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MINISTRY OF POWER, ENERGY AND MINERAL RESOURCES
ENERGY AND MINERAL RESOURCES DIVISION
GEOLOGICAL SURVEY OF BANGLADESH

2nd National Seminar

on

"Geology for the Sustainable Development of Bangladesh"

09-10 May, 2024

Abstract Volume

Geological Survey of Bangladesh (GSB)

Cover and Theme Design: Mr. Arif Mahmud, Director (Geology), GSB

2nd National Seminar
on
"Geology for the Sustainable Development of Bangladesh"
09-10 May, 2024

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MESSAGE

It is my privilege to extend my warmest greetings to you on the occasion of the publication of the abstract volume compiled from various research endeavors conducted by the both young and experienced researchers of the Geological Survey of Bangladesh (GSB), esteemed universities, and other organizations. As the Director General of GSB, it is both an honor and a responsibility to oversee the publication of this significant contribution to our understanding of the geological landscape and its implications for the sustainable future of our nation.

As we prepare to convene for the 2nd National Seminar on Geology for the Sustainable Development of Bangladesh, This abstract volume represents a culmination of rigorous research, analyses, and innovative solutions proposed by esteemed scholars, researchers, and practitioners in the field of geology and geoscience. Through their collective expertise and dedication, this volume serves as a testament to our commitment to harnessing geological knowledge for the betterment of Bangladesh and its people.

Within these pages, readers will find a rich tapestry of topics ranging from Geo-hazard and Geo-Environmental Problems, Urban Development and Mineral Exploration to Tectonics, Groundwater Management and Geo-tourism. Each abstract encapsulates a unique perspective, offering valuable insights and actionable recommendations for policymakers, stakeholders, and the broader community.

I extend my sincere gratitude to all the contributors, reviewers, and organizers who have played a pivotal role in bringing this abstract volume to fruition. May it serve as a beacon of knowledge and inspiration, guiding our collective efforts towards a future where geology becomes synonymous with sustainability and progress.

Tahmina Yeasmin
Director General (Additional Charge)
Geological Survey of Bangladesh

PREFACE

The Geological Survey of Bangladesh has organized the 2nd National Seminar 2024 on "Geology for Sustainable Development". Considering the fundamental and applied areas of Geology, it is an immense pleasure and pride for me to introduce the abstract volume, an amalgamation of the vibrant discussions and groundbreaking research presented in the seminar. This will underscore the vital role of geological research in shaping the sustainable progress of Bangladesh.

Geology serves as the bedrock for sustainable development, leading us in the conscientious management of Earth's resources, addressing environmental challenges, and ensuring equitable economic growth to secure the prosperity of both current and forthcoming generations. The government has taken some visionary initiatives, including SDGs by 2030, Vision 2041, and Delta Plan 2100; all are science-intensive, emphasizing geological research and innovation. This abstract volume offers a glimpse into the cutting-edge research being conducted in the field of geology, covering all the mentioned frameworks and beyond, as well as demonstrating innovative ideas to implement accordingly. Moreover, it represents a snapshot of the diverse range of topics from geological resource management and environmental conservation to climate change adaptation, disaster risk reduction, and resilience, including the latest accretion of geo-tourism.

The abstract volume comprises 77 insightful abstracts covering 17 major themes for the seminar. In addition, we are eagerly anticipating the forthcoming publication of approximately 40 full scientific papers, which will serve as the official proceedings of the seminar. The seminar was primarily planned to involve the participation of local geoscientists. However overwhelming international attention has been drawn to the seminar by foreign experts submitting their geo-scientific papers from India. Despite facing multiple constraints, three delegates have confirmed themselves to attend the seminar on their initiative, for which the organizer extends heartfelt appreciation to these delegates for their generous participation.

I wish to express my sincere gratitude for all the unwavering dedication and contributions that have been instrumental in bringing this abstract volume to life. As the Chair of the Editorial Board, I believe that this abstract volume will be a valuable resource for geological and interdisciplinary researchers, professionals, and practitioners, and an excellent reference to express the imperative necessary of geology for the sustainable future of Bangladesh.

Md. Ali Akbar
Chairperson (Editorial Board, 2nd National Seminar) &
Director (Geology), Geological Survey of Bangladesh

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Session Schedule

2nd National Seminar on "Geology for the Sustainable Development of Bangladesh"

09-10 May, 2024

Day	Time	Venue: Dr. Habibur Rahman Auditorium, 1st Floor, Petrobangla	Venue: Board Room, 3rd Floor, Petrobangla	Venue: Conference Room, 3rd Floor, Petrobangla
	09.00 - 10.00 hrs.	Registration		
Day 1 09 May 2024	10.00 - 11.30 hrs.	Opening Session	-	-
	Refreshment			
	12.00 - 13.00 hrs.	Technical Session 1 Theme 1: Quaternary Geology and Delta Building Processes	Poster Session, Premises of Dr. Habibur Rahman Auditorium, 1st Floor, Petrobangla	
	Lunch and Prayer			
	14.30 - 15.30 hrs.	Technical Session 2 Theme 12: Remote Sensing and Geospatial Technologies	Technical Session 3 Theme 10: Petrology and Mineralogy	Technical Session 4 Theme 11: Geophysical Applications
	Tea			
	16.00 - 17.00 hrs.	Technical Session 5 Theme 12: Remote Sensing and Geospatial Technologies	Technical Session 6 Theme 8: Structural Geology and Tectonics	Technical Session 7 Theme 11: Geophysical Applications
Day 2 10 May 2024	09.30 - 11.00 hrs.	Technical Session 8 Theme 7: Engineering Geology and Urban Development	Technical Session 9 Theme 2: Mineral and Energy Resources	Technical Session 10 Theme 4: Groundwater, Hydrogeology, Geochemistry
	Refreshment			
	11.30 - 12.45 hrs.	Technical Session 11 Theme 6: Geo-hazard and Geo-environmental Problems	Technical Session 12 Theme 2: Mineral and Energy Resources	Technical Session 13 Theme 4: Groundwater, Hydrogeology, Geochemistry
	Lunch and Prayer			
	14.30 - 16.00 hrs.	Technical Session 14 Theme 5: Climate change	Technical Session 15 Theme 2: Mineral and Energy Resources	Technical Session 16 Theme 3: Blue Economy, Coastal and Marine Geology
				Technical Session 17 Theme 14: Geo-tourism, Geo-heritage and Conservation
	Tea			
	16.30 - 18.00 hrs.	Closing Session	-	-

Programme Schedule

Registration: 09.00 - 10.00 hrs

Inaugural Session

Venue: Dr. Habibur Rahman Auditorium, 1st Floor, Petrocentre, Petrobangla
Date: 09 May, 2024
Time: 10.00 -11.30 hrs.

Technical Session 1

Theme 1: Quaternary Geology and Delta Building Processes

Venue: Dr. Habibur Rahman Auditorium, 1st Floor, Petrobangla
Date: 09 May, 2024; Time: 12.00 -13.00 hrs.

Chair: Prof. Dr. Sharif Hossain Khan, Department of Geological Sciences, Jahangirnagar University
Co-Chair: Mrs. Nasima Begum, Director (Geology), GSB
Rapporteur: Mr. Rajib Kumar Saha, Assistant Director (Geology), GSB

1. Microtextures on Detrital Sand Grains from the Sundarban Forest Site in Satkhira, Bangladesh
   ***Mohidul Islam**, Md Aminul Islam Rony, H. M. Zakir Hossain and Anas Al Hossain*
2. Sustainable Management of the Coastal Areas of Bangladesh -A review
   Md. Bazlar Rashid
3. The Influence of Watershed Geomorphic Characteristics on the Flash Flood of the Transboundary Khowai River, Bangladesh
   ***Jonahid Chakder** and Md. Mahfuzul Haque*
4. Grain Size Analysis of the Plio- Pleistocene Dupitila Formation in the Kutubpur Magnetic Body Area, Dinajpur, Bangladesh: Implications for depositional setting
   ***Md. Sohel Rana**, Md. Ali Akbar,Farhan Ahmed Bhuiyan, Zobayer Mahmud,Md. Al Amin, Md. Al Razi and Anwer Sadat Mohammad Sayem*

Poster Session

Venue: Premises of Dr. Habibur Rahman Auditorium, 1st Floor, Petrobangla
Date: 09 May, 2024, Time: 12.00-13.00 hrs.

Technical Session 2

Theme 12: Remote Sensing and Geospatial Technologies

Venue: Dr. Habibur Rahman Auditorium, 1st Floor, Petrobangla
Date: 09 May, 2024; Time: 14.30-15.30 hrs.

Chair: Prof. Dr. Md. Badrul Islam, Department of Geology and Mining, University of Rajshahi
Co-Chair: Mr. Mohammad Ashraful Kamal, Director (Geology), GSB
Rapporteur: Dr. Hossain Mohammad Arifeen, Assistant Director (Geology), GSB

1. Jamuna River Shifting Assessment at Belkuchi Upazila, Sirajganj District Using RS and GIS Technique

   ***Md. NazwanulHaque**, Khaleda Afrin, Rintu Roy, Syed Nazrul Islam and Minhazul Abedin Shakik*

2. Role of Spatial Technologies Towards Groundwater Resource Augmentation

   Debasish Das

3. Evaluation of the Performance of EGM 2008 and other Global Geoid Models in Determining Orthometric Heights with Respect to Local Geoid Model Formed with the Help of GNSS/Levelling Data

   *MultashimRafiq Chowdhury, **MostazerBillah**, AbeerQuddus and Md. Amirul Islam*

4. Forty Years of Riverbank Dynamics and Socio-Economic Consequences along Kobadak River at Koyra Upazila, Bangladesh: An Integrated Remote Sensing and GIS based approach

   ***Md. Hasnat Jaman**, Md. Helal Ahmmed, Md. Saiful Islam, Md. Yeasin Arafath, Md. Abdur Razzaque, Mst. Nur-E-Taj Tamannaand Md. Mohaimenul Islam*

Technical Session 3

Theme 10: Petrology and Mineralogy

Venue: Board Room, 3rd Floor, Petrobangla

Date: 09 May, 2024; Time: 14.30-15.30 hrs.

Chair: Prof. Dr. Subrota Kumar Saha, Department of Geology, University of Dhaka

Co-Chair: Mrs. Asma Huque, Director (Geology), GSB

Rapporteur: Md. Ahsan Habib, Assistant Director (Geology), GSB

1. Geological Controls on Sustainable Road Conservation in Hilly Terrains of Bangladesh: A Case Study of the BayezidBostami Link Road, Chattogram, Bangladesh

   ***Rajib Kumar Saha**, Md. Faruk Hasan and Mohammad Arifuzzaman*

2. Petrography and Geochemistry of the Tipam Sandstone Formation from the Eastern Fold Belt of the Bengal Basin, Bangladeshy

   ***Papiya Mondal**, Abu Sadat Md. Sayem, Rashed Abdullah, Julleh Jalalur Rahman, Rumana Yesmin*

3. Grain Size Analysis and Sedimentologic Study of Neogene Exposed Sediments, Sitapahar Anticline, Rangamati, Bangladesh

   ***Minhazul Abedin Shakik** and K. M. Imam Hossain*

4. Major, Trace, and Rare Earth Elements in the Multicore Sediments of the Bay of Bengal off Bangladesh

   H. M. Zakir Hossain

Technical Session 4

Theme 11: Geophysical Applications

Venue: Conference Room, 3rd Floor, Petrobangla

Date: 09 May, 2024; Time: 14.30-15.30 hrs.

Chair: Prof. Dr. A.S.M. Wobaidullah, Department of Geology, University of Dhaka
Co-Chair: Mr. Mohammad Zohir Uddin, Deputy Director (Geophysics), GSB
Rapporteur: Mr. Tushar Kanti Roy, Assistant Director (Geophysics), GSB

1. Delineation of Bagzana-Koktara Horst and Panchbibi Basin from the Regional Gravity Survey in Hili-Panchbibi-Joypurhat area, Bangladesh
   ***Md. Shahjahan**, Md. Selim Reza and Ershadul Haque*
2. Seismic Refraction Survey: An Effective Geophysical Tool for Delineating Basement Configuration in and Around NiamatpurUpazilaof Naogaon District, Bangladesh
   ***Selim Reza**, Mohammad Zohir Uddin, Lubna Yesmin Khondakar and Sultana Nasrin Nury*
3. Gravity Clue Indicating Non-Existence of any Major Fault in the Present Location of Jamuna Between Raomari and Chilmari, Kurigram and other Tectonic Inference from Gravity Observation in Raumai-Kurigram Region, Bangladesh
   Md. Shahjahan
4. Detail Gravity and Magnetic Profiling Surveys to Delineate the Geometry of Panchbibi Basin
   ***K.A.H.M. Syfur Rahman** and Md. Selim Reza*

Technical Session 5
Theme 12: Remote Sensing and Geospatial Technologies
Venue: Dr. Habibur Rahman Auditorium, 1st Floor, Petrobangla
Date: 09 May, 2024; Time: 16.00-17.15 hrs.

Chair: Dr. A.K.M. Khorshed Alam, Former Director General, GSB
Co-Chair: Mrs. Kazi Mansura Akter, Deputy Director (Geology), GSB
Rapporteur: Mr. Md. Hossain Al Imran, Assistant Director (Geology), GSB

1. Inundation Mapping Using SAR Satellite Images and Analysis of Flood Potential on Present Land Use Classes - A Case Study of Sirajganj Town and Surrounding Areas
   ***Tahera Afrin**, Mohammad Ashraful Kamal and Mohammad Khairul Islam*
2. Photogeological Mapping of Nawabganj Upazila, Dhaka District, Bangladesh
   MunirHossain, Md. NazwanulHaque andSudipSaha
3. River Course Change Detection by NDWI Analysis Method - A Case Study of Jamuna River from Kazipur Upazila of Sirajganj District to Bera Upazila of Pabna District, Bangladesh
   ***Mohammad Khairul Islam**, Mohammad Ashraful Kamal and Tahera Afrin*
4. Vertical Ground Motion Analysis of Khulna City and Surroundings of Bangladesh Using InSAR
   ***Md. Nazwanul Haque**, Rintu Roy, Mohammad Ashraful Kamal*
5. Changes in Land Use Land Cover (LULC) - an Environmental Impact of Engineering Construction: A Case Study
   Piya Bhattacharjee

Technical Session 6

Theme 8: Structural Geology and Tectonics

Venue: Board Room, 3rd Floor, Petrobangla

Date: 09 May, 2024; Time: 16.00-17.15 hrs.

Chair: Prof. Dr. Yunus Ahmed Khan, Department of Geology and Mining, University of Rajshahi

Co-Chair: Mr. Mohammad Masum, Deputy Director (Geology), GSB

Rapporteur: Mr. Mohammad Omer Faruq Khan, Assistant Director (Geology), GSB

1. Crustal Evolution and Characteristics: An Appraisal on Basement Rocks in Bangladesh
   Ismail Hossain
2. Fault Kinematics and Stress Distribution along the Dauki Fault Zone - A Potential Source of Recent Seismic Activity
   S.M.A. Shoib, *Md. Ibna Reday, Fatema Tuz Zohora, Md. Sakawat Hossain, Md. Sharif Hossain Khan*
3. Active Tectonic Convergence of the Indian Plate in the Northeastern and Eastern Portions Reveals Oblique Faulting: Implication for Seismic Hazards
   Aktarul Ahsan, *Afroz Ahmad Shah and Dhiman R. Mondal*
4. Formation of Boga Lake and Raikhong Lake, Bangladesh: An Appraisal on Geological and Geo-morphological Characteristics
   Md. Shamsuzzaman and ***Md. Bazlar Rashid***
5. Recent Earthquake Distribution and Pattern from Thrust to Strike-Slip around NE India-Bangladesh-Myanmar, Predicting Future Earthquake Occurrences
   Aktarul Ahsan, *Santanu Baruah, A. S. M. Maksud Kamal, Md. Zillur Rahman, Dhiman R. Mondal, Afroz Ahmad Shah, Md. Shakhawat Hossain, A. K. M. Khorshed Alam*

Technical Session 7

Theme 11: Geophysical Applications

Venue: Conference Room, 3rd Floor, Petrobangla

Date: 09 May, 2024; Time: 16.00-16.45 hrs.

Chair: Prof. Dr. Delwar Hossain, Department of Geological Sciences, Jahangirnagar University

Co-Chair: Mrs. Lubna Yesmin Khondaker, Deputy Director (Geophysics), GSB

Rapporteur: Ms. Sirajum Monira, Assistant Director (Geophysics), GSB

1. Gravity Signatures of Kutubpur Magnetic Body and adjoining areas, Parbatipur and Chiribandar Upazilas, Dinajpur District and its implication in exploration for economic mineral resources
   Md. Shahjahan, *Md. Zohir Uddin and Nazmun Nahar*
2. Geoelectrical Resistivity Survey for Fresh Groundwater Investigation in the South-Western Coastal Areas of Bangladesh
   Md. Selim Reza *and Mohammad Zohir Uddin*

3. Hydrostartigraphy of Noakhali, Laxmipur and Patuakhali based on Geophysical Logging and it's Implication in Finding Potable Water in the Coastal Region of Bangladesh

Md. Shahjhan

Technical Session 8

Theme 7: Engineering Geology and Urban Development

Venue: Dr. Habibur Rahman Auditorium, 1st Floor, Petrobangla

Date: 10 May, 2024; Time: 09.30-11.15 hrs.

Chair: Prof. Dr. A.T.M. Shakhawat Hossain, Department of Geological Sciences, Jahangirnagar University

Co-Chair: Mr. Md. Mahmood Hossain Khan, Deputy Director (Geology), GSB

Rapporteur: Mrs. Tahera Afrin, Assistant Director (Geology), GSB

1. Geo-scientific Information for Sustainable Development: A Case Study of Shahzadpur Upazila, Sirajganj District, Bangladesh

   Rintu Roy, *Md. Nazwanul Haque, Khaleda Afrin*

2. SAGA-ISEG Database for Dynamic and Spatial Geo-technical Data Analysis

   Sarwat Jabeen, *Andreas Gunther,Mohammad Ashraful Kamal,Werner Buchert*

3. Identification of Geotechnical Weakzones and Candidate Locations for Quicksand Phenomenon: A Resistivity Imaging Approach in Chittagong City Outer Ring Road Site, Chittagong Bangladesh

   Md. Shahjahan

4. Geomorphology, Geology and Engineering Geology of Teknaf Pourashava and Surrounding, Cox's Bazar District

   Mohammad Anisur Rahman, *Salma Akter and Md. Nazwanul Haque*

5. Voxel Model, A Sub-Surface Visualization and Analytical Tool for Geoscientific Analyses and Decision Making: Case Study Satkhira Town and Surroundings

   Nurun Nahar Faruqa, *Sara Schade, Faruk Hossain, Mohammad Ashraful Kamal*

6. A 3D Geotechnical Review for Structural Configuration of Bengal Basin and Earthquake Magnitude Projection in Bangladesh

   Mir Fazlul Karim

7. Applicability of H/V Fourier Spectral Ratio of Ambient Vibrations in Seismic Microzonation- case study in Chattogram City, Bangladesh

   Md. Shahjahan, *Cees Van Westen and Mark Van der Meijde*

Technical Session 9

Theme 2: Mineral and Energy Resources

Venue: Board Room, 3rd Floor, Petrobangla

Date: 10 May, 2024; Time: 09.30-11.00 hrs.

Chair: Prof. Dr. Md. Anwar Hossain Bhuiyan, Department of Geology, University of Dhaka

Co-Chair: Mr. Md. Ashraf Hossain, Deputy Director (Geology), GSB

Rapporteur: Mr. Md. Harun Or Rashid, Assistant Director (Geology), GSB

1. Heavy Minerals Analysis in the Bukit Puteri Area, Bangi, Selangor, Malaysia
   Md. Sohel Rana *and Mohd. Basril Iswadi Bin Basori*
2. Pilot plant study for separation of heavy minerals from the Tista River sand, Bangladesh
   Pradip Kumar Biswas*, M. Shafiqul Alam, Syed Samsuddin Ahmed, Mohammad Nazim Zaman, Md. Sha Alam, Md. Shohel Rana, Md. Shams Shahriar and Md. Imam Sohel Hossain*
3. Biomarker Characteristics of Organic Matter in the Sylhet Basin Mudstones, Bangladesh
   Sk. Tamanna Taher Turni*, H. M. Zakir Hossain, Tanzila Hasan Moyuri, Zarin Tasnim Khusbu and Farjana Afrin Rima*
4. Prospect oflron ore at Kutubpur Magnetic Body, Parbatipur, Dinajpur
   Md. Sohel Rana*, Md. Ali Akbar, Anwer Sadat Mohammad Sayem, Zobayer Mahmud, Md. Al Amin and Md. Al Razi*
5. Geochemical Characterization and Economic Importance of Tajpur Limestone Deposit in Naogaon District, Bangladesh
   Mohammad Hasan Shahariar*, Mohammed Masum, Mohammed Nurul Haque, A.J.M. Emdadul Haque and Zobayer Mahmud*
6. Decontaminating NORM via Monazite Beneficiation from Radioactive Waste of the Heavy Minerals Separation Plant at BSMEC, Cox's Bazar
   Md. Masud Karim *and Md. Fahad Hossain*

Technical Session 10

Theme 4: Groundwater, Hydrogeology, Geochemistry

Venue: Conference Room, 3rd Floor, Petrobangla
Date: 10 May, 2024; Time: 09.30-10.30 hrs.

Chair: Dr. Anwar Zahid, Director, Bangladesh Water Development Board
Co-Chair: Dr. Md. Ahsan Habib, Deputy Director (Geology), GSB
Rapporteur: Mr. Anwar Sadat MdSayem, Assistant Director (Geology), GSB

1. Radiation exposure and health concerns associated with environmental geochemistry of greater radioactivity in Atrai river (Bangladesh)
   Md. Samium Basir*, Rahat Khan, Sayma Zahan Akhi, Amit Hasan Anik, Shabiha Hossain, Umma Tamim, A.R.M. Towfiqul Islam and Shafi M. Tareq*
2. Simulating River-Aquifer Dynamics in Left Bank of River Ganges (Padma) in Drought-prone North-West Bangladesh
   Md. Arifur Rahman, ***Chowdhury Sarwar Jahan****, Md. Ferozur Rahaman and Quamrul Hasan Mazumder*
3. Variations of Water Quality in Floodplains and Barind Tract of South Eastern Part of Chapai Nawabganj District, Bangladesh
   Shamim Ahmed, ***KhondakerEmamulHaque****, Most. AfrojaKhatunSuborna, Md. Moniruzzamanand TasnimAbdaryAnonna*
4. Variation of Groundwater Recharge Rate with Urbanization in Barishal City
   Tanvi Sarker

Technical Session 11

Theme 6: Geo-hazard and Geo-environmental Problems

Venue: Dr. Habibur Rahman Auditorium, 1st Floor, Petrobangla

Date: 10 May, 2024; Time: 11.45-12.45 hrs

Chair: Prof. Dr. Md. Zillur Rahman, Department of Disaster Science and Climate Resilience, University of Dhaka

Co-Chair: Mr. Md. Feruj Alam, Deputy Director (Geology), GSB

Rapporteur: Mr. Faruk Hossain, Assistant Director (Geology), GSB

1. Alternatives to Mitigate the Waterlogging and Siltation Problems in the Southwest Tidal Delta of Bangladesh

   Reshad Md. Ekram Ali, *Md. Shafiqul Alam and Khalil R. Chowdhury*

2. Geological Evolution of Boga lake on Hilly Terrain of Ruma Upazila, Bandarban District, Bangladesh

   Mohammad Anisur Rahman, *Mohammad Alamgir Kabir, Salma Akter and Md. Ahsan Habib*

3. An Attempt to Investigate Rupture of the Dauki Fault in 1897 Earthquake by Trench Investigation at MajerTila Area, Taherpur Upazila, Sunamganj District, Bangladesh

   Reshad Md. Ekram Ali, *Mohammad Anisur Rahman, Animesh Talukder, Mohammad Alamgir Kabir, Salma Akter, Faruk Hossain and Md. Ahsan Habib*

4. Landslide Hazard Zonation of Ruma Upazila, Bandarban District, Bangladesh

   Mohammad Anisur Rahman, *Mohammad Alamgir Kabir, Salma Akter and Md Ahsan Habib*

Technical Session 12

Theme 2: Mineral and Energy Resources

Venue: Board Room, 3rd Floor, Petrobangla

Date: 10 May, 2024; Time: 11.30-12.45 hrs.

Chair: Dr. Md. Nehal Uddin, Former Director General, GSB

Co-Chair: Mr. Mohammad Hasan Shahriar, Deputy Director (Geology), GSB

Rapporteur: Mrs. ShahrinAzmee, Assistant Director (Geology), GSB

1. Geophysical Investigations: Leading to the Discovery and Delincation of Metallic Iron Deposit at Chakurpara-Masidpur Area, Alihat, Hakimpur Uapzila of Dinajpur District, Bangladesh

   K. A. H. M. Syfur Rahman and ***Md. Shahjahan***

2. Mineralogical Characterization of the Masidpur Magnetic Body of Dinajpur, Bangladesh

   Md. Sohel Rana, Md. Ali Akbar, Mohammed Maxum, Mohammed NurulHoque, Md. NuruzzamanSabuj, Md. Abu Sayem, Zobayer Mahmud, Md. Al Amin1 and Md. Abdur Razzaque

3. Alluvial Clay of Bagha Upazila: Physico-Chemical Characterizations and its Industrial Potential

   Shawon Talukder *and Azimah Bintu Hussin*

4. Identification of Valuable Heavy Minerals in Sand Bars of Upstream part of the Brahmaputra River, Bangladesh

   Md. Ashraf Hossain *and K. M. Imam Hossain*

5. Discovery of Silica Sand at Patiya in Chattogram of Bangladesh

   Md. Sohel Rana*, Zobayer Mahmud and Md. Al Amin*

Technical Session 13

Theme 4: Groundwater, Hydrogeology, Geochemistry

Venue: Conference Room, 3rd Floor, Petrobangla

Date: 10 May, 2024; Time: 11.00-12.00 hrs.

