
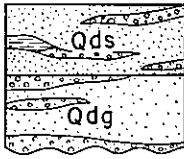
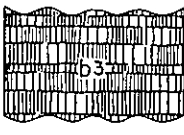
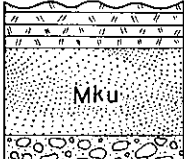
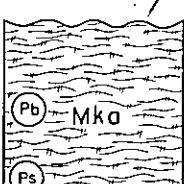

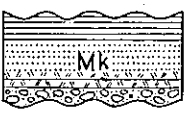
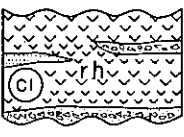
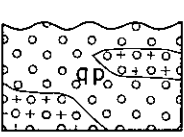
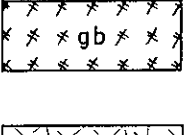

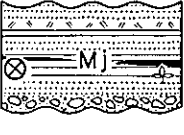

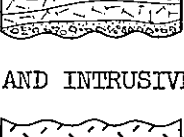
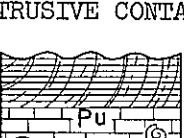
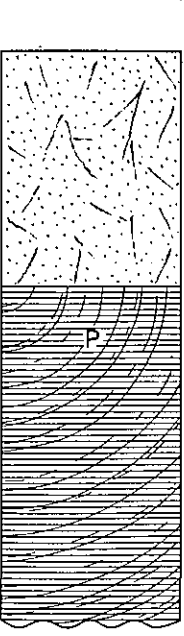
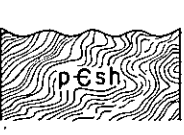


# GEOLOGIC COLUMN AND UNIT DESCRIPTION

AGE	ROCK UNIT	LITHOLOGY; THICKNESS WHERE KNOWN	UNIT DESCRIPTION	ECONOMIC VALUE	REFERENCES
QUATERNARY	Alluvium	 Sand, clay and gravel; thickness less than 10 meters	Alluvium, consisting of sand, clay and gravel, is widely distributed in the drainage basins on both sides of the Ta-hsing-an-ling (Greater Khingan Range). It covers low terrace remnants and forms broad swampy valleys. Pebbles of the gravel are 3 - 5 cm in diameter. The total thickness is less than 10 meters.	Placer gold Placer gold derived from Cretaceous granite is found in the Recent deposits along the valley 4 km northwest of Erh-tao-ho-tzu. It was worked by Chinese from 1930 to 1933. Placer gold near Heing-an station and near T'ou-tao-ho-tzu (柳道河) along the Huo-liao is negligible in both quality and quantity.	HARAGUCHI, Kuman, and others, 1937, Geology and geography of northwestern Manchuria: Geol. Inst., S. Manchuria Ry. Co. SAITO, Rinji, compiler, 1940, Geological map of Manchuria and adjacent areas, scale 1:3,000,000: Manchoukuo Geol. Inst. USHIMARU, Shitaro, and others, 1937, Geology and geography of northern Manchuria: Geol. Inst., S. Manchuria Ry. Co.
	Diluvium	 Qds: sand, clay and gravel Qdg: sand and gravel Total thickness more than 10 m	Diluvium (Qds), consisting of aeolian sand, associated with sand, silt, and gravel of fluvial origin, is distributed in the western part of the map area along the west foot of the Ta-hsing-an-ling (大興安嶺). Diluvium (Qdg), consisting of fluvial sand and gravel, is found along the Ch'o-erh Ho (綽爾河) near its junction with the T'a-erh-ch'i Ho (塔爾奇河). Four km north of the junction, it forms a river terrace 5 - 10 m high.		
