Publications

1**. Dutta, M.,** Saikia, J., Taffarel, S.R., Waanders , F.B., Diego de Medeiros , Cesar M.N.L. Cutruneo , Silva L.F.O., Saikia, B.K., 2017. Environmental assessment and nano-mineralogical characterization of coal, overburden and sediment from Indian coal mining acid drainage. **Geoscience Frontiers**. 8, 1285-1297. (IF: 4.256)

2**. Dutta, M**., Khare, P., Chakravarty, S., Saikia, D., Saikia, B.K., 2018. Physico-chemical and elemental investigation of aqueous leaching of high sulfur coal and mine overburden from Ledo coalfield of Northeast India. **International Journal of Coal Science & Technology** 5(3), 265-281. (SJR: 2.063)

3. **Dutta, M.,** Islam, N., Rabha, S., Narzary, B., Bordoloi, M., Saikia, D., Luis F.O. Silva, Saikia, B.K., 2019. Seasonal variability of acid mine drainage in a high-sulphur coal mine area: a cytotoxicity assay and nano-remediation study. **Chemosphere** (Under revision) (IF: 5.104).

Book Chapters

1. Madhulika Dutta, Durlov Saikia, Binoy K Saikia. *Acid mine drainage in Assam (Northeast India) coal mining Industry: Physico-chemical characteristics of mine water, coal, overburden, soil, sediment, and their seasonal variations.* XVII International Seminar on Mineral Processing Technology (MPT-2018), IIT(ISM) Dhanbad.

2. Madhulika Dutta, Durlov Saikia, Binoy K Saikia. *Environmental issues from coal mining activities in Assam: a case study in Ledo colliery.* International Conference and Exhibition on Energy and Environment - Challenges and Opportunities (ENCO-2019), Bigyan Bhavan, New Delhi.

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** Mrs. Madhulika Dutta is working as Ph D. Scholar with CSIR-North East Institute of Science & Technology. Her area of specialization is Inorganic chemistry; Environmental Sciences. She has 3 papers to her credit.*
Contact: duttamadhulika@gmail.com

Acid Mine Drainage in Assam (Northeast India) Coal Mining Industry: Physico-Chemical Characteristics of Mine Water, Coal, Overburden, Soil, Sediment, and their Seasonal Variations

Madhulika Dutta , Durlov Saikia and Binoy Saikia*

[1] CSIR-NEIST [2] USTM

The state of Assam has substantial deposits of high sulphur coals. Due to unique mineral and chemical composition of these coal makes, it is more significant on processing, application, and environmental aspects. The mining operations including blasting, excavation, transportation and other mining associated activities carried out in open cast mining are responsible for damaging the environment in an unacceptable amount. The open cast mining activities have a large hydrological affect (both ground and surface water) in the nearby area. The acid mine drainage (AMD) results from weathering and leaching of sulfide minerals (main pyrite) associated with coal is the major source for contamination of water resources. AMD production is largely dependent on the role of two acidophilic bacteria, Thiobacillusferrooxidans and Leptospirillumferrooxidans. The formation of AMD and variation of physico-chemical parameters are directly related to the seasonal change. The environmental degradation around Ledo colliery of Northeast Indian coalfield is reported in this paper. The study is mainly carried out to correlate the different physic-chemical parameters of coal, OB, soil and mine water with seasonal changes. It was found that the of physico-chemical parameters like pH (5.31-9.39), Total Dissolved Solids (TDS) (47.0-620ppm), Electrical Conductivity (EC) (94.4-1239 µscm-1) of mine water s in monsoon season are quite different from the values of pH (3.9-6.1), EC(600-1600 µscm-1) and TDS (472-1339 ppm). The variations of elemental concentration in mine water with seasons are also studied by using ICP-OES analytical technique.

Key Words: Northeast Indian coal, Open cast mining, Acid Mine Drainage, Acidophilic bacteria, Physico-chemical parameters


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Environmental Characteristics of Coal, Overburden, Soil and Sediment from Assam Coal Mining Drainage

Madhulika Dutta,[1] Binoy K Saikia[2]
[1]Department of Chemistry, CNB College, Bokakhat-785612, India
[2] Polymer Petroleum & Coal Chemistry Group, MSTD,
CSIR-North East Institute of Science & Technology,
Jorhat-785006, India

