

AGE	ROCK UNIT	LITHOLOGY; THICKNESS WHERE KNOWN	REMARKS	ECONOMIC VALUE
QUATERNARY	Recent alluvium	Sand, gravel, clay; 1 to 10 m thick	Qal, Alluvial material covering terrace remnants in front of cliffs; stream gravel.	Placer gold was worked by native miners in former times.
	Pleistocene deposits	Loess, aeolian sand, gravel; 5 to 30 m thick	Qd1, Aeolian loess, redeposited loess, and sand and gravel. Probably the major valley fill during the Pleistocene. Remnants are distributed on terraces along large valleys and in remote passes.	Placer gold was worked by native methods from the gravel bed until very recently, especially in the district south of the Great Wall.
TERTIARY	Neogene basalt	Augite-olivine basalt, pyroclastics; 200 m or more thick	b2, Large flow of augite-olivine basalt, intercalated with some tuff and breccia in the vicinity of Shih-hui-yao-tzu (石灰窑子) and Ying-shu-ying-tzu (鹰山营子), in the northern part of the map area. This is the southern edge of the plateau basalt west of Ling-yuan (凌源). The age of eruption is supposed to be Pliocene.	No recognized mineral value.
	Rhyolite	Rhyolite, trachyte, trachyandesite, pyroclastics; 300 m or more thick	rh, Cretaceous rhyolitic volcanics, consisting mainly of flows and sheets of rhyolite, trachyte, and trachyandesite, in places intercalated with pyroclastic rock. Also forms dikes, necks, and marginal facies of the acidic intrusive rock. The rhyolitic volcanics are widely distributed along the upper reaches of the Ta-ling Ho (大凌河). Color varies from gray to light brown.	No recognized mineral value.
	Quartz porphyry	Quartz porphyry, granite porphyry, diorite porphyry	qp, Occurs as dikes and marginal facies of the E3.	Gold-quartz veins and mercury deposits of the Chou-chang-tzu (周场子) district, Ching-lung Hsien (兴隆县), are considered to have a genetic connection with the quartz porphyry dikes.
	Cretaceous granite	Granite porphyries	E3, Porphyritic granite and granite porphyry. Granitic rock composing the hill of Chia-shan (甲山), in the Yung-ho (永和) coal field east of Hsia-pan-ch'eng (下板城) is an intrusive mass into the LOWER JEHOI FORMATION. In the Shih-men-chai (石门寨) coal field the dikes of granite porphyry intrude the LOWER JEHOI coal-bearing formation. These rocks were divided by SASAKURA and UEDA (1937) into "porphyritic granite", approaching a characteristic hypabyssal texture, and "granite porphyry", actually a hypabyssal rock, but approaching plutonic texture.	
MESOZOIC	Jehoi formation	Flows, tuffs, sandstone, conglomerate, oil shale, coal seam. Total thickness 1,500 to 2,300 m	MJ, The Jurassic succession of this area generally correlates with the "JEHOI FORMATION" named elsewhere by various Japanese geologists. It is a terrestrial sequence, total thickness between 1,500 m and 2,300 m, divided as follows: (a) UPPER JEHOI FORMATION (or Upper volcanic series): Consists, in descending order, of an alternating sequence of rhyolitic lava flows, buffaceous sandstone, conglomerate, several thin beds of fresh water limestone, and beds of rhyolitic tuff. Fossils from the limestone along the upper reaches of the Ta-ling Ho (大凌河) were reported as <i>Corticula anderssoni</i> Grabau, <i>Campeloma tani</i> Grabau, <i>Cyrena</i> sp., etc. Thickness in the upper Ta-ling Ho district is estimated as 500 - 600 m. (b) MIDDLE JEHOI FORMATION (or Jehoi formation of Grabau and Chiu-fo-tang formation of R. Endo): Consists, in descending order, of thinly bedded shale, tuff beds with a few interbedded andesite flows, oil shale-bearing beds, and thick conglomerate beds. Fossils from the MIDDLE JEHOI FORMATION were reported as <i>Lycoperia joholensis</i> Grabau, <i>L. joholensis</i> var. <i>minor</i> Grabau, and <i>Estheria</i> sp. Estimated thickness in the upper Ta-ling Ho basin is 300 m; at Chiu-fo-tang it is as thick as 1,000 m. (c) LOWER JEHOI FORMATION (or Lower volcanic series plus lower coal-measure): Consists, in descending order, of thick flows and sheets of andesite and trachyte interbedded with pyroclastic rock; underlain by the coal-bearing formation containing sandstone, shale and coal, and a basal conglomerate. The predominant color of the LOWER JEHOI is purple. Fossils collected from the coal-bearing beds are <i>Cladophlebia</i> sp., <i>C. haiturmensis</i> , <i>Podosamites lanceolatus</i> , and <i>Phoenicopsis</i> sp. The lower volcanic series north of Han-kou-ch'en (韩家沟) is about 100 m thick. The thickness of the lower coal-bearing formation (with the basal conglomerate) is at least 300 m at the Yung-ho (永和) coal field near Hsia-pan-ch'eng (下板城).	The oil shale deposits of Chiu-fo-tang (九佛寺) are not economically workable because of their low bituminous content and the difficulty of access.
