The research on the characteristics of skarn alteration zones in Haxiyatu iron-polymetallic deposit of East Kunlun

To cite this article: Namkha Norbu et al 2018 IOP Conf. Ser.: Earth Environ. Sci. 108 042112

View the article online for updates and enhancements.

You may also like

- Glacier mass changes on the Tibetan Plateau 2003–2008 derived from ICESat laser altimetry measurements
  N Neckel, J Kropáek, T Bolch et al.

- Geological Features of Iron Formations and Associate Rock in Bulunkuole Group, West Kunlun, Xinjiang, China
  Chaoyang Huang, He Wang, Guangli Ren et al.

- Glacier Changes in the West Kunlun Mountains Revealed by Landsat Data from 1994 to 2016
  J Zhang, B H Fu, L M Wang et al.
The research on the characteristics of skarn alteration zones in Haxiyatu iron-polymetallic deposit of East Kunlun

Namkha Norbu¹, a, Shuguang Wang², *, Wei Liu³

¹ Shaanxi Provincial Land Engineering Construction Group Co., LTD, xi'an 710075, China
² School of Earth Science and Resources, Chang'an University, Xi'an, Shaanxi 710054, China
³ Scientific research project: Shaanxi provincial land engineering construction group DJNY-201714, DJNY-201713

¹nkew1989@163.com,*Corresponding author Email: 101224622@qq.com

Abstract. Haxiyatu iron-polymetallic deposit in Qinghai East Kunlun is a typical regional strata bound skarn ore deposits, the major ore-host rock is Jinshuikou rock group and the metallogenic epoch is the early Triassic. This paper studied the amphibole, epidote, garnet and pyroxene, garnet and petrographic of Haxiyatu skarn deposit, divided the deposit alteration zoning characteristics in detail, and according to the mineral assemblages and skarn deposit mineral sequence, figured out three formation periods, including the skarn deposit stage, degenerate alteration stage and metal sulfide stage.

1. Introduction
The skarn deposit has important industrial significance and is an important source of iron, copper, lead, zinc and gold. Recently, with the in-depth investigation of geology and mineral resources of Qinghai-Tibet plateau, remarkable achievements of the mineral exploration in East Kunlun metallogenic belt have been made, especially a skarn deposit related to Triassic mid-acid intrusive rocks[1-8]. The abundant resources and wide distribution of this deposit made it an important skaryan metallogenic potential zone.

Haxiyatu iron-polymetallic deposit is a typical skarn deposits, which discovered by Qinghai Nuclear Industry Geological Bureau during the process of 1:500,000 magnetic anomaly verification in 2011. The ore-bearing strata of Haxiyatu iron-polymetallic deposit is Jinshuikou group, formed in the early Triassic, and the metallogenic element mainly is iron, associated with gold and zinc. The previous studies on petrology, chronology and geological characteristics of ore deposits were carried out, while little researches on the zonal properties of skarn [9-11], which not only restricts the understanding of the whole study of this deposit, but also affects the next deployment. Thus, this paper intends to study the lithology and petrographic of the typical skarn deposit, and aims to clarify the zonal division and metallogenic stages of the deposit, to provide a new way for the study of the skaryan deposit in this area.

2. Geological Background
The stratas of East Kunlun exposed widely, mainly include Paleoproterozoic Jinshuikou group, Mesoproterozoic Langyashan formation, Cambrian-Ordovician Tanjianshan group, Upper Devonian Maoniushan formation, Carboniferous Dagangou and Upper Triassic Elashan formation. Among them,
the unique carbonate rock formation laid a good foundation for the skarn ore-forming. Each period of magmatic rocks can be seen and the type of the rocks mainly includes granite, granite diorite, quartz diorite, diorite, gabbro, diabite, etc, forming a great magmatic belt extended along east-west [12]. The magmatic activities is quite obvious that can be divided into 4 stages, namely Precambrian, Early Proterozoic, Late Paleozoic-Early Mesozoic and Late Mesozoic-Cenozoic. Late Paleozoic-Early Mesozoic is the main metallogenic stage and the granite formed in this period constitutes the principal part of East Kunlun. Kunbei, Kunzhong and Kunnan faults extending along east-west are three dominate fractures in this region (Fig.1). The three faults divides East Kunlun into Kunbei, Kunzhong, Kunnan tectonic belts[13], and the secondary faults are relatively developed and most of them extended along east-west.

3. Geology of the Study Area

Haxiyatu iron-polymetallic deposit, belonged to the western part of East Kunlun middle tectonic zone, lies in Haxiyatu Utumien Golmud of Qinghai Province. The main exposed layer is Jinshuikou group, and its lithologies are biotite plagioclase gneiss and marble. The primary mineral constituents of the former rock are plagioclase (55%), quartzs (30%) and dark mineral, auxiliary mineral (30%), for the marble are calcite and dolomite, with a small amount of silt and iron particles. Because most of the mining areas are seriously covered, it’s inferred that the faults and the regional fracture extend in the same direction (Fig.1). Among the magmatic rocks, the quartz diorite and contact zone of Jinshuikou group are skarnized, while granodiorite not. The ore-containing skarn is developed in the outer contact zone of quartz diorite. In this area there are 54 concealed orebodies, distributed in layered and lenticular. The ore-containing belt extends in south, length is about 1400 m and the thickness 200-350 m, with dip angle 45°~75°. The ore minerals are dominated by magnetite, sphalite, galena and gold, and ore structures are dense infestation, bulk, infestation and banded structure. The gangue minerals riched in magnetite are diopside, cummingtonite-actinolite and white mica calcite, while that riched in the lead-zinc ore are diopite, amphibolite, calcite and chlorite.