Chair: Prof. Dr. KaziMatin Uddin Ahmed, Department of Geology, University of Dhaka

Co-Chair: Mr. Md. Kamal Hossain, Director (Geology), GSB

Rapporteur: Mrs. Khaleda Afrin, Assistant Director (Geology), GSB

1. Importance of Monitoring for the Sustainable Development and Management of Groundwater in the Bengal Basin, Bangladesh

   Anwar Zahid

2. Primordial Radionuclides in Punarbhaba river, northern Bangladesh: Origin and affiliated radiological risks

   SaymaZahanAkhi*, Rahat Khan, MdSamiumBasir, Amit Hasan Anik, Shabiha Hossain, UmmaTamim, A.R.M. Towfiqul Islam, Shafi M. Tareq*

3. Geochemistry of Major, Trace and Rare Earth Element in Khalaspir Coal (Bangladesh) and Hazardous Elements Impact on Environment

   Md. Jafar Hossain*, Md. Ahosan Habib and Minhaj Uddin Monir*

4. Hydrogeochemistry and Groundwater Quality of Alluvial Aquifer of DhamraiUpazila of Central Bangladesh

   Shahtaj Karim*, Riyadul Islam, Md. Rashedul Hasan, Shahida Akter and Md. Kamal Hossain*

Technical Session 14

Theme 5: Climate Change

Venue: Dr. Habibur Rahman Auditorium, 1st Floor, Petrobangla

Date: 10 May, 2024; Time: 14.30-15.45 hrs.

Chair: Dr. Reshad Md. Ekram Ali, Former Director General, GSB

Co-Chair: Dr. Bazlar Rashid, Deputy Director (Geology), GSB

Rapporteur: Mrs. Sabina Yesmin, Assistant Director (Geology), GSB

1. Pore Size Distribution of Granite Residual Soils under Multiple Drying-Wetting Cycles using NMR Technique

   Hossain Md. Sayem*, Ling-wei Kong and Huihui Tian*

2. Climate Change and Landslide Effects on Environment of Kawkhali Upazila, Rangamati District, Bangladesh
   Md. Azahar Hossain, *Md. Ahsan Habib, Abu Syed Mohammed Faisal, Mohammad Anisur Rahman and Salma Akter*
3. A Preliminary Study on Particle Size Distributions of the Late Cenozoic Sediments Exposed in the Sylhet Trough, Bengal Basin, Bangladesh: Implications for Climate Change
   Md. Sazzad Hossen, *Abu Sadat Md. Sayem, Rashed Abdullah and Rumana Yesmin*
4. Greenhouse Gases and Indian Coal Mining Industries Initiatives
   Gyanindra Kumar Pradhan
5. Pollen Catalogue of Contemporary Dry Flower Samples of Bangladesh by Establishing a Standard Sample Processing Technique
   Syeda Jesmin Haque, *Kazi Munsura Akther, Md. Faruq Hossain, Tanzim Tamanna Afroz and Asma Huque*

Technical Session 15

Theme 2: Mineral and Energy Resources

Venue: Board Room, 3rd Floor, Petrobangla
Date: 10 May, 2024; Time: 14.30-16.00hrs

Chair: Prof. Dr. Ismail Hossain, Department of Geology and Mining, University of Rajshahi
Co-Chair: Mrs. Nurun Nahar Faruqa, Director (Geology), GSB
Rapporteur: Mr. Md. Al Amin, Assistant Director (Geology), GSB

1. The Emerging Trends and Necessity of Policy Appraisal in this Energy Transition Period for Ensuring Energy Security Perspectives of Bangladesh
   Md. Jahangir Alam
2. Geochemical Characterization of Peat Deposits at South-Western Part of Sunamganj District, Bangladesh
   Mohammad Hasan Shahariar, *Mohammad Omar Faruq Khan, A.J.M. Emdadul Haque*
3. Environmental Degradation: A case study of the Patgram
   Md. Sohel Rana, *Md. Al Amin and Md. Abdur Razzaque*
4. Outlook for the Potentiality of Economic Mineral Resources of Northwestern Part of Bangladesh from Gravity and Magnetic Survey Perspective
   Md. Shahjahan
5. Sustainable Development of Coal Resources
   Santanu Dasgupta *and Bhupendra K. Mishra*
6. Nuclear Geoscience for Sustainable Development of Bangladesh
   Mohammad Rajib, *Md. Golam Rasul, Mohammad Zafrul Kabir, Farah Deeba, Md. Moniruzzaman Sumon, Nafisa Tamannaya Dina, Sudeb Chandra Das and Tumpa Saha*

Technical Session 16

Theme 3: Blue Economy, Coastal and Marine Geology

Venue: Conference Room, 3rd Floor, Petrobangla
Date: 10 May, 2024; Time: 14.30-15.15 hrs

Chair:Prof. Dr. Md. Mahfuzul Haque, Department of Geological Sciences, Jahangirnagar University
Co-Chair: Dr. Md. Samsuzzaman, Deputy Director (Geology), GSB
Rapporteur: Ms. TanzimTamannaAfroz, Assistant Director (Geology), GSB

1. Grey Area Over the Blue: Hindrance to Potentiality of Blue Economy
   A.J.M. Emdadul Haque
2. Potentiality of Marine Resources of the Bay of Bengal and Indian Ocean: Bangladesh Perspective
   Md. Bazlar Rashid, *Mohammad Abdul Aziz Patwary and Md. Shamsuzzaman*
3. Necessity of Integrated Coastal Management for the Sustainable Development of Bangladesh Coast
   Mohammad Abdul Aziz Patwary, *Mohammad Hasan Shahariar and. Md. Bazlar Rashid*

Technical Session 17

Theme 14: Geo-tourism, Geo-heritage and Conservation

Venue: Conference Room, 3rd Floor, Petrobangla
Date: 10 May, 2024; Time: 15.15-16.00 hrs

Chair:Prof. Dr. M. ShafiqulAlam, Department of Geology and Mining, University of Rajshahi
Co-Chair: Mr. Md. NazwanulHaque, Deputy Director (Geology), GSB
Rapporteur: Mr. Md. Jahangir, Assistant Director (Geology), GSB

1. Geotourism: A Tool for Perspective Development in Developing Countries
   Md. Nehal Uddin
2. The Context of Geoconservation Measures for the BDP2100's Hotspots Area of Bangladesh
   Md. Ali Akbar, *Md. Jahangir Alam and Mohammad Al Razi*
3. Geoethics: My Understandings
   A. K. M. Khorshed Alam

Closing Session

Venue: Dr. Habibur Rahman Auditorium, 1st Floor, Petrocentre, Petrobangla
Date: 10 May, 2024; Time: 16.30 -18.00 hrs.

List of Posters

Theme 4: Groundwater, Hydrogeology, Geochemistry

1. Trace Element Geochemistry of Shallow Aquifer Sediments and its Significance on Aquifer Quality at Bhanga Upazila of Faridpur District, Bangladesh

   Mohammad Omer Faruk Khan, *Shahida Akter, Md. Mahmood Hossain Khan and Md. Moshfequr Rahman*

2. Hydrochemistry of Shallow Groundwater and Its Implication on Health in Tungipara Upazila of Gopalganj District, Bangladesh

   Mohammad Omer Faruk Khan, *Md. Kamal Hossain, Md. Alamgir Kabir, Md. Shakhin-Uz-Zaman and Begum Shakera*

3. Groundwater Quality Assessment of Shallow Aquifer and its Impact on Human Health at Bhanga Upazila of Faridpur District, Bangladesh

   Shahida Akter, *Md. Mahmood Hossain Khan,Mohammad Omer Faruk Khan and Md. Moshfequr Rahman*

4. Geochemistry of Miocene Sediments from Sitapahar Anticline, Chittagong-Tripura Folded Belt, Bangladesh: Implications for Provenance, Source area Weathering and Depositional Environment

   Md. Hossain Al Imran, *Md. Ahosan Habib, Animesh Talukder, Md. Jahangir Alam and Md. Mohi Uddin*

5. Groundwater Management in the Salinity Induced Aquifers in the Coastal Area of Bangladesh

   Md. Abdur Razzaque,*Abu Syed Mohammed Faisal, Md. Jahangir Alam,Md. Ali Akbar, Md. Hasnat Jaman andMd. Kamrul Ahsan*

Theme 6: Geo-hazard and Geo-environmental Problems

1. Understanding the Groundwater Level Fluctuations for Better Management of Groundwater Resource: A Case Study in Part of Chapai Nawabganj District, Bangladesh

   Khondaker Emamul Haque, *Shamim Ahmed, Most. Afroja Khatun Suborna, Md. Moniruzzaman and Tasnim Abdary Anonna*

Theme 7: Engineering Geology and Urban Development

1. Importance of Using Geoinformation for Safe, Inclusive and Climate Resilient Urban Planning

   Md. Ali Akbar and ***Md. Jahangir Alam***

Theme 8: Structural Geology and Tectonics

1. Source-to-Sink History of the Cenozoic Sylhet Trough (Bengal Basin, Bangladesh): Insights from Detrital Zircon Geochronology

   Farzana Haque Lucky, *Rashed Abdullah, Matthew Campbell, Abu Sadat Md. Sayem and Farida Khanam*

2. Style of Deformation and Kinematics in the Eastern Fold Belt of the Bengal Basin: Implications for Future Hydrocarbon Exploration

   Md. Shahadat Hossain, *Delwar Hossain, Rashed Abdullah and Mohammad Moinul Hossain*

3. Structural Modelling and Kinematic Analysis of the Dakhin Nhila Anticline (Cox's Bazar, Bangladesh)

   Shuvankar Sarkar, *Rashed Abdullah and Md. Shahadat Hossain*

Theme 10: Petrology and Mineralogy

1. Petrography and Provenance of Plio-Pleistocene Fluvialy Influenced Sandstones of Sitapahar Anticline, Chittagong-Tripura Folded Belt, Bengal Basin, Bangladesh

   Md. Hossain Al Imran, *Md. Ahosan Habib, Nasima Begum, Md. Nuruzzaman Sabuj, Md. Hossain Khasru, Animesh Talukder, Md. Jahangir Alam and Md. Mohi Uddin*

Theme 12: Remote Sensing and Geospatial Technologies

1. Quantitative Analysis on Morphological Changes of Delta along Southern Coast of Bangladesh; A Remote Sensing and GIS Based Approach

   Mst. Laboni *and Ayon Saha*

2. Big Data Analytics and Machine Learning Prospects in the Fields of Geological Exploration and Activities in the Geological Survey of Bangladesh to Cope with Sustainable Development and Bengal Delta Plan 2100

   Md. Jahangir Alam

Theme 14: Geo-tourism, Geo-heritage and Conservation

1. Positive Impact of Geo-tourism and Geo-heritage on Human Civilization

   Noor Mohammad

2. Geoclimatic Conditions and Ecosystem Services of Hakaluki Haor, Bangladesh

   Mohammad Omer Faruk Khan*and Muhammad Masum*

Content

Abstracts

ISSN 2958-616X

Microtextures on Detrital Sand Grains from the Sundarban Forest Site in Satkhira, Bangladesh

Mohidul Islam[1], Md Aminul Islam Rony[1], H. M. Zakir Hossain[1]* and Anas Al Hossain[1]

[1]Department of Petroleum and Mining Engineering, Jashore University of Science and Technology, Jashore - 7408, Bangladesh

*Corresponding author's E-mail: zakirgsd@yahoo.com

Abstract

Microtextures on medium to coarse-grained detrital sands (n = 25) collected from ~100 m drilled core section of the Sundarban forest site in Satkhira, Bangladesh, were identified using scanning electron microscope (SEM) to examine the transport mechanism, source, and deposition environment. Twenty-eight microtextures were recognized from 200 quartz grains, and classified as mechanical (18 features), chemical (5 features), and both mechanical and chemical (5 features) origins. Sub-rounded to rounded quartz grains with smooth edges, V-shaped pits, straight or curved grooves, crescent-shaped features, and straight or arcuate steps suggest the quartz grains were derived from lengthy transportation over a fluvial environment. An abundant well-rounded outline, low relief with dish-shaped depression, mechanically upturned plates, and arcuate steps in the investigated sand grains imply an aeolian process associated with the shoreface environment. Etching, solution or irregular pits, and variable reliefs were also detected in the quartz grains representing chemical origin under a subaqueous environment.

Keywords: Microtexture, Quartz grain, SEM, Sundarban forest site, NW Bangladesh.

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Sustainable Management of the Coastal Areas of Bangladesh - A review

Md. Bazlar Rashid[1]*

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Abstract

In the coastal areas of Bangladesh, polders and embankments were constructed during the 1960s and 1980s to protect the areas from saline water intrusion. During construction, the authority disconnected the tidal channels and creeks from the tidal plain areas. Though, few of them were connected and regulated by sluice gates. The tidal channels and creeks play the key role to build up the coastal areas through sedimentation, and consequently raising the areas in respect with relative sea level rise. However, the authority completely overlooked the very important issue regarding the natural delta building process. As a result, due to obstacles, the tidal plain areas gradually go under sea level due to lack of sedimentation. On the contrary, the sediments from upstream and also from the sea started to take place within the channels, and they are gradually congested and, in many cases, completely silted. Consequently, drainage congestion, flooding, water logging, salinity intrusion, etc. made the areas more and more complicated, and it is now almost uninhabitable. Recently, many organizations took initiatives to restore the tidal rivers by implementation of the tidal river management (TRM) project through reconnecting the tidal rivers with the tidal plain areas. However, it is not a very easy task. In many cases, the sedimentation is only taking place very near to the embankment cut points. Some cases, uneven sedimentation is taking place within the plain lands. The channels are restored just after operation of the TRM. But it congested again a few years later. In many cases the social conflicts arise due to poor management of the TRM project. In a word, the situation is becoming critical day by day. Therefore, to take any further management plan or any development policy, it is very important to think about the delta building process. Consequently, the inherently delta building knowledge rich specialist (geologist) must be included in the policy/plan making team. Otherwise, due to mismanagement/improper policy making like earlier eras, the coastal area of Bangladesh will be further complicated in reflection of climate change, sea level rise, sedimentation rate, upstream barrages, water logging, flooding, salinity intrusion, etc.

Keywords: Delta building, Drainage system, Anthropogenic activities.

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The Influence of Watershed Geomorphic Characteristics on the Flash Flood of the Transboundary Khowai River, Bangladesh

Jonahid Chakder[1]* and Md. Mahfuzul Haque[1]

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Abstract

Due to its unique geographical location, topography and climate, the rivers of Bangladesh are generally very responsive. It is one of the most flood-prone countries in the world. In the northeastern region of the country, flash floods are regular annual events. Generally, most of the country is inundated by the slow onset river flood, which gradually progresses from the upstream Himalayan side to the downstream deltaic flatland. However, during a flash flood, the water levels rise very rapidly with limited or no warning. As a result, this sudden flood affects the agriculture, livelihood and infrastructure of this part of the country more than the other areas.

Khowai River is a transboundary river in the northeastern part of Bangladesh and is a flash flood-prone river. But until now, there are no previous studies about the flash flood of this river. The nature of the Khowai River flash flood depends on both the intensity and duration of the rainfall as well as the catchment characteristics. Due to the unavailability of precipitation data across this transboundary catchment, the present analysis focused on the catchment geomorphology using satellite imagery and a digital elevation model (DEM). The analysis indicates that the catchment geomorphology like the elevation, gradient and drainage density profoundly impacts the flash flood characteristics of the Khowai River. In such a context, the analysis of Khowai catchment characteristics is critical for hydrologic modeling, identification of vulnerable areas and planning for flash flood risk mitigation.

Keywords: Khowai River, Flash flood, Geomorphology, Catchment characteristics.

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Grain size Analysis of the Plio- Pleistocene Dupitila Formation in the Kutubpur Magnetic Body Area, Dinajpur, Bangladesh: Implications for Depositional Setting

Md. Sohel Rana[1]*, Md. Ali Akbar[1], Farhan Ahmed Bhuiyan[2], Zobayer Mahmud[1], Md. Al Amin[1], Md. Al Razi[1], Anwer Sadat Mohammad Sayem[1]

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[2]University of Minnesota Duluth, Minnesota, USA

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Abstract

This study investigates the depositional setting of thePlio- Pleistocenesedimentary rocks of the Kutubpur Magnetic Body Area according to grain size analysis of sandstones.This research based on sedimentary data from geological drill hole GDH-77/2022. Thirteen sandstone samples were collected and studied from the Plio- PleistoceneDupitila Formation atKutubpur Magnetic Body Area in Dinajpur District of Bangladesh. The analysis results specify fine to medium grained sediments and unimodal nature of grain size distribution. The sorting values of the studied sandstones vary from 0.62φ to 1.08φ, which indicates that the sediments are moderately well-sorted to moderately sorted with poorly sorted. The skewness values of investigated samples vary from -4.32φ to 1.8φ, which indicates nearly symmetrical to strongly coarse- coarse skewed nature. The kurtosis of the studied samples varies between 0.60φ and 2.55φ which shows mesokurtic and leptokurtic nature. Linear discriminant function and interpretation diagrams of sediments demonstrate that the Plio- Pleistocene Dupitila Formation of the Kutubpur area was mainly beach sand and beach environment by rolling and suspension. Sediment was deposited by shallow marine turbidity currents by high-energy open channels.

Keywords: Grain size analysis, Dupitila Formation, Passive margin, Shallow marine delta, Kutubpur Magnetic Body.

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Pilot Plant Study for Separation of Heavy Minerals from the Tista River Sand, Bangladesh

Pradip Kumar Biswas[1]*, M. Shafiqul Alam[2], Syed Samsuddin Ahmed[3], Mohammad Nazim Zaman[1], Md. Sha Alam[1], Md. Shohel Rana[1], Md. Shams Shahriar[1], Md. Imam Sohel Hossain[1]

[1]Institute of Mining, Mineralogy and Metallurgy (IMMM), Bangladesh Council of Scientific and Industrial Research (BCSIR), Joypurhat 5900, Bangladesh
[2]Department of Geology and Mining, University of Rajshahi, Rajshahi 6205, Bangladesh, [3]Bangamata Sheikh Fojilatunnesa Mujib Science and Technology University,Jamalpur, Bangladesh
*Corresponding author's e-mail: pradip_immm@yahoo.com

Abstract

A pilot plant study for separation of heavy and light minerals from the sample of Tista river sand has been accomplishedusing gravity, magnetic, and electrostatic separation method in the Mineral Processing Center at IMMM, BCSIR. The sand samples were collected from the Tista River bed by suction dredging method.In wet processing plant, the sample was simultaneously wetted and screened using a 500µm aperture and run through wet gravity concentrator of rougher, scavenger, cleaner and re-cleaner spirals. The low intensity magnetic separator and wet high intensity magnetic separator have also been introduced in wet processing plant to separate magnetic and non-magnetic minerals. Individual minerals have been separated in dry processing plant by the combination of RED, HTRS, RERMS, and EPS equipment. The result of the pilot plant study shows that 2.66% of total heavy minerals are achieved in spiral gravity concentrator. In dry separation plant 0.194% ilmenite, 1.508% garnet, 0.064% zircon, 0.038% rutile are recovered among THM. During separation, 0.469% mixture of various magnetic minerals (amphiboles, pyroxenes, etc.) and 0.212% mixture of non-magnetic minerals (alumino-silicate) were also found. Individual minerals and different fractions have been extensively characterized by using microscopes, XRF, XRD, and FE-SEM. From these analyses, the ilmenite concentrates contain minor amount of titano-hematite, garnet, and leucoxene, whereas the garnet concentrates contain quartz, ilmenite, amphibole, chlorite, and titano-hematite as minor impurities. However, zircon concentrate was still dominated by apatite, sillimanite, rutile, and titanite. Chemical analysis of the HM Mix fraction, which is the admixture of different heavy magnetic minerals, reveals that this fraction contains REEs, e.g., La, Ce, Pr, Nd, Sm, and Gd. The employed separation technique elucidates that closely sized fractions offer high yields. At present, dredging and extraction of river sand are pivotal in Bangladesh for deepening of rivers to make water-ways navigable, land filing, and also for

construction materials. Considering this fact, recovery of the VHMs as a byproduct from river sand has excellent implications for our economy. Subsequently, the framework of this research could potentially be used for exploration and mining of sand from the other large rivers, which would boost the sustainable economic development of Bangladesh.

Keywords: Heavy Minerals, Pilot Plant, Tista River.

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Biomarker Characteristics of Organic Matter in the Sylhet Basin Mudstones, Bangladesh

Sk. Tamanna Taher Turni[1], Tanzila Hasan Moyuri[1,2], H. M. Zakir Hossain[1]* and Farjana Afrin Rima[1]

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[2]Department of Petroleum and Mineral Resources Engineering, Bangladesh University of Engineering and Technology, Dhaka, 1000, Bangladesh

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Abstract

Eleven mudstone samples from the Surma Group, Sylhet basin of Bangladesh, were investigated to evaluate the source of organic matter, vegetation type, and hydrocarbon potentiality. Total organic carbon (TOC) content in the Surma Group mudstones varies from 0.31 to 0.53 wt%, with an average of 0.41 wt%. Long-chain *n*-alkanes (C_{21} to C_{37}) are more abundant than mid- and short-chain ones, indicating terrestrial higher plant-derived organic matter input into the mudstones. The Carbon Preference Index, $CPI_{(25\text{-}35)}$ values range from 0.97 to 1.68, with an average of 1.27, suggesting the contribution of waxy materials from terrestrial vascular plants. The Average Chain Length, $ACL_{(25\text{-}35)}$ values range between 27 and 28, with an average of 28.33, indicating organic matter in the Sylhet succession was derived predominantly from trees and shrub-type vegetation. The aquatic parameter, P_{aq} values ranged from 0.57 to 0.86, with an average of 0.63 belonging to the submerged and floating aquatic macrophytes. The waxy parameter, P_{was} proxy ratio values range from 0.25 to 0.49 (average 0.37) and show a strong positive correlation with ACL (r = 0.96), representing high waxy material input into the basin. The natural *n*-alkane ratio (NAR) values are close to zero (-0.07 to 0.05), demonstrating a petrogenic source. However, the terrigenous/aquatic ratio (TAR) value ranges from 0.14 to 0.39 (average 0.27), indicating aquatic organic matter source. The overall observation suggests that organic matter in the Sylhet basin mudstones is dominantly kerogen type-III, thermally immature to mature in nature, and primarily of gas-prone source rocks.

Keywords: Bangladesh, Biomarker, Kerogen type,*n*-Alkane, Organic matter, Sylhet basin.

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Geochemical Characterization and Economic Importance of Tajpur Limestone Deposit in Naogaon District, Bangladesh

Mohammad Hasan Shahariar[1]*, Mohammed Masum[1], Mohammed Nurul Haque[1], A. J. M. Emdadul Haque[1] and Zobayer Mahmud[1]

[1]Geological Survey of Bangladesh, 153 Pioneer Road, Segunbagicha, Dhaka, Bangladesh

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Abstract

The present paper deals with the geochemical characterization, and economic importance of limestone deposits at Tajpur basin of Badalgachi Upazila under Naogaon District, which is located in the north-western part of Bangladesh. The Tajpur basin covers an area of about 400 sq. km. Tectonically, the area lies in the Bogra shelf of a stable platform. The investigation work was carried out by two exploratory drilling operations.Among the collected samples, twenty-three samples at different depths were analyzed to determine calcium carbonate andvarious oxides by classical gravimetric method and complexometric titration followed by digestion with HCl and HNO_3. Besides, fourteen samples from different depths were also selected for elemental analysis in XRF method.A thick layer of limestone was found at depths ranging from 643 meters to 675 meters with a variation in thickness of around 30 meters. Considering the thickness, the reserve of the limestone will be around 25,000 million tons, which may be considered one of the most significant subsurface limestone deposits around the world.The limestone deposit of the Middle Eocene age is light grey to very light grey in color, hard, and compact. From the physical and chemical characteristics (86-94% $CaCO_3$, 44-53% CaO, 1.0-2.8% MgO and 2.1-10.2% SiO_2) of this limestone, it reveals that this limestone is of a high order.If the extraction of limestone is techno-economically feasible it may be used as the main ingredient of cement clinkers. Besides, it may have a wide range of applications in industrial fields including paper, rubber, plastics, paint, and building materials, etc.

Keywords: Cement, Characterization, Economic, Geochemical, Limestone, Tajpur.

