

# ***General Review of the Coal Fields in Central and South China***

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## **Preface**

Central and South China include the environs and southern districts of the Yang-tze-chiang (Yangtze River), six prefectures of Central China, three prefectures of South China, and four prefectures of West China. Most of the coal fields in the northern part of Chiang-su Province and An-hui Province, as well as those in the western provinces, are excluded from this paper because they are geologically considered to belong to the coal fields of North China. Most of the four prefectures in West China are not dealt with either, as they are outside the designated survey area.

Coal resources in Central and South China are extremely inferior to those in Manchuria and in North China. Only a few coal fields in the northern part of An-hui Province and in some parts of Chiang-hsi Province and Hu-nan Province are worth discussing, as our survey during 1938–1945 was limited to checking the previous investigations in known coal fields. The results of the survey were not clarified by the discovery of new coal fields, and very little new information on stratigraphy was gathered, as it had already been well studied. The mining companies which had prospected and developed the coal fields are as follows:

The Central China Mining Company carried out a precise survey of the coal fields, as well as of other mineral resources, in the Yang-tze-chiang area.

The Huai-nan Coal Mining Company carried out precise geological surveys and the seismic prospecting of the Huai-nan coal field and vicinity.

The Oriental Colonization Company conducted prospecting by boring in the Hsi-shan-tao coal field.

The newly discovered coal field in the northwestern extension of the Huai-nan coal field, which was reported by C. Y. HSIEH,<sup>1)</sup> was not included in our area of survey because of wartime conditions.

The present report only outlines my investigation, because most of the survey and research data were lost in the surveyed area in 1945, and neither the report nor

<sup>1)</sup> HSIEH, C. Y., 1949. Pai-kung-shan coal field—A new discovery in the Huai-nan Basin, North An-hui, Central China. *Econ. Geol.*, v. 44, no. 2, pp. 128–142.

a copy of it had been sent to Japan. Therefore, I have been obliged to complete this paper from memory.

## 1. Geographical Distribution of the Coal Fields

Many small coal fields are distributed in Central and South China, but there are only a few important ones. Throughout all the provinces the coal fields are arranged in several zones of an almost E-W trend.

The largest coal field in Central China—the Huai-nan coal field—is located in the drainage area of the Huai-ho River, the north-central region of An-hui Province. Many small coal mines are distributed in the Nan-ching mountainland (Ning-chen mountain range) in Chiang-nan,<sup>2)</sup> and in the western region is the Hanchao coal field, An-hui Province. Along the coast of the Yang-tze-chiang from An-ching to Nan-kou there are several small coal fields: Tao-chung, Su-sung, Tai-hu, Su-chun, Yang-hsin, Ta-yeh, Hsieng-ning, Pu-chi, Chia-yu, and Pao-nan. One of these, the Ta-yeh coal field at Shih-hui-yao, is relatively large. In Chiang-su Province there are coal localities at Hsi-shan-tao on Lake Tai-hu, at Hu-chou on its southern shore, and at I-hsing on the west; of these, the Chang-hsing coal field in the northern region of Che-chiang Province is most famous. In the region between Chang-hua and Chi-chi there are some localities of characteristic calcareous anthracite and in its western region—the southwestern region of An-hui Province—there is the relatively wide I-ching coal field.

In the east corner of Chiang-hsi Province, there are some small coal fields in the districts of Yu-shan and Kuang-feng, and along the Hsiu-shui River; the coal fields of Chin-hsien, Lin-chuan, Yu-yu, Le-ping, Feng-cheng, etc are distributed in the area southeast of Nan-chang. The An-yuan and the Ping-hsiang coal fields in the western region of the province are as famous as the Ta-yeh iron mine for production of caking coal. The zone of this coal field reaches the coal fields of Li-ling and Shi-men-kou in Hu-nan Province.

In Hu-nan Province there are many small coal fields: Shih-men-kou, Lai-ho, Chi-chang, Hsia-liu-chung, Hsiang-tan in the vicinity of the Hsiang-shui River, and Tzu-men-chiao, Hung-shan-tien, Hu-ping, Feng-kuan-shan, and Ching-chi-chung in the district of Hsiang-ning. There are also some coal localities in the districts of Hsin-hua, An-hua, and Shao-yang along the drainage area of the Tzu-chiang River. In the southern part of the province lie the coal fields of Yang-mei-shan and Kou-ya-tung in the Wan-yang-shan range, which grade into the Ju-yuan coal field in Kuang-tung Province.

