

The Formation and Development of Mining and Metallurgy in Ustrushana In Ancient Times

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Abstract: This article examines the emergence and development of mining and metallurgy in ancient Ustrushana based on archaeological materials and historical sources. It analyzes the natural prerequisites for the development of mining, the extraction and processing of copper, bronze, iron, and other metals, as well as the role of metallurgy in the growth of handicrafts and the regional economy. Particular attention is given to archaeological evidence from mining sites, metallurgical workshops, and craft production centers, which demonstrates the significant contribution of Ustrushana to the technological and socio-economic development of Central Asia during antiquity.

Keywords: Ustrushana, mining, metallurgy, archaeometallurgy, copper, bronze, iron, handicrafts, archaeological sources, ancient Central Asia.

Introduction: Ustrushana was one of the major historical and cultural regions of Central Asia, distinguished by its abundant mineral resources and favorable natural environment, which created the conditions for the early development of mining and metallurgy. Archaeological discoveries indicate that the inhabitants of the region were engaged in the extraction and processing of copper, bronze, iron, and other metals from ancient times, contributing significantly to the advancement of handicraft production, military technology, and economic development. The emergence of mining and metallurgical activities not only accelerated technological progress but also promoted urbanization, specialization of crafts, and the expansion of interregional trade and cultural contacts. Therefore, the study of archaeological materials and historical evidence related to mining and metallurgy is essential for understanding the socio-economic development of ancient Ustrushana and its role within the broader civilization of Central Asia. This article examines the origins and development of mining and metallurgy in Ustrushana on the basis of archaeological evidence and evaluates their contribution to the historical development of the region.

LITERATURE REVIEW

The historiography of mining and metallurgy in ancient Ustrushana is based on the works of archaeologists, historians, and geologists who have investigated the region's material culture and mineral resources. Fundamental studies by N.N.Negmatov, Y.F.Buryakov, A.A.Gritsina, B.B.Tuychiev, M.H.Pardaev and other scholars have significantly expanded our understanding of Ustrushana's mining traditions, metallurgical production, and craft specialization. Archaeological excavations conducted at mining sites, metallurgical workshops, and ancient settlements have provided substantial evidence for the extraction and processing of copper, bronze, iron, and other metals, highlighting the important role of metallurgy in the socio-economic development of the region.

At the same time, the available literature mainly focuses on individual archaeological sites, specific mining districts, or particular categories of archaeological finds. Comprehensive studies integrating archaeological evidence, written sources, and technological aspects of mining and metallurgy across the entire territory of Ustrushana remain limited. Therefore, this article synthesizes the existing archaeological and historical data to provide a broader assessment of the emergence, development, and historical significance of mining and metallurgy in

ancient Ustrushana.

METHODOLOGY

This study is based on the principles of historicism, objectivity, and a systematic approach. The research employs historical-comparative, archaeological, and analytical methods to examine the emergence and development of mining and metallurgy in ancient Ustrushana. Archaeological data obtained from ancient mining sites, metallurgical workshops, settlements, and craft production centers were analyzed alongside published excavation reports and relevant scholarly literature. Particular attention was given to archaeological evidence concerning the extraction, processing, and use of copper, bronze, iron, and other metals in order to reconstruct the technological and economic development of the region. In addition, a comparative analysis of archaeological materials from Ustrushana and neighboring regions was conducted to identify similarities and distinctive features in mining technology, metallurgical production, and craft specialization. The collected data were synthesized and evaluated to determine the role of mining and metallurgy in the economic development, urbanization, and technological progress of ancient Ustrushana.

DISCUSSION AND RESULTS

Considering the natural geographical characteristics of Ustrushana, it can be argued that the region possessed favorable conditions for the early emergence and development of various branches of handicraft production. According to the historian S. Davlatova, handicrafts initially developed as part of agriculture and animal husbandry and gradually evolved into specialized crafts such as weaving, pottery, blacksmithing, stone carving, jewelry making, carpentry, gold embroidery, leatherworking, wood carving, and other forms of craftsmanship. Consequently, handicraft production did not develop uniformly across all regions; rather, its growth largely depended on the availability of natural resources essential for particular crafts. For example, pottery flourished in areas with high-quality clay, weaving and leatherworking developed where wool and hides were abundant, while shipbuilding emerged along riverbanks[1].

