GEOLOGIC COLUMN AND UNIT DESCRIPTIONS

AGE	ROCK UNIT	LITHOLOGY; THICKNESS WHERE KNOWN	UNIT DESCRIPTION	ECONOMIC VALUE
QUATERNARY	Alluvium	Qal — *Sand, clay and gravel; thickness less than 10 meters*	Alluvium is chiefly younger fluviatile deposits distributed along rivers. It consists of sand, clay and gravel, and includes low terrace deposits which fringe rivers.	
	Diluvium	Qdg — *Sand, gravel and clay; thickness less than 20 m*	Diluvium is older fluviatile deposits generally covering low terraces and undulating hills.	
	~~ *Unconformity* ~~~			
TERTIARY	Neogene(?) basalt	b_2 — *Olivine basalt and tuff; thickness variable*	Basalt is chiefly olivine basalt flows in association with tuff and probably Neogene in age; approximate thickness is less than 30 m, but in places it may be more than 100 m.	
	~~ *Unconformity* ~~~			
MESOZOIC	Chuantou formation	Mk — *Pebbly sandstone, tuffaceous shale, shale and sandstone; thickness less than 500 m*	The Chuantou formation[穿鬪層], or the so-called "red-formation", consists chiefly of pebbly sandstone and tuffaceous shale, intercalated with reddish or variegated sandstone and shale beds; generally soft and not much disturbed; the thickness may be less than 500 m.	
	Rhyolite or Cretaceous volcanics	rh — *Rhyolite and breccia, thickness variable*	Rhyolite lava sheets and lava breccia are generally believed to associate with Upper Jurassic and Cretaceous rocks; they probably erupted before and during the early stage of the Chuantou formation (Mk).	
	~~ *Effusive and intrusive contact* ~~~			
	Upper Jurassic formation	Mju — *Sandstone, shale, conglomerate, tuffaceous sandstone, and coal; thickness about 450 m*	The Upper Jurassic formation (Mju) chiefly consists of soft sandstone in association with shale, conglomerate, tuffaceous sandstone and coal. This formation forms the coal-measures of various coal fields in the map area, and, along with the underlying sheets of porphyrite, rests unconformably on the granite and other older rocks. Occasionally the formation is intruded or covered by such volcanic rocks as basalt (b_2), rhyolite (rh), and andesite (a). A thickness of the formation in the coal field of Hsi-an[西安] was measured as 450 m. Fossils known from this coal field are Asplenium sp., Podozamites lanceolatus (L. et H.), Ginkgo sibirica Heer, etc.	The Hsi-an coal mine is located north of Pei-feng[北豐] or Hsi-an. Coal was discovered in 1911. A Sino-Japanese coal mining company started working in 1927 and supplied the bituminous coal for local industrial and household uses. Coal reserves, estimated as of 1945, are reported to be 224 million tons. No other coal localities are worth regular operation.
	Porphyrite or Jurassic volcanics	p — *Propylitic andesite, and pyroclastics*	Porphyrite (or Jurassic volcanic complex) consists largely of flows and sheets of microcrystalline andesite and associated breccia, and generally shows effect of propylitization. In the Ping-kang[平崗] coal fields thick, superimposed propylitic andesite sheets are found to underlie the Upper Jurassic formation unconformably. The porphyrite may be somewhat older in age than the overlying formation. Locally thin seams of coal are associated with the tuff and breccia beds.	
	~~ *Probable unconformity* ~~~			
	Pre-Jurassic intrusives	qp, d, g_2 — *qp, quartz porphyry; d, diorite; g_2, granite*	Quartz porphyry (qp) was reported from a spot south of San-yüan-pu[三源浦]. This may be a marginal facies of the granite (g_2). Diorite (d) is known as irregular plutonic bodies that might be differentiated from the granite (g_2). Granite (g_2) of pre-Jurassic age affected the rocks of the Chilin formation (Pu) by contact metamorphism.	Gold-quartz veins are found in the district of Kou-nai-tien-tzu[勾乃甸子], north of Ch'ing-yüan[淸源]. Before World War II, the Ch'ing-yüan gold mine was working the veins which are distributed in the border zone between g_2 and ggn.
	~~ *Intrusive contact* ~~~			
	Undifferentiated Mesozoic rocks	M — *Conglomerate, sandstone and shale; thickness unknown*	Rocks probably Mesozoic in age have been known, though vaguely, to be distributed in the upper reaches of the I-tung Ho[伊通河] and the San-tung Ho[三通河]. The rocks are believed to extend beyond the map area and to be distributed widely in the area of the Tung-hua sheet (NK 51-9), adjacent to this sheet on the south. In the T'ung-hua sheet the rocks are described as undifferentiated Mesozoic rocks (M) by S. OKADA (1956), but no positive data are available to verify a Mesozoic or Upper Paleozoic age for them.	
