

Coal Resources of Mongolia: Some Assumptions and Suggestions for Coal Bed Methane Gas (CBMG) Recovery

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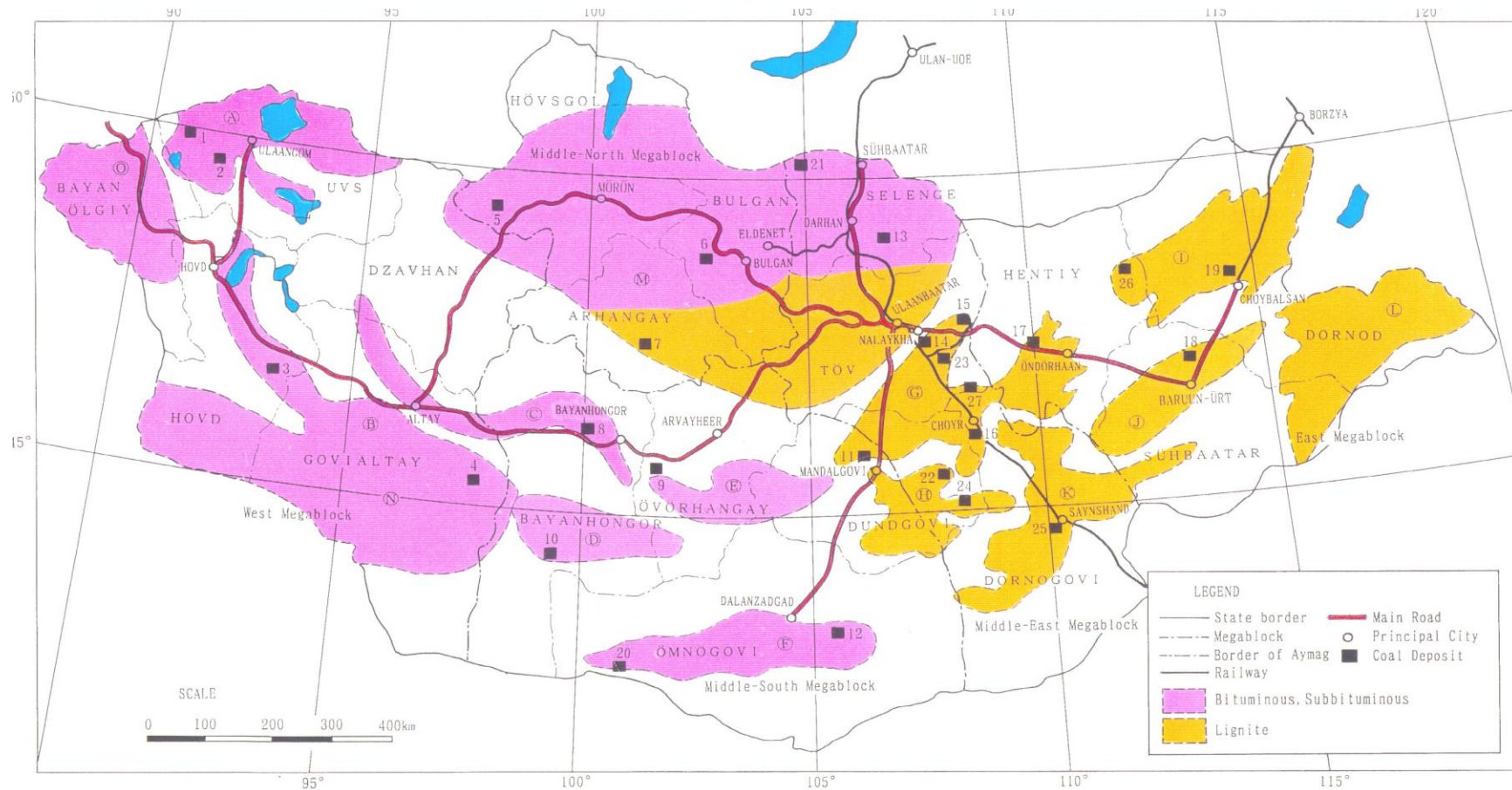
Coal resources and coal deposits

- Mongolia contains vast coal resources within 15 large-scale coal bearing basins
- There are around 320 coal deposits and occurrences (80 deposits and 240 occurrences)
- Total geological coal resources are estimated at approx.150 billion tons, including about 20 billion tons explored.
- Major coal deposits:
Tavantolgoi, Ulaan-Ovoo, Tugrug nuur, Tsaidam nuur, Baga nuur, Shivee-Ovoo, Nariin sukhait

Coal Age and Coal type

- All the coal deposits and occurrences are located relatively in all areas of the country, but most of them –in east, central and south areas.
- The Carboniferous and Permian coals belong to the bituminous to sub-bituminous or transitional (to lignites) coals.
- The Jurassic and Cretaceous ones belong mostly lignites of high grade and partially to transitional (to sub-bituminous) coals.
- About 2/3 of all coal resources belong to lignites of high grade.

