



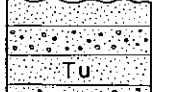
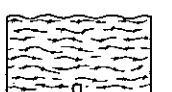


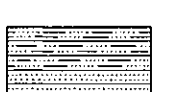
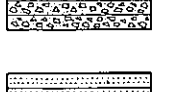

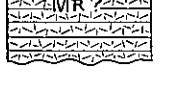




## GEOLOGIC COLUMN AND UNIT DESCRIPTIONS

AGE	ROCK UNIT	LITHOLOGY, THICKNESS WHERE KNOWN	UNIT DESCRIPTION	ECONOMIC VALUE	REFERENCES
QUATERNARY	Recent alluvium	 Sand, gravel, and clay; thickness 0.5 to 20 meters.	Recent alluvial deposits consist of sand, gravel, and clay. In the basin of the Ka-ya Ho (开河) the alluvium is fluvial deposits, and in the Ma-tan Chiang (牡丹江) basin it is mostly fluvial-lacustrine. The thickness varies from 0.5 to 7 m, but near Tun-hua (屯化) in the Ma-tan Chiang basin it attains a maximum thickness more than 20 m.	Placer gold was formerly worked from the Quaternary gravel beds distributed in the basin of the Ka-ya Ho.	ASANO, Gorō, 1942, On the occurrences and properties of some ultrabasic igneous rocks in Manchuria: Bull. Geol. Inst. of Manchoukuo, Changchun, no. 107. Geological Institute of Manchoukuo, Changchun, 1940, Geological map of Manchuria and adjacent areas, at scale 1:3,000,000. Geological Institute of South Manchuria Railway Company, Dairen, 1938, Geological map of Manchuria, at scale 1:1,000,000.
	Quaternary(?) basalt	 Flows of olivine basalt; thickness 5 to 100 m.	Quaternary(?) basalt is an olivine basalt which fills the valleys in the regions north and northwest of Tun-hua. Because of its vitreous surface and rather fresh appearance, the basalt has been considered to belong to a younger age. A specimen from San-chia-kou (三岔口), north of Tun-hua, is reported to show an interstitial or hyal-optic texture, with minute phenocrysts of idiomorphic olivine and the groundmass consisting of labradorite, augite, olivine and glass. In mineral composition, the basalt closely resembles the so-called "Pleistocene basalt" lava flows of Tung-ching-chang (通庆昌) north of the map area (refer to Ma-tan-chiang sheet, NK 52-11). On this map, the boundary of the basalt was drawn by conjecture.		KOBAYASHI, Teiichi, 1942, Stratigraphic relation among the Mesozoic fossil-beds in the Koro-Manchurian land and their ages: Proc. Imp. Acad. Tokyo, v. 18.
	Diluvium	 Sand, gravel, and clay; thickness less than 20 m.	Diluvium consists mainly of gravel and pebbly sand. Along the lower course of the Ka-ya Ho the diluvium covers the remnants of higher terraces.	Placer gold was worked by Chinese before the Pacific War.	NAGAO, Suteichi, 1952, On the Mesozoic coal-bearing formations of the Eastern and Northeastern Manchuria: Compilation Committee of the Geology and Mineral Resources of Far East, Tokyo Geographic Society.
TERTIARY	Unconformity				
	Neogene basalt	 Flows of olivine basalt, trachyandesite, tuff, sand and gravel; thickness 30 to 400 m.	Neogene basalt consists of superposed horizontal sheets of lava intercalated with a few beds of tuff. A broad basalt plateau east of the Ma-tan Chiang consists mainly of lava flows of olivine-titanite basalt, with a thickness varying between 30 m and 400 m. The flows may have been erupted at various stages of the Neogene period. A number of mesa and buttes of olivine basalt are distributed in the basin of the Ka-ya Ho.		SAKAMOTO, Takao, WADA, Shieh-ih, TAKEYAMA, Toshi, SUZUKI, Shun'ichirō, SAIJŪ, Kinji, and ASANO, Gorō, 1937, Geology and geography of the northeastern Manchuria: Geol. Inst. South Manchuria Railway Co., Dairen.
	Neogene beds	 Tuffaceous sand and gravel; thickness about 50 m.	Neogene beds consist of undisturbed and unconsolidated tuffaceous sand and gravel. Around the Lao-sung-ling (老松岭) tunnel on the Tumen - Kiamusse Railway (图们线) a tuffaceous sandstone occurs at the bottom of the plateau basalt (Nb) or occurs as intercalated beds within the lower part of the basalt. Unconsolidated sand and gravel beds of the Neogene were reported to occur at the bottom of basalt flows at Ts'ao-mao-ting-tau (草帽顶) in the lower reaches of the Ka-ya Ho and in the vicinity of Nan-hu-tou (南湖头) on the east coast of the Ching-po Hu (清泊湖). No fossils have been reported.		UCHINO, Toshio, and ASANO, Gorō, 1938, Geology along the highway between Ming-yueh-kou (明月口) and An-tu (安图): Bull. Geol. Inst. Manchoukuo, no. 97. USHIMARU, Shūtarō, 1932, Geology along the Tun-hua - Tumen Railway (敦化线): unpublished report, Geol. Inst. South Manchuria Railway Co., Dairen.
Probable unconformity					
MESOZOIC	Andesite	 Dikes and flows of augite andesite.	Cretaceous andesite consists of flows and sheets of andesitic lava. An intrusive sheet of andesite occurring 7 km west of Pa-tao-kou (八道沟) in the basin of the Ch'ao-yang Ho (朝阳河) is probably penetrating the Cretaceous granite (G <sub>3</sub> ). A few exposures of andesite accompanied by lava breccia occur southwest of Pai-to'ao-kou (排炮沟) (or Wang-ching (汪清)) in the basin of the Ka-ya Ho. The andesite covering the summit of the Pei-so-p'an Shan (北所盘山) and Kao-li Ling (高力岭), east of the Ka-ya Ho, is considered by some Japanese geologists as andesitic basalt.		