	~~ *Unconformity* ~~~			
PALEOZOIC	Chilin formation	Pu — *Sandstone hornfels, slate hornfels, conglomerate hornfels, and limestone; thickness 1,000 to 2,000 m*	The Chilin formation (after Michio KAWADA, 1932) was reported by Shigeyuki MONDEN (1936) to be widely exposed on the west side of the I-tung Ho and on either side of the San-tung Ho. According to MONDEN, its probable ascending sequence is thick beds of limestone, sandstone hornfels intercalated with lenses of limestone, conglomerate hornfels, and slate hornfels; the thick limestone beds that predominate along the San-tung Ho are assigned to Lower Paleozoic (Pl) in this map area, because when the beds are traced to the adjacent map area of the Fu-sung sheet (NK 52-4) they grade into the rock which was confirmed as Lower Paleozoic. Total thickness of the Chilin formation excluding that limestone may be 1,000-2,000 m. The formation is intensely affected by granitic intrusions.	
	~~ *Probable unconformity* ~~~			
	Undifferentiated Lower Paleozoic rocks	Pl — *Ordovician formation and Cambrian formation included*	Undifferentiated Lower Paleozoic rocks (Pl) may be divided into the Ordovician formation (Plo) and the Cambrian formation (Plc), should further field work be done.	
	Ordovician formation	Plo — *Limestone, dolomite, and marl; thickness about 500 m*	The Ordovician formation (Plo) consists chiefly of dark grayish, massive or bedded limestone and magnesian limestone, with subordinate vermicular limestone and marl. Usually Collenia limestone occurs at the base. No other fossils were reported.	
	Cambrian formation	Plc — *Shale, sandy shale, and limestone; thickness about 500 m*	The Cambrian formation (Plc) consists, in descending order, of dark gray bedded limestone, alternations of limestone, shale, and marl, and red shale with thin limestone and micaceous sandstone. Fossils were not reported.	
	~~ *Probable unconformity* ~~~			
PRECAMBRIAN	Sinian(Fanho) system	pCu — *Quartzite, slate, limestone, and dolomite; thickness more than 4,000 m*	The Sinian system of the map area consists chiefly of quartzite and dolomite, and minor amounts of limestone, slate and phyllite; a cycle of sedimentation beginning with quartzite and ending in dolomite appears repeatedly in the rocks. In the predominance of dolomite, the Sinian system of the map area closely resembles the rocks of the Middle Precambrian of southern Manchuria. The thickness is unusually great. Rinji SAITŌ (1943) proposed the term Fanho system to designate the type of Sinian rocks that are distributed mainly in the Fan Ho[范河] basin.	
	~~ *Unconformity* ~~~			
	Granite gneiss	ggn — *Biotite granite gneiss, and migmatite gneiss*	The granite gneiss is mostly biotite granite gneiss with schistosity parallel to rocks of the Liaoho system (pCm). Migmatite gneiss also occurs locally.	
	~~ *Intrusive contact* ~~~			
	Liaoho system	pCm — *Mica schist, graphite slate, chlorite phyllite, phyllitic slate, and calcareous rocks; thickness unknown*	Middle Precambrian rocks of the Liaoho system are distributed south of Hsiao-fei-ti[下肥地] where they consist, in ascending succession, of mica schist, graphite slate, chlorite phyllite, phyllitic slate, and then grade into thick beds of limestone. The thickness excluding the thick limestone was estimated at 350 m by JŪkichi HATA (1931). The Liaoho system corresponds in age to the Wutai system of North China.	
	Undifferentiated metamorphosed Precambrian rocks	pC — *Crystalline calcareous rock, schist, slate, phyllite, and quartzite; thickness unknown*	Undifferentiated metamorphosed Precambrian rocks consist of an intensely metamorphosed sedimentary complex. This rock unit probably includes the Fanho system, the so-called NÜchen system[女兒系](of R. SAITŌ, 1943) of metamorphosed pre-Sinian(?) rocks probably underlying the Fanho system, and the Liaoho system (R. SAITŌ, 1938). Formerly the rocks were assigned entirely to the Lower Precambrian or pre-Sinian system, although the compiler has some doubts about such age determination.	