Locations of main coal deposits: Coal Age or Coal Type



- Names of basins
 (A): Kharkhiraa (C)
 (B): Mongol Altay (C)
 (C): South Khangay (P)
 (D): Big Bogdyn (J)
 (E): Ongiyngol (J)
 (F): South Govi (P)
 (G): Choir-Niarga (K)
 (H): Middle Govi (K)

* C-Carboniferous, P-Permian, J-Jurassic, K-Cretaceous

- (K): Choybalsan (K)
 (K): Sukhe Bator (K)
 (K): East Govi (K)
 (K): Tamsak (K)
 (J): Orkhon-Selenge (J)
 (C): Altay-Chandmani (C)
 (C): Bayan-Ulegei (C)

Names of deposits

- 1 Nuurshotgor Deposit
 2 Khartarvagatai Deposit
 3 Khusheet Deposit
 4 Zeegt Deposit
 5 Mogoingol Deposit
 6 Saihan-Ovoo Deposit
 7 Bayantsagaan Deposit
 8 Uburchuluut Deposit
 9 Bayanteeg Deposit
 10 Shinjinst Deposit

- 11 Tevshingovi Deposit
 12 Tavantologoi Deposit
 13 Sharyngol Deposit
 14 Nalaykha Deposit
 15 Baganuur Deposit
 16 Shivee-Ovoo Deposit
 17 Chandagantal Deposit
 18 Talbulag Deposit
 19 Aduunchuluun Deposit
 20 Narynsokhait Deposit

LEGEND

- State border
 --- Megablock
 - - - Border of Aymag
 — Railway
 ● Principal City
 ■ Coal Deposit
 ■ Bituminous, Subbituminous
 ■ Lignite

