Original Article

Geology of the Primary Selenium Deposits in Mainland China

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Abstract

Selenium deposits in mainland China are distributed across various tectonic units, including the North China Platform, Yangtze Platform, South China Geosyncline, Qinghai-Tibet Plateau, Tarim Terrane, and Tianshan and Qilianshan tectonic belts. These deposits exhibit a diverse geological background, with varying genetic types and geochemical properties. China's selenium deposits include both independent and associated/symbiotic deposits. They are classified into sedimentary, magmatic, skarn, hydrothermal, and volcanic types. Selenium deposits in the Yangtze Platform are mostly sedimentary, while those in the North China Platform are primarily hydrothermal and sedimentary. In the South China Geosyncline, selenium deposits are closely linked to igneous rocks, with hydrothermal and volcanic types dominating. The Qinghai-Tibet Plateau contains mainly hydrothermal and sedimentary selenium deposits. Other regions, such as the Tianshan tectonic belt, Tarim terrane, and Qilian Mountain tectonic belt, feature hydrothermal and sedimentary deposits. Selenium deposits have formed at varying rates throughout geological history, with the highest output occurring during the Mesozoic era. These deposits contain diverse metallogenic series, and selenium is often found alongside organic matter, sulfides, and various metal elements. Selenium content varies significantly across deposits.

Key words: Geology; primary selenium deposit; genetic type; temporal and spatial distribution; metallogenic series; mainland China

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1. Introduction

Semi-metallic selenium (Se) is a rare element considered critical by many countries. Though sharing similar chemical properties with sulfur, selenium's abundance in the Earth's crust is low, making independent selenium deposits scarce. Selenium has widespread applications in metallurgy, glass, ceramics, electronics, solar energy, chemicals, agriculture, feed, nutritional food, medicine, and other emerging industries[1-4]. As an essential trace element for humans, selenium plays a vital role in anti-oxidation, immunity enhancement, thyroid hormone regulation, detoxification, and cancer prevention. However, both selenium deficiency and excess can cause health issues, with 72% of China's land area being generally selenium-deficient.

Russia, Peru, and the United States possess the world's largest selenium reserves, accounting for 24.7%, 16.0%, and 12.3%, respectively, in 2022. China's selenium reserves have declined over time, with 15,600 tons in 2007, reducing to 6,051.8 tons in 2020 and 3,362.1 tons in 2021, before increasing to 6,000 tons in 2022[1-3].

Although China is the world's largest producer of selenium mineral products, with 1,260 and 1,300 tons in 2021 and 2022, respectively, its domestic market demand for selenium products is strong. Consequently, the output cannot meet domestic consumption demands, resulting in a significant supply-demand gap, ranging from 669 to 1,749 tons in the past decade[3-6].

This paper aims to provide a comprehensive overview of primary selenium deposits in mainland China, focusing on their geological and geochemical characteristics, genetic types, spatial and temporal distribution, and metallogenic series. By sharing this information, we hope to encourage international collaboration, analysis, and research on selenium deposits, ultimately benefitting human society through the discovery of additional selenium resources worldwide.

2. Distribution

China has researched associated and symbiotic selenium deposits within non-ferrous metal deposits since the 1950s. Selenium-containing metal deposits have been discovered in several provinces, including Hubei, Guizhou, Gansu, and Sichuan. Further associated and symbiotic selenium deposits were found in additional provinces, municipalities, and autonomous regions. Notably, independent selenium deposits, which are rare globally, were also uncovered.

Selenium deposits in mainland China are distributed across over 90 production sites in 24 provinces and autonomous regions, including Heilongjiang, Jilin, Liaoning, Inner Mongolia, Xinjiang, Gansu, Qinghai, Shaanxi, Shanxi, Hebei, Shandong, Jiangsu, Anhui, Hubei, Jiangxi, Hunan, Zhejiang, Guizhou, Sichuan, Yunnan, Guangdong, Guangxi, and Fujian.

The distribution of selenium deposits across these regions is not uniform, with concentrations in Gansu (5,831 tons), Xinjiang (2,443 tons), and Jiangxi (2,124 tons). These three provinces combined account for 57% of China's selenium reserves (Figure 1)[2-3].