Most scholars who have studied the history of handicrafts classify their development, in connection with the evolution of society and the division of labor, into three principal forms:

1. Household handicrafts;
2. Commission-based handicraft production;
3. Market-oriented handicraft production.

The inhabitants of Ustrushana exported a wide variety of agricultural products, including fresh and dried fruits, grain, livestock products, and handicraft goods such as agricultural implements, weapons, ornaments, pottery, and textiles, to neighboring regions as well as to distant lands. In particular, military weapons forged from iron extracted in the Mink district (rustaq) gained widespread renown and were highly valued in remote regions[2]. During this period, several cities and rustaqs of Ustrushana specialized in the production of particular commodities for trade. Referring to historical sources, B.Tuychiboev notes that Jizzakh specialized in the production of woolen textiles, Mink in weapons and military equipment, and Bunjikat and its surrounding area in jewelry manufacture, where specialized artisan quarters were established for this purpose[3].

Commercial activities were conducted primarily in marketplaces, the largest of which was located in the city of Marsmand. According to written sources, a market was held there once at the beginning of every month, lasting for a single day, with a trade turnover amounting to 100,000 dinars. In addition, written sources also mention the existence of a covered market in Sabat, indicating the presence of well-developed commercial infrastructure in the region.

Specialized branches of handicraft production developed differently across various regions of Central Asia. For example, Margilan, Khujand, and Kokand became renowned for silk production; Beshariq and Kokand specialized in textile processing; Tashkent, Samarkand, and Namangan were major centers for leather production; Rishtan and Ura-Tepa were particularly noted for pottery; Termez and Karshi specialized in carpet weaving; the villages of Oyim and Dardak were famous for producing polos (striped woven fabrics); Samarkand and Margilan for abr (ikat) textiles; Chust and Shahrisabz for knife-making; while Tashkent gained prominence as one of the leading centers for the production of robes (khalats)[4].

For instance, in the Kashkadarya region, the head of the craft guild was known as the bobo ("grand master"), who occupied the highest position within the organization[5]. Likewise, in Shahrisabz, the chief of metalworkers, known as the gholib, was regarded not only as the leader of the blacksmiths of Shahrisabz but also as the head of craftsmen from Kitab, Yakkabagh, Chiroqchi, and the surrounding steppe, desert, and rural settlements[6]. According to the recollections of elderly craftsmen, the katta bobo ("chief master") supervised several craft guilds simultaneously and also exercised authority over the potters of Shahrisabz, Kitab, Yakkabagh, and Chiroqchi.

Craft associations were headed by bobo (master elders)

and oqsoqols (community elders), and their activities were regulated by a special document known as a risola (guild code or manual). This document set out the ethical, legal, and social norms governing the profession in accordance with the principles of Islamic (Sharia) law. In particular, the risola provided detailed descriptions of technological processes, types and quality standards of products, tools of production, and the customs and rituals associated with each craft. In addition to these practical regulations, the document also incorporated legends and didactic narratives that were used for the moral education and professional training of apprentices. According to B.Tuychiyboev, who has extensively studied the historical geography and historiography of Ustrushana, the region's economic and cultural development, the evolution and specialization of handicrafts, and the processes of rural and urban formation can be divided into four major stages:

- a) 7th–4th centuries BC – the establishment of a number of settlements in the foothill regions;
- b) 3rd–1st centuries BC – the emergence of villages and towns in the plains and steppe areas;
- c) 1st–4th centuries AD – the expansion of urban and rural settlements and the development of new cultural and agricultural oases;
- d) 5th–7th centuries AD – the feudalization of society, demographic growth of the local population, intensification of the sedentarization of nomadic groups, expansion of newly cultivated oases, and the continued growth of rural settlements and cities[7].

Taking these factors into consideration, it should be noted that the handicraft industry of Ustrushana was divided into a number of specialized branches, among which mining and metallurgy represented the oldest sector, distinguished by its indigenous traditions and long-established local characteristics. The development of mining and metallurgical production was closely associated with the needs of prehistoric communities. As early as the Stone Age, people were naturally motivated to search for raw materials superior to flint and other types of stone. It is well known that the earliest metal objects entered human society during the Late Mesolithic and Early Neolithic periods. This is evidenced by the discovery and study of the earliest metal artifacts from the archaeological sites of Çatalhöyük and Çayönü, dating to the late eighth and early seventh millennia BC in Asia Minor[8]. Considering the distribution of mineral resources in Central Asia, it is evident that Neolithic populations had already encountered naturally occurring copper, gold, and meteoritic iron. This development marked the beginning of a new stage in mining production—the

Age of Metallurgy—as early as the fourth millennium BC[9]. By the second half of the fourth millennium BC, the earliest copper tools had become widespread in the major centers of ancient civilization, including Mesopotamia, Egypt, Asia Minor, India, and Central Asia. This process signified the gradual replacement of the Stone Age by the Metal Age and marked the beginning of the metallurgical era, which played a decisive role in the technological and socio-economic development of human civilization.