Location of Coal-bearing basins

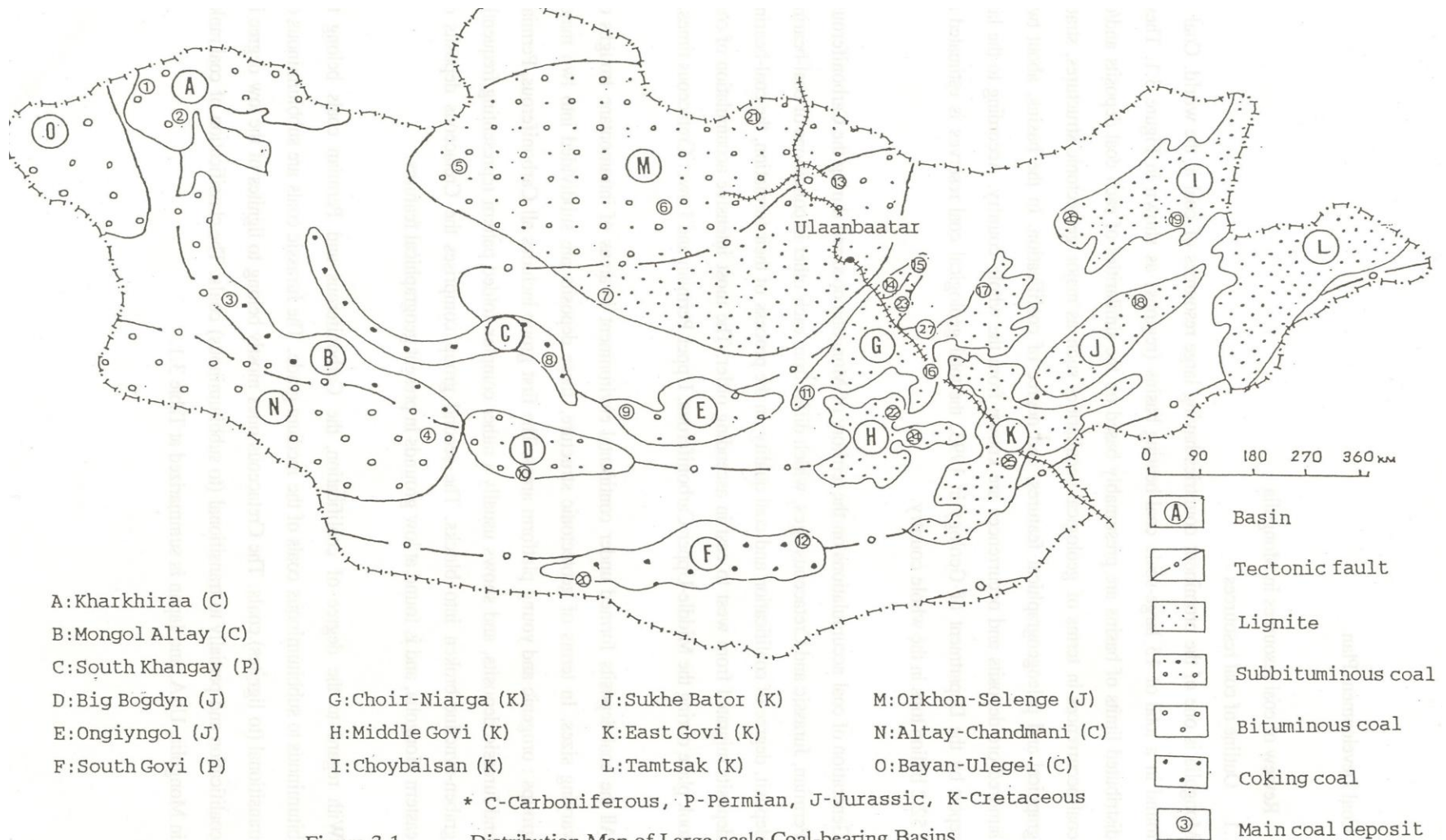


Figure 3.1 Distribution Map of Large-scale Coal-bearing Basins

Coal Mining in Mongolia



- Most coal deposits are suitable for open cast mining because of geological condition.
- More than 30 coal deposits are now under operation. (Locations are shown in figure 5.)
- Coal is most important primary energy source in Mongolia, because of great coal reserves, which dwarfs the reserves of other energy resources, such as oil and gas.
- In 2007, annual coal production was 8,5 million tons and coal export – 3,25 million tons.

CBM : General

- CBM occurs in association with coal during the coalification process.
- Methane is locked in coal by the water in cleats. So, water must be pumped out, also water quality in coal seams needs to be investigated.
- Generally, the gas content of coal increases with depth and rank of the coal seam.
- CBM is produced in association with coal mining. There exist mine-gas problems. At the same time, many ways exist to develop CBM.
Drilling: (Conventional drilling, Horizontal drilling, Drilling before mining, Post-mining gas extraction etc.)
- Gas composition (60-90% CH₄ + Nox, Cox) Gas cleaning!
- Unlike natural gas from conventional reservoirs, CBM contains very little heavier hydrocarbons (propane, butane) and no natural gas condensate.

Advantages and disadvantages of CBMG recovery

- Advantages
 - Relatively large reserves and high calorific value (1000m³ CBMG equals to 1 ton of oil products)
 - Significant environmental benefits, because of reducing greenhouse gas emissions and comprehensive utilization of natural resources
 - Economic benefits, encouraged by relatively low cost of exploration and extraction, comparing with oil and natural gas (But exploration and production technologies are quite similar to oil and natural gas technologies .)
 - Possibility of use CBMG as raw materials for chemicals production, including liquid fuel, singas, fertilizers, methanol, ammonia, polymers, solvents etc.
 - Support to safe underground mine operation

Advantages and disadvantages of CBMG recovery

- Disadvantages
 - Requirements for infrastructure development, including gas transportation pipelines, distribution network, railways etc.
 - Limited possibility of direct filling of CBMG into gas containers or cylinders under pressure. It will require CBMG cooling or liquefaction plant.
 - Some environmental problems, associated with water, pumped out from coal seam due to high salinity.

International experience and efforts

- U.S.A
 - Intensive efforts and achievements since mid of 1980's
 - New policy and legislation, relating unconventional energy sources.
 - Tax reduction by 0,9 US\$ for every 28 m³ of extracted CBMG
 - Geological reserves – 11 300 billion cubic meters, mineable reserves – 2 832 billion cubic meters.
 - Main basins:
 - Powder River (Wyoming and Montana), Sa Juan (Colorado and New Mexico), Raton (Colorado and New Mexico) Black Warrior (Alabama), Cahaba (Alabama), Cherokee (Kansas)
 - Extraction in 2004 was 45 billion cubic meters. Average gas content is 14-16,7 m³ / ton.
- Australia
 - Australia has rich basins and deposits along the east coast of the country
 - Bowen basin (Fairview, Scotia, Spring Gully) in Queensland

International experience and efforts

Surat basin (Berwyndale, Windibri, Kogan, Daandine, Tipton West) in Queensland

Basins in New South Wales Geological resources of 3 deposits in NSW are estimated to 2 500 billion cubic meters, mineable reserves- 500 billion cubic meters.

