GFOLOGIC COLUMN AND UNIT DESCRIPTION

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EE ROO	CK UNIT		LITHOLOGY; THICKNESS WHERE KNOWN	UNJIT DESCRIPTION	ECONOMIC VALUE
Al	Lluvium	Qal	Sand, gravel and clay; thickness less than 20 meters	Alluvium is widely distributed in the drainage basins between the Amur River and the Sung-hua Chiang, covering the low terrace remnants and the flood plains. It consists chiefly of sand, clay and gravel, and is covered by vast marshes and black peaty mud.	Placer gold in the alluvial deposits was worked in the upper reaches of the Wu-t'ung Ho and the Tu-lu Ho. Wu-t'ung Ho placer gold: The geology along the river consists of biotite schist and biotite granite associated with diorite, overlain by andesite flows. The total length of the gold-producing area along the Hsi-wu-t'ung Ho, the Lao-wu-t'ung Ho and the Hsiao-wu-t'ung Ho is 40 km. It was reported that 1,500 men worked in 1916
Di	lluvium	Qd	Qd: clay, sand, gravel and aeolian-lacustrine sand; thickness unknown	Diluvium (Qd), consisting chiefly of clay, sand and gravel, is sporadically distributed as inliers in the vast alluvial deposits. Diluvium (Qdg), consisting chiefly of coarse sand, gravel and rarely clay, is exposed in the western half	Tu-lu Ho placer gold: The geology along the river consists of biotite schist and chlorite schist. Auriferous beds of the alluvial deposits are composed of sand ar gravel consisting of schist and quartzite pebbles. The Kuan-Tu [积 都] gold mine, situated between the Tu-lu Ho and Kuan-yin Shan [积 节 山] along the Amur River (refer to Fo-shan sheet, NM 52-12, adjacent on the north), was operated by the T'ai-p'ing-kou Mining Office(太平 法金知局). The gold-producing area comprises to
QUAT		Qdg	Qdg: sand, gravel and clay; thickness less than 100 m	of the map area, covering the high terrace remnants that fringe the flood plains of the Sung-hua Chiang (社 花 江and the Hao-li Ho[鶴 立 河]. It is mostly overlain by the Recent fluvial deposits. The thickness ranges from 5 m to 100 m. On the basis of the fossils such as molar and incisor teeth of Elephas primigenius unearthed in the Hao-kang coal field, Qdg is correlated with the Kuhsiangtum series (衛 海 屯 統) of Upper to Middle Pleistocene age.	important gold mines and produced 500 kg of pure gold in 1917.
	nary basalt	100 m	Flows of doleritic olivine basalt; thickness variable	Flows of doleritic olivine basalt occur at *Ma-an Shan [馬鞍山] on the southern bank of the Sung-hua Chiang. * Not shown on the map.	
	ene basalt		Augite-clivine basalt with tuffaceous sand and breccia; thickness 20 m to 100 m	The Neogene basalt occurs in the U.S.S.R. territory (E. AHNERT, 1935) in association with tuffaceous sand and breccia, but no other data are available.	
Cretaceo	ous andesite		Hornblende andesite and andesite porphyry	Flows of hornblende andesite and andesite porphyry are sporadically distributed in the hills in the western part of the map area. The rock consists of dark-gray groundmass and phenocrysts of hornblende, 3 to 5 mm long, and plagicalse 2 mm long. It rests upon the Nankang [南 崗] conglomerate (Mku), the Hsunte(城 總) pyroclastic formation (Mk), the Mishan [空 山] series (Mj), the pre-Jurassic granite (g ₂) and the granite gneiss (ggn).	
Nankang	conglomerate	INCONFORMATIV	Conglomerate and sandstone; thickness less than 100 m	The Nankang conglomerate consists of conglomerate and lenticular sandstone. Pebbles of the conglomerate are round, 1 cm to 20 cm in diameter, and are mainly quartz porphyry, sandstone, quartzite and basalt. The conglomerate unconformably overlies the Hsunte pyroclastic formation and the Mishan series, and is considered probably Middle Cretaceous in age.	
