# GEOLOGIC COLUMN AND UNIT DESCRIPTIONS

| AGE | ROCK UNIT | LITHOLOGY; THICKNESS WHERE KNOWN | REMARKS | ECONOMIC VALUE |
|---|---|---|---|---|
| QUATERNARY | Alluvium | Qal — *Sand, gravel, and clay. Thickness less than 10 meters.* | Recent deposits of sand, gravel and clay covering river flats. | Placer gold was worked in ancient times from the river gravel at various places. |
| | Diluvium | Qd — *Aeolian sand, loess, and gravel. Thickness less than 40 m.* | Pleistocene deposits including aeolian sand, loess, redeposited loess, and gravel. | Placer gold was worked until quite recently, especially from the terrace deposits along the streams of the gneiss region. |
| | | *Unconformity* | | |
| TERTIARY | Neogene basalt | N — *Augite-olivine basalt, tuff, and breccia. Thickness 100 m to 400 m.* | Neogene basalt consists mainly of flows and sheets of augite-olivine basalt intercalated with tuff and breccia. It is best developed in the mountain land around Hei Shan[黑山], west of Ling-yuan[凌源]. Age of its eruption is believed to be Pliocene. | |
| | | *Effusive contact* | | |
| MESOZOIC | Rhyolite | r — *Rhyolite, trachyandesite, tuff, and breccia. Thickness more than 300 m.* | Rhyolite of probably Middle Cretaceous age is mostly in flows and dikes, associated with tuff and breccia. Trachyandesite also occurs though in minor amount. Because of scarce data, the Cretaceous rhyolite is hardly distinguishable from the rhyolitic volcanic series of the Upper Jehol formation. | |
| | | *Effusive contact* | | |
| | Quartz porphyry | qp — *Quartz porphyry and granite porphyry.* | Quartz porphyry and granite porphyry intruded during the period of Lower Cretaceous; may have been differentiated from the same magma as that of the granite ($g_3$). | (Au) (gold mines) 1. Chang-kou 2. Hsin-tien[新店]; 3. Ta-hsi-kou [大西沟]; 4. Mei-lin-wo-pu[梅林窝铺], north of Fu-chia-wo-pu[傅家窝铺]; 5. Tsao-mao-shan[草帽山]; 6. Kao-chia-tien[高家店]; 7. A-ho-ying-tzu[阿鹤营子]; 8. Chin-chang[金厂沟]; 9. Miang-niang-miao[娘娘庙]; 10. Ching-chien-ti[清泉坦]; 11. Wu-lung-tai[五龙台], northwest of Ching-chien-ti; 12. Hsiao-chang-kou [小厂沟], north of Fa-leng-kuan[八楞关]; 13. Yao-shang [窑沟]; 14. Chien-chang-ying-tzu[建昌营子], south of Lung-wang-miao[龙王庙]. |
| | Cretaceous granite | $g_3$ (Au Ag Pb) — *Biotite granite, quartz monzonite, and felsitic granite.* | Biotite granite, quartz monzonite and felsitic granite. The age of intrusion of these rocks may be late Jurassic or early Cretaceous, from the fact that in the mining localities (see Economic Value) a number of ore veins which are genetically related with the granitic intrusives cut the flows and sheets of andesite and rhyolite of the Jehol formation. | (Au) (Cu) (gold-copper mine) 15. Ping-chuan[平泉] |
| | Diorite | d — *Diorite and granodiorite* | Diorite and granodiorite; may be products of differentiation of the same magma as that of the granite ($g_3$). | (Ag Pb) (silver-lead mines) 1. Yang-shu-lin[槐树林]; 2. Yu-shu-ti[榆树底]; 3. San-tao-kou[三道沟] |
| | | *Intrusive contact* | | |
| | Jehol formation | *Upper: alternation of tuff, sandstone, and conglomerate; with acidic volcanic rocks and pyroclastic rocks. Thickness about 500 m.* | The Jehol formation is predominantly Jurassic accompanied locally by Uppermost Triassic and Lower Cretaceous; corresponds to the so-called "Jehol formation" by Isao MATSUZAWA and others, and is divided into the upper, the middle, and the lower parts as follows: | |
| | | | The Upper Jehol formation consists of an alternation of tuff, sandstone and conglomerate, and is characteristically intercalated with flows and sheets of acidic volcanic rocks and pyroclastic rocks. Its total thickness in the district of Ling-yuan may be more than 500 m. With no data available it is often very hard to distinguish the Upper Jehol formation from the overlying rhyolite flows; this is particularly so in the northwestern part of the map area. The age of the Upper Jehol formation is considered to be Uppermost Jurassic, although locally it may range to Lower Cretaceous. | |
