WEST ANATOLIAN MINING IN EARLY BRONZE AGE (3000-2000 BC)

Abstract: The discovery of people's mines and the use of them has been a major breakthrough in the development of civilization. In Anatolia, which has rich ore deposits, it is seen that people recognized the mines from the Neolithic Age. When the Early Bronze Age came, mining activities became very widespread. In western Anatolia, centers such as Troy, Limantepe and Beycesultan have become masters of metal production. In this article, in the Early Bronze Age, the mining of the western Anatolian region is evaluated. In this context, mineral deposits of the Western Anatolian region, mineral products and their usage areas, archaeological sites that found metal were investigated. In addition, the use of metals such as copper, tin, bronze, lead, gold, silver and iron in the region has been discussed.

Keywords: West Anatolia, Early Bronze Age, Mining, Troy, Beycesultan.

1. INTRODUCTION

Anatolia is an important region in terms of mineral resources and prehistoric mining. Determination of mineral deposits in Konya-Catalhöyük and Aksaray-Aşıklı Mound in Anatolia from the Neolithic Age (9000 BC) shows that mines have been explored and used in Anatolia since the earliest times. This early period mining will show great improvement over time. Following the Chalcolithic Age (5000-3000 BC), the discovery of bronze, a mixture of copper and tin, gave a name to the age of the Bronze Age (Bronze Age), due to the fact that mining and mining techniques reached a very advanced stage. During the Early Bronze Age (3000-2000 BC) mining will develop very much in Anatolia. The presence of various metal objects in most of the Early Bronze Age (EBA) centers reveals the development of mining.

Mining requires specialization. For this reason, it should be thought that mining has developed independently in various forms in various centers. The ore extracted from the mine or from the galleries is turned into metal ingots in a place nearby. These metal ingots are also taken to the centers where the workshops for the mines are located. The metal ingots brought to the workshops are processed here by specialists and various tools and artifacts are made.

After the metal is extracted from the soil, it is subjected to various procedures ranging from being metalized. These steps should be as follows. The ore extracted as crude is first turned into a metal ingot. The mines which are produced are distributed by trade. The specialists produce the desired tools and artifacts through the various operations of the metal ingots. They are then traded. The passing of mines through different processes requires
knowledge and experience that will require the expertise of various professional groups. Commercial distribution is an important branch that requires organization and control.

The mined ore is transported to various centers after being made into ingots. For this reason, mines that are formed into nut-shaped, oxhide-shaped and rod-shaped metal ingots are commercially easier to market. Nut-shaped metal ingots were found in Troy II (2500-2300 BC) in Western Anatolia. Oxhide-shaped metal ingots was found in various shipwrecks dated to the Bronze Age in the Mediterranean. Rod-shaped metal ingots were discovered at various Bronze Age centers.

In the Early Bronze Age (3000-2000 BC), metals such as copper, tin, lead, as well as gold, silver and electron are used1. In the early days, objects made from mine were used as objects of prestige, but they became widespread with the use of tools and weapons2. It is known that during the Early Bronze Age various minerals were extracted, processed and made in the form of ingots in Anatolia.

In the Early Bronze Age mass production is not seen in mining. More local production centers will develop mining through trial and error. Advanced mining activities can be seen in many different regions. There is also a great increase in the Early Bronze Age in respect of the metalwork recovered. Much of the finds are dated to the Early Bronze Age. This marks the development of the mining industry in the Early Bronze Age.

In the Early Bronze Age, mines found on the surface of the soil as well as on the bottom of the soil and in the depths have been started to be searched and extracted. It is seen that the mining has developed thanks to the mine galleries dated to this period. Along with these developments, at 4000 BC new mines will begin to be recognized and processed in Anatolia.

Western Anatolian mining will be shaped in the Late Chalcolithic Age (5000-3000 BC) with local characteristics and will begin to develop in the Early Bronze Age I (3000-2700 BC). In the Early Bronze Age II (2700-2400 BC) it will rise to the top3. Over time, stone tools will be replaced by tools made of metal. Metal finds are encountered in almost all of the settlements where archaeological excavations are performed. The presence of metal artifacts in many settlements not close to the mine beds suggests that the mines distributed in trade are being processed in these settlements4. Many mine pots and tunnels discovered in excavations support this. In very rare works with very fine workmanship, it goes to the remote regions as a prestige object.

Early Bronze Age II (2700-2400 BC) is a period of time when the metal industry developed, the methods of metal processing were diversified, the raw materials and metal trade were organized and concentrated and new techniques were used. In addition, various mines are being mixed and used in this period. The mines extracted from the quarries are transformed into ingots and delivered to the distant point of trade. Mining has become organized in the process of producing the ore extracted from the galleries until the production in the manufacturing5.

From the Early Bronze Age II, there is an increase in the number of metal works. It is used in casting in closed molds besides open molds6. Due to the increase in metal usage, the production and trade of obsidian and chipped stone tools will begin to decrease from Early Bronze Age II7.

The mining activities that existed in the Chalcolithic Age continued in the Early Bronze Age in a much more diverse, organized way. For this reason, Anatolia is an important center for the development of early metallurgy8. In Early Bronze Age II, mining technology has shown great improvement9. Early examples of mining are found in Anatolia, making Anatolia an important center for mining10.

