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Coal mining in Meghalaya - a boon or bane?

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ABSTRACT : Thin seams of coal occur associated with the Lakadong sandstones of Eocene age in the Jaintia Hills of Meghalaya. These Tertiary coals are low-ash coking coals but due to their high sulfur content they do not find proper market in the iron and steel industries. However, they are being mined rampantly for use as a fuel for other small and medium-scale industries such as power, cement, tea, fertilizer and brick etc. Due to unscientific mining methods the environment is seriously affected destroying the land, soil, forest, water and the natural heritages. The law of the land is also a major bottleneck for persuading large-scale integrated mechanized mining by public and private sectors. Government efforts are yet to deliver a clear cut mineral and mining policy or any significant results towards protecting the environment. This is a serious issue which needs attention of the policy makers, planners, administrators, mining engineers, geo-environmentalists, scientists, technocrats, entrepreneurs and academicians to discuss, deliberate and suggest some solution for the benefit of the people of Meghalaya as well as for the protection of the environment.

1. INTRODUCTION

The State of Meghalaya in Northeast India is rich in coal deposits that are confined to the Tertiary rocks. According to the Indian Bureau of Mines the geological reserves of coal in Meghalaya is 460 million tons [1]. However, recent explorations and other unofficial sources indicate a total reserve of about 600 million tons. The Jaintia Hills alone have about 40 million tons of coal. There are nine significant coal deposits out of which Bapung and Lakadong are the most important ones. The others are: Lumshnong, Malwar Musiang Lamare, Mutang, Sutnga, Jarain Tkentalang, Ioksi and Khliehriat. The coal bearing areas of the district present a panorama of flat topped low hills, low vegetation and plateau of rolling grasslands intersected by river valleys. Coal mining is privately controlled by small-scale ventures and being the most profitable business rampant and scattered mining is going on in this area. Due to unscientific mining methods various environmental problems have cropped up. Meghalaya is a tribal dominated State where the land belongs to individuals or communities and therefore, development of large-scale mining by private or public sectors is not foreseeable in near future and the Government is yet to deliver a concrete mineral policy for the state.

In this paper we present the geology, mining methods and characters of coal in Jaintia Hills and discuss the issues hindering mineral development in the state and the impacts of mining on the environment.

2 GEOLOGY OF THE COAL DEPOSITS

The Jaintia and Eastern Khasi Hills expose a well developed sequence of the Lower Tertiary sediments and constitute the type area of the Jaintia Group [2,3]. The generalized sequence of rock formations are given in Table-1.

Table 1: Geological Formations around Jaintia Hills, Meghalaya

Group	Formation	Rock-types	Age
JAINTIA GROUP	Kopili Formation	Alternations of shales and sandstones with bands of calcareous sandsones and shales	Upper Eocene
	Sylhet Formation	Prang Limestone: Fossiliferous limestone Narpuh Sandstone: Sandstone with subordinate calcareous bands	Middle Eocene
		Umlatdoh Limestone: Foraminiferal limestone containing a few sandstone bands Lakadong Sandstone: Sandstone with coal-seams	Lower Eocene
		Lakadong Limestone: Fossiliferous limestone	to
		Upper Therria: Hard sandstones	Upper Paleocene
	Therria Formation	Lower Therria: Limestones and calcareous sandstones	Lower Paleocene

The coal seams of Jaintia Hills in Meghalaya occur in Lakadong Sandstone Member of the Sylhet Formation belonging to Eocene age. The coal occurrences around Bapung occupy an area more than 15 sq. km. A coal seam varying in thickness from 0.3 to more than 1 m is associated in the basal part of the Sylhet Limestone. Two coal seams are also exposed near Sutnga within the lowermost member of the Sylhet limestone. The top seam varies from 0.1m to 0.2m while the bottom one ranges in thickness from 0.3m to more than 1m. The intervening parting is 2 to 4m. These seams are well exposed in the valleys towards east and north of Sutnga village.

3. CHARACTERS OF COAL

Coals of Jaintia Hills are sub-bituminous to bituminous coking coals. Compared with the Gondwana coals of the peninsular India, they have lower ash content. However, their sulfur content is quite high. It varies from less than a percent up to about 10 per cent. Sulfur occurs both as organic and inorganic sulfurs. In general the organic sulfur is higher than the inorganic sulfur the ratio being 5-7:1. The proximate and sulfur analyses of some bulk coal samples are given in Tables 2 and 3. It can be observed that these are high sulfur and high VM coals. Our samples also show higher ash contents compared with usually reported values by others and the fixed carbon is naturally low.