Now, in Sydney power plant on CBMG with 100 MW capacity is operating.

- Canada

- Canada also has big experience on CBM development and rich deposits, such as:

- Telkba basin (British Columbia)

- Western Canadian Sedimentary basin (Alberta)

- China

- Intensive efforts in this field , including expanding CBMG exploration, establishment of many joint ventures and projects, purchasing know-how , technology etc.

International experience and efforts

Power plant on CBMG with 10-15 MW capacity is operating in China by Yangquan Coal Mine Group.

- Russia

- Special project “ Uglemetan”

- Mini power plant on CBMG put into operation in 2008 at Kirov underground mine in Kuzbass.

- Electric capacity – 0,96 MW, steam capacity – 10 tons/ hour. Plant uses 13,3 m³ CH₄ per minute. Cost is 250 thousand roubles.

- Japan

- Power plants on CBMG were operated at Taihaiyo, Akabira and other coal mines in 1990's.

STORMCAT ENERGY CORPORATION – A CANADIAN OIL AND GAS COMPANY

OPERATIONS: Recluse and Sheridan areas in Powder River Basin, Wyoming,
Fayetteville Shale Property in Arkoma Basin, Arkansas, U.S.A



STORM CAT ENERGY: MONGOLIA PROJECTS

- Noyon Project in South Gobi Desert
 - 5 Year Product Sharing Contract with Petroleum Authority on April 19,2004
 - Exploration license on 49 000km² of land, including parts of the Nemegt-VI and Borzon –VII petroleum exploration areas in the Noyon Uul region
 - Exploration program: Summer 2004 to March 2005 .
 - Investigation area - 144 km long x 10-20 km wide band.
 - Mapping of coal outcrops- Six preliminary maps, covering 300 km² area.
 - Drilling core holes – 11 core holes (up to 250 m) were drilled to evaluate the location and quality of coals in the mapped areas. 5 additional deep core holes (up to 600 m) were drilled to better determine the thickness and gas content of the coal. Four of them were drilled and cored in the Central Nariin Sukhait of Noyon area and one hole was drilled and cored in the Erdene Bulag area over 200 kilometers to the east.
 - Results of the coring and desorption –
 - The coal rank is high volatile C Bituminous

STORM CAT ENERGY: MONGOLIA PROJECTS

Vitrinite reflectance $R_0 = 0,62\%$.

Twenty one coal seams were penetrated.

Total coal thickness of 76,6 meters.

Gas content of these coals ranged from 75,7scf/ton to 379,9scf/ton.

Potential CBMG resource of the Nariin Sukhait area ranges from 0,6 to 1,2 trillion cubic feet (TCF), with a best estimate of 0,9 TCF.

The coals of Permian age in the Noyon uul area are believed to be of similar rank as those found in the prolific San Juan basin of Colorado and New Mexico.

- Tsaidam project in Central Mongolia
 - Exploration Contract with the Petroleum Authority on December 14, 2004
 - Exploration area is comprising 5 536 893 acres of land, of which over 500 000 acres include geologically mapped coal deposits.
 - In first half of 2005, Storm Cat negotiated an extension of the Tsaidam block area to include an additional 5 632 km², increasing the total contract area to 28 039 km² (or 6 928 436 acres)
 - The Tsaidam Project area is located within the close proximity to Ulaanbaatar, the country's capital.

STORM CAT ENERGY : MONGOLIA PROJECTS

- Initial Drilling Program at the Tsaidam area was started and a large coal sample was taken and analyzed for coal rank and adsorption capacity.
- The Geologists observed that the Tsaidam coal is similar to Powder River Basin coals in rank, absorption capacity and depth and potentially thicker coals.
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Suggestions for further activity

- According to world-wide experience, recovery of CBMG resource is one of possible option for clean and efficient energy development.
- Based on coal age ,type, reserves and structures of the deposits, Mongolia should posses large CBMG potential. First activities of some foreign investment companies show the relatively large potential for CBMG in the country. However, no economic reserves have been identified presently, that requires more intensive geological exploration and investigations on CBMG resource.
- We suggest followings for the future activities:
 - improving and creating basic legal frameworks, that ensures flexible economic incentives to develop unconventional energy resources and attract foreign direct investment in the related field (Petroleum law, Minerals law, law on Gas Supply etc.)
 - Capacity building and international cooperation, focusing on personnel training, resource evaluation and investigation facilities
 - Expanding exploration program and geological surveys, financed by state budget with target on CBMG potential of largest, perspective deposits (Tavantolgoi area)