Research indicates that humanity's acquaintance with copper began as early as the Stone Age. However, it took several centuries for people to understand the distinctive properties of copper in comparison with various types of stone. While searching for durable and suitable stones for the manufacture of tools, prehistoric communities naturally encountered deposits of native copper exposed on the earth's surface. Over time, they became familiar with the characteristics of this new raw material and discovered that its properties changed when exposed to fire, allowing it to be shaped into various forms. Subsequently, people learned to smelt copper and began producing a wide range of implements, including agricultural tools and military weapons. As metallurgical techniques advanced, numerous copper deposits were exploited throughout Central Asia, leading to the establishment of metal-smelting workshops in the vicinity of these mining sites. This process laid the foundation for the further development of mining, metallurgy, and specialized craft production in the region.

By the end of the third millennium BC, a new metal alloy—bronze—had come into use in Central Asia, particularly in Southern Turkmenistan, where tools made from this material began to appear[10]. Produced by alloying copper with tin or copper with lead, bronze was considerably stronger than pure copper and greatly expanded the range of implements used in agriculture, hunting, and warfare. Evidence also indicates that during the late stage of the Kaltamir culture (fourth millennium BC), the tribes inhabiting the lower reaches of the Amu Darya had already begun to use copper. Archaeological investigations have identified thirteen ancient copper mines dating to the Early Bronze Age in the Central Kyzylkum region, where remains of copper-smelting workshops have also been discovered. Based on the chemical composition of copper artifacts, particularly the presence of alloying elements such as arsenic and antimony, researchers suggest that the raw material used for manufacturing these tools originated from the copper deposits of Fergana or the Lower Zarafshan region.

The adoption of copper metallurgy by ancient

communities marked the beginning of a new stage in the development of mining production. During this period, people not only mastered the use of copper but also discovered other metals, particularly tin, silver, and gold. This development represented a significant milestone in the evolution of mining in Central Asia and reflected broader social transformations, including the gradual transition from a primitive communal system to a class-based society. These changes, in turn, stimulated the expansion of settled agricultural communities and created favorable conditions for the intensification of urbanization throughout the region.

Archaeological excavations conducted in Central Asia, particularly within the territory of present-day Uzbekistan, have yielded numerous copper artifacts from Eneolithic and Bronze Age sites, including knives, spearheads, awls, needles, rings, beads, and other ornaments[11]. However, because copper is a relatively soft metal, it was not capable of completely replacing stone tools. For this reason, the transitional period between the Late Stone Age and the Bronze Age is commonly referred to as the Eneolithic, or Copper–Stone Age.

According to specialists who have studied the archaeological sites and artifacts of the Copper Age, the earliest metal objects were made of native copper. The oldest of these artifacts were produced by cold hammering, without smelting the metal, in much the same way as stone tools were manufactured. Only by the late fourth millennium BC did ancient communities discover one of copper's most important properties—its ability to melt under high temperatures, be cast into various shapes, and retain those shapes after cooling[12].

The transition to the Copper Age marked a significant advance in the development of productive forces. Although copper tools represented a considerable technological improvement over stone implements, copper itself was relatively soft and lacked the durability required for the manufacture of heavy-duty implements, particularly agricultural tools and other equipment subjected to intensive use.

Based on the artifacts recovered from Copper Age and Bronze Age archaeological sites, it can be concluded that copper was used primarily for the manufacture of ornaments, weapons, and household implements. Nevertheless, the emergence of copper metallurgy and the gradual introduction of bronze tools into prehistoric economies initiated a slow but steady replacement of traditional stone implements.

By the end of the third millennium BC, copper tools had become increasingly sophisticated. During this period, the extraction of metallic ores—including copper, tin,

and gold—expanded considerably. Communities mastered the techniques of smelting metals and casting them into molds to produce objects of various forms. The discovery of open-pit mines and metal-smelting workshops throughout Central Asia and Kazakhstan provides convincing archaeological evidence supporting this technological development.

