MINERALIZATION OF CENTRAL KITAMI MINING DISTRICT IN HOKKAIDO, JAPAN

By

Yukitosi URASIMA

Contribution from the Department of Geology and Mineralogy,
Faculty of Science, Hokkaido University, Sapporo; No. 678

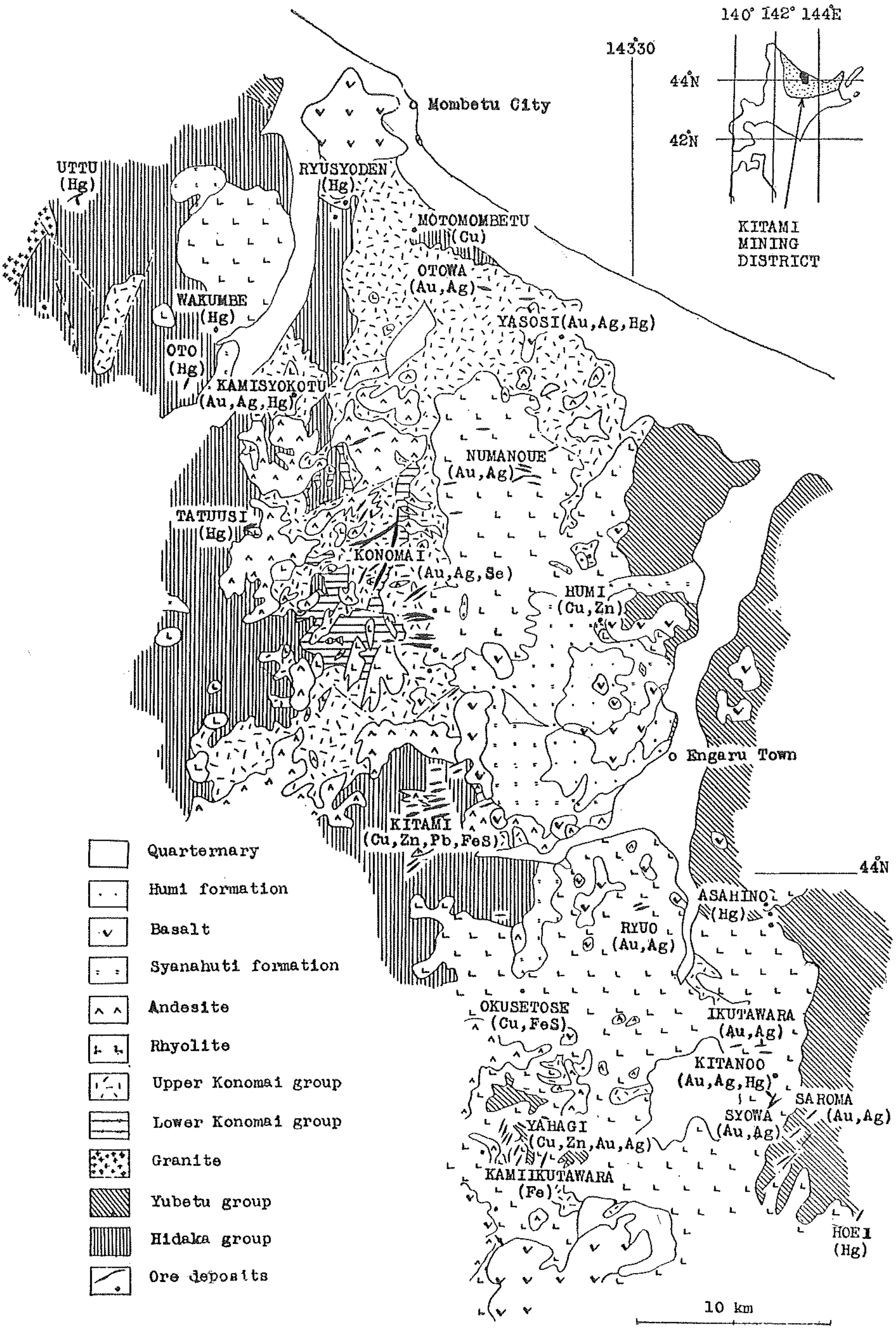
CONTENTS

Introduction

Along the inside of the Japanese Islands arc belonging to the circum-Pacific volcanic region, Tertiary volcanism and accompanying mineralization were very active. In such a volcanic area of Hokkaido, at the northern extremity of the Islands, there are some mining districts amongst which the Kitami mining district lying in the northeastern part of Hokkaido is known for mercury, gold-silver and base metal mines. In central Kitami, especially, many hydrothermal ore deposits are distributed in some regular arrangement; the Konomai mine in the centre of this district is one of the most productive gold-silver-selenium mines in Japan. It is, therefore, considered that the district is a representative metallogenetic province in Hokkaido.