In Fu-chien Province, there are only a few small coal fields—some anthracite localities near Lung-yen. In Kuang-tung Province are the Ju-yuan coal field mentioned above and some coal fields in the east and west. In Kuang-hsi Province there are some small coal fields in the districts of Chuan-hsien in the north and Kuei-

<sup>2)</sup> The term Yang-tze-chiang, or “Chang Chiang,” refers to the course of the Yangtze-River below Chen-kiang (Chen-chiang), and the term Chiang-nan denotes the southern coastal region.

hsien in the south, as well as along the course of the Liu-chiang River. Some areas of lignite are found in the districts of Ho-hsien in the east and Nan-ning and Ping-ma in the southwest. In Kuei-chou Province there are several coal fields in the districts of Kuei-yang and Ta-ting; in Ssu-chuan Province some thin coal beds are distributed throughout the Pa-shu basin, and some of them along the course of such rivers as Yang-tze-chiang, Chi-chiang, and Wu-chiang have been worked on a small scale.

## 2. Geological Distribution of the Coal Beds

The stratigraphically oldest coal in Central and South China is the so-called "stony coal" in the graptolite-bearing Ordovician shale in the northwestern part of Che-chiang Province. It is used as fuel by the inhabitants and contains 70–80 per cent ash. Microscopic examination shows that fine-grained carbonaceous material is finely dispersed in the inorganic material; it can be said to belong to the *brand schiefer*, but, as the carbonaceous matter probably originated from algae by a huminous phenomenon, it is considered sapropelic coal.

Proper coal is found in the Carboniferous systems. Lower Carboniferous coal measures are found in the Tseshui system in central Hu-nan Province, in the Chin-hsien system in Fu-chien Province to the southwestern part of Chiang-hsi Province, in the Linwu system in the eastern region of Kuang-tung Province, in the Ssumen system in the western part of Kuang-hsi Province, in the Hsiwan system in the district of Ho-hsien, and in the Eulkai system in central-eastern Yun-nan Province. It is not clear whether there are any coal measures in the middle Carboniferous system in Yun-nan Province.

The most important coal measures in Central and South China are found in the Permian system: the Middle and Upper Permian Huai-nan coal measure and the Lung-tan coal measure of the Nan-ching mountainland and of the border regions of Chiang-su Province and An-hui Province, the Li-hsien coal measure in the northwestern part of Che-chiang Province, the I-ching coal measure in the southern part of An-hui Province, the Chin-hsien coal measure in the central part of Chiang-hsi Province, the Feng-tien coal measure in the western part of the same province, the Lao-hu-shan coal measure and the Wangchiopo system in the northwestern part of Chiang-hsi Province and in the western part of An-hui Province, the Tou-ling coal measure in the central part of Hu-nan Province, the Tan-shan-wan coal measure and the Chushan system in Hu-pei Province, the Huang-kang-ling coal measure in the northern part of the Deoling system in the eastern part of Nan-ling, Kuang-tung Province, the I-chia-ping coal measure in the southern part of Kuei-chou Province, etc. Most of them are characterized by the presence of *Gigantopteris nicotianaefolia*—*Leptodus* flora and belong to the Upper Permian.

The above-mentioned coal measures in the central regions of Central China are often grouped under the name of the Le-ping system. The Yuan-chia-chung coal

measure in Hu-nan Province has been assigned to Middle Permian, but this has not yet been checked by the author.

The Hsiang-chi coal measure, distributed widely in the Pa-tung region of Hu-pei Province and in the Pa-shu basin of Ssu-chuan Province, has been identified as Triassic (Rhaeto-Liassic), but the other Mesozoic coal measures, relatively widely distributed, belong to the Jurassic system. One of these, the Hsiang-shan formation in the Nan-ching mountainland, is intercalated with some nonworkable coal beds. On the other hand, the Shih-men-kou system (Ping-hsiang coal measure) in the western part of Chiang-hsi Province and in the eastern part of Hu-nan Province is intercalated with rich coal beds. In addition, the Tsungjen system is distributed in the southeastern part of Chiang-hsi Province and in the northern part of Fu-chien Province, the Chin-chu-wo coal measure in Kuang-tung Province, the Kenkou system in the eastern part of Nan-ling, the Yang-mei-shan coal measure from the southern part of Hu-nan Province to the northern part of Kuang-tung Province, and some Jurassic coal measures in the course of the Han-shui River in Hu-pei Province.