In Northern Sogdiana, particularly in the southern Kyzylkum region, mining complexes dating to the Mesolithic and Neolithic periods have been identified. Ancient mining shafts were discovered in the low mountain ranges of Kuljuktau, Aumingzatau, Toshditau, and Bukantau. Geological surveys conducted by archaeologists also revealed the presence of gold deposits in these areas. However, the majority of the identified mining remains are associated with ancient copper extraction, indicating that copper mining constituted the principal focus of early mining activities in the region.

The Kentov mining complex in the Yetimtov Mountains is regarded as one of the most important ancient mining centers, containing more than fifty mining shafts. Most of these mines were exploited through open-pit mining, and the copper ore contained an average copper concentration of approximately 10 percent. Further to the west, in the Aumingzatau area, archaeologists have identified more than twenty additional mining shafts, whose structure and extraction methods closely resemble those of the Kentov complex. Smaller mining workings have also been discovered at Toshditau and Beltau. Ancient miners primarily exploited shallow deposits of oxidized copper ores, which were easier to smelt and process[13].

Near Koktau, at a site believed to have been the bank of an ancient river, archaeologists uncovered specialized facilities used for ore smelting. The largest copper-processing center, Boysag'onok, is situated west of Yetimtov, in close proximity to the major Koktepa ore deposit. This area contains extensive mineral deposits composed of malachite, chalcocite, and other copper-bearing ores. During investigations conducted by the Uzbek–German archaeological expedition in 1999, researchers discovered a circular smelting furnace equipped with an artificial air-blowing system, which had been used for ore smelting. Preliminary analysis of these discoveries suggests that further investigation of these mining districts will provide a more comprehensive understanding of ancient mining activities and will make it possible to assess more objectively the contribution of Sogdiana to the economy of Central Asia during the Bronze Age and the Early Iron Age[14].

According to researchers, the Lavlakon and Beshbulok sites in the Bukhara region, as well as the lowest cultural layers of the Zamonbobo cemetery, date to the Eneolithic period. Archaeological excavations at these sites have yielded not only flint implements but also copper needles and beads, providing evidence for the early use of copper in the region[15].

In the vicinity of Kattatuzkon in the Lower Zarafshan region, Eneolithic sites have been identified at four different locations. Surface finds from these sites include stone grinders, sickles, knives, and fragments of copper tools scattered across clay flats and sandy terrain. The archaeological assemblage, comprising both metal and stone implements as well as ornamental objects, exhibits characteristics typical of the Copper–Stone (Eneolithic) Age. These discoveries suggest that metallurgy had already reached a relatively advanced stage among the ancient populations of Central Asia, including Khwarazm, during the Eneolithic period.

Nevertheless, the environmental conditions of Central Asia were not uniformly favorable for the early development of agriculture, and among communities living in the mountainous regions, the use of metal did not initially play a significant role in everyday economic life.

During the early stages of metallurgy, copper was a highly valuable raw material, and deposits of native copper ore were found only in a limited number of locations. The expansion of early agricultural communities into distant territories was motivated not only by the search for new arable lands but also by the exploration of mineral resources and metal ore deposits. Evidence supporting this interpretation can be found in the development of the Sarazm culture, an Eneolithic sedentary agricultural culture located in the upper reaches of the Zarafshan Valley. Its formation is closely associated with the advanced phase of the Anau culture in Southern Turkmenistan. According to the archaeologist A. I. Isakov, who conducted extensive research at the site, the Sarazm culture was established by groups that migrated from Turkmenistan in search of mineral resources.[16].

Archaeological discoveries made at several inhabited sites across Central Asia, including the remains of domesticated animals, stone grinding implements, and copper artifacts, indicate that by the third and second millennia BC, the foundations of animal husbandry, agriculture, handicraft production, and metallurgy had already begun to emerge in the region. These findings demonstrate the gradual formation of an increasingly complex economic system based on diversified production and technological innovation.

CONCLUSION

In conclusion, archaeological evidence indicates that mining and metallurgy played a significant role in the economic and technological development of ancient Ustrushana. The region's abundant mineral resources supported the growth of metal production, handicrafts, and trade, contributing to the broader development of Central Asian civilization. Further interdisciplinary research will provide a more comprehensive understanding of Ustrushana's mining and metallurgical traditions.

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