	Jurassic andesite	Andesite, trachy andesite, porphyrite	a, Consists of andesite, porphyrite, and pyroclastic rock, and is a characteristic feature of the LOWER JEHOI FORMATION. In some places the entire LOWER JEHOI FORMATION is occupied by the JURASSIC ANDESITE. A genetic connection may exist between this formation and the Triassic plutonic rocks.	The coal field of Yung-ho (永和) and Wei-chang-kou (魏长沟) extending northeast of Hsia-pan-ch'eng (下板城), the coal fields of Ping-kou (平谷) district southeast of Ling-nan (凌南), and the so-called "upper coal measure" of the Shih-men-chai (石门寨) coal field, Lin-yu Hsien (临榆县), are all classified as the LOWER JEHOI FORMATION. All these coal fields have been operated by native enterprise for many years. The coal seams generally have been affected by the volcanic activity. The coal reserves are not promising.
	Triassic diorite	Diorite and granodiorite	d, Occurs mainly in association with the TRIASSIC GRANITE.	The time of granitic intrusion of the Triassic is generally believed to be the principal metallogenic epoch of this area. A number of gold-quartz veins exploited in the past, in and around the Great Wall District, probably have a genetic connection with the TRIASSIC GRANITE. A Japanese mining company carried on extensive gold prospect workings around Ta-chang-tzu (大场子) before World War II.
	Triassic granite	Biotite granite, biotite-hornblende granite; quartz syenite, quartz monzonite, felsitic granite	E2, Consists of biotite granite, biotite-hornblende granite, quartz syenite, quartz monzonite, and felsitic granite. Pebbles from this formation occur in the basal conglomerate of the JEHOI FORMATION.	
	Permian formation	Shale, sandstone, conglomerate, coal; thickness 450 m ±	Pu, The PERMIAN FORMATION is uppermost Paleozoic, but possibly includes some Upper Carboniferous beds. This terrestrial formation generally overlies the Lower Ordovician limestone. The lower part of this formation is occupied by the fire-clay "G" bed. Fossils such as <i>Calamites</i> sp., <i>Lepidodendron</i> , and <i>Oculiferus</i> Goepf. have been reported from the coal beds of the coal fields of Shih-men-chai (石门寨), Lin-yu Hsien (临榆县), and Wu-tao-ling (五道岭), Ping-chuan Hsien (平泉县), etc. The PERMIAN FORMATION consists of sandstone, shale, and conglomerate, and is generally coal-bearing. Upward it may grade into a Triassic sandstone, but this possible transition cannot be observed owing to the Jurassic rock cover. A thickness of about 450 m is estimated at the Shih-men-chai coal field. A thin limestone lens, containing fragments of crinoids and corals, was reported by R. KIMURA (1928) from a horizon near the base of the Permian coal measure of Shih-men-chai. From this it is inferred that a stratum of the marine Upper Carboniferous may be included at the base of this PERMIAN FORMATION.	The coal fields of Sung-shu-tai (松樹台), Wu-tao-ling (五道岭), Ta-miao-ling (大庙岭), as well as the lower coal-measure of the Shih-men-chai coal field are all classified as Upper Paleozoic. Coal mines around the district of Shih-men-chai have been worked for many years by regular working methods. The coal of the Permian formation is generally high-rank bituminous, and has undergone the effects of igneous contact.
	Cambro-Ordovician formation	Shale, slate, marly shale, limestone	Pl, The CAMBRO-ORDOVICIAN FORMATION of the Lower Paleozoic, as ascertained by fossil evidence, includes much smaller areas than was formerly supposed. The Lower Paleozoic of the Shih-men-chai (石门寨) district, as studied by various Japanese geologists, consists of Lower to Upper Cambrian shale, slate, calcareous shale, and limestone, and Lower Ordovician marly shale, dark gray limestone, magnesian limestone, and vesicular limestone. Fossils from the Ordovician of Shih-men-chai district are ophiolopods such as <i>Manchuroceras</i> , <i>Kaspinoceeras</i> , <i>Chihlioceras</i> , and <i>Yehlioceras</i> . The Cambrian of same district yields <i>Poorthis</i> , <i>Agnostus</i> , <i>Phyllospira</i> , <i>Quadraticoceras</i> , <i>Changshania</i> , <i>Drepanura</i> , <i>Anomocare</i> , <i>Solenopleura</i> , <i>Blackwelderia</i> , <i>Redlichia</i> , and <i>Hirvanella</i> . <i>Calymene</i> and <i>Orthoceras</i> were reported from a Lower Ordovician limestone hill south of Chiu-fo-tang (九佛寺). Fragments of <i>Actinoceras</i> sp. and <i>Maclurea</i> sp. were obtained in the Sung-shu-tai (松樹台) coal field area.	No recognized mineral value.
PALEOZOIC	Gneiss complex (Tai-shan complex)	Gneissose granite, crystalline schist, gneissose diorite, lamprophyre, pegmatite	gn, The GNEISS COMPLEX is the so-called "Tai-shan complex (泰山系)" of Northern China. This is believed to be the foundation rock of the region and covers broad areas around the so-called "Great Wall District". It consists of various gneissose granites (migmatite), injection gneiss, and crystalline schist. Gneissose diorite, lamprophyre, and pegmatite also occur.	Many gold deposits have been found within the gneiss. However, these gold deposits are believed to have been genetically connected with the granitic intrusions of later ages.

