yalvaç (İsparta) are iron bauxite.**
- **Milas (Muğla), Alanya (Antalya), Bolkardağ (İçel), Tufanbeyli (Adana) are diasporitic bauxite.**

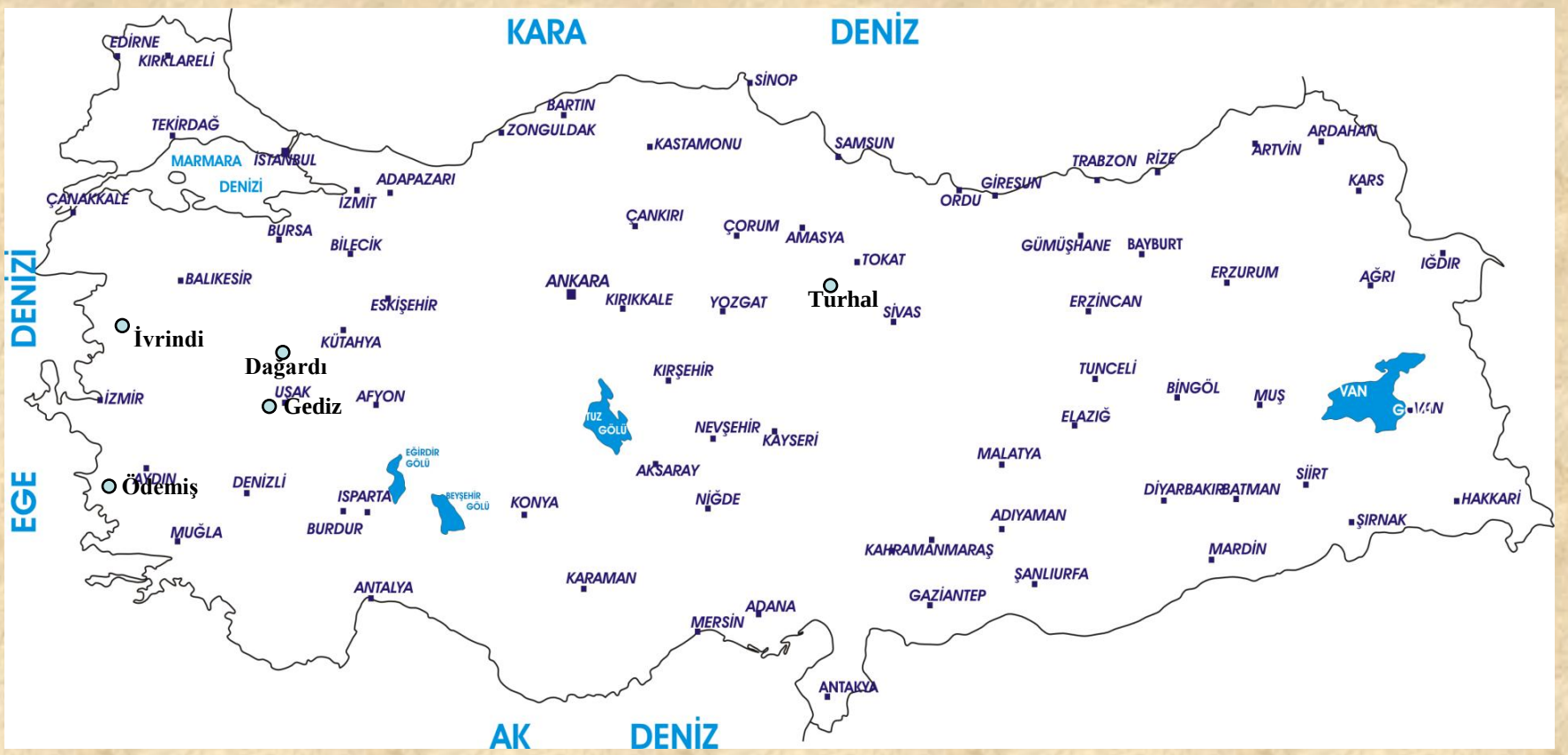
- **Böhmitic bauxite deposits in Seydişehir, Akseki supply material to the alumina plant in Seydişehir (Konya).**
- **Diasporitic bauxites from Milas are exported for grinding purposes**
- **Iron bauxites in Yalvaç and Payas have technological problems.**
- **Aluminium reserve of Turkey is estimated to be 85 million tons at 55% Al_2O_3 grade.**

