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GEOINNOVATION

Bulletin of Nepal Geological Students' Society

NEPAL GEOLOGICAL STUDENTS' SOCIETY (NGSS)
Kathmandu, Nepal
(EST. 1990)
Email: info@ngssgeology.org, ngssorg1990@gmail.com
Website: www.ngssgeology.org

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NEPAL GEOLOGICAL STUDENTS SOCIETY 26th EXECUTIVE COMMITTEE 2080-2081

PRESIDENT
Mr. Sanam Oli
Central Department of Geology
Tribhuvan University
Olisanam701@gmail.com
+977 9844904359

VICE- PRESIDENT
Ms. Khushbu Lama
Central Department of Geology
Tribhuvan University
khusbulama007@gmail.com
+977 9861002312

VICE- PRESIDENT
Mr. Yadav Bhatta
Central Department of Geology
Tribhuvan University
yadavbhatt.tu@gmail.com
+977 9868571617

SECRETARY
Mr. Niranjan Sapkota
Central Department of Geology
Tribhuvan University
niranjansapkota97@gmail.com
+977 9845954335

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Mr. Suman Khadka
Central Department of Geology
Tribhuvan University
khadkasuman0564@gmail.com
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Mr. Tapendra Bahadur Shahi
Central Department of Geology
Tribhuvan University
Shahitopae10@gmail.com+977 9844898393

MEMBER
Ms. Alija Dahal
Central Department of Geology
Tribhuvan University
elizadahal14@gmail.com
+977 9866399896

MEMBER
Ms. Apeksha Lamichhane
Central Department of Geology
Tribhuvan University
apekshalamichhane48@gmail.com
+977 9845196252

MEMBER
Ms. Prakriti Neupane
Central Department of Geology
Tribhuvan University
prakritineupane69@gmail.com
+977 9846736612

MEMBER
Mr. Rubin Ranpal
Central Department of Geology
Tribhuvan University
robyenranpaheli@gmail.com
+977 9865509106

MEMBER
Mr. Namtige Phudong Limbu
Central Department of Geology
Tribhuvan University
bhagatlimbu45572@gmail.com
+977 9842593424

Ph. No. 4-244047

Tribhuvan University
Tri-Chandra Multiple Campus
(Estd. 1918 A.D.)

Office of the Campus Chief
Saraswati Sadan,
Kathmandu, Nepal.

Institute of Science & Technology
Tri-Chandra Campus

Ref. No.:-

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Message from the Department Head

I am delighted to hear that Nepal Geological Students' Society (NGSS) is publishing the third volume of "GeoInnovation: Bulletin of Nepal Geological Students' Society". I have no doubt that the activities of this type by students help not only in their research capabilities but also in overall development of their academic endeavors. I suggest and encourage NGSS to be more proactive in extending its activities and to widen the scope of GeoInnovation bulleting by increasing the quality of the papers. At the same time, I am quite aware that the publication of this type from the student's level is not an easy job and therefore I congratulate all our students involved in this journey, the current executive committee of Nepal Geological Students' Society (NGSS), entire editorial board, the contributors and all the members of NGSS.

Department of Geology, Tri-Chandra Multiple Campus has been supporting the academic and research activities of students and positive endeavors of NGSS. In the capacity of Department Head, I assure that the department will continue such support in future as well.

I hope the NGSS can play better role in disseminating the importance of geology and advocating the scope of geology to the wider community and wish every success in future endeavors.

Subodh Dhakal, PhD

Associate Professor and Head

Department of Geology, Tri-Chandra Multiple Campus

Tribhuvan University, Nepal

E-mail: subodh.dhakal@trc.tu.edu.np

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ADVISORY COMMITTEE AND INVITED MEMBERS

ADVISORY COMMITTEE

Dr. Dinesh Pathak
Professor, Head of Department (HOD)
Central Department of Geology
Tribhuvan University
Email: dpathaktu@gmail.com

Dr. Khum Narayan Paudhyal
Professor, Former Head of Department (HOD)
Central Department of Geology
Tribhuvan University
Email: khum99@gmail.com

Dr. Subodh Dhakal
Professor, Head of Department (HOD)
Department of Geology
Tri-Chandra Multiple Campus
Email: dpathaktu@gmail.com

Dr. Suman Panthi
Co-ordinator M.Sc. Engineering Geology
Central Department of Geology
Tribhuvan University
Email: forstudentid@gmail.com