2. WESTERN ANATOLIA MINERAL DEPOSITS

Anatolia has rich gold, silver, copper, lead, zinc and iron mines. These mines are concentrated in the south of the Black Sea11, in the Taurus Mountains12 and in the Troas Region in Western Anatolia13. The Taurus Mountains are especially important for mining activities in Early Bronze Age II and III14. Strabo from the Antiquity writers; Hermos and the Pactolos River through Sardis and Astyra in Troas speak of the wealth of gold15. These rich mineral deposits in Western Anatolia have always attracted people’s attention.

These rich deposits in Western Anatolia can be summarized as follows; Gold in Kirazli district of Çanakkale Province, copper in Lapseki, gold in Kartalkaya in the south of Çanakkale Province, and silver mines in Üsküçü16. Gold in the province of Salihli of Manisa, Arapdağ Mevki of Karşıyaka District of İzmir, Bergama, Tire and Ödemiş17. Balikesir has rich silver and lead deposits in the Balya District18. There are lead mines in Balikesir, Çanakkale, İzmir-Gümüldür19 and Edremit. Gold deposits especially in Western Anatolia. The rich gold mines of Western Anatolia were operated in the Early Bronze Age20.

There are rich silver mines in İzmir, Uşak, Güre and Kütahya21. The C 14 analyzes on the slags in the mineral deposits in Kütahya Gümüşköy indicate today 4000 years ago. It is evident that this mine in Kütahya-Gümüşköy was

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4 BİLGİ 1997, 7.
7 KOLANKAYA BOSTANCI 2008, 175.
8 YENER 2000, 17.
10 MULER KARPE 1994, 184.
12 YENER et alii 1991, 541-570.
13 WAGNER et alii 1984, 48, Abb. 1; STOS GALE/MACDONALD 1991, 276-280; STOS GALE/GALE 1990, 92; KASSIANIDOU/KNAPP 2005, 219, Fig. 9, 1; GALE 2008, 221, Fig. 9.
14 ŞAHOĞLU 2005, 341.
15 STRABO, GEOGRAPHICA 13, 4-5.
16 WAGNER et alii 1984; KORFMANN 2003b, 7; PERNİCKA/EİBNER/ÖZTUNALI/WAGNER 2003, 150.
20 YOUNG 1972, 13.
used in 3000-2000 BC, and various underground galleries are dated to this period\textsuperscript{22}.

The closest copper, lead, zinc deposits and formations to İzmir-Limantepe, which is located on the shore other than Troya in Western Anatolia, are Buca-Maden Tepe, Kemalpaşa-Yeni Kurudere and Ovacık Yayla, Bayindir-Sarıyurt-İlıcadere, Menderes-Efem Çukuru, Gümüldür-Gümüşsu is thought to be. These formations and deposits do not currently represent economic value. However, it can be considered that these deposits, which are close to Limantepe, were used in the Late Chalcolithic Age (3500-3000 BC) and the Early Bronze Age (3000-2000 BC). The closest mining site to İzmir-Baklatepe is Sandıköy. This mine contains lead, zinc, copper, manganese, gold deposits. Although it is not economically important today, this area should have been used by Baklatepe miners in the early period. It is inevitable that at least some of these rich mineral deposits in Western Anatolia have attracted the attention of Early Bronze Age people.

3. MINING PRODUCTS AND USAGE AREAS

Despite the fact that the mineral products and fields of use are a very wide subject, the artefacts discovered in the archaeological excavations are composed of jewelry, ornaments, various tools and works. For this reason, we give definite mines products and usage areas here (Fig. 1).

Early Bronze Age is a time when mining has developed and new techniques have been used in mining. \textsuperscript{22}KAPTAN 1982, 59-67; KAPTAN 1990, 77-78; KAPTAN 1995b, 191.

In many centers in western Anatolia, as well as obtaining metal artifacts, blowers, metal melting and casting pots and pestles were found. Various metal molds are used in casting of metals. When casting, three-way mine molds were used besides single and double faced mine molds. These molds are made of flat and armored axes, knives, daggers, chisels, tools and weapons, figurines and various items. In wax molds, Troia II (2500-2300 BC) was also used for casting lead figurines and ornamental needles.

Copper ingots are found in Anatolia, Çorum-Boğazköy, Antalya coasts, Gelidonya and Uluburun wrecks, Tekirdağ-Şarköy. Copper ingots were also found in the Aegean Islands and Greece, in the Sicilian coasts, and in the western coasts of the Black Sea\textsuperscript{23}. Oxhide-shaped ingots found in many places in the Mediterranean are cast in a certain standard and shape with an average weight of 25-29 kg, which is easy to carry\textsuperscript{24}. This is important in that it demonstrates that mining production and operations are very systematic and standardized.

Because the metals are valuable, they have been used by melting again. For this reason, we could find information about early-period mining in small quantities. We obtain most of these limited mine finds from wrecks in the seas and grave gifts. Most of the metal works in the museums consist of the finds recovered from the graves. The vast majority of these finds consist of jewelry and ornamental items. It is...

