AGE UNKNOWN	VN ARCHEAN-PROTEROZOIC			OTEROZOIC		PALEOZOIC				MESOZOIC				TERTIARY					QUATERNARY	AGE	
Unclassified granite Diorite	Liaoho system (Wutai system) Taishan complex (Gneiss and crystalline schi	Granite gneiss		Sinian system	Lower Cambrian System (Mantou series)	Middle Cambrian System (Changhsia series)		Upper Cambrian System (Ch'aomitien series)	Ordovician system	Taitzuho system.	Jurassic volcanic formation (Kangtai formation)	Upper Jurassic formation (Heishan formation)	Lower Cretaceous formation (Miyanohara formation)	Chienshan granite	Rhyolite Quartz porphyry	Paleogene basalt		Fushun series	Neogene(?) basalt	A Iluvium Diluvium	ROCK UNIT
Biotite granite, biotite-hornblende granite, and gneissose granite.	thickness more than 500 m. Liaoho system Crystalline schist, amphibolite, magnetite-hematite- quartz schist, crystalline limestone; thickness not known. This because the granite gneiss, hornblende granite gneiss, paragneiss and crystalline schist.	Intrusive contact	www.mconformity.m.m.m.m.m.m.m.m.m.m.m.m.m.m.m.m.m.m.m	Shale, marl, siliceous slate and quartzite; thickness about 1,200 m.	Limestone, shale and sandstone; thickness about 300 m.	Limestone and shale; thickness 230 to 460 m.		Limestone; thickness 80 to 200 m.	Limestone, dolomite and marl; thickness less than 500 m.	Upper(Tsaichia series), sandstone and shale; thickness 440 m. Middle(Liutang series and Huangchi series), sandstone, shale, fire-clay and coal; thickness 170 m. Lower(Penchi series), sandstone, shale, fire-clay, coal and limestone; thickness 120 m. Thickness 120 m.	「	Sandstone, shale, conglomerate and coal; MIU thickness about 550 m.	Conglomerate, sandstone, shale, tuff and lava flows;	Biotite-hornblende granite, monzonite, pegmatite + + + + + + + + + + + + + + + + + + +	Rhyolite, quartz andesite, tuff and breccia	四門の日間の日間の日 「中国の日間に関いた」 「中国の日間に対する。 「中国の日間の日間では、 「中国の日間に対する。」 「中国の日間に対する。 「中国のの日間に対する。 「中国のの日間に対する。 「中国のの日間に対する。 「中国ののの日間に対する。 「中国のののののののののののののののののののののののののののののののののののの	Thickness 1,200 m or more	SASSASSASSASSASSASSASSASSASSASSASSASSAS	Flows of olivine basalt; Thickness unknown.	Sand, clay and gravel; thickness less than 20 meters. Loess, slit, sand and gravel; thickness less than 50 m.	CEOLOGY; THICKNESS WHERE KNOWN
Unclassified granite represents granitic rocks probably older than Cretaceous granite (g3) and includes Twimienshan granite of pre-Anshan age, Mungchangling[号张枫] granite of pre-Sinian age, and some pre-Jurassic granites. District includes quartz diorite and may have been erupted in association with granite of various ages.	phyllite group (including sericite phyllite, chlorite-sericite phyllite, and chlorite-briotite-sericite phyllite), phyllitic grit, quartzite, actinolite schist, and banded hematite-quartzite or magnetite-hematite quartzite. Some rhyolite flows and tuffaceous rocks occur on the top. The series unconformably rests on the so-called Tuimlenshan[#] mil granite. The total thickness of the series is more than 500 m. The lower part or Liacho system occupies the basin of the Fai-tzu Ho and extends further northward. It consists mainly of a crystalline schist group (biotite schist, muscovite schist, two-mica schist, graphite-quartz schist, epidote amphibolite, amphibolite, chlorite schist, quartz schist, magnetite-hematite-quartz schist, and crystalline calcareous rock), and is penetrated by the granite (g) of different ages. The gneiss complex in the northwestern part of the map area consists chiefly of orthogneiss of various compositions, including biotite granite gneiss and hornblende granite gneiss, associated with paragneiss and crystalline schist, and is correlated to the so-called Taishan[# wi] complex.	