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***Research Article***

# CORRELATION RELATIONSHIPS OF CHEMICAL ELEMENTS IN THE WASTE DUMPS AROUND THE GUZAKSOY GOLD DEPOSIT

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## ABSTRACT
Today, in global geological–prospecting practice, extensive research is being conducted to study the geological–genetic characteristics, formation conditions, spatial distribution patterns, and exploration criteria of endogenous deposits. This is driven by the growing demand of industry and the national economy for raw materials of rare, non-ferrous, ferrous, and other metals. Similar investigations are currently underway to perform a geochemical analysis of samples collected from the waste dumps of the Guzaksoy gold deposit located within the Chodak ore field. In this regard, special attention is being given to the waste dumps of known and actively mined deposits—particularly gold deposits—to expand the mineral-raw material base of the country.

***Keywords:*** *Chodak, Qurama, Clarke Value, Correlation, Clarke Concentration, Ore, Gold, Waste Dump*

## INTRODUCTION
The Chodak ore field is situated on the southeastern flank of the Qurama mountain range and includes the Chodak mountain river and its tributaries—Kokinsoy, Uriklisoy, Kaydaksoy, and Julaysoy. Administratively, this area is located in the Pop district of Namangan region, Republic of Uzbekistan (Fig. 1).

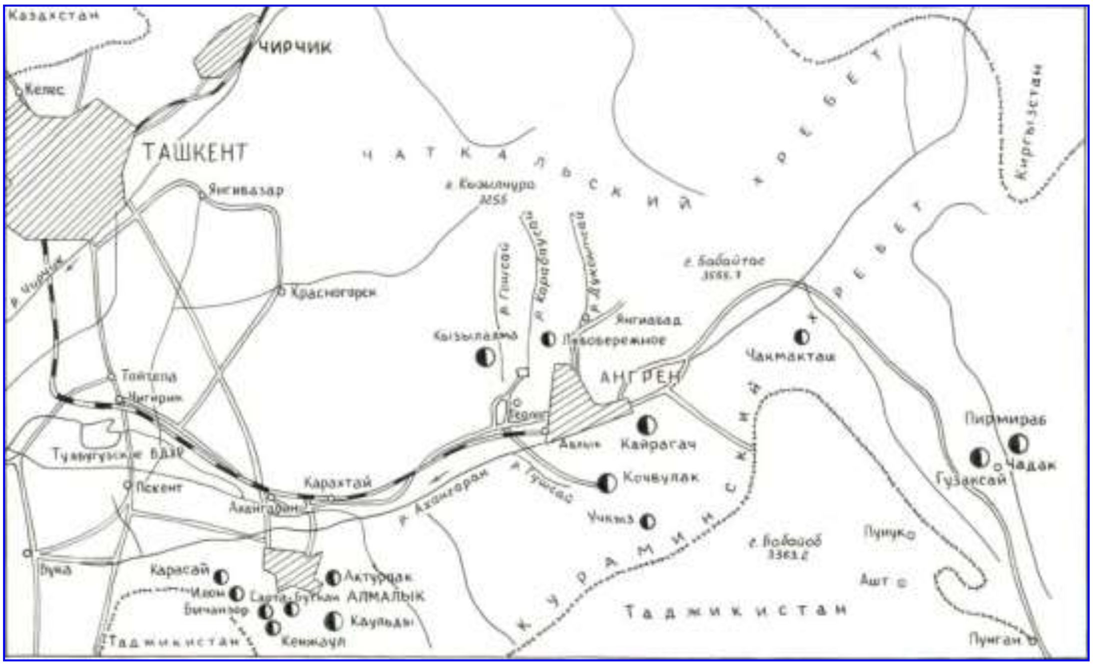


**Figure 1: Overview map of the study area**

## STUDY AREA
The first geological descriptions of the region date back to 1873 and 1890–1912 and are found in the works of G.E. Romanovsky, I.V. Mushketov, I.A. Severtsev, and S.F. Mashkovtsev. These researchers carried out individual geological traverses, forming the foundation for geological studies of Central Asia. Between

1927 and 1947, the region was covered by reconnaissance and small-scale surveys, including radiometric studies (I.P. Kirikov, 1927; A.S. Petrenko, 1944), polymetallic exploration (A.A. Zvereva, 1933), investigations of iron and polymetals (F.I. Volfson, 1933), studies of iron, fluorite, polymetals, and tin (I.M. Safonov, 1941; A.S. Sadykov, 1942; K.N. Vendlant, 1943), as well as exploration of fluorite, bismuth, and rock crystal (G.M. Golovin, 1943). Geological mapping at a scale of 1:50,000 was performed by A.S. Adelung, N.V. Ivanov, and N.M. Sinitsin (1932–1936), alongside petrographic research by F.Sh. Radjabov (1939). In 1933, F.I. Volfson proposed the first metallogenic scheme of the region, identified ancient mine workings in the drainage basins of the Ktepa, Irisu, Rizak, and Kandagan rivers, and discovered several iron ore deposits, including Dugan and others [3].

