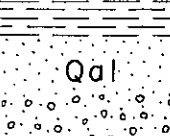
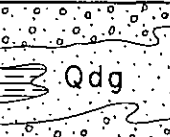



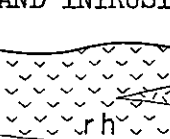

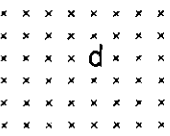


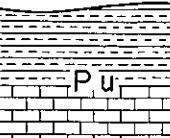
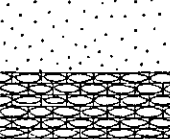



GEOLOGIC COLUMN AND UNIT DESCRIPTIONS

AGE	ROCK UNIT	LITHOLOGY; THICKNESS WHERE KNOWN	UNIT DESCRIPTION	ECONOMIC VALUE	
QUATERNARY	Alluvium	 Sand, clay and gravel; thickness less than 10 meters	Alluvium, consisting of sand, clay and gravel, is distributed in the drainage basins of the Ko-ni Ho (格泥河), the A-lun Ho (阿倫河), the Ya-lu Ho (雅魯河) and their tributaries, covering low terrace remnants and flood plains.	<p>Gold</p> <p>Placer gold derived from gold-bearing veins intruding Cretaceous granite occurs in alluvial deposits along the Ya-lu Ho between Horigoru and Pa-li-mu and along the uppermost reaches of the Pi-la Ho (畢拉河); the quality of the gold is poor.</p>	
	Diluvium	 Sand, gravel and clay; thickness more than 100 m	Diluvium in the southeastern part of the map area covers high terrace remnants, which are 40 m in relative height near Ch'i-li-t'un (奇禮屯). It consists of light gray coarse-grained quartz sand and water-worn gravel, accompanied by some clay. It forms an uplifted delta deposit fringing the east side of the Ta-hsing-an Ling.		
TERTIARY	UNCONFORMITY				
	Paleogene basalt	 Doleritic augite-olivine basalt; thickness more than 130 m	Paleogene basalt occurs as flows in the northeastern part of the map area and forms a gently undulating lava plateau. The rock is black, compact, vesicular, doleritic augite-olivine basalt with agates and rock crystals, and consists of a dark gray to black microcrystalline groundmass and phenocrysts of plagioclase, olivine and augite. As it is covered by the Diluvium and rests upon the Cretaceous granite (g ₃), the Cretaceous rhyolite (rh) and the Jurassic volcanic complex (Mjv), its age is probably Oligocene.		
MESOZOIC	EFFUSIVE CONTACT				
	Cretaceous andesite	 Hornblende andesite and biotite andesite	The Cretaceous andesite is compact and vesicular hornblende or biotite andesite showing a fluidal texture. It erupted as flows after the rhyolite effusion at the end of the Cretaceous period. The andesite flow around Hei-lung-shan (黑龍山) is covered by the Diluvium and rests on the Cretaceous granite (g ₃).		
	EFFUSIVE CONTACT				
	Trachyte	 Flows and dikes of hornblende trachyte	Trachyte is a marginal facies of the Cretaceous rhyolite (rh) and the quartz porphyry (qp) and occurs as flows and dikes in the following places: 5 km west of Chiu-san-chan (邱三站), a light grayish yellow to grayish green trachyte flow consists of an almost decomposed groundmass and orthoclase phenocrysts. The flows 5 to 8 km northeast of Ya-lu (Cha-lan-t'un, 札蘭屯) are associated with flows of the rhyolite and the quartz porphyry. Several dikes of trachyte 7 km north of Ya-lu intrude the Jurassic volcanic complex (Mjv). Not shown on the map are trachyte dikes 1 km west of Pa-li-mu (巴里木), which are light gray to light green, contain hornblende phenocrysts, and intrude the Jurassic volcanic complex.		
	EFFUSIVE AND INTRUSIVE CONTACT				
	Cretaceous rhyolite	 Rhyolite flows with tuff, tuffaceous sandstone and breccia; thickness more than 300 m	Cretaceous rhyolite occurs as flows and is exposed in the western part of the map area. It is light gray rhyolite containing idiomorphic quartz phenocrysts and shows a fluidal texture; it is associated with tuff, tuffaceous sandstone and breccia containing diorite porphyry pebbles. The thickness of the rhyolite is probably more than 300 m.		
	EFFUSIVE CONTACT				
Quartz porphyry	 Quartz porphyry and granite porphyry	The quartz porphyry flows may be a marginal facies of the Cretaceous rhyolite (rh), because they are accompanied by trachyte and rhyolite flows resting upon the Jurassic volcanic complex (Mjv). The quartz porphyry on the hills northeast of Cha-lan-t'un is light gray, holocrystalline, and porphyritic. The granite porphyry exposed in a small area near Ha-la-su (哈拉蘇) Pa-li-mu, and Ya-lu (雅魯) are intruded by some aplite dikes which strike generally N 50° W.			
Diorite	 Hornblende diorite	Diorite is also a marginal facies of the Cretaceous granite, and occurs as stocks or bosses intruding the crystalline schist (psh), the Paleozoic formation (P) and the Cretaceous granite. The diorite stock 2 km northeast of Chiu-san-chan is dark green to light green, hard, compact, massive diorite, consisting of hornblende and feldspar. It is locally associated with gneissose diorite which is slightly schistose. The hornblende diorite in the uppermost reaches of the Horen-ka, a tributary of the A-lun Ho, occurs as a boss overlain by rhyolite flows. The diorite is also exposed as bosses near Ha-la-su, Pa-li-mu and along the Po-sung-ni Kou (博松泥溝).			
Cretaceous granite	 Biotite granite	The Cretaceous granite throughout the map area is characterized by granitic intrusives such as graphic granite, granite porphyry, syenite, syenite porphyry, monzonite, diorite and aplite. An ordinary biotite granite is found in the vicinities of Cha-lan-t'un, Ha-la-su, Pa-li-mu and Ya-lu. The rock near Cha-lan-t'un is pinkish white biotite granite overlain by the flows of contemporary quartz porphyry, and seems to occur as a laccolith. It consists of feldspar, biotite, and a small amount of quartz. Under a microscope, the feldspar consists of pink orthoclase and white or light pink plagioclase; the biotite is almost completely altered to chlorite, sphene, and epidote. The granite is intruded by dikes or sheets of propylite. The aplite dikes exposed on the northern bank of the Ya-lu Ho near Ha-la-su are 5 cm wide and intrude the Jurassic volcanic complex.			
INTRUSIVE CONTACT					
Jurassic volcanic complex (Greenstone complex)	 Diorite porphyry, andesite porphyry, diabase, dolerite, propylite, rhyolite, volcanic breccia, tuff and tuffaceous sandstone; thickness more than 500 m	The Jurassic volcanic complex, previously known as greenstone complex or porphyrite, is characterized by a greenish tinge due to chloritization and propylitization. It is a complicated assemblage of dark-colored igneous intrusives and extrusives such as diorite porphyry, andesite porphyry, diabase, dolerite, propylite, black rhyolite, volcanic breccia, tuff, and tuffaceous sandstone. The total thickness probably exceeds 500 meters. Several dikes belonging to this complex are found in a cliff southeast of Kan-ch'in (甘沁) in the northeast corner of the map.			
EFFUSIVE AND INTRUSIVE CONTACT					
PALEOZOIC	Upper Paleozoic formation	 Limestone and slate; thickness less than 50 m	The Upper Paleozoic formation is found on a hill 5 km west of Pa-li-mu, where it consists of limestone and slate that occur as xenoliths in the granite, and are about 50 m wide, about 100 m long, and trend roughly northward.		
	Undifferentiated Paleozoic formation	 Sandstone, chert, chlorite phyllite, chlorite-sericite schist, clay slate, hornfels, and quartzite; thickness unknown	The undifferentiated Paleozoic formation is exposed along the Po-sung-ni Kou and along the Ta-weng-pu-ch'i Ho, and consists of pinkish chert and dark blue sandstone, striking NE. The chert is intruded by diorite and the sandstone by aplite dikes. The formation distributed between Sheng-chia-tien (盛家店) and Lao-ying-tzu (老營子) via Hsiang-yang-yü (香楊峪), covering an area 5 km by 20 km, is characterized by crystalline schist and consists of chlorite phyllite, clay slate and quartzite. The phyllite is metamorphosed into chlorite-sericite schist by the granite intrusion, and shows a marked schistosity manifested by sericite flakes. The clay slate is metamorphosed into hornfels. The formation is cut on the south by an east-west fault.		
PRECAMBRIAN	UNCONFORMITY				
Crystalline schist	 Chlorite schist and chlorite-sericite schist; thickness unknown	The crystalline schist, consisting of chlorite schist and chlorite-sericite schist is exposed near Ha-la-su along the Ya-lu Ho. The rock is overlain by the Jurassic volcanic complex and is intruded by many small quartz veins as well as by granite and diorite. The rock locally shows a marked banded structure. The schist is probably Precambrian in age.			