Table 2: Proximate analytical results of coal samples (in wt.%) from Meghalaya

Source	Moisture	Volatile	Ash	Fixed Carbon(by difference)
Sutnga	0.95	37.41	20.04	42.55
Bapung	1.03	37.72	14.68	47.60
Mondiati	1.26	36.13	16.22	47.65
Khliehriat	1.69	38.75	14.56	46.69

Table 3: Sulfur analysis of coal samples (in wt.%) from Meghalaya

Source	Total S	Pyritic S	Sulfate S	Organic S
Sutnga	8.71	0.59	0.42	7.70
Bapung	9.00	0.86	0.80	7.34
Mondiati	7.96	0.60	0.66	6.70

Optical microscopic studies indicated that most of the mineral matter in Meghalaya-coal is fine grained though some minerals (e.g., pyrite, marcasite) occur as coarse grains, nuggets and in massive form. Sometimes the pyrite clusters are big enough to be separated manually. In the present case we have recorded even more than 3 cm massive pyrite in its maximum dimension (Fig. 1). Various forms of pyrite are also reported by others [4]. Our study reveals the presence of various mineral phases in the coals of Jaintia Hill such as: sulfides- pyrite, marcasite, sphalerite, pentlandite; sulfates- barite, jarosite; oxides- hematite; hydroxide- goethite; phosphate- monazite; and silicates- quartz, mica, chlorite, and kaolinitic clay. The average grain size for most of the discrete mineral grains observed in coal is ~50 microns.

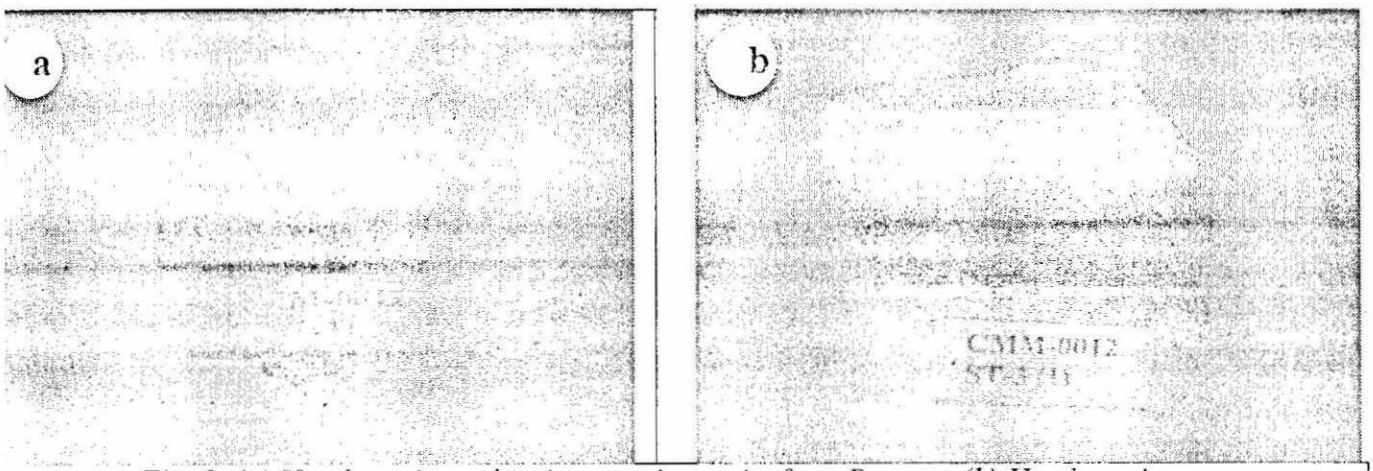

Fig. 1: (a) Hand specimen showing massive pyrite from Bapung; (b) Hand specimen showing fracture filled pyrite in Sutnga coal; length of the white sticker is 5cm

4 METHOD OF COAL MINING

Mining of coal in Jaintia Hills is done privately by people following primitive surface mining methods, also called **rat-hole mining** as literally means, the hole has about 1m opening along which the miners crawl and excavate coal (Fig. 2). The land is cleared by removing the vegetation and then pits, 5 to 100 sq m in size, are dug to reach the coal seam. The miners go as deep as 50-100m in length from the opening. The coal is brought out in small wooden barrows, and head shifted to the roadside to be loaded onto trucks. The excavated overburden is dumped in the surrounding area. The mined coal is sometimes manually hand-sorted to remove pyrite-rich or shale-rich pieces to improve the grade. Mostly the rejected pieces lie on the pit-head or in the proximity of the stockyards. The present extent of coal exploitation is about 2 million tons per annum in this district only.