While these spatial and administrative divisions provide an overview of selenium deposits, it's important to note that they are largely artificial and don't necessarily align with the geological structural units that influence the distribution of selenium deposits.

Geologically, selenium deposits in mainland China are primarily found in the margins of the North China and Yangtze Platforms, the South China Geosyncline, the Qinghai-Tibet Plateau,

the Tarim Terrane, and the Tianshan and Qilianshan tectonic belts. Each of these geological structural units has unique characteristics that influence the geological, geochemical, and genetic types of selenium deposits within them, which will be discussed further in the subsequent sections.

Figure 1. Distribution of selenium deposits in mainland China (modified after Wang et al.[3])

3. Type and geology

In mainland China, most selenium deposits are associated and/or symbiotic, with the exception of the Yutangba independent sedimentary deposit in Enshi, Hubei Province. Various genetic classifications have been proposed for these deposits based on factors like industry, formation, and genesis[7-11]. Wang et al. classified Chinese selenium deposits into eight genetic types, with epithermal, skarn, and marine volcanic rock types being the most common. Other types include magmatic hydrothermal, magma detachment, porphyry, and chemical/biochemical sedimentary, and continental volcanic rock types[3,7-11].

Chinese associated/symbiotic selenium deposits consist mainly of skarn copper deposits in the Yangtze River's middle and lower reaches, magmatic copper-nickel sulfide deposits in the northwest, and sedimentary selenium deposits in Hubei and Hunan Provinces. The Yutangba

deposit in Enshi, Hubei, has the highest average selenium content globally, with concentrations ranging from 0.0047% to 0.035%.

The distribution of these deposits varies across tectonic units. In the North China Platform, spanning Shanxi, Hebei, and the Inner Mongolia Autonomous Region, selenium deposits are primarily hydrothermal and sedimentary, influenced by the platform's geological history and conditions. Selenium in hydrothermal deposits is often associated with metal sulfides like copper, gold, lead, and zinc, while in sedimentary deposits, it is linked to coal-bearing strata and black shales. Selenium content varies widely, ranging from tens to hundreds of ppm.

Wang et al.[3], based on the occurrence, ore-bearing host rocks, and genesis of 92 selenium deposits in mainland China, combined with previous classification schemes and the main mineralization processes (e.g., magmatic activity, ore-bearing fluids, sedimentation), categorized China's selenium deposits into eight genetic types. Statistical analysis reveals that epithermal, skarn, and marine volcanic rock types are the predominant genetic types of selenium deposits in mainland China. Other genetic types, based on the proportion of deposits, include magmatic hydrothermal, magma detachment, porphyry, chemical/biochemical sedimentary, and continental volcanic rock types.

China's associated and/or symbiotic selenium deposits are primarily found in skarn copper deposits in the middle and lower reaches of the Yangtze River, magmatic copper-nickel sulfide deposits in the northwest, and sedimentary selenium deposits in Hubei and Hunan Provinces[2-5,10-15].

The Yutangba independent selenium deposit, located in Enshi City, Hubei Province, contains selenium concentrations ranging from 0.0047% to 0.035%, with localized highs of 0.112% to 0.54% and an average of 0.0084%. This average is 1,628 times the Earth's Clarke value for selenium[4,16-19], making Yutangba the region with the highest average selenium content in the world.

The distribution of associated and/or symbiotic selenium deposits varies across different tectonic units. A brief overview is provided below:

3.1 The North China Platform

This region, encompassing parts of Shanxi and Hebei Provinces, and the Inner Mongolia Autonomous Region, primarily hosts hydrothermal and sedimentary selenium deposits. This distribution reflects the platform's geological evolution and conditions. In hydrothermal deposits, selenium is often associated with metal sulfides such as copper, gold, lead, and zinc. In sedimentary deposits, selenium is closely linked to coal-bearing strata and black shales. Selenium concentrations in these ores vary significantly, ranging from tens to hundreds of ppm.

3.2 The Yangtze Platform

Located in southern China, this platform is a key area for selenium deposits, particularly in Hubei, Hunan, and Guizhou Provinces. The selenium deposits here are predominantly

sedimentary and are closely associated with black shales, phosphorite and carbonate rocks. Selenium in these deposits is often found alongside organic matter and sulfides (e.g., pyrite), with selenium-rich layers containing concentrations of up to hundreds of ppm. Other associated elements include uranium, vanadium, and molybdenum.