The Paishan system in the southern part of Fu-chien Province is intercalated with some thin coal beds and may be cited as an example of Cretaceous coal measures; the others are not yet clear.

In the provinces of Kuang-tung and Kuang-hsi, there are some Tertiary lignite-bearing formations called the Yung-ning system, which contains fresh-water shells and plants and has been identified as Pliocene. Almost the same formations are reported to be distributed in Ning-erh and other places in Yun-nan Province.

Near Hai-cheng, Fu-chien Province, there are some peat areas, and the peat is considered Quaternary. Some layers of peat have formed on the bottom of Lake Hsi-hu near the city of Hang-chou, Che-chiang Province. They are only a few centimeters thick and are of no economic value, but are interesting in regard to the genesis of peat.<sup>3)</sup>

### 3. Coal Measures

In another paper, "The Paleozoic Era in Central and South China," the author discusses the stratigraphic succession and the correlation of the coal measures. Here, the author will briefly describe the characteristics of the coal measures. The Paleozoic coal measures are generally thin and composed of sandstone, shale, sandy shale, calcareous material, and occasionally black or bituminous limestone. The lower and upper formations consist of thick limestone. This may indicate that the coal measures were paralic sediments in the coastal region during the repeated transgressions and regressions, but sometimes some marine coal measures are found

<sup>3)</sup> SHIMAKURA, M. and KASUYA, T. (1943). The sediments on the bottom of Lake Hsi-hu near Hang-chou. *Science* (Kagaku), v. 13, no. 5, pp. 168-169 (J).

intercalated with limestone. For example, the Lung-tan coal measure<sup>4)</sup> exists between the Chi-hsia and the Ching-lung limestone and is generally 30–50 m thick and occasionally 100 m thick where workable coal seams are contained. The Tan-shan-wan coal measure is between the Yang-hsin and the Ta-yeh limestone and is about 80 m thick. The Tse-shui coal measure lies between the Shih-teng-tzu and the Tzu-men-chiao limestone and is 30–100 m thick.

The Lower Mesozoic coal measures lie on thick Triassic basement rocks and are of various thicknesses; the Hsiang-chi coal measure is 450 m, the Ifeng coal measure 300 m, and the Tsungjen coal measure 1,000 m thick. These facts may indicate that Central and South China have been land since the Rhaetic stage and that the coal measures were formed in the lake basins under remarkable orogenic movements (the Yen-shan orogenic movement).

Judging from their topographic characteristics, the fossils contained, and the existence of oogonium of *Chara*, geologists consider the Tertiary coal measures small-scale limnic sediments.

#### 4. Types of Coal Fields

The Paleozoic coal fields in China are generally classified into the Central and South China type and the North China type. The latter has many thick coal seams which often form large coal fields and which are intercalated with aluminous shale, while the former has thinner and fewer coal seams and the mode of occurrence of the cyclothem is different. The coal fields of the Central and South China type are widely distributed along the course and the more southern regions of the Yangtze River. The coal fields in the central and northern parts of An-hui Province, for example the Huai-nan coal field, are extensive and have relatively thick coal beds and more aluminous shale, which is characteristic of the coal fields of the North China type.

There is a stratigraphic difference between the coal measures of these two types. The Lower Carboniferous coal measure, for example the Tse-shui coal measure in Central and South China, is not found in North China, and the Lower to Middle Permian coal measures, such as the Po-shan—Tsu-chuan series and Tai-yuan—Shan-hsi series in North China, are very small or completely absent in Central and South China. The main coal measures in Central and South China are characterized by the Upper Permian flora, *Gigantopteris nicotianaefolia*—*Leptodus*, but in the Huai-nan coal field this flora is confined to the uppermost coal measure, whereas in the lower coal measure an older flora, *Caulopteris*—*Callipteridium*, is found.

