
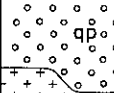



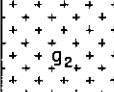
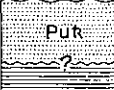
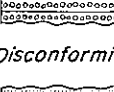


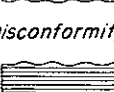
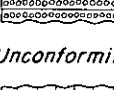

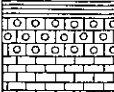

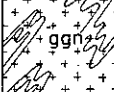



GEOLOGIC COLUMN AND UNIT DESCRIPTIONS

AGE	ROCK UNIT	LITHOLOGY; THICKNESS WHERE KNOWN	UNIT DESCRIPTION	ECONOMIC VALUE	REFERENCES
QUATERNARY	Alluvium	 <i>Loess, sand, gravel, and clay; thickness less than 30 meters.</i>	Alluvium consists of Recent loess, sand, gravel, and clay. Redeposited loess at the foot of hills attains 30 m in thickness, but fluvial sediments are generally less than 10 m thick. Near the estuary of the Ma-ling Ho (大凌河), however, the Alluvium may be very thick, although the thickness was not measured.		Anonymous, 1945, Geology of the Hua-tung-kou (抚顺) mine and the vicinity: Bull. Econ. Geol. Research Inst., no. 1, South Manchuria Railway Co., Dairen.
	Quartz porphyry and granite	 <i>qp, quartz porphyry and granite porphyry. Gs, granite quartz monzonite, quartz diorite, and felsite.</i>	Quartz porphyry and granite porphyry are intrusive rocks which may have been differentiated from a magma similar to the Cretaceous granite (G3). The quartz porphyry and the dikes of leucoporphyr-like rock in the district of Chia-shan (铁山) where gold ore deposits occur can be considered as ore bringers. Cretaceous granite is usually marked with predominant feldspar crystals of pinkish tinge. The granite and quartz diorite, in contact with the Cambro-Ordovician rocks, form numerous lead-silver and copper deposits, and also the molybdenite deposit of the Yang-chia-chang-tzu (杨家杖子) mines, about 30 km northwest of Hsing-chung (兴城). An intrusive mass of quartz diorite in the district of K'uan-t'ung-shan (宽城子) formed contact-metamorphic deposits of copper ore, within the zone of pre-Sinian dolomitic limestone.	At: The Chia-shan (铁山) gold mine, 22 km north of Hsing-chung (兴城), was closed a long time ago. Qu: Hua-tung-kou (抚顺) copper mine. Exploitation was started during World War II. Some geologists thought it very promising. Mo, Cu, Pb, Zn: Yang-chia-chang-tzu mines. Primarily opened as a lead-silver-copper mine; working of molybdenite was not started until right before World War II. This is one of the most important molybdenum resources in China.	ASANO, Goro, 1938, Report of the ore deposits in the district around Tung-ch'ing-shih-ling (汪清市), Chai-hsi Hsien, Chai-chow Province: Bull. Geol. Inst., no. 93, South Manchuria Railway Co., Dairen. Geological Institute, South Manchuria Railway Co., Dairen, 1938, Geological map of Manchuria, scale 1:1,000,000.
MESOZOIC	Undifferentiated Mesozoic rocks	 <i>Sandstone, shale, tuff, conglomerate, and volcanic rocks.</i>	Undifferentiated Mesozoic rocks probably include Jurassic volcanic complex and some Jura-Cretaceous rocks. No information on the sequence is available.		
	Upper-Middle Jurassic volcanic complex	 <i>Sandstone, conglomerate, breccia, tuff, andesite flows, and porphyrite; thickness not known.</i>	Jurassic volcanic complex consists of tuffaceous sandstone and thick conglomerate, intercalated with flows and sheets of andesite and porphyrite. The complex may be Middle-Lower Jurassic in age.		
	Andesite	 <i>Porphyritic andesite and diabase-porphyrite.</i>	Andesite and diabase-porphyrite are probably mainly intrusive sheets that may have been intruded at the bottom of the Jurassic volcanic complex (Mjv). Breccia is found locally.		