3.3 The South China Geosyncline

The selenium deposits in the South China Geosyncline are primarily distributed in Jiangxi, Fujian, and Guangdong provinces in mainland China. Depending on the geological conditions of the geotectonic unit, the deposit types are mainly hydrothermal and volcanic. In hydrothermal selenium deposits, selenium is often associated with metal sulfides such as copper, gold, and silver. In volcanic deposits, selenium is naturally linked to volcanic and sub-volcanic rocks, with selenium content typically reaching hundreds of ppm.

3.4 The Qinghai-Tibet Plateau

In the Qinghai-Tibet Plateau, known selenium deposits are mainly distributed in the Tibet Autonomous Region, Qinghai Province, and some adjacent provinces. The deposit types identified so far are predominantly hydrothermal and sedimentary. In hydrothermal deposits, selenium coexists with metal sulfides such as copper, lead, and zinc. In sedimentary deposits, selenium is associated with lake sediments and evaporates. The selenium content in these ores varies significantly, ranging from tens to hundreds of ppm.

3.5 The Tarim Terrane, Tianshan and Qilianshan tectonic belts

In the Tarim Terrane, Tianshan, and Qilianshan Tectonic Belts, selenium deposits are primarily hydrothermal and sedimentary. In hydrothermal deposits, selenium is mainly associated with metal sulfides such as copper, lead, and zinc. In sedimentary deposits, selenium is linked to coal-bearing strata and black shales. The selenium content in these deposits is usually high, often reaching hundreds of ppm.

4. Geochemistry and mineralogy

Selenium has a Clarke value of 0.05 × 10-6 in the Earth's crust and typically exists in a dispersed state, making it difficult to form independent deposits[10,13-14]. More than 90% of China's selenium resources are found in associated selenium deposits, with selenium being recovered as a by-product. Selenium shares properties and characteristics with elements such as sulfur and tellurium, often forming isomorphisms or micro-grained inclusions in metal sulfides[10,13-14, 20-23].

Selenium has similar properties and characteristics to elements such as sulfur and tellurium in crystallography and geochemistry, and they are easy to form isomorphisms with each other.

Selenium exists in two main forms in metal sulfides, isomorphism, and/or micro-grained selenium mineral inclusions[1-5]. There are two categories of selenium deposits: independent and associated/symbiotic. The Yutangba deposit in Enshi, Hubei, is China's only known independent sedimentary selenium deposit. Associated/symbiotic selenium deposits are more common, primarily found in porphyry copper and copper-molybdenum deposits.

5. Time and space

5.1 Metallogenic age

According to Wang et al.'s analysis of 68 Chinese selenium deposits, selenium mineralization occurred throughout geological history, with peaks during the Proterozoic, Early Paleozoic, Late Paleozoic, Mesozoic, and Cenozoic eras. The Mesozoic saw the most selenium deposit formation, followed by the Late Paleozoic and Early Paleozoic (Figure [2])[3]. The Permian, Jurassic, and Cretaceous periods were peak selenium mineralization periods, with the Sinian, Ordovician, Silurian, and Triassic periods also contributing significantly.

The age of selenium mineralization is primarily determined by the age of selenium-bearing strata and the formation time of associated/symbiotic selenium ores. Selenium deposits exhibit a correlation between mineralization timing and spatial distribution.