The geological complexes composing the ore field were formed during the Hercynian tectono-magmatic activation cycle and are subdivided into two structural tiers: the Middle–Upper Carboniferous ($C_{2-3}$) and the Lower Permian ($P_1$).

The Middle–Upper Carboniferous tier is composed of rocks of the Nadak volcanic complex, represented by andesites, trachyandesites, dacites, liparite–dacites, their tuffs, and interbedded sedimentary lenses of various types. The volcanic cover facies belong to the Nadak Formation ($C_{2-3}nd$), which is subdivided into a lower ($C_{2-3}nd_1$) and an upper ($C_{2-3}nd_2$) subformation. According to formation classifications, the Nadak Formation ($C_{2-3}nd$) is assigned either to the trachyandesite formation (V.P. Korzhaev et al., 1990) or to the dacite–andesite formation (V.A. Arapov, 1983; T.Sh. Shayakubov et al., 1988). Within the study area, the Nadak Formation is represented by both subformations.

At the base of the Lower Nadak Subformation ($C_{2-3}nd_1$) lie tuffogenic–sedimentary rocks consisting of alternating sandstones, siltstones, siliceous limestones, and fine-grained lithocrystalloclastic tuffs of acidic composition. These deposits are exposed in the Central Guzaksay area as well as on the southern flank of the Bomatsay site. Overlying these tuffogenic–sedimentary rocks are alternating tuffs and andesite–dacite porphyrites of the Lower Nadak Subformation.

Macroscopically, the andesite–dacite porphyrites are grey to greenish-grey, with fine- to medium-porphyritic textures and an aphanitic groundmass. The andesite–dacite tuffs are greenish-grey, fine- to medium-fragmental, and lithocrystalloclastic in composition. The clastic material is highly variable—from felsites to andesitic porphyrites. The cementing mass consists of a finely dispersed felsitic, quartz–feldspar aggregate. These rocks are exposed on the right bank of the Chodak River and within the Central and Northern Guzaksay, Bomatsay, Dalniy, and Julaysay sites.

## MATERIALS AND METHODS

In the implementation of scientific work, using traditional geochemical methods, determining the material composition of samples by various analytical methods (spectral analysis, mass spectrometer ICP-MS), using the results of field and laboratory work, geological maps were created using ArcGIS software.

The Upper Nadak Subformation ($C_{2-3}nd_2$) is represented by acidic tuffs of grey to light-grey color, fine-fragmental, and composed of angular clasts predominantly of rhyolitic and, less commonly, dacitic composition. Throughout the section, interbeds of sandstones and siltstones are frequently observed. These rocks constitute a significant part of the Bezwodny and Chulakterek areas and the adjacent Chulakterek site. Smaller exposures have been mapped in Akbulak, Central Guzaksay, and Yuzhny Pirmirab. The maximum thickness of the Upper Nadak Subformation reaches about 400 m, while the total thickness of the entire formation is approximately 800 m.

According to I.N. Ganiev et al. [2], the Chodak ore field is located in the central part of the Chodak volcanic–plutonic depression, which is associated with the meridional deep-seated Chodak–Kandagan zone. The southern boundary of this structure follows the marginal part of the North Fergana fault zone. To the northwest, north, and east, it is delineated by the outcrops of the Uryuklin dome uplift composed of granodiorites of the Kuyundin Complex ($\gamma\delta C_3k$), while its southwestern boundary is defined by the tectonic contact between granodiorites of the Karamazar (Kurama) Complex ($\gamma\delta C_3k$) and volcanic rocks of the $C_2$–$P_1$ sequence.

The Chodak depressive volcanic–plutonic structure is segmented by a sublatitudinal system of faults into four blocks, which gradually subside from north to south and therefore differ in their degree of erosion [1, 4].