Coal mining is one of the major industries that contribute development of economy of a country but it also deteriorates the environment. As a primary source of energy, coal has become essential to meet the energy demand of a country. In northeastern region of India, it is excavated by both open cast and underground mining methods and has large environmental effects, especially water resources like streams, rivers, nallahs by discharging huge amounts of mine water. The Assam coals have high sulfur content, which is present in both inorganic and organic forms. The Acid Mine Drainage (AMD) is produced due to high sulfur content in coals and degrades the water quality of the coal mine region in terms of lowering the pH of the surrounding water resources and increasing the level of Total Dissolved Solids (TDS), hardness etc. high hardness of mine water reduces its utility in domestic purposes. The physico-chemical parameters including moisture, volatile matter, ash content, total sulfur, C and H contents have been analysed for coal, overburden, soil and sediment collected from Assam coal mining areas. From the analysis, it has been found that the total sulfur content in coal samples is very high compared to overburden and soil samples. The volatile matters in coal samples are sufficiently high. On the other hand the soil and overburden samples have high ash content. The higher Electrical Conductivity and Total Dissolved Solid values have been observed and the lowering of pH indicates the dissolution of minerals present in coals as well as other mine rejects. The present study aims to illustrate the effect of acidic mine water of open cast coal mining in Ledo and Tirap coal mines (Assam) to the nearby areas.

Seminar/ workshop attended

1. Madhulika Dutta, Binoy K Saikia.,"Environmental characteristics of coal, overburden, soil and Sediment from Assam coal mining drainage'', Material Research Society of India Symposium- 2016 on "Advanced Materials For Sustainable Applications" CSIR-NEIST, Jorhat, 2016, 18-21 February, pp154.

2. Madhulika Dutta, Binoy K Saikia. "Environmental pollution from coal mining activities: a case study of Ledo open cast mining (Assam)". UGC sponsored National Seminar on "Recent Trends in Environment Responsive Chemical Processes (RTERCP-2017)".D.R. College, Golaghat, Assam.

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Workshop attended

National Thematic Workshop on "Advances in Nanostructured Materials: Applications and Perspectives (ANMAP)". 2016, The Assam Kaziranga University, Jorhat, Assam.

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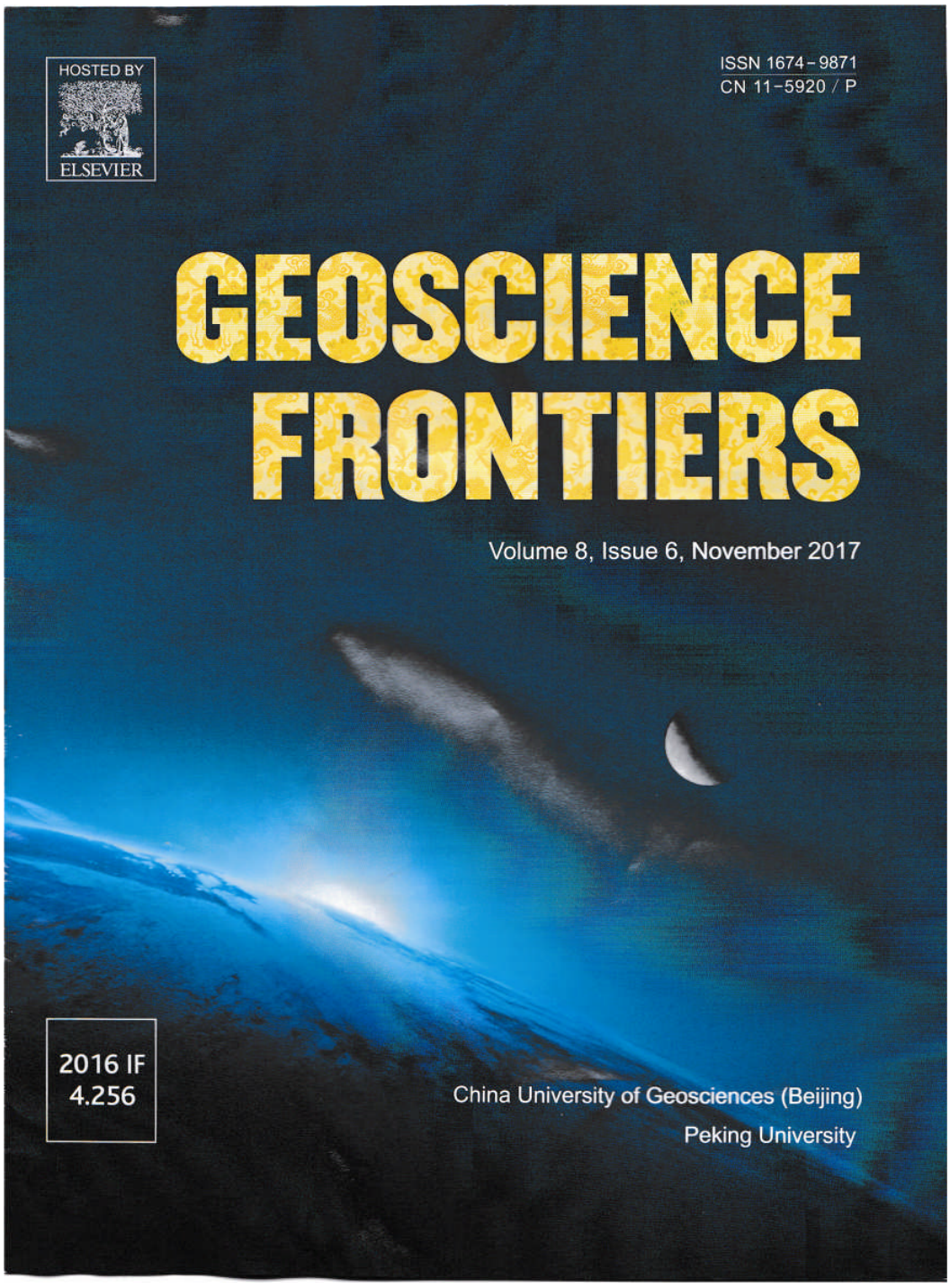
National Conference on "IPR IN BIO SCIENCES FOR SCIENTISTS FROM NORTH- EAST INDIAN STATES'', 2015, University of Science & Technology, Meghalaya.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Research Paper

