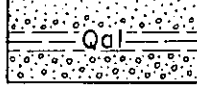
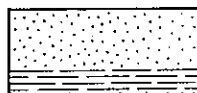
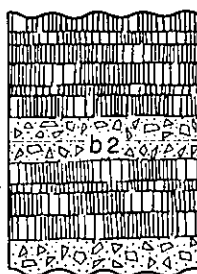
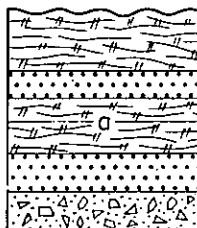
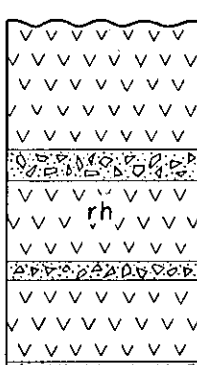
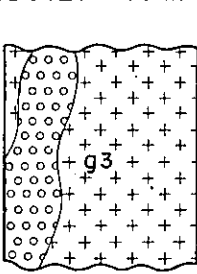
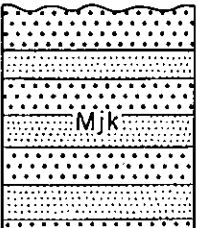
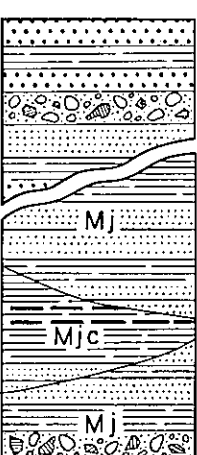
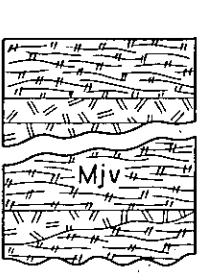
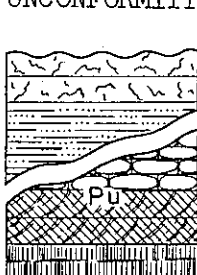