(Column not drawn to scale)

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Building stone

The medium-grained hornblende-biotite granite near K'u-ju-ch'i (庫和奇) along the No-min Ho (諾敏河) forms a steep cliff 40 to 50 m high and can be used as building stone.

Copper

The copper deposits are located on the crest of a mountain about 10 km southwest of Pa-li-mu station. The topography near Pa-li-mu is considerably rugged, with local relief attaining about 200 m, but the valleys are comparatively broad, and even swampy in places. The road between the station and the deposit is accessible only on foot.

The deposit is found in xenoliths of the Upper Paleozoic limestone and slate captured in the Cretaceous granite. The limestone has entirely altered to garnetiferous rock associated with hornfels derived from the slate, and is characterized by a greenish yellow tinge due to grossularite. The deposit is regarded as a contact deposit accompanied by epidote skarn formed between slate and granite.

The area is divided by a ridge into two slopes, steeper on the west than on the east. The center of mineralization is found in the gently sloping area on the east. At the end of WW II there remained many short trenches and two pits of several meters deep. Some hand-sorted stockpiled ore, chiefly malachite (about 100 tons), had been accumulated near the pits. A tunnel was driven from both the eastern and the western sides, toward the base of the trenches, but the ore body was not reached. Operations seem to have been continued until the end of the war.

The richest part of the deposit is about 10 m wide and 50 m long, but its downward extension is unknown. Skarn minerals are magnetite, pyrrhotite, pyrite, sphalerite, chalcocite, malachite, azurite, garnet, diopside, epidote, vesuvianite, amphibole, chlorite, feldspar, apatite, fluorite and zeolite. The ore minerals are composed chiefly of oxidized equivalents of chalcocite, pyrite, magnetite, etc., but malachite is most predominant.

In 1952, the Geological Survey of Ch'ang-ch'un scheduled two drillings in order to ascertain the lower limit of the deposit, although no information is available as to whether the plan was carried out or not.

The deposit is the only copper deposit known in northern Manchuria, and together with the Ha-erh-ch'o-erh deposits (refer to Ch'i-ch'i-ha-erh sheet, NL 51-2, adjacent on the south), it throws a fresh light on the future investigation of mineral resources in the northern Ta-hsing-an-Ling.