| | | *Middle: sandstone, shale, conglomerate, and coal. Thickness 500 m to 1,000 m.* | The Middle Jehol formation consists of sandstone, shale, and conglomerate, and is characterized by the occurrence of fresh-water fossils such as Estheria and Lycoptera. The Middle Jehol formation, distributed in the districts of Ling-yuan, Kun-tu-hai[瓦大海], Ta-cheng-tzu[大城子], and in the area east of Meng-shu-kou[蒙树沟], is characterized by oil shale-bearing beds, while the exposures in the vicinities of Szu-tzu-kou[斜子沟], Wu-chia[吴家], Wei-tzu-kou[韦子沟], Ta-niu-hsi[大牛西], Fa-li-kan-tien-tzu[八里甘淀子], Szu-lung-kou[四龙沟] southeast of Wa-fang-tien [瓦房店], and in the area southeast of Chien-chang[建昌] are marked with a coal-bearing formation. The Middle Jehol formation generally lacks tuff and contemporaneous volcanic rocks which present a characteristic feature of the Upper Jehol formation. A thick basal conglomerate occurs. The total thickness may range between 500 m and 1,000 m. Fossils reported from the Lycoptera-bearing formation near La-ma-chang-tzu[喇嘛场子] southwest of Ling-yuan were: Monjurosuchus splendens Endo, Rhynchosaurus orientalis Endo et Shikama, Lycoptera davidi (Sauvage), Sinoblatta Laiyuangensis Ping, Spheenopsis tristalis Richward, Astacus liconti V. Straelen, A. spinirostrius Imaizumi, Czekanowskia rigida Heer, and Schizolepsis joholensis Yabe et Endo. Those from Ta-shen-fang-tzu [大申房子] north of Ling-yuan were Lycoptera joholensis Grabau, L. joholensis var. minor Grabau, Esteria sp., and Corbicula joholensis Grabau. Yu-cheng-tzu[大城子]is also a well-known locality of the Lycoptera-bearing formation. Fossils reported from the coal-bearing formation of Wu-chia coal field were Elatocladus sp., Phoenicopsis sp., Gingkoites sibirica Heer, Czekanowskia dichotoma Heer, Pityophyllum sp., Samaruna sp., and a bone of Lycoptera(?). As to the age of the Middle Jehol formation no decisive agreement has been reached among geologists, and it varies between Middle Jurassic and Uppermost Jurassic. | (⊗) (coal) 1. Wu-chia[五家]; 2. Ssu-tzu-kou[斜子沟], southwest of Tung-feng-tai[东丰台]; 3. Wei-tzu-kou[韦子沟], northwest of Wei-tzu-kou-men[韦子沟门]; 4. Yang-chia-kou[杨家沟]; 5. Lao-yao-kou[老窑沟], northeast of Wa-fang[瓦房]; 6. Ta-niu-hsi[大牛西] The coal-bearing beds at the coal fields of Wu-chia, Ssu-tzu-kou, Wei-tzu-kou, Yang-chia-kou, Lao-yao-kou, and Ta-niu-hsi belong to the Middle Jehol formation. The coal is generally low-grade bituminous coal or black lignite, and was intermittently worked by Chinese for local consumption. The coal field of Wu-chia has the largest reserves, estimated at about 10 million tons by geologist B. BESSHO, although the coal was not used for the railway because of its low calorific value. |
| | | *Unconformity* | | |
| | | *Lower: andesite, andesitic pyroclastic rocks, sandstone, conglomerate, and coal. Thickness more than 500 m.* | The Lower Jehol formation is generally characterized by a predominance of andesite and andesitic pyroclastic rocks, and is covered either by the Middle Jehol formation or by the Upper Jehol formation. The succession of the Lower Jehol formation at the Niu-ying-tzu[牛营子] coal field, 20 km south of Ling-yuan, is reported to be as follows, in descending order: a reddish formation (consists of conglomerate, sandstone, andesitic lava, agglomerate, and tuff), a coal-bearing formation, and a bedded, thick basal conglomerate. The Sinian limestone was thrust over the reddish formation from northwest to southeast, and the limestone is in turn unconformably covered by the acidic volcanic series of presumably Upper Jehol formation. Fossils such as Cladophlebis haiburnensis, and Neocalamites sp. were reported from the coal-bearing formation. The age of the Lower Jehol formation varies between Lower Jurassic to Rhaetic according to different opinions among geologists. | (⊗) (coal) 7. Niu-ying-tzu[牛营子] The Niu-ying-tzu coal field was intermittently operated by the neighboring villagers for local consumption. The mine locality is hard to reach. The coal-bearing beds belong to the Lower Jehol formation. |