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Geochemical Characterization of Peat Deposits at South-Western Part of Sunamganj District, Bangladesh

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Abstract

The present paper deals with the geochemical characterization of peat deposits at Sulla and Derai Upazilas, which is located in the south-western part of Sunamganj District, Bangladesh. A total of three hundred and forty-seven auger holes have been drilled covering an area of about 660 sq. km. The peat layers occur at shallow depths ranging from 0.66 meters to a maximum of 11.67 meters below the surface and have thickness ranging from 0.15 meters to 2.67 meters. The total reserve of peat in dry conditions is 196 million tons. Peat found in this area is brownish black to black in colour, slightly mature to mature, dry and fibrous, and contains partially decomposed leaves, twigs and tree scales, and wood fragments. A total of 116 no. of samples has been selected for proximate analysis. The physical and chemical properties of peat (average fixed carbon 21.6 %, average ash content 29.6 %, average moisture content 12.7 %, average sulfur content 0.65 %, and average calorific value 5252 BTU/lb) indicate that the peat of this area is of moderate to good quality. This peat is currently contributing to meeting the local energy demand in Bangladesh as a heating fuel in household cooking. The peat may act as a heating fuel in small industries like brick kiln and tobacco curing as well as for retaining moisture in soil, raw material in horticulture or to run small-scale power generating units. A policy, followed by a detailed feasibility study, should be adopted for the sustainable use of peat.

Keywords: Calorific, Characterization, Geochemical, Peat, Sunamganj.

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Decontaminating NORM via Monazite Beneficiation from Radioactive Waste of the Heavy Minerals Separation Plant at BSMEC, Cox's Bazar

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Abstract

In beach sand processing, decontamination of Naturally Occurring Radioactive Materials (NORMs) from mining waste is essential and thereby lowering radiation levels can prevent radiation hazard to occupational as well as public limit. In the heavy minerals separation plant at Beach Sand Minerals Exploitation Centre (BSMEC), Cox's Bazar, most of the radioactive minerals become concentrated as waste (Radioactivity for ^{232}Th is 23±3.45 KBq/kg) in the middling of Induced Roll Magnetic Separator (IRMS). Beneficiation experiment was performed applying physical separation technique with multiple cycles of shaking table, laboratory Electrostatic Plate Separator (ESPS) and laboratory IRMS. With this beneficiation process the initial feed (about 13% monazite) become enriched to 42.5% monazite after 3rd cycle of shaking table, 62.8% after single cycle of ESPS and 93.6% after 3rd cycle of IRMS as measured with a Metallurgical Microscope (Olympus BX53M). The beneficiation product is mainly Monazite ($(Ce,La,Nd,Th)PO_4$) and fragmented Zircon ($ZrSiO_4$) minerals, which are responsible for the elevated radioactivity in the beach sands of Bangladesh. This product is enriched with NORMs like Uranium (^{238}U) and Thorium (^{232}Th) and some other Rare Earth Elements (REE) like Cerium (^{140}Ce), Lanthanum (^{139}La), Neodymium (^{142}Nd), and Yttrium (^{89}Y) etc. This process or protocol for beneficiation of monazite is more feasible and economic rather than the traditional forth flotation technique. The final product of NORM decontamination by means of monazite beneficiation would be favorable for our future aspiration of nuclear energy and nano-electronics industries.

Keywords: Beneficiation, Decontamination, Monazite, NORM, Rare Earth Elements.

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Alluvial Clay of Bagha Upazila: Physico-Chemical Characterizations and its Industrial Potential

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Abstract

The study emphasizess on physical, mineralogical and chemical properties of the alluvial clay of Bagha Upazila (Rajshahi District, NW Bangladesh) to explore its potential as local industrial raw material. In this regard, 10 samples were collected from two boreholes with depths of 1.5 to 9 meters. All samples have been examined through physical, chemical and mineralogical tests which include particle size distribution by hydrometer, Atterberg limit following the ASTM procedure D-4318, brightness test by chromameter, X-ray Fluorescence Spectrometry (XRF) and X-ray Diffraction (XRD) analysis. Liquid limit (LL), plastic limit (PL) and plasticity index (PI) values were found in ranges of 41-62% with an average of 49.5%, 21.47-35.27% with an average of 30% and 12-32% with an average of 20.66% respectively. These data reveal that the clay is medium to high plastic. The clay from the study area was considered medium to high brightness as shown by Delta L value (51.65 - 68.00%). The XRF results represent Si_2O (48.12 - 63.63 wt%), Al_2O_3 (14.68 - 24.75 wt%), Fe_2O_3 (0.06 - 7.39 wt%), TiO_2 (0.66 - 0.87 wt%), CaO (1.00-6.02 wt%), Pb_2O_5 (0.09-3.52 wt%), K_2O (0.04-3.47 wt%), MgO (1.27-5.22 wt%), MnO (0.11-3.19 wt%), Na_2O (0.99-1.37wt%) while L.O.I values are between 5.26 - 11.73 wt% respectively. The total content of Si_2O and Al_2O_3 is more than 50% and CaO is less than 10% which implies the clay might have pozzolanic properties. The Xrd analysis determine that illite/mica (42.25%), kaolinite (25.22%) and vermiculite (2.2%) are the clay minerals present in all samples whereas quartz is present with an average of 30.33%. The analytical results reveal that the clay can be used for brick and pottery making and also can play a role as raw material in the production of smaller tiles, which may contribute a great prospect in the economic development of the study area.

Keywords: Alluvial clay, Chemical, Physical properties.

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Identification of Valuable Heavy Minerals in Sand Bars of Upstream Part of the Brahmaputra River, Bangladesh

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Abstract

Bangladesh is a riverine country with 700 rivers including tributaries that carry about 1.8 billion tons of sediments per year. The Brahmaputra is one of the major rivers of Bangladesh, having sand bars and point bars of different sizes that occupy about 50% of the channel with lots of valuable minerals. The study aims to find out the presence of valuable heavy minerals at the upstream of the Brahmaputra River. The study area occupies an area of about 500 Km^2. Total 820 nos. of sediment samples have been collected from different places of the study area employing three (03) different methods i.e., SPT (30m depth), Chopping (30m depth) and Pit section (2m depth). The concentration of total heavy mineral (THM) varies from 5.8% (T 223, depth-20-30 m) to 15.68% (T 217, depth-3-10 m) and valuable heavy minerals (VHM) from 1.42% (T 223, depth-20-30 m) to 3.67% (T242, depth-10-20 m) in bulk samples. Again, considering the borehole, the average percentage of THM varies from 7.55% to 13.24% and the VHM from 1.89% to 2.82%. Seven (07) types of valuable heavy minerals have been identified including Ilmenite (0.74%), Garnet (1.215%), Rutile (0.088%), Zircon (0.131%), Monazite (0.033%), Leucoxene (0.066%), and Kyanite (0.229%). Most of the minerals have been found at the depth of 10-20 m as the highest concentration except Monazite. Therefore, the abundance of valuable heavy minerals can contribute meaningfully to the economy of the country.

Keywords: Bangladesh, The Brahmaputra River, Economy, Sand bars, Valuable heavy minerals.

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The Emerging Trends and Necessity of Policy Appraisal in this Energy Transition Period for Ensuring Energy Security Perspectives of Bangladesh

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Abstract

Bangladesh is standing at historical crossroads concerning energy policy now. Electricity generation capacity has increased to meet up the increased demand and access to energy has expanded to a target of 95 percent. The demand is being increased to meet up the cumulative demand but the natural gas reserve is depleting with the impairment of existing a poor transmission line. The energy mix is being changed continuously with fuel diversification to ensure an uninterrupted power supply. Traditional energy infrastructure and institutional systems need to be adjusted to give way to innovative, effective and alternative solutions that will accelerate the clean energy transition.A strong combination of native, alternative sources and imported fuels in the energy mix can play a vital role to meet the challenge. We must have to go for more offshore and onshore prospects exploration immediately. Bangladesh must adopt an appropriate strategy to optimize the utilization of its own fuel resources and finance to fast-track their transition to low-carbon energy. Our native coal resources should be utilized properly with clean coal technologies and coal-fired plants with CCS and zero emission should be strictly upheld. New initiatives to connect electricity generation by convenient, alternative and other unconventional sources, added to the national grid by underground and surficial coal gasification, hydrogen fuel prospects, synthetic gas (Syngas) and some reliable REs like Tidal and macro-micro hydroelectricity prospects. An environmental appraisal and sustainable policy should be taken for overcoming the challenges 'the global temperature goal of staying below 1.5 °C' issue as well as to achieve SDGs goal 7 (clean and affordable) with targets including SDG 13 (climate action). For a robust policy, some vibrant issues that deserve to be on the list like energy economic considerations, real-time databases, infrastructure modernization (transmission and distribution), clean fuels adaptation, different types of alternative and REs, global trending modern technology and fuel shifting, EVs, near-zero emission system, nuclear, oceanic sources like tidal energy and others. Some strategic shifts in policies, regulatory framework coordination, real-time data and investments, new business models, geo-diplomatic cooperation and sharing of best practices as well that lay the foundation for resilient and low-emission economics are the main concerns of ensuring energy security.

Keywords: *Energy Policy, Fuel mix, UCG,* low-emission*and SDGs.*

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Heavy Minerals Exploration in the Bukit Puteri Area, Bangi, Selangor, Malaysia

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Abstract

This research aims to provide the overview of distributions, types, original source and economic potential of the heavy minerals in the Bukit Puteri area. A total of 15 selected heavy mineral concentrate samples were panned from stream sediment using standard panning "*dulang*", dried and separated from other light minerals using gravity method. The heavy minerals were separated into different fractions at different amperes using Frantz Isodynamic magnetic separator. Mineral identification was done using binocular microscope. Dominant minerals present in the heavy mineral samples collected are ilmenite (45.80% to 67.60%) average 57.63%, tourmaline (2.40% to 12.00%) average 6.07%, monazite (2.20% to 17.10%) average 7.27%, hematite (0.6% to 10.10%) average 2.88%, cassiterite (0.30% to 4.80%) average 2.02% and magnetite (0.3% to 10.50%) average was 2.99%. The less common minerals, present in trace amounts are xenotime, allanite, rutile, garnet, gahnite and zircon. The study area is famous for cassiterite/tin, so almost all samples contain varying amounts of cassiterite grains. From the mineral assemblage, cassiterite is sourced from mineralized quartz veins that cut granitic rocks as well as metasedimentary rocks in the area. Examination of the heavy mineral assemblage shows that they originated from granite as well as from the metasedimentary rock in the area. The above analysis shows that the presence of ilmenite, monazite and cassiterite in the study area is economically important and promising.

Keywords: Frantz Isodynamic Magnetic Separator, Metasedimentary rock, Ilmenite, Monazite Cassiterite.

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Prospect of Iron ore at Kutubpur Magnetic Body, Parbatipur, Dinajpur

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Abstract

The country's first Iron Ore deposit has been discovered at Alihat, Hakimpur Upazila, Dinajpur District, Bangladesh. Recently, revisualization of the drilling log for GDH-59/2001 revealed that some core samples exhibited a high level of magnetic susceptibility at the Kutubpur Magnetic Body which lies in the Dinajpur Shield area of Bangladesh. With the aim of providing mineralogy, stratigraphy and the economic potential of the iron ore deposit, this study is based on the information from the 3rd geological drill hole GDH-77/2022 in the Kutubpur Magnetic Body. A total of 11 selected basement samples were analyzed using different methods at different depths for physical properties, beneficiation methods and field microscope. Analytical results show that the bulk amount of magnetite (19-34%) avg. 25.18%, quartz (25-50%) avg. 36.09%, feldspar (10-22%) avg. 14.64%, amphibole (5-20%) avg. 11.82%, pyroxene (2-10%) avg. 4.55%, mica (1-6%) avg. 2.82%, epidote avg. 0.36% among the identified minerals in basement rock. Kutubpur magnetic body are composed of alternating bands of quartz and magnetite. Thick to thin layers, foliations, fractures, gneissic bands and secondary mineralization are common in this magnetic body. Ideally, an iron ore should contain 25% of iron oxide. From beneficiation, microscopic, and other analyses, it is evident that there are more than 25% iron oxides at Kutubpur magnetic body. Samples containing rich in iron is black or brownish-black with a metallic luster, slightly to strong magnetic susceptible, high specific gravity, leaves a black streak.Moderate concentration of iron minerals bearing layers or band occurred within the depth of 1498 feet to 1669 feet with cumulative thickness is around 100 feet which is a prospective zone for iron ore of the study area.

Keywords: Kutubpur, Magnetite, Quartz, Geological Drill Hole (GDH), Precambrian.

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Mineralogical Characterization of the Masidpur Magnetic Body of Dinajpur, Bangladesh

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Abstract

This research aims to provide the overview of minerals composition, distribution and characterization in Precambrian basement complex of the Masidpur magnetic body area at Alihat, Hakimpur in Dinajpur. The study area is located in north-western part of Bangladesh which is tectonically lies on Rangpur Saddle area.GSB has drilled four consecutive Geological Drilling Holes namely GDH-68, 73, 74 & 75 in the the year of 2013, 2019 and 2020 at Masidpur.A total of 98 selected basement samples of four drill holes were analyzed using XRD, XRF, FE-SEM, ICP-OES and Polarizing Microscope (TL&RL). Qualitative XRD analysis shows quartz & magnetite is the dominant minerals in the graph followed by amphibole, mica, and feldspar. Microscopic analysis shows that magnetite (6.50-57.30) avg. 27.75%, quartz (26.80- 62.10) avg. 44.5%, amphibole (1.80-14.50) avg. 8.01%, pyroxene (0.30-2.90) avg. 1.72%, mica (1.30- 20.50) avg. 8.83%, epidote (0.1- 3.60) avg. 1.37% and feldspar (0.20-15.4) avg. 2.93%. XRF analysis (Oxides wt. %) of iron oxides vary from 2.85-74.68; avg. 36.76% and silicon di-oxides vary from 7.53-65.25; avg. 38.82 % are major oxides. Minor oxides are Na_2O, MgO, Al_2O_3, P_2O_5, SO_3, Cl, K_2O, CaO, TiO_2, V_2O_5, Cr_2O_3, MnO, Co_2O_3, NiO, CuO, ZnO, Ga_2O_3, Rb_2O, SrO, Y_2O_3, ZrO_2, Nb_2O_5, and BaO. FE-ESM analysis magnetite (05.88-47.05) avg. 26.84 %, quartz (29.41 - 64.70) avg. 41.47 %, amphibole avg. 8.19 %, feldspar avg. 7.42 %, mica avg. 3 %,pyroxene avg. 1.96 %, epidote avg. 0.5 % and and ICP-OES analysis shows percentages of Iron oxide (Fe_2O_3) varies from 46.20% to 77.67%. Masidpur magnetic body are composed of alternating bands of quartz and magnetite. Thick to thin layers, foliations, fractures, gneissic bands and secondary mineralization are common in this magnetic body. Ideally, an iron ore should contain 25% of iron oxide. From chemical, microscopic, and other analyses, it is evident that there are more than 25% iron oxides at Masidpur magnetic body. The extensive laboratory analysis of mineralogical character shows that Sedimentary - metamorphic iron ore deposits thatsone sort of criteria of Banded Iron Formation (BIF).

Keywords: Magnetite, Quartz, Precambrian, Mashidpur.

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Discovery of Silica Sand at Patiya in Chattogram of Bangladesh

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Abstract

Silica sand deposit has been discovered in the Recent Piedmont Alluvium in the Patiya area, Chattogram. The total study area covers about 50 square km. This paper aims to provide an overview of the exploration and economic potential of the silica sand deposit in Bangladesh. A total of 52 bulk samples from 20 boreholes, 70 auger holes, and 4 pit holes with different depths were analyzed at different laboratories by mechanical, chemical, and polarizing microscope (TL&RL). The analytical results such as microscopic analysis shows that quartz is dominating mineral which ranges from 82.11% to 96.55% with an average of 93.66% and the other accessory minerals are feldspar, amphibole, pyroxene, muscovite, biotite, tourmaline, etc. present. Chemical analysis shows that the percentage of SiO2 (the principal ingredient of the silica sand) varies from 80.4% to 95.2%; an average of 91.91% and iron oxides from 0.24% to 3.64%; an average of 0.78%. Mechanical or sieve analysis shows that more than 98% of the sand population falls within the coarse to very fine sand class category. Among the sand, coarse sand size (-1000-+500µm) constitutes 12 wt.%, medium sand size (-500 - +25 µm) 51 wt.%, fine sand size (-250 - +125 µm) 26 wt.% and very fine sand and clay, etc. present. Chemical and microscopic analyses result indicate that it might be used for the manufacturing of colored glass wares. But it is not suitable for manufacturing good quality glass due to the presence of a comparatively high percentage of ferruginous materials. For quality glass sand, the sand needs to be properly washed or chemically treated. The mechanical analyses show that 90 to 98 percent of the sand grain is in between 35 to 120 size mesh that is fine to medium with coarse sand which is the acceptable size range for the glass industry.

Keywords: Chemical, Mechanical, Microscopic, Quartz and Silica Sand Analyses.

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Environmental Degradation: A Case Study of the Patgram

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Abstract

This study is based on the gravel deposits at different parts of Patgramupazila, Lalmonirhat District. The area is covered by Tista fan deposits of Pleistocene and Holocene ages. The surveyed area was about 55 kilometers along the bank of Dharola River and the bank of Saniazan River.A total of 199 samples were collected from 40 bore holes, 53 augers and 07 pits at different depths. The collected samples were analyzed by Macsalab sieve for the percentage of boulder, cobble, pebble, granule and sand.Analysis shows that significant amounts of gravel (boulder, cobble, pebble and granule together) are observed in 09 samples at depths greater than 08 meter.As per government rules, instead of manually extracting gravels from this greater depth, gravels are being extracted using pea-powered machines, resulting in huge holes and high dunes on the river banks causing environmental damage. This unplanned extraction poses serious environmental problems such as land degradation, river course change, river degradation, loss of agricultural lands, and biodiversity etc. According to government regulations, manual gravel extraction should be done in such a way that environmental damage is limited during exploitation and the land can be reclaimed after extraction is completed.Therefore, government regulations and proper supervision are needed to preserve the ecological balance and decrease the negative impact of this extraction. In this way, sustainable development can be guaranteed.

Keywords: Environmental Degradation, Government Regulations, Gravel.

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Geophysical Investigations: Leading to the Discovery and Delineation of Metallic Iron Deposit at Chakurpara-Masidpur Area, Alihat, Hakimpur Uapzila of Dinajpur District, Bangladesh

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Abstract

The only metallic iron deposit discovered, so far in Bangladesh remains within the shallow basement rock at Chakurpara-Masidpur area, Alihat Union under HakimpurUpazila of Dinajpur District. Prior to this discovery in 2013, several geophysical surveys were conducted over this region in different years. Two prominent magnetic anomalies were detected as an outcome at Chakurpara and Masidpur areas of Dinajpur district. The magnetic anomalies were considered very significant for metallic mineral deposits. To delineate the magnetic bodies and identify the basement structure, detail gravity and magnetic profiling surveys had been conducted in this area in 2012.

Six magnetic profiles of total 36 line kilometer length and three gravity profiles of total 12 line kilometer length covering an area of about 60 square kilometer were designed for the surveys. Continuous magnetic data along the profiles were recorded by a Cesium Vapour magnetometer. Gravity data were recorded along the same profile simultaneously at250 meter interval by using a Sodin gravity meter. Magnetic anomaly contour map was prepared using magnetic data processing software. Magnetic and Bouguer gravity anomaly graphs were also plotted.

The magnetic contour map clearly shows two distinct sets of magnetic anomalies atMasidpur and Chakurpara areas. AtMasidpur area magnetic anomaly graphs are characterized by high amplitude, short wave length and asymmetric nature. There is a well developed magnetic bi-pole with magnetic high anomaly at the southwestern portion of the survey area and the low magnetic anomaly of the bi-pole lies at the northwest. Another bi-pole of shorter wavelength lies at the northeastern part around Chakurpara village. Gravity and magnetic signatures are found congruent. The survey findings suggest high possibility of intrabasementmagnetic mineral deposit, which has been confirmed by GDH-68, GDH-73, GDH-74 and GDH-75 drill holes.

Keywords: Alihat, Bouguer gravity anomaly, GDH-73, Magnetic anomaly, Magnetic bi-pole, Masidpur Chakurpara Magnetic Body, Intrabsement magnetic mineral deposit.

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Outlook for the Potentiality of Economic Mineral Resources of North Western Part of Bangladesh from Gravity and Magnetic Survey Perspective

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Abstract

Gravity and magnetic surveys have been carried out in the north western part of Bangladesh since 1960s to answer curiosity of the geoscientist community exploring for mineral resources similar to neighboring regions in west Bangle and Meghgalaya of India. Till date, a total of 77 drilling operations conducted by Geological Survey of Bangladesh follow-ups investigations targeting gravity and magnetic signatures have also been carried out. As a result shallow basement rocks with numerous gravity low and high closures with different axial trend have been delineated. Magnetic anomaly bi-poles with different symmetry patterns and frequency-amplitude have also been identified. Correlation of gravity and magnetic signatures along with the findings of drilling investigations gives clues to the type of the causative bodies and its possible mineral content. Gravity low closures are interpreted as graben and gravity high closures are interpreted as horst blocks. Intra basement occurance of rocks of different densities may cause local gravity high and low closures. But not all gravity low closures are Gondwana coal bearing basins. Gravity low closures with northwest-southeast and east-west axial trend have high preservation potential for Gondwana coal. And, if there is a density contrast of basement and basin fill material is around -0.45 gm/cc, the basin is coal bearing and if the contrast is less (around -0.27gm/cc), it is non-coal bearing. So far three North-South trending and one East-West trending coal bearing basins have been confirmed. Two more East-West trending basins namely Tilakpur and Ronail basin need to re-confirm. Regarding metallic mineral deposits of Alihat has been indicated as iron ore bearing. Besides this Pirganj body, Kutubpur Body, Haripur-Nandanpur body, Baripara body are potential for magnetic minerals. Episodic volcanism may cause volcanic plug and dykes of different volcanic events. There is a possibility of rear earth minerals rich in ultrabasic Carbonatite volcanic plug at Gomostapur. As the basement of the region is among the oldest rock of the world, tracing back to Rhodenia-Nuna supercontinent, there is a possibility of Archean basins with Banded Iron Formation (BIF) and other mineral resources found elsewhere of the non-recycled (existing) part of the supercontinent. The paper compiles a salient feature of the future prospect for exploration for the mineral resources in the north western part of the country in gravity and magnetic point of view.

Keywords: Causative body, Gravity anomaly, Gondwana basin, Magnetic bi-pole, Carbonatite plug, Rhodenia-Nuna.

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Sustainable Development of Coal Resources

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Abstract

Coal along with other fossil fuels will continue to be the major source of energy despite of serious environmental challenges. Apart from economic energy generation, it also assists directly in employment generation and local area development. This is true in respect of countries like India and Bangladesh. In order to meet the global stipulations with respect of COP26, all efforts are needed to regulate the use of coal so as to reduce CO2 emissions. While majority of European countries have switched over to non-coal sources of energy generation, India will continue to depend on its use for energy security. As envisaged by Central Electricity Authority (CEA), both in Short term and Long term perspective, the total installed capacity of coal based thermal power plants in India will continue to grow despite of relative improvement in the contribution of renewable and other resources in Indian energy mix. For ensuring better standards of emissions, several new technologies are being adopted during excavation, coal handling and transport, storage and use through coal quality improvements. Efforts are also being made to ensure better utilization of fly ash generated with the use of higher ash content coal in the thermal power plants. Use of fly ash in cement manufacturing, brick making, landfills etc are some of the initiatives which has reduced the fly ash management burden in its disposal etc. All these aspects being part of sustainable development and for coal occurring at greater depths together with complex geological anomalies can be extracted by adopting underground coal gasification, coal bed methane technologies. They comprise a series of clean coal technologies. While India has adopted coal bed methane and coal gasification, the results are quite encouraging too. An attempt is being made in this paper to furnish the roadmap of India in the direction of clean coal technologies following the principles of sustainable development framework for mining with an attempt to study the coal resources of Bangladesh and share our experiences in sustainable utilization of coal resources for the benefit of both the nations.

Keywords: Sustainable development, Coal gasification, Coal Bed Methane, Energy security.

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Nuclear Geoscience for Sustainable Development of Bangladesh

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Abstract

In line with the stated vision, the geoscientific activities of Bangladesh Atomic Energy Commission (BAEC), as referred to Nuclear Geoscience, are related to the peaceful application of nuclear science and technology in geological prospects for socio-economic development of Bangladesh. Those activities are significant to achieve several objectives of SDGs, 7th fifth year plan as well as the Delta Plan-2100. According to BAEC Act-2017, BAEC has been given the authority of utilizing and managing radioactive materials and exploration of radioactive minerals in Bangladesh territory. Under the given responsibility, nuclear geological activities have started with the exploration for radioactive minerals in different parts of Bangladesh. Among more than 300 radiometric anomalies in the north-eastern region, at least 22 counts were found to be 10-60 times higher than background values. Thorite and uranothorite as uranium bearing minerals were identified where 15-42% of uranium was measured. Radiometric counts in a 300-meter-deep borehole in hard rock showed 20-25 times higher radioactive counts. Besides, zircon and monazite in the beach minerals of Bangladesh were also found to have 0.51% uranium and 3.76% thorium. Presence of uranium deposits in the nearby Indian region indicate the possibility of similar mineral deposition in Bangladesh territory. These results indicate the potentiality of detail radiometric survey in the region for a sustainable mineral resource management. As other activities, application of gamma-gamma logging in the subsurface of the northern region of Bangladesh resulted delineation of several coal seams. Saline water intrusion identification in the coastal areas, aquifer delineation via nuclear geophysical logging provided noticeable results in ground water study. Combination of several geophysical and nuclear logging provided a major part for the site survey of the under-construction Rooppur Nuclear Power Plant (RNPP). Therefore, enhancement of such nuclear geoscientific activities would contribute significantly in the sustainable development of Bangladesh.

