GEOLOGIC COLUMN AND UNIT DESCRIPTIONS

AGE	ROCK UNIT	LITHOLOGY; THICKNESS WHERE KNOWN
QUATERNARY — Recent	Alluvium	Sand and clay; thickness not known
	UNCONFORMITY	
QUATERNARY — Pleistocene	Diluvium	Clay, sand and gravel; thickness less than 100 meters
	UNCONFORMITY	
TERTIARY — Paleogene	Paleogene or Shulan formation	Sandstone, conglomerate, clay, tuff and coal; thickness not known
	CLINO-UNCONFORMITY	
MESOZOIC — Cretaceous	Andesite	Augite andesite
	INTRUSIVE CONTACT	
	Sunghuachiang series	Shale, sandstone, marl and bentonite; thickness 50 m or more
	UNCONFORMITY	
MESOZOIC — Pre-Jurassic	Porphyrite	
	INTRUSIVE CONTACT	
	Quartz porphyry	
	Pre-Jurassic granite	Hornblende-biotite granite
	INTRUSIVE CONTACT	
PALEOZOIC — Permo-Carboniferous	Permo-Carboniferous or Chilin formation	Sandstone, slate, hornfels and limestone; thickness not known

(Column not drawn to scale)

UNIT DESCRIPTION

The Alluvium, consisting chiefly of sand and clay, is distributed in the drainage basins of the Sung-hua Chiang [松花江], the A-shih Ho [阿什河], the Fei-k'o-t'u Ho [哲克圖河] and the La-lin Ho [拉林河]. The plain of the Sung-hua Chiang is composed of fine sand and clay, mingled with coarse sand. The Alluvium along the A-shih Ho consists of sandy clay intercalated with fine sand and granitic sand, or occasionally with pebbly sand. In the Harbin area the geologic boundary between the Alluvium and the Diluvium has not been defined.

The Diluvium generally consists of clay, sand and gravel, and constitutes vast flat hilly lands 20 to 50 m high above the alluvial plain. The Diluvium in the city of Harbin and its suburbs consists of clay 15 - 20 m thick and alternating sand and clay 30 to 50 m thick. The Diluvium in Ku-hsiang-t'un [顧鄉屯], 5 km southeast of Harbin, was named the Wenchuanho bed [溫泉河層] and the Kuhsiangtun bed by Shigeyasu TOKUNAGA and Nobuo NAORA (1936) who excavated the region in 1933 and 1934 to study mammalian fossils and human artifacts. The geology of the beds follows:

Wenchuanho bed		Black silt (about 1 m thick)
Kuhsiangtun bed	Upper	D. Yellowish-brown loessic clay (10 m thick at the maximum)
		C. Gravel with bluish-gray clay (0.8 m thick at the maximum)
		B. Bluish-gray sandy clay (1 - 2 m thick)
	Lower	A. Dark-gray clay (2.7 m thick at the maximum)

Fossils were collected from the lower part of D, C, B and the upper part of A, amounting to about 90 species which included 28 Mollusca, 1 Insecta, 5 Pisces, 2 Aves, 1 Reptilia, 10 Carnivora, 16 Rodentia, 5 Perissodactyla, 20 Artiodactyla, 2 Proboscidea, and 1 Primates (gen. et sp. indet.). Human artifacts were also unearthed, amounting to 262 pieces including 24 stone implements, 217 bone implements and 4 horn implements. Six fragments of fossil plants were also found. On the basis of these fossils, TOKUNAGA correlated the Kuhsiangtun bed with the upper part of the Middle Pleistocene. The geology of the Diluvium around the waterwell at Harbin Airport is as follows (in descending order): black soil (2.1 m thick), water table, red clay (20.3 m), blue clay (1.8 m), gravel-bearing red clay (8.2 m), sand and gravel (3.4 m), blue clay (2.1 m), coarse sand (10 m), blue clay (6.3 m), coarse sand (6.4 m), blue clay (1.5 m) and black clay (22.9 m).