les (pcm) along the contact. The so-called "Kungchangling transcription of the contact. The so-called "Kungchangling transcription of the contact. The so-called "Kungchangling transcription of the contact of Lower Proterozoic of Lower Prot	e medium-grained granite gneithe liacho system (refm). It	The Sinian system is widely distributed, especially in the districts of Man-fen(南 坎 and Ch'iao-t'ou where the system is subdivided as follows, in descending order: (3) Kangchia series[紀 宋 山 松 and thickness 50 m. (2) Wuhsingshan series[五 石 山 松 mart, limestone, quartzite, and shale, ll0 m thick. (1) Hsiho series; Ch'iaotou quartzite, Manfen shale and marl, and Tiaoyut'ai[幼魚台] quartzite, 1,000 m	The Lower Cambrian system (Mantou series領無知的 North China) consists chiefly of an alternation of micaceous shale and sandy shale of reddish color, intercelated with limestone lenses and thin sandstone beds in the lower part. R. ENDÖ divided the system at Huo-lien-ch'ai and Niu-hsin-t'ai into the upper part or Shih-ch'iao stage(5 48 Hz) and the lower part or Misaki stage(5 48 Hz). Hyolithes kantungensis Resser and Endo is found in the Shih-ch'iao stage of Huo-lien-ch'ai and Redlichia chinensis Walcott in the Misaki stage of Niu-hsin-t'ai. No fossils have been reported from other localities. The thickness, where measured, ranges between 205 and 335 m.	143.7 m at Smang-miao-tzn. (2) Taitzu stage; generally dark gray bedded limestone intercalated with oblitic limestone. Shuang-miao-tzu is the type locality where the stage was subdivided into 4 fossil zones, the Damesella-Teiniston zone, the Amphoton zone, the Amphoton zone, and the Anomocarella-Manchuriella-Ptychoparia zone. At Yen-t'ai the Damesella-Teiniston zone, the Amphoton zone, and the Grepicephalina zone occur. At Huo-lien-ch'ai, the Damesella-Teiniston zone and the Grepicephalina zone are found. At Fu-chin-ling the Crepicephalina zone only occurs. Some fragments of Trilobites were reported from Niu-hsin-t'ai. Measured thicknesses are 165.7 m at Yen-t'ai, 89.5 m at Fu-chin-ling, 212 m at Huo-lien-ch'ai, 60 m at Niu-hsin-t'ai, and 287.1 m at Shuang-miao-tzu. (1) Tangshih stage; generally alternating shale and sandstone, intercalated with lenticular limestone. Tang-shih-ling of Yen-t'ai is the type locality. Bailiella ulrichi zone and Proasphiscus yabei zone are found at Yen-t'ai, and Shuang-miao-tzu. At Fu-chin and Huo-lien-ch'ai fossils of the above-mentioned two zones occur together. At Niu-hsin-t'ai Proasaphiscus zone alone occurs. Measured thicknesses are 47 m at Yen-t'ai, 70.7 m at Fu-chin-ling, 20 m at Huo-lien-ch'ai, 50 m at Niu-hsin-t'ai, and 31.3 m at Shuang-miao-tzu.	brian (Changhsia series(埃及約)of North Christic collitic limestone. R. ENDO subdithe Tangshih stage(當十階) in descending ENDO, the stratigraphic sequence of the Niu-hsin-t'ai, Shuang-miao-tzu(寶廣千月, Niu-hsin-t'ai, Shuang-miao-tzu(寶廣千月, an stage; consists of marly bedded limes on occurs at Yen-t'ai. Measured thicknone occurs at Yen-t'ai.	marly limestone with intraformational limestone conglomerate, and alternating shale and sandstone. The thickness attains more than 200 m near Ch'ao-t'ou[橋原], but is less than 100 m in other places. Ryuji ENDÖ made a stratigraphic study of the Upper Cambrian system at Tang-shih-ling (衛 十 横) esst of Yen-tai-t'an-k'eng, at Huo-lien-chai[火運 寒], at Niu-hsin-t'ai (Hsia-niu-hsin-t'ai on map), and at Shuang-miao-tzu[紫庵]. The geologic section at Tang-shih-ling seems to present typical fossil zones as given below in descending succession. [2] Tiasham stage [卷 11 18] Alternating shale and changshania are found. [3] Paishan stage [台 11 18] Alternating sandstone and shale (13 m thick) Alternating sandstone and shale (18.5 m thick) Chuangia nitida zone and Prochuangia zone(7)	ian formation consists of dark grayish, thick bedded limestone (including with thin beds of marl and shale. Characteristic Cryptozoon limestone inoceras and Maclurea are the most common fossils. On the basis of pales assigned to Lower and Middle Ordovician. The stratigraphic sequence of of Pen-ch'i-hu district and at Yen-t'ai-t'an-k'eng[ff	The Taitzuho system constitutes the well-known coal fields of the Tai-tzu Ho basin, such as Yen-t'ai[第音], Pen-ch'i-hu, and Niu-hsin-t'ai[第音]. The system in the Pen-ch'i-hu coal field comprises 3 parts in descending order: Upper, or Tsaich'ia