	Quaternary (Pleistocene?) basalt	 Augite-olivine basalt	Quaternary basalt, probably Pleistocene in age, occurs as flows, filling the present valley basins. Along the I-min Ho (伊敏河) it extends northward for 35 km, occurring intermittently between Ch'uan-shih Shan (穿山) to Saoro San. The rock has been dissected by the present stream and forms basalt terraces. It is a porous vesicular augite-olivine basalt, containing microcrystals of augite and feldspar, and shows marked platy joints. Basalt flows are found in small areas along the Ch'o-erh Ho. The rock has been eroded out almost entirely owing to the uplift of the Ta-hsing-an-ling		
	Upper Cretaceous formation	 Sandstone and conglomerate; thickness unknown	The Upper Cretaceous formation or I-min formation is sporadically distributed along the I-min Ho and its tributaries. It is characterized by reddish rocks that are markedly false-bedded and are horizontal, whereas other Mesozoic beds have been severely disturbed by folding. Near the junction of the I-min Ho and the T'a-erh-su Ho (塔爾蘇河), the formation rests horizontally on granite hills. It consists of tuffaceous sandstone and conglomerate, pebbles of which are rhyolite and granite ranging from 2 cm to 4 cm in size. In the several hills on both sides of the Utohen-gorū (river), the formation consists of yellowish red tuffaceous sandstone and conglomerate, resting unconformably on granite hills. The formation is also found in small areas in the divide between the Utohen-gorū and the Cina-gorū, resting unconformably on Cretaceous rhyolite. It has undergone peneplanation.		
MESOZOIC	Cretaceous andesite	 Quartz andesite, biotite andesite, hornblende andesite and crypto-crystalline andesite	The Cretaceous andesite comprises the following four rock-types: (1) Biotite andesite is predominant. It is dark or light green, massive, compact, vesicular, and rhyolitic in texture. (2) Quartz andesite is exposed near Haratahol along the Hsi-ni-k'o Ho (西尼克河) and in the upper reaches of the I-min Ho. It is generally massive, light gray, brown or dark brown, and contains phenocrysts of quartz, feldspar and biotite. (3) Hornblende andesite is found in a small area at San-shih-chiu-ch'ien (三十九村) in the eastern part of the map. (4) Crypto-crystalline andesite exposed in the northwest part of the map near Lo-t'o Ho (老圖河) is a black compact rock having rarely visible hornblende phenocrysts. Under a microscope, the groundmass shows an andesitic structure.	Lead Galena is found in Cretaceous andesite at the following four localities: (1) 1 km north of Po-k'o-t'u, (2) 4 km east of I-lieh-k'o-te (伊列克特), (3) a hill near Pai-huo Shan (白火山) along the Utohen Ho, and (4) a hill near Hsiung-chao Shan (熊爪山) along the Hsi-ni-k'o Ho. Available data are very few.  Agate A small amount of milky white or light blue agate, accompanied by quartz veins that penetrate Cretaceous hornblende andesite, is found in the valley north of San-shih-chiu-ch'ien along the Huo-liao Ho.  Fire clay Potter's clay derived from rhyolite occurs near Ch'i-hao station (not shown on the map) on the logging railway from I-lieh-k'o-te between Ha-erh-pin and Man-chou-li. The clay east of the station is reddish brown, contains much ferric oxide, and is not suited for pottery making. The clay west of the station, however, is light green and is a superior raw material for pottery making. The reserves are abundant.	
	Trachyte	 Trachyte and sanidine trachyte	Trachyte flows near Mashawo-san are gray, white or reddish brown, crypto-crystalline, and rhyolitic in texture, showing marked platy joints. Phenocrysts are chiefly orthoclase, rarely accompanied by plagioclase and biotite; the groundmass is glassy with microcrystals of orthoclase. The rock exposed in a small area near Huo-liao-kou (火燒溝) along the Hori-gorū is a light brown trachyte containing square sanidine phenocrysts.		
	Cretaceous formation	 Sandstone, shale, tuff and conglomerate; thickness unknown	The Cretaceous formation in the hills east of the Hori-gorū consists of sandstone, shale, tuff and conglomerate, intercalated with rhyolite flows, and has the same strike and dip as the rhyolite.		
