

HYDROGEOLOGICAL CONDITIONS IN THE MAIN COAL BASINS OF VIETNAM

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ABSTRACT

Three problems are presented in the following paper:
1. Distribution and general geology of the main coal basins,
2. Hydrogeological characteristics of the basins,
3. Hydrogeological classification of the basins and their mining conditions.

1. DISTRIBUTION AND GENERAL GEOLOGY OF THE MAIN COAL BASINS IN VIETNAM.

The most important coal basins in Vietnam are located in Dong Bac (Quang Ninh and Bac Thai Basins) and Bac Bo Districts (Khoai Chau Basin). Additionally, several small basins are present in other districts: i.e., Tay Bac (Suoi Bang Basin) and Trung Bo (Nong Son Basin). A small basin (Na Duong) is located in Dong Bac District, as well (Fig.1).

Most of the basins contain hard coals which were deposited in Upper Triassic (T_{3n-r}). These are: Quang Ninh (Hon Gai Stage), Bac Thai (Van Lang Stage), Suoi Bang (Suoi Bang Stage) and Nong Son (Nong Son Stage).

Hon Gai Stage of total thickness 1500 - 1800 meters embraces conglomerates, sandstones, shales, coal shales and anthracite seams. Coarse grained sediments predominate in lower and upper parts of the sequence whereas coal seams occur in the middle one.

Van Lang Stage consists of two parts. Lower part is composed calcareous sandstones and shales. The upper one embraces shales, sandstones, carbonaceous shales and coal seams. Total thickness varies from 400 to 600 meters.

Suoi Bang Stage contains basaltic conglomerates varying in thickness from 2-3 up to 200-300 meters along with shales, sandstones, carbonaceous shales and coal seams. Total thickness reaches 800 - 1200 meters.

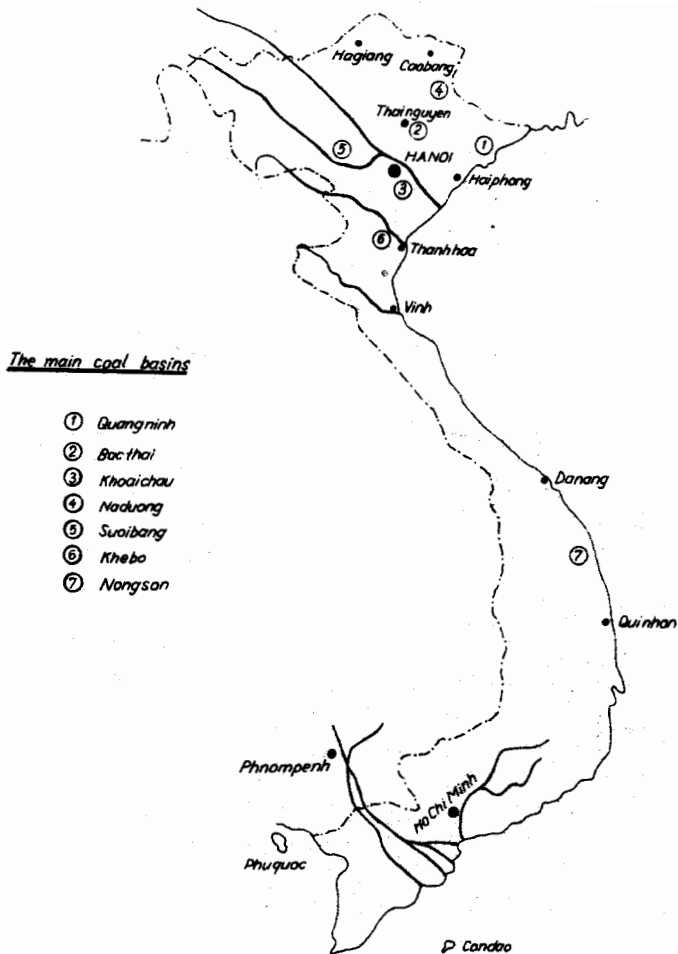


Fig.1. The localization of main coal basins.