	Granite	 <i>Biotite granite, biotite-hornblende granite, and pegmatite.</i>	Triassic granite (G2) intrudes Sinian and Paleozoic rocks, and is covered unconformably by the Jurassic volcanic complex (Mjv). The intrusions of the granite formed numerous minor deposits of asbestos in the siliceous or dolomitic limestone of Sinian system, due to contact metamorphism.		
	Hamashan series	 <i>Coarse sandstone. Shale, sandstone and arkose. Basal conglomerate. (Total thickness 340-1,200 m)</i>	Undifferentiated Upper Paleozoic (Pu) probably contains Triassic (Puh) and Permian (Pup) rocks. The Hamashan series (H # 4 # 1), in the district of Yang-chia-chang-tzu, ranges from 340 to 1,200 m in thickness. The succession in descending order is: (1) thick bedded white coarse sandstone, (2) alternating reddish shale and sandstone intercalating with false-bedding white sandstone, and (3) basal conglomerate. In the area east of Yang-chia-chang-tzu the whole sequence is reported to have been observed, but in the western area the basal conglomerate seems to be directly covered by the thick bedded white quartz sandstone, due to a probable unconformity.		
	Hunlohsien series	 <i>Sandstone, shale, conglomerate, fire clay, coal, and limestone; thickness 100-200 m.</i>	The Hunlohsien series (H # 4 # 2) is a coal-bearing formation consisting of sandstone, shale, conglomerate, fire clay, coal, and limestone. It generally covers the Ordovician limestone (Pi0) with a presumed disconformity. Two or three seams of coal are intercalated in the lower part of the series, but coal is not prominent due to discontinuous seams. Lenses of fossiliferous limestone are found below these coal seams. The bottom of the series is occasionally marked with the fire clay G-bed. Floras from these coal seams are <i>Psaronius</i> sp., <i>Cordaites</i> sp., <i>Pinus</i> sp., and <i>Lepidodendron</i> , etc., showing a resemblance to the Permian floras of the Tai-tzu Ho (太子河) Basin in South Manchuria. According to Kitano 1934, a bed of slaty shale resting below the coal seam at Ping-ting Shan (平顶山), 10 km south of Yang-chia-chang-tzu, yielded such fauna as <i>Chonetes</i> cf. <i>intermedia</i> Schell, <i>Productus taiyuanensis</i> Grabau, and <i>Sanguinolites</i> cf. <i>oblongus</i> Grabau. The series may be Permian-Carboniferous in age.	Coal fields in the Yang-chia-chang-tzu district were worked by natives long ago; usually accompanied by fire clay beds.	
PALEOZOIC	Ordovician formation	 <i>Limestone, dolomitic limestone, shale, and calcareous sandstone; thickness 700 m.</i>	Undifferentiated Lower Paleozoic (Pl) probably contains Ordovician (Pi0) and Cambrian (Pic) rocks. The Ordovician formation, about 700 m thick, in the district of Yang-chia-chang-tzu consists in ascending order of calcareous sandstone, white limestone, white limestone, purple shale, variscular limestone, and dark gray dolomitic limestone. The formation is injected by a batholith of granite (G3), and the silver-lead-molybdenum deposits of the Yang-chia-chang-tzu mines were formed within or near the zone of contact metamorphism. <i>Girardinella mancharica</i> was collected from the dark gray limestone.		
	Cambrian formation	 <i>Shale, calcareous sandstone, quartzose sandstone, and basal conglomerate; thickness 100-1,000 m. (Section near Kao-chiao)</i>	The Cambrian formation in the district of Kao-ch'iao (高跷) was reported as Lower Cambrian, and consists of shale, calcareous sandstone, quartzose sandstone and basal conglomerate; 100-1,000 m in thickness (see the section). The formation near Yang-chia-chang-tzu consists mainly of quartzite and is 100-150 m in thickness; this quartzite is resistant to erosion, results in conspicuous scarps. Limestone is found in the northwestern quarter of the map area.		