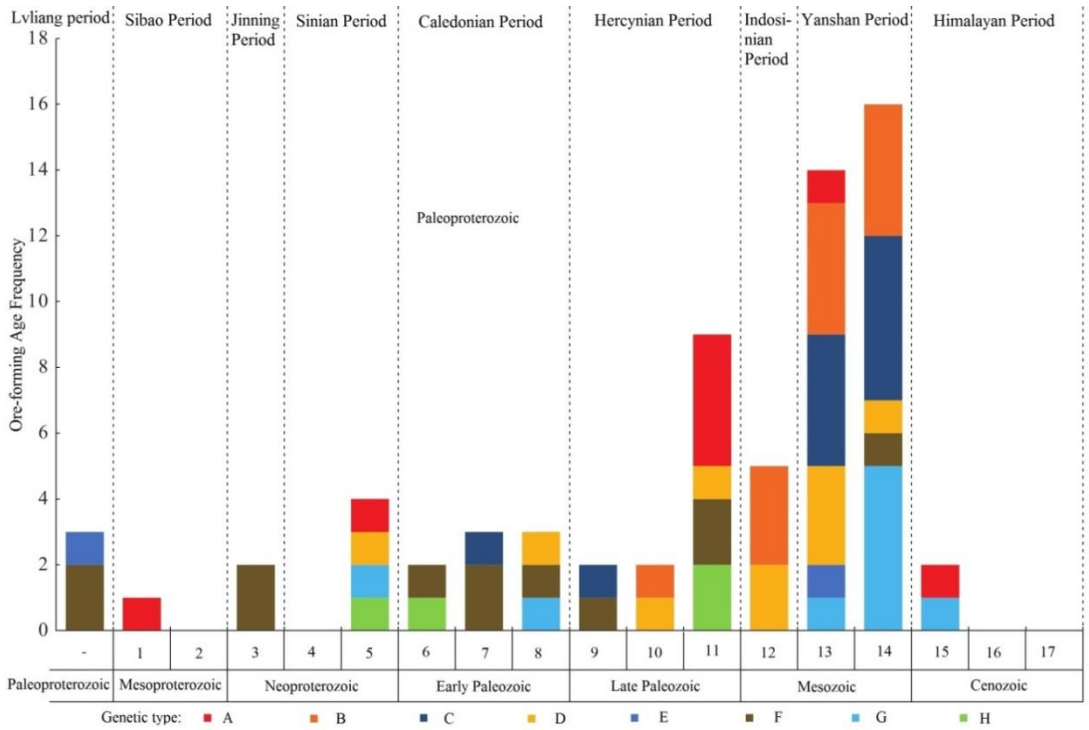

Figure 2. Genetic types and formation ages of selenium deposits in mainland China (modified after Wang et al.[3])
1. Changcheng Period; 2. Jixian Period; 3. Qingbaikou Period; 4. Nanhua Period; 5. Sinian Period; 6. Cambrian; 7. Ordovician; 8. Silurian; 9. Devonian; 10. Carboniferous; 11. Permian; 12. Triassic; 13. Jurassic; 14. Cretaceous; 15. Paleogene; 16. Neogene; 17. Quaternary. A. Magma melting separation; B. Skarn; C. Porphyry; D. Magmatic hydrothermal; E. Continental volcanic; F. marine volcanic; G. Epithermal; H. Chemical and biochemical deposition

5.2 Spatiotemporal connection

Selenium deposits in mainland China exhibit distinct spatial and temporal distribution patterns across different mineralization periods, reflecting a correlation between the timing of selenium mineralization and its geographic occurrence. The key characteristics are summarized below:

- **Proterozoic deposit**
  - **Distribution:** Primarily concentrated in the North China Platform and Yangtze Platform.
  - **Deposit types:** Magmatic, hydrothermal, and sedimentary.
- **Early Paleozoic (Cambrian) deposit**
  - **Distribution:** Focused in the Yangtze Platform, Altyn-Qilian Orogenic Belt, and Yili Plate.
  - **Deposit types:** Predominantly sedimentary and hydrothermal.
- **Late Paleozoic deposit**
  - **Distribution:** Widely scattered across the Yili Terrane, Yangtze Platform, Altyn-Qilian Orogenic Belt, North China Platform, Bayan Har-Songpan Orogenic Belt, Greater Khingan Range, and Junggar Area.
  - **Deposit type:** Magmatic, sedimentary and hydrothermal.
- **Mesozoic (Yanshanian Period) deposits**
  - **Distribution:** Broadly distributed along the western edge of the Qinling-Dabie Orogenic Belt, margins of the North China Platform and Yangtze Platform, and the Karakoram-Sanjiang Orogenic Belt.
  - **Deposit type:** Skarn and hydrothermal.
- **Cenozoic (Himalayan Period) deposits**
  - **Distribution:** Mainly localized in the Karakoram-Sanjiang Orogenic Belt and the margins of the Yangtze Platform.
  - **Deposit type:** Hydrothermal and magmatic.