Published contributions concerning the ore deposits in the district are not abundant. However the geological maps of the whole district embodying the results of the prospecting of the mineral resources, the survey of the general geology by TAKAHASHI et al. (1936, 1942), and the comprehensive studies on the gold ores by FUKUTOMI (1949) were published in the first half of the 20th century.

For several years, the present writer and co-workers have been investigating the geological environment of the ore deposits in northeastern Hokkaido. Some research data on the igneous activities and mineralization of central, eastern, and southwestern Kitami have already been reported (URASIMA et al. 1953, URASIMA and OKADA 1956. YAMAGUCHI et al.


140° 142° 144°E
143°30
44°N
42°N
KITAMI
MINING
DISTRICT
Mombetu City
UTTU
(Hg)
RYUSYODEN
(Hg)
MOTOMOMBETU
(Cu)
OTOWA
(Au,Ag)
WAKUMBE
(Hg)
YASOSI(Au,Ag,Hg)
OTO
(Hg)
KAMISYOKOTU
(Au,Ag,Hg)
NUMANOUE
(Au,Ag)
TATUUSI
(Hg)
KONOMAI
(Au,Ag,Se)
HUMI
(Cu,Zn)
Engaru Town
KITAMI
(Cu,Zn,Pb,FeS)
44°N
ASAHINO
(Hg)
RYUO
(Au,Ag)
OKUSETOSE
(Cu,FeS)
IKUTAWARA
(Au,Ag)
KITANOO
(Au,Ag,Hg)
SAROMA
(Au,Ag)
SYOWA
(Au,Ag)
YAHAGI
(Cu,Zn,Au,Ag)
KAMIIKUTAWARA
(Fe)
HOEI
(Hg)
10 km
Quarternary
Humi formation
Basalt
Syanahuti formation
Andesite
Rhyolite
Upper Konomai group
Lower Konomai group
Granite
Yubetu group
Hidaka group
Ore deposits

1953). Sequential to the preceding studies which seem to show that the mineralization of central Kitami has distinguishing traits as compared with the other parts, this paper presents a preliminary metallogenetic consideration for the entire Kitami mining district.

Geology

The stratigraphical succession of central Kitami which was established by TAKAHASI et al. (1936), and TAKEUTI (1942), and redefined recently by URASIMA et al. (1953) is presented as follows.

TABLE 1. General geological formations in central Kitami

Quarternary	Alluvial and terrace deposits.	
	Sawaki formation—volcanic ash.	
Neogene Tertiary	Syanahuti group	Humi formation—tuff.
		Syanahuti formation—basalt, rhyolite, tuff, and conglomarate.
		Rhyolite and andesite.
	Konomai group	Tuff formation.
		Tuff and mudstone formation.
		Gray shale formation.
		Black shale formation.
		Granite.
Mesozoic	Yubetu group —	black shale and sandstone.
	Hidaka group —	black slate, sandstone, schalstein, and diabase.

The Hidaka group and Yubetu group which develop as the basement complex of central Kitami are distributed around this area, and especially the former extends to the west and the latter east. The distribution of the contemporaneous groups is not found in the south of southeastern Kitami and around the eastern Kitami (Siretoko) mining district. The overlying Neogene Tertiary spreads in a N-S trended zone of 25 km width which is restricted by the above-mentioned older basements. The Konomai group, the lower member of the Neogene Tertiary, develops well in the neighborhood of the Konomai. The distribution of the normal sediments of the lower formations is limited within the central-western zone, while the tuffaceous upper formations develop widely in the marginal area. Therefore it is considered that this area was geologically formed of a sedimentation unit in the Konomai epoch. The group may be Miocene in age judging from its faunal aspect.

In eastern and southwestern Kitami, green tuff is abundant in the groups which seem to be correlative to the Konomai group, but the tuffaceous rocks in central Kitami are mostly not green. Also, quartz-dioritic rock, granophyre, or holocrystalline andesitic rock are often recognized in the green tuff area, but they are scarcely found in this central area. Such characters of the igneous activities within the above-mentioned areas are shown for easy comparison in the following table.

TABLE 2. Comparative table of the igneous activities in Neogene Tertiary among three areas of Kitami Province

(○, abundance; ×, scarcity.)