\textsuperscript{22}WHEELER/MADDIN/MUHLY 1975; JONES 2007, 420-430.
\textsuperscript{23}WHEELER/MADDIN/MUHLY 1975; JONES 2007, 420-430.
also seen in tombs in instruments, weapons, various vessels and symbolic goods.

Ornamental needles occupy an important place in metal finds. Bronze, copper, iron, silver, gold, electron ornaments made of metals such as the needles, as well as examples of bone, glass and wood can be seen. Ornamental needles have existed since the Late Chalcolithic. But it is intensively seen in the Early Bronze Age.

Troia is the most important center for mining in Western Anatolia and the Aegean during the Early Bronze Age\(^2\). The example of the mine found in the Troia I (BC 2900-2500) layers indicates the mining activities there\(^26\). In Beşik-Sivritepe, which is close to Troia, there are tools made of mineral materials. The metal axes recovered here are important for showing the mining activities in the region. In Gökçeada-Yenibademli Höyük located in Troas region, stone hammer, crushing stones, pots, molds and blowers related to mining were discovered. Minor finds such as knives, pins, buckles, tweezer and arrows indicate mining activities there\(^27\).

It is important to show mining activities such as mine mines, blowers, copper slags, pots, mine preparation, crushing and breaking tools which are unearthed in İzmir-Limantepe Late Chalcolithic Age and Early Bronze Age I-II layers on the western Anatolian coast\(^28\). In the Early Bronze Age architectural layers of İzmir-Baklatepe, copper, gold, silver materials and finds belonging to mining production such as copper slags, blowers, pots made from cooked soil emerged. Late Chalcolithic and Early Bronze Age I copper slags and pot remains indicate the presence of these mining activities\(^29\).

The metal tools, axes and pins found in Eskişehir-Küllioba indicate the existence of mining activities here. In Küllioba there is a large increase in the number of tools made of ornamental needles and mine in Early Bronze Age II\(^30\). Demircihöyük Early Bronze Age I-II belongs to various jewelry and ornaments, cutters and tools and some works were found. It is important to show that mining is done in Demircihöyük, which is a metal mold of copper lead alloy casting mold piece and tin traces\(^31\).

Antalya-Bademâncı'da various jewelry, ornaments, weapons and tools, gold ear plugs are available\(^32\). In addition to gold works, there are arsenic copper production items in the majority. These works shed light on Bademâncı's mineral products and uses in the Early Bronze Age. Kuruçay Höyük has advanced mining in the Late Chalcolithic Age. Many of the metal casting found in the settlement show this.

A large number of wedges were found in the tombs of Balikesir-Ovabeyindir. These wedges are similar in Northwest Anatolia, Central Anatolia and the Aegean. In Isparta-HarmAnnore, various ornamental needles, rings and bracelets, earrings and rings, metal objects and amulet were found\(^33\). In Azyonkarahisar-Kusura Höyük there are various metal needles, bices and axes\(^34\). In Denizli-Karadaha, bronze pins, bracelets and a melting pot were seized\(^35\). The metal artifacts found in the western Anatolia and its surrounding and excavated centers are important for revealing the richness of mining in the region.

3.1. COPPER USAGE

Copper is a soft, easy to process metal. Copper, the first mine that man first met, was used in Anatolia from the Neolithic Age (9000 BC Diyarbakır-Çayönü and Aksaray-Aşklı Höyük). At first, the copper obtained by collecting from the soil surface was started to be obtained from the ores later (5000 BC)\(^36\). In the Chalcolithic Age, arsenic copper production started first and then tinned copper production was started. Arsenic copper is common in most places. The use of copper in the Aegean increases in the Early Bronze Age I\(^37\). The copper that Greece needs is probably from Anatolia and the Balkans. During the Early Bronze Age II, mining became more widespread and demand for mining increased. From 2000 BC the use of tinned bronze will increase\(^38\).

There are copper mines in Crete and Cyclades, especially in Cyprus, in the Aegean\(^39\). Many settlements in Cyprus have finds pointing to the Early Bronze Age mining\(^40\). The use of tinned copper in Troya is widespread, the use of arsenic copper in the Aegean islands is widespread. This shows that Troia is getting tinned\(^41\). In the Early Bronze Age II in Troya, the analysis of at least two different roots belonging to copper was concluded\(^42\). The production of tinned bronze must have passed from the Western Anatolia to the Aegean islands\(^43\). Some examples of lead isotope analysis in the Aegean Islands show that some of them are of Anatolian origin\(^44\).

It is thought that arsenic copper technology emerged in Anatolia and spread rapidly in 4000 BC to the west of the Black Sea, to the Balkans and Central Europe\(^45\). Besiktepe metal finds are related to Troia I finds\(^46\). Similar to the bird-headed copper needle found at Beşik-Yassitepe, it is seen in Thermi\(^47\). Kumepe Ib-c layers copper pins, daggers and wedges were found. This is important in that it points to links with other centers in Troia's territory.