5.3 Type and spatiotemporal distribution

Associated/symbiotic selenium deposits associated with other mineralization processes exhibit distinct temporal-spatial patterns:

- **Magmatic deposit**: Copper-nickel sulfide-associated selenium deposits span multiple eras:
  - **Meso-Neoproterozoic:** e.g., Pingshui copper deposit formed in the Qingbaikou Period in Zhejiang Province.
  - **Late Paleozoic to Early Mesozoic:** e.g., Xiaonanshan nickel-copper polymetallic deposit (Inner Mongolia, Middle Permian); Heishan copper-nickel deposit (Gansu, Late Devonian); Huayangchuan uranium polymetallic deposit (Shaanxi, Late Devonian).
  - **Cenozoic:** e.g., Baimazhai nickel deposit formed in Himalayan Period in Yunnan Province.
- **Porphyry deposit**: Span from the Paleoproterozoic to Cenozoic:

- **Paleoproterozoic:** e.g., Tongkuangyu copper-molybdenum deposit in Shanxi Province.
- **Early Paleozoic:** e.g., Duobaoshan copper-molybdenum deposit formed in Ordovician in Heilongjiang Province.
- **Mesozoic:** e.g., Ulugtushan copper-molybdenum deposit formed in Early Yanshanian Period in Inner Mongolia.
- **Cenozoic:** e.g., Marathon porphyry copper deposit formed in Himalayan Period in Tibet.

- **Hydrothermal deposit**: These deposits are predominantly linked to hydrothermal iron, copper, and lead-zinc systems, with formation ages spanning multiple geological epochs:
  - **Proterozoic:** e.g., Xiagaoyue lead-zinc deposit formed in Xuefeng Period in Guizhou Province; Paleoproterozoic Laoyu Dongliushui copper deposit in Shaanxi Province.
  - **Paleozoic:** e.g., Caihuagou tungsten-copper-pyrite deposit formed in early Devonian in Xinjiang.
  - **Mesozoic:** e.g., Luqu Laerma gold deposit formed in Yanshanian Period in Gansu.
  - **Cenozoic:** e.g., Wengzi silver-lead-zinc deposit formed in Himalayan Period in Yunnan.
- **Skarn deposit**: These selenium deposits are primarily associated with skarn-type copper mineralization, with ages concentrated in the Mesozoic (Yanshanian Period).
  - **Mesozoic:** e.g., Shizishan copper deposit formed in Yanshanian Period in Anhui Province.
- **Sedimentary deposit**: Sedimentary selenium deposits in mainland China include two categories: Associated/symbiotic selenium polymetallic deposits, and independent selenium deposits (rare, hosted in specific sedimentary sequences):
  - **Neoproterozoic:** e.g., Baiguoyuan silver-vanadium deposit formed in the early Sinian in Hubei Province.
  - **Early Paleozoic:** e.g., Ganziping-Wangjiazhai selenium polymetallic deposit formed in Cambrian in Tianmenshan, Hunan Province.
  - **Late Mesozoic:** This kind of deposit formed in the organic-rich siliceous rocks interbedded with high-carbon mudstone and shale, forming layered or lenticular deposits. e.g., Shuanghe selenium deposit formed in Permian in Hubei Province.

6. Discussion

Elements exhibit uneven crustal distribution due to their distinct geochemical properties, resulting in geochemical anomalies and/or zoning. Selenium follows this pattern. Selenium's crustal distribution is highly heterogeneous, with localized anomalies reflecting enrichment in specific tectonic and lithological settings. This zoning provides a critical framework for understanding selenium resource potential and targeting exploration efforts.

6.1 Selenium metallogenic belt

Selenium deposits in mainland China are predominantly distributed along the margins of the North China Platform, Yangtze Platform, Qinghai-Tibet Plateau, South China Geosyncline,

Tarim Terrane, Tianshan Mountains, and Qilian Mountains tectonic belts. Based on associated/symbiotic mineral types, spatiotemporal distribution, geological settings, and regional metallogenic factors, researchers have categorized these deposits into 24 metallogenic belts[2-3,10-20].