	Central Kitami	Southwestern Kitami	Eastern Kitami
Olivine basalt (younger)	○	○	×
Pyroxene andesite	×	○	○
Rhyolite without quartz of phenocryst	○	○	×
Olivine basalt (older)	×	×	○
Propylite	○	○	○
Rhyolite	○	○	○
Holocrystalline andesitic rock	×	○	○
Green tuff	×	○	○

As mentioned above, it is considered that the sedimentation of the Konomai group and the related igneous activities have distinct local characters and central Kitami may form a geological unit, although the boundary of the area is not distinct.

Ore deposits

Metallogenetic epoch.—The copper, lead, zinc, iron, and iron sulphides ore deposits in central Kitami are mostly found in the black shale and sandstone of the basement complex, but the such kinds of workable ore deposits are not found in the Konomai group. SHIBOI (1953a) states that the copper veins were formed in the pre-Konomai epoch within Tertiary, but some such veinlets or impregnated zones in rhyolite and so-called Kuroko (black ores) in tuff have been recorded (NOTOMI 1920, KINOSITA 1944). So, the present writer has too few data to determine if all such ore deposits were formed in the same epoch.

The epoch of the gold-silver mineralization in this area is clearer than that of the base metals. The basal conglomerate of the Syanahuti group contains pebbles of vein quartz (URASIMA et al. 1954) but gold-bearing quartz veins have not been found in the group. As all ore deposits of the gold-silver mines present similarities in mineral composition (Table 4), vein features, and their country rocks—mostly the Konomai group and accompanying volcanics,—it is believed that most of them formed in the upper Miocene or lower Pliocene ages when the Konomai group may have upheaved and the sedimentation area moved aside.

At some mines, for example the Yahagi and the Kitanoo mines, cinnabar is found as the mineral in the later stage of gold-silver mineralization. It is, therefore, considered that the mineralization of the mercury ore deposits was not earlier than that of the gold-silver deposits, though they are both formed in all rocks of pre-Syanahuti epoch.

Distribution.—Central Kitami is formed of the above-described geologic unit. At first sight the distribution of many ore deposits in this area seems unsystematic, but there is some regularity from the following points of view: the geological division, the horizon of the geological group, and the geological structure.

Ore deposits of base metal are found in the Hidaka and Yubetu groups distributed around this present area and there are gold-silver ore deposits in the Konomai group, but there are no workable veins in these other cases, while the mercury ore deposits have not such a regularity. The gold-silver ore deposits in this central Kitami area are mostly found in veins, but in the tuffaceous upper formation of the Konomai group they have a tendency to appear as a massive silicified body with clayey parts. But there is some inclination for the ore shoots of the Konomai mine to be disposed in the lower and middle horizons of the Konomai group.

In this area, well-mineralized zones extend with N-S or NNW-SSE trend. The many veins of the Konomai mine are distributed within one of the zones, and the base metal ore deposits are also found along those zones. Furthermore, the mercury ore deposits, which are obscurely restricted by the differences of the geological series, are arranged in the same trend alongside and somewhat across the above-mentioned zones. These trends are related to the folding structure which are also shown by the lineation of the Konomai group, the elongation of some rhyolite dykes, and arrangement of basalts. It is considered that such a tendency which is generally parallel to the distribution of the Konomai group may have some intimate relation with the structural movements of the bases. On the other hand, the strikes of the veins are generally E-W or NE-SW, and

TABLE 4. Minerals of the some ore deposits in central Kitami

	Kamiikutawara	Yahagi (Cu)	Humi	Kitami (Inausi)	Konomai	Numanoue	Ryuo	Otowa	Kitanoo	Ryusyoden	Uttu
Quartz	○	○	○	○	○	○	○	○	○		○
Adularia				○	○	○	○	○	○		
Calcite				○	○	○		○	○		○
Barite					○	○					
Chlorite		○	○	○	○	○					○
Sericite				○	○	○					
Montmorillonite			○?		○					○?	
Kaolinite					○						
Hisingerite				○							
Hematite	○				○						
Pyrrhotite				○							
Pyrite	○	○	○	○	○	○	○	○	○		○
Marcasite				○	○		○				
Limonite				○	○	○					
Chalcopyrite	○	○	○	○	○	○	○		○		
Tetrahedrite			○?		○		○		○		
Chalcosite				○							
Bornite	○		○	○			○				
Covellite					○	○	○				
Sphalerite		○	○	○	○	○	○				
Galena		○	○	○	○	○	○				
Native gold					○	○	○	○	○		
Native silver					○	○	○				
Argentite		○?			○	○	○	○	○		
Pyrargyrite					○	○	○				
Polybasite					○	○?					
Stephanite					○?						
Myargyrite						○					
Argyrodite					○	○					
Aguilarite					○?						
Cerargyrite					○	○		○			
Germanite					○?						
Native mercury										○	○
Cinnabar									○	○	○

it is considered that these correspond to strike of faults and the direction of intrusion of some andesite dykes in the above mineralized zones.