	Cretaceous granite, and quartz porphyry	 qp, quartz porphyry and granite porphyry G <sub>3</sub> , biotite granite.	Quartz porphyry (qp) is exposed mainly in the area north of the Ching-po Hu. It may be an acidic variety of granite porphyry (G <sub>3</sub> ). The granite porphyry, including biotite granite, is generally pink, medium to coarse in texture, and intrudes the so-called Talatzu (大柞子) series (refer to the Yen-chi sheet, NK 52-5).		
	Talatzu series	 Shale, sandstone, conglomerate, and coal.	The Talatzu (大柞子) series generally consists of conglomerate, conglomeratic sandstone, gray and reddish shale, occasionally intercalated with a few thin coal seams. Its continuation occurring in the Yen-chi sheet was correlated with the Lower Cretaceous. The Talatzu series in the vicinity of Wang-ching on the west bank of the Ta-wang-ching Ho (大汪清河) consists, in descending order, of shale, alternation of sandstone and conglomerate, and basal conglomerate. Estheria was found in the shale. A gently undulating formation consisting of sandstone and conglomerate, distributed west of the Ching-po Hu, has been correlated with the Talatzu series although it lacks fossil evidence. The thickness is not known.		
MESOZOIC	Lungching series	 Sandy shale, tuffaceous sandstone, conglomeratic sandstone, and boulder conglomerate, intercalated with the andesite and tuff-breccia of the so-called upper pyroclastic formation.	The Lungching (隆庆) series occurs only poorly at the southern limit of the map area. In the district of the Yen-chi (延吉) coal fields adjoining the map area to the south, the stratigraphic sequence of the Lungching series in descending order, shown by Shōichi NISHIDA, is as follows: (3) Reddish brown sandy shale and tuffaceous sandstone, 60 m thick (2) Upper pyroclastic formation, consisting of andesite and tuff-breccia, 150 m thick (1) Boulder conglomerate and conglomeratic sandstone, 390 m thick The opinions of geologists differ concerning the age of the Lungching series. S. NISHIDA (1940) assigned it to the Upper Jurassic, Teiichi KOBAYASHI (1942) to the Lowermost Cretaceous, and Suteichi NAGAO (1952) maintained on the basis of this field observation that the Lungching series is a facies of the Talatzu series.		
	Upper Jurassic beds	 Sandstone, shale, conglomerate, and coal.	The Upper Jurassic beds are generally a complex of sandstone, shale, and conglomerate, distributed mostly in the basin of the Ka-ya Ho. Some Japanese geologists correlate it with the so-called Mulung formation of the Mishan (密山) series which is a representative Upper Jurassic unit in northeastern Manchuria. The strata exposed at the Ka-ya-ho (开河) coal mine west of the south terminal of the Tumen - Kiamusse Railway are composed of a coal-bearing sandstone and an overlying conglomerate. Other exposure near Ku-lung Shan (窟窿山) west of Pai-to'ao-kou Ling consists of sandstone and conglomerate and has a coal seam near the base. The one in the Ta-huang-wei (大荒围) district is reported to show the following succession in ascending order: basal conglomerate, sandstone, and an alternation of sandstone and shale with some coal seams. Thickness is not known.		
	Lower volcanic complex; Lower pyroclastic formation	 Andesite, trachyandesite, dacite, plagioclase rhyolite, and pyroclastics; thickness about 300 m.	Lower volcanic complex (Mlv) and Lower pyroclastic formation (Mlp) are composed of andesite, trachyandesite, dacite, plagioclase rhyolite, and their pyroclastic matters, and are characterized by porphyritization. In the Yen-chi sheet (NK 52-5), adjacent to this map area on the south, the Lower pyroclastic formation was assigned to Triassic-Jurassic for the reason that it underlies the Middle Jurassic Holung (红山) series, while in the Tung-hsing-chen sheet (NK 52-3), adjacent to the east, the Lower volcanic complex was assigned to the Middle-Lower Jurassic as it underlies the Upper Jurassic. However, it has been recently agreed by the geologists concerned that the Holung series can be correlated to the Upper Jurassic. Should this correlation be correct, the two formation (Mlv and Mlp) may be contemporaneous.		
PALEOZOIC	Pre-Jurassic granite	 Biotite granite, biotite-hornblende granite, augen gneiss and metagneiss.	Pre-Jurassic granite consists mainly of biotite granite and hornblende-biotite granite, occasionally associated with augen gneiss, gneissose granite and metagneiss.		
	Touman formation	 Graywacke, phyllite, slate, diabase tuff, hornfels, chlorite schist, mica schist, and crystalline limestone.	The Touman (透满) formation in the map area is an aggregation of metamorphosed marine sediments including graywacke, phyllite, spotted slate, conglomerate-hornfels, diabase tuff, chlorite schist, quartz schist, mica schist, and crystalline limestone. Thickness is not known.		
	Unconformity				
PRECAMBRIAN(?)	Gneiss	 Metagneiss and other gneisses, and crystalline schist.	Gneiss consists of various kinds of metagneiss and orthogneiss, in association with some schists. It is distributed mainly in the region northeast of the Ching-po Hu.		
(Column not drawn to scale)					