Environmental assessment and nano-mineralogical characterization of coal, overburden and sediment from Indian coal mining acid drainage

Madhulika Dutta [a,b,c], Jyotilima Saikia [b,d], Silvio R. Taffarel [e], Frans B. Waanders [f], Diego de Medeiros [e], Cesar M.N.L. Cutruneo [e], Luis F.O. Silva [g,h], Binoy K. Saikia [b,d,*]

[a] Department of Chemistry, CNB College, Bokakhat, 785612, Assam, India
[b] Polymer Petroleum and Coal Chemistry Group, Materials Science and Technology Division, CSIR-North East Institute of Science & Technology, Jorhat, 785006, India
[c] School of Applied Sciences, Department of Chemistry, University of Science & Technology, Meghalaya, India
[d] Academy of Scientific Innovative Research, CSIR-NEIST Campus, Jorhat, 785006, India
[e] Laboratory of Environmental Researches and Nanotechnology Development, Centro Universitário La Salle, Mestrado em Avaliação de Impactos Ambientais em Mineração, Victor Barreto, 2288 Centro, 92010–000, Canoas, RS, Brazil
[f] School of Chemical and Minerals Engineering, North West University (Potchefstroom Campus), Potchefstroom, 2531, South Africa
[g] Research Group in Environmental Management and Sustainability, Faculty of Environmental Sciences, Universidad De La Costa, Calle 58 #55–66, 080002, Barranquilla, Atla ntico, Colombia
[h] Universidade do Vale do Rio dos Sinos. Av. Unisinos, 950 Cristo Rei 90510030, São Leopoldo, RS, Brazil

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ABSTRACT

The deterioration of environmental conditions is the major contributory factor to poor health and quality of life that hinders sustainable development in any region. Coal mining is one of the major industries that contribute to the economy of a country but it also impacts the environment. The chemical parameters of the coal, overburden, soil and sediments along with the coal mine drainage (CMD) were investigated in order to understand the overall environmental impact from high sulphur coal mining at northeastern coalfield (India). It was found that the total sulphur content of the coal is noticeably high compared to the overburden (OB) and soil. The volatile matter of the coal is sufficiently high against the high ash content of the soil and overburden. The water samples have a High Electrical Conductivity (EC) and high Total Dissolve Solid (TDS). Lower values of pH, indicate the dissolution of minerals present in the coal as well as other minerals in the mine rejects/overburden. The chemical and nano-mineralogical composition of coal, soil and overburden samples was studied using a High Resolution-Transmission Electron Microscopy (HR-TEM), Energy Dispersive Spectroscopy (EDS), Selected-Area Diffraction (SAED), Field Emission-Scanning Electron Microscopy (FE-SEM)/EDS, X-ray diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), Raman and Ion-Chromatographic analysis, and Mössbauer spectroscopy. From different geochemical analysis it has been found that the mine water sample from Ledo colliery has the lowest pH value of 3.30, Tirap colliery samples have the highest electrical conductivity value of 5.40 ms cm^{-1}. Both Ledo and Tirap coals have total sulphur contents within the range 3–3.50%. The coal mine water from Tirap colliery (TW-15B) has high values of Mg^{2+} (450 ppm), and Br^{-} (227.17 ppm). XRD analysis revealed the presence of minerals including quartz and hematite in the coals. Mineral analysis of coal mine overburden (OB) indicates the presence both of pyrite and marcasite which was also confirmed in XRD and Mossbauer spectral analysis. The presented data of the minerals and ultra/nano-particles present shows their ability to control the mobility of hazardous elements, suggesting possible use in environmental management technology, including restoration of the delicate Indian coal mine areas.