Nong Son Stage also contains basaltic conglomerates along with breccias red coarse grained conglomerates, continental sandstones, carbonaceous shales and coal seams of total thickness varying from 1200 to 1500 meters.

Geology of the coal basins mentioned above is rather complicated because of extensive tectonic processes.

Brown coals of Neogene age occur in Khoai Chau and Na Duong Basins Stratigraphic sequences embrace shales, sandstones, conglomerates and coal seams of total thicknesses ranging from several hundreds (Na Duong Stage) to several thousands of me-

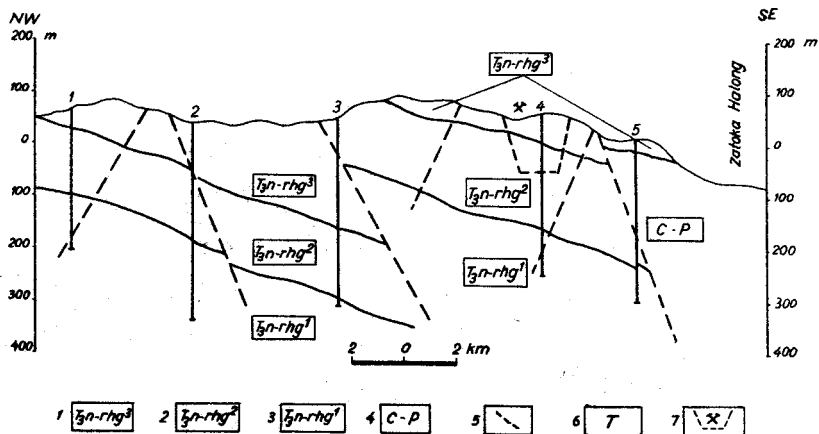


Fig. 2. Hydrogeological cross-section of the Quang Ninh coal basin.

Water bearing horizons: 1-above coal bearing formation, 2-within coal bearing formation, 3-beneath coal bearing formation; 4-hydrogeological system of permo-carbon rocks; 5-faults; 6-test wells; 7-open pit mine Coc Sau.

ters (Tien Hung Stage). In Khoai Chau Basin the coal bearing formation is overlain by Quaternary and Pliocene sediments several hundreds of meters thick.

2. HYDROGEOLOGICAL CHARACTERISTICS OF THE COAL BASINS IN VIETNAM.

The main hydrogeological features of coal basins are presented on Fig.2,3 and in Tab.1,2. Generally, the wall rocks terrigenous conglomerates, sandstones and shales are hard and faintly jointed. Average thickness of coal bearing series varies from 500 to 1600 meters. Prevailing morphological features are gentle hills. Surface waters system is relatively well developed but consists of small streams of low discharge. Thickness of weathering zone is insignificant. (0.5 - 1-2 meters). Ground waters reveal free or low pressure tables. Coefficient of permeability varies from 10^{-3} to 10^{-5} cm/s. Specific yields of test wells are often below 0.1 l/s/m. Only in tectonic zones these may increase up to 0.5 - 1.0 l/s/m or even more. Total dissolved solids (TDS) varies between 0.3 - and 0.6 g/l and pH is 6.0 - 6.5 which allows the waters to be classified as fresh. Chemical composition corresponds to HCO_3 -Cl-Ca, occasionally HCO_3 -Cl-Ca-Na types. Increased SO_4 contents result from oxidation of sulfides within coal seams.