**Fig. 2. Sampling points from the waste dumps around the Guzaksoy gold deposit.**

**Table 1.** Correlation of chemical element concentrations in primary geochemical halos at the southern end of the Chelpeksay, Chulakterek, and Dalny zones of the Chodak ore field (excluding anomalously high values of Ag, Pb, W, Bi, Ba; 2,005 samples; critical correlation coefficient value = 0.05).

| Elements | Mn | V | Ti | Cr | Ag | Cu | Pb | Zn | As | Bi | Co | Sb | Mo | W | Sn | Be | Nb | Li | Ga | Ge | Ba | Au |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mn** | 1 | 0.15 | 0.15 | -0.02 | 0.09 | 0.08 | 0.05 | 0.07 | 0.03 | 0.08 | **0.58** | -0.09 | 0.19 | -0.02 | -0.05 | 0.18 | -0.1 | 0.13 | 0.1 | 0.07 | 0.19 | -0.03 |
| **V** | 0.15 | 1 | **0.56** | -0.15 | 0.03 | 0.18 | -0.01 | 0.13 | -0.04 | -0.03 | 0.21 | -0.15 | -0.02 | 0.02 | -0.09 | 0.01 | -0.28 | **0.49** | **0.42** | 0.14 | 0.17 | -0.04 |
| **Ti** | 0.15 | **0.56** | 1 | -0.07 | -0.01 | 0.05 | 0 | 0.04 | -0.04 | -0.04 | 0.2 | -0.22 | -0.03 | -0.03 | -0.03 | 0.04 | -0.21 | **0.38** | **0.45** | 0.12 | 0.19 | -0.03 |
| **Cr** | -0.02 | -0.15 | -0.07 | 1 | 0.05 | -0.04 | 0.04 | -0.07 | 0 | 0 | -0.02 | -0.04 | -0.01 | 0.08 | 0.11 | 0.09 | 0.1 | -0.05 | 0.14 | -0.02 | -0.06 | 0.03 |
| **Ag** | 0.09 | 0.03 | -0.01 | 0.05 | 1 | 0.23 | 0.16 | 0.19 | 0.2 | 0.16 | 0.06 | 0.06 | 0.15 | **0.48** | 0 | 0.02 | 0.01 | 0.13 | 0.07 | 0.08 | 0.01 | 0 |
| **Cu** | 0.08 | 0.18 | 0.05 | -0.04 | 0.23 | 1 | 0.15 | **0.37** | 0.17 | 0.23 | 0.06 | 0 | 0.11 | 0 | 0.05 | 0.08 | -0.08 | 0.1 | 0.02 | 0.02 | 0.01 | -0.03 |
| **Pb** | 0.05 | -0.01 | 0 | 0.04 | 0.16 | 0.15 | 1 | 0.17 | 0.24 | 0.06 | 0 | 0.01 | 0.1 | 0 | 0.01 | 0.04 | 0.13 | 0.03 | 0.04 | 0.02 | 0 | 0.13 |
| **Zn** | 0.07 | 0.13 | 0.04 | -0.07 | 0.19 | **0.37** | 0.17 | 1 | 0.22 | 0.03 | 0.05 | 0.07 | 0.04 | 0.01 | -0.04 | 0.14 | -0.02 | 0.11 | -0.01 | 0.08 | 0.01 | -0.01 |
| **As** | 0.03 | -0.04 | -0.04 | 0 | 0.2 | 0.17 | 0.24 | 0.22 | 1 | 0.1 | -0.01 | 0.06 | 0.05 | -0.01 | 0 | 0.07 | -0.07 | 0.03 | -0.02 | 0.08 | -0.03 | 0 |
| **Bi** | 0.08 | -0.03 | -0.04 | 0 | 0.16 | 0.23 | 0.06 | 0.03 | 0.1 | 1 | 0.01 | 0 | **0.36** | 0 | **0.32** | 0.14 | 0.05 | -0.02 | -0.03 | 0 | 0 | 0.01 |
| **Co** | **0.58** | 0.21 | 0.2 | -0.02 | 0.06 | 0.06 | 0 | 0.05 | -0.01 | 0.01 | 1 | -0.06 | 0.05 | 0 | -0.01 | 0.16 | -0.09 | 0.14 | 0.12 | 0.05 | 0.06 | 0 |
| **Sb** | -0.09 | -0.15 | -0.22 | -0.04 | 0.06 | 0 | 0.01 | 0.07 | 0.06 | 0 | -0.06 | 1 | -0.02 | 0 | -0.04 | -0.12 | 0.11 | -0.13 | -0.26 | -0.01 | -0.1 | 0.03 |
| **Mo** | 0.19 | -0.02 | -0.03 | -0.01 | 0.15 | 0.11 | 0.1 | 0.04 | 0.05 | **0.36** | 0.05 | -0.02 | 1 | 0.04 | 0 | 0.09 | 0.08 | -0.03 | -0.03 | -0.03 | 0.02 | 0 |
| **W** | -0.02 | 0.02 | -0.03 | 0.08 | **0.48** | 0 | 0 | 0.01 | -0.01 | 0 | 0 | 0 | 0.04 | 1 | 0.1 | 0.06 | 0.01 | 0.02 | -0.03 | 0.03 | -0.01 | 0.01 |
| **Sn** | -0.05 | -0.09 | -0.03 | 0.11 | 0 | 0.05 | 0.01 | -0.04 | 0 | **0.32** | -0.01 | -0.04 | 0 | 0.1 | 1 | 0.13 | -0.04 | -0.05 | 0.1 | -0.03 | -0.02 | -0.02 |
| **Be** | 0.18 | 0.01 | 0.04 | 0.09 | 0.02 | 0.08 | 0.04 | 0.14 | 0.07 | 0.14 | 0.16 | -0.12 | 0.09 | 0.06 | 0.13 | 1 | 0.04 | -0.01 | 0.05 | -0.04 | 0.11 | 0.03 |
| **Nb** | -0.1 | -0.28 | -0.21 | 0.1 | 0.01 | -0.08 | 0.13 | -0.02 | -0.07 | 0.05 | -0.09 | 0.11 | 0.08 | 0.01 | -0.04 | 0.04 | 1 | -0.22 | -0.2 | -0.09 | -0.1 | 0.05 |
| **Li** | 0.13 | **0.49** | **0.38** | -0.05 | 0.13 | 0.1 | 0.03 | 0.11 | 0.03 | -0.02 | 0.14 | -0.13 | -0.03 | 0.02 | -0.05 | -0.01 | -0.22 | 1 | **0.48** | 0.17 | 0.13 | -0.05 |
| **Ga** | 0.1 | **0.42** | **0.45** | 0.14 | 0.07 | 0.02 | 0.04 | -0.01 | -0.02 | -0.03 | 0.12 | -0.26 | -0.03 | -0.03 | 0.1 | 0.05 | -0.2 | **0.48** | 1 | 0.15 | 0.21 | -0.05 |
| **Ge** | 0.07 | 0.14 | 0.12 | -0.02 | 0.08 | 0.02 | 0.02 | 0.08 | 0.08 | 0 | 0.05 | -0.01 | -0.03 | 0.03 | -0.03 | -0.04 | -0.09 | 0.17 | 0.15 | 1 | -0.03 | 0.01 |
| **Ba** | 0.19 | 0.17 | 0.19 | -0.06 | 0.01 | 0.01 | 0 | 0.01 | -0.03 | 0 | 0.06 | -0.1 | 0.02 | -0.01 | -0.02 | 0.11 | -0.1 | 0.13 | 0.21 | -0.03 | 1 | -0.02 |
| **Au** | -0.03 | -0.04 | -0.03 | 0.03 | 0 | -0.03 | 0.13 | -0.01 | 0 | 0.01 | 0 | 0.03 | 0 | 0.01 | -0.02 | 0.03 | 0.05 | -0.05 | -0.05 | 0.01 | -0.02 | 1 |