REFERENCES

ASANO, Goro, 1939, On the cinnabar deposits at Chou-chang-tzu (周场子) district, Ch'ing-lung Hsien (兴隆县): Mem. Geol. Inst. Manchoukuo, no. 8.

BESSHO, Bunkichi, 1936, Preliminary notes on the mineral resources in the San-kou (三沟) and Liu-kou (六沟) quadrangles (with map, scale 1:100,000): Bull. Geol. Inst. South Manchuria Railway Co., no. 92.

ENDO, Ryuji, 1953, The Ordovician period: Geology and mineral resources of the Far East, published by the Geographic Society of Japan.

——— and SHIKAMA, Tokio, 1942, Mesozoic reptilian fauna in the Jehol Mountainland: Bull. Central Museum Manchoukuo, no. 3.

FULLER, M. L. and CLAF, F. G., 1915, Reconnaissance sheets on the oil field survey in China, no. 12: published by Standard Oil Co. (Quadrangle no. 1, Sui-chung Hsien (绥中县); no. 2, Shih-men-chai (石门寨); no. 3, Kien-chang Hsien (锦昌县); no. 20, Jehol; no. 21, Sha-ho-chiao (沙河桥); no. 22, Tang-shan (唐山)). Geological Institute of South Manchuria Railway Co., 1936, Geologic map of Manchuria, scale 1:1,000,000.

Geological Survey of Manchoukuo, 1940, Geological map of Manchuria and adjacent area, scale 1:3,000,000 (compiled by Rinji SAITO).

Geological Survey of Manchoukuo, 1941, Geologic sheet of Ch'eng-te (承德), scale 1:100,000.

GRABAU, A. W., 1923-1924, 1928, Stratigraphy of China: in 2 volumes.

KAWATA, Michio, 1933-1934, 1. Geologic map of Wu-tao-ling (五道岭) coal field, scale 1:10,000; 2. Geologic map of Sung-shu-tai (松樹台) coal field, scale 1:10,000; 3. Geologic map of Ta-miao-ling (大庙岭) coal field, scale 1:10,000; Maps appended to Report of Field Party II of Strategic Mineral Resources Survey Commission, published by Economic Research Committee of South Manchuria Railway Co.

KIMURA, Rokuro and OHBA, Tokio, 1928, Geology of I-yuan-kou (义院口) district of Shih-men-chai (石门寨), Lin-yu Hsien (临榆县), Chihli (直隸) Province; Manchuria Geological and Mining Review, no. 69.

KIRITANI, Fumio, 1941, Oil shale deposits in Manchuria: Jour. Geol. Soc. Manchoukuo, no. 2.

KOBATA, Tadashi, 1953, The Ordovician system in North China: Geology and Mineral Resources of the Far East, published by Geographic Society of Japan.

KOBAYASHI, Teichi, 1942, Stratigraphic relations among the Mesozoic fossil beds in the Korea-Manchurian land and their ages: Proc. Imp. Acad. Tokyo, v. 18.

———, SUZUKI, Koiti and TAKAI, Fuyuji, 1942, A preliminary report on four distinct suites of Mesozoic faunas in the Korea-Manchurian land: Jour. Fac. Sci., Imp. Univ. Tokyo, sec. 2, v. 6.

———, 1953, Cambro-Ordovician "Chosen system" of the Jehol block: Geology and Mineral Resources of the Far East, published by Geographic Society of Japan.

LEE, J. S. and CHAO, Y. T., 1926, Classification and correlation of Paleozoic coal-bearing formations in North China: Bull. Geol. Soc. China, v. 5, no. 2.