(Column not drawn to scale)

REFERENCES

ASANO, Gorō, 1938, Iron deposits in the neighborhood of Ku-lung-tun [古龍屯], Hsi-fong Hsien[西豐縣], Liaoning: Bull. Geol. Inst. Manchoukuo, no. 93.

Geol. Inst. S. Manchuria Ry. Co., 1937, Geologic map of Manchuria, scale 1:1,000,000.

HATA, JŪkichi, 1931, Explanatory text to the geological map of Kung-chu-ling[公主嶺]: Geol. Inst. S. Manchuria Ry. Co.

KAWADA, Michio, 1932, Explanatory text to the geological map of Chi-lin[吉林]: Geol. Inst. S. Manchuria Ry. Co.

KOBAYASHI, Teiichi, 1942, Stratigraphic relation among the Mesozoic fossil-beds in the Koreo-Manchurian land: Proc. Imp. Acad. Japan, v. 18.

MITA, Shōichi, 1951, Surveying of the coal properties and coal reserves in Manchuria, in Geology and Mineral Resources of the Far East, Manchuria, Non-metallic Ore Deposits, VII-2c: Comp. Comm., Geology and Mineral Res. Far East, Tokyo Geog. Soc.

MONDEN, Shigeyuki, 1936, Geology along the railroad between Mei-ho-kou and Tunghua, Mukden Province: Bull. Geol. Inst. S. Manchuria Ry. Co.

MORITA, Gijin, 1943, Stratigraphic sequences and their peculiarities of the Ping-kang coal field, Ssuping Prov.: Jour. Geol. Soc. Manchoukuo, nos. 4 and 5.

OKADA, Shigemitsu, 1956, Geologic map of T'ung-hua, sheet NK 51-9: Comp. Comm., Geology and Mineral Res. Far East, Tokyo Geog. Soc., scale 1:250,000.

OZAKI, Hiroshi, 1933, Chuantou formation in the district of Chuan-t'ou[穿鬪] and Chang-tu[昌圖]: Unpub. rept., Geol. Inst. S. Manchuria Ry. Co.

SAITŌ, Rinji, 1938, Study on "Liao-ho system", newly adopted name for the so-called Lower Precambrian formation in South Manchuria: Bull. Geol. Inst. Manchoukuo, no. 93.

_____, 1940, Geologic map of Manchuria and adjacent areas, scale 1:3,000,000: Geol. Survey Manchoukuo.

_____, 1943, Precambrian stratigraphy of South Manchuria and North Manchuria:, Mem. Geol. Survey Manchoukuo, no. 18.

YABE, Shigeru, 1930, Chü-lung[鉅隆] Gold Mine Ching-yuan Hsien [淸源縣], Liaoning: Manchuria Geol. and Mining Rev. (Shina KōgyŌ JihŌ), no. 75.