INVITED MEMBERS

Name: Prajina Adhikari
Contact No: 9863318043
Gmail: prajeenaadhikari333@gmail.com
Address: Thakre-7, Dhading
College: Tri-Chindra Multiple Campus

Name: Safalta Timilsina
Email:safaltatimilsina9@gmail.com
Phone No: 9864656872
College: Prithvi Narayan Campus

Name: Bhuwani Prasad Pokhrel
Gmail: bhuwanpok198@gmail.com
Contact No : 9849384919
Address : Chaubise, Dhankuta
College :Central Campus of Technology, Hattisar,Dharan

Name: Ganesh Sharma
Contact No: 9848821495
Email: www.ganesh987mmm@gmail.com
Address: Jaiminii-01 Kushmisera, Baglung
College: Birendra Multiple Campus

FOREWORD

It is with great pleasure that the 25th Executive Committee presents the third volume of the Bulletin of the Nepal Geological Students' Society (NGSS). This edition highlights the activities conducted by the NGSS over the past year, along with articles penned by emerging geologists. It features news and information about the society, the election of the 26th Executive Committee, a detailed list of previous Executive Committees, and webinars with distinguished scholars. Additionally, it includes biographies and thesis topics of students from the Central Department of Geology, Tribhuvan University, and Tri-Chandra Multiple Campus, Tribhuvan University.

The Bulletin also contains an entrance mock test, sports events, welcome and farewell programs, old photographs of NGSS, and upcoming events. It acknowledges the accomplishments of current and past NGSS members and includes general and review articles evaluated by respected senior NGSS members. Furthermore, the Bulletin offers a variety of popular geology articles aimed at the general public. We trust that both geoscientists and the public will find these articles informative.

The Executive Members extend their heartfelt thanks to all the authors for their contributions to this volume. We also express our gratitude to all esteemed NGSS members for their ongoing cooperation and active involvement in the society's activities. On behalf of NGSS, we deeply appreciate the financial and technical support from consulting firms, personal donations from former members, agencies, governmental and non-governmental organizations, and industries.

We hope readers find this volume valuable and insightful. We always welcome constructive feedback and suggestions from society members and well-wishers to enhance the quality of the Bulletin. We look forward to receiving continuous support and cooperation for future publications.

Thank you.

25th Executive Committee, Nepal Geological Students' Society

INSIGHTS INTO THE NEPAL GEOLOGICAL STUDENT'S SOCIETY

Manisha Thapa

Department of Geology,

Tri-Chandra Multiple Campus

Email:thapamanisha278@gmail.com

Nepal Geological Students' Society (NGSS) is a non-profitable organization established in 1990 A.D., in the Central Department of Geology, Tribhuvan University, Kirtipur-Kathmandu, Nepal to foster academic and professional development among geology students in Nepal. The involvement of B.Sc. (final year) students and M.Sc. students plays a vital aspect of its structure and functionality to geo science education, growth and development of geology students and contributing to the geology landscape in Nepal through: mission, membership, activities, educational initiatives and so on.

The organization aims to promote the study and appreciation of geology among students in Nepal. It seeks to foster learning, collaboration, and networking opportunities for aspiring geoscientists. The society comprises students, researchers, and professionals with a shared interest in geology and earth sciences. It offers membership opportunities for students pursuing studies in geosciences related fields all over the Nepal. It organizes various activities such as workshops, webinars, seminars, to enhance the knowledge and skills of its members. Through these events, students have the opportunity to interact with experts, share experiences, and stay updated on the latest trends and advancements in the field of Geology. The society facilitates networking opportunities by connecting students with professionals, researchers, and industry experts. This networking not only broadens students' perspectives but also opens up avenues for mentorship, and future career opportunities. These events provide practical learning experiences and networking opportunities within the geo science community. The society engaged in educational initiatives such as guest lectures, career guidance sessions, and academic support programs to help students excel in their geology studies and future careers. These programs cover a wide range of topics, including fieldwork techniques, data analysis, GIS applications, and technical writing. By honing their skills through hands-on training and workshops, students are better prepared to tackle challenges and excel in their academic and professional pursuits. The society involved in community outreach programs, environmental conservation efforts, and public awareness campaigns related to geology and natural hazards in Nepal. It aims to educate the public about the significance of geology in society. The society is led by a team, including the President, Vice President, Secretary, and other executive members who work together to plan and coordinate the society's activities. They ensure that the society operates effectively and fulfills its objectives. In addition to academic support, NGSS focuses on promoting the welfare and well-being of its members. The society fosters a sense of belonging and camaraderie among students, creating a supportive environment where they can exchange ideas, seek advice, and collaborate on projects. Through social events, outreach programs, and community service initiatives, NGSS cultivates a spirit of unity and solidarity among its members.