MATSUDA, Kamezo, 1938, Report on the silver-lead deposits in Ping-chuan Hsien (平泉县) and Lung-ha Hsien (凌化县): Bull. Geol. Inst. South Manchuria Railway Co., no. 92.

MATSUSHITA, Susumu, 1953, Sinian system of northern Hopeh: Geology and Mineral Resources of Far East, published by Geographic Society of Japan.

MATSUZAWA, Isao, 1935, Geologic structure and stratigraphic correlation in the district of Jehol: Jour. Geol. Soc. Tokyo, v. 42, no. 501.

MINAKAWA, Shinya, 1953, The Mesozoic in Manchuria: Geology and Mineral Resources of the Far East, published by Geographic Society of Japan.

MIYAKOSHI, Masaji, 1937, Development plans and data on the Shih-men-chai (石门寨) Coal Field, Lin-yu Hsien (临榆县), published by South Manchuria Railway Co.

NAKAMURA, Koshiro, 1935, Coal fields of Manchuria and properties of the coal: published by South Manchuria Railway Co.

NISHIDA, Shoichi, 1942, On some facts regarding the Mesozoic formation in the district of Pei-piao (北票): Bull. Geol. Survey Manchoukuo, no. 107.

NISHIO, Osamu, 1937, Report on the placer gold deposits at Ma-chia-kou (马家沟); on the placer gold deposits at Ta-huai-ti (大槐地); Report on the placer gold deposit at Ma-ti-yu (马台峪); published by South Manchuria Railway Co.

OISHI, Saburo and MORITA, Gijin, 1943, General statement on the subdivision of the Mesozoic in Manchuria: Jour. Geol. Soc. Tokyo, v. 50.

OKI, Kenichi, 1936, Preliminary notes on the mineral resources in the Syu-chung Hsien (绥中县) quadrangle, with map, scale 1:10,000: Bull. Geol. Inst. South Manchuria Railway Co., no. 92.

OZAKI, Hiroshi, 1937, Report on the Shih-men-chai (石门寨) coal field, Lin-yu Hsien (临榆县), Hopeh; Plans and Data on the Shih-men-chai Coal Field, published by South Manchuria Railway Co.

———, 1941, On the Sinian system in the vicinity of Ch'ing-lung Hsien (兴隆县) (at the northern border of the Kai-luan (开滦) coal field, Hopeh Province: Jour. Geol. Soc. Tokyo, no. 569.

SASAKURA, Masao, 1937, The Ma-chia-yu (马家沟) gold mine, Lin-yu Hsien (临榆县); Plans and Data on the Gold Resources in Northern Hopeh, published by South Manchuria Railway Co.

SATO, Hokoto, 1941, Manganese deposits of Wa-fang-tzu (瓦房店): Jour. Geol. Soc. Manchoukuo, no. 2.

———, SATO, Genro, et al., 1933-1934, Asbestos deposit at Liu-shu-hang (柳樹行), Ch'ing-lung Hsien (兴隆县), Jehol, with geologic map, scale 1:5,000: Report of Field Party VI of Strategic Mineral Resources Survey Commission, published by Economic Research Committee of South Manchuria Railway Co.

SATO, Shinzo, 1943, On the distribution of the so-called "Pei-piao (北票) series" along the Chin-ku (Chinchou (锦州)- Kupeik'ou (古冶)) Railway: Jour. Geol. Soc. Manchoukuo, no. 4-5.

TAMAKA, Sumi, 1937, Report on the placer gold deposits worked by Ho-hsing Co., Chien-an Hsien (迁安县); Report on the placer gold deposits worked by the natives in Chien-an Hsien; Report on the placer gold mine worked by Pao-fang Co., Chien-an Hsien: Plans and Data on the Gold Resources in Northern Hopeh, published by South Manchuria Railway Co.

UEDA, Fusao and SASAKURA, Masao, 1937, Geology and geography of southwestern Manchuria; published by South Manchuria Railway Co.

WANG, H. C. & KAO, C. T., 1943, Correlation of the principal pre-Cambrian rock system of North and South China: Contrib. Nat. Research Inst. Geology (of Nationalist China), no. 8.

YABE, Shigeru, 1934, Geology in the vicinity of the projected railway tunnels along the line between Hsia-pan-ch'eng (下板城) and Ch'eng-te (承德): (Unpublished typographic report furnished by the South Manchuria Railway Co. for official use only).

———, 1937-1938, Reconnaissance maps on the survey of gold deposits between Kuan-ch'eng-tzu (宽城子) and Kan-kou-ch'en (宽城子), Jehol: (Unpublished typographic report furnished by the South Manchuria Railway Co. for official use only).