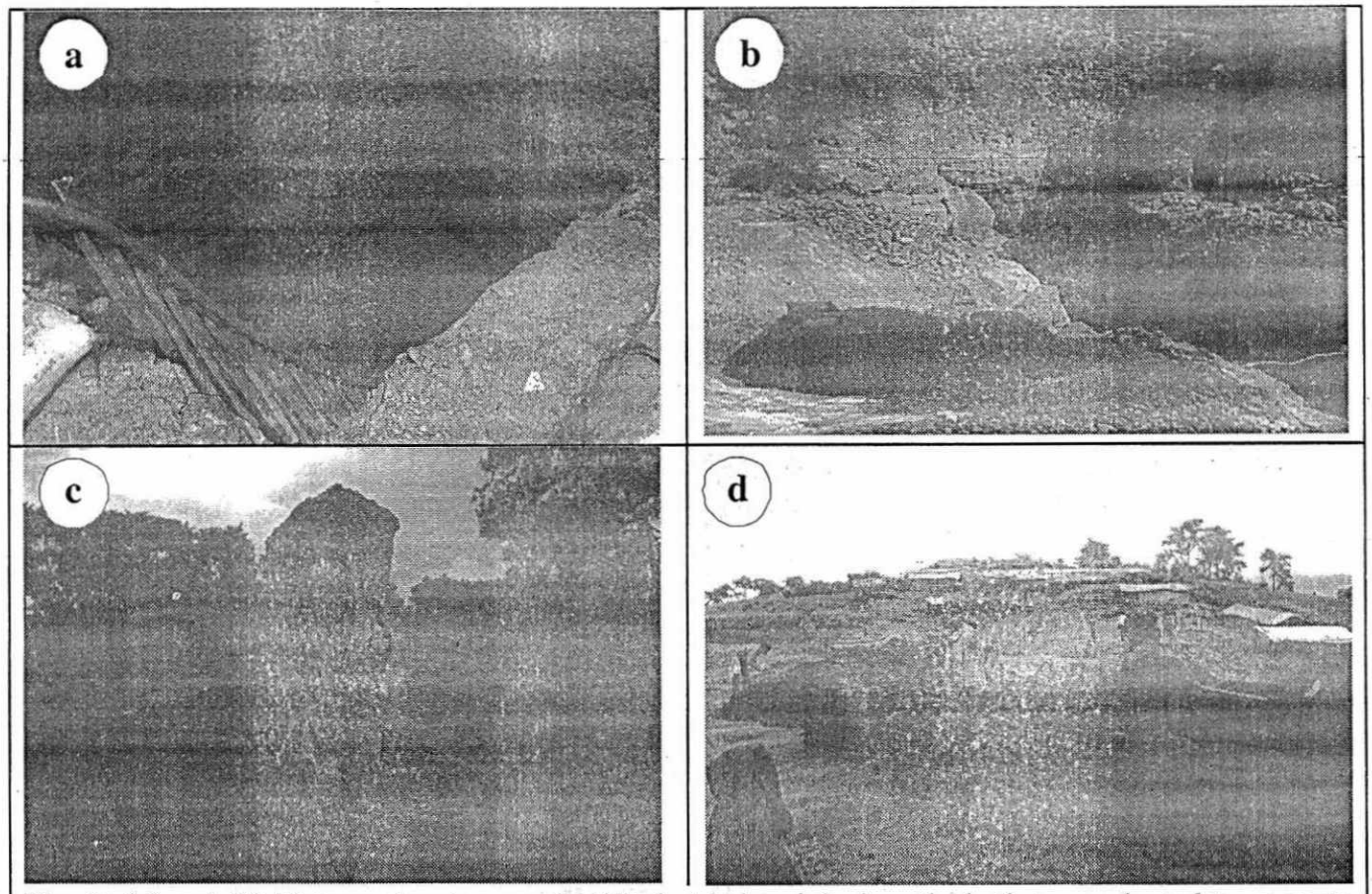

Fig. 2: **(a)** and **(b)** Pictures showing unscientific 'rat-hole mining' methods that are adopted to excavate coal in Jaintia Hills, Meghalaya; **(c)** A man carrying coal to the stockyard from the pithead; **(d)** Excavated coal are stacked in the stockyard for dispatch.