# GEOLOGIC COLUMN AND UNIT DESCRIPTIONS

AGE	ROCK UNIT	LITHOLOGY; THICKNESS WHERE KNOWN	UNIT DESCRIPTION	ECONOMIC VALUE	REFERENCES	
QUATERNARY	Recent	Alluvium 	Sand, gravel and clay; thickness less than 15 meters.	Alluvium consists chiefly of sand, gravel and clay, and is distributed in the flood plains and swampy basins. The thickness is less than 15 meters.	Soda and salt accumulate seasonally in swamps and playas.	AOJI, Otoji, 1924, Reconnaissance report along the route T'ao-nan -- T'u-ch'uan -- So-lun: Geol. Inst., S. Manchuria Ry. Co.
	Pleistocene	Diluvium 	Sand, gravel, loess, clay and silt; thickness 10 to 50 m.	Diluvium, 10 to 50 m thick, can be roughly classified into the fluvio-lacustrine type and the aeolian type. Diluvium of the fluvio-lacustrine type constitutes the main body of the Quaternary beds of the map area, and consists in ascending order of sand and gravel, sandy loess, clay and wind-blown sand and silt, covering low plains and large valley systems. Diluvium of the aeolian type is represented by loess that covers hillsides in the mountainous districts, and is underlain by residual red clay probably Early Pleistocene in age.		HATA, Jūkichi, 1932, Preliminary report on the mineral localities northwest of T'ao-nan: Geol. Inst., S. Manchuria Ry. Co. KATAYAMA, Ryōhei, 1914-1917, Reports on the mineral resources in East Mongolia: Temporary Econ. Inv. Bur., Japan Ministry of Agriculture and Commerce. MONDEN, Shigeyuki, 1933, Geology along the route from T'ao-nan to Tabuso-nor, Chahar: Geol. Inst., S. Manchuria Ry. Co. SAITŌ, Rinji, compiler, 1940, Geologic map of Manchuria and adjacent areas, scale 1:3,000,000: Manchoukuo Geol. Inst. SHIKAMA, Tokio, 1951, The Quaternary period of Manchuria, in Geology and mineral resources of the Far East, Manchuria, III-10: Comp. Comm. Geology and Mineral Res. Far East, Tokyo Geog. Soc.
TERTIARY	Neogene	Neogene basalt 	Basalt with tuff and breccia	Flows and sheets of basalt, intercalated with tuffaceous rocks, are distributed along the Horen-ka basin and may attain a maximum thickness of several hundred meters. The basalt may have overflowed the pre-existing peneplain during the Neogene period. The basalt has a dark-greenish tint and often shows a marked joint structure. The texture varies from microcrystalline to vitreous. Phenocrysts are augite and basic plagioclase, accompanied by some hornblende, and the glassy groundmass contains microcrystalline biotite and magnetite.		UEDA, Fusao, and others, 1937, Geology and geography of southwestern Manchuria: Geol. Inst., S. Manchuria Ry. Co.
	Cretaceous	Andesite 	Augite andesite, tuff and breccia	Andesite consists of flows of augite andesite and glassy andesite, associated with tuff and breccia. It probably overlies rhyolite (rh) and granite (g <sub>3</sub> ). Thickness is not known.		USHIMARU, Shūtarō, and others, 1937, Geology and geography of northern Manchuria: Geol. Inst., S. Manchuria Ry. Co.
MESOZOIC	Cretaceous	Rhyolite 	Rhyolite, trachyte and pyroclastics; thickness more than 1,000 m	Rhyolite consists of flows and sheets of rhyolite and trachyte, intercalated with their pyroclastics, and the thickness is estimated at more than 1,000 m. It may have been erupted during the Early Cretaceous, and now forms the main body of the Ta-hsing-an-ling range. Rhyolite on the north bank of the Horen-ka is ash-white or light brown; the phenocrysts consist essentially of quartz and alkali-feldspar, with lesser amounts of biotite and hornblende, and the groundmass is either partly glassy or cryptocrystalline, often showing a flow structure marked by banding. Trachyte has been reported at several localities in the Horen-ka basin, e.g., a hill north of T'u-lieh-mao-tu, several hills north of T'u-pu-tan-pu-la-ka farther west, and an extensive exposure below the Neogene basalt northwest of Mi-ch'in Shan (明 鏡 山) still farther west. Trachyte consists essentially of alkali-feldspar with small amounts of colored minerals, and generally lacks quartz.		
	Cretaceous	Granite 	Biotite granite, hornblende granite and quartz porphyry	Granite comprises biotite granite, hornblende granite and allied quartz porphyry.		
	Upper Mesozoic	Upper Mesozoic formation 	Tuff and tuffaceous sandstone, thickness unknown	The Upper Mesozoic formation (Mjk) consists chiefly of tuff and tuffaceous sandstone, and is several hundred meters thick in the No-na-i-miao sheet (NL 59-9) to the west.		
	Upper Triassic - Jurassic	Jehol formation 	Mj, tuff, tuffaceous sandstone and agglomerate, conglomerate, shale, and calcareous sandstone; Mjc, coal measures. Total thickness more than 1,000 m	The Mesozoic formation (Mj and Mjc) of the map area may be more than one thousand meters thick, and can be correlated with the Jehol formation of southern Jehol. The formation northeast of T'u-ch'uan consists of tuff, tuffaceous sandstone and agglomerate, conglomerate, shale, calcareous sandstone and coal. The coal measures at Hei-ting-shan (黑 明 山), Lien-hua Shan (蓮 花 山) near Ha-la-wo-su-t'un, and Erh-lung-so-k'ou-t'un (二 龍 峯 口) may belong to the lower part of the formation. The coal measures at Hei-ting-shan consist of sandstone, conglomerate, shale and tuffaceous sandstone, with a workable coal seam; these strike E-W and dip more than 30° N. The coal measures at Erh-lung-so-k'ou-t'un are geographically surrounded by the tuffaceous greenstone complex, presumably Upper Triassic in age, and consists of shale, sandstone and conglomerate. An exposure west of T'u-pu-tan-pu-la-ka in the upper reaches of the Horen-ka consists essentially of calcareous sandstone interbedded with the trachyte sheets. The formation may locally vary in age from Upper Triassic to Jurassic, because plant fossils from Upper Triassic to Jurassic in age are found in the coal measures at Erh-lung-so-k'ou-t'un.		
PALEOZOIC	Upper Triassic - Jurassic	Jurassic volcanic complex 	Andesite, porphyrite and pyroclastics; thickness 1,000 m	The Jurassic volcanic complex consists essentially of flows and sheets of andesite and porphyrite, associated with their pyroclastic rocks. It is often accompanied by the Lower Mesozoic beds. The maximum thickness may attain 1,000 m.		
	Permo-Carboniferous	Upper Paleozoic formation 	Quartzite, graywacke, chert, graphite phyllite and schalstein; thickness unknown	The Upper Paleozoic formation is a metamorphic complex of unknown thickness and sequence. It consists of quartzite, graywacke, chert, graphite phyllite and schalstein. The formation yields no fossils, but is thought to be Permo-Carboniferous in age.		
(Column not drawn to scale)						

**Coal**

1 Hei-ting-shan is about 40 km NW of T'u-ch'uan. A workable seam, 5 to 7 m thick, was intermittently worked from 1914 to 1932. Analyses of the coal follow (analyzed by S. Manchuria Ry. Co. in 1934): (1) H<sub>2</sub>O, 2.05%; volatile matter, 6.45%; fixed carbon, 61.45%; ash, 30.02%; S, 0.64%; calorific value, 6,386; non-coking; (2) H<sub>2</sub>O, 6.55%; volatile matter 16.24%; fixed carbon, 47.56%; ash, 29.64%; S, 0.94%; cal. value, 5,735; non-coking. The coal, affected by igneous action, has no promising reserves.

2 Erh-lung-so-k'ou-t'un is 24 km northwest of Hei-ting-shan. Coal was intermittently worked from 1915 to 1932. Three workable seams, 1 m, 1.35 m, and 1.62 m thick respectively, were confirmed by test boring. Analysis of the coal (S. Manchuria Ry. Co., 1938) shows: H<sub>2</sub>O, 1.99%; volatile matter, 19.21%; fixed carbon, 50.12%; ash, 28.70%; cal. value, 5,067; faintly coking. The coal reserves were not estimated but the coal measures are reported to have an areal extent of 150 sq. km.

3 Lien-hua Shan is located west by south of Hei-ting-shan near Ha-la-wo-su-t'un. Coal measures are known to occur, although prospecting was unsuccessful.

Small iron deposits were reported from the metamorphic complex southwest of Hsien-tien-ti (鮮 天 地), but they are of no economic value. (The outcrop was not entered on the map.)