GEOLOGIC COLUMN AND UNIT DESCRIPTIONS

AGE	ROCK UNIT	LITHOLOGY; THICKNESS WHERE KNOWN	UNIT DESCRIPTION
QUATERNARY	Alluvium	Qal — *Sand, gravel, clay, and mud. Thickness less than 5 meters.*	Younger fluvial deposits, composed of sand, gravel, clay and mud; sometimes contains placers of gold in the southeastern regions.
	Diluvium	Qdg — *Sand, gravel, and clay. Thickness 10 to 20 m.*	Diluvium, composed of sand, gravel, and clay, is widely developed west of Chi-lin, covering the land of gentle relief about 40 m above the flood plain. Diatomite beds, 2.5 m or less in thickness, are interbedded within the clay bed which rests on the dissected basalt plateau along the Sung-hua Chiang.
	Pleistocene basalt	b_3 — *Olivine basalt in flows and sheets. Thickness 10 to 150 m.*	Flows and effusive sheets of olivine basalt, with phenocrysts of labradorite and olivine.
		Intrusive contact	
MESOZOIC	Rhyolite	h — *Biotite rhyolite, hornblende rhyolite, and rhyolite breccia.*	Rhyolite; generally dark-colored, gray to black, with or without quartz phenocrysts. Oligoclase sometimes becomes as much as orthoclase. Locally the rock is brecciated.
	Quartz porphyry	qp — *Dikes of quartz porphyry.*	Quartz porphyry occurs as dikes; its appearance is similar to the rhyolite, but has less or no flow structure. It is covered by basalt (b_3) near the dam site southeast of Chi-lin.
	Porphyrite	p — *Dark-brown or dark-green porphyrite; occasionally agglomeratic.*	A common volcanic rock covering or penetrating the Jurassic and other rocks; dark brown or dark green; contains phenocrysts of labradorite, biotite, and hornblende; occasionally agglomeratic. Sometimes occurs as effusive sheets overlain by a part of the Jurassic rocks. The age of eruption is considered to range from Jurassic to Cretaceous.
	Jurassic coal-bearing formation	Mju — *Shale, oil shale, sandstone, coal, bentonite, and conglomerate. Thickness more than 1,000 m.*	The coal-bearing formation at Chiao-ho[蛟河]includes several coal seams at relatively lower horizons, with a total thickness of 12 m. Coal is sometimes accompanied by bentonite. Owing to the scantiness of fossils, the age of the formation has not been determined, although it is generally assigned to Upper Jurassic or Lower Cretaceous. However, a species of Margaritifera from the lowermost coal seam has been reported lately as identical with M. perdahurica (Yokoyama) which is a common species in the Japanese Paleogene, and some geologists are doubtful of assigning the formation to the Mesozoic.
		Unconformity	
	Diorite	d — *Dark, medium-grained quartz diorite.*	Dark, medium-grained diorite occurs as dikes and a marginal facies of granite (g_2). It consists chiefly of quartz, oligoclase, orthoclase, and hornblende, with some biotite and muscovite.
	Granite	g_2 — *Medium-grained biotite granite and hornblende granite.*	Most commonly biotite granite; medium-grained, grayish or reddish; consists chiefly of quartz, orthoclase, microcline, oligoclase, and biotite. Hornblende granite in contact with the Chilin formation also occurs in many places and occasionally grades into diorite. The age of intrusion is considered to be younger than Permian and older than Jurassic. The contact-metasomatic copper deposit at Shih-tsui-tzu[石咀子], one of the most important ore deposits in Manchuria, is believed to be genetically connected with this granite intrusion, although the deposit occurs in a limestone bed which is separated by slate from the granite mass.
		Intrusive contact	
PALEOZOIC	Chilin formation — Permo-Carboniferous	Pu — *Lithoiditic tuff and black shale. Thickness more than 1,000 m.*	Chilin formation; a thick complex of shale, slate, limestone, and volcanic tuff and breccia, of which black shale and slate are predominant but often changed to hornfels, phyllite, and chlorite schist. Shale and slate are partly marine and partly non-marine, as indicated by occasional occurrence of plant fossils and bedded graphite which is believed to have been derived from coaly material. A characteristic lenticular limestone occurs, with a maximum thickness about 2,000 m. The limestone is known for its high purity in calcium carbonate, and is rarely associated with dolomite. Volcanic tuff and breccia, andesitic or rhyolitic, are not rare. The Chilin formation is always accompanied by granite intrusion, and the base has not been confirmed. One of the oldest fauna, a Silurian (Gotlandian) coral, Pseudomphyma, is reported from a limestone lense in tuff-breccia near Erh-tao-kou[二道溝](not shown on map) north-northwest of Hsing-lung-tien[興隆店] about 12 km west of Chi-lin, and the youngest is a Permian Foraminifera, Pseudoschwagerina, probably of the Sakmarian, from near the base of a thick limestone bed at Ming-cheng[明城](Hsiao-ch'eng-tzu[小城子] on the map) in the southwestern corner of this sheet.
		Limestone. Thickness about 2,000 m.	
		Shale, phyllitic slate and limestone. Thickness about 1,500 m.	
		Limestone. Thickness 100 to 800 m.	
		Shale, phyllitic slate and limestone. Thickness more than 2,500 m.	
	Silur-Devonian	Pl — *Tuff, tuff-breccia, and limestone. Thickness about 1,500 m.*	
		Shale and slate. Thickness not known	
PRECAMBRIAN	Granite gneiss	ggn — *Granite gneiss and migmatite gneiss.*	Granite gneiss occurs in association with migmatite gneiss which is widely developed in the area adjacent to the south (see Fu-sung sheet, NK 52-4) where the Precambrian banded iron ore occurs in a close relation to the gneiss. In the map area, both granite gneiss and migmatite gneiss, as well as those derived from the younger granite (g_2), have not been differentiated and their distribution may not be so distinct as shown on the map.

(Column not drawn to scale)

Chilin formation is tentatively divided into the Permo-Carboniferous (Pu) and Silur-Devonian (Pl), although the relation between the two is not always distinct. The geologic sequence of Pu given here is as observed in the Ming-ch'eng district. The lower to middle horizons of Pu, as numbered (2) to (10) in the column, yield many species of fossils, as follows, which represent Lower Carboniferous:

(11) Pseudoschwagerina
(10) Lonsdaleia floriformis floriformis Martin
(9) Auloclisia sp.
(8) Siphonodendron sp.
(7) Tongue-fern flora
(6) Gigantella manchuriensis Minato
(5) Dibunophyllum sp.
(4) Productus sp.
(3) Orthotetes aff. O. ruber Frech
(2) Diphyphyllum aff. D. platiforme
(1) Pseudomohyma infudibula Yabe and Eguchi

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