Lateritic aluminium (bauxite) deposit, Mortas,Seydisehir

Wolfram Deposits

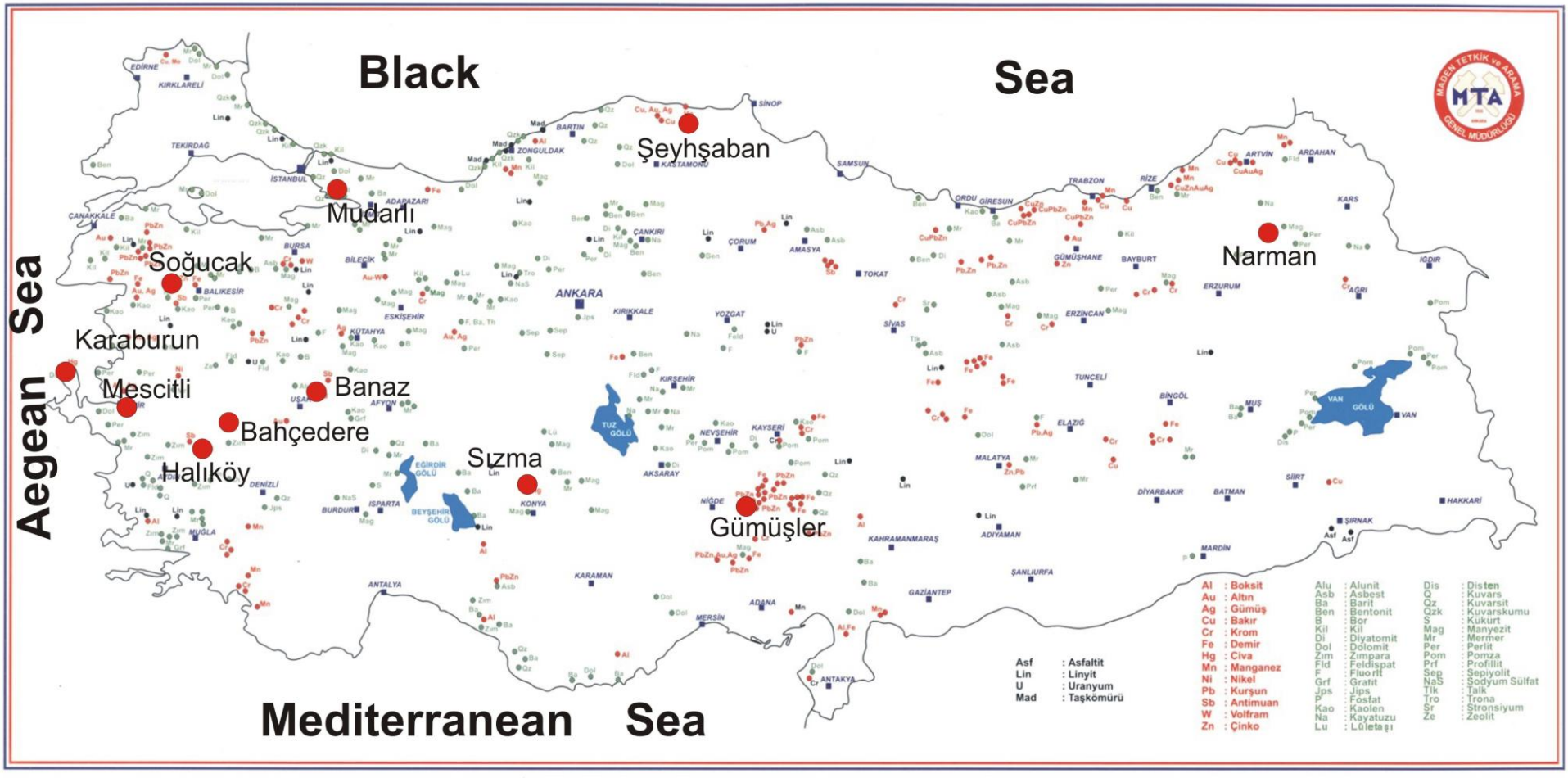
- Wolfram occurences are located in Uludağ (Bursa), Gümüşler (Niğde), Keban (Elazığ).
- Only Uludağ occurence is at a deposit scale.
- In Uludağ the mineralization is located in the skarn zone along the contact between intrusive and crystalline limestone.
- Reserve of the Uludağ deposit is calculated to be 37000 tons of metal.
- Uludağ deposit was mined for some time in the past but because of some technological difficulties and unatractive market price it was abondoned in 1990.