- **Magmatic selenium metallogenic belt:** These occur along the margins of the North China and Yangtze Platforms, as well as the Altun-Qilian orogenic belt. Key belts include the western section of the North China Platform's northern margin, East Liaoning, South Qilian, Alxa, Xiaoqinling-Xiong'er Mountain, Wugong Mountain-Hangzhou Bay, and Ailao Mountain.
- **Porphyry metallogenic belt:** Distributed across the Greater Khingan Range, Karakoram-Sanjiang, North China, Yangtze, and Qinling-Dabie geological units. Notable examples include the Hailar, East Ujimchin Banner-Nenjiang, Lesser Qinling-Xiong'er Mountain, Qamdo, and Wugong Mountain-Hangzhou Bay belts.
- **Hydrothermal selenium metallogenic belt:** Widely dispersed across major tectonic units in China, including the North China Platform, Yangtze Platform, Greater Khingan Range, Bayan Har-Songpan, Altun-Qilian, South China Geosyncline, Karakoram-Sanjiang, Qinling-Dabie Mountains, Yili, and Junggar regions. Specific belts include: Wutai-Taihang, Xiaoqinling-Xiong'er Mountain, Junggar, Yili, East Ujimqin Banner-Nenjiang, North Qilian, West Qinling, Bayan Har, Yidun-Shangri-La, Middle and eastern Upper Yangtze, Western Jiangnan Paleoland, Middle-lower Yangtze River, Eastern Jiangnan Uplift, Wugongshan-Hangzhou Bay, Changning-Lancang, Yunnan-Guizhou-Guangxi, and Nanling.
- **Skarn-type metallogenic belt:** Predominantly associated with the Qinling-Dabie orogenic belt, the North China and Yangtze Platforms, and the South China geosyncline belt, and other tectonic units. Specific belts include: West Qinling Mountains, Xiaoqinling-Xiong'er Mountains, Middle-lower Yangtze River, Eastern Jiangnan Uplift, Wugong Mountain-Hangzhou Bay, and Nanling selenium mineralization belt.
- **Sedimentary metallogenic belt:** Mainly found in the Yangtze Platform, including the middle and eastern part of the Upper Yangtze and the western section of the Jiangnan paleo-land selenium metallogenic belt.

6.2 Selenium metallogenic series

Researchers have categorized known selenium deposits in mainland China into over 30 metallogenic series, establishing a comprehensive metallogenic spectrum for these deposits[2-4,7,10-11]. Building on prior studies, the author of this paper proposes the following classification of selenium metallogenic series:

• **Se-Fe-Cu-Pb-Zn metallogenic series:** mainly found in the East Wuzhumuqin Banner-Nenjiang area of the Greater Khingan Range in Northeast China. The development of this metallogenic series is related to the basic-intermediate-acidic magmatic activity of the Ordovician in the Hercynian period.

• **Se-Fe-Cu-W metallogenic series:** found in the Hailar area of the Greater Khingan Range in China, a metallogenic series related to the intermediate and acidic magmatic intrusions of the early Yanshan period.

• **Se-Cu-Ni-Co-Pt metallogenic series:** developed in the Hercynian basic-ultramafic intrusive bodies in east Liaoning, China.