The Paleogene formation is poorly exposed in the southeastern corner of the map area and consists of sandstone and conglomerate, the sandstone being intercalated with clay, tuff and coal. There are seven coal seams, each being less than 2 m thick. The formation is thought to be an extension of the Shulan [舒蘭] formation or the Kangyao [杠窯] formation of the Yü-shu map area (Yü-shu sheet, NL 52-10) adjacent on the south. It strikes generally N 70° E and dips 25° - 40° NW, and rests unconformably upon the slate bed of the Permo-Carboniferous Chilin formation (Pu).

The andesite is augite andesite occurring as lava-flows or intruding the quartz porphyry (qp) or the Permo-Carboniferous Chilin formation (Pu). The andesite of North Manchuria is generally believed to be post-Cretaceous or pre-Paleogene in age.

The Cretaceous formation in the map area was named the Sunghuachiang series by Toshio UCHINO (1937). It is distributed in the area south of the Sung-hua Chiang in the northeastern corner of the map area and on the south side of the La-lin Ho in the south. The formation consists chiefly of gray tuffaceous shale intercalated with marl in the lower part. The marl contains some fossils of unidentified Crustacean species. The formation rests unconformably upon the granite (g_2) and is unconformably covered by the Diluvium (Qdg). The thickness where known is about 50 m or more. The formation on the south bank of the Sung-hua Chiang is composed of shale and sandstone, both tuffaceous and reddish-yellow or green, and generally strikes N 50° - 60° W and dips 50° - 60° NE. The shale is partly bentonitic.

The porphyrite in the map area is exposed only in the river cliff of the Sung-hua Chiang at the north edge of the map. It intrudes the Chilin formation and is quarried for ballast.

The quartz porphyry (qp) comprises two kinds: one is contemporaneous with, and a marginal facies of, the hornblende-biotite granite (g_2); the other intrudes the said granite and the Permo-Carboniferous Chilin formation (Pu). The quartz porphyry is reddish-brown or gray to grayish-black, consisting of phenocrysts of quartz, orthoclase and oligoclase, and a microgranitic or felsitic groundmass of quartz, orthoclase, biotite and rarely hornblende.

The granite (g_2) is reddish-brown to grayish-white hornblende-biotite granite, intruding the Permo-Carboniferous Chilin formation in the vicinity of Yü-ch'üan [玉泉] and is intruded by the quartz porphyry (qp) at Mao-erh Shan [帽兒山]. About 10 km southwest of the Hsiao-ling [小嶺] station the granite contains a small iron ore deposit originating in the Permo-Carboniferous limestone which was contact-metamorphosed by the granite. The ore deposit is lenticular, measuring about 320 m in length and 40 m in maximum width. The ore consists chiefly of hematite associated with limonite, siderite, magnetite and much quartz, and contains about 36 percent iron.

The Permo-Carboniferous or Chilin formation (Pu) consists chiefly of fossiliferous sandstone and slate, both occasionally grading into hornfels, intercalated with two thin limestone beds. The formation generally strikes WNW and dips 80° S or almost vertically. It is intruded by the granite (g_2), and also by such later eruptive rocks as rhyolite, porphyrite, porphyry and andesite, according to S. OKADA. The following fossils were collected from the limestone by E. AHNERT in 1928 and the age of the formation was designated as Middle Permian:

Productus cf. boliviensis D'ORB.
P. weyprechti TOUL
P. mammatiformis FREDR.
P. aculeatus MARTIN
P. waageni FOTHP.
P. purdoni DAVIDS.
Paramarginifera peregrina FREDR.
Spirifer striatus mut.neostriatus FREDR.
Spiriferella rajah (SAIT)
S. lytha FREDR.
S. cf. vercherei WAAGEN
Polypora sykeri WAAGEN
Aviculopecten cf. subclathratus KEYS
Bellerophon sp.

In 1940, S. OKADA collected the following fossils of probable Lower Permian age from the sandstone about 8 km southwest of Yü-ch'üan:

Neospirifer moosakhailensis (DAVIDSON)
Waagenoconcha cf. purdoni (DAVID.)
Linoproductus cora (D'ORBIGNY)
Pseudomonotis (Aviculomonotis) kazanensis (DE VERNEUIL)

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