	Cretaceous rhyolite	 Rhyolite, crypto-crystalline rhyolite, tuff, sandstone and agglomerate	The Cretaceous rhyolite consists of an alternation of rhyolite and crypto-crystalline rhyolite, with tuff, sandstone and agglomerate. The rhyolite is light yellow to brown or reddish brown, and consists of visible quartz phenocrysts and a glassy groundmass rarely containing microphenocrysts of feldspar and biotite. The rhyolite without visible phenocrysts shows an agglomeratic texture.		
	Quartz porphyry	 Quartz porphyry, granite porphyry and porphyry	Quartz porphyry in association with granite porphyry is probably a marginal facies of the Cretaceous granite (G <sub>3</sub> ). The quartz porphyry near Erh-tao-ho-tzu (二道河子) along the Hori-gorū intrudes the Jurassic volcanic complex (M <sub>3v</sub> ) as dikes and sheets. The gray porphyry along the T'a-erh-su Ho and near Tsao-miao Shan (草廟山) consists of orthoclase phenocrysts, rarely biotite phenocrysts, and a gray groundmass.		
	Gabbro	 Basic plutonic rock	Basic plutonic rock consisting chiefly of gabbro is found at Hanoza-san along the Hsi-ni-k'o Ho. It may be a marginal facies of the Cretaceous granite (G <sub>3</sub> ).		
	Cretaceous granite	 Biotite granite, biotite-hornblende granite, graphic granite, diorite, syenite, porphyritic granite, granite porphyry, microgranite and aplite	The Cretaceous granite in the map area consists chiefly of biotite granite and biotite-hornblende granite, but also includes various granitic intrusives such as graphic granite, diorite, syenite, porphyritic granite, granite porphyry, microgranite and aplite. It intrudes the Jurassic volcanic complex (M <sub>3v</sub> ) in several places, markedly contact-metamorphosing it. The biotite granite associated with hornblende granite near Hsing-an station is intruded by dikes of aplite and granite porphyry. The porphyritic granite near Yu-te'ai Shan (裕泰山) consists of reddish idiomorphic microcline, idiomorphic or hypidiomorphic quartz and a few colored minerals. The microgranite along the Nan Kou (南溝) and the Wu-no-erh Ho (烏諾爾河) intrudes the Jurassic formation (M <sub>3</sub> ).		
	Jurassic formation	 Shale, sandstone, conglomerate, tuff and coal; thickness unknown	The Jurassic formation crops out along the Nan Kou and the Wu-no-erh Ho. It consists of sandy shale, sandstone, conglomerate, tuff and thin coal seams. The sandy shale in the Mien-tu-ho (免圖河) coal field along the Nan Kou yields fossils of the plant <i>Podocarpites</i> sp. The formation is contact-metamorphosed by the Cretaceous microgranite.		
	Jurassic volcanic complex or Greenstone complex	 Diorite porphyry, andesite porphyry, diabase, dolerite, propylite, rhyolite, breccia, tuff and sandstone; thickness more than 300 m	The Jurassic volcanic complex sporadically exposed in the eastern half of the map area was heretofore defined as porphyrite or the greenstone complex owing to its greenish tinge resulting from chloritization and propylitization. It is an intricate assemblage of dark green igneous intrusives and extrusives, namely, diorite porphyry, andesite porphyry, diabase, dolerite, propylite, black rhyolite, volcanic breccia, tuff and tuffaceous sandstone. The thickness is more than 300 m. The complex near Yao-pei-kou (姚北溝) is overlain by the Cretaceous rhyolite (rh), trachyte (t), andesite (a) and the Jurassic formation (M <sub>3</sub> ), rests upon the Precambrian (?) schist (p <sub>3</sub> sh), and is intruded by the Cretaceous granite (G <sub>3</sub> ).		
	Pre-Jurassic(?) granite	 Biotite granite	Biotite granite along the Su-ko Ho (蘇科河) and near Chung-tao Shan (中島山) is considered by some geologists as pre-Jurassic granite, although no decisive information is available.		