Hsunte pyroc	clastic formation	MkI COOP CAN COOP COOP COOP COOP COOP COOP COOP COO	Mkl: sandstone, conglomerate and coal; thickness more than 500 m Mkv: andesitic agglomerate, tuffaceous conglomerate, shale, sandstone and rhyolitic tuff; thickness 2,000 m	The Hsunte pyroclastic formation is divided into the upper part (Mkl) and the lower part (Mkv), and rests upon the Mishan series with an apparent disconformity. Its age is considered to range from Upper Jurassic to Lower Cretaceous. The upper part of the Hsunte pyroclastic formation (Mkl) consists chiefly of yellowish-brown, coarse-grained sandstone, intercalated with lenticular conglomerate and a coal seam 5 cm thick. The lower part (Mkv) consists of dark gray andesitic agglomerate, tuffaceous conglomerate containing quartzite and granite pebbles 5 cm in diameter, blackish-gray foliated shale (marly nodules of it contain Brachyphyllum sp. and mollusk fossils), grayish-white sandstone, grayish-yellow conglomeratic sandstone, dark green sandy shale and rhyolitic tuff.	★ Hao-kang(前 所) coal field The coal field, extending for 35 km NE from Hsun-te to Ta-ling (大 孝), was prospected by drilling five hundred deep holes. The coal field is well known for the largest amount of probable reserves, amounting to 1,762,000,000 tons in 1945, with the largest tonnage throughout Manchuria. The coal is good for iron smelting and gas manufacture. Coal Thickness (m) of Intervening Rock Mining Method Coal Seam Thickness (m) of Intervening Rock Mining Method
Mishs	No. 140	DISCONFORMITY	Upper: sandstone, conglomerate and coal; thickness more than 500 m	The Mishan series, or the Upper Jurassic coal-bearing formation is distributed in a narrow northeast-trending band that extends for a distance of 120 km from the Sung-hua Chiang to the Belaya River in the U.S.S.R. beyond the Amur River. It is a continuous fresh water deposit, 1,000 m to 1,300 m thick, locally marked with contemporaneous erosion. The series in the vicinity of Hsing-shan-chen [Pulifically divided into the upper, middle and lower coal-bearing beds. The upper coal-bearing bed consists of gray or grayish-yellow coarse-grained sandstone, yellowish-gray conglomeratic sandstone, conglomerate and shale, interbedded with thin lenticular coal seams in the middle and lower parts. The shale in the middle part 1 yields plant fossils. The middle coal-bearing bed consists chiefly of yellowish gray or grayish-white sandstone, grayish-white arkosic and tuffaceous sandstone, intercalated with five important coal seams (Nos. 1, 2, 3, 4 and 5) and three fossiliferous zones (2, 3 and 4). 2 A markedly fossiliferous zone lies in the horizon 10 to 20 m above coal seam No. 2, and yields the following plant fossils: Coniopteris hymenophylloides, Onychipsis elongata, Sphenopteris suessi, and Podozamites lanceolatus. 3 An alternation of shale and sandstone lying above coal seam No. 3 yields the following plant fossils: Cladophlebis denticulata. C. lobifolia. Sphenopteris suessi. Taeniopteris sp Ginkgoites	(m) (Chiefly Sandstone) No. 1 2.0 No. 2 9.0 No. 2 9.0 No. 3 10.2 No. 4 4.1 No. 5 6.3 No. 6 9.5 No. 6 9.5 No. 6 9.5 No. 7 3.7 No. 8 3.6 No. 9 2.6 No. 10 No. 10 No. 10 No. 10 Not worked Strip and underground Underground Underground Vinderground Not worked Not worked Not worked Not worked Not worked Not worked
	No No No No No No Io		coal; thickness 200 to 300 m Lower: sandstone, conglomerate and coal; thickness 300 to 400 m	digitata, Baiera gracilis, Elatocladus manchurica, Pityophyllum lindstroemi, Podozamites sp., and Carpolithus sp. 4 A white arkosic sandstone above coal seam No. 5 yields the following fossils: Equisetites sp., Cladophlebis denticulata, C. lobifolia, C. nebbensis, Coniopteris cf. hymenophylloides, Sphenopteris suessi, Taeniopteris sp., Nilssonia? sinensis, Pseudocycus? sp., Ginkgoites sibirica, G. digitata, Baiera manchurica, Czekenowskia rigida, Phoenicopsis sp., Stenorachis sp., Elatocladus manchurica, E. submanchurica, Pityophyllum longifolium, Pityostrobus Endo-riujii and Podozamites lanceolatus. The lower coal-bearing bed consists of grayish-brown arkosic sandstone, gray conglomerate and one important coal seam (No. 6) with four other unworkable seams (No. 7, 8, 9 and 10). The conglomerate is composed of round pebbles, 2 to 10 cm in diameter, of quartz porphyry, rhyolite, rarely granite and quartzite. There are two fossiliferous zones 5 6. 5 A shale below coal seam No. 6 yields the following fossils: Equisetites sp., Cladophlebis denticulata, Otozamites sp., Czekanowskia rigida, Pityophyllum longifolium, Podozamites lanceolatus and Pinites sp. (Coal seam No. 8 yields the following fossils: Equisetites sp., Cladophlebis cf. lobifolia and Phoenicopsis sp. The Mishan series strikes N 20° - 50° E, dips 5° - 30° SE, showing a monoclinal structure, and is cut by many dip-faults, generally with a northward throw, and a few strike-faults with a throw to the west.	The Upper coal-bearing bed is intercalated with lenticular unworkable coal seam The coal is a medium-grained bituminous coal; analytical results follow: Coal Fixed Volatile Seam Carbon Matter(%) Water(%) Ash(%) Sulphur Property (calorie) No. 2 53.36 33.76 2.13 10.84 0.44 Caking 7,120 No. 3 55.01 34.72 2.24 8.03 0.21 " 7,370 No. 5 56.23 34.49 1.42 7.88 1.02 " 7,530 The analytical results of coke manufactured from the Hao-kang coal are as follow fixed carbon 89.37%, volatile matter 1.09%, water 1.32%, ash 8.22%, sulphur 0.89 and heat value 7,471 calories.