The mining slags recovered in Altünbe, near Menderes District in the south of Izmir, are an important place showing the Chalcolithic and Early Bronze Age copper

\(^{26}\) MÜLER KARPE 1994, 43.
\(^{27}\) HÜRYILMAZ 2008, 148.
\(^{28}\) ERKANAL 2008b, 180.
\(^{29}\) ERKANAL 2008a, 165.
\(^{31}\) SEHER/KAÜDER 1996, 313-314.
\(^{32}\) DURU 1995, 72.
\(^{33}\) OZSAF 2000, 372.
\(^{34}\) LAMBERT 1937, 64; DE JESUS 1980, 132; YAKAR 1985, 384.
\(^{39}\) BEAR 1983; BRANIGAN 1974, 59-60; WHEELER/MADDIN/MÜLHER 1975, 32.
\(^{40}\) STOS GALE/GALE 1990; JONES 2007, 253-255.
\(^{41}\) BRANIGAN 1974, 74; EATON/MCKERRELL 1976, 170.
\(^{42}\) STOS GALE/GALE/GILMORE 1990, 147.
\(^{43}\) WRIGHT 1998, 366.
\(^{44}\) GALE/STOS GALE 2004.
\(^{45}\) BRANIGAN/PERNIĆKA/SCHMIDT STRECKER 1994; MÜLHER 1999, 16; YENER 2000; NIKOLOVA 2005, 89, Fig. 1; NIKOLOVA 2008, 164.
\(^{46}\) BRANIGAN/PERNIĆKA/SCHMIDT STRECKER 2003, 173-200.
mining. This is an important center for processing raw mine in Western Anatolia. A large number of copper slags were discovered between the Late Chalcolithic Age (7th layer) and Early Bronze Age II (5th Layer) of İzmir-Limanıtepe. In the Early Bronze Age architectural layers of İzmir-Baklutepe, findings belong to mining production such as copper, copper slags, blowers and pots came out. Late Chalcolithic Age and Early Bronze Age I copper slags and pot remains indicate the presence of these mining activities.

Eskişehir-Demircihöyük various jewelry and ornaments belonging to the Early Bronze Age I-II, cutters and tools, arsenic copper and tin bronze artifacts were found. The part of the copper lead alloy casting mold indicates the casting activities there. Among the various finds found in the Demircihöyük-Sarıkent graveyard are metal finds consisting of various tools, jewelry and ornaments, 156 copper or bronze, and 4 arsenic copper. This number indicates that copper and its alloys are heavily used. In Eskişehir-Kückük Höyük Early Bronze Age II grave, various jewelry and ornaments made from copper were found.

The metal artifacts found in the Balikesir-Yortan graveyard were all made of arsenic copper. Only one piece was identified as tinned bronze. The works of Bursa-Ipmnar Late Chalcolithic Age are made of arsenic copper. At Barçın Höyük, a copper or copper alloy ax dating to the Late Chalcolithic Age was found in the M11 area.

Denizili-Beycesultan has developed metallurgy since the Chalcolithic period. Copper finds here are important for the metallurgy of Western Anatolia. In Afyonkarahisar-Kusura Höyük, artefacts such as various needles, wisps and axes contain arsenic copper.

Antalya-Badmecığiçda various jewelry, ornaments, weapons and tools were found. In addition to gold works, there are also arsenic copper production items in the majority. In Antalya-Karatay-Semayük, most of the metal works belonging to Early Bronze Age II are copper or bronze, and very few arsenic copper. Among these finds, the use of copper and its alloys in addition to the use of other metals in the Karatay community is more widespread. Arsenic copper and tinned copper are widely used in Western Anatolia.

3.2. TIN USAGE

It’s a question of where the tin is supplied. In the Early Bronze Age, it was unclear from where the tin was obtained, and it was acquired by traders from Mesopotamia in 2000 BC for trading from the sides of Afghanistan. Branigan notes that Troia II (2500-2300 BC) is very flourishing and that tin and bronze are obtained through trade. In Troia II, the tinned tin ratio is 10%, which is ideal. In Crete this rate is only 5%. In this case, it can be seen that Troia easily obtained the tin. Dayton states that tin is imported from Hungary or Spain. Rich cities such as Troy and Poliochefni can commercially obtain tin. But this has not been proven. Lapislazuli and amber were found in Troy. Lapislazuli came from Afghanistan, amber from the Baltic Sea. It is possible that Troy, which has commercial relations at such a long distance, can also commercially obtain tin.

In the presence of various tools belonging to the Eskişehir-Demircihöyük Early Bronze Age I-II period in Western Anatolia as well as the presence of a mine base from the basement with tin traces is important as it shows that tin is processed in Demircihöyük.

Tinned copper production is spreading to northern Mesopotamia, Central Anatolia and Western Anatolia to Troia. In other regions arsenic copper production continued. In Anatolia, the use of arsenic copper in Troy, Yortan, Kusura, Alisar, Alacahöyük, Mahmatlar, Horoztepe, Gözlükule and Yumuktepe as well as the use of tinned copper is observed. However, the use of arsenic copper continues in settlements such as Samsun-Ikittepe and Malatya-Asantepe. Since the earliest examples are seen in Anatolia, it is probable that tin was produced. According to another opinion, there are some tin in alluvial sand. It is thought that tin may have been obtained from these sand.