Keywords: Nuclear Geoscience, Radioactivity, Uranium, Thorium, Geophysical Logging.

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Grey Area over the Blue: Hindrance to Potentiality of Blue Economy

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Abstract

Opening the new window of great potentiality of blue economy, Bangladesh got the final verdicts on maritime area with Myanmar and India in 2012 and 2014 respectively. Here a novel term "Grey Area" was firstly introduced in maritime delimitation history, which turned into a nodus to the abutting states. The tribunal set this area inside the Bangladesh delimitation line beyond 200 nautical miles off Bangladesh's coast that overlaps the EEZ of India and Myanmar. Here Bangladesh has rights on seabed and subsoil to explore and exploit resources but is not the owner of the water columns. It creates the complexity- how Bangladesh could explore the seabed or the subsoil using other state's water column. The arbitral tribunal left it to the states to set a pragmatic arrangement to exercise their respective rights. But the dilemma is both neighboring states have objected to the demarcation of this gray area, rather than arranging a peaceful modality to use. It turns the maritime area into an indecisive state. Thus, the main focus on the prosperity of the nations from the promising blue economy sucked behind the door. To exploit the immense potential of precious untapped below the blue, we need to overcome the hurdle of the disputes. This article illuminates the adjuvant analysis of present objections and disputes, and attempted to propose three approaches– Joint Submission, Mutual Dividing and Combined Operation to settle the grey area dilemma among the states. These approaches could efficaciously assist in reaching a judicious settlement and turn the grey into the blue to unveil the potential of blue economy as well as to achieve the SDGs.

Keywords: *Bangladesh Maritime dilemma, Blue economy, Extended Continental Shelf, Grey area.*

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Potentiality of Marine Resources of the Bay of Bengal and Indian Ocean: Bangladesh Perspective

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Abstract

The Bay of Bengal (BoB) (part of the Indian Ocean) is rich in resources (both living and non-living resources). Marine living resources include fisheries, mangrove forests, coral ecosystems, plankton, seagrass, seaweeds, etc. Whereas, non-living resources are oil, gas, gas hydrates, sea salt, heavy minerals, etc. The present study reveals that the oil and gas fields discovered in the BoB are parallel with exploration activities. Bangladesh part of the BoB includes the low exploration area, consequently only one producing gas field, whereas India and Myanmar discovered many significant gas and oil fields in their territory. India discovered gas hydrates in the BoB in 2016. Bangladesh also discovered 0.11tcf to 0.63tcf gas hydrate in 2022, which is worth 17-103tcf of natural gas, in the Exclusive Economic Zone (EEZ) of the country, though the industrial scale of gas hydrates exploration is still a big challenge in the world due to stability, composition, and distribution of gas hydrates in nature. Different types of heavy minerals are also present in the coastal areas of the country. The Indian Ocean has about 20% of the global tuna production, though Bangladesh contributes very little to it. In the marine part of the country, 475 species of fishes are found compared to 250 species on land. BoB is very important for BIMSTEC countries and China in consideration of Seaborne trade. Bangladesh can introduce modern cruises like other BoB countries to visit the coastal islands as well as Sundarbans mangrove forest, etc. contributing significantly to economic growth and local employment. Marine organisms have unique nutritional value and contain many kinds of bioactive substances. At present, internationally recognized antibiotics of cephalosporin series, vidarabine antiviral drugs, and a series of sodium alginate marine drugs have been existing. Japan has invested much manpower and material resources in seawater extracting Lithium and achieved gratifying progress. Japan, Germany, the United States, Sweden have also a certain scale of seawater-extracting uranium experiment devices. Despite of the challenges such as lack of trained manpower, scientific equipment and weak maritime governance, Bangladesh has to take the opportunity to explore its own potential marine areas.

Keywords: Coastal tourism, Gas hydrates, Marine organisms, Oil and gas and Tuna.

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Necessity of Integrated Coastal Management for the Sustainable Development of Bangladesh Coast

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Abstract

Coastal area of Bangladesh is very dynamic in nature. The area is influenced by the huge sediment supply from upstream, and faces cyclones and storm surges regularly. Sea level rise is also an issue. Altogether, they make a terrible impact, especially in the exposed coastal areas of the country. Integrated Coastal Management (ICM) is the framework of natural resource and environmental management through several stages like preparation, initiation, development, adoption, implementation, refinement and consolidation. Marine planning, laws and regulations, scientificand technologicalsupport systems, integrated marine coordination and joint law enforcement mechanism, international and regional cooperation on marine management have a strong influence on the ICM. Therefore, necessary action required to implement the laws and regulations to strengthen sea use management and marine environmental protection. Hence, the establishment of a scientific and technological support systems and strengthening of international and regional cooperation in marine management is essential. Moreover, scientific management and reasonable use of marine resources, maintaining marine ecological balance promotes marine sustainable development. Maintaining the health of marine ecosystems for the coast, bay and marine area through marine ecological restoration is also important. As the coastal area of Bangladesh is divided into three different natural coastal behaviors. Therefore, different approaches are required in each part of the coast. Development of a scientific database for each part of the coast is essential to formulate the proper sustainable plan. Bangladesh is continuing development activities at different parts of the coast like, export processing zone, deep sea port, multiple power plants. To make the development sustainable, this is the high time to adopt an ICM master plan and thus to develop and manage the entire coast, bay and marine area. The Blue Economy Cell of Bangladesh can play a positive role as an anchor for successful integrated coastal management, which will definitely contribute to the sustainable development of the country.

Keywords: Integrated coastal management, Ecosystem, Marine management.

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Trace Element Geochemistry of Shallow Aquifer Sediments and its Significance on Aquifer Quality at Bhanga Upazila of Faridpur District, Bangladesh

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Abstract

A geochemical investigation on occurrence of trace elements in the shallow aquifer of Bhanga Upazila of Faridpur District has been carried out which has not been done in this area before. Six environmentally hazardous metals (Pb, Cu, Cd, Co, Ni, Zn) were measured in the shallow aquifer sediments using *Inductively Coupled Plasma - Optical Emission Spectrometry* (ICP-OES). Sediment samples (n = 7) were collected from two boreholes and analyzed for the elemental abundance, pollution status, and probable ecotoxicological risk. Three environmental pollution indices namely the enrichment factor (EF), geo-accumulation (I_{geo}) and pollution load index (PLI) were estimated to assess the contamination level. The different indices suggest that the sediments are contaminated with Cd, Pb, Ni, and Co which may cause acute-chronic health problems. These are likely contributed from both anthropogenic and lithogenic (rock weathering, leaching, and cation exchange) sources. However, inversely the enrichment of hazardous elements in the sediment may indicate that the aquifer sediments may have very good absorption capacity and inhibit the metals to be released in the groundwater. The outcome of this study suggests a potential threat to the environment as well as to the community health of nearby inhabitants in case the elements are released in the environment. Thus, strict regulation and efficient management should be focused on monitoring and appraisal of heavy metals in the shallow aquifer of the area.

Keywords: Sediment Geochemistry, Aquifer Quality, Enrichment Factor, Geo-accumulation, Pollution Load Index.

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Simulating River-Aquifer Dynamics in Left Bank of River Ganges (Padma) in Drought-Prone North-West Bangladesh

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Abstract

The drought-prone area in the left bank of river Ganges (Padma) in north-west (NW) Bangladesh is facing challenges of water scarcity. The insightful numerical modeling study for interaction of surface water (SW) of rivers and nearby groundwater (GW) of aquifer system in the area is lacking. So study on simulation of GW flow characteristics, its dynamic exchanges with SW, and prediction of its long-run scenario using Visual MODFLOW has carried here. The study demonstrates that groundwater level (GWL) follows topography, and discharge capacity varies with time due to reduction in river water flow immediately after rainy season or recharge from the river, and over-exploitation of groundwater with increasing irrigation demand. Higher GW head reveals higher discharging rate, and its maximum velocity vectors also reflects major outflow towards the river basins that will be aggravated in coming days. The simulated total deficit amount between recharge and discharge is 2044000 liters/ year, and after 40years it will increase steadily (nearly four times) along with irrigation demand for country's food security. Higher declining rate of GWL also occurs due to declining amount of groundwater recharge due to rainfall scarcity. The GWL scenario for the period of 1980-2020 and predicted up to 2050 reveals steadily declining trend and the area will face severe water scarcity if appropriate adaptation measures will be not be taken timely. Finally, this river-aquifer model opens a window for better understanding the relationship of SW-GW system and thereby finding the potential causes of groundwater depletion in this drought prone area that will to develop appropriate water resources management strategy in this region.

Keywords: Ganges (Padma), NW Bangladesh, River-Aquifer Dynamics, Simulation, Visual MODFLOW.

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Variations of Water Quality in Floodplains and Barind Tract of South Eastern Part of Chapai Nawabganj District, Bangladesh

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Abstract

Excessive groundwater extraction and rapid urbanization caused water quality degradation. The hydrogeochemical analysis was applied to assess groundwater quality for drinking and irrigation in Chapai Nawabganj and Nachole Upazila. Thirty-four (34) groundwater (20 to 50 m depth) samples were collected from the study area. This area is divided into three physiographical zones: Younger Ganges Floodplain (YGF), Older Mahananda Floodplain (OMF), and Barind Tract (BT). Most of the analyzed parameters were within allowable limits of drinking water guidelines except NO_3^- (avg.-5.32 mg/L), NO_2^- (avg.-0.595 mg/L), As (avg.-0.048 mg/L), Fe (avg.-1.178 mg/L), and Mn (avg.-0.321 mg/L) of some samples. Higher concentrations of all parameters were found in YGF, OMF, and BT respectively due to both geogenic and anthropogenic contributions. The Piper and Chadha diagram showed that water is mainly the Ca-Mg-HCO_3 type. The WQI values showed that BT water is suitable for drinking while contamination was noticed in OMF and YGF. The irrigation water quality parameters: Electrical Conductivity (EC) (avg.-512.99 µS/cm), Total Dissolve Solid (TDS) (avg.-345.59 mg/L), Kelly's Ratio (KR) (avg.-0.355), Sodium Adsorption Ratio (SAR) (avg.-0.706), Magnesium Adsorption Ratio (MAR) (avg.-44.65), Permeability Index (PI) (avg.-76.23), Residual Sodium bicarbonate (RSBC) (avg.-0.886), Total Hardness (TH) (avg.-154.42 mg/L), and Soluble Sodium Percentage (Na%) (avg.-26.82) showed similar results. These variations in water quality depend on the geological characteristics of this area. The BT region has no problem with quality while Floodplain aquifers faced reverse conditions. This study implies that the subsurface hydrogeological environment should be monitored for the sustainable development of groundwater resources for future generations.

Keywords: Groundwater, Contamination, Floodplains, Barind Tract, Water Quality.

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Variation of Groundwater Recharge Rate with Urbanization in Barishal City

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Abstract

Urbanization is a sign of modern civilization. However, rapid and unplanned urbanization can affect groundwater recharge. Groundwater is the large store of fresh water that maintained by groundwater recharge. If it is disrupted, threatens human life. In this research we assessed the groundwater recharge rate affected by rapid and unplanned urbanization. Our study high lights a strong negative correlation between groundwater recharge rates and the extent of the urban area. To this end we have calculated urbanization rate and have also estimated rate of groundwater recharge). To achieve this, we used Landsat TM, ETM + & OLI-TIRS imageries, which were surveyed in 2000, 2010, 2015 and 2020. Geographic Information System (GIS) was applied to evaluate water bodies, urban, fallow, agriculture, vegetation, and lowland by maximum likelihood classification which show rate of urbanization. The water budget is calculated from rainfall, runoff, evapotranspiration, and leakage from the historic BWDB data. Our water budget measurements indicate that the conversion of natural landscapes to impermeable areas decreases groundwater recharge rates because the decreased infiltration less than makes up for the increased runoff. We argue that progress toward sustainable water management requires a greater understanding of groundwater recharge changes in urban areas. We believe that this depiction will persuade the hydrogeological community to give urban groundwater recharge more prominence.

Keywords: GIS, Groundwater recharge, Remote sensing, Urbanization, Water budget.

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Hydrochemistry of Shallow Groundwater and Its Implication on Health in Tungipara Upazila of Gopalganj District, Bangladesh

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Abstract

A hydro-chemical investigation of shallow groundwater at Tungipara Upazila of Gopalganj District was carried out to assess the water quality for drinking purposes its potential impact on human health. One water bearing zone was identified within the boring depth of 50 m which belongs to the shallow aquifer (<150 m) of Late-Pleistocene to Holocene Formation which is widely used for drinking purposes. Physicochemical parameters of groundwater measured in the field imply that the water is nearly acidic to neutral (pH 6.2 to 7.06), the environment is reducing (ORP -202.4 to -116.3 mV) and is slightly salinity (0.38% to 4.4%). The major ion concentration shows the water is magnesium bicarbonate type. Trace element and heavy metal content were measured in water sample preserved with HNO_3 by ICP-OES (Varian 710-ES) reflects that Cu (0.0068 mg/l), Ni (0.0108 mg/l), Zn (0.0167 mg/l), F (0.36 mg/l), As (29.34) are lower than the DoE standard values. Cd (0.0112 mg/l), Mn (0.2144), and Fe (10.66 mg/l) concentrations are greater than that of DoE standard values. NO_2 (0.76 mg/l) concentration is in accordance with the DoE standard. There is no standard acceptable value for HCO_3. Among the toxic elements only Co and Pb are below the detection limit of the measuring instrument. Different health issues may arise from the access or deficiency of different elements which should be taken care of.

Keywords: Groundwater Quality, Hydrochemistry, Health, Physicochemical Parameters.

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Groundwater Quality Assessment of Shallow Aquifer and its Impact on Human Health at Bhanga Upazila of Faridpur District, Bangladesh

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Abstract

Due to the growing consumption of groundwater various elements are also incorporated into human food chain from the environment. As a result, their health issues are becoming a growing concern. To assess the impact of different elements on human health a groundwater geochemical analysis was carried out at the Bhanga Upazila of Faridpur District, Bangladesh. On the basis of the geochemical analysis of ten (n=10) groundwater samples from hand tube wells (18 to 70 m depth). The groundwater in the surveyed area is found to be almost neutral in nature (avg. pH 7.1) and the water resides in a reducing environment (avg. ORP -83.5 mV). The groundwater is free from salinity (avg. salinity 0.3‰). Geochemical analysis by ICP-OES (Varian 710-ES) suggests that the average concentrations (mg/l) of the analyzed elements were HCO_3 (442.9), Na (39.1), Ca (107.0), Mg (30.2), Cl (24.0), SO_4 (8.5), K (5.7), NO_3 (8.4), NO_2 (13.9), Fe (4.9), Mn (0.5), As (0.2), respectively. In groundwater, the concentrations of most of the elements are within the standard limit of DoE, 1997 for Bangladesh except Ca, Mg, NO_3, NO_2, Fe, Mn and As.Majority of the samples (61.54 %) belong to the excellent class and many (23.05 %) are unsuitable for drinking according to the water quality index. Low K intake can cause K deficiency or hypokalemia. However, high As intake can cause hyperpigmentation, depigmentation, keratosis, peripheral vascular disorders and also skin cancer. The continuous monitoring and assessment of water quality is very important to ensure a safe and sustainable use of groundwater.

Keywords: Groundwater Quality, Geochemical Analysis, Human Health Risk, Shallow Aquifer.

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Geochemistry of Miocene Sediments from Sitapahar Anticline, Chittagong-Tripura Folded Belt, Bangladesh: Implications for Provenance, Source area Weathering and Depositional Environment

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Abstract

Geochemical appraisal of sedimentary rocks are globally employed to decipher the provenance, degree of maturity, recycling-sorting, weathering conditions, and tectonic setting of the depository basins. Geochemical analysis of Miocene Sediments from Sitapahar Anticline, Chittagong-Tripura Folded Belt (CTFB) of Bangladesh was assessed to anticipate the provenance, source area weathering and depositional environment. Inductively coupled plasma - optical emission spectrometry (ICP-OES) is used to analysis of major and trace elements of the sediments. Different concentrations and ratios of major oxides indicate that the sediments were derived from the higher Himalayan to lower Himalayan, granodioritic and felsic source rocks, and deposited under semi-arid climatic conditions. The Chemical Index of Alteration (CIA) (values ranging from 47.13 to 86.10%) and the major element oxides indicate that moderate to high weathering processes affected the depositional area. The plot of ICV (Index of Compositional Variability) versus CIA shows that most of the sediments are geochemically immature to mature and were derived from both moderately weathered source rocks. The tectonic setting discrimination diagrams support active continental margin setting of the provenance.

Keywords: Bangladesh, Geochemistry, Provenance,Sitapahar, Weathering.

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Radiation Exposure and Health Concerns Associated with Environmental Geochemistry of Greater Radioactivity in Atrai River (Bangladesh)

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Abstract

This study was carried out on a negligible anthropogenically impacted Indo-Bangla transboundary river basin (Atrai, Bangladesh) to elicit radionuclide and elemental distribution. Thirty sediment samples were collected from the Bangladesh portion of the Atrai river and Instrumental Neutron Activation Analysis (INAA) techniques and HPGe Gamma Spectrometry were used to identify naturally occurring radionuclides (NORMs; ^{226}Ra, ^{232}Th, ^{40}K) and their elemental concentrations. Metal concentrations (transition metals Sc, Fe, and V; rare earth elements Eu, Sm, La, Ce, and Yb; high field strength elements Hf and Ta) were determined to comprehend the genesis of greater radioactivity. This work helps to trace the mechanism of co-occurrence between the radioactivity concentration and the "rare earth elements" (REEs) pertaining to heavy minerals. The measured activity concentrations of ^{226}Ra, ^{232}Th, and ^{40}Kobserved in the analyzed river sediment ranged from 30.9 to 176.4, 34.0 to 231.7, and 637 to 1496 Bqkg^{-1}, respectively. This investigation shows that the mean concentration (µg.g^{-1}) of REEs (152.97), Hf (6.585), and Ta (1.169) is 1.2-1.5 times greater than the upper continental crustal values and has shown negative anomalies for Ce and Eu. Alongside, geo-environmental indices demonstrate 'practically unpolluted to moderately polluted' pollution status with considerable contamination level. Recognizing the mean concentration (hGyh^{-1}) of absorbed gamma dose rate, D (158.7) is 2.88 times more than the recommended value (55 hGyh^{-1}) that describes ionizing radiation concerns regarding potential health risks to surrounding communities and the houses of native residents, which are constructed

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by Atrai river sediment. This work will assist relevant policymakers in exploring geogenic and non-crustal constituent genesis in the composite riverine sediment in a trivial anthropogenically influenced river.

Keywords: Atrai river, Sediment, Naturally Occurring Radioactive Materials, elemental abundances, Environmental geochemistry.

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Primordial Radionuclides in Punarbhaba River, Northern Bangladesh: Origin and Affiliated Radiological Risks

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Abstract

To study the geogenic processes of primordial radionuclides' (^{226}Ra, ^{232}Th, ^{40}K) distribution, a transboundary Himalayan River (Punarbhaba) is chosen due to its trivial anthropogenic contamination. In explaining the origin of radionuclides, transition elements (Fe, Sc, and V), rare earth elements (La, Ce, Eu, Sm, Yb, Lu), high field strength elements (Ta and Hf) and actinides (Th and U) 30 river bed-sediments collected from Bangladeshi portion of the Punarbhaba river were analysed. HPGe Gamma Spectrometry and research reactor-based Instrumental Neutron Activation Analysis (INAA) were utilized to measure the radionuclides and other elemental abundances. The analysis showed that Radioactivity concentrations (in Bq.kg^{-1}) in average 68.4 for ^{226}Ra, 85.7 for ^{232}Th and 918 for ^{40}K, and for elemental abundance for REE is 126.81, LREE is 122.41, HREE is 4.40 (in μgg^{-1}), respectively. In the aggregation of elements, the mean affluence of La (57), Ce (58), Sm (62), Eu (63), Yb(70), Lu(71),Ta(73) were 1.02 to 1.38 fold higher than UCC. Geo-accumulation indices showed that this study area is practically unpolluted to moderately polluted (I_{geo} -1.94 to 0.217) and retains minor enrichment (EF 0.674 to 3.31); contamination factor indicates low contamination to moderate contamination; Pollution Load Index adherent contaminated level. Excess lifetime cancer risk and Absorbed dose rate are 1.8 to 2.23 folds accrete the health hazards of the adjacent dwellers. This study will help the affiliated policy-makers in exploring the technogenically valuable heavy minerals as well as to provide information regarding the radiological health risks.

Keywords: Punarbhaba river, Sediment; Primordial radionuclides; Elemental abundances; Upper Continental Crust (UCC); HPGe Gamma Spectrometry; Instrumental Neutron Activation Analysis; Radiological risks.

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Groundwater Management in the Salinity Induced Aquifers in the Coastal Area of Bangladesh

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Abstract

Fresh water for the running development activities along with its universal use for existence from domestic utility to agriculture has been a great challenge due to saline water intrusionin the coastal area of Bangladesh. All the 19 coastal districts along the 720km long coastline have been experiencing salinity either in the surface or subsurface and facing severe scarcity of safe water for their livings in many areas of the districts. Groundwater is the primary source of fresh water in the region, but not easily accessible for all. Moreover, over abstraction and arsenic contamination in the shallow aquifer are deteriorating the fresh water availability. To meet the thriving demand of clean water for growing population and agrarian economy is a herculean task and circumstances may even be exacerbated by the absence of proper groundwater management. The area is highly vulnerable to salinity intrusion on account of low elevation, cyclones and storm surges, high springs inundation, declining water supply by theGanges-Brahmaputra-Meghna (GBM) and climate change. Assessment, monitoring and regulation of the groundwater in the region are yet to be implemented properly.Operation and management of deep tube wells, building large reservoir to store rain water, making embankments, dams and sluices to prevent saline water intrusion with proper plan, and treated water supply through pipe line system by the governmentcan be effective measures for the problem. Furthermore,mitigating impediments to recharge and introducing artificial recharge for the area can contribute to desalination and yielding of the aquifers. Comprehensive studies on the hydrology and hydrogeological understanding of salinity intrusion to the ground water, investigation of the aquifer systems, finding new fresh water aquifers through geophysical survey, monitoring groundwater reservoir and quality as well as integrated water management system are essential in order to ensure sustainable fresh water for the present and future generation in the coastal area of Bangladesh.

Keywords: Aquifer, Groundwater, Hydrology, Intrusion, Management.

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Hydrogeochemistry and Groundwater Quality of Alluvial Aquifer of Dhamrai Upazila of Central Bangladesh

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Abstract

Dhamrai Upazila of central Bangladesh depends entirely on groundwater for various purposes. The presence of high concentration of iron in shallow aquifer and arsenic in both shallow and deep aquifers in some locations make the development challenging as well. Sixteen boreholes were constructed to explore the subsurface aquifer lithology and thirty two groundwater samples were collected to analyse groundwater chemistry and quality. Various in-situ field parameters were measured by different probes and chemical elements were measured in the laboratory by ion chromatography (IC) and inductively coupled plasma mass spectrometry (ICP-MS) following standard protocols. Two major aquifers are encountered up to the depths of 150 m. Aquifer-1 is mainly composed of gray fine to medium sands of Upper Dhamrai Formation (5-38 m) and gray medium to coarse sands and gravels of Lower Dhamrai Formation (50-95 m). Aquifer-2 (95-150+ m) is mainly composed of light yellowish brown to brownish yellow medium sands of Dupi Tila Formation. Most of the groundwater elements meet the standards set by WHO (2011)and DoE (2023) except for few samples containing higher levels of F^-, NO_2^+, Fe, $Mn^{2-}$and As. The main water facies are Na^++K^++HCO_3^-+CO_3^{2-}type with no dominant type and representing mainly rock-water interaction dominance. The water chemistry of the study area reflects low sodium and medium salinity hazard and is controlled by reverse ionic exchange processes. Water quality index for most of the samples of both shallow and deep aquifer confirms suitable for drinking, irrigation and industrial purposes with few exceptions in case of shallow aquifer.

Keywords: Alluvial aquifer, Rock-water interaction, Water quality index.

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Importance of Monitoring for the Sustainable Development and Management of Groundwater in the Bengal Basin, Bangladesh

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Abstract

Water resources management in Bangladesh faces immense challenge for resolving many diverse problems and issues. The most critical of these are alternating flood and water scarcity during the wet and the dry seasons respectively. Bangladesh receives huge water during monsoon causing regular seasonal flood in it's low elevated areas and during dry irrigation season, scarcity of water threats time-bound irrigation in many areas that leads to extensive use of groundwater. Importance of groundwater irrigation increased with the introduction of HYV (High Yield Variety) seeds in late sixties to meet the food demand for growing population. To protect the population from water-borne diseases, millions of hand tubewells (HTWs) have been installed in the shallow aquifers (<100m depth) that is mostly affected by arsenic contamination. Declining of groundwater table in many areas are due to over exploitation for irrigation abstraction in rural areas and huge domestic and industrial usage in cities like Dhaka. High rates of pumping from the shallow aquifers may result in widespread saltwater intrusion in coastal areas, and the degradation of water resources. Since the early 1990's, deep tubewells (DTWs) have been installed (100-250m depth) in an attempt to find safe groundwater for drinking water supplies. However, the wells often contain high concentrations of iron, manganese and chloride.