Fig.1 Geological sketch map of Haxiyatu Iron-polymetallic ore district1-Quaternary, 2-upper Jinshuikou group, 3-lower Jinshuikou group, 4-quartzdiorite, 5-granodiorite, 6-geological boundary, 7-faults, 8-occurrence, 9-outcrops, 10-study area
Fig. 2 Microscopic characteristics of skarn minerals of Haxiyatu iron-polymetallic deposit Q-quartzs, Pl-plagioclase, Ep-epidote, Cun-cummingtonite, Act-actinolite, Di-diopside, Grs-essonite, Tl – tremolite, Cc-dolomite

4. Skarn Alteration Zones
The ore-hosting rock is Jinshuikou group. Based on the previous studies, the skarn alteration zones can be divided into garnet skaryan belt, diopside skaryan belt, epidote skaryan belt, actinolite skaryan belt, tremolite skaryan belt etc. The skarn symptomatic mineral from lower temperature to higher contains amphiboles, epidote group, pyroxene group and garnet group etc.

4.1. Amphiboles
Amphiboles mainly includes actinolite, cummingtonite and tremolite, with the features of metasomatizing the early skaryan mineral and is the product of regressive alteration. Fig. 2 showed that the hornblende has the transverse section of diamond hexagon, with a long cylindrical output. The mineral contains higher iron content, suffering biotitization and the color is dark brown. Magnesite occurred in conical and radial shape and dark green, accompanied by magnetite and underwent weak alteration. The actinolite is grayish green, with small fibrous output and radiated collection,
metasomatosed the skaryan minerals formed in early stages like diopside. The tremolite distributed less, metasomatosed garnet and diopside, with a acicular output (Fig.2-a–f).

4.2. Epidote group
Epidote appeared in small granular, which is between 0.2–0.5mm, and existed in radiated collection, metasomatosed the skaryan minerals formed in early stages like diopside (Fig.2-g~h).

4.3. Pyroxene group
The pyroxite mineral is mainly monoclinal pyroxene, which is dorminated by diopside, with an irregular granular output and particle size of 1–2mm under microscopic observation. Its transverse section has two groups of nearly vertical joints, and the interference color is level 2, positive light. The mineral is easy to be choritizated and micasized when suffering pneumatolytic hydrothermal metamorphism (Fig.2-i~l).

4.4. Garnet group
The garnet mineral is mainly essonite. The garnet has granular shape, with internal cleavages, zonary structure and bicrystals developed (Fig.2-m~o). It metasomatosed dolomite and is replacemented by calcite and epidote.

5. Metallogenic Stage
According to the mineral intergrowth association and sequence of mineral formation in skarn mineral deposits, the Haxiyatu iron-polymetallic deposit can be divided into skarn stage, retrograde alteration and metal sulfide stage, in which the skarn stage includes early and late periods. In the early stage, skarn rock underwent initial metasomatic process of magmatic hydrothermal and marble, forming the dry minerals such as garnet, diopite and magnesium olivine. With the continuous metasomatism, the temperature gradually decreases, and the semitic minerals such as mafic and ferroxite begin to appear, co-precipitating magnetite and pyrrhotite, etc. The degenerate alteration stage is marked by the formation of a large number of amphibolite, epidote and pyrrhotite. The metal sulfide phase is characterized by the formation of sulfur-containing metallic minerals, and a large number of wet skarn rocks such as pyrite, sphalerite and galena. The natural gold is formed in the late hydrothermal reaction under lower temperature.

6. Conclusion
(1) According to petrology and geological characteristics of deposit, the skarn alteration zones of Haxiyatu iron-polymetallic deposit can be divided into garnet skaryan belt, diopside skaryan belt, epidote skaryan belt, actinolite skaryan belt, tremolite skaryan belt etc. In addition, the forming periods includes skarn stage, retrograde alteration and metal sulfide stage.

(2) The main metallogenic elements in Haxiyatu iron-polymetallic deposit is gold. Mineralization occurred in a subduction stage, during which the crust-mantle magma action can bring about deeper and mantle-derived magma that are rich in gold, forming specific strata-bound deposits of this region.

Acknowledgments
Scientific research project: Shaanxi provincial land engineering construction group DJNY-201714, DJNY-201713

Biography: Namkha Norbu (1989-) , male, DR read, mainly engaged in solid mineral exploration and soil remediation work. Email: nkew1989@163.com,

Corresponding author: Shuguang Wang (1967-), male, senior economist, mainly engaged in land reclamation and soil remediation work. Email: 101224622@qq.com
References

[1] Li W Y. The geological composition and metallogenetnic prospect in the Qimantage prospective region, East Kunlun [J]. Northwestern Geology, 2010, 43(4): 1-9.