Though tin minerals are found in Anatolia, their economic dimension is not sufficient. For 5,000 years, tin has been used as an alloying material in Anatolia. Bursa, Sogukpinar, Madenbelenitepe, Kirkclarey Saray and Burgaz districts in Western Anatolia, a tin deposit was found near Eskişehir. But they are not economically adequate and qualified. It is known that tin stones occur in Western Anatolia, in Darmanlar in the southern part of İzmir, in Murat Mountain near Uşak and in Bilecik, Mihalgazi and Sakarya valleys.

It is thought that the tin needed in the Early Bronze Age was obtained from small deposits in Anatolia. Yener states that the Niğde Kestel mine has been used in this date and that its need is provided here. This situation has not been accepted by many scientists. Lately, in Kayseri-Hisarcık, tin deposits have been discovered and new tin deposits will be discovered in Anatolia with the progress of the investigations.

The only tin source of Western Anatolia was found
in Bursa Kestel (Madenbelenitepe)\(^\text{75}\). But it has not been proven to be used in prehistoric times\(^\text{76}\).

In Central Anatolia Niğde, Ulukışla Bolkar Mountains were found tin presence\(^\text{77}\). The tin mines in Niğde Celaller were operated from the Early Bronze Age (3000 BC) to the Byzantine period\(^\text{78}\). During this time it is estimated that 1000 tons of tin production has been carried out here. It is thought that 1.7 tons of tin production has been carried out in the 600 years of the year and that it fulfills 3/1 of the needs of the region. The old mine in Niğde Celaller has found mining workshops, mine melting pots and mortars used for grinding mines\(^\text{79}\). Göltepe is dated to between 4350-1978 BC. It has been documented that tin production has been made in the analysis carried out on a large number of metal slag, pots and vessels recovered here\(^\text{80}\).

Small tin mines in Kestel (3623-2147 BC) in Niğde and Göltepe (4350-1978 BC) were used and consumed in the Early Bronze Age\(^\text{81}\). Since the tin need was not met from Anatolia in 2000 BC, tin was supplied from outside.

The tin deposits that exist in the Taurus Mountains have been consumed extensively in the Early Bronze Age. For this reason, Assyrian traders brought tin out of Anatolia in 2000 BC. The activities of Assyrian merchants are beginning to gain intensity in this period\(^\text{82}\). Tin is distributed not only in Anatolia but also in the Mediterranean and the Aegean, as it is a mineral required by other regions\(^\text{83}\).

### 3.3. BRONZE USAGE

Besides the copper mine, the production of bronze, which is a mixture of copper tin, followed by the production of arsenic bronze and different alloys, shows the specialization in mining\(^\text{84}\). The earliest examples of tinned bronze in Western Anatolia were discovered in Troia I and Bzeńkitepe\(^\text{85}\). Early Bronze Age II shows an increase in the use of tinned bronze. Troia should have made its distribution to tinned Aegean islands in Early Bronze Age II (2500-2300 BC). In the Early Bronze Age III this situation is suddenly interrupted. The reason for this is that the tin was supplied by Assyrian merchants from Mesopotamia in 2000 BC\(^\text{86}\).

It is seen that settlements giving rich metal finds for Early Bronze Age in İzmir region\(^\text{87}\). Important information about copper mining in İzmir-Baklatepe has been reached. The earliest examples of tin bronze were found in Baklatepe\(^\text{88}\). In Baklatepe, gold, silver, bronze artifacts, knives, daggers, headed needles, bracelets, rings and other mineral finds indicate a rich tradition of mining\(^\text{89}\).

In Eskişehir-Demircihöyük Early Bronze Age I-II, various jewelry and ornaments, cutters and tools, tin bronze artifacts were found\(^\text{90}\). In the Demircihöyük-Sariket graveyard, ten of the axes, ax heads and other metal finds were made of bronze\(^\text{91}\). In Eskişehir-Küçükköy Höyük Early Bronze Age II cemetery, various jewelry and ornaments and tools and utensils were found. Some of these works are made of bronze\(^\text{92}\).

Bronze bracelets and needles belonging to the Early Bronze Age were found in the excavations of Manisa-Alaşehir\(^\text{93}\). A large number of wedges were found in Balikesir-Ovabayunlu graves. These wedges are similar in Northwest Anatolia, Central Anatolia and the Aegean. Two flat bronze axes were also found. Most of the metal works belonging to Early Bronze Age II in Antalya-Karataş-Semayük are copper or bronze\(^\text{94}\). In addition to these centers, bronze finds in the metal finds in other centers in Western Anatolia are higher than other metals.

### 3.4. LEAD USAGE

Lead has been a mine used since early times for melting at very low temperatures. The earliest examples of lead beads are Çatalhöyük IX. (Neolithic)\(^\text{95}\). A lead figure dated to Troia IIg (EBA) is a fine example of the use of this mine in the Early Bronze Age in Western Anatolia\(^\text{96}\). The oldest lead mine ingot was found at Kestel-Göltepe in Niğde\(^\text{97}\). The presence of figurines, ornaments, spindles, weights, seals and various vessels made from lead in the Early Bronze Age indicates that the use of this mine is increasing. A lead ingot dating to 2000 BC was found in İzmir-Panaztepe in Western Anatolia. In Western Anatolia, the molds of the figures from the lead were found in İzmir, Troia and Küllüoba\(^\text{98}\).