Constituents of the ore deposits.—Table 4 shows the hypergene and supergene minerals of the ore deposits of base metal, gold-silver, and mercury in central Kitami.

The pyrrhotite of the Seibo ore deposits of the Kitami mine occurs with iron-rich sphalerite but without pale-colored sphalerite and adularia which are found in the 3rd ore deposits of the same mine. As the former sulfides may not usually be formed under low temperature in hydrothermal ore deposits and the crystallizing-temperature of adularia is under about 400°C (BATEMAN 1950), the upper limit of the temperature of such a vein-forming in this area is assumed. No continuous relation between the sulfides of the base metal and gold-silver ore deposits of the Kitami mine can be observed at present.

Adularia are ubiquitous in the gold-silver ore deposits in this area, and sometimes cinnabar has been recognized as a mineral in the later stage of the mineral sequence of the Yahagi mine (OMACHI and URASIMA 1953) and of the Kitanoo mine (WATANABE 1940). The temperatures required for the formation of the quartz of the Konomai mine from liquid inclusions are 267°C, 228°C and 132°C from the early to later stage (TAKASHIMA 1954). It seems that the mercury ore deposits which mainly consist of cinnabar were not formed above them. As mentioned above, the hydrothermal ore deposits are distributed in recognizable successions and zones in this area.

The ratios of calcite to quartz in each of the ore deposits are variable. The Kuttyannai ore deposits of the Konomai mine are the gold-silver bearing adularia-calcite-quartz veins; calcite is rarely found in the gold-silver ore deposits of the Numanoue (OTAGAKI 1951). With a few exceptions calcite is abundant in the veins either having black shale, schalstein and propylite as their country rocks or being distributed in their neighborhoods. It is considered with respect to the crystallization and dissolution of the gangue minerals, that their origin in the Kitami mine is different from that of the ore minerals according to SHIBOI's statement (1953b), and that it is closely related with the geological surroundings—especially with the chemical compositions of the basements and the country rocks (URASIMA 1956).

No minerals which contain arsenic and tellurium as main compositions of the minerals have been found in many mines in central Kitami, though such minerals occur often in the ore deposits in southwestern Hokkaido. About twenty samples from the gold-silver ores of the Konomai mine and the Numanoue mine were analyzed spectrographically and microchemically; the results show that arsenic and tellurium are too insufficient to form any megascopic or microscopic minerals. Arsenopyrite in the gold ore of the Takinoue mine (FUKUTOMI 1949) and realgar in the mecury ore of the Oketo mine (YAJIMA 1951) which are located beside this area have been reported, and so it is a interesting problem whether or not this area is a metallogenetic province where arsenic and tellurium minerals are free in the basements and Cenozoic series.

Conclusions

The present writer attempts to arrange the data on the ore deposits in central Kitami from the viewpoint of metallogenetic province. The principal points may be summarized as follows:

1. Central Kitami is formed of a geological unit.
2. The base metal, gold-silver and mercury ores were respectively formed of different mineral sequences, but mercury mineralization followed the gold-silver mineralization in Neogene Tertiary.
3. The distribution of many ore deposits in this area forms a somewhat regularly zoning on the country formation and geological structure.
4. Arsenic and tellurium gave scarcely been formed as main chemical compositions of the minerals of many mines in the area.

The geological and metallogenetical provinces of north-eastern Hokkaido in Neogene Tertiary have been considered by SUZUKI (1954) and other authors. The writer (1953) recognized some striking differences between the southeastern zone which includes eastern Kitami and the internal area including central Kitami. According to MINATO et al. (1956), the tectonic movements of the bases that are supposed by the Bouguer anomaly distribution caused such differences. The internal area of northeastern Hokkaido may be subdivided into some units such as central Kitami as used in the present paper. It is considered that most of mineralization in this area is similar to the igneous activities in Tertiary, though the specific igneous rock found at present is not their ore bringer. How the metallogenetic provinces correspond to the above-mentioned geological units must be investigated in future.

Acknowledgment

Indebtedness to Prof. Jun SUZUKI, Prof. Zyunpei HARADA and Assist.