series[彩彩], is Upper Permian in age and is composed of e) varicolored shale with thin beds of sandstone, 20 m thick; d) alternation of pale greenish sandstone and varicolored shale, 80 m thick; and a) red shale containing limonite nodules, 20 m thick. Middle, or Lower Fermian Liutang series[柳彩新], 170 m thick, and Lowermost Fermian Huangch'i series [柳本新], 70 m thick, is composed of aggregated sandstone, shale, high alumina clay, basal conglomerate, glomerate, with intercalation of more than 10 seams of coal. Lower, or Middle Carboniferous Fench'i series, 120 m thick, is characterized by alternation of varicolored shale and sandstone, intercalated with limestone lenses, thin seams of coal and aluminous shale. Fossil plants collected from this system include various species belonging to Calamites, Annularia, Sphenophyllepidodendron, Sigillaria, Stigmaria, Cordaites, Tingia, etc. The limestone lenses in the lower part abundantly contain Moscovian fauna which includes Foraminifera, Cephalopoda, Brachiopoda, Pelecypoda, and coral.	The Jurassic volcanic formation (or Kangt'ai formation) constitutes the hilly land, 225 m high, east of Ch'ien-chiang-t'ai[# % I &]. The formation consists chiefly of porphyrite or propylitic andesite flows intercalated with tuff and breccia. It underlies Mju unconformably, and its age may be Middle or Lower Jurassic.	The Upper Jurassic formation (or Heishan formation) constitutes the coal-bearing beds of the Pa-t'ao-hao[入道读] coal field in the northwest (out of the map area). The formation has the following succession in descending order: Upper (alternation of shale and sandstone, with coal), thickness 200 m Middle (alternation of sandstone, shale, and conglomerate), 220 m Lower (alternation of shale, sandstone and conglomerate), 220 m Lower (alternation of shale, sandstone and conglomerate), 100 m Fossils include Dioonites kotol Yokoyama, Ginkgo dignitata Brongn., Phenicopsis speciosa Heer., Pityophyllum nordenskijoldi (Heer) Nath., and species belonging to Podozamites, Czekanowskia, Nagelopsis, Taxodium, Corbicula, etc.	The Lower Cretaceous formation (or Miyanchara formation), unconformably overlies the Permo-Carboniferous red sandstone in the southern part of the Pen-ch'i-hu coal field, and is covered by rhyolite (rh). The formation was formerly called the Pen-ch'i-hu formation and was believed to be Triassio, but since Otoji AdJI (1927) found Salvania sp. in a marly shale of the formation it has been assigned to Cretaceous. It may be raneous with the Lower Cretaceous Huashan series/# u in ortheastern Manchuria. In the Hei-shan! M udistrict MRI consists chiefly of conglomerate intercalated with tuffaceous sandstone, tuffaceous shale, tuff, and lava flows, and can be correlated with the Hou-hsin! Mij conglomerate of the Hou-hsin sheet (NK 51-4) which is adjacent on the west. In the Fu-shun district in the northeastern corner of the map area MKl is characterized by intercalation of lava sheets and flows of rhyolite, andesite, and dolerite.	nshan gr 604 m k monzor No dire but pet	Rhyolite (or "Cretaceous volcanics") is dark reddish brown or dark greenish gray and consists chiefly of rhyolite, quartz andesite, tuff and agglomerate. It covers the Miyanohara formation (Mkl) on both banks of the Tai-tzu Ho[太亨河] east of Fen-ch'i-hu[本泉湖]. Quartz porphyry consists of dikes and intrusive bosses of quartz porphyry, quartz-syenite porphyry, and granite porphyry. An intrusive boss of quartz-syenite porphyry in the upper reaches of the Hsi Ho[編河], a tributary of the Tai-tzu Ho, has been reported as a Cretaceous intrusive rock. Most of exposures of qp in the map area may be about the same age.	asalt and olivine dolerite form a row of hills on the sourcontemporaneous with the tuffaceous sediments and coal of ies. The thickness generally increases westward.	