Challenges to Board Members:

Being a board member of the Nepal Geological Student's Society (NGSS) comes with its own set of challenges which can vary from managing organizational tasks to addressing the needs and expectations of the members such as:

- Board members often have to balance their academic commitments, personal responsibilities, and NGSS duties as well by managing time effectively to fulfill their roles and responsibilities within the society can be challenging, especially during busy academic periods,
- Coordinating activities, events, and meetings within the society requires strong organizational skills. Ensuring smooth communication among board members, volunteers, and participants, as well as overseeing logistics and planning, is the most demanding task,
- Managing the finances of the society, including budgeting for events, securing sponsorships, and handling financial transactions, requires careful attention to detail and financial documents which is harder to ensure financial stability and transparency within the organization,
- Keeping members actively engaged and involved in the society's activities and initiatives is essential for the success of NGSS where some challenges encounter in promoting participation, maintaining enthusiasm, and addressing the diverse needs and interests of the members,
- Resolving conflicts or disagreements that arises among board members, volunteers, or members of the society is a delicate task and it need to navigate interpersonal dynamics, mediate disputes, and promote a harmonious and respectful environment within the organization,
- Developing long-term goals, strategic initiatives, and growth plans for the society requires foresight and strategic thinking where board members face challenges in aligning priorities, setting clear objectives, and mobilizing resources to achieve the desired outcomes,
- Grooming future leaders within the society is crucial for continuity and sustainability and it requires to provide mentorship, guidance, and opportunities for leadership development among members,
- Building and maintaining relationships with external stakeholders, such as industry partners, academic institutions, and other organizations, is vital for the growth and visibility of an

organization. Board members may face challenges in networking, negotiating partnerships, and representing the society effectively in external engagements,

- The landscape of student organizations and the geosciences field is constantly evolving. Board members need to adapt to changing trends, technologies, and needs of the members to stay relevant and responsive to the dynamic environment.

Despite these challenges, NGSS play a crucial role in driving the vision, mission, and impact of the society by collaborating, communicating effectively, seeking feedback, and prioritizing the well-being of the members; board members navigate these challenges and lead NGSS towards continuous growth and success.

Advantages to Students and Society:

The Nepal Geological Student's Society (NGSS) offers a range of benefits to both students and society at large. For instance, this organization provides students with opportunities for academic enrichment through webinars, seminars, workshops etc. which help to enhance students' knowledge, skills, and exposure to the geosciences field, complementing their formal education. Also, it offers students a platform to enhance their professional development through networking opportunities, mentorship programs, and career guidance. Students can gain valuable insights, guidance, and connections to pursue successful careers in the geosciences industry to promote research and innovation among students by facilitating research collaborations, projects, and presentations thence students can engage in scientific inquiry, data analysis, and dissemination of research findings, contributing to the advancement of knowledge in the geosciences. Moreover, the organization fosters a sense of community among students by organizing social events, community service projects, and volunteer opportunities. Students can build connections, friendships, and a support network within the geosciences community, enhancing their overall college experience by connecting students with industry professionals, experts, and organizations in the geosciences sector. Students can gain insights into industry trends, job opportunities, and career pathways through guest lectures, industry visits, and networking events.

Involvement of the Nepal Geological Student's Society (NGSS):

- Cultivate a team of dedicated and visionary leaders who can steer NGSS towards its goals, inspire members, and drive innovation and growth within the organization;
- Define a clear mission and set of goals for NGSS that align with its purpose, vision, and values. Ensure that all activities and initiatives are guided by this strategic direction;
- Prioritize student engagement by creating opportunities for active participation, collaboration, and involvement in NGSS activities, projects, and decision-making processes;

- Provide members with access to professional development resources, workshops, training programs, and mentorship opportunities to enhance their skills, knowledge, and career prospects in the geosciences field;
- Foster connections and partnerships with industry professionals, academic institutions, government agencies, and other organizations to expand NGSS's reach, influence, and impact within the geosciences community;
- Engage in community outreach activities, awareness campaigns, and advocacy efforts to promote environmental stewardship, scientific literacy, and sustainable practices among students and the wider community;
- Develop a robust financial plan and fundraising strategy to ensure the long-term sustainability and growth of NGSS, including securing funding for activities, events, and initiatives;

- Promote diversity, equity, and inclusion within NGSS by creating a welcoming and supportive environment for students from diverse backgrounds, cultures, and identities to thrive and contribute to the organization;
- Embrace a culture of continuous improvement by soliciting feedback from members, evaluating the effectiveness of programs and initiatives, and implementing changes and innovations to enhance NGSS impact and relevance.