	Upper or Limestone formation	 <i>Siliceous limestone. Quartzite. Gray, thickly bedded limestone. Clayey limestone. Siliceous limestone. Cryptozoön limestone. Quartzite, shale. Cryptozoön limestone. Siliceous limestone. (Total thickness 2,000-2,500 m)</i>	The Sinian system in the district of Kao-ch'iao on the Peiping-Liaoning Railway consists in ascending order of the Lower or Quartzite formation 1,000-1,500 m in thickness, and the Upper or Limestone formation 2,000-2,500 m in thickness, according to Saito (1940) (see the section). The Sinian of this district was correlated by R. Saito with the Lower part of the "Sanchiatzu series" (三岔子组), or the Lower Sinian of the Kai-yuan (开原) district. Sinian stratigraphy in the district of Hua-tung-kou (抚顺) was differently interpreted by various geologists because of complicated overthrusts. A section prepared by Susumu MATSUSHITA (1940) in descending order is as follows: VI, slate and siliceous slate (over 800 m in thickness); V, quartzite and conglomerate (over 2,050 m thick); IV, siliceous limestone (over 400 m thick); III, quartz sandstone, arkose, and compact silt rock (200 m thick); II, black slate (250 m thick); I, arkose and fine sandstone (250 m thick). MATSUSHITA suggested its resemblance in lithology to the so-called "Tao-shan-shan series" (桃山山组), or the Lower Sinian in the Liaoting Peninsula. On the upper reaches of the Liu-sha Ho (六甲河) the Sinian system seems to consist mainly of siliceous and dolomitic limestone, but no detailed information is available.	Mn: Manganese deposits may be intercalated at the top of the Sinian system; not very promising. As: Asbestos deposits are distributed in the thick limestone of the Sinian system; probably formed by contact metamorphism of the granite intrusion.	
	Lower or Quartzite formation	 <i>Quartzite, shale. Arkose. Conglomerate. (Total thickness 1,000-1,500 m) (Section near Kao-chiao)</i>			
UPPER PRECAMBRIAN	Granite gneiss	 <i>Granite gneiss, migmatite gneiss, biotite granite, and pegmatite.</i>	Granite gneiss consists of orthogneiss and pre-Sinian granite. The orthogneiss includes biotite granite gneiss, pegmatite and some migmatite gneiss. Pre-Sinian granite with no schistosity was reported by S. MATSUSHITA from the district of Hua-tung-kou.		
	Middle Precambrian system	 <i>Crystalline limestone, chlorite schist, and phyllite.</i>	The Middle Precambrian system, distributed in the district of K'uang-t'ung-shan (宽城子) on the south coast of Liao-tung-shan, consists of crystalline limestone, chlorite schist and phyllite. Thickness unknown.		
	Lower Precambrian complex	 <i>Phyllite, crystalline schist, calcareous rocks and various gneisses.</i>	The Lower Precambrian complex consists of phyllite, crystalline schist, calcareous rock, and various gneisses; in features, it resembles the so-called "Tao-shan-shan complex". Thickness unknown.		
LOWER-MIDDLE PRECAMBRIAN	Granite gneiss	 <i>Granite gneiss, migmatite gneiss, biotite granite, and pegmatite.</i>	Granite gneiss consists of orthogneiss and pre-Sinian granite. The orthogneiss includes biotite granite gneiss, pegmatite and some migmatite gneiss. Pre-Sinian granite with no schistosity was reported by S. MATSUSHITA from the district of Hua-tung-kou.		
	Middle Precambrian system	 <i>Crystalline limestone, chlorite schist, and phyllite.</i>	The Middle Precambrian system, distributed in the district of K'uang-t'ung-shan (宽城子) on the south coast of Liao-tung-shan, consists of crystalline limestone, chlorite schist and phyllite. Thickness unknown.		

(Column not drawn to scale)