Estimation of the availability of water and preparation of water budget and water allocation plans for different uses down to Union (administrative area consisting of few villages) level need to be formulated. Strengthening appropriate monitoring organizations for tracking groundwater recharge, surface and groundwater interaction, and changes in water quality are important.Due to arsenic contamination in shallow groundwater and salinity at different depth levels, deep fresh water aquifers may serve as sustainable options for safe drinking water, however, more use of surface water mainly for irrigation and industrial use may reduce the stress on groundwater resources. The lack of appropriate methods and research for groundwater resources assessment is considered to be a significant gap in present water resource management. Sustainable development and management of groundwater can be done with a clear understanding of the groundwater system, its geology, hydrogeology, the subsurface flow and the response of the system

considering seasonal, tidal and pumping stresses. As such, investigation of the aquifer systems, understanding of formation behavior, regular monitoring and assessment of groundwater storage and quality are important considering adoption of appropriate and sustainable strategy to ensure food security, healthy society and safe water supply of the country.

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Geochemistry of Major, Trace and Rare Earth Element in Khalaspir Coal (Bangladesh) and Hazardous Elements Impact on Environment

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Abstract

This research investigates the distribution, concentration, and modes of occurrences of rare earthelements (REE) in cored coal samples from the Khalaspir coal basin in NW Bangladesh. This article describes whole-rock major, trace, and REE employing X-ray fluorescence and Inductively coupled plasma mass spectrometry analyses of samples from the designated basin drill hole GHD-45. Samples are divided into Khalaspir coal (KC, n =15) and non-coal rocks (KCS, n =5) those are high quality bituminous coal. The mineral content in coals is primarily kaolinite and quartz, with low quantities of pyrite and rozenite. The sum of REE mean is 287.4 ppm, where the average of Chinese and USA coals are 140.0 ppm and 66.3 ppm, respectively and worldwide bituminous and anthracite coal is 72.4 ppm. In investigated coals, the average U and Th contents are 3.1 ppm and 10.9 ppm where the mean of world hard coal U and Th are 1.9 and 3.2 ppm, respectively. The S composition of coals ranges between 0.43 and 0.74%, low content (<1%) indicating freshwater-influenced terrestrial origin. This paper also discusses some of the health problems connected with the presence of certain hazardous elements in coals and coal-burning activities.Inorganic contaminants from coal mining, storage, and utilization were investigated and compared with global data to address the potential risks of adverse effects on the environment and civic health.Adequate steps must be taken to ensure the safe use of solid fuel coal.

Keywords: Geochemistry;Provenance,Sediments, Hazards.

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Pore Size Distribution of Granite Residual Soils Under Multiple Drying-Wetting Cycles Using NMR Technique

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Abstract

Pore size distribution is the most significant intrinsic attribute of soils that regulates their mechanical, hydraulic, and physical behaviors. In recent years, Nuclear Magnetic Resonance (NMR) relaxometry has emerged as a quick, non-destructive, and potentially effective approach for determining the distribution of pore sizes in soils. Climatic variability, namely drying-wetting cycle, on the other hand, is thought to be one of the important factors that can significantly alter soil moisture distribution and hydro-mechanical behaviors.In this study, the pore size distributions of granite residual soils collected in the vicinity of Taishan Section (Kaiping), Gaungdong Province, China are evaluated using NMR spin-spin relaxation time (T_2) measurements and the effects of multiple drying-wetting cycles on pore size distributions are analyzed. The findings demonstrate that the NMR signal proportion decreases with increasing drying-wetting cycles i.e., the water holding capacity drops. With more drying-wetting cycles, the pore volume and optimum porediameter decrease.Pores with a diameter >0.1 μm affected more than those with a smaller diameter.The impact of first drying-wetting cycle is more, decreased with increasing subsequent cycle numbers and finally reaches a nearly constant state after 4 drying-wetting cycles.The pore size distributions also become more uniform with increasing drying-wetting cycle numbers. A modified van Genuchten model, where pore diameter takes the place of suction pressure, can be used to explain the pore size distributions.The predicted curve is in good agreement with the calculated pore size distribution. Although NMR T_2 relaxation is very sensitive to various factors, it can develop as a fast and very simple alternative for the assessment of pore size distribution.

Keywords: Drying-wetting cycles, Granite residual soil, Nuclear magnetic resonance, Pore size distribution.

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Climate Change and Landslide Effects on Environment of Kawkhali Upazila, Rangamati District, Bangladesh

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Abstract

The tropical to sub-tropical monsoon climate prevails over Kawkhali Upazila of Rangamati District. Historical meteorological data analysis from 1960 to 2021 indicates the ascending nature of high weather, temperature. The maximum temperature of 43.3^{0}C was recorded in April 1966. On an average the mean annual maximum temperature of South-eastern region of Bangladesh has been found to be increasing at a rate of 0.018^{0}C per year in the last 60 years which is a prominent indication of global warming in that region. In June 2017, the annual total rainfall was recorded 1189 mm, which is the highest in the last six decades. The progressive trend lines of humidity, associated with the increase in temperature resembles as climate change scenario. The water level reduces by about 2.8 m from 1956 to 2020 in that region. All are indications of climate change in this region. Moreover, pre-monsoon and monsoonal heavy rainfall are occurring which often creates natural disasters like flash floods and landslides in that area. Moreover, the population incremental value (%) in the study rises almost double from 1981 to 2011 which adds significant effects on the overall environment. For dwelling and cultivation purposes, inhabitants cut hills frequently, destroying the slopes of hills which amplify the landslide incidences in this area. One hundred and fifty-nine landslide points were identified in November 2021 during field survey. Twenty-six people died due to landslides in 2017. The casualties were high in the Ghagra union. Earth observation data showed the significant changes on Land Use and Land Cover changes from 2017 to 2021. Area of 18 sq. km and 11 sq. km of sparse and dense vegetation respectively have reduced due to landslides, deforestation and hill-cutting. Monsoonal heavy rain triggers flash floods on Ichamoti and Dabua rivers often creating river bank erosion and landslides in the hilly terrain which cause human casualties and economical losses. Preparing landslide hazard maps and installing Early Warning Systems could reduce casualties. Finally, increase of awareness is necessary to save the people from environmental degradation and landslide hazards in that area.

Keywords: Environmental, Historical meteorological data, Kawkhali, Landslide, Rainfall.

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A Preliminary Study on Particle Size Distributions of the Late Cenozoic Sediments Exposed in the Sylhet Trough, Bengal Basin, Bangladesh: Implications for Climate Change

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Abstract

The Himalayan exhumation began in the Oligocene and is still continuing, and thus, it is important to understand the climatic history of Asia during the Cenozoic. However, the evolutionary history and possible mechanisms of the Late Cenozoic climate change in South Asia, despite significant breakthroughs in recent decades, are still unknown. The Sylhet Trough in the Bengal Basin contains a nearly continuous sequence of Late Miocene to Early Pleistocene clastic sediments, which provides the opportunity to resolve long-term climate changes during this period. Here, we present the findings of lithofacies analysis and particle size variation of Late Cenozoic sediments from the Shari River section of the Sylhet Trough. A drastic change in lithofacies between the Late Miocene and Pliocene onwards suggests that a significant climatic shift is thought to have led the depositional environment to transfer from a deltaic to a fluvial environment. Based on the particle distribution (sand, silt and clay percentage) and textural parameters (mean and median), the entire sedimentary succession is divided into two distinctive climate zones. Zone I (Late Miocene to Middle Pliocene) is distinguished by higher mean (114μm), median (104μm) and sand (~60%) concentrations and a lower clay proportion (~10%), which points to a relatively colder period. Zone II (Middle Pliocene to Early Pleistocene), on the other hand, exhibits lower mean (70μm), median (57μm), and sand (39%) concentrations as well as higher clay percentage (40%), which indicates a relatively warmer period. The mean particle size and clay concentrations in Zone I remain surprisingly steady despite some variations, which is consistent with the period's global constant sea level fall. Zone II is marked by long-term decreasing and increasing trends of mean size and clay concentrations, respectively. These changes are correlated well with the rising sea level and a warmer event during the period. To accurately show the climatic periods, high-resolution clay mineral and geochemical analyses are needed in addition to numerical age dating.

Keywords: Climate Change, Late Cenozoic, Lithofacies, Particle size distribution, Sylhet Trough.

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Greenhouse Gases and Indian Coal Mining Industries Initiatives

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Abstract

Climate Change has been a topic of global as well as local area of concern. Every country, state, organisations have laid emphasis on evolving solutions to face Climate Change related problems. Economic development and activities have directly impacted on climate change. But the handling of this issue needs a ba;anced approach so that economic activities do not get derailed. In case of min erals and mining rel;ated activities, climate change initiative have taken a prominent place. Every activity in exploration, exploitation, transportation and use of minerals had several influencing factors on climate change. Improvements in technologies to ensure energy efficient systems in mining activities together with search for alternate fuel over the conventional diesel and electricity as source of power. Right from exploration activities the emphasis has been to select methods and technologies where CO2 emission is within tolerable limits. In case of opencast mines or quarries the mining plan, mine excavation plan and mine closure plan have been subjected to changes so as to enhance better recovery with least damage to flora and fauna. An attempt has been made in this paper to elaborate the activities, the technological changes (equipment selection, computer assisted mine plan/digitisation, low emission fuel use etc) which have been made and under various stages of implementation has been enumerated.

Keywords: Exploration, Exploitation, CO_2 emission, Mine closure, Digitization.

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Pollen Catalogue of Contemporary Dry Flower Samples of Bangladesh by Establishing a Standard Sample Processing Technique

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Abstract

Palynological research is a powerful tool in the fields of stratigraphy, biostratigraphy, palaeoenvironment, palaeoecology, hydrocarbon resource analysis, and palaeobiogeography. The Geological Survey of Bangladesh (GSB) has undertaken a significant step towards creating a pollen-spore inventory to support contemporary palynological research. This study aims to prepare a pollen catalogue from different modern dried flower samples of the Bandarban area that have been collected from the Bangladesh National Herbarium, Dhaka, and to establish a complete sample processing technique from dry flowers for pollen analysis in the laboratory of the GSB. The research outcomes will help to identify the prehistoric palynological zone and palaeoenvironment since most of the biota of the Holocene period are almost identical to current flora and fauna assemblages. Twelve dry flower samples of seven families were analyzed using the acetolysis technique, prepared temporary slides, and then observed under the microscope in 400x and 1000x magnification. This study records the pollen morphology of different taxa, including plant habit, category, and local and botanical names of flowers. Ecological information is also collected from various open-source resources. This pollen catalogue will be a valuable resource for students, teachers, oil-petroleum industrial sector, professionals, and researchers to learn and conduct research in the field of palynology. This research will significantly contribute to understanding the natural history of the country and other similar climatic regions. With a complete pollen-spore inventory, researchers will be able to explore the natural resources of the country, including its hydrocarbon resources, to make informed decisions about the country's economic progress. Therefore, the study is of utmost importance, and its results will be beneficial for the future generations of Bangladesh.

Keywords: Sample Processing,Acetolysis, Catalogue, Palynology, Pollen.

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Geological Evolution of Boga Lake on Hilly Terrain of Ruma Upazila, Bandarban District, Bangladesh

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Abstract

Boga Lake is located on the tightly folded Sakhudaung Anticline in the southeastern Tertiary hilly area of Bangladesh. Its maximum width and length are measured at 272 m and length of 362 m. An attempt has been made to disclose the geological evidence and mechanism of the lake's evolution. For this purpose, the general geomorphology, geology, and field data are used herein. Aerial photographs, RapidEye and Google Earth images have been used for precise geomorphological interpretation. Field data shows the evidence of the original bedding plane of sedimentary strata in the north, west and southern parts which are the remnant of hills. Conversely, on the eastern side a different about horizontal landscape is marked that differs from the other parts. Inside the lake the highest depth of the gully is the highest water depth which varies from 35 m to 46.54 m and gully is in the NE-SW direction. Giant hill blocks were eroded in the north-eastern part of the lake. Many fissures are marked nearby the lake. Big blocks of sedimentary rock debris are found inside the lake and the eastern part of the lake demonstrates that massive landslides have occurred in recent past time while the exact timing of the landslide was not possible to determine. From the historical earthquake data analysis from 1737 to 2010, it is evident that no larg earthquake (Mw>6.5) occurred close to the territory of the lake. There is no geological evidence of volcanoes or meteorites near the lake as well. Geomorphology, geology, landslide debris and landslide's rupture surface expose that the badland process and massive landslides are the combined forces for the evolution of the lake on the long slope of the Hill.Exploring the age of the lake is a challenging issue and any leakage or further landslide in future can change the current landscape.

Keywords: Aerial photographs, Debris, Lake, Landslide, Rapid Eye.

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Understanding the Groundwater Level Fluctuations for Better Management of Groundwater Resource: A Case Study in Part of Chapai Nawabganj District, Bangladesh

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Abstract

The north western part of Bangladesh is now facing water scarcity problems in both agriculture and drinking purposes. Groundwater forms the major portion of earth's fresh water source and it is almost safe to drink. But recently the depletion of groundwater level has become the most talk able topic in the study area. Fluctuation of groundwater-level is associated with both anthropogenic activities such as over pumping and natural processes including lack of rainfall, lithological variations that mainly responsible for the reduction of recharge. So, information about groundwater table is required for future management of ground water supply to general people. The present study includes field investigation for measuring groundwater level, rainfall, and lithological variations. From this investigation, it has been established that, water table lowering during the dry seasons but comes up during the beginning of rainy season. From these observations, it is clear that groundwater table is not replenish completely as the before that caused depletion of water level day by day. At the beginning of rainy season, the water table starts to come up. The excess groundwater withdrawal and lack of groundwater recharge caused the depletion of the water level. The water level has decreased about 8.5 m since 2011-2021. Therefore groundwater through shallow tube well is not sufficient to fulfill the required demand for the general people as it is becoming out of reach through shallow well day by day. From this analysis, it is found that the groundwater level is lowering in almost all the region of the study. So, alternative water source should be ensured to mitigate the problem. Moreover increasing public awareness, practicing rain water harvesting, artificial groundwater recharge, and cultivation of less water consuming crops – all these steps should be applied to solve this problem. Otherwise the next generation will face intense water scarcity for drinking and irrigation.

Keywords: Depletion, Fluctuation, Management, Scarcity, Water table.

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Landslide Hazard Zonation of Ruma Upazila, Bandarban District, Bangladesh

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Abstract

Landslides in hilly terrain are a natural degradation as well as a significant earth surface building process. Every year landslide hazards take place in the mountainous region of Bangladesh. It is the costliest and damaging natural hazard in hilly regions. In Bangladesh, landslides are mainly triggered by rainfall. In the current research, the landslide Hazard Zonation (LHZ) map of Ruma Upazila, of Bandarban District is prepared using Remote Sensing and Geographic Information System (GIS) along with field data. The hazard map shows the probability of landslide occurrences. Different thematic maps particularly slope, aspect, curvature, lineament buffer, distance to road buffer, distance to river buffer, elevation, geology, and geomorphology were generated using remote sensing and data from different sources. The weightage rating system is based on the relative urgency of numerous causative elements as extracted from remote sensing data and other thematic maps were applied for the LHZ. The different classes of thematic layers were assigned the corresponding rating value. Each class within a thematic layer was fixed an ordinal rating from 0 to 9. The summation of these attribute maps was then multiplied by the corresponding weights to yield the Landslide Hazard Index (LHI) for each cell. The LHI threshold values are assigned as *145, 165, 180, and 205 for a different class*. Field landslide point data (150 landslide location data) are incorporated here for validation of the map. The prepared LHZ map displays the five zones- (i) very low hazard, (ii) low hazard, (iii) moderate hazard, (iv) high hazard, and (v) very high hazard. This map could play an important role to make any administrative decisions and sustainable development planning.

Keywords: Hazard, Landslide, Remote sensing and Zonation.

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Alternatives to Mitigate the Waterlogging and Siltation Problems in the Southwest Tidal Delta of Bangladesh

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Abstract

The study area lies in the greater Khulna and Jessore districts of southwestern part of Bangladesh is characterized by its flat topography and a dense network of tidal channels. In the name of development, construction of polders caused geo-environmental degradation of the area by severe waterlogging, drainage congestion, rapid siltation and land subsidence. This unwanted situation has been paralyzing the natural processes and social activities of the area severely. Moreover, normal land use, ecology, economic activities and livelihoods of the people put out of places.

The following alternatives independently or collectively proposed to improve the degraded situation of the area: i) flow improvement and augmentation ii) ensuring selective sedimentation under controlled conditions, Controlled Depositional Model (CDM) iii) dewatering by flash gates, iv) drainage of water by power and v) adaptation to waterlogging. Considering the fragile eco-system of the area, combination of alternatives may be the best way to improve the present harsh environment of the area.

CDM has been developed to overcome the waterlogging and drainage problems of the area sustainably. Model describes excavation and re-excavation of new and old channels together with the implementation of the Gorai Augmentation Project and allows sedimentation under coordinated manner to raise the tidal flats up to mean high tide level. This is an eco-friendly, sustainable non-structural type of solution as comparatively less expensive and has minimum impact on the existing ecosystem. Moreover, it can fulfil the expectation of southwest Coastal Embankment Project of Bangladesh.

Keywords: Augmentation, Coastal, Embankment, Waterlogging, Siltation.

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An Attempt to Investigate Rupture of the Dauki Fault in 1897 Earthquake by Trench Investigation at Majer TilaArea, Taherpur Upazila, Sunamganj District, Bangladesh

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Abstract

Dauki fault is one of the important active faults lying northeast of Bangladesh along the Bangladesh-India border. Morino et al 2011 divided the fault into the western, central, eastern, and easternmost segments and opined that the 1897 Assam earthquake might have been caused by the rupture of the central segment. Attempt was made to find out the surface rupture of 1897 earthquake at the central part of the fault near Majer Tila, Taherpur upazila, Sunamganj District in the southern edge of the Shillong Plateau. Majer Tila is a back-tilted hillock oriented in opposite to the regional slope and trench was done near southern periphery of the Tila. A clear rupture of a gravel layer was identified dipping about 35° towards north. Two wood samples were taken from the trench for radiocarbon age dating in the Beta Analyic Inc. USA. Result shows age of the upper and lower layers of gravel is AD 1950 and AD 1160 -1265 respectively. Historical catalog shows M ≥ 8.0 earthquake near Dauki fault happened in 1897. The easternmost segment ruptured in AD 840–920 and western in AD 1548 (Morino et al., 2011). At Majer Tila, there is no evidence of rupture, warping or liquefaction dated AD 840–920. Moreover, event of AD 840–920 confirmed from easternmost segment far from the site. Therefore, earthquake of 1897 might be responsible for the present rupture at Majer Tila (Majer Tila fault) but still need more investigation to confirm the event.

Keywords: Active fault, Dauki fault, Earthquake, Rupture, Trench.

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Geo-scientific Information for Sustainable Development: A Case Study of Shahzadpur Upazila, Sirajganj District, Bangladesh

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Abstract

Geoscientific information is prerequisites for proper planning and development activity of any area. Now a day's many development works of our country facing different types of hazards due to the lack of proper geo-scientific information. The study area comprises Shahzadpur Upazila under Sirajganj District,which is an important commercial arcaand at presents,is booming in development activities. The present work aims mainly for acquiring geomorphology, subsurface lithology and engineering geological properties of the soil of the study area. The area is mainly composed of non-cohesive sandy sediments. Geomorphological map was prepared on the basis of multispectral satellite image data such as Rapid eye, Landsat, SPOT, Google Earth as well as Topographic maps followed by field investigations. The area is classified into 10 geomorphic map units. There were 12 bore holes (depth up to 30 meters) and 26 auger holes (depth 5 to 8 meters) had been carried out to collect subsurface lithological data. Spontaneous Penetration Test (SPT) value also collected during boring operation. Grain size and encountered N value used to determine the engineering geological properties of the soil. The N value ranges 20 to 50 and grain size ranges from clay to coarse sand. On the basis of subsurface lithological analyses, a generalized subsurface stratigraphic succession had been prepared. Lithological analysis reveals that sand percentage is increase with the increasing of depth. Clay, silt and finer sand are found on the shallow depth. The results and maps of the present study is helpful for understanding the lithological and engineering geological properties of the soil of the area. It may help the decision makers to take proper decision regarding future development activities such as land use planning, river training etc. as well as for sustainable development.

Keywords: Geoscientific, Geomorphology, Lithology SPT, Sustainable Development.

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SAGA-ISEG Database for Dynamic and Spatial Geo-technical Data Analysis

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Abstract

Geotechnical data management is essential for analysis and spatial representation of diverse surface and subsurface geological information. Information System Engineering Geology (ISEG) is developed using PostgreSQL, a flexible open-source object relational database management system, and works with open source 'SAGA' GIS software. It can contain various types of geotechnical and other spatial geo-scientific information which are generated from the field investigation and from laboratory analysis. An advanced geo-technical database can be robust by combining field data, geo-technical borehole information, SPT-N value, lithological information, laboratory test data (grain size analysis, plasticity test, density, moisture content, specific gravity test, soil strength test such as direct shear test, unconfined compressive test etc.), engineering geophysical data and other types of spatial data for analysis and generation of different types of engineering geological maps. ISEG database can easily be exported to Excel. Annoying value and data in the database can be processed and filtered for data accuracy, completeness, consistency, uniqueness etc. easily by data query. Excel and the ISEG Database can be connected through an Open Database Connectivity (ODBC) connection. Multiple users can update the same database at the same time if it is installed on a server. ISEG is used as an extension of SAGA GIS software. Data processing, geo-statistical analysis, interpolation, spatial visualization and generation of various geo-technical maps can be done through the combination of SAGA software and ISEG database naming 'SAGA-ISEG' software. SAGA-ISEG allows conditional query and has opportunity to generate different types of engineering geological maps by processing the same database. This powerful database map plotting tool may be used to perform various functions like- sub-surface data evaluation, qualitative and quantitative representation of spatial geo-technical data etc. A variety of geostatistical analyses and engineering geological map have been generated utilizing this database which will be very helpful for future research.

Keywords: Geotechnical database, SAGA-ISEG software, PostgreSQL, ODBC.

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Geomorphology, Geology and Engineering Geology of Teknaf Pourashava and Surrounding, Cox's Bazar District

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Abstract

Teknaf is one of the vital Paurasahva located in the extreme southern part of Bangladesh.The town is bounded by the Bay of Bengal in the west and south and Naf River in the east which plays an important role in the economy of the country. The key objectives of the research are to prepare geomorphological, geological and engineering geological maps which could assist in developing an earthquake-resilient port town in the study area. For map preparation, aerial photographs of 1954, topographic maps and satellite images were interpreted. For subsurface lithological and engineering geological data, augering up to 3m and boring up to 30m depth were done. ArcGIS software is used to represent the map. Based on the interpretation of aerial photos and geological field survey, geomorphologically the Teknaf paurashava and surrounding areas are classified into four major units, e.g, fluvio-tidal landform, tidal landform, transitional landform, and hilly landform. Each landform is again classified into several sub-units. Geologically, the mapped area is classified into fluvio-tidal deposits, tidal deposits,valley and slope deposits and Tertiary deposits. Considering the geology and SPT-N value, the mapped area is classified into seven engineering geological map units. Considering geomorphology, geology and N value unit IV (3 m composed of medium stiff silty clay underlain by Tertiary shale; N value > 50) and unit V (1.5 to 7.5 m depth composed of medium stiff clay with silt (max. N value 5) underlain by medium dense sandy silt (max. N value 3) and hard, compacted Tertiary shale (N value >50) are more suitable for infrastructure development under natural conditions. More detailed research, as well as large-scale mapping is required for sustainable planning and development of the area.

Keywords: Engineering Geology, Landform, Map unit and N-value.

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Voxel Model, A Sub-Surface Visualization and Analytical Tool for Geoscientific Analyses and Decision Making: Case Study Satkhira Town and Surroundings

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Abstract

Satkhira Town is located in the "Mature Delta" of the Ganges-Brahmaputra-Meghna River System (GBM), south western part of Bangladesh which is highly influenced by the fluvio-deltaic and fluvio-tidal effect. Mainly fine sediments were successively deposited by minor tributary flows. Litho-profile units with sharp boundaries indicates the significant sedimentary sequence changes.

This complex lithological succession could be display by 3D voxel modeling technique for replicating the near-reality and visualizing the data sequences. The percentage of clay, silt, and sand is used to create coarseness-finesse curves to detect the changes of sedimentary sequences, trends, probable genetic background and depositional stages to distinguish geological litho-profile units. Voxel positions of the litho-profile units are used as categorical indicator variable to perform a 3D indicator kriging resulting the 3D model. The model used 100x100x0.5 metres voxel dimension and 6 different depth levels of the litho-profile unit distribution at top, -5 m, -10 m, -15 m, -20 m, and -25 m.

The fining-up trend and rapid siltation of sediments is clearly traceable within upper 5 m showing the diversity of co-existing litho-profile. It is noticeable that, finer sediment succession is associated with the recent tidal flat in the south. This analysis will help the town planners, engineers and geo-scientists in decision making and plan for further study.

Keywords: GeoUPAC, 3D indicator kriging, 3D voxel model, Sedimentary sequence changes.