**Table:** Correlation coefficients of chemical elements in the waste dumps surrounding the Guzaksoy gold deposit (ICP-MS sample 23).

| | ***Mo*** | ***Ag*** | ***W*** | ***Pb*** | ***Cu*** | ***Zn*** | ***As*** | ***Se*** | ***Sb*** | ***Te*** | ***Au*** | ***Bi*** | ***Cd*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Mo*** | 1.00 | -0.23 | 0.13 | 0.04 | 0.15 | -0.23 | -0.45 | -0.26 | -0.29 | -0.10 | -0.36 | **0.58** | -0.21 |
| ***Ag*** | -0.23 | 1.00 | -0.17 | -0.15 | 0.15 | 0.30 | 0.25 | 0.34 | **0.72** | 0.37 | **0.87** | -0.17 | 0.28 |
| ***W*** | 0.13 | -0.17 | 1.00 | -0.07 | -0.02 | -0.07 | -0.01 | -0.09 | -0.27 | -0.23 | -0.11 | 0.14 | -0.10 |
| ***Pb*** | 0.04 | -0.15 | -0.07 | 1.00 | 0.32 | 0.27 | 0.14 | 0.16 | -0.14 | 0.09 | 0.07 | 0.14 | 0.36 |
| ***Cu*** | 0.15 | 0.15 | -0.02 | 0.32 | 1.00 | **0.77** | 0.21 | **0.72** | -0.08 | -0.11 | 0.20 | 0.48 | **0.73** |
| ***Zn*** | -0.23 | 0.30 | -0.07 | 0.27 | **0.77** | 1.00 | 0.28 | **0.98** | 0.13 | -0.07 | 0.38 | -0.11 | **0.97** |
| ***As*** | -0.45 | 0.25 | -0.01 | 0.14 | 0.21 | 0.28 | 1.00 | 0.26 | 0.28 | 0.24 | 0.25 | -0.05 | 0.29 |
| ***Se*** | -0.26 | 0.34 | -0.09 | 0.16 | **0.72** | **0.98** | 0.26 | 1.00 | 0.17 | -0.08 | 0.40 | -0.16 | **0.93** |
| ***Sb*** | -0.29 | **0.72** | -0.27 | -0.14 | -0.08 | 0.13 | 0.28 | 0.17 | 1.00 | 0.35 | **0.72** | -0.21 | 0.23 |
| ***Te*** | -0.10 | 0.37 | -0.23 | 0.09 | -0.11 | -0.07 | 0.24 | -0.08 | 0.35 | 1.00 | 0.35 | -0.11 | -0.06 |
| ***Au*** | -0.36 | **0.87** | -0.11 | 0.07 | 0.20 | 0.38 | 0.25 | 0.40 | **0.72** | 0.35 | 1.00 | -0.16 | **0.41** |
| ***Bi*** | **0.58** | -0.17 | 0.14 | 0.14 | 0.48 | -0.11 | -0.05 | -0.16 | -0.21 | -0.11 | -0.16 | 1.00 | -0.09 |
| ***Cd*** | -0.21 | 0.28 | -0.10 | 0.36 | **0.73** | **0.97** | 0.29 | **0.93** | 0.23 | -0.06 | **0.41** | -0.09 | 1.00 |