| | Andesite | *Andesite, and agglomeratic andesite* | Flows and sheets of andesite and agglomeratic andesite; mainly contemporaneous with the Lower Jehol formation, and partly associated with the Upper Jehol formation. | |
| | | *Unconformity* | | |
| PALEOZOIC | Permian formation | Pu — *Slate, sandstone, conglomerate, and coal. Thickness about 450 m.* | The Upper Paleozoic in the map area is represented by a Permian terrestrial formation consisting of slate, sandstone, conglomerate, and coal. The formation, along with the Lower Paleozoic formation, crops out as a "window" south of San-tzo-tien[三座店], Ping-chuan Hsien, as a consequence of local erosion cutting through the overriding thrust. The total thickness of the formation, judged from that in the Lin-yu sheet (NK 50-12) area, may not be less than 450 m. | |
| | | *Unconformity* | | |
| | Cambro-Ordovician formation | Pz — *Limestone, magnesian limestone, shale, and slate. Thickness more than 500 m.* | The Lower Paleozoic formation consists of limestone, magnesian limestone, shale and slate. No fossil has been collected from this formation in the map area, but from the lithological resemblance it can be considered as a northern extension of the Cambro-Ordovician formation of the Lin-yu sheet area. The total thickness may be more than 500 m. | |
| | | *Unconformity* | | |
| PRECAMBRIAN | Sinian system | pCu — *Upper: limestone, magnesian limestone, siliceous limestone, siliceous phyllite, calcareous slate, and red slate. Thickness about 2,000 m.* | The Upper Precambrian in the map area is represented by the Sinian system. Stratigraphy of this system in the map area has not been studied in detail, but generally it shows no large difference from that of the adjacent Lin-yu sheet area. Lithologically the Sinian system can be roughly divided into the upper and lower formations. | |
| | | *Lower: quartzite, sandstone, and conglomerate. Thickness 1,000 m to 1,500 m.* | The upper formation with a probable thickness of more than 2,000 m has the following succession, in descending order: a limestone, a magnesian limestone, a siliceous limestone, an alternation of siliceous phyllite and calcareous slate, and a red slate at the base. The lower formation consists, in descending order, of a thickly bedded quartzite, a siliceous sandstone, a conglomerate, and a basal conglomerate. Thickness ranges between 1,000 m and 1,500 m. No recognizable unconformity occurs between the upper and lower formations. Generally a few beds of red slate mark the base of the upper formation. The Sinian system in this map area presents large-scaled warping structures associated with thrusts. | |
| | | *Unconformity* | | |
| | Wutai system (?) | Sch — *Schist complex consisting of crystalline limestone, mica schists, and hornfels. Thickness unknown.* | Schist complex of the Wutai system(?); consists of crystalline limestone, mica schist, and hornfels. It crops out in the districts of Yu-shu-ti[榆树底], Chin-chiang[金厂沟], Kung-yeh-fu[公爷府], and Chiang-kou[姜沟]. It is a product of contact metamorphism caused by injection of granitic rock or orthogneiss into sedimentary rocks. The age of the schist complex has not been determined yet, but it is generally correlated with the Wutai system or Lower Precambrian. | |
| | Sangkan system (?) | gn — *Gneiss complex consisting of orthogneiss, injection gneiss, and schist. Thickness unknown.* | Gneiss complex of the Sangkan system(?); consists mainly of medium-grained orthogneiss and injection gneiss of variable mineral compositions. Some crystalline schist also occurs. It is a complicated mixture formed by metamorphic diffusion of both the pre-existing sedimentary rocks and the later granitic intrusives. The age of this complex may be Archean. From its lithological resemblance, O. B. Barbour correlated the gneiss complex of this map area with the Sangkan system of Kalgan area. | |
| | (Column not drawn to scale) | | | |

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