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Importance of Using Geoinformation for Safe, Inclusive and Climate Resilient Urban Planning

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Abstract

Bangladesh is a growing economy and continuing its economic size over the past decades. So, urbanization and cities are growing in size, to both vertical and horizontal extents. Moreover, many mega-structures and infrastructure development, tunneling, nuclear power plants and etc. are going on. Geoinformation can play a key role in future urban planning to limit conflicts, reduce risks and lower the costs of subsurface challenges. By managing the subsurface based on geological knowledge and data, cities may tackle challenges for a climate-neutral future and become resilient. Surficial and sub-surficial information is very significant for sustainable infrastructure development and management. But the importance of geotechnical investigation and geoinformation usage is still ignored. The geological survey can serve a significant role in city development by providing the large data archives and cutting-edge expertise necessary for sustainable urban development. Geoinformation can bring better success in urban planning by considering structures for surface-water diversions, drainage, sewerage, waste disposal sites and living homes with some recreational green spaces for urban sprawl or suburbarea. There should have design guidance and actions for the geotechnical design of buildings and civil engineering works like the Eurocode 7, which is currently used at the stage of maintenance and evolution to address the variety of new methods, new materials, new regulatory requirements and new societal needs developing and to extend harmonization in the EUs urban planning. GSB can introduce a database that includes geological, geotechnical, hydrological and geophysical data, outline techniques, maintenance, secondary database and professional software with quality assured data and promote it to stakeholders and policy makers suggesting for policy affirmation with BNBC. For achieving this destiny, GSB has to develop skilled and equipped manpower as well as to work in different detail geotechnical scales for need base and national demand. This way, geoinformation and its usage can and make cities and ensure safe human settlements inclusive, safe, resilient and sustainable.

Keywords: Database, Geoinformation, SDGs, infrastructures and Urban Planning.

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A 3D Geotechnical Review for Structural Configuration of Bengal Basin and Earthquake Magnitude Projection in Bangladesh

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Abstract

Bangladesh is an earthquake prone country and regionally surrounded by various strong seismo-tectonic structures. A major part of the country is constituted of Bengal Basin. The basin is filled up with thick (~ 30km) fluvio-deltaic sedimentary deposits, laid down since the Late Cretaceous orogeny to turn into the thickest sedimentary sequence in the planet.

This study identifies that Bengal Basin is deeply influenced by the regional tectonic activities. The rise of Arakan-Yoma mountains in the east and Shillong plateau in the north of Bangladesh caused a puzzling crustal deformation. As a result, the Bengal Basin crustal floor was intensely fractured, faulted, fragmented, and undulated. We have delineated the crustal topography and presented a 3D geometry of the basin by analysing and reviewing available published geophysical, tomographic, Receiver-Function data and sections. Maps are prepared for both vertical and horizontal fractures and faults with possible depths of the Mohorovicic discontinuity and mantle.

A detailed geotechnicalreview of the identified geo-structures is done for seismogenic behavior analysis and examined for earthquake generation capacities. The faults are classified and characterized as active and inactive. The possible earthquake magnitudes from respective active faults are calculated for determination of Peak Ground Acceleration and Surface Acceleration. The Srimangal earthquake event (1918; Mw 7.1) is considered as a scenario case for the future earthquake magnitude projection in Bangladesh. This study did not find any favourable tectonic structures for the development of any megathrusts that can generate very high magnitude (9 M) catastrophic earthquakes in the Bengal basin.

Keywords: Seismo-tectonic, Earthquake, Peak Ground Acceleration.

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Identification of Geotechnical Weakzones and Candidate Locations for Quicksand Phenomenon: A Resistivity Imaging Approach in Chittagong City Outer Ring Road Site, Chittagong, Bangladesh

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Abstract

Subsurface geotechnical weakzones are a hindering issue for the stability of a roads or embankments in the coastal area due todifferential settlements with time and load; or failure possibility due to liquefaction or else. Mapping lateral variations related to geotechnical weakzones by drilling or other approaches often subjects to over extrapolation and missing out important anonalies, so a continuous observation with closely and uniformly spaced data is needed. Hence, a continuous resistivity imaging surveywith 15 meter lateral and vertical data interval has been accomplishedto identify the subsurface geotechnical weakzones along 10 kilometer site ofChittagong City Outer Ring Road.It was a 10 channels dipole-dipole survey with 13 electrodes planted at 15 meter interval for every set of measurement. Acquired data matrix of 43 meter depth for 10 kilometer length was processed with an inversion software. Resistivity pseudosectionshave been prepared with least square inversion method and compared with Standard Penetration Test(SPT) data and lithology. Layers with low and high resistivity values refer to sand with high stiffness, while medium resistivity zone correspond to silty clay zones with low stiffness. High resistivity zone at the bottom of the pseudo-sections found correspond to higher SPT blow counts that implies engineering bedrock, whose depth in general was about 25 meter. In some places, narrow 'pockets' with deeper (>35m) bedrock have been identified; such 'pockets' are filled with medium resistivity loose silty clay with low SPT counts. These zones having higher clay and water content are higher settlement possibility zones, therefore identified as geotechnical weakzones. Through the present survey eleven geotechnical weak zones have beenidentified among them one is quicksand of zero SPT blow count. Inferred geological process of the geotechnical weakzones matches the assumed erosion and deposition processes linked to late Pleistocene-Holocene sea level fluctuation. Location of the narrow incised valley that cut through the olderbed of lower permeably(Pleistocene), later filled-up with water saturated loose sediments, are the candidate zones for quicksand phenomenon. Paleo-drainage map may give clue about the candidate area. Ground truth of the delineated weak zonesagrees with the settlement test observation during ground development.

Keywords: Chittagong City Outer Ring Road, Geotechnical Weakzone, Quicksand Phenomena, Resistivity Imaging and Standard Penetration Test.

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Applicability of H/V Fourier Spectral Ratio of Ambient Vibrations in Seismic Microzonation- Case study in Chattogram City, Bangladesh

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Abstract

The research addresses the applicability of single station microtremor studies through the analyses of the H/V spectral ratio of ambient vibrations to determine predominant period (eigenfrequency) and ground amplification, applied to soil sites in Chottogram City, Bangladesh. The outcome of the research aims to contribute to get a low cost and reliable method for seismic microzonation of urban areas. Single station microtremor records and standard penetration tests (SPT)of the corresponding (same) siteshave been accomplished in Chottogram City.A 3D geotechnical model of 56 square kilometer area has been constructed from SPT data of 75 boreholes around the location of microtremor records. Shear wave velocity has been estimated for a 50 square meter grid of the 3D model, which is chosen for the calculation of the predominant period and amplification factor.14 sets of microtremor records for the soil sites have been analyzed.Analyses of microtremor records taken at the top of some buildings were also attempted. The predominant periods of the corresponding (same)soil sites has been estimated from the H/V spectral ratio of microtremor measurements. Predominant period derived from the microtremor method conforms in almost all cases with the predominant period derived from 1D soil response estimation from geotechnical data interpretation with EduSHAKE. To validate the effectiveness of the estimations, damage potentiality map for the buildingsof different height (assumed predominant periodfor height) have been prepared and validated with known phenomena. In one site, assumed predominant period of a building and the predominant period of the ground estimated from microtremor method suggested a resonance phenomenon. The building subjected to unusually higher damage from the effect of an earthquake.The study concludes that, if recorded carefully, the H/V spectral ratio of microtremor can be a cost-effective reliable primary tool for seismic microzonation of Chottogram City.

Keywords: Chottogram City, Predominant period, Eigen frequency, H/V Spectral ratio, Resonance phenomenon, Single station microtremor records, Seismic microzonation.

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Source-to-Sink History of the Cenozoic Sylhet Trough (Bengal Basin, Bangladesh): Insights from Detrital Zircon Geochronology

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Abstract

The Bengal Basin in the northeastern Indian plate, a Himalayan foreland basin was developed in response to the multiple episodes of the Cenozoic Himalayan Orogeny. However, very little is known about the source-to-sink history of the Bengal Basin in response to this Himalayan Orogeny. Therefore, we aimed at understanding the possible provenance of the Cenozoic sediments and basin-fill history of the Sylhet Trough in the northeastern Bengal Basin using detrital zircon geochronology (U-Pb method). Results show that all the Cenozoic successions have three dominant populations at 500 Ma, 1000 Ma and 1700 Ma and a minor population of younger (<200 Ma) zircons. Except the Eocene Jaintia Group, all the successions show a dominant peak at 500 Ma, This implies that the major influx of sediments were possibly received from the cratonic India into the passive margin during the Eocene with a major tectonic switching since the Oligocene when the foreland Bengal Basin started to receive recycled sediments from the Himalaya (i.e., the Tethyan, Higher and the Lesser Himalayas). Again, the Miocene Surma Group shows only one dominant population at 500 Ma, indicating another shift in source-to-sink history when the basin received a major influx of the Himalayan recycled sediments. In contrast, the Plio-Pleistocene Dupi Tila Group has two major age populations at 500 Ma and 1000 Ma and a minor population at 1700 Ma, indicating additional input of older grains from the Precambrian Shillong Plateau. The younger grains (<200 Ma) from the pre-Miocene successions are aged ~185-71 Ma and include zircons from an early episode of magmatism in response to the ocean-continent collision at 120-55 Ma. However, the post-Oligocene successions show two young age clusters at 187-118 Ma and 50-28 Ma. We infer that the younger cluster is possibly linked to the second intense pulse of magmatism of the Himalayan Orogeny.

Keywords: Bengal Basin, Himalayan Orogeny, Himalayan recycled sediments, Source-to-Sink History, Zircon geochronology.

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Style of Deformation and Kinematics in the Eastern Fold Belt of the Bengal Basin: Implications for Future Hydrocarbon Exploration

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Abstract

The Eastern Fold Belt (EFB), a distinct geo-tectonic province of the Bengal Basin has evolved due to oblique subduction of the Indian plate underneath the Burmese plate to the east of the Basin. However; the geometry of the major structures, kinematics, possible timing of structural activation and possible trapping mechanisms are poorly understood. This drawback has led us to undertake the present research on establishing the style of deformation, possible timing of structural development and kinematics in the EFB in a regional scale using gravity, magnetic and seismic data. Additionally, fault seal analysis and identification of possible new gas bearing horizons have been carried out in the EFB using seismic and wireline log data from the Semutang anticline as a case study. Interpretation of gravity data in the EFB exhibits locally closed, approximately N-S trending high and low anomalies, possibly corresponding to the structural highs (i.e., anticlines) and lows (i.e., synclines). Interpretation of seismic data also supports the identification of features on regional gravity maps. Results from seismic data interpretation also show that the anticlines in the EFB represent fault-propagation folds (i.e., pop-up structures with minor back-thrust). To the west, in the Hatia Trough, the anticlines are relatively gently folded with upright axial planes and can be classified as detachment folds. Distribution of the syn-kinematic package across the structures indicates that the rate of upliftment and structural complexity are greater in the EFB compared to the deep basinal part in the west. Pliocene to Recent syn-kinematic package suggests that the structural development in the EFB possibly initiated since Pliocene and is still ongoing. Fault seal analysis of the Semutang anticline shows at least five gas bearing zones sealed against the reverse faults in both the flanks which opens a new opportunity to explore fault bounded traps in the EFB.

Keywords: Detachment folds, Fault bounded traps, Fault propagation folds, Fault seal analysis, Kinematics.

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Structural Modelling and Kinematic Analysis of the Dakhin Nhila Anticline (Cox's Bazar, Bangladesh)

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Abstract

The Dakhin Nhila Anticline is one of the westernmost structures along the eastern coast of the Bay of Bengal. This is also one of the structures along the frontal fold thrust system within the Chittagong Tripura Fold Belt of the Indo-Burman Ranges and was developed in response to the late Cenozoic convergence between the Indian and Burmese plates. However, very little is known about the style of deformation, kinematics and tectonic evolution of the anticline in the context of regional tectonics. To fill this knowledge-gap, we present structural analysis of 156 bedding attitude data and the field observations which are suggesting that the Dakhin Nhila is a narrow, elongated, asymmetrical anticline with NNW-SSE trending axial plane. The dip amount of the beds in the eastern and western flanks are ranging from ~20°-60° and ~5°-80°; respectively. Three major faults are identified,among these, two are axis parallel east-dipping reverse faults in the west and another is an E-W trending left-lateral strike-slip fault originated in response to the movement along the lateral ramp of the main thrust fault system. A geological cross section across the anticline shows that the uniformly thick Upper Surma Group and underlying sediments constitutes the pre-kinematic package (i.e., possibly deposited at the time of no major structural activation). In contrast, the overlying Pliocene Tipam Group resembles wedge-shaped growth strata in the eastern flank and represents the syn-kinematic package (i.e., possibly deposited at the time of major structural activation). Based on the tectonostratigraphic relationship of the kinematic packages, it can be speculated that the Dakhin Nhila Anticline possibly initiated during the Pliocene and is still on going. In the regional context, this structural development can be linked to the Late Cenozoic subduction of the Indian plate beneath the Burmese plate to the far east.

Keywords: Dakhin Nhila Anticline, Chittagong Tripura Fold Belt, Structural Modelling Kinematic analysis, Tectonic evolution.

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Fault Kinematics and Stress Distribution Along the Dauki Fault Zone - A Potential Source of Recent Seismic Activity

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Abstract

The Dauki Fault Zone (DFZ) lies in a very complex geological setting, separating the subsiding Surma basin in the south and the uplifting Shillong Plateau in the north. The complexity of the structural setting and observed deformation structures suggest the area is tectonically active. The research provides the structural and geomorphic interpretation of the deformation structures and associated kinematics. The analysis is based on primary structural data recorded during the fieldwork and collected satellite images. The equal area and lower hemisphere stereographic projections of all the data demonstrated the bedding(s) in the area is dipping south. The study area shows an overall east-west strike, local deviation has also been observed. However, considering the variation of the strike trend distribution as a measure of the deformation intensity, the maximum structural disturbance is observed along the eastern segment of the study area. The 3D visualization of the geo-referenced bedding attitude data revealed structural pattern. Kinematic analysis of the exposed structures also suggests an increased number of deformations towards the eastern segment of the DFZ. Based on DEM, Hillshade results, and structural data sets the DFZ area is divided into four tectonic domains (Domain 1-4). The Valley Floor Width to Height Ratio (V_f), and Mountain Front Sinuosity (S_{mf}) for these tectonic domains have been calculated. The S_{mf} and V_f for the domains suggest an increasing trend of tectonic activity towards the east. This study suggests that the DFZ area is segmented, and the intensity of the tectonic activity is greater in the eastern domain.

Keywords: Deformation structure, Fault segmentation, Geomorphic indices, Tectonic activity.

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Formation of Boga Lake and Raikhong Lake, Bangladesh: An Appraisal on Geological and Geo-morphological Characteristics

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Abstracts

The present study is an attempt to imply the formation and evolution of two Tertiary hilly terrains lakes, known as the Boga Lake and Raikhong Lake (also known as Pukurpara Lake), on the basis of geomorphological and geological observation. Boga Lake is a rectangular shape with ~35 m water depths and situated ~372 m above mean sea level (amsl). On the other hand, Raikhong Lake is an elongated shape with ~28 m water depths and situated ~360 m amsl. The surrounding hills of both lakes are composed of thinly laminated friable siltstone and shale which are underlain by a very hard and a compact thick sandstone bed, and trending NW-SE directions with highly steep eastern side and moderately steep in the western side, beds are inclined with NW directions. During the early stage of development of these lakes a series of *en-echelon* faults were developed in the area to compensate for the N-S and E-W compression stress by collision of Indian, Eurasian and Burmese plates. There are three prominent faults observed in the Boga Lake area, of which two are NE-SW directions and another is NW-SE direction. Whereas, in the Raikhong Lake area, there are 7 prominent faults observed, of which five are NW-SE directions and another 2 are NE-SW directions. Due to faulting a NW-SE and NE-SW elongated valleys were developed in the Boga and Raikhong lake areas, respectively. After faulting, the NW and NE edges of the valleys of Boga and Raikhong lakes were blocked by impermeable land sliding sediments from northern and western hilly terrains, respectively. The hilly deposits (thinly laminated friable siltstone and shale underlain by hard sandstone bed) and the structure (dip of the beds ranges from 65-70^0) of both the lakes surrounding are susceptible to landslides, especially during the rainy season. The southern edges of the valleys are blocked by hills. The bottoms of the valleys are composed of impermeable sediments which also come from the nearby hills. In the hilly terrains of Bangladesh, rainfall is normally higher than other parts of the country, and all the circumstances are favorable to these lakes's formation.

Keywords: Hilly lake formation, Landslides, Tertiary hilly terrain.

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Active Tectonic Convergence of the Indian Plate in the Northeastern and Eastern Portions Reveals Oblique Faulting: Implication for Seismic Hazards

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Abstract

The lithospheric plate convergence between the India and the overriding plates in the northeastern and eastern portions of the Himalayan and Indo-Burman orogenic belts has some characteristic earthquake occurrences that remain unanswered. Therefore, the present work has mapped the tectonic geomorphological features such as faulted alluvial fans, river terraces, marine terraces, topographic breaks, triangular facets, and so on. The geomorphological mapping was supplemented with seismological, geological, geodetic, and seismic data. The earthquake centroid moment tensor (CMT) solutions were related to the mapped active tectonic features and other datasets. The results suggest a predominance of strike-slip and reverse faults, with some textbook examples of active faults in the study area. On a tectonic scale, the region north of the Dauki fault is experiencing oblique compression related to the northward indentation of India, which is compensated by the occurrence of thrust, reverse, and left-lateral strike-slip faulting. The area south of the Dauki fault experiences E-W tectonic compression related to the tectonic interaction between India and Burma, mainly compensated by reverse, thrust, and dextral-strike-slip faulting. Interestingly, a few N-S striking normal faults at more than 30km depth were also observed under the tectonic wedge formed because of the convergence between India and Burmese plates. It suggests a crustal extension parallel to the tectonic compression, interpreted as the result of the faulting of the subducting slab. Therefore, the active tectonic framework of the study area is actively accommodating the tectonic stresses generated by the northward and eastward convergence of India, which are reflected by the occurrence of earthquakes. Such interactions will continue in the future and create earthquakes dominated by reverse, thrust, and strike-slip faults.

Keywords: Active tectonics, Earthquake,North-east Indian plate, Plate convergence, Subduction.

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Recent Earthquake Distribution and Pattern from Thrust to Strike-Slip around NE India-Bangladesh-Myanmar, Predicting Future Earthquake Occurrences

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Abstract

World earthquake zones where earthquakes take place time to time are generally well known. However, the places where earthquakes do not occur on a regular pattern or occur with hundred years interval, still remain challenging to predict in case of magnitude-location and time. Bengal Basin more specifically Bangladesh territory where several major events (M>7) documented in historical earthquake catalogue (1762-M8; 1885-M7; 1897-M8.7; 1918-M7.6) falls in such an unpredictable earthquake occurrence zone. Bangladesh lies on Indian Plate which is moving to the NE at a rate of ~46 mm/yr moving beneath Tibet. This compression generates earthquakes in NW Himalaya, Shillong Plateau and Eastern Syntaxis for last hundred to thousand years. Past earthquakes showed mostly thrust to slightly oblique focal mechanisms. Recent instrument records clusters of medium scale earthquakes in the Mikkir Hill areas along the east and Dhubri-Chedrang alingments along the western border of Shillong Plateau. Focal mechanisms of these earthquakes show strike-slip motion. Another source of earthquake in Bangladesh-India-Myanmar region is the subduction process of Indian Oceanic Plate beneath the Burma Continental Micro-Plate. Major earthquakes of strike-slip pattern occur in Sagaing Fault regions with magnitude ranging from 3-7. The Sagaing Fault contributes to take half of the India-Burma slide motion. Rest of the stress is distributed over Bengal Basin and Indo-Burman Ranges (IBR). Interpretation of GPS data show a shortening of ~13 mm/yr along the IBR. Recent instrumental data show several earthquake occurrences in Imphal Valley. Focal Mechanism of these earthquakes shows strike-slip motion. Few medium scale earthquakes with strike-slip also took place in the Central IBR. Recent earthquake data show almost no mentionable (M>3) earthquakes inside Bangladesh. This could be due a) a rigid

portion of plate covering major part of the country b) could be due to long recurrence time c) could be due to a locked fault. Considering all recent available earthquake data we assume that Indian-Tibetian motion has transferred from full thrust to oblique at present time along NE India and IBR, meaning sliding past motion is more active at shallow depth in this region. We also conclude that Bangladesh is in risk for major earthquake events (M>6) in near future.

Keywords: Bengal basin, Indo-Burman Ranges, Earthquake, Oblique, Strike-slip.

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Geological Controls on Sustainable Road Conservation in Hilly Terrains of Bangladesh: A Case Study of the Bayezid Bostami Link Road, Chattogram, Bangladesh

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Abstract

Although excavation of hills of the Bayezid Bostami Link Road in some cases now posing a great risk of landslide and road collapse however opened a site for exploring the geology, geodiversity and became a place of tourist attraction for the inhabitants of Chattogram. A preliminary attempt had been taken to make a short but comprehensive analysis of the geological setting of the area to relate with landslide problem. Geological map, soil permeability map has been created considering the water infiltration capacity with the aid of ArcGIS software. Six samples have been analyzed for inferring the grain size parameter:The analyzed results reveals that sands (%) were very fine to fine in nature, moderate to well sorted, near symmetrical to finely skewed and platykurtic to mesokurtic. From Field Emission Scanning Electron Microscope (FESEM) images it has been evident that sand grains (125-230 µm sized) were irregular in shape, partially rounded and some possess conchoidal fracture. Signatures of micro-folding, micro-faulting, joints and fractures on the rocks and sediments of hillocks and road cut section revealing the history of tectonic influences. Field surveys have inferred the presence of permeable silty clay, sandy silty clay, and permeable sand on top of the shale layer in the Bokabil Formation. Rainwater generated during monsoon (high precipitation) causes surface and sub-surface runoff and seepage, erosion, weathering (leaching, alteration, disintegration, decomposition, dissolution) resulting to loose sediments inter-granular cementing strength and compactness along with slope (high angle) and gravity factors accelerating altitude placed geological materials sliding process and cyclones surges infiltrates higher substances and accumulates in the sediments below, creating weaknesses that are thought to be the cause of landslides. The study suggests that geological risk assessments (Hazard X Vulnerability X Exposure) is necessary to design appropriate and rational plans for excavation in hills bearing soft sediments for sustainable road construction and maintenance. Therefore, it should be a prerequisite for a major infrastructure project of national interest to prepare.

Keywords: Heavy Mineral, Mineral Appraisal Programme, Sustainable Development.

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Petrography and Geochemistry of the Tipam Sandstone Formation from the Eastern Fold Belt of the Bengal Basin, Bangladesh

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Abstract

Petrography and geochemistry (major and trace elements) of sandstones from the Tipam Sandstone Formation, Eastern Fold Belt (EFB), Bengal Basin have been investigated to understand their provenance, weathering of the source rocks and depositional tectonic setting. Tipam Sandstone Formation is composed mainly of sandstones with occasional shale beds. The sandstones are yellowish gray to yellowish brown color, micaceous and contain clay galls and coal fragments. The sedimentary structures and composition of this formation refers to fluvial conditions. Texturally, Tipam sandstones are immature, fine to medium grained, poorly to moderately well sorted and grain supported. The petrographic results suggest the sandstones are characterized by high content of quartz (59.9%), followed by mica (13.3%), lithic grains (9.1%) and feldspar (8.9%). The sandstones are classified as litharenites and greywacke, which are in accordance with that of geochemical classification. Geochemical analyses reveal that the sandstones have high SiO_2, K_2O>Na_2O, and low Fe_2O_3 values, which are consistent with the modal data. The provenance discrimination of the investigated sandstones suggest recycled and collision orogen provenance. They were mainly derived from felsic igneous, metamorphic and sedimentary sources. The petrography and geochemistry indicate that Tipam sandstones were deposited in an active continental margin basin. The weathering indices (CIA, CIW and PIA) of the Tipam sandstones indicate moderate intensity of chemical weathering, which may reflect semi-arid to sub-humid climate condition in the source area. The results of this study suggest the main sources for the Tipam Sandstone Formation were likely located in progressively uplifted blocks of the Himalaya and Indo-Burman Ranges.

Keywords: Bengal Basin, Geochemistry, Petrography, Provenance, Tipam Sandstone Formation.

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Petrography and Provenance of Plio-Pleistocene Fluvialy Influenced Sandstones of Sitapahar Anticline, Chittagong-Tripura Folded Belt, Bengal Basin, Bangladesh

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Abstract

The Plio-Pleistocene sediments are well exposed in the Sitapahar anticlineof Chittagong-Tripura Folded Belt, SE Bengal Basin (Bangladesh). A total of five (5) representative composite sand sub-samples were systematically collected, carefully transported, prepared, analyzed and grain slides were prepared and examined by point-counting following conventional petrographic protocol using the Gazzi-Dickinson methodin order to infer sediment source region and tectonic evolution. The samples are mainly composed of light quartz, feldspar, lithic grains and heavy minerals (HM) where quartz, feldspar and lithic grains are the major fractions, whereas mica and HM occurred as minor accessories. Among the main detrital framework grains, the mean of quartz is 70%, feldspar 5.6% and lithic grains 8%, while HM 8.6% (including augite 39%, hornblende 31%, diopside 23%, rutile 21%, enstatite 17%, garnet 9%, kyanite 4.5%, sillimanite 3% and zircon 2.6% etc.), and the Muscovite/Biotite ratio is 1:8. Different triangular plots reveal that the sandstones are immature and sublitharenit in nature suggesting near source recycled orogen province. Presence of Sillimanite and Kyanite indicate the sediments were sourced from protoliths of high-grade regional metamorphic rocks. This study suggests that sediments were probably derived from mixed source rocks of felsic and mafic containing gneisses and granitoid rocks as well as recycled sedimentary sources area.