5 DISCUSSION

The adverse environmental impacts of mining activities are well visible in Meghalaya. Land degradation, large scale denudation of forest cover and depletion of biodiversity, pollution of water and soil, and degradation of agricultural land are some of the serious environmental implications of the mining activity. The impacts extend well beyond the mining areas and lead to many social, economic and political perturbations.

UNSCIENTIFIC MINING METHOD

For mining of coal, the land is cleared by removing the vegetation and then pits are dug to reach the coal seam and therefore, the available **vegetation is lost**. During mining, large amounts of shale are brought to the surface as by-product of coal cleaning. The mined coals are neither beneficiated nor washed except some hand-sorting at pit-heads to reject shale and pyrite-rich pieces. These pyritic rejects normally do not find a suitable market and are piling at the dump sites which cause **acid drainage** and spoil the water and soil. Iron pyrites in shale decompose when exposed to air and water, and produce sulphuric acid and ferrous hydroxide. These flow into the surface and underground water, making it unsuitable for human consumption and aquatic

life. Already all the rivers in Jaintia Hills are polluted and highly acidic due to mining. Environmental destruction caused by **acid rain** due to SO_2 emission through coal combustion is also a global concern.

Natural Heritage in Danger

Cave sediments and stalagmites generally represent an undisturbed chronological repository of records of climate change which can stretch back to one million years. Therefore, caves hold the key to understand world climatic changes. Taken in their totality caves should be considered national and archaeological heritage sites that call for concerted protection at both the national and state levels. The natural caves found in Jaintia Hills are a storehouse of geological treasures. Small rivers and streams flow through some of them adding to the beauty of the caves. Various life forms and geomorphological features of the caves carry records of climate change of the past. These treasures may just be lost before they are fully appreciated because **rampant coal mining is systematically destroying these caves**. Indiscriminate mining has begun to threaten the famed Krem Liat Prah-Um Lm-Labit cave system in Jaintia Hills, the longest in India (~31 km). Numerous caves have been discovered in the past decade and most of these are yet to be explored and mapped. According to some reports, besides being geologically important, these caves are rich in biodiversity including some rare bat species [5]. These are yet to be studied properly. Unscientific mining of coal is a hazard to the existence of these caves and their fragile ecosystems. A large amount of soil runs off and gets swept inside the caves and coats the stalagmite and calcite formations with mud. In many areas sandy clear underground streams are getting replaced by torrents of mud. Mining may be partly responsible for this as water gets accumulated in the excavated pits and seeps into the caves. Higher water levels inside the caves erode sediments. Coincidentally, caves are adjacent to huge reserves of coal and limestone. Therefore, there is an urgent need for the government to have a new approach to 'coal mining'.

Government Inabilities

Meghalaya is the only state in India where coal mining is done privately by mine owners who use cheap methods to take out coal. Therefore, regulating mining in Meghalaya is very tricky. In other states anyone interested in mining coal has to obtain a mining lease from the state government under the Mines and Mineral (Development and Regulation) Act, 1957. However, the centre has marked coal mines of Meghalaya as small-scale mines. This means they do not have to abide by the environmental and safety norms laid down by the Coal Mines Act, 1973. **The law of the land is also a bottleneck for development of large-scale mining by public or private sectors.** Because, Meghalaya falls under the 6th Schedule of the Indian Constitution, so the land is solely owned by the people and the State and Center have little or no control whatsoever. The regulations are elaborated under the Provision of Article 244(2) of the Constitution of India and the provision of the Meghalaya Land Transfer of Land (Regulation) Act, 1971. This Act forbids the transfer of tribal land to any non-tribal. Under the Indian law a 'company' is regarded as 'non-tribal.' Transfer of land to any one other than a local tribal has always been a controversial issue in the state. The state government, which had promised to formulate a comprehensive policy to regulate private coal mining and limestone quarries few years ago, is yet to deliver. According to latest reports of UNI [6] (United News of India, 29 June 2008), the State Government is all set to have a mining policy to regulate unscientific mining in different areas of this mineral rich state. However, the ground reality is the same as before.

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