ANTIMONY DEPOSITS IN TURKEY



○ **(Sb) Deposits**

MERCURY DEPOSITS IN TURKEY

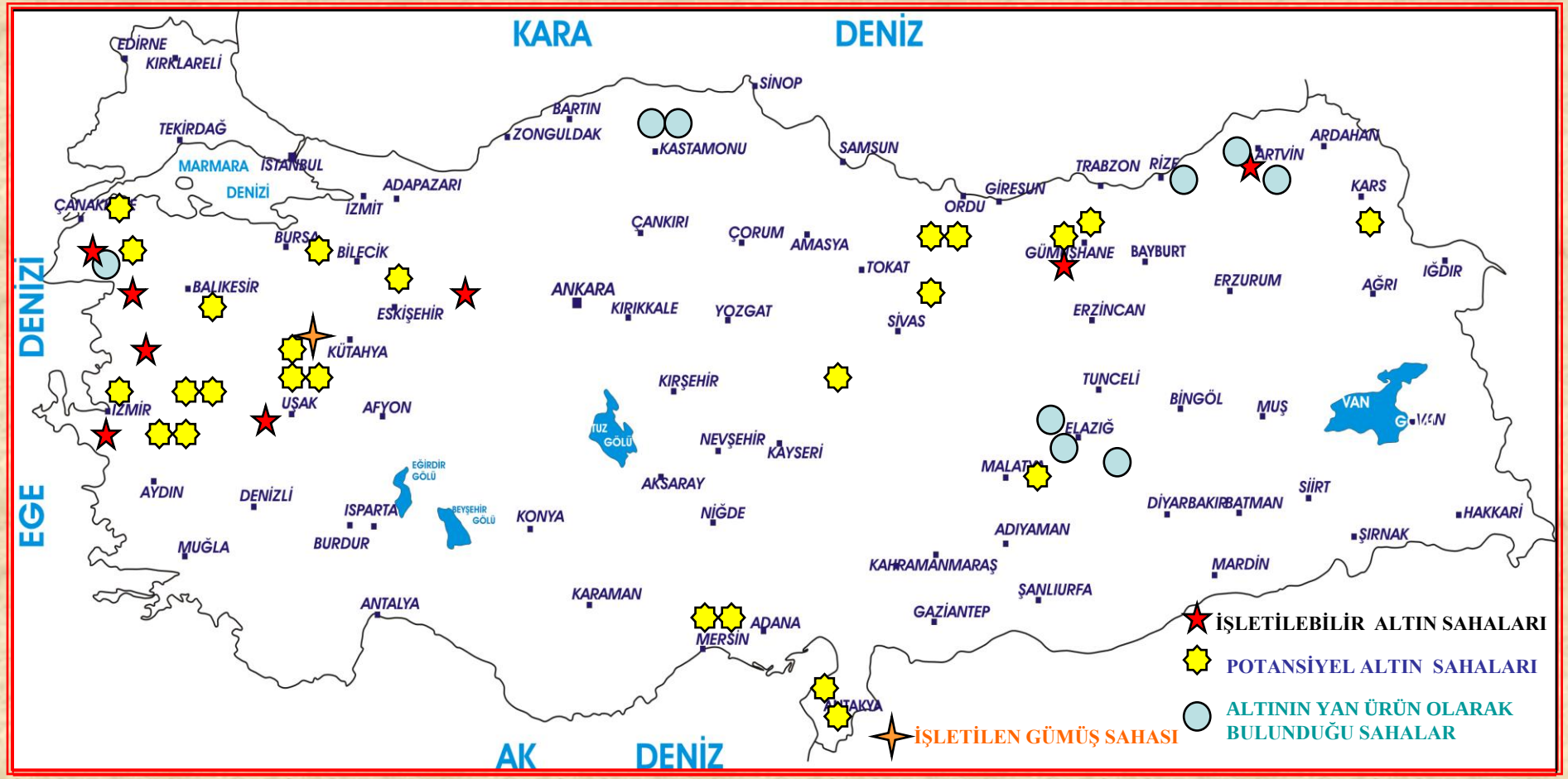


Mercury Deposits

- History of mercury mining in Anatolia goes back to 1500 B.C.
- Mercury explorations in Turkey started towards the end of 19th. Century.
- Until 1975 Turkey was among the 7 major mercury producing countries in the world.
- Since 1975 because of environmental concerns mercury explorations and mining have been rather limited.