Eskişehir-Demircihöyük Early Bronze Age I-II belonging to various jewelry and ornaments, cutters and tools were found. It is important to show the use of lead in Demircihöyük, which is a metal mold of copper lead alloy casting mold and tin traces in Eskişehir-Demircihöyük\(^\text{99}\). Among the 238 pieces of metal works in Demircihöyük-Sariket graveyard, 35 works of lead are remarkable. Lead finds are a little more than gold finds\(^\text{100}\).

The metal tools, axes and pins found in Eskişehir-Küllüoba indicate mining activities in settlement. In Eskişehir-Küllüoba, a large increase is observed in the

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\(^{75}\) ÇAGATAY/ALTUN/ARMAN 1979, 25-34; KAPTA\text{N} 1981; ÖZTÜRK/HANIL\text{C} 2009, 105.

\(^{76}\) WAGNER et alii 1984, 45.

\(^{77}\) KAPTA\text{N} 1990; YENER 2009, 105.


\(^{80}\) YENER/VANDIVER 1993A; ADRI\text{A}NS/YENER/ADAMS 1999, 1069-1073; DE RYCK/ADRI\text{A}NS/ADAMS 2005, 266; YENER 2008, 57-58.


\(^{82}\) KLENGEL 2009, 175.


\(^{84}\) MÜHL/PERNICKA 1992; TREISTER 1996, 229-234.


\(^{87}\) SEEHER 2000, 230.

\(^{88}\) ŞAHÖGLÜ 2005, 347.

\(^{89}\) ERKANAL 2008a, 165-175.

\(^{90}\) SEEHER/KAUDER 1996, 313-314.

\(^{91}\) SEEHER 1995, 179.

\(^{92}\) ERKANAL 2007.


\(^{94}\) EMRE 1971, 18.

\(^{95}\) YENER 1995, 179.

\(^{96}\) EFE 2006, 301.

\(^{97}\) SEEHER/KAUDER 1996, 313-314.

\(^{98}\) SEEHER 2000, 230.
number of tools made of ornamental needles and mines in the Early Bronze Age II103. In Küllioba, a lead figurine dating to Early Bronze Age III was found102. In Eskişehir-Kuçükköy Höyük Early Bronze Age II cemetery, various jewelry and ornamental items and tools were found. Three of them were made from lead103. In Afyonkarahisar-Kusura Höyük, it has been determined that various objects such as needles, wedges and axes contain lead104.

3.5. GOLD USAGE

Gold in the Kirazli county of Çanakkale in Western Anatolia, and gold in Kartalkaya in the south of Çanakkale105. There are gold mines in Salihli District of Manisa, Arapdaghi Mevkii, Karşıyaka District of İzmir, Bergama, Tire and Odemis106. Especially gold deposits are widespread in Western Anatolia. The rich gold mines of Western Anatolia were used in the Early Bronze Age107.

The various gold jewelery, artifacts and vessels in the treasure finds dated to Troia II (2500-2300 BC) are important for showing the point where Troia came socioeconomically108. Besiktepe metal finds are related to Troia I finds109. The earring made of gold from the Early Bronze Age I period of settlement is important in that it shows gold processing109. A golden band was found at the base of a house in İzmir-Liman tepe. This band dating to Early Bronze Age I is the earliest example of East Aegean and Western Anatolia. This is an important socioeconomic example of the development of Limantepe111. In the Early Bronze Age architectural layers of İzmir-Baklatepe, gold and jewelery made of gold indicate the presence of mining activities there112.

In the 1993 excavations of Manisa-ALAŞEHIR, a golden necklace consisting of 89 pieces, 2 gold rings, 2 gold ear plugs, and a rich and crafted gold necklace belonging to a girl's Early Bronze Age grave are important for showing the art and craftsmanship of metal113. Golden bracelets were found in the Eskişehir-Kuçükköy Höyük Early Bronze Age II graveyard114. In the Demircihöyük-Sarkeykaveyard, 238 pieces belonging to Early Bronze Age, which consist of a wide variety of tools, jewelery and ornaments, beak rim test, bowl, earplugs, moon axes, knob heads, bracelets and tapes and other metal finds, were found. 31 of these works are gold115.

Of the metal works belonging to Early Bronze Age II in Antalya-KARATAŞ-Semayük, 23 of them are made of gold116.

3.6. SILVER USAGE

There are rich silver mines in İzmir, Uşak, Güre and Kütahya118. The C 14 analyzes on the slags in the mineral deposits in Kütahya Gümüşköy indicate today 4000 years ago. It was determined that this mine was used in 3000-2000 BC and that various underground galleries belong to the same period119. Troia II (2500-2300 BC) works of silver and other precious metals indicate that Troia is an important center for mining and artifacts120. In the Early Bronze Age architectural layers of İzmir-Baklatepe, various materials made from silver were found121. Denizli-Beycesultan, one of the important centers in Western Anatolia, has developed metallurgy since the Chalcolithic period. The various silver works found here are important for Western Anatolian metallurgy. In addition, the earliest silver finds of Western Anatolia were unearthed in Beycesultan122. In Eskişehir-Kuçükköy Höyük Early Bronze Age II cemetery, various jewelry and ornamental items and tools were found. Among these works are bracelets made of silver123. Of the metal finds found in the Sarnet Cemetery, 15 are silver124. In the Antalya-Kara taş-Semayük metal works belonging to Early Bronze Age II, there are many silver finds125.

