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Geology of ARUN Minerals Mining Concerns

Geology Of Jiangxi Province

Regional Setting

Jiangxi Province is located on the Southeast portion of China. It is surrounded by mountainous regions on three sides: on the West by the Mufu, Jiuling and Luoxiao Mountains; on the east by the Huaiyu and Wuyi Mountains; and on the South by the Jiulian and Dayu Mountains. Ranges and valleys dominate the Southern half portion of the Province while the remaining Northern half is generally flat and low. The highest peak on Jiangxi is found on Mt. Huanggang of the Wuyi Mountain Range with an altitude of 2,157 masl. Gan River meanders through the whole length of the Province from North to South.

Jiangxi experiences humid subtropical climate, characterized by short, cool and moist winters and extremely hot, humid summers. Temperatures average from 3-9 °C in January and 27-30 °C in July. Yearly rainfall averages 1,200-1,900 mm arriving in late spring and during the summer months.

Jiangxi's capital, Nanchang City, has the highest population and is considered one of the largest cities in China. Nanchang served as the center of Jiangxi's civilization, providing a venue for its rich history and achievements in business, intellectual, industrial and political concerns.

Regional Geology

The Northwest terrain of Jiangxi lies in the middle portion of the Jiangnan gold mineralization belt. In relation to surrounding areas, no major breakthrough had been made in gold exploration in the past two decades or so and no large to medium-sized gold deposits were found until recently. Not surprising since this area possesses the advantage of having excellent metallogenetic conditions and dispersed existences of gold ore deposits. As present and future research will show, this area has provided a great value in terms of its potential for a significant output in gold production.

Geotectonically, the northwest Jiangxi terrain is located in the uplift area of Jiuling Mountain Range which lies in the middle of the Jianggan Ancient Arc Belt. The WE-extending fault was produced during the end of the Proterozoic Era and is considered the most ancient basement structure. Beginning in the Donganian, regular activities in magmatism has occurred, thus producing widespread presence of granitoids of various ages, as well as some basic intrusive and eruptive rocks. The entire strata system is adequately exposed, except for the Lower Paleozoic and the Tertiary.

The Jiuling Group is the most widespread and ancient strata, which can be geochronologically related to the adjacent Lengjiaxi or Shuangxiwu Group.

Gold Deposits

Based on past research and detailed field investigations of the Dexing porphyry copper deposit, the Yinshan Ag-Pb-Zn deposit and the Jinshan shear zone – hosted gold deposit in the Dele Jurassic volcanic basin, in the northeastern Jiangxi province, East China. The findings show that the three deposits share spatial, temporal and genetic relationships and belong to the same metallogenic system. Dexing is a typical porphyry Cu–Au–Mo deposit in which both ore-forming fluid and metals are derived from the granite porphyry. The Yinshan deposit consists of a porphyry copper ore located in the cupola of a quartz porphyry stock, in the lower part, and Ag–Pb–Zn ore veins in the upper part. The hydrothermal fluids were mainly derived from the magma in the early stages of the mineralizing event and became mixed with meteoric waters in the late stages. Its ore metals are magma-derived. Both the Jinshan base metal veins and the Hamashi, Dongjie and Naikeng quartz vein-type gold deposit are hosted by brittle–ductile structures, which are distal in relation to the porphyry intrusions and were formed by mixed magmatic fluids and meteoric water, whereas the gold was mainly leached from the country rocks (Mesoproterozoic Shuangqiaoshan Group phyllite and schist).

The deposits show a distinct spatial arrangement from porphyry Cu, to epithermal Ag–Pb–Zn and distal Au. It suggests a porphyry–epithermal–distal vein ore system model for this group of genetically related mineral deposits. They were form in a back-arc setting in a Middle Jurassic active continental margin, with magmas derived from the subducted slab.

Geology of Yunnan Province

Regional Setting

Yunnan Province lies in the far Southwest of the People's Republic of China, spanning about 394,000 square kilometres, and had a population of 45.7 million as of 2009. Its capital is Kunming, also previously called Yunnan. Yunnan borders Vietnam on the Southeast, Laos on the South and Myanmar on the West.

Yunnan covers a mountainous area, with high terrains in the Northwest and low terrains in the Southeast. A large part of the populace resides in the eastern portion of the Province. The Western side is characterized by mountain peaks and river basins as high as 3,000 meters.