By focusing on the above mentioned necessities and continually striving for excellence in its operations, programs, and initiatives, itself as a leader in the geosciences community, empowering students, advancing knowledge, and making a positive impact on society in shaping the success and excellence of the Nepal Geological Student's Society (NGSS) by providing leadership, guidance, and strategic direction.

Responsibilities and contributions of NGSS:

By actively engaging in these areas and leveraging their skills, experiences, and networks, it significantly contribute to the success, growth, and impact of the Nepal Geological Student's Society (NGSS) and help advance its mission of promoting geosciences education to the community.

The organization is responsible for setting the strategic direction of NGSS by defining its mission, vision, and goals. They develop long-term plans and initiatives to advance the organization's objectives and ensure alignment with its core values, oversee the governance of NGSS, ensuring compliance with regulations, ethical standards, and organizational policies to provide oversight on financial matters, risk management, and organizational performance to safeguard the interests of NGSS and its members, provide leadership and decision-making support to make informed decisions on key issues, initiatives, and policies that impact the organization's operations, reputation, and sustainability and play critical role in resource development by identifying funding opportunities, securing sponsorships, and engaging in fundraising activities to support NGSS's programs, events, and initiatives.

By delving into these insights, one can gain a better understanding of the Nepal Geological Students' Society role in nurturing the next generation of geoscientists, promoting geo science education, and contributing to the geology landscape in Nepal.

NGSS NEWS

1. **Annual General meeting**

   Annual General Meeting of Nepal Geological Students' Society was held by the 25th executive committee at Central Department of Geology, Tribhuvan University. The 24th executive committee members handed over the official keys and documents to the new committee and wished for a successful tenure.

2. **Formation of sub- committee**

   NGSS encouraged its members to join various sub-committed like Sports Sub-committee, Scientific Sub-committee to encourage active participation while conducting any kinds of activities organized by the committee.

3. **Scientific Talk programs/ Webinars**

   Various scientific talk programs and webinars were organized by NGSS. Various spokespersons with their expertise in Geology imparted knowledge to the students and assisted them clearing their queries. The following are the list of scientific talk programs and webinars:

   a. Scientific talk programs
      - Program on Scientific paper writing skills (Presented by Dr. Upendra Baral)
      - Tracking Orogenic Origin: Collaborative research in the Nepal Himalaya (Presented by Dr. Mary Hubbard)

   b. Webinars
      - Career Opportunities and Challenges in Field of Geology (Government and Private Sectors in Nepal and Abroad) (Presented by: Churna Bahadur Ali and Mr. Ajay Raj Adhikari)
      - An Introduction to QGIS (Presented by: Mr. Bhuwan Awasthi)
      - Forensic Geology-An Introduction (Presented by: Dr. Kamal Raj Regmi)
      - From Source to Sink: Navigating Himalayan cascading hazards (Presented by: Dr. Basanta Raj Adhikari.)
      - Critical Aspects of Mineral Exploration Targeting (Presented by: Mr. Dharma Raj Khadka)

4. **Student Awareness Programs**

   NGSS conducted various awareness programs in various schools to educate the students on the Geology of Nepal, the scope of the subject, various disasters that occurs due to Geological challenges and the measures that can be used to minimize the risk. The following is the list of awareness programs that were conducted:

- Student Awareness Program on Geology and Natural Disaster (Presented by: Sandesh Pandey at' श्री शिव माध्यमिक विद्यालय, कावासोति, नवलपुर)
- Frequent earthquake reoccurrence in Nepal, it's Causes and Prevention (Presented by: Rajan Tiwari at श्री नवजागरण नमूना माध्यमिक विद्यालय, चोरमारा, नवलपुर)
- Understanding earthquakes: Causes, Effects and Safety Measures (Organized by: Nepal Geological Students' Society (NGSS) र Society of Exploration Geophysics (SEG) at नेपाल ग्रीन भ्याली माध्यमिक विद्यालय, चौरङ्गी, नवलपुर)
- Natural Disasters in Nepal, it's Causes and Prevention (Presented by: Shiksha Lamsal at श्री जनप्रीय माध्यमिक विद्यालय, चिन्नेबास, स्याङ्जा)

5. **Trainings**

Nepal Geological Students Society also conducted a training program on Fundamentals of QGIS and Remote Sensing was presented by Mr. Bhuwan Awasti.