3.7. IRON USAGE

There are iron deposits in Çanakkale, Balıkesir and Aydın, Muğla and İzmir in Western Anatolia126. Iron is a mine produced in 3000 BC. The use in the Early Bronze Age is not common, as high heat is needed for iron production. The widespread use of iron and its technological development has been in the Iron Age (1000 BC)127. In Çorum-Alacahöyük, there were items made of iron dating to the Early Bronze Age (3000 BC). When the iron cools down, its process is a difficult mine, so this early example is important in that it consciously processes the iron ore and shows the point reached in mining128. Analyzes made on a scepter head belonging to Troia II (2500-2300 BC)

104 EFE 2006, 303.
106 LAMB 1937, 64; DE JESUS 1980, 132; YAKAR 1985, 384.
112 KORFMANN 1986, 264.
113 ERKANAL/ARTHZ/KOUKA 2003, 425.
114 ERKANAL 2008a, 165-175.
115 MERİÇ 1993, 366.
118 WARNER 1994.

117 DURU 1972, 133.
121 ERKANAL 2008a.
125 WARNER 1994, 207.
126 MUHLY/MADDİN/STECH/ÖZGEN 1985, 74-77.
127 KAPTAN 1990, 76.
show that it was made of an iron mine. The gold, silver, electrum, iron and bronze finds recovered in the tombs of Corum-Alacahöyük are important artifacts showing the extent of the development of mining in Anatolia during the Early Bronze Age. In Kaman-Kalehöyük in Central Anatolia, objects made of iron from the Early Bronze Age and the Middle Bronze Age were found.

CONCLUSION
During the Early Bronze Age (3000 BC) there is a great improvement in mining and metal processing techniques. In this period, mines are removed from the underground gallery as well as the mines on the surface of the earth. During the Early Bronze Age, mining activities are systematically carried out. In this period, specialization in mining was provided and new techniques were used. In addition to the processing of the metals by hand, production in the mold will become widespread. During the Early Bronze Age there is no mass production in metal processing. Western Anatolian mining, which developed in the Early Bronze Age I (3000-2700 BC), followed a process that reached to the higher point in the Early Bronze Age II (2700-2400 BC). Early Bronze Age II is the period of development of the mining industry and casting techniques. This development continued in the Early Bronze Age III (2400-2000 BC).

Western Anatolia is a region rich in mineral resources. There are rich gold, silver, copper, lead, zinc, iron deposits in Troas Region in western Anatolia. There are rich gold mineral deposits around Izmir-Uşak and rich silver deposits around Kutahya. Western Anatolia settlements during the Early Bronze Age must have provided the needed metals from these sources in the surrounding area. Other metals in need should be brought to Western Anatolia by trade from other regions. In both cases, a region with a large number of metal works, such as Western Anatolia, is specialized in mining and has an advanced structure.

Early Bronze Age II shows an increase in the number of settlements in Western Anatolia. As a result, the population of the region also increased. In this period, the need for metal has increased. During the Early Bronze Age there is a large increase in the number of metal works in Western Anatolia and the quality of the works being processed. During the Early Bronze Age, metal production and use and trade increased due to mining activities.

In the Early Bronze Age, metal objects and finds in western Anatolia as well as mining molds, blowers, copper slags, pots, mine preparation, crushing and crushing tools in archaeological centers are important to show the presence of mining workshops in Western Anatolia. In the Early Bronze Age, like Alacahöyük in Central Anatolia, Troia is a center where mining has developed very much in Western Anatolia. The rich gold, silver, bronze and copper objects found in the Troia excavations are important for showing the development of mining in the Early Bronze Age. In Western Anatolia, as well as Troia, centers such as Limantepe and Beycesultan should be seen as important mining centers in their respective regions. For this reason, Troas Region (Troia), Izmir Region (Limantepe) and Inner West Anatolia Region (Beycesultan) are the main centers of mining in Western Anatolia (Fig. 2).

There is an increase in the number of jewelry, ornaments, figurines, pins, axes, knives, daggers, chisels, various weapons and artifacts produced in these centers. In addition to other metals, there is an increase in number
and variety, especially in bronze-produced objects. The widespread use of arsenic copper in some regions should be due to the low availability of tin in Anatolia. During the Early Bronze Age, both the number of metal works and the variety of works, as well as the quality and the quality, are increasing. In the Early Bronze Age, in addition to the large number of metal finds found in settlements in Western Anatolia, it is important to reveal a large number of metal objects in the Early Bronze Age graves in order to show the prevalence of the metal in the region.

As a result of ongoing investigations and archaeological excavations, a large number of new finds of mining are emerging. As a result of the increase in research, some unclear points will be illuminated in the future.

REFERENCES
ADRIAENS/YENER/ADAMS 1999

AKANUMA 2008
Akanuma, H., The Significance of Early Bronze Age Iron Objects from Kaman-Kalehöyük, Turkey, AAS XVII, 313-320.