flows (150 m) The following fossils were collected from the main coal beds and oil shale: Leaves: Sequoia chinensis Endő, Taxodium disticum miocenicenum Heer, Ginkgo cfr. adiantoides Heer, Fragus feroniae Unger. Fruits: Glyptostrobus europaeus (BR.), Alunus kefersteini Goepp., Querqus drymeja Ung., Carpinus grandis Ung., Planera ungeri Ett. Insects in amber within the coal seams: Populus occidentalis Lesg., Cecidomyia byjunensis Naora, Exetates manchuricus Naora, Componetus tokunagai Naora, Cainoblattinopsis fushuensis Ping. Fresh-water Chelonia: Anosteira manchuriana R. Zangeri, 1947.	The Fushun series constitutes the Fushun[馬扇] coal field along the southern bank of the Hun Ho[泽河], and forms a monoclinal graben stretching 17 km east-west and 2 km north-south. The generally monoclinal strata dip to the north, with the northern boundary sharply marked by a large reverse strike fault. The succession in descending order is as follows: (2) Upper coal-bearing formation Green calcareous shale (thickness 800 m or more) 011 shale (120-180 m) Main coal beds (10-100 m averaging 60 m) (1) Lower coal-bearing formation Agglomeratic tuff, tuffaceous sandstone and shale, poor coal seems, and interbedded basalt	Flows of olivine basalt occur as caps of hills.	Younger fluviatile deposits composed of sand, clay and gravel cover lower terrace remnants and flood plains. Older aeclian and fluviatile deposits composed of loess, silt, sand, and gravel cover higher terrace remnants fringing the broad flood plain of Liao-ning.	IC COLUMN AND UNIT DESCRIPTIONS UNIT DESCRIPTION
							(9) Kung-chang-ling 55 1,200 (14) Miso-erh-kou 55 350 (8) Ying-t'so-yuan 60 50 (7) Wang-chia-pu-tzu 50 20 (7) Total 1,620 (thousand tons)	(B) "High grade ore" King-chang-ling is the top importance in the reserves of Ning-chang-ling is the top importance in the reserves of Ning-chang-ling is the top importance in the reserves of 1940 regarding this mine, listed actual and probable reserves of 40 million tons, and a possible reserves of 60 million tons, or in total 1 00 million tons. The above figures, however, might include a degree of exaggeration due to business policy. Miso-erh-kou ranks next in importance, with probable reserves of more than 4 million tons. Ying-t'ac-yuan and Wang-chia-pu-tzu of the Anshan district are both minor in the reserves of high-grade ore, and may be about 500 thousand tons in total. The annual production of the high-grade iron ore from the map area, as of the end of World War II, were as follows:	iron ore" belonging probably to the Anshan series. The "banded iron ore" is separated into the "banded low-grade ore", as will be shown below. (A) "Banded low-grade ore" The ore around the Anshan Iron Mines is the most important. Wai-t'ou-shan, II-shu-shan, Ch'iao-t'ou, and Miao-erh-kou, in addition to Kung-chang-ling, are large in reserves. The grade of ore ranges from 20 to 40% Fe, and is usually 30% Fe or so. Total ore reserves throughout the map area would be 4,000-5,000 million tons (calculated to a depth of 50 meters below the valley levels). The low grade ore has been worked exclusively in the An-shan district, where the annual productions of crude ore near the end of World War II (1944) were as follows: (3) Thug-an-shan (2) Hsi-an-shan (3) Tomage (3) Thaku-shan (5) Yen-ch'ien-shan (5) Total (1940)	Ta-ku-shan[天海山] block (4) Ta-ku-shan[天海山] block (4) Ta-ku-shan (4) Ta-ku-shan (5) Yen-ch'ten-shan Ying-t'ao-yuan[標海山] block (6) T-tan-shan[- 跨山] (7) Wan-ch'ta-pu-tzu[王家堡于] and (8) Yin-t'ao-yuan (9) Su-chia-pu-tzu[玉家堡于] (10) Kao-chia-pu-tzu[燕家海] (11) Pa-pan-ling[八藝莉] Mine (12) Ch'iao-t'ou[希斯] (14) Miao-erh-kou Iron Mines [海兒海城山] (14) Miao-erh-kou Iron Mines [海兒海城山] (15) Ii-shu-shan[梨樹山] (15) Ii-shu-shan[梨樹山]	Limestone of the Lower Paleozoic has been quarried at various spots of the map area, to feed local lime kilns, and portland cement kilns, or to supply iron smelters. Iron An-shan Iron Mines (An-shan block (1) Tui-mien-shan (2) Hsi-an-shan	ten seams of coal are there, of which 5 are workable with a thickness of 0.5-2.0 meters each. The coal rank is samianthracite. The measured reserves total 53 million tons. Fire clay and high-alumina clay In every Upper Carboniferous coal field mentioned above, the fire clay and high-alumina clay (or bauxite-clay) are intercalated with the coal-measures. The bauxite-clay from Yen-t'ai-t'an-k'eng and Niu-bsin-t'ai was shipped to Fushum, where it was utilized for manufacturing metallic aluminum.	