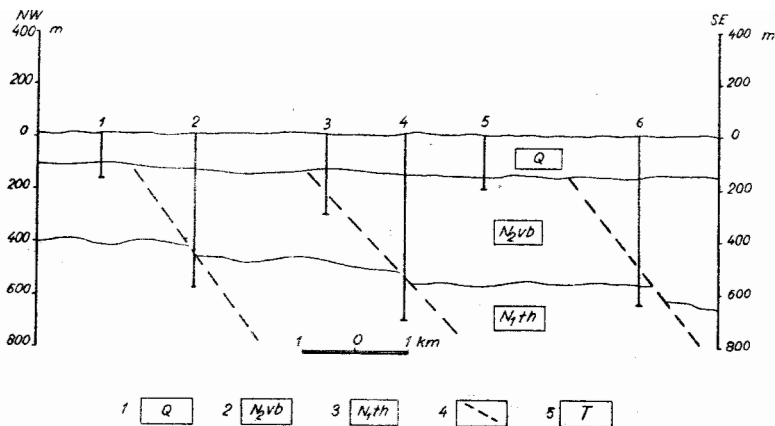


Fig.3. Hydrogeological cross-section of the Khoai Chau coal basin.
 1-Quaternary, 2-Pliocen (Vinh Bao stage), 3-Miocen Tien Hung stage - coal bearing formation, 4-Faults, 5-Test wells.

Stratigraphy of brown coal basins includes Quaternary sediments, Pliocene marine deposits (Khoai Chau Basin) and continental Upper Miocene ones.

Quaternary sediments are pebbles, gravels, sands, silts and clays. Pliocene beds consist of sands, silts clays and soft shales. Upper Miocene continental deposits are sandstones, shales, coal shales and brown coal seams of an average thickness between 100 and 600 meters. The land in the vicinity of basin is flat and cut with surface flows. Quaternary sediments especially, in Khoai Chau Basin are rich in water. Coefficient of permeability varies from 10^{-3} - 10^{-4} cm/s with specific yields of test wells commonly exceeding 0.5 l/s/m. Continental Miocene deposits reveal permeability coefficient 10^{-3} to 10^{-6} cm/s with specific yields often below 0.2 l/s/m. Ground water aquifers appear to be unconfined or semi-confined reveal in Quaternary and confined in Neogene ones. TDS vary in wide range: from below 0.5 g/l (Na Duong Basin) to 10 g/l (Khoai Chau Basin). Chemical composition is mainly HCO_3 - SO_4 -Ca (Na Duong Basin) and HCO_3 -Cl-Ca-Na (Khoai Chau Basin). PH values change from 3- 6.5 in Na Duong Basin to 6.5 - 7.5 in Khoai Chau one. Low pH values for Na Duong area are caused by the intense oxidation of sulfides within coal seams which simultaneously results in the increased contents of SO_4 in the underground waters.

General hydrogeological		
coal-basins	strati-graphy	formation
1	2	3
Quang Ninh	T _{3n-rly} ³	terrigenic
	T _{3n-r-ly} ²	terrigenic coal-bearing
	T _{3n-rly} ¹	terrigenic
Bac Thai	T _{3n-r} ^{v1}	terrigenic, coal-bearing
	T _{3n-r} ^{v1} ²	terrigenic
Khosi Chau	Q	terrigenic and lagoon
	N _{ob}	marine
	N _{th}	terrigenic
Na Duong	N _{rc}	terrigenic

x - Specific yield test w

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3. HYDROGEOLOGICAL CLASSIFICATION OF COAL BASINS AND THEIR MINING CONDITIONS.

Two groups of coal basins can be distinguished basing on hydrogeological conditions:

I. Triassic hard coal basins revealing suitable mining conditions and low inflows of underground waters. Hydrogeological conditions is mainly controlled by precipitation and surface waters. Dewatering methods are simple.

II. Neogene brown coal basins. Two groups are proposed:

A. low inflows of underground waters but high oxidation rates. Dewatering methods are relatively simple but land slides in the open pits cause problems. Typical example is Na Duong Basin.

B. high inflows of underground waters and difficult mining conditions including very complicated dewatering systems. Typical example is Khoai Chau Basin.

References

Vu Ngoc Ky, 1977, Hydrogeological conditions of North Vietnam, Proc. Acad. of Mining and Geol., Hanoi.

Vu Ngoc Ky et al., 1986, Groundwater in Vietnam, Proc. First Conf. on Geology of Indochina, vol. 2, Ho Chi Minh City.

Vu Khuc, 1986, Triassic in Indochina. Proc. First Conf. on Geology of Indochina. Ho Chi Minh City.

Tran Duc Luong, 1986, Sketches of the present understanding on the regional geology of the Socialist Republic of Vietnam, Proc. First Conf. on Geology of Indochina, Ho Chi Minh City.