* Corresponding author. Polymer Petroleum and Coal Chemistry Group, Materials Science and Technology Division, CSIR-North East Institute of Science & Technology, Jorhat, 785006, India.
E-mail addresses: bksaikia@gmail.com, bksaikia@neist.res.in (B.K. Saikia).
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Physico-chemical and elemental investigation of aqueous leaching of high sulfur coal and mine overburden from Ledo coalfield of Northeast India

Madhulika Dutta[1,2,3] · Puja Khare[4] · Sanchita Chakravarty[5] · Durlov Saikia[2] · Binoy K. Saikia[1]

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Abstract Acid mine drainage (AMD) is one of the major problems in high sulfur coal mining areas generating acidic water. The acidic mine water generated contain hazardous elements in varying concentrations. The Northeastern Indian coalfield produces considerable amounts of AMD. The AMD and metal leaching from coal and mine over burden (OB) are the two important naturally occurring processes. In order to know the AMD potential, the aqueous leaching experiment of a few coal and OB samples from the Ledo colliery of the Northeastern coalfield, Mergherita (India), at different time periods (1, 3, 5, and 8 h) and at different temperatures (25, 45, 65, and 90 °C) were performed in the laboratory. The physico-chemical analysis of the aqueous leachates shows the pH, electrical conductivity (EC), and total dissolved solid (TDS) in the range of 1.62–3.52, 106–2006 µs/cm, and 106–1003 ppm for the raw coal samples respectively. The OB samples produced pH, EC, and TDS in the range of 3.68–6.92, 48.6–480 µs/cm, and 69.5–240 ppm respectively. From the study, it was revealed that the concentrations of major (Si, Al, K, Na, Fe, Ca, Mg), minor (Mn) and trace/hazardous elements (As, Ba, Cd, Co, Cr, Cu, Hg, Ni, Pb, Se, Zn) considerably change with leaching time as well as with leaching temperature. Out of these elements As, Cd, Hg, Pb, Cr, and Se are of greater environmental importance. Alteration of the physico-chemical structure of the coal and OB samples resulting from leaching was also studied by field emission scanning electron microscope- energy-dispersive X-ray spectroscopy method. The release of the potentially hazardous elements from the raw coal and OB during leaching time periods to the leachates was detected by inductively coupled plasma-atomic emission spectroscopy and ion-chromatographic analyses. The major minerals found in coal and OB are quartz (SiO_2), pyrite (FeS_2), hematite, marcasite, and kaolinite. The association of different functional groups in minerals and their mode of association were studied by Fourier-transform infrared spectroscopy and X-ray diffraction analytical techniques. The present laboratory study will be useful in relating the characteristics of aqueous leaching from coal and mine OB with the natural weathering condition at the coal mine area.

Keywords AMD · High sulfur coal · Coal mine overburden · Aqueous leaching · Elements in coal and OB · Coal quality assessment

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s40789-018-0210-9) contains supplementary material, which is available to authorized users.

✉ Binoy K. Saikia
bksaikia@neist.res.in; bksaikia@gmail.com

[1] Polymer Petroleum and Coal Chemistry Group, Materials Sciences and Technology Division, CSIR-North East Institute of Science and Technology, Jorhat 785006, India

[2] School of Applied Sciences, Department of Chemistry, University of Science and Technology, Ribhoi 793101, Meghalaya, India

[3] Department of Chemistry, CNB College, Bokakhat 785612, India

[4] Agrotechnology Division, CSIR- Central Institute of Medicinal and Aromatic Plants, Lucknow 226015, India

[5] Analytical Chemistry Division, CSIR- National Metallurgical Laboratory, Jamshedpur 831007, India

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https://www.academia.edu/29213356/Geochemistry_and_nano-mineralogy_of_feed_coals_mine_overburden_and_coal-derived_fly_ashes_from_Assam_North-east_India_a_multi-faceted_analytical_approach
https://mafiadoc.com/central-ground-water-board-ministry-of-water-resources_5b7213a8097c474a788b45b1.html
http://neccoal.co.in/introduction.php
https://www.yumpu.com/en/document/view/11680923/eco-restoration-of-a-high-sulphur-coal-mine-overburden-dumping-
https://en.wikipedia.org/wiki/Coal
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