[2] Zhao Y M, Feng C Y, Li D X, et al. Metallogenetnic setting and mineralization-alteration characteristics of major skarn Fe-polymetallic deposit in Qimanta area, western Qinghai Province [J]. Mineral deposits, 2013, 32(1):1-19.

[3] Liu J N, Feng C Y, Zhao Y M, et al. Characteristics of intrusive rock, metasomatite, mineralization and alteration in Yemaquan skarn Fe-Zn polymetallic deposit, Qinghai Province [J]. Mineral deposits, 2013, 32(1):77-93.

[4] Li Y C, Li B, Chen J, et al. Sr-Nd-Pb isotopic characteristics of ore-bearing granodiorites from lalingzaohuo deposit and its geological significance [J]. Mineral petrol, 2013, 33(3):110-115.

[5] Li W L, Xia R, Qing M, et al. Re-Os molybdenite ages of the Shiduolong skarn Mo-Pb-Zn deposit and geodymanmic framework, Qinghai Province [J]. Rock and mineral analysis, 2014, (6):32-43.

[6] Yu M, Feng C Y, Zhao Y M, et al. Fluid inclusion geochemistry in the Kaerqueka copper polymetallic deposit, Qinghai Province and Its Genetic Significances [J]. Acta Geologica Sinica, 2014, 88(5):903-917.

[7] Chen J, Xie Z Y, Li B, et al. Geological and geochemical characteristics of ore-bearing intrusions from the Lalingzaohuo Mo polymetallic deposit and its metallogenetic significance [J]. Geology and exploration, 2013, 49(5):813-824.

[8] Ma S C, Feng C Y, Zhang D J, et al. Alteration and mineralization zoning of Hutouya polymetallic deposit in Qimantage area, Qinghai Province [J]. Mineral deposits, 2013, 32(1):109-121.

[9] Li C L, Dai Y, Wang X P, et al. Discover and significance of the iron-polymetallic deposit in Haixiyatu Areas of Glomud city in Qinghai [J]. Northwestern Geology, 2012, 45(1):222-228.

[10] Nam K N B, Jia Q Z, Tang L, et al. Zircon U-Pb age and geochemical characteristics of granodiorite from the Haxiyatu iron-polymetallic ore district in Eastern Kunlun [J]. Geology in China, 2015, 42(3):702-712.

[11] Nam K N B, Jia Q Z, Li W Y, et al. LA-ICP-MS Zircon U-Pb age and geochemical characteristics of quartzs diorite from the Haxiyatu iron-polymetallic ore district in Eastern Kunlun [J]. Geological Bulletin of China, 2014 (6):841-849.

[12] Mo Y X, Luo Z H, Deng J F, et al. Granitoids and crustal growth in the East-Kunlun orogenic belt [J]. Geological Journal of China Universities, 2007, 13(3):403-414.

[13] Jiang C F, Wang Z Q, Li J T, et al. The opening-closing tectonic of Central Orogenic Belt [M]. Beijing: Geological Publishing House, 2000.

[14] Yu M. Characteristics and zonation of skarn minerals in Galinge iron deposit, Qinghai Province [D]. China University of Geosciences, Beijing, 2013.

[15] Song Z B, Jia Q Z, Zhang Z Y, et al. Study on geological features and origin of Yemaquan Fe-Cu deposit in Qimantage Area [J]. Northwestern Geology, 2010, 43(4):209-217.

[16] Xiao Y, Feng C Y, Liu J N, et al. LA-MC-ICP-MS zircon U-Pb dating and sulfur isotope characteristics of Kendekkeke Fe-polymetallic deposit, Qinghai Province [J]. Mineral Deposits, 2013, 32(1):177-186.

[17] Tian C S, Feng C Y, Li J H, et al. 40Ar/39Ar geochronology of Tawenchahan Fe-polymetallic deposit in Qimantage Mountain of Qinghai Province and its geological implications [J]. Mineral Deposits, 2013, 32(1):169-176.

[18] Feng C Y, Wang S, Li G C, et al. Middle to late Triassic granitoids in the Qimantage area, Qinghai Province, China, chronology, geochemistry and metallogenetic significance [J]. Acta petrologica sinica, 2012, 28(2):665-678.

[19] Nam K N B, Jia Q Z, Li W Y, et al. Melting, assimilation, storage and homogenization (MASH) process and crust-mantle magma mixing of mesozoic in east Kunlun region [J]. Journal of earth science and environment, 2015, 37(1):37-46.
[20] Nam K N B, Jia Q Z, Li W Y, et al. A Comparative Study on isotopic geochronology and tectonic-magmatic hydrothermal events of igneous rock in Qinghai province [J]. Northwestern Geology, 2014, 46(2): 51-62.

[21] Chen G C, Pei X Z, Li R B, et al. Late Triassic magma mixing in the East Kunlun orogenic belt: A case study of Helegang Xilikete granodiorites [J]. Geology in China, 2013, 40(4): 1044-1065.