• **Se-Au (Ag) metallogenic series:** spatially distributed in the northern margin of the North China Platform and the Northeast China in northern China, and the Xiaoqinling-Xiong'ershan area in the central region, i.e. the southern margin of the North China Platform.
• **Se-Fe-Cu-Mo-Au metallogenic series:** mainly developed in the southern margin of the North China Platform, and is a metallogenic series related to the shallow-ultra-shallow intrusions of the Indosinian and Yanshanian periods.
• **Se-Fe-Cu-Ni-Au-Ag-Pt metallogenic series:** developed in the Hercynian mafic-ultramafic magmatic intrusions at the southern margin and the western end of the northern margin of the North China Platform.
• **Se-Cu-Mn-P-V metallogenic series:** developed in the Junggar area, mainly in Xinjiang and other provinces in northwest China, and is a metallogenic series related to late Paleozoic sedimentation.
• **Se-Cu-Ni-Au-Fe-Mn-Pb-Zn metallogenic series:** developed in the Early Devonian (Caledonian) intermediate-basic and intermediate-acidic magmatic rocks in the Yili area of Xinjiang, northwest China.
• **Se-Cu-Ni-Au-Pb-Zn-Fe metallogenic series:** developed in the Altun-Qilian Mountains in northwest China, and is a metallogenic series related to Paleozoic submarine volcanic eruption sedimentation.
• **Se-Cu-Co-Zn-Au metallogenic series:** developed in the Qinling-Dabie Mountains in central China, and is a metallogenic series related to the deep-source magmatic intrusion of the Indosinian and Yanshanian periods.
• **Se-Au-Cu-Mo-W-Sn-Pb-Zn-Ag metallogenic series:** concentrated in Wugongshan and Yushan in Jiangxi, the middle and lower reaches of the Yangtze River, Yunnan-Sichuan-Guizhou and the eastern section of the Jiangnan uplift, and is a metallogenic series related to the acidic-acidic magmatic intrusion-eruption activities in the Yanshanian period.
• **Se-Cu (Au) metallogenic series:** concentrated in the middle and lower reaches of the Yangtze River and the Yunnan-Sichuan-Guizhou region in southern China, dominated by skarn-type copper deposits.
• **Se-Pb-Zn-Mn metallogenic series:** concentrated in the Yunnan-Guizhou-Sichuan area, and is a metallogenic series related to the Early Paleozoic carbonate formation.
• **Se-Pb-Zn-Fe-Mn metallogenic series:** concentrated in the central and eastern Yunnan-Guizhou-Sichuan area, and is a metallogenic series related to the Early Paleozoic-Permian marine-continental transitional carbonate and clastic rock formation.
• **Se-Pb-Zn-Fe-Mn metallogenic series:** concentrated in the central and eastern Yunnan-Guizhou-Sichuan area, it is a metallogenic series related to the carbonate and clastic formations of the early Paleozoic-Permian marine-continental transition phase.
• **Se-Cu-Fe-Nb-Ta metallogenic series:** developed in Jiangxi and northeastern Zhejiang, it is a metallogenic series related to the Cambrian carbonaceous siliceous mudstone.
• **Se-Cu-Au-Fe-Zn metallogenic series:** developed in the middle and lower reaches of the Yangtze River, a metallogenic series related to the development stage of the continental margin of the Caledonian cycle.
• **Se-Au-Sb-Hg-Ag-Mn metallogenic series:** mainly developed in Yunnan, Guizhou and Sichuan, a metallogenic series related to the Indosinian and Yanshanian intermediate-light acidic granites.
• **Se-Pb-Zn-W-Mo-Cu metallogenic series:** developed in the Nanling area of China, a metallogenic series related to the Yanshanian shallow-ultra-light granodiorites.

• **Se-Cu-Zn-Co metallogenic series:** developed in the Bayan Har-Songpan area of China, a metallogenic series related to the Hercynian Animaqing ophiolite formation.
• **Se-Pb-Zn-Au-Cu metallogenic series:** developed in the Yidun and Shangri-La areas of the Karakoram-Sanjiang area of China, a metallogenic series related to the Yanshanian magmatic intrusion activity.

7. Conclusions

Selenium mineralization is widespread across mainland China's diverse tectonic units. Each unit's unique geological history has led to different types of selenium deposits, resulting in distinct genetic deposit types for each tectonic unit.

Selenium mineralization has occurred throughout various geological periods in China, though its development has been uneven across this history. Selenium mineralization has primarily occurred during specific geological periods.

Different types of selenium mineralization exhibit unique temporal and spatial distribution patterns. Selenium deposits of certain genetic types are typically associated with specific geological periods and tectonic units, creating an imbalanced distribution across time and space.

Independent selenium mineralization is typically limited to particular rock types and tectonic units, while associated/symbiotic selenium mineralization is more common. In mainland China, independent selenium mineralization is predominantly found in sedimentary rocks, exhibiting a stratabound nature.

Selenium mineralization in mainland China has only been discovered in sedimentary and igneous rocks thus far, with limited evidence of selenium mineralization in metamorphic rocks. Current research has yet to identify a significant role for metamorphic rocks in selenium mineralization.

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Author contributions

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Data availability

The data that support the findings of this study is available from the author upon reasonable request.

Declaration of competing interest

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Use of AI tools declaration

The author declares that he has not used Artificial Intelligence (AI) tools in the creation of this article.