The same relation is observed in the Liu-chuan coal field in the northern part of Chiang-su Province and in the Chung-hsing coal field in the southern part of Shan-tung Province. The well-developed coal measures of the Po-shan and the Tai-yuan series in the regions north of the Huang-ho River thin out toward Central China,

<sup>4)</sup> The Ku-feng formation, 20 m thick, is included.

and the upper coal measures in the Shih-ho-tzu series are worth working.<sup>5)</sup> The Huai-nan and Liu-chuan type of coal fields, therefore, is considered a transitional type between the North China type and the Central and South China type.

Among the Mesozoic coal fields, the Hsiang-chi coal measure can be tentatively correlated with the Men-tou-kou coal measure as well as with the coal measure in the Ta-tung series of North China, but this is not a positive correlation because of lack of satisfactory data. The other coal measures, the Hsiang-shan system, the Shih-men-kou system, the Yang-mei-shan system, etc., cannot be correlated with the Mesozoic coal measures of North China and Manchuria at present because of the lack of data.

### 5. Coal Beds and Coal Quality

Although the coal beds are generally thin and few in number, except in the region of Huai-nan, they often expand and these expanded parts are workable.

There are three or four coal seams in the Tse-shui coal measure and they are 0.3–1.4 m, rarely 3 m, thick. There are from one to seven coal beds in the Lung-tan coal measure which are generally 0.2–one m thick, rarely 2–3 m in the expanded parts. In the Huai-nan coal field there are more than twenty coal seams, of which fourteen or fifteen are workable; the largest seam is about 8 m thick. In the Ping-hsiang coal field there are five or six coal seams and the largest seam is about 2 m thick.

Most coal fields underwent such remarkable orogenic movement after they were deposited that the strata dip steeply, and are sometimes perpendicular or recumbent. They are also cut by several faults. The coal of Central and South China, except that in the Huai-nan and Ping-hsiang coal fields, is generally rich in ash and sulphur and powders easily. Only the shallow parts of the smaller coal fields are worked by native methods and the coal produced is of low quality, containing much weathered coal and soil. The anthracite produced in the districts along the Yangtze River is brittle and full of ash, but that near Lung-yen, Fu-chien Province, and near Kuei-yang, Kuei-chou Province, is of good quality.

Permian and Jurassic coal is generally high-grade bituminous coal or semi-bituminous coal, and sometimes low-grade bituminous coal. The coal of the Ping-hsiang and the Huai-nan coal fields is of the best quality: ash, 15–20 per cent; volatile matter, 30–40 per cent; fixed carbon, 50–60 per cent; calorific value, 6,000–7,000 cal.; and generally non-caking. No strongly caking coal, such as that of the Kai-luan and the Chung-hsing coal fields of North China, has been found.

Liptobiolith, the so-called lopinite, which contains a large amount of tar and is favorable for dry distillation, is found near Le-ping, Chiang-hsi Province. Near the boundary of Chiang-hsi and Che-chiang Provinces, there is a small amount of limy coal of small economic value; nearly all the inorganic matter of this coal is lime

<sup>5)</sup> ONUKI, Y. (1951). Upper Paleozoic formations of coal fields in North China. *Geology and Mineral Resources of the Far East*, v. 1.

and powders easily, or is scoriaceous and foams in a dilute acidic solution. The limestone of Hsi-shan-tao, Chiang-su Province is intercalated with some coal seams 10–20 cm thick, which microscopically show a fibrous texture and carbonaceous matter mixed with limestone distinctly showing the algal origin.

The lignite in the provinces of Kuang-hsi and Yun-nan is yellowish-brown or brown and earthy, resembling the *Braunkohle* of Germany. Also, some blackish-brown woody coal, similar to the Japanese coaly lignite, has been found.

## 6. Reserves

The author's revised calculation of reserves cannot be cited here because all the data and survey results were lost during the war. According to one published report,<sup>6)</sup> the reserves in Central and South China are as follows:

Province	Reserves (unit, million tons)
Chiang-su	217
Che-chiang	100
An-hui	360
Chiang-hsi	992
Hu-pei	440
Hu-nan	1,764
Ssu-chuan	9,784
Kuei-chou	1,549
Fu-chien	396
Kuang-tung	421
Kuang-hsi	300
Yun-nan	1,627

<sup>6)</sup> Hou, T. F., 1935. *General Statement on Mining Industries of China*, 5th ed. Peking, China (C).