AKISKA/ÜNLÜ/SAYILI 2008

AKDENİZ 2009
Akdeniz, E., New Observations about Yortan Cemetery, Turkish Academy of Sciences Journal of Archaeology 12, 49-64.

APAKIDZE 2008

BEAR 1963

BEGEMANN/PERNICKA/SCHMITT STRECKER 1994
Begemann, F./Pernicka, E./Schmitt Strecker, S., 1994 Metal Finds from Ilipinar and the Advent of Arsenical Copper, Anatolica 20, 203-209.

BEGEMANN/SCHMITT STRECKER/PERNICKA 2003

BILGİ 1997
Bilig, Ö., Trade in Anatolia During the Pre-Classical Period, PALMET, I, 1-57.

BILGİ/ÖZBAL/YALÇÃOĞLU 2004

BOSTANCI 2006

BRANİGAN 1974
Branigan, K., Aegean Metalwork of The Early and Middle Bronze Age (Oxford: Clarendon Press).

CIERNÝ/WEISBERGER 2003

ÇAĞATAY/ALTUN/ARMAN 1979
Çağatay, A./Altun, Y./Arman, B., Mineralogy of the Madenbelenitepe (Şogukpinar-Bursa) Tin Mineralization, Bulletin of The Mineral Research and Exploration, No. 92, 25-34.

ÇAMBİL/BRAIDWOOD 1970
Çambil, H./Braidwood, R. J., An Early Farming Village in Turkey, Scientific American 222/3, 50-56.

DAYTON 1971

DE JESUS 1972
De Jesus, P. S., Prehistoric Metallurgy—Another Look, Anatolia XVI, 129-140.

DE JESUS 1978
De Jesus, P. S., Metal Resources in Ancient Anatolia, Anatolian Studies 28, 97-102.

DE JESUS 1980

DE JESUS/DARDENIZ 2015

DE RYCK/ADRIAENS/ADAMS 2005

DURU 1972

DURU 1995

EARL/H. ÖZBAL 1996

EATON/MCKERRELL 1976

EFE 2006

EFE/AY EFE 2001

EFE/FİDAN 2008
Efe, T./Fidan, M. E., Pre-Middle Bronze Age Metal Objects from Inland Western Anatolia: A Typological and Chronological Evaluation, Anatolia Antiqua XIV, 15-43.

EMRE 1971

ERKANAL 2008A

PULAK 2009
Pulak, C., The Uluburun Tin Ingots and the Shipment of Tin by Sea in the Late Bronze Age Mediterranean, Turkish Academy of Sciences Journal of Archaeology 12, 189-208.

SAZCI/TREISTER 2006

SEEHER 2000

SEEHER/KAUNDER 1996
Seeher, A. B./Kaunder, J. O., Demircihüyük IV, Die Kleinfinde (Mainz am Rhein).

SHEPHERED 1993
Shepherd, R., Ancient Mining (London / New York: Published for the Institution of Mining and Metallurgy by Elsevier Applied Science).

SOYKAN/MUTLUER 1995

STOS/GALE/GALE 1990
Stech, T./Piggott, V., The Metals Trade in Southwest Asia in the Third Millennium B.C., Iraq 48, 39-64.

STOS GALE/GALE 1990

STOS GALE/GALE 1990

STOS GALE/GALE 1990
Stos Gale, Z. A./Gale, N. H., Bronze Age metal artefacts found on Cyprus- metal from Anatolia and the Western Mediterranean, Trabajos De Prehistoria 67, 2, julio-diciembre 2010, 389-403.

STOS GALE/MACDONALD 1991

STRABO
Strabo, Geography, Loeb Classical Library.

STRONACH 1959
Stronach, D., An Early Metal Hoard from Beycesultan, Anatolian Studies 9, 47-50.

ŞAHÖGLU 2005

ŞENER 2003

TREISTER 1996

WAGNER et alii 1984

WARNER 1994

WHEELER/MADDIN/MULHLY 1975

WILLIES 1990

WILLIES 1992A

WILLIES 1992B

WILLIES 1995

WRIGHT 1998
Wright, J. C., The Place of Troy Among the Civilizations of the Bronze Age, Classical World 91, 356-368.

YAKAR 1984
Yakar, J., Regional and Local Schools of Metalwork in Early Bronze Age Anatolia, Anatolian Studies 34, 59-86.

YAKAR 1985

YALÇIN 2003

YALÇIN 2008

YALÇIN 2009
Yalçın, Ü., A Strategically Important Metal: Tin, Turkish Academy of Sciences Journal of Archaeology 12, 99-103.

YALÇIN/ÖZBAL 2009

YAYLALI/AKDENİZ 2002

YENER 1995
Yener, K. A., Göltepe 1993 Kazı Sonuçları, Kazı Sonuçları Toplantısı 16-1, 177-188.

YENER 2000

YENER 2008

YENER 2009

YENER/GOODWAY 1992

YENER/VANDİVER 1993A
Yener, K. A./Vandiver, P. B., Tin Processing at Göltepe, an Early Bronze Age Site in Anatolia, American Journal of Archaeology 97, 207-238.

YENER/VANDİVER 1993B
Yener, K. A./Vandiver, P. B., Reply to J. D. Muhly, Early Bronze Age Tin and the Taurus, American Journal of Archaeology 97, 255-264.