6. **Blood Donation program**

NGSS and Rotaract District 3292 Nepal conducted one- day blood donation program with the title of “10TH LATE RTR. SACHIN MEMORIAL NATIONWIDE BLOOD DONATION PROGRAM” on 9th of Mangshir, 2080.

7. **NGSS Specials**

   a. Sports Week: NGSS and Central Department of Geology conducted 3-day spots week where various games such as Badminton, Chess and Futsal for both men and women teams were conducted.
   b. Physical Mock Test: NGSS conducted physical mock tests for all the aspirants appearing to be selected for MSc General and Engineering Geology.
   c. Saraswati Puja: NGSS conducted prayer program on the occasion of Saraswati Puja and along with this organized Welcome Program for the newly admitted MSc. Geology and Engineering Geology first semester students.

8. **NGSS Election**

As the tenure of 25th executive committee comes to an end, the general election for the new executive committee 2080-2081 was conducted successfully on 8th Jestha, 2081 with 97.3% participation of students. The election was conducted for the post of President, Secretary and Members and open results were published.

9. **Farewell for 2076 batch and handover program**

A farewell for the 2076 batch was conducted in 26th Asar 2081 and along with this, the official handover program of the office to the 26th executive committee was also conducted on this day with the presence of all the valued members of 25th executive committee.

नेपाल भौगर्भिक विद्यार्थी समाजको २४ औँ कार्यकारिणी समिति (२०७८/ २०७९) का अध्यक्ष श्री सुरेन्द्र तिमिल्सिना ज्यूको २५ औं साधारण सभामा व्यक्त मन्तव्य

धन्यवाद यस समाजका सचिवज्यू,

यहां उपस्थित सम्पूर्ण महानुभाहरू लाई मेरो नमस्कार। यस कार्यक्रमका प्रमुख अतिथि यस समाजका सल्लाहकार एवम्भूगर्भशास्त्र केन्द्रीय विभागका विभागीय प्रमुख प्रा. डा. खुमनारायण पौड्यालज्यू, तथा अन्य अतिथि महानुभावहरू !

हाम्रो निमन्त्रणालाइ स्वीकार गरि यहा पाल्नुभएका नेपाल भौगर्भिक विद्यार्थी समाजका सम्पूर्ण उपस्थित सदस्यज्यूहरु, सर्बप्रथम यस गर्विलो इतिहास बोकेको नेपाल भौगर्भिक विद्यार्थी समाजको कार्यकारिणी समितिमा म एवम् अन्य पदाधिकारी र सदस्यलाई निर्वाचित गराई १ वर्षको लागि समाजको नेतृत्वदायी भूमिका दिनुभएकोमा समाजका सम्पूर्ण सदस्य महानुभावहरुलाई हार्दिक आभार तथा धन्यवाद ज्ञापन गर्दछु।

साजको यस वर्ष २३ औँ कार्यसमिति मार्फत हामीलाई एक विशेष जिम्मेवारी आएको थियो समाजले आफ्नो दायरा फराकिलो बनाउदैँ कार्यसमितिमा त्रि-चन्द्र बहुमुखी क्यामपस लगायत भविष्यमा थप हुने अन्य क्यामपस समेतलाइ मध्यनजर गरि विधान संशोधनको जिम्मेवारी दिएको मा सो कार्य पुरा गर्न हामी सफल भएका छौँ। हामी अब गर्व साथ भन्न सक्छौँ कि नेपाल भौगर्भिक विद्यार्थी समाज नेपाल भर भूगर्भ शास्त्र अध्धयनर विद्यार्थीहरूको समाज हो।