**Gold**

1. According to Shūtarō USHIMARU, the gold deposits of Po-ho-la-tzu (何何砬子), occurring in the region of Cretaceous andesite, consist of auriferous quartz veins and stockworks which may be related genetically with the post-volcanic activity of the andesite. The country rock is generally modified by porphyritization. The ore deposits were discovered during the Hsuan-tung (宣统) Era (1909-1912), and were intermittently worked by Chinese until 1932 when the Manchoukuo Government was established by the Japanese Army in Manchuria and the mining operation was taken over by the Manchuria Gold Mining Co. Yields of un-refined gold (fineness 35-40% Au) from 1913 to 1930 totalled about 1,717 kg (data according to Chinese Government sources). The mine production culminated in 1932, and then declined due to the political situation.

**Coal**

1. Ka-ya-ho (开河) coal mine:- A thick coal-bearing sandstone underlies a thick conglomerate. Eight coal seams occur, with thickness varying between 20 cm and 40 cm. Distribution of the coal seams is narrow. The coal is bituminous, with 26-42% ash and 3,610-4,550 calorific value. The coal reserves are estimated as only 150,000 tons.

2. Ku-lung Shan (窟窿山):- A thin coal seam, probably intercalated within a sandstone, was worked until 1933. It is reported that the coal is a relatively higher grade than that of the Ka-ya-ho coal mine.

3. Ma-lu-kou (马鹿沟):- According to Chinese natives, the coal seam once worked is less than 1 m in thickness and the grade is very low.

Lime has been produced by lime kilns at Kuan-ti (官地) in O-mi Hsien (额穆县).