- **Mercury mineralizations are hydrothermal origin and are found in tectonic zones in the form of irregular veins, veinlets, bands and disseminations with limited extensions.**
- **Some important mercury deposits are located in Karaburun, Ödemiş (İzmir); Sızma (Konya); Banaz (Uşak); Savaştepe, Gönen (Balıkesir).**
- **Mercury reserves of Turkey is estimated to be 5320000 tons at 0.15-0.39% Hg grade.**

GOLD AND SILVER DEPOSITS IN TURKEY



- **Turkey has favourable geology for epithermal gold mineralizations.**
- **At present 8 economically viable gold deposits have been discovered.**
- **Because of environmental concerns only two of these deposits are exploited.**
- **At present Turkey's total gold reserve is estimated to be about 340 tons.**
- **Gümüşköy (Kütahya) silver deposit is the only operating silver mine in Turkey. Estimated reserve is about 21.5 million tons at 180gr/ton and 0.2gr/ton tons silver and gold grades respectively.**

Commodity	Turkey's reserve (Metal content) Ton	Share in world reserve (%)	Annual production (Ton)	Annual demand (Ton)	Production and demand (%)
Iron	82 458 750	0.1	4 million (ore)	9-10 million (ore)	49
Aluminium	25 667 000	0.35	60 thousand (metal)	150-200 thousand (metal)	30
Copper	1 697 204	0.31	30-35 thousand (metal)	170 thousand (metal)	20
Zinc	2 294 479	1.15	0	50 thousand (metal)	0
Lead	860 387	0.86	0	35 thousand (metal)	0
Chromite	26 000 000 (ore)	0.5	1 million (ore)	530 thousand (ore)	100
Manganese	1 576 000	0.1	25 thousand (ore)	150 thousand (ore)	25
Nickel	529 300	0.35	0	1.5-2 thousand (metal)	0

Commodity	Turkey's reserve (Metal content) Ton	Share in world reserve (%)	Annual production (Ton)	Annual demand (Ton)	Production and demand (%)
Gold	338	0.85	3-4	150	3
Silver	6740	1.44	80-90	100 (metal)	90
Molybdenum	-	-	0	1 000 (ferromolybden)	0
Cobalt	-	-	0	1-2 hundred (metal)	0
Wolfram	67 000	1.15	0	50 (metal) 25 (Tungsten carbur)	0
Vanadium	0	-	0	100 (metal)	0
Antimony	106 306	3.32	0	500 (metal)	0
Mercury	3 820	1.59	0	-	0

DEVELOPMENTS EXPECTED

- **Considering the deposits, which have already been discovered and the size, kinds and extensions of the metallogenic belts in the country one is led to believe that there are enough rooms for more discoveries.**
- **It is well understood that many of the deposits, discovered so far mostly had some degree of clear surface manifestations. The deposits yet to be discovered would need more detailed studies and it would cost more.**

- **Turkey has 8 economic gold deposits discovered at present. As Turkey has favourable geology for gold mineralizations, it is believed that new exploration works will lead to new discoveries. With the start of mining of the already discovered deposits new deposits are expected to be discovered.**
- **With favorable market conditions porphyry copper mineralizations will probably be operational.**

- Payas (İskenderun, SE.Turkey) and Yalvaç (İsparta SW:Turkey) iron bauxite deposits; low grade Hasançelebi (Malatya, E.Turkey) iron ore deposit; Uludağ (Bursa, NW.Turkey) wolfram deposit all have some technological problems. When these problems are overcome no doubt these deposits will be exploited.

Turkey is among the top producers of chromite

- Chromite deposits in Turkey are alpine type. Exploration for new chromitite bodies generally goes along with mining. Careful examination and evaluation of geological data gathered during the process of mining usually led to new discoveries. So far Turkey hasn't had any difficulty on meeting the markets demands.

- Turkey doesn’t have experience and tradition of large scale open pit mining operations. Aladağ (Adana, S.Turkey) low grade chromite deposit with 200 million tons reserve at 5.42% Cr_2O_3 grade is not operating (The reserve could go up to 400 million tons).
- Technological tests showed that the ore could be upgraded with 70 % recovery. With suitable market conditions no doubt Aladağ chromite deposit will come into operation.

THANK YOU