***Correlation coefficient interpretation:*** *R<sub>yqh</sub> = R<sub>k</sub> – 0.41; 0.1–0.3: weak correlation; 0.3–0.5: moderate correlation; 0.5–0.7: noticeable correlation; 0.7–0.9: high correlation; 0.9–0.99: very high correlation.*

Correlation is a measure of the dependence between variables. In this study. Pearson's pairwise correlation was used. The analysis was performed on a dataset of 1.998 samples for 22 chemical elements (Table 1). Gold shows a noticeable correlation only with lead (0.13). Weak positive correlations (0.05–0.09) are observed with chromium and beryllium.
The lithogeochemical association exhibits a "core" of elements with strong correlations—Ga. Li. V. and Ti—and a peripheral group with less stable relationships—Ge. Mn. Co. Ba. and Be. The suite of correlated ore-forming elements includes Ag. As. Pb. Zn. Cu. Bi. Mo. W. and Sn. which in turn form two geochemical parageneses: a relatively higher-temperature assemblage (Ag + W + Sn + Bi + Mo) and a lower-temperature assemblage (Pb + Zn + Cu + Bi + As + Ag). Silver and bismuth act as linking or transitional elements. showing correlated distributions across both geochemical associations [5].
In the waste dumps around the Guzaksoy gold deposit. gold (R<sub>k</sub> – 0.41) exhibits high positive correlations with silver (0.87) and antimony (0.72). and moderate correlations with cadmium (0.41). selenium (0.40). zinc (0.38). and tellurium (0.35). Conversely. gold shows negative correlations with molybdenum (–0.36) and bismuth (–0.16) (Fig. 3).

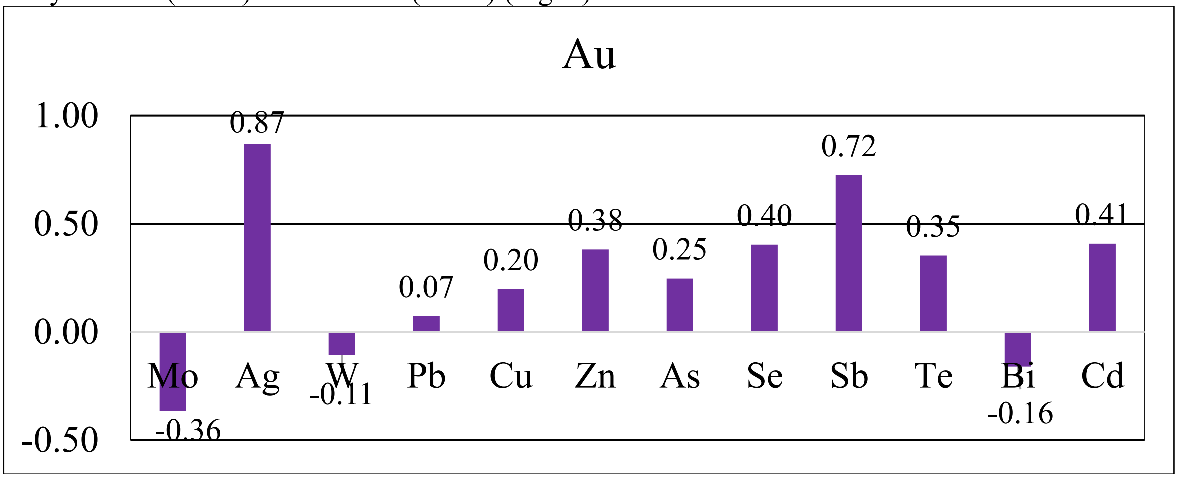


**Fig. 3. Correlation histogram of gold with associated elements in the waste dumps around the Guzaksoy gold deposit.**

In the waste dumps surrounding the Guzaksoy gold deposit. selenium (R<sub>k</sub> – 0.41) shows a very high positive correlation with zinc (0.98). a high positive correlation with copper (0.72). and moderate correlations with gold (0.40) and silver (0.34). Conversely. selenium exhibits negative correlations with molybdenum (–0.26). bismuth (–0.16). and tellurium (–0.09) (Fig. 4).