Keywords: Bengal Basin, Petrography, Plio-Pleistocene sandstone, Provenance, Sitapahar.

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Grain Size Analysis and Sedimentologic Study of Neogene Exposed Sediments, Sitapahar Anticline, Rangamati, Bangladesh

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Abstract

Sitapahar anticline is situated in the central part of Chittagong Tripura Folded Belt (CTFB) region of Bengal Basin, Bangladesh. Neogene sedimentary rocks are well exposed in this area. Total fifteen outcrop samples were collected from different formations of the Sitapahar structure. The objective of the analysis is to determine the depositional environment of these area by using sieve analysis data. Wet sieving method was used for analyzed these samples. The Ternary plots diagrams indicate that these samples are sandy. The graphic mean ranges from 2.26 φ fine grained to 3.63 φ very fine grained. Graphic standard deviation (sorting) ranges from 0.36 φ to 0.87 φ which indicate well sorted to moderately sorted. Inclusive graphic skewness ranges from -0.34 to 0.49 (strongly coarse skewed to strongly fined skewed). The graphic kurtosis values are ranges from 0.56 to 3.63 (very platykurtic to extremely leptokurtic). This variation of data suggests that the sorting of the sediment goes under high energy to moderate energy depositional environment.The histograms of the sediments shows unimodal and bimodal both trends. The arrangement of the histogram is predominantly asymmetrical and thus indicates the variation of the energy of the transporting medium. The Linear function values also also shows that the depositional environment was fluvial to shallow marine.

Keywords: Sitapahar Sediments, Standard Deviation, Graphic Mean, Depositional Environment.

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Major, Trace, and Rare Earth Elements in the Multicore Sediments of the Bay of Bengal off Bangladesh

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Abstract

Three sediment multicore samples (n = 15) were collected from the Bay of Bengal off Bangladesh to evaluate their elemental variations, provenance, and source-area weathering signatures. Major, trace, and rare earth elements (REEs) show high enriched in TiO_2, Fe_2O_3T, Ni, Cr, V, Rb, Th, Zr, Sc, La, and Y and depleted in CaO, Na_2O, Sr, Ba, and Pb relative to the average upper continental crust (UCC) composition. SiO_2 and Al_2O_3 contents ranging from 54 to 71 wt.% and 12 to 18 wt.%, respectively with high Al_2O_3 in clay-rich sediments. Chondrite-normalized REE patterns for the Bay of Bengal sediments show a high enrichment in light REE (LREE) relative to the heavy REE (HREE; La_N/Yb_N, 7.26-8.46) coupled with clear negative Eu anomalies (Eu/Eu*, 0.60-0.71), suggesting a felsic source provenance. Geochemically, the sediments are compositionally low mature to immature in nature and classified as greywacke and litharenite. Provenance discrimination diagrams suggest that the sediment samples were derived largely from felsic sources with compositions close to the average dacites, rhyolites, and I- and S-type granites. Trace element ratios of Th/Sc, La/Sc, Zr/Sc, Cr/Th, and Th/Co indicate a felsic provenance overall. Comparison with potential source rocks of the Himalaya-Tibetan Plateau supports the Bay of Bengal sediments originating from felsic quartzose recycled detritus. The ICV (Index of Compositional Variability), CIA (Chemical Index of Alteration), and PIA (Plagioclase Index of Alteration) proxies, and Rb/Sr and K_2O/Rb ratio values of the marine sediments indicate low to moderate degree of chemical weathering in their source area. This weathering pattern in the sediment samples could be influenced by the intensity of Himalayan monsoon climates.

Keywords: Geochemistry, Provenance, Chemical weathering, Sediments, Bay of Bengal, Bangladesh.

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Detail Gravity and Magnetic Profiling Surveys to Delineate the Geometry of Panchbibi Basin

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Abstract

Detail gravity and magnetic profiling surveys were carried out over Panchbibi and adjoining areas of Joypurhat district, Bangladesh. A 'Basin like structure' was identified in this area during previous geophysical investigations. The main objective of this geophysical profiling survey was to decipher the detail basin geometry and physical properties of the basin along with its probable economic mineral deposits. Total 40-line kilometer was surveyed by four profiles in this area. Data were recorded from 153 observation points at an interval of ~250 meter. The longest profile was oriented along the North-South direction, while the remaining three profiles were oriented along the East-West direction. Necessary corrections were made for removing unwanted effects. After that distance vs. Bouguer gravity anomaly and distance vs. magnetic anomaly graphs were plotted for all the four individual profiles. From the interpretation of Bouguer gravity anomaly values an oval shape Basin has been delineated in the study area. There is an indication of sharp fault in the northern side of the Panchbibi Basin. Magnetic findings do not show any prospective signature. There are some scattered magnetic anomalies along the four profiles which seem to be insignificant.

Keywords: Basin geometry, Bouguer gravity anomaly, Geophysical investigation, Gravity and Magnetic survey, Panchbibi Basin.

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Geo-electrical Resistivity Survey for Fresh Groundwater Investigation in the South-Western Coastal Areas of Bangladesh

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Abstract

Salinity in the groundwater is one of the major concerning issues in the south-western coastal areas of Bangladesh as the people of these areas are suffering tremendously for severe scarcity of drinking water. The surface water in these areas is contaminated by saline water intrusion due to the sea level rise and frequent anthropogenic reasons. Considering this problem, a geo-electrical resistivity survey has been conducted to delineate fresh groundwater in Paikgachha, Koyra and Dacope upazilas of Khulna District. Sixty Vertical Electrical Soundings (VES) have been conducted in different parts of the area. The maximum penetration of VES was 350m depth. In Paikgachha, two fresh water bearing zones have been identified. The top of shallow aquifer, 45m to 109m thick, has been identified within 10m depth and its resistivity is more than 10Ωm. The second fresh water bearing zone is encountered at a depth of about 250m and its base has not been reached at Kopilmoni Union. Compared to Paikgachha, Dacope is more vulnerable to saline water intrusion through numerous rivers and channels. But there might have a chance to identify very shallow perched aquifers which are recharged by rain water. Koyra possesses an aquifer zone in the middle of the upazila near Pouroshova building and adjacent to the Madinabad Ghat at less than 80m depth having thickness of more than 160m with a resistivity range from 13.6Ωm to 35Ωm. These delineated aquifers would be the source of potable water after following aquifer development processes. Therefore, delineation of fresh water aquifers through resistivity survey will open the door of possibility to encounter such aquifers in other coastal parts facing scarcity of drinking water.

Keywords: Aquifer, Geo-electrical resistivity survey, Salinity, Vertical Electrical Sounding.

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Delineation Bagzana-Hili Horst and Koira-Kutubpur Basin from the Regional Gravity Survey in Hili-Panchbibi-Joypurhat area, Bangladesh

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Abstract

Regional gravity survey has been carried out in the Hili-Panchbibi-Joypurhat area of Dinajpur and Joypurhat Districts covering an area of about 400 square kilometers. The main objective of the survey is to prepare a Bouguer gravity anomaly map and to interpret it to understand subsurface geology. Regional gravity data have been collected from 441 observation points in a 1 kilometer square grid sampling pattern covering the study area. Gravity base connection has been established with respect to the national gravity base. Acquired gravity data has been processed to eliminate all the effects other than the effects of the subsurface rocks by applying diurnal, latitude and elevation corrections. Bouguer gravity anomaly map with respect to Sylhet gravity base has been prepared. The result of the interpretation of the data reveals the basement topography and some major geological features. There is a prominent gravity low closure of -40mGal in the west of Panchbibi township. The gravity low closer has been interpreted as a basin whose bottom extends from Koira to Kutubpur with NNW-SSE axial trend. Two profiles have been drawn over the delineated Panchbibi basin (Koria-Kutubpur basin) and modeling has been attempted, which help to delineate the structural configuration of the basin. The estimated density contrast of -0.47gm/cc of the basin fill material with the basement rock helps discussion on the economic resource potentiality of the basin. There is an uplifted gravity high zone in the middle of the basin. The basin is bounded by a NWW-SEE trending fault in the north east between Bagzana and Kutubpur with a gravity throw of 12 mGal. There is a gravity high closer of -28 mGal covering Hili-Bagzana area. The basement topography revealed by the survey has implication of economic mineral resource potentiality of the area.

Keywords: Bagzana-Hili Horst, Regional Gravity Survey, Panchbibi basin.

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Gravity Clue Indicating Non-Existence of any Major Fault in the Present Location of Jamuna Between Raomari and Chilmari, Kurigram and other Tectonic Inference from Gravity Observation in Raumai-Kurigram Region, Bangladesh

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Abstract

Regional gravity survey has been carried out in the Raomari-Rajibpur-Chilmari and the surrounding areas of Kurigram District, covering an area of about 600 square kilometers that includes east and west banks of the present course of Jamuna River. The main objective of the survey is to prepare a Bouguer gravity anomaly map that may help to understand subsurface geology. Regional gravity data have been collected from 185 observation points scattered all over the study area. Base connection has been established with Sylhet gravity base. Acquired gravity data has been processed to eliminate all the effects other than the effects of the subsurface rocks by applying diurnal, latitude and elevation corrections. Bouguer gravity anomaly map with respect to Sylhet gravity base has been prepared. The result of the interpretation of the Bouguer anomaly map reveals the basement topography and some major geological features. Raomari lies within the zone of shallow basement called Rangpur Saddle and Bogura Platform. Gravity anomaly data of east and west side of the Brahmaputra River suggests that the basement is flat with a northward slope and there is no faulting along the present north-south course of Brahmaputra River between Chilmari and Raumari. But there is an east-west trending basement trough in the north of Raumari halfway towards Kurigram under the present course of Jamuna. Besides, the Bouguer Anomaly contours show two distinct pattern zones separated by an SSE-NNW diagonal line from South of Chilmari via Raomari downtown. This line seems to be the boundary line between Rangpur Saddle and Bogura Platform. The survey contributed to the understanding of the regional tectonics.

Keywords: Raomari, Bouguer gravity anomaly, Rangpur Saddle, Brahmaputra River, Fault, Basement trough.

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Gravity Signatures of Kutubpur Magnetic Body and Adjoining Areas, Parbatipur and Chiribandar Upazilas, Dinajpur District, Bangladesh and its implication in Exploration for Economic Mineral Resources

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Abstract

Kutubpur Magnetic body was suggested by earlier surveys and confirmed by drillhole GDH 59. But missing it in subsequent two drilling operations raised a query about its extension and rechecking of the surveys on which the drilling points were suggested . Therefore Regional gravity survey have been carried out in Parbattipur-Ambari-Phulbari-Chirirbandar area of Dinajpur District covering an area of about 325 square kilometers. Gravity data have been collected in 12 non-straight roads crossing the geological features indicated in the previous surveys along and across their axial trends. Collected data has been processed to remove all affects other than the affects due to the variations of subsurface geological materials. Then a Bouguer gravity anomaly map has been prepared with respect to Sylhet gravity base. Obtained map has been analyzed for major anomaly features. Then 14 gravity anomaly profiles have been prepared by picking bouguer gravity anomaly values along sets of 6 east-west and 7 north-south parallel lines and one northeast-southwest line, all crossing the major anomalies delineated in the Bougur anomaly map. Observed gravity anomaly relief of 22.60 mGal (maximum -14.84 mGal and minimum -36.60 mGal with respect to Sylhet Gravity Base) across the survey area indicates that the basement of the area is quite diversified and undulated which may be due to either intrusion of rocks of different densities in the basement rock or fault controlled up-thrown blocks of basement or both. There is a gravity high closer of -17 mGal round Ambari, which primarily seems to be a fault controlled uplifted part of the basement, it is demarcated as Ambari horst with a maximum residual gravity anomaly of 18.84 mGal. Inferred from the close spacing of the gravity contour lines. The top of the horst covers an area of about 8 square kilometer. There is a sign of a northeast-southwest trending igneous intrusion (dyke) of denser rock in the middle of Ambari horst. The drillhole GDH-59 (Kutubpur) is located in the north end of Ambari horst and falls on the dyke of magnetic rock, GDH-76 is located in the west at a slope (at a 1.37mGal lowerlocation). Signs of faulting have been observed along several directions in the basement. Since a denser rock of higher gravity anomaly could be due to high densityferro-magnesium minerals. Therefore Ambari horst has

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a potentiality for magneto-metallic ore mineralization which can be verified by conducting a drillhole near the center of Ambari horst (towards the southeast from GDH59). Besides, a intrabasement denser body has also been identified in the south of Barapukuria Tharmal Power Plant. Later body is also potential for metallic minerals.

Keywords: Bouguer Gravity Anomaly, Kutubpur Magnetic Body, Causative body, Mafic rocks, Intrabasement denser material, Banded Iron Formation, Episodic Volcanism.

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Hydrostratigraphy of Noakhali, Laxmipur and Patuakhali based on Geophysical Logging and it's Implication in Finding Potable Groundwater in the Coastal Region of Bangladesh

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Abstract

Availability of potable groundwater in coastal townships of Bangladesh is subjected to challenges due to the issues of salinity and hazardous chemicals whose dynamics are mostly controlled by subsurface strata and groundwater flow. A geophysical logging approach has been attempted to delineate the hydrostratigraphy of the area. Gamma, resistivity (long normal and short normal), spontaneous potential, temperature and caliper logs have been carried out along with lithological samples in 17 bore holes up to a depth of 375 meter in Begumganj of Noakhali, Raipur of Laxmipur, Amtoli and Sadar of Patuakhali during construction of deep tubewells for the coastal townships during 1997 to 1998. Obtained logs have been analyzed combined with lithlogical logs, grain-size analyses, electrolytic conductivity, Iron and Arsenic content of different layers to delineate hydrostratigraphy. Geophysical responses are combined effect of lithology and chemical properties of pore water. Different layers of same grain size shows different electric responses due to variation in ion content of pore water. Formation boundaries, which were unclear in lithlogical wash sampling, has been demarcated clearly by spontaneous potential logs. Gamma logs showed the clay content and resistivity logs helped to identify the fresh and brackish aquifers. Based on these geophysical log data four layered hydrostratigraphy with three aquifers and an aquitard have been identified. The upper aquifer (I) and lower aquifers (II and III) are separated by a clay aquitard bed of about 30 meter thickness throughout the study area. Chemical analysis of water samples shows that the aquifer (I) above the aquitard is Arsenic contaminated and brackish (of about 6 Ohm-m). Whereas aquifers bellow the aquitard contain fresh water and safe from Arsenic hazard. Immediately below the aquitard, aquifer-II, has higher Iron content but at lower depth aquifer-III (of about 60 Ohm-m) is better suitable for drinking water with lower Iron, Arsenic and Salinity content within standard acceptable limit. The marker aquitard hypothesis agrees with a resistivity survey result. Geophysical logging is an effective tool to find potable groundwater in the coastal region of Bangladesh

Keywords: Hydrostratigraphy, Coastal aquifers, Aquitard, Spontaneous potential log, Gamma log, Resistivity logs.

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Seismic Refraction Survey: An Effective Geophysical Tool for Delineating Basement Configuration in and Around Niamatpur Upazila of Naogaon District, Bangladesh

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Abstract

A seismic refraction survey was conducted in Niamatpur and adjoining areas of Naogaon District, Bangladeshto delineate the major stratigraphic sequence with emphasis to find out the depth of Archean Basement Complex of the study area. In this program, total 35-line kilometers were surveyed along three profiles having WNW to ESE and NNE to SSW directions. The WNW-ESE profiles were laid out in between Paschim Jagat, Parbatipur to Rudrapur, Bhabicha and the NNE-SSW profile was laid out in between Monpura, Rasulpur to Paroil, Dakhin Para in Niamatpur Upazila which was across the WNW-ESE profile. Along each profile, the seismic data were recorded by forward, reverse and split shootings. Dynamite was used as the seismic source in this survey. Interpretation was made based on the conventional intercept time method. Four distinct velocity zones have been delineated having velocities vary from 755 m/sec to 1316 m/sec in the first layer, 1807 m/sec to 2072 m/sec in the second layer, 2137 m/sec to 2939 m/sec in the third layer and 4264 m/sec to 5505 m/sec in the fourth layer respectively. Comparing with the existing drill holes (EDH-1, EDH-2, EDH-18 and EDH-22), it seems to be the layers are Alluvium/Barind Clay Residuum, Upper Dupi Tila, Lower Dupi Tila and the Archean Basement Complex/Rajmahal Trap/Limestone respectively. Depth and thickness of all the four layers vary at different places along these seismic profiles. The depth of the 1st profile varies from 592m to 948m which dipping towards eastern direction and the depth of the 2nd profile having 719m to 791m that dipping towards southern direction. From the variation of depth along these two profiles, it appears that there might be two faults in NNE-SSW directions near Rudrapur village of Bhabicha Union in Niamatpur Upazila. However, some low velocity zones were identified within high velocity zones of 5505 m/sec due to the fracture/weak zone in the Archaean Basement Complex and may be significant for economic mineral deposits.

Keywords: Archaean Basement Complex, Conventional Intercept Time Method, Reverse Shooting, Seismic Refraction, Velocity Zone.

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Role of Spatial Technologies towards Groundwater Resource Augmentation

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Abstract

Water is one of the most important natural resources on which survival and progress of mankind depends. In a semi-arid, sub-tropical country, like India, where fresh water is not ubiquitously present everywhere throughout the year to meet the basic requirement, here the water reserve depends mainly on the monsoon rainfall and on the snow melt run-off. In the drought prone and in the hard rock region groundwater has to be augmented through artificial recharge method. In fact, natural recharge is not adequate to replenish the dried up and potential aquifers as rainfall and subsequent natural way of infiltration is inadequate. High regional slope, impervious/ crystalline granitic lithology play a vital role towards low natural recharge and high surface run-off. And this has resulted in declining of water table. With the above back drop the present investigation mainly aims towards to delineate area suitable for artificial recharge. The area under study is the upper catchment area of Kansabati River basin, Purulia district, West Bengal, eastern India. The study involves an approach which is watershed based. Spatial technology has played a vital role in creation of several thematic layers like hydro-geomorphology, lineaments, aerial aspects of drainage basin to derive drainage density thematic layers. Composite map in GIS environment reveals the suitable sites for artificial recharge.

Keyword: Artificial recharge, Spatial Technology, Watershed.

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Quantitative Analysis on Morphological Changes of Delta along Southern Coast of Bangladesh; A Remote Sensing and GIS Based Approach

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Abstract

The coastal setting, defined as the interface between land and sea is sometimes complex in nature. The sustainability of coastal communities, infrastructure, and ecosystems is significantly influenced by changes in coastal morphology. The nearshore zone of Bangladesh's coast is constantly changing due to the movement of sediments by rivers, nearshore currents, and waves. Every year, the Ganges-Brahmaputra-Meghna (GBM) river system deposits a massive pile of sediments in the coastal zone of Bangladesh resultingin delta progradation towards the Bay of Bengal. On the other hand, coastal erosion due to the activities of waves, currents, tides, sea-level rise, and storm surges accelerates the landward migration of the shoreline. Therefore, along with gaining land due to sedimentation, a massive amount of land is lost due to erosion. Observing the amount of erosion and accretion rate in the coastal area and its future trend is essential to delineate the stability of the delta for sustainable management. This study, based on Geographic Information System (GIS) and Remote Sensing (RS), attempts to distinguish the newly formed lands in front of deltas, as well as the extent of morphological changes they face due to coastal activity.

Keywords: Coastal morphology, Delta stability, Future trend, Morphological changes, Remote sensing.

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Jamuna River Shifting Assessment at Belkuchi Upazila, Sirajganj District Using RS and GIS Technique

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Abstract

The Jamuna River is highly dynamic. Bank shifting through relentless erosion-deposition processes is a characteristic feature of the Jamuna which is also responsible for channel instability. BelkuchiUpazila is situated on the right bank of the Jamuna River suffered continuous bank erosion. The present study evaluates the spatio-temporal variation of the lateral channel shifting of the previous 65 years by adopting the Remote Sensing and GIS techniques followed by field check. In the study area, the Jamuna River has undergone a significant change in its course, shifting from East to West between 1956 and 2021. During this timeframe, the river has accreted a total area of 21.02 km2 in this Upazila, while simultaneously eroding 32.98 km^2 of land. Consequently, the total landmass lost during this period amounts to 11.96 km^2 during that period. The rate of erosion from 1956 to 2021 was 0.51km^2/year whereas the accretion rate was 0.32km^2/year. Most of the land was accreted during 1956-1977 year interval in which the accreted area was 12.50 km^2. On the other hand, the lowest amount of land eroded during the 2005-2010 year interval which was 0.07 km^2. The lowest accretion was during the 2010-2015 year interval which was 0.01 km^2. The maximum rate of river shifting was 94.46 meters/year and the minimum was 43.07 meters/year. The maximum river area existed during 2000 which was 15.70 km^2. The research is expected to have practical implications for stakeholders who are responsible for managing the river, such as environmental regulators, engineers, and policy-makers. The outcomes of this study can be used to develop effective strategies for mitigating the impact of river movements on infrastructure, property, and human life.

Keywords: Accretion, Channel Shifting, Erosion,GIS, Remote Sensing.

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Vertical Ground Motion Analysis of Khulna City and Surroundings of Bangladesh Using InSAR

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Abstract

Khulna is a large important city in the south-western part of Bangladesh which is expanding rapidly. Geologically, it comprises of Recent Flood Plain deposits composed of mixture of un-consolidated sand, silt and clay sediments. This research work is carried out based on RADAR InSAR to estimate vertical ground motion of Khulna City and surrounding areas. Persistent Scatterer Interferometry (PSI) method have been used for the present study. The goal of this analysis is to assess vertical ground motion of the study area. There are 277 ascending and descending Sentinel-1 satellite images, covering the period from 2014 to 2020 has been used for analyses. Envi SARScape Analytics, Python, and QGIS software have been used for image processing, data analysis, and result calculation. The PSI result shows that the ground motion of the study area ranges from -24.02 mm/year to + 6.61 mm/year, having a mean value of -0.76 mm/year. The negative mean value indicates that the overall trend of vertical motion of the area is slow ground subsidence. This results and geo-factors are very important to consider for geologic conditions like Bangladesh for future sustainable development and urban expansion planning.

Keywords: Ascending, Descending, Deformation, InSAR, PSI, Sentinel-1.

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Evaluation of the Performance of EGM 2008 and other Global Geoid Models in Determining Orthometric Heights with Respect to Local Geoid Model Formed with the Help of GNSS/Levelling Data

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Abstract

Global geoid models are fundamental to obtaining orthometric heights from GNSS-Real Time Kinematic (RTK) surveys. Survey by GNSS-RTKs is one of the fastest and most accurate methods for topographical survey of both small and large area. Differential GNSS such as GNSS-RTK are only capable of delivering ellipsoidal height data from the satellite information. Only when a geoid model is included in the GNSS, altimetry data can be obtained in the form of orthometric height. The accuracy of this derived orthometric height is entirely dependent on practical modelling of the geoid. Earth Gravity Model EGM 2008 is one of the most widely used geoid models which has been developed from gravimetry data and GPS/levelling data collected around the world. The performance of this geoid model along with other Global Geoid Models (GGM) have been assessed with respect to a quasi-geoid model developed with the help of 44 control points, established by GNSS and levelling survey. These control points encompass an area of 4900 sq. km in between the Rajshahi and Dhaka division of Bangladesh. The mean and standard deviation of the residual value between EGM 2008 and quasi-geoid is evaluated to be 44.01 cm and 14.11 cm respectively. Best performance has been observed for the XFGM2019e-2159 model within the compared models which yielded residual values of mean and standard deviation of 16.02 cm and 13 .74 cm respectively. A review of studies based on comparison between local quasi-geoids and EGM 2008 has been done to analyze the residual values worldwide. Different variations of undulation differences between local quasi-geoid and EGM 2008 has been found at different parts of the world. This suggests the absence of actual geoid separation values at those places in the data which was used to model EGM 2008.

Keywords: GNSS, Levelling, Earth gravity model, Orthometric height, Geoid.

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River Course Change Detection by NDWI Analysis Method - A Case Study of Jamuna River from Kazipur Upazila of Sirajganj District to Bera Upazila of Pabna District, Bangladesh

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Abstract

The rivers of Bangladesh are very dynamic, undergoing drastic changes in locations over the course of a few years and have the potential to alter the entire landscape within a few decades. The goal of this study is to provide information on the changes in the Jamuna River total course and the direction of shifting. In this study, the river course includes the 'water bodies' and mid-channel 'point bar'. Landsat MSS, Landsat TM and Sentinel-2 satellite images are used to carry out the Remote Sensing based mapping using SNAP and QGIS software. Based on the NIR and green bands change detection maps are calculated by the Normalized Difference Water Index (NDWI) analysis method. Six no's river course maps are prepared by time interval images of the years 1973, 1980, 1990, 2000, 2010 and 2022. Sentinel-2 and Landsat TM level-2 images are already atmospherically corrected and the Landsat MSS image is corrected using the Dark Objects Subtraction (DOS1) method. During the processing, threshold values are applied to discriminate between water and non-water areas. Vectorization of NDWI images is done to eliminate water bodies in the land area and to distinguish only the river course. All the individual vector maps are converted to a raster map with a characteristic value and a raster calculation is done to create the final change detection map.