Yunnan, which is abundant in natural resources, contains the largest botanical diversity in China with about 17,000 species of higher plants out of the approximately 30,000 species found in the whole country.

Yunnan's deposits of aluminium, lead, zinc and tin are the biggest in China, plus additional major reserves of gold, copper and nickel.

Regional Geology

Yunnan is situated at the far eastern reaches of the Himalayan Range, and was pushed up in the Pleistocene, mainly during the Middle Pleistocene, although the process of mountain-building or uplift remains active today. Yunnan's eastern portion is a limestone plateau with karst topography and impassable rivers running through deep mountain gorges. The primary exposed formations of the plateau are the Lower Permian Maokou Formation, which contain thick depositions of limestone, the Lower Permian Qixia Formation, containing dolomitic limestones and dolostones, the Upper Permian basalts of the Ermeishan Formation (formerly Omeishan plateau basalts), and the red sandstones, siltstones, mudstones and conglomerates of the Mesozoic–Paleogene, including the Lufeng Formation and the Lunan Group (Lumeiyi, Xiaotun, and Caijiacong formations).

Western Yunnan contains the Ailaoshan gold belt which lies geotectonically on the eastern part of the Tethyan-Himalayan tectonic domain and at the junction of the Gondwana and Eurasian continent. This is considered one of the major gold mineralizing belts in China. Since the 1980's, three major gold reserves, two medium reserves and several small deposits have been found.

The Ailaoshan Belt lies at the junction of the Yangtze Continental Block and the Tanggular-Changdu-Lanping-Simao fault system and exhibits a broom-like geometry converging northwestward and spreading southwestward.

The structural framework of the Ailaoshan area is made up primarily of three thrust faults striking northwest which are the principal fracture zones contributing to the regional geological metamorphism and magmatic occurrences of the area. The three faults from east to west are: Honghe, Ailaoshan and Jiujia-Mojiang. They strike N20-300W and dip N60-800E and run more than 100-km long and are approximately 1 to 3-km wide. They exhibit multi-periodic movements, widespread mylonitization and the apparent ductile shear property.

Gold deposits normally occur at the intersection of the NW, NS and EW trending structures. The individual gold deposits are mainly controlled by NW-striking shear zones and tectonic placements of mafic-ultramatic rocks.

Gold Deposits

The Ailaoshan gold belt is more than 100-km in length and about 0.5 to 5-km in width. In the 1980's, three large gold deposits (averaging 5-7 g/t in grade and with over 50 tons of Au output) have been found. Likewise, medium deposits with average grade of 3-8 g/t and tonnage of 10 tons were discovered, along with smaller reserves.

Gold deposits in the area can be generally categorized into four classes:

1. Metamorphic hydrothermal (Kudumu, Daqiaoqin and Donggualin deposits)
2. Volcanic/Sub-volcanic hydrothermal (Laowangzhai deposit)
3. Ultramatic-rock type (Jinchang deposit)
4. Polymetallic sulfide-quartz vein type (Daping deposit)

Geology of Shandong Province

Regional Setting

Shandong lies on the eastern coast of the People's Republic of China, being part of the East China region. It has played an important role in the country's history from the beginning of civilization along the lower reaches of the Yellow River and served as a hub of culture and religion for Taoism, Chinese Buddhism, and Confucianism.

Shandong's Mount Tai is the most revered mountain of Taoism and one of the world's sites with the longest history of continuous religious worship. The Buddhist temples in the mountains to the south of the provincial capital of Jinan were once among the foremost Buddhist sites in China. The city of Qufu is the birthplace of Confucius, and was later established as the center of Confucianism. Shandong's location at the intersection of ancient as well as modern north-south and east-west trading routes has helped to establish it as an economic center.

After a period of political instability and economic hardship that began in the late 19th century, Shandong has emerged as one of the most populous (95,793,065 inhabitants at the 2010 Census) and most affluent provinces in the People's Republic of China (GDP of CN¥5.468 trillion in 2013).

Regional Geology

Shandong Province lies within the eastern Block of the North China craton. Beginning in the Mesozoic, Shandong has undergone an unusual crustal thinning of a craton which has reduced its thickness from 200 km (120 mi) to as low as 80 km (50 mi). Hence, Shandong has undergone extensive volcanism beginning in the Tertiary.