Prof. Mitsuo HUNAHASHI is gratefully acknowledged. They gave shown much kindness in guiding the writer. Thanks are extended to co-workers for very kind discussions and also to Mr. Yutaka KIKUCHI, mining geologist of the Sumitomo Metal Mining Co., for very helpful suggestions.

References

BATEMAN, A, M. (1950): Economic Mineral Deposits. 2nd Edition, 42, 43.

FUKUTOMI, T. (1949): Applied geological study on gold ores in Hokkaido (1, 2). Mem. Fac. Eng. Hokkaido Univ., (2), 1–92; (3), 1–96.

KINOSITA, K. (1944): Koroko in Japan. Ore deposits in Japan, **3**, 1–263.

MINATO, M., YAGI, K. and HUNAHASHI, M. (1956): Geotectonic synthesis of the green tuff regions in Japan. Bul. Earthq. Reser. Inst., **34**, Part 3, 237–265.

NOTOMI, S. (1920): The iron ores of the Kamiikutawara mine in Kitami province. Rep. Miner. Resources, (28), 49–68.

OMACHI, H. and URASIMA, Y. (1953): Ore deposits of the Yahagi mine in Hokkaido. Jour. Min. Inst. Hokkaido, **7**, (5), 177–181.

OTAGAKI, T. (1951): Geology and ore deposits of the Numanoue mine in Kitami district. Bul. Geol. Comm. Hokkaido, (18), 5–17.

SHIBOI, T. (1953a): On the epoch of the copper mineralization of the Inaushi mine and its neighbourhood. Bul. Geol. Comm. Hokkaido, (23), 33–34.

SHIBOI, T. (1953b): Consideration of the different origins between gangue and ore of epithermal ore deposits. Min. Geol. **3**, (7), 59–61.

SUZUKI, J. (1954): Mineralized province of Hokkaido. Jour. Min. Inst. Hokkoido, **10**, (5), 170–173.

TAKAHASHI, T., SOMA, Y., MUTUKAWA, M., and MATSUDA, H. (1936): Mineral resources in Hokkaido (No. 6). Bul. Indust. Stat. Hokkaido, (60), 1–58.

TAKASHIMA, K. (1954): The gold-silver deposits of the Konomai mine, Hokkaido. Bul. Geol. Surv. Japan, **5**, (10), 529–544.

TAKEUTI, K. (1942): Explanatory text of the geological map of Konomai. Bul. Geol. Indust. Stat. Hokkaido, (6), 1–22.

URASIMA, Y. (1953): Comparison between the igneous activities and mineralization of the central part of Kitami district and those of Siretoko district in Hokkaido. Jour. Geol. Soc. Japan, **59**, (694), 343–344.

URASIMA, Y., ADATI, K., HARIYA, Y., ISIDA, Z., OMACHI, H., OMURA, H., OTAGAKI, T., and SIMIZU, I. (1953): Epochs of the igneous activities and mineralization of the central part of Kitami in Hokkaido. (Studies on the ore deposits in eastern Hokkaido--first report). Bul. Geol. Comm. Hokkaido, (21), 1–14.

URASIMA, Y. and HARIYA, Y. (1954): Geology of Syanahuti Tableland in Engaru Town, Hokkaido. Jour. Min. Inst. Hokkaido, **10**, (1), 23–28.

URASIMA, Y. (1956): "Bosa" quartz veins, especially the fine-grained quartz aggregates, of the Konomai mine in Hokkaido, Japan. Jour. Fac. Sci. Hokkaido Univ., Ser. IV, **9**, (3), 371–380.

URASIMA, Y. and OKADA, A. (1956): Geology of the Neighbourhood of the Itomuka mercury mine and the Harutomi gold-silver mine, Hokkaido. (Studies on the ore deposits in eastern Hokkaido—third report.) Bul. Geol. Comm. Hokkaido, (33), 9–18.

WATANABE, M. (1940): Characteristics of gold deposits of the Showa-Kitanoo type. Jour. Jap. Ass. Min. Petr. Econ. Geol., **23**, (1), 28–39.

YAJIMA, S. (1951): Mercury ore deposits in Hokkaido. Bul. Geol. Comm. Hokkaido, (17), 1–78.

YAMAGUCHI, S., HASEBE, K., and OTAGAKI, T. (1953): Mechanism of the mineralization in the southern part of Shiretoko Penninsula, Hokkaido. (Studies on the ore deposits in eastern Hokkaido—second report.) Min. Geol., **3**, (9), 145–155.