Comparison between the river course of 1973 and the recent 2022 shows that middle part of the study area, from Sirajganj town to Enayetpur, the river has shifted about 4 km towards the east direction. In the northern part, from Kazipur Upazila to Sirajganj town the shifting is about 1.5 km to the east and about 3.5 km to the west. In the southern part, from Enayetpur to Bera Upazila, the course has shifted about 5.5 km to the east and about 3 km to the west direction as per this study. The change detection maps also show the present and former location of sedimentation, stable point bar areas, frequent shifting and width change of the main channel etc., which are very important for suitability study.

Keywords: Change detection, DOS1, NDWI, QGIS, Threshold.

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Inundation Mapping Using SAR Satellite Images and Analysis of Flood Potential on Present Land Use Classes - A Case Study of Sirajganj Town and Surrounding Areas

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Abstract

The riverine delta of Bangladesh faces various natural crises. Inundation is one of them influencing the floodplains as well as urban areas. Therefore, identifying inundation-prone areas is essential for local to national sustainable floodplain development planning and management operations. The study is concentrated on the mapping of the inundated areas for the years from 2015 to 2022 in Sirajganj town and surroundings to extract information on the frequency of inundation in areas that are at risk of flooding and explore the impact of flooding on different land use classes.The inundation mapping was carried out using Sentinel-1 Synthetic Aperture Radar (SAR) satellite images. These image processing were done using Google Earth Engine (GEE) and QGIS software. A threshold approach was used to differentiate between inundated and non-inundated areas.To get the inundated areas, a threshold value smaller than -20.5 dB was applied to images of all years. On the other hand, the Sentinel-2 image of 2020 and QGIS are used to classifythe present land use pattern into 5 classes to assess the spatial coverage and frequency of inundation with land use classes. After overlaying the inundation map over the land use map, it was seen that some areas of the 'agriculture' class in the northern, western and southern periphery of the study area were inundated a maximum 8 times while the 'urban' class covering Sirajganj town in the east, was rarely inundated during the 8-year study period. A "Point bar" in the southeast corner of the study area was also regularly inundated. Compared to the study area time series analysis of inundation maps show maximum inundation occurred in the year 2020 (31.63%) and minimum in the year 2015 (22.38%). Some locations of agricultural and sand-filled "Point bar" areas are always at risk of repeated flooding. This information is very useful for planning and managing future urban expansion and development in the study area.

Keywords: Inundation,Sentinel-1 and 2, Google Earth Engine (GEE), QGIS, Threshold, Land use.

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Forty Years of River Bank Dynamics and Socio-Economic Consequences along Kobadak River at Koyra Upazila, Bangladesh: An Integrated Remote Sensing and GIS based approach

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Abstract

The peoples in the Kobadak River floodplain face severe challenges every year because of the flood and erosion threats. The purpose of this study was to quantify the lateral shifting of the river over a 40-year period (1980-2020) and assess the socio-economic consequences of erosion in Koyra upazila. Landsat satellite images from 1980 to 2020 were used in an integrated Geographic Information System (GIS) and remote sensing (RS) environment to analyze the dynamics of riverbanks. Ten cross-sections, labeled 'A' to 'J,' were drawn to determine the lateral shifting of the river. The highest erosion 464.87m (44.75%) was detected on the right bank at section 'F,' which is at Maharajpur union, whereas the minimum erosion 48 meters (4.62%) was found at section 'H,' which is located at same union. On the other hand, the maximum accretion 689.97 meters (57.98%) was also identified on the left bank at section 'F,' which is at Mahajrajpur union, and the minimum accretion was detected at section 'C,' which is at Uttar Bedkashi union. The study found that poor land cover along the riverbank and seasonal storm surge are the primary reasons of riverbank erosion. To evaluate the resulting socio-economic impacts, a questionnaire survey based on purposive random sampling method was conducted. Many people (45% of respondents) have lost their homesteads in the last 40 years. Agricultural lands of less than one acre were also lost by 60% of the interviewee. More than 50 families are forced to relocate each year from the upazila because of losing their homestead, agricultural property, and occupation.

Keywords: Bank dynamics, GIS, Kobadak River, Remote sensing, Socio-economic impact.

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Photogeological Mapping of Nawabganj Upazila, Dhaka District, Bangladesh

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Abstract

The photogeological mapping based on aerial photography is the prime technique for geoscience for research work. The photogeological mapping based on aerial photography is more useful to identify the geological and geomorphological features. The present research work is carried out for Nawabganj Upazila, Dhaka district.For the current research work, the aerial photographs are used for regional geological study and to interpret sedimentation history, geomorphology processes, drainage variation and local tectonics. On the basis of tonal variation, texture, shape, size, association of the area have been classified into active channel, abandoned channel, natural levee, flood Plain,flood basin, ox-bow lake. The shifting nature of Padma and flowing nature of the Ichamati and the Kaliganga represent this area is neotactonically active. The Padma always tends to shift to north-western portion of the investigated area. The normal course of the Ichamati and the Kaliganga are east - west direction which is abnormal with regional north -south gradient. Moreover, this two-river shifted within certain limited area and show same bending nature. Both of them flow parallel and no tendency to close one another along with their course but eastern most they meet together and join into Dhaleswari river. All of these characters show tectonically this area is active and two mighty river flow along the periphery of uplifted portion. This information and maps are helpful for understanding the geology, geomorphology and river shifting which ultimately help to development planning of the area.

Keywords: Aerial photographs, Geomorphology, Photogeology, Shifting, Padma.

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Changes in Land Use Land Cover (LULC) - An Environmental Impact of Engineering Construction: A Case Study

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Abstract

A change in land use land cover has received tremendous impact on the environment. A general understanding about land use and land cover (LULC) change is usually influenced by anthropogenic activities including engineering constructions. In fact, engineering activities involves water reservoir construction, development of road network, mining practices etc which are responsible for LuLc changes up to a considerable extent. Though there are several adverse hydro-ecological impacts of water reservoirs, it has many beneficial environmental impacts as well. Multiple crop production is one of the noteworthy benefits out of several other environmental gains. This work investigates the upper catchment area of Kumari river basin, Purulia, West Bengal. Two reservoirs i.e. Kumari and Hanumata and related canals were investigated.The main objectives of the research is to assess the land use land cover changes (LULC) patterns between pre and post construction of the water reservoir and connected irrigation canals. Geospatial technique was used to investigate the area.

Agricultural land use and other land other land use patterns have been changed after initiation of canal irrigation in the study area through reservoir construction. These were made for multiple cropping purposes in the area. Water reservoir provides irrigation water to the downstream area and makes the command area more suitable for agricultural productivity through multiple cropping. Changes in crop land area during 1972 to1995 and 1995 to 2018 is clearly evident through GIS generated thematic maps.

Keywords: Environmental Impact, Irrigation canal, Land use land cover, Purulia, Eastern India.

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Big Data Analytics and Machine Learning Prospects in Geological Exploration and Activities of GSB to Deal with Sustainable Development and BDP 2100

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Abstract

Geological survey has historical data of sub-surface strata with mineral exploration data, geochemical data, climate change data, stratigraphic information and other geological information. Geodatabase comprised of multi-dimensional surveying data could help to infer further investigative and pertinent usages which can offer better data access for researchers and stakeholders who have research interests, data assimilation, data analysis and preferred visualization modelling, perform better than before in any visual and decision-making issue. There are some constraints to overcome like old manual data and units, lack of standards and definite protocols (units, projections-datum, methodology, sampling and analyses etc.),having no comparability, no standardized datasets and overall skills in computers-language, multi-scale and multi-dimensional, spatio-temporal heterogeneity and correlation of surveying data. The data validation and model reliability should be considered as a prime concern to get better results and technological excellency. GSB could prepare an integrated and uniformed cloud hoisting data and adding to IoT's database comprising of data from all types the previous works. The database for planning in future and land-based development could be used to integrate sector plans and policies for the long term and to present actionable interventions with a roadmap for realization. A little portion of machine learning with python and MALAB are being used in image analyses, remote sensing and visualizations of geophysical surveying. R, SAS, Python, Java (visual), C++, SPSS, MATLAB, MySQL, VBA and others could be used for assimilating them in a pattern for data preparation. GIS, JAVA, PHP, Open-Source datasets, Perl and Hadoop could be chosen so for data reduction, manipulation and visualization. GPS for GEO-observatory, SLR monitoring, sediment budgeting instruments, airborne LiDAR for DSMs and UAV- UAS for inaccessible bars, hillyand coastal part could be introduced. GSB could develop its manpower for a geostatistical database and introduce AI based big data analytics to monitor change detection in landscape evolutionary processes as well as 4IR concept and 4D development in the Bengal basin management in the need for sustainable utilization with technical enhancement,increasing economic and infrastructure development and contribution in the upcoming development project Delta Plan 2100s.

Keywords: Big Data Analytics, Machine Learning, Artificial Intelligence, Quality assured data and development.

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Positive Impact of Geo-tourism and Geo-heritage on Human Civilization

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Abstract

Geo-tourism and geo-heritage are two crucial facets of how people value the Earth's geological riches. While geo-tourism is a sort of tourism that is based on some features of the Earth's geological and/or geomorphological legacy, geo-heritage refers to the characteristics of the planet that humans cherish. Geo-tourism could have either favorable or unfavorable effects on geo-heritage. Geo-tourism, at its best, encourages an appreciation for and a relationship with geological features through exploration, interpretation, and instruction. Heritage, both natural and cultural host community, tourism is a form of economic development that results in economic growth. We specifically identify six major areas that present chances to raise the profile and mainstreaming of geo-conservation: s(1) incorporating geo-conservation principles into the management of protected areas, including the promotion of geo-heritage conservation across the full spectrum of IUCN Protected Area Management Categories; (2) assisting in biodiversity preservation and climate change adaptation through the use of nature-based solutions and "conserving nature's stage"; (3) contributing to the valuation of natural capital and ecosystem services; and (4) assisting in conservation of the marine environment 5) enhancing the connections between people, place, and nature and contributing to human well-being; and (6) promoting ecosystem stewardship and contributing to the achievement of the UN Sustainable Development Goals. Through a series of instances of geo-tourism in selected ocations, this chapter explains the relationships between geo-heritage and geo-tourism and outlines the tourism link between the two.

Keywords: Assessment, Basics, Economy, Geo-heritage, Human aspect.

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Geoclimatic Conditions and Ecosystem Services of Hakaluki Haor, Bangladesh

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Abstract

The geology, topography, hydrology, climatic conditions, ecosystems and ecosystem services of Hakaluki Haor have been discussed. The Hakaluki Haor is one of the largest wetland ecosystems of Bangladesh. It is located in the northeastern synclinal basin and sediments are characterized by fine grained sand, silt, clay and peat deposits. The surface is very flat with some big depressions. The relief is very low ranging from 0 to 10 m. Two periods can be distinguished based on the climatic variability. The Wet period is characterized by heavier rainfall (100 to 150 mm per month), higher mean temperature (19.9 to 24.9°C), higher relative humidity (75 to 88 %), higher evapotranspiration (121.5 to 157.1 %) than the Dry period (rainfall of 0 mm, mean temperature of 11.9 to 17.8 °C, relative humidity of 65 to 78 % and low evapotranspiration 102.6 to 162.4 mm). Among different ecosystems grassland, plainland with shrubs, beel, river channel, swamp forests are apparant during the Dry period since all the water is evaporated while during the Wet period the whole haor goes under water. Different ecosystem services have also been identified such as grazing field and temporary ranches for cattle, duck rearing, swampy forest, fire wood, fishing, bird sanctuary, cultivation of rice, mustard, vegetables etc. which are of great economic importance. Thus it is important to sustain the haor ecosystem for the services they provide the people. Since the generation and survival of haor is largely due to geological causes, geologists can play important role in the management and development of haor ecosystem.

Keywords: Geoclimatic conditions, Hakaluki Haor, Ecosystem, Ecosystem Services, Wetland.

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The Context of Geoconservation Measures for the BDP2100's Hotspots Area of Bangladesh

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Abstract

Hotspots could be simply defined as a broad grouping which undergo same processes, facing similar natural hazards and climate change risks of the Bengal Delta (as in the BDP 2100). At a glance many Geosites could be considered for Geoconservation, such as Pleistocene terraces, Tertiary hilly region, Eocene Sylhet Limestone, Jaintia hill, Bichanakandi etc., Coastal Zones and adjacent Mangrove Forest, Wetlands, Prominent Rivers, white clay sites of Durgapur, Estuarine Part, Beach and offshore features of Bay of Bengal such as SONG, islands like St. Martin's Island and others etc. These areas are facing a threat of being endangered by anthropogenic activities, abrupt hydrological change and problems induced by natural hazards.Moreover, newly introduced river engineering, poldering, embankments, robust construction works and mega-infrastructures development are creating new impediments for these areas.The protection and preservation of geodiversity is the paramount aim of Geoconservation as per UNESCO Global Geoparks (UGGp). Moreover, it contributeseffectually to a set of indicators and targets of several emphasis on SDGs12 (responsible consumption and production), 14(life on water) and 15 (life on land). It Compliances with these principles a set of indicators and targets for SDGs 8, 16 and 17 too.GSB can initiate programs to delineatethe endangered zones, prepare database inventory, exploring the sensitivity and vulnerability index, mapping about the existing natural processes and systems by different surveying; public awareness and geoeducation,assessing risks and impacts of extractable and non-extractable resources, promoting 3Rs activities and etc. Geoconservation will make sure to protect Ecodiversities and climate resilience from the upcoming mega-structural invasion to the environment. To make it true, it must be approaching to legislative, policy and administrative procedures; participation of local people for the safeguarding of important Geosites; raising awareness; establish SOP, implementable innovative policy and guidelinefor continuous monitoring as earth observatory program and maintenance will be needed. Conservation measures should be taken into account so that natural processes and resources are conserved and properly and their management is regulated with a sustainable manner for resilient and green future.

Keywords: Geodiversity, Geoconservation, Hotspots, SDGs and Guideline.

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Geotourism: A Tool for Perspective Development in Developing Countries

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Abstract

Geotourism focuses on an area's geology and landscape that encompasses geological features, use of geo-trails and viewpoints, guided tours, geo-activities, and patronage of geological sites. The areas depend on the geological features of a particular country; it may be landforms, volcanoes, caves, precious metals, sea beaches with resources, biotic, mining sites, karsts, canyons, gorges, waterfalls, scenic beauty areas with geological heritage, etc. It involves the diversification of geological knowledge to the tourist and the communities living and working in and around the geological features.

Sustainable tourism development could be a tool for the economic development of many developing countries. Each year more than a billion peoples travel internally and externally to enjoy nature and it involves billions of dollars. The SDG goals of many developing countries may be achieved by developing geotourism. In many developing countries there are enough geotourism opportunities but goals are not achieved due to the lack of infrastructure development, security, political stability, good governance, exposure to the outer world, awareness of the local communities, etc. To overcome the situation government agencies and NGOs should work together. The local communities should be educated about the geological features so that they can work as a guide to the tourist. The local heritage like music, culture, craft, accommodation, etc. may be used as an additional tool to attract the tourist. All the planning should be environmentally friendly during the development of sustainable geotourism.

Keywords: Geology, Landscape, Development, Tourism.

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Geoethics: My Understandings

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GeoEthics is an emerging subject that encompasses many dimensions of the relationship of geoscientists to society and the planet. In the early '90, the word 'Geoethics' began to be used to define the ethical and social implications of geosciences. The International Association for Promoting Geoethics (IAPG) defines it as -- "*Geoethics consists of the research and reflection on those values upon which to base appropriate behaviours and practices where human activities intersect the Geosphere. Geoethics deals with the ethical, social and cultural implications of Earth Sciences research and practice, providing a point of intersection for Geosciences, Sociology and Philosophy. Geoethics represents an opportunity for Geoscientists to become more conscious of their social role and responsibilities in conducting their activities.*" *The Cape Town Statement on Geoethics-2016 reflects an international consensus aiming to capture the attention of geoscientists and organizations, and to stimulate them to improve their policies, guidelines, strategies and tools to ensure they consciously embrace geoethical professional conduct in their works.* It is a tool to influence awareness of the society regarding problems related to georesources and geoenvironment (Di Capua and Peppoloni, 2019). Geoethics is concerned to encourage critical analysis of the use of natural resources, and provide accurate data and information, and extending its principles to planetary protection (Martinez-Frias *et al.*, 2011).

The Earth system now, Anthropocene (?), functions in ways unpredictable without understanding how human systems function and how they interact with and control Earth system processes. Human systems have become as integral and defining a component of this planet's processes as are biological, atmospheric, hydrologic, and geologic systems (Ellis and Haff, 2009). Hence, this provides a common ground for integrating ideas, experiences and proposals on how geosciences can provide additional services to society, in order to improve the way humans, interact responsibly with the Earth system (Di Capua *et al.*, 2021). How we can keep the planet habitable for humans and others -- this should be the question of the geoscientists in the context of manmade climate change, Covid-19 and emerging infectious diseases. But we have no geoethical solutions if we do not consider geology as a part of our culture (Peppoloni and Di Capua, 2012). Together, geological culture and geoethics can strengthen the bond that joins people to their territory, and can help to find solutions and answers to some important challenges in the coming years, importantly climate change risks.

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However, the international debate on geoethics focuses on some important environmental issues. In the coming years energy, georesources (clean water, food security, mineral resources), land use planning and management, pollution and waste disposal, georisks, manmade climate change (sea level rise, extreme events, carbon emission) will be the main issues in geoscientific and public discussions. Moreover, human-induced hazards like response to events like dam failure, subsidence, pipeline failure and health related issues like vector borne diseases, environmental and ecological issues etc. cannot be ignored. In the recent days frequency of thunderbolt with consequent fatalities increased terrifically in our country which needs intense research for risk reduction and/or mitigation.

In Bangladesh, geoscientists are working in different organizations, public or private, in various fields but their main target is to support our people for safe and improved life. Besides the investigation for mineral and energy resources geoscientists of the country are engaged with water, urban and engineering geological, environmental and natural hazard issues etc. related activities. The concept of geoethics in our geoscientific community is fairly new and not widely known to them and even published materials are not generally seen here. However, our geoscientists mostly respect the ethical values in their works although those are not always formal. But it is significant that with time, natural environment has changed, population has increased, their demands have become increased and varied. Involvement of geoscientists in different disciplines has also increased in many folds. As we know now that geoethics is concerned to judicious analysis of the use of our natural resources, disseminate accurate data and information and extending its principles to planetary protection as well. Here honesty, integrity, transparency, reliability, competency, sharing knowledge and communication, education, research, ensuring sustainability are very important for geoscientists. And the early-career geoscientists have some more ethical pledge which they should promote and respect values. From organizational perspectives we have to prepare code of conducts in the background of a changed world in the 21st century, meeting the demands of the people using limited georesources sustainably and protecting the environment. So our goals of geoethics should be focused to raise awareness among the geoscientists community about individual and social responsibilities towards the benefit of our people and mankind as a whole. For better accomplishment, geoscientists need to take multidisciplinary approaches embracing advanced technology to economic, social and environmental problems upholding geoethics, gender-balance and anti-discrimination. Dissemination to the social scientists, intellectuals, law- and decision-makers, and publics and their representatives should be necessary concentration.

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Keywords: Awareness and responsibilities, Bangladesh, Climate change, Geoethics, Geoscientists

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Crustal Evolution and Characteristics: An Appraisal on Basement Rocks in Bangladesh

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Bangladesh occupies a major part of the Bengal Basin with high sediment thickness (>22 km in places; Curray, 1991). It is one of the largest deltas in the world which is built by the detritus of the Himalaya and Indo-Burma ranges carried by the Ganges, Brahmaputra and Meghna river systems. The strata are mostly Tertiary and Quaternary fluvial or deltaic to shallow marine in the north, becoming progressively deeper to the south. In the northwestern part of Bangladesh, Paleoproterozoic metamorphic and magmatic basement rocks are buried under hundreds to thousands of meters of Late Permian to Quaternary sediments. These subsurface Paleoproterozoic basement rocks are widespread at a shallow depth of Dinajpur (e.g., Maddhapara, Barapukuria, Baraipara, Khagrabandha, Gurguri), Rangpur (e.g., Pirgonj, Mithapukur, Badargonj, Lalpukur, Madarpur), Gaibandha (e.g., Dariapur), and Bogura (e.g., Kutchma) Districts in Bangladesh. Recently discovered reasonable iron-rich BIF at Hakimpur, Dinajpur (e.g., BIF and BIF-hosted rocks) has opened up more possibilities of economic boosting for the nation. On the whole, the main rock types of the subsurface basement rocks in Bangladesh are mainly intermediate (e.g., diorite, quartz diorite, monzodiorite, quartz monzonite), mafic (e.g., Gabbro), felsic (e.g., granite, charnockite), ultramafic (e.g., Kimberlites and MARID-type kimberlites), and metamorphic rocks (e.g., BIF, quartzite, amphibolite, biotite schist/gneiss). Different research works on basement rocks in Bangladesh show that the intermediate rocks of the area demarcate within calc-alkaline suites. Little tendency towards peraluminous suite implies that some magmas formed from the hydrous melting of mafic rocks or forming from the sedimentary source. The latest rigorous mineral chemical study shows that the enstatite-ferrosilite series pyroxene-rich igneous charnockite is present in Dariapur, Gaibandha. However, OPX and CPX-rich gabbroic rocks are common in Barapaharpur, Pirgonj, Rangpur. Whereas newly discovered BIF and BIF-hosted rocks are mainly banded iron formation (BIF) and quartzite, amphibolites, biotite schist/gneiss. These rocks genetically link with chemically precipitate sedimentary rocks, which went through rigorous tectonic activities to form metamorphic rocks in the area during 1728±28 Ma (Hasan et al., 2023). Several geochemical and mineral chemical data provide exclusive petrogenetic history, as for examples, the basement rocks at Maddhapara may have evolved the distinctive chemical features by a progress that included partial melting of calc-alkaline lithologies and mixing of mantle-derived magmas, followed by

fractional crystallization, and by assimilation of country rocks. Similarly, the mineral data of the dioritic rocks in Voktipur, Pirganj also provide the signature of calc-alkaline orogenic complexes, indicating mostly I-type suites formed within subduction-related environments, derived by melting of crustal sources. However, gabbroic rocks in Barapaharpur show dominantly island arc signature substantiating the suprasubduction zone, also have the affinity of the island arc tholeiitic and calc-alkaline basaltic equivalents within orogenic environments and marginally boninitic (BON) affinities. Charnockitic and granitic rocks in Gaibandha also suggest calc-alkaline orogenic suites.

Mineral chemical data also offer the emplacement depth of the dioritic rocks at ~19-22 km at Maddhapara (Hossain et al., 2009), the monzodioritic rocks at ~19-22 km at Voktipur (Hossain et al., 2023), the gabbroic rocks at ~20-33 km at Barapaharpur (Hossain et al., 2023) of the basement rocks. Though some late stage emplacement evidence is also available, e.g., emplacement depth of ~16 km from the pegmatite and aplite veins intruding the dioritic rocks in Maddhapara, Bangladesh (Hossain and Tsunogae, 2008).

Moreover, the crustal age from U–Pb SHRIMP zircon geochronological data provide the oldest signature (1730±11 Ma; Hossain et al., 2007) from diorite of basement rocks in Maddhapara, Dinajpur, Bangladesh. Other geochronological results of granitic pegmatite (1722±10 Ma; Hossain et al., 2018) are definitely consistent with diorite (1730±11 Ma) and tonalite (1722±6 Ma; Ameen et al., 2007) and those data showing convincing geochronological sequence (i.e., diorite – tonalite – granitic pegmatite). Consistent dioritic rock types at Voktipur (1686±4 Ma, diorite age; Ameen et al., 2022), Barapukuria, Baraipara, Khagrabandha, Gurguri, Badargonj, Lalpukur and Barapaharpur (1641±7 Ma, tonalite age; Ameen et al., 2022) to be believed to consistent age range due to their mineralogical and textural similarities. Charnockite and monzogranite gneiss from Gaibandha have been recorded at considerably younger ages of 1144±10 Ma and 1133±16 Ma, respectively (Ameen et al., 2022). Within the basement of Mithapukur, the $^{40}Ar/^{39}Ar$ age dating of phlogopites yields the Lower Cretaceous kimberlites (109–115 Ma) occurrence in Bangladesh, emplaced during the break-up of India and Antarctica-Australia (Hossain et al. 2022). It is the first report on kimberlites occurrence in the Bengal Basin, and the rocks are typically orangeites, comparable with Indian orangeites, Antarctica and some African transitional or hypabyssal kimberlites.

In due course, the rocks of Maddhapara, Voktipur, Barapaharpur and Hakimpur have a consistent relationship with the Central Indian Tectonic Zone (CITZ) and Meghalaya-Shillong Plateau in the Indian Shield. The occurrences of comparable ~1.73 Ga geologic units with identical magmatism and metamorphism also suggest

their apparent continuation with a configuration of the Columbia supercontinent (Hossain et al., 2007). The CITZ links up with Chotonagpur Gneiss in the east, then subsurface Palaeopreterozoic Maddhapara basement rocks in Dinajpur and possibly the monzodioritic and gabbroic rocks in Rangpur continue into Meghalaya Plateau, also related with East Antarctica, the Albany-Fraser belt in Australia, which combinedly suggest that the basement rocks in Bangladesh were as a part of the final stages of the assembly of Columbia supercontinent (Hossain et al., 2018).

Still, there is lots of scope for the study of the basement rocks, it is essential to verify these genetic and tectonic conditions for the present rocks through the isotopes and whole rock geochemical studies.

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