PALEOZOIC	Upper Paleozoic formation	 Clay slate and limestone; thickness unknown	The Upper Paleozoic formation, probably Permian-Carboniferous in age, is found in the following three places: (1) The formation 4 km south of Wu-no-erh consists of dark blue clay slate and light gray limestone which yields fossil corals and crinoids. (2) The formation 3 km west of Lo-t'o Shan consists of grayish muddy limestone. (3) The formation along the I-min Ho near Shih Shan (石山) consists of dark gray siliceous slate and light gray limestone, is 7 m thick, strikes N 50° E, dips 50° NW, and forms a monoclinical structure.	Limestone The Permian-Carboniferous limestone exposed on a hill 4 km south of Wu-no-erh station is good in both quality and quantity, and is calcined for lime. Lime production by four limekilns amounted to 5,500 tons in 1927.	
	Undifferentiated Paleozoic formation	 Graywacke, clay slate, phyllite, gneiss, hornfels, biotite schist, sandstone and shale; thickness unknown	The undifferentiated Paleozoic formation 4 km southeast of Po-k'o-t'u consists of graywacke and clay slate; it is overlain by the Cretaceous rhyolite (rh) and is intruded by propylite dikes. Although the formation is markedly disturbed, it strikes roughly N 60° E and dips 30° NW. The formation 4 km north of Wu-no-erh is a bluish black clay slate which is intruded by dikes and sheets of diabase. In the hills south of the T'a-erh-su Ho the formation is a black slate which forms a monoclinical structure, striking N 60° - 70° E and dipping 30° - 40° SE. It is intruded by the quartz porphyry (qp) along the northern boundary, and is cut by a northeast-trending fault along the southern boundary. The fault resulted in a marked "kernbut" topography between the Paleozoic formation and the quartz porphyry. The formation on the northern bank of T'a-erh-su Ho consists of dark gray phyllite and gneiss containing pebbles of black porphyritic crystalline schist, 2 cm in diameter. It strikes E, dips 50° - 60° S, and is overlain by a whitish rhyolite in the east and by a black agglomeratic rhyolite in the west. Along the Cha-o-ma Ho (車馬河) the formation consists of banded metagneiss derived from alternating slate and siliceous rock. It is intruded by whitish crypto-crystalline rhyolite dikes, strikes E, and dips steeply to the N and S. In the east it borders the granite, and in the west is overlain by black crypto-crystalline diorite porphyry. The formation exposed widely along the Ch'o-erh Ho and its tributaries is composed of metamorphosed sedimentary rocks. The eastern half consists of dark gray phyllite in the upper part and alternating grayish black hornfels and gray biotite schist in the lower part. It strikes E and dips 70° - 80° N or S, showing repeated folds. The western half along the Su-ko Ho consists of phyllite in the upper part and hornfels in the lower part. It is associated with black fine-grained gneiss metamorphosed from diorite porphyry. The formation strikes N 10° - 20° E and dips 40° - 70° E or W, showing repeated folds. In the south the formation is cut by a northeast-trending fault, bordering with quartz porphyry. Owing to the fault, the formation in the vicinity strikes N 40° W and dips 50° SW. The beds near Jo-t'ai Shan (角台山) consist of black hornfels, light gray calcareous sandstone, black siliceous shale, locally accompanied by gneiss which shows a banded structure with white quartz and black sandy rock. It strikes N 70° E, dips 50° - 60° S, and is intruded by the quartz porphyry (qp) in the east and by the pre-Jurassic granite (G <sub>2</sub> ) in the west. The formation near Tsao-miao Shan consists of dark gray phyllitic siliceous slate intercalated with a small amount of hornfels. It strikes N 80° E, dips 70° S, and is surrounded by gray porphyry.		
	Precambrian(?) schist	 Sericite-chlorite schist	The crystalline schist, probably Precambrian in age, in the hill 10 km west of Po-k'o-t'u consists of sericite-chlorite schist intruded by many small quartz veins. It is surrounded by the pre-Jurassic granite (G <sub>2</sub> ) and is overlain by the Jurassic volcanic complex (M <sub>3v</sub> ) on the east.		

(Column not drawn to scale)