Quart:	z porphyry	G	Quartz porphyry and granite porphyry	Quartz porphyry and granite porphyry intrude the granite gneiss (ggn) in the vicinity of Hsing-shan-chen and in the area along the Amur River. Both rocks are considered marginal facies of the pre-Juraesic granite (g_2).	The coal field is cut by many faults. The most important one is the Shih-tou-ho (石 頂 河) fault, a normal strike-fault with a throw to the west, which runs N-S passing through the hill east of Hsing-shan-chen. Due to this fault the principle coal seams are repeated, which caused an increase in the actual reserves of coal SAN Upper Jurassic coal seam near Chen-tung-ts'un (紅 東 村) on the south bank of
	ussic granite	VIRUSIVE CONTA	Biotite granite, hornblende- biotite granite, gneissic granite, aplite, pegmatite, diorite and granite porphyry	The pre-Jurassic granite consists of biotite granite and hornblende-biotite granite, accompanied by gneissic granite, aplite, pegmatite, diorite and granite porphyry. It intruded presumably during the Triassic period. The rock along the Lao-wu-t'ung Ho(老格洞河) is a coarse-grained biotite granite occasionally containing large phenocrysts of pinkish orthoclase.	the Amur River is 2 m thick and has an area of 10 sq. km. Probable coal reserves were reported by Chinese geologists as 20,000,000 tons.
Upper Pale	ozoic formation	2000 00 00 00 00 00 00 00 00 00 00 00 00	Crystalline limestone, hornfels, graywacke, clay slate, phyllite and conglomerate; thickness less than 1,000 m	The Upper Paleozoic formation is exposed only in the southeastern corner of the map area. It consists of massive crystalline limestone, hornfels, graywacke, clay slate, phyllite and conglomerate. It is correlated with the Permo-Carboniferous formation of marine origin.	(The Upper Paleozoic crystalline limestone in granite gneiss is found at a quarry 2.5 km north of Hsing-shan-chen. It is calcined for lime. The limestone deposit is 80 m long, 50 m wide and 30 m thick, and its probable mineral reserves are estimated at about 70,000 tons.
	ozoic formation	00000000000000000000000000000000000000	Sandstone, clay slate, phyllite and conglomerate; thickness less than 500 m	The Lower Paleozoic formation, consisting of sandstone, clay slate, phyllite and conglomerate, is exposed only at Stolbovskoye and Soyuznoye in the U.S.S.R. The formation is assigned to Lower Cambrian by D. V. NALIVKIN (1955), although no details are available.	
	PROB	pe pe	Crystalline limestone, clay slate, sandstone, quartzite, mica schist, chlorite schist, talc schist and quartz schist; thickness unknown	The Proterozoic formation is exposed only in the U.S.S.R. It consists of crystalline limestone, calcareous clay slate, sandstone, quartzite, mica schist, chlorite schist, talc schist and quartz schist, and is occasionally associated with Anshan-type iron ore deposits extending northward parallel to the strike of the formation.	
	rian gneiss	p£gn	Biotite orthogneiss, hornblende- biotite metagneiss, gneissic granite and crystalline lime- stone	The Precambrian gneiss is light gray biotite orthogneiss or hornblende orthogneiss, locally accompanied by biotite metagneiss or hornblende metagneiss. Where it outcrops, north of the Amur River, Soviet geologists define it as Archean. It may be equivalent to some of the granite gneiss (ggn) in the northwestern part of the map sheet.	
	line schist	p € sh	Biotite-quartz schist, chlorite schist, biotite gneiss, hornfels and crystalline limestone; thick- ness unknown	Crystalline schist is exposed in the upper reaches of the Tu-lu Ho[都 舊河]. It consists of biotite-quartz schist, chlorite schist and biotite gneiss, in association with hornfels and lenticular crystalline limestone. Although its age is unknown, it is tentatively correlated with the Precambrian schist exposed in the Fo-shan sheet (NM 52-12), to the north.	
	.te gneiss	ELATION UNKNOW	Biotite orthogneiss, hornblende- biotite metagneiss, gneissose granite and crystalline limestone;	Granite gneiss of unknown age is distributed in the western part of the map area. It consists chiefly of biotite orthogneiss, in association with various kinds of hornblende-biotite metagneiss, gneissose granite and crystal-line limestone at the quarry 2.5 km north of Esing-shan-chen was contact-	

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