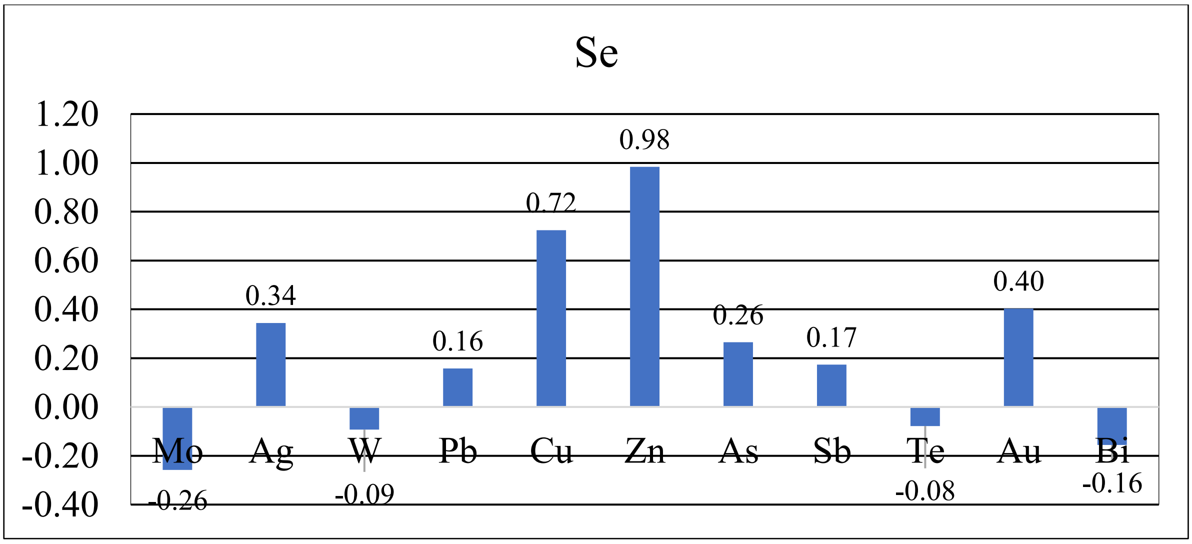


**Fig. 4. Correlation histogram of selenium with associated elements in the waste dumps around the Guzaksoy gold deposit.**

**Table 3:** Average concentrations. background values. and Clarke concentration levels of major and associated elements in the waste dumps surrounding the Guzaksoy gold deposit (ICP-MS sample 23).