यस वर्ष हामीले सदस्य साथीहरूलाई Scientific, Sport's Committee बनाई उहाँको क्षमताको प्रयोग साथै अभिवृद्दि गर्न सफल भएका छौं समाजको कुनैपनि कार्यक्रमको सञ्चालन सहभागिता, स्वयम्सेवक लगायत अन्य सम्पूर्ण कार्यको निमित्त विद्यार्थी समाज सदस्य लाई१नं प्रथमिकता दिएका थियौं Sport's Committee मार्फत हामीले फुटसल कार्यक्रम आयोजना गर्न सफल भएका थियौँ।

भूविज्ञानको महत्तव आम जनमानस विद्यार्थी लगायत सम्म पूर्याउनका लागि हामीले यस वर्ष चौथो भूविज्ञान प्रदर्शनि आयोजना गर्ने लगायत समाजका सदस्यद्वारा विपद जोखिम निउनिकरण, भुकम्प पहिरो लगायतका विभिन्न सचेतना कार्येक्रम स्थानिय तह सार्बजनिक स्थल एवम्बिद्यालयमा गई कार्यक्रम सम्पन्न गरेका थियौं

विभिन्न राष्ट्रिय तथा अन्तर्राष्ट्रिय भौगर्भिक संघसंस्थाहरु, जस्तै Nepal Geological Society (NGS), Department of Mines and Geology (DMG) लगायत सँग सहकार्य गर्न सफल भएका थियौं साथै यस वर्ष केन्द्रीय भूगर्भ शास्त्र विभाग सँग हामीले ठुलो सहयोग प्राप्त गरेका थियौँ यस कार्यसमितिको कार्यक्रम यो सहकार्य विना सम्भव थिएन।

समाज सदस्यका लागि ७दिने Python Training कार्येक्रम सन्चालन गर्न सफल भएका थियौं Laboratory maintenance एवम्प्राथमिक उपचार तथा छात्राहरुको लागि विशेष Safety Precautions जस्तै Sanitary Pad को व्यवस्थाको केन्द्रिय भूगर्भशास्त्र विभाग सँग पहल गरि सो कार्य सम्पन्न गराउन सफल भएका थियौं

Editorial Board को गठन गरि यस समाजको"GEOINNOVATION" नामक Bulletin को ISSN नं**2961-1865(Print) ISSN2961-1873(Online)**को प्राप्त गर्ने कार्य सम्पन्न गरी दोस्रो संस्सकरण समेत प्रकाशित गरेका थियौं। Scientific Sub-Committee मा रहनु भएका सदस्यहरूलाई जिम्मेवारी प्रदान गरि Entrance Preparation साक्षरता कक्षा एवम्Mock Test लिएका थियौं भूविज्ञान क्षेत्रका दिग्गज व्यक्तित्त बाट वभिन्न वेबिनार कार्यक्रम समेत राख्न सफल भएका थियौं विशेषत यस समाजका सदस्य प्रसन राईको आँखा उपचारका निमित्त गरिएको सहयोग आहवानमा जोडिने व्यक्तिहरू र प्राप्त रकमहरू देख्दा भूगर्भ क्षेत्रका व्यक्तिहरू बिच रहेको एकता उजागर भएको मा म हर्ष विभोर छु।

यस कार्यकालको सफल पार्न सहयोग गर्नुहुने यस २४औँ कार्यसमितका सम्पूर्ण केन्द्रिय भूगर्भशास्त्र विभाग एवम् त्रि-चन्द्र बहुमुखी क्याम्पसका २०७६ब्याज भूगर्भशास्त्र एवम् इन्जिनिएरिङ्ग भूगर्भशस्त्र साथीहरु, विभिन्न सल्लाहका लागि पूर्व अध्यक्षहरु तथा सिनियरहरु, २३औँ कार्यसमिति अध्यक्ष पवन कु. आचार्य, विभिन्न आर्थिक तथा भौतिक सहयोगका लागि विभागका आदरणीय विभागिय प्रमुख प्रा. डा. खुमनारायण पौड्यालज्यू, विभागका गुरुहरु, कर्मचारीहरु लगाएत सबै२०७६ ब्याजका साथीहरु, देश विदेशबाट सहयोग दिनुहुने अग्रज एवम्गुरुहरु, स्पोन्सरहरु साथै सम्पूर्ण सहयोगी हातहरु मास-हृदय धन्यबाद टक्रयाउँदछु।

यस साथै नयाँ आउदै गरेको कमिटीलाई हाम्रो साथ-सहयोगको खाँचो परेमा कुनै बखत पनि हामी साथ दिन पछी पर्ने छैनौं भन्दै सफल कार्यकालको शुभकामना व्यक्त गर्दछौं।