Several geological formations in Shandong contain many fossils. For instance, Zhucheng, which lies in the southeastern part of the province, has seen numerous findings of dinosaur fossils. One of the largest collections ever found yet are the remains unearthed in 2008 which include a tyrannosaurus and an ankylosaurus, numbering to about 7,600 pieces of dinosaur bones.

Integrated gravitational, electrical-magnetic investigations and data-processing conducted in the Sanshandao–Jiaojia area, Eastern Shandong Province, have shown the geological characteristics of this shallow-covered area and delineate deep-seated gold prospecting targets. In this area, a total number of 12 faults exert critical control on distribution of three types of Early Precambrian metamorphic rock series, namely:

1. In the metamorphic rock area
2. In the granitic rock area underlying the metamorphic rock
3. In the remnant metamorphic rock area in granites, respectively.

Moreover, the faults have primary control on the distribution of four Mesozoic Linglong granite bodies, namely:

1. Cangshang
2. Liangguo
3. Zhuqiao-Miaojia
4. Jincheng granites

The Sanshandao and Jiaojia Faults are two recognized regional ore-controlling faults and possess opposite dip direction. They intersect at a depth of 4,500 m. Fracture alteration zones have significant geophysical differences pertinent to the surrounding county rocks. The two faults extend down along its dip direction in a gentle wave form and seem to show some steps with different dips. These steps favour the mineralization of gold in the areas, as borne by a step metallogenic model. Six deep-seated gold-prospecting prospective sites are delineated, which are:

1. Jincheng-Qianchenjia
2. Xiaoxizhuang-Zhaoxian
3. Xiyou-Wujiazhuangzi
4. Xiangyangling-Xinlicun
5. Panjiawuzi
6. Miaojia-Pinglidian

Gold Deposits

Discoveries of gold deposits in the Jiaolai Basin, Shandong have shown great potential for production in the area. As part of Jiaoliao anticline, Jiaodong peninsula constitutes three second-order tectonic units from north to south, which are:

1. Jiaobei uplift
2. Jiaolai (depression) basin
3. Jiaonan uplift

Several gold deposits of economic worth were found in Jiaobei uplift, which can be more or less categorized into altered-rock type in the shattered zone (Jiaojia type) and quartz-vein type (Linglong type).

Recent discoveries have proven the existence of Pengjiakuang gold deposit and Fayunkuang gold deposit on the northeastern boundary of Jiaolai basin. The Pengjiakuang gold deposit is found in epi-basin faults with decollement segregation character on the margin of Jiaolai basin and the ore bodies conform to the attitude of faults and are disseminated discontinuously along faults in lenticular forms. Distinct ore bodies are 300-400 m long, 0.39-19.45 m thick and possess a gold grade of 10-26.8 g/t. Native gold is distributed in silicified, phyllic or carbonatized tectonic breccia, with confirmed gold deposits reaching as much as 20 t.

The Fayunkuang gold deposit is found in conglomerate of Early Cretaceous Laiyang Group on the rim of Jiaolai basin and the parent rocks have significantly undergone silicification, pyritization, sericitization, carbonatization and chloritization. Ore bodies stratoid in character are found gently (at about a dip angle of 10°) along inter-layers of conglomerate. Specific ore bodies have a maximum length of 400 m, oblique extension of 600-700 m and gold grade of 10-15.3 g/t, with potential gold amounting to 12 t.

Mining records reveal that gold-rich veins are also controlled by several bed-cutting faults of various attitudes. Comparative investigations prove that the principal ore-producing stages of Jiaojia-type and Linglong-type gold reserves in Jiaobei uplift and the Pengjiakuang and Fayunkuang gold deposits on the boundary of Jiaolai basin might have separately transpired in Early Cretaceous. Being rare results of geological fluids produced by Late Mesozoic tectonomagmatic activities in the Jiaoliao anticline, they fall under the same ore deposit collection formed in the same tectonic environment and the same era.

An integrated assessment of the geological, geophysical and geochemical data suggests that Jiaolai basin is a field of reasonably viable gold potential in Jiaodong peninsula. In particular, the north-eastern and north-western rims of this basin include excellent ore-exploration prospects for the Pengjiakuang-type and Fayunkuang-type gold reserves.

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Email: info@arunminerals.com