| № | Sample | Mo | Ag | W | Pb | Cu | Zn | As | Se | Sb | Te | Au | Bi | Cd |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SND-1 | 6.50 | 0.44 | 83.16 | 1250.00 | 88.07 | 634.10 | 28.41 | 0.15 | 4.82 | 0.44 | 0.02 | 0.93 | 8.39 |
| 2 | SND-2 | 1.30 | 1.01 | 6.99 | 295.96 | 44.60 | 364.22 | 34.94 | 0.11 | 5.06 | 0.53 | 0.04 | 0.81 | 4.77 |
| 3 | SND-3 | 1.68 | 0.90 | 2.90 | 379.83 | 74.94 | 317.96 | 48.36 | 1.20 | 9.56 | 0.61 | 0.07 | 1.40 | 3.87 |
| 4 | SND-4 | 8.09 | 1.15 | 8.73 | 1250.00 | 82.69 | 701.71 | 25.75 | 0.37 | 8.39 | 0.60 | 0.10 | 6.04 | 18.82 |
| 5 | SND-5 | 0.46 | 1.30 | 1.07 | 1250.00 | 81.18 | 731.10 | 64.36 | 0.55 | 8.87 | 0.41 | 0.91 | 8.04 | 15.09 |
| 6 | SND-6 | 2.14 | 0.59 | 123.48 | 1250.00 | 34.57 | 344.09 | 24.05 | 0.51 | 7.54 | 0.45 | 2.48 | 2.70 | 7.50 |
| 7 | SND-7 | 1.72 | 41.12 | 7.45 | 368.55 | 62.88 | 462.08 | 50.76 | 1.83 | 16.93 | 1.37 | 4.77 | 0.96 | 5.36 |
| 8 | SND-8 | 1.17 | 2.62 | 11.89 | 271.82 | 59.89 | 363.12 | 60.65 | 1.15 | 5.96 | 0.13 | 0.09 | 2.22 | 1.56 |
| 9 | SND-9 | 1.57 | 0.88 | 4.01 | 1250.00 | 59.28 | 403.03 | 41.90 | 0.12 | 3.19 | 0.10 | 0.05 | 0.15 | 1.90 |
| 10 | SND-10 | 2.89 | 0.45 | 528.73 | 378.08 | 50.29 | 514.89 | 38.32 | 0.99 | 2.43 | 0.07 | 0.03 | 1.30 | 2.86 |
| 11 | SND-11 | 1.06 | 16.34 | 9.83 | 1250.00 | 466.95 | 11315.98 | 52.64 | 29.14 | 7.78 | 0.29 | 2.60 | 0.67 | 70.84 |
| 12 | SND-12 | 2.96 | 2.23 | 30.04 | 1250.00 | 95.23 | 621.19 | 55.00 | 0.49 | 4.15 | 2.33 | 0.54 | 3.78 | 3.64 |
| 13 | SND-13 | 2.92 | 0.93 | 7.49 | 1250.00 | 103.78 | 418.16 | 36.67 | 0.85 | 2.84 | 0.32 | 0.04 | 0.32 | 2.25 |
| 14 | SND-14 | 8.14 | 1.16 | 159.84 | 1250.00 | 251.54 | 313.19 | 34.83 | 0.11 | 3.48 | 0.22 | 0.07 | 25.86 | 1.95 |
| 15 | SND-15 | 8.11 | 0.58 | 49.24 | 341.94 | 312.80 | 330.18 | 21.94 | 0.07 | 1.63 | 0.24 | 0.03 | 19.51 | 2.42 |
| 16 | SND-16 | 2.99 | 1.49 | 4.10 | 1250.00 | 64.43 | 416.12 | 26.57 | 0.22 | 1.46 | 0.22 | 0.17 | 0.48 | 3.79 |
| 17 | SND-17 | 5.96 | 1.19 | 129.68 | 370.36 | 53.63 | 687.64 | 36.45 | 0.70 | 2.37 | 0.25 | 0.07 | 4.54 | 3.42 |
| 18 | SND-18 | 5.87 | 5.71 | 21.89 | 189.12 | 20.24 | 97.43 | 25.80 | 0.06 | 4.25 | 0.50 | 0.42 | 2.61 | 0.69 |
| 19 | SND-19 | 5.76 | 4.96 | 22.83 | 127.79 | 16.82 | 66.77 | 24.44 | 1.40 | 10.47 | 0.40 | 0.27 | 1.33 | 0.50 |
| 20 | SND-20 | 4.40 | 4.29 | 19.91 | 105.45 | 42.74 | 186.62 | 48.75 | 3.58 | 4.37 | 0.52 | 0.12 | 1.24 | 0.64 |
| 21 | SND-21 | 5.71 | 3.98 | 6.31 | 1250.00 | 62.68 | 409.33 | 13.07 | 0.99 | 3.58 | 0.51 | 0.22 | 3.23 | 2.54 |
| 22 | SND-22 | 2.71 | 3.22 | 6.30 | 219.94 | 28.20 | 114.32 | 13.21 | 1.96 | 5.21 | 0.39 | 0.53 | 1.55 | 0.71 |
| 23 | SND-23 | 2.10 | 2.46 | 8.49 | 94.50 | 19.76 | 62.32 | 1.40 | 0.38 | 5.49 | 0.49 | 0.25 | 1.64 | 0.62 |
| **Summ** | | 86.20 | 98.99 | 1254.34 | 16893.33 | 2177.18 | 19875.57 | 808.26 | 46.92 | 129.84 | 11.39 | 13.90 | 91.33 | 164.14 |
| **Average** | | 3.75 | 4.30 | 54.54 | 734.49 | 94.66 | 864.16 | 35.14 | 2.04 | 5.65 | 0.50 | 0.60 | 3.97 | 7.14 |
| **Klark** | | 1.10 | 0.07 | 1.30 | 16.00 | 47.00 | 83.00 | 1.70 | 0.05 | 0.50 | 0.001 | 0.0043 | 0.01 | 0.13 |
| **K.concentration** | | 3.41 | 61.48 | 41.95 | 45.91 | 2.01 | 10.41 | 20.67 | 40.80 | 11.29 | 495.05 | 140.59 | 441.20 | 54.90 |
| Geochemical sequence of element enrichment intensity in the waste dumps surrounding the Guzaksoy gold deposit: (Te–Bi–Au–Ag) – Cd – Pb – W – Se – As – Sb – Zn – Mo – Cu | | | | | | | | | | | | | | |

In the waste dumps surrounding the Guzaksoy gold deposit. cadmium (R<sub>k</sub> – 0.41) shows very high positive correlations with zinc (0.97). selenium (0.93). and copper (0.73). moderate correlations with gold (0.41) and lead (0.36). and weak correlations with mercury (0.29). silver (0.28). and antimony (0.23). Conversely. cadmium exhibits negative correlations with molybdenum (–0.261). bismuth (–0.09). and tellurium (–0.06) (Fig. 5).