धन्यवाद।।

नेपाल भौगर्भिक विद्यार्थी समाजको २४ औँ कार्यकारिणी समिति (२०७८ / २०७९) का कोषाध्यक्ष श्री अमृत मरासेनी ज्यूको २५ औं साधारण सभामा व्यक्त मन्तव्य

धन्यवाद कार्यक्रम सञ्चालक, यस समाजका सचिव ज्यू,
यस सभाका सभा अध्यक्ष ज्यू,
कार्यकारिणी समितिका साथीहरू ,
साथै समाजका उपस्थित साथीहरू,

सम्पूर्णमा नमस्कार । आज मिति २०८०/०४/१९ गते यस नेपाल नेपाल भौगर्भिक विद्यार्थी समाजको २४ औँ कार्यकारिणी समितिको कोषाध्यक्षको रूपमा यहाँ समक्ष गत आर्थिक वर्ष २०७९ / ८० को एक वर्षको कार्यकालमा गरेको आर्थिक आयव्ययको विवरणहरू पेश गर्न चाहन्छु । हामीले २४ औँ कार्यकारी समितिको पदभार समहाल्दाका बखत २३ औँ कार्यसमितिको बेला कबुल भएका रकम समेत आई पुग्दासम्म यस समाजको बैङ्क खातामा रु. ६९,३३७/- रहेको थियो र समाजको पहिलो बुलेटिन को छपाई लगायत अन्य शिर्षक मा २३औँ कार्यकारी समितिले बुझ्नु पर्ने रकम रू.४६,६९९/- रकम चेक मार्फत फिर्ता गरेका थियौँ ।

आ.व. ०७९/८० मा यस समाजले सदस्यता शुल्क बाट रू. १३,६००/- उठाएको थियो भने समाजको बुलेटिन को दोस्रो संस्करणमा विज्ञापन का लागि रु. २६,०००/- संकलन भएको थियो । फुटसल खेलकुद कार्यक्रमको लागि टिम सहभागिता, विज्ञापन दर्खास्त एवम् भूगर्भशास्त्र विभाग समेत बाट गरि रु. १८,०००/- प्राप्त भएको थियो । Python Training का लागि सहभागिता शुल्क बापत रू. १३,०००।- प्राप्त भएको थियो । चौथौँ भू-विज्ञान प्रर्दशनीका लागि सहभागिता शुल्क, भूगर्भ शास्त्र विभाग, विज्ञापन लगायत मार्फत रू. १५८,९४५।- प्राप्त भएको थियो । Geology Mock Test का लागि सहभागिता मार्फत रू.१,६००/– प्राप्त भएको थियो । Geo-Diary मार्फत रू.४१,०००/- प्राप्त भएको थियो । समाजका सदस्य प्रसन राई को आँखा उपचारका निमित्त गरिएको सहयोग आहवान मार्फत रू.२५९,९३१.६९/- यस समाजको खातामा प्राप्त भएको थियो । समाजले आयोजनका गरेको स्वागत तथा विदाई कार्यक्रमका लागि कुल रू. ९,५००/- प्राप्त भएको थियो । उल्लेखित कार्यक्रमहरूका लागि विभिन्न समय गरि भूगर्भशास्त्र केन्द्रिय विभागबाट कुल रकम रू. १३४,५२६/- प्राप्त भएको थियो । समाजको २५ औँ कार्यसमितिको निर्वाचन का लागि निवेदन शुल्क बापत रु. २९,५००/- प्राप्त भएको थियो ।

आ.व. ०७९/८० मा यस समाजको खर्च तर्फ प्रसाशनिक खर्च(जि.प्र.का तथ नगरपालिका नविकरण, कर लगायत अन्य) रु. १९,७४०/- , फुटसल खेलकुद कार्यक्रमा खर्च रू. ३४,९०५/- , Python Training को लागि खर्च रू. १३,०२४.७१/- , चौथौँ भू-विज्ञान प्रर्दशनीका लागि खर्च रु. २१६,१६५.२९/- , Geology Mock Test का लागि खर्च रू. १,०००।- , समाजले आयोजनका गरेको स्वागत तथा विदाई कार्यक्रमका लागि खर्च रु. ९२,५००/- , २५ औँ कार्यसमितिको निर्वाचन का लागि रू. ९,०५०।-, Geo-Diary खरिदका लागि खर्च रू. २२,०००/- तथा समाजका