contain 28 seams of coal, of which 3 are more than 1 meter thick and workable. The rank is semi-anthracite, with estimated reserves of 29.8 million tons (as of 1942). A certain coal seam abounds with pyrite nodules which, upon separation, were shipped to Fu-shun for manufacturing sulphuric acid. The mine has a briquette plant with a capacity of 150 thousand tons a year. 4. Coal at Mu-hsin-t'ai Coal has been mined here since a century ago, but the mining rights were acquired by a Sino-Japanese corporation in 1914. Coal has been confirmed over a 4 km by 5 km area. More than	the most important strong coking coal resource in South Manchuria. The Pen-ch'i-hu Iron and Steel Works was established at Miyanohara, just south of Pen-ch'i-hu. 3. Coal at Yen-t'ai-t'an-k'eng Coal has been worked here since a thousand years ago, but regular production was begun in 1909 by the South Manchuria Railway Co. The coal-measures show a boat-shaped synclinal Structure 6.3 km long, and the strata din 20° - 30° They	2. Coal at Pen-ch'1-hu. Coal was mined since ancient times, but systematic operation began in 1911, when a Sino-Japanese corporation originated here. The coal-measures occupy a 6 km by 7 km area, and contain 17 seams of coal of which 8 seams are workable with thicknesses of 0.6-3.0 m, and dips of 10°- 30° S; the coal reserves (as of 1942) measured 225 million tons. This was	rons of yield was started here in 1930, since then the project was expanded very quickly. A statistic for the 1939 fiscal year shows that the West Opencut of Fu-shun has stripped an overburden amounting 3.2 million cubic meters; of which the shale ore (5.8% shale oil yield) actually sent to the distillating plant was 8.47 million tons for the year. The project reached a peak during World War II. This was the largest shale oil industry in	Oil shale at Fu-shun Oil shale 120-180 m thick rests conformably on the main coal seam at Fu-shun, and it in turn is overlain by a green calcareous shale 800 m thick. Average yield of oil from the Fushun oil shale has been reported as 5.8% by weight, in which the shale at the basal part, about 30 m thick, was excluded because of excessively low grade. Re- serves of payable one were measured as 5,400 million tons. A shale oil industry with a yearly capacity of 36 thousand	the coal production. The development of the open-cuts in the western field, and the sinking of the vertical shaft in the eastern field mark the highlights of both type operations. Coal reserves as of 1942 were estimated as about 661 million tons. A sharp decline in the output has been reported since the mines were captured by Communist China. The coal from the eastern coal field was made a metallurgical coke by blending with strongly coking coal from Penchi-hu; and the coal from the central and western field had a good market as steam and gas coal, as domestic coal, and as coal for synthetic petroleum products.	rupe herthary strend on 20 - 40 morth, except in the western part of the field where the homocline is interrupted by an anticline and a syncline plunging northeast and southwest respectively. The coal is high-volatile bituminous coal. About two-thirds of the area overlain by coal is covered by alluvium. Regarding mining, open-cut and underground mining have contributed almost equally to	1. Coal at Fu-shun The Fushun Colliery is 25 miles east of Shen-yang. Coal was first mined here some 700 years ago, but a large scaled production did not start until 1907 when mining rights were acquired by the South Manchuria Railway Company. Output of coal from 1907 to 1944 totaled approximately 183 million tons. Peaks in production were reached in 1929 and 1937.	ECONOMIC VALUE
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