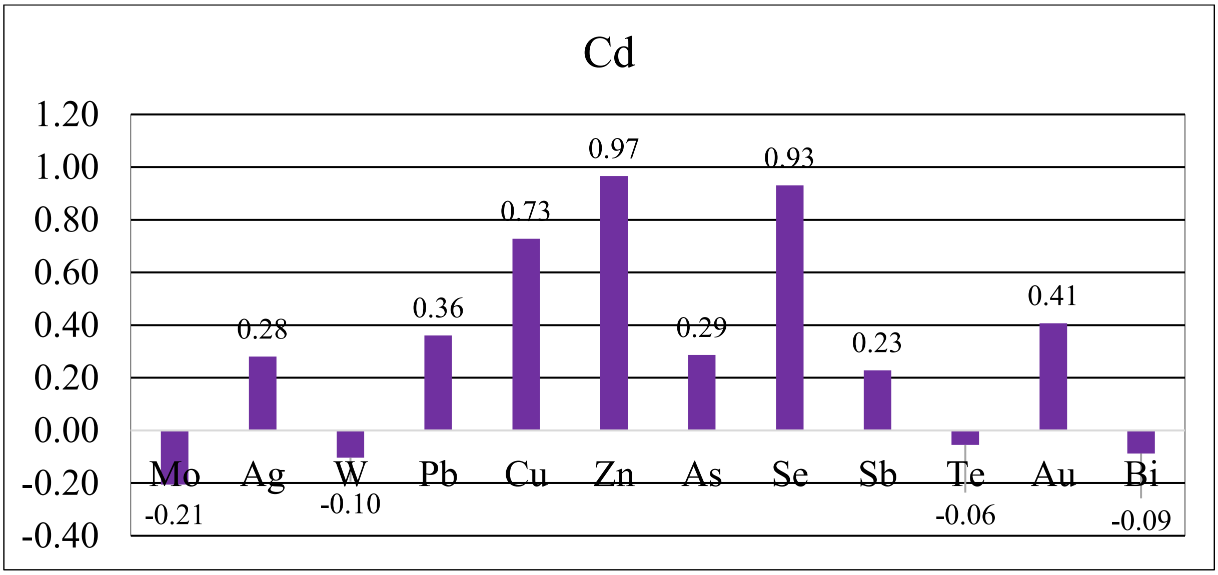


**Fig. 5. Correlation histogram of cadmium with associated elements in the waste dumps around the Guzaksoy gold deposit.**In the waste dumps surrounding the Guzaksoy gold deposit. silver (R<sub>k</sub> – 0.41) shows very high positive correlations with gold (0.87) and antimony (0.72). moderate correlations with tellurium (0.37). selenium (0.34). and zinc (0.31). and weak correlation with cadmium (0.28). Conversely. gold exhibits negative correlations with molybdenum (–0.23). bismuth (–0.17). tungsten (–0.17). and lead (–0.15).

The geochemical sequence of element enrichment intensity in the waste dumps is as follows: (Te–Bi–Au–Ag) – Cd – Pb – W – Se – As – Sb – Zn – Mo – Cu. The (Te–Bi–Au–Ag) element group may correspond to an association of tetradymite–tellurobismuthite–chalcopyrite minerals (Table 3).

The Clarke concentration levels of major and associated elements in the waste dumps are as follows: tellurium (495). bismuth (441). gold (141). silver (61). cadmium (55). lead (46). tungsten (42). selenium (41). mercury (21). antimony (11). zinc (10). molybdenum (3). and copper (2) (Table 3).

## CONCLUSION

In the waste dumps around the Guzaksoy gold deposit. gold shows high correlations with silver (0.87) and antimony (0.72). moderate correlations with cadmium (0.41). selenium (0.40). zinc (0.38). and tellurium (0.35). Selenium exhibits very high correlation with zinc (0.98). high correlation with copper (0.72). and moderate correlations with gold (0.40) and silver (0.34). Cadmium demonstrates very high correlations with zinc (0.97). selenium (0.93). and copper (0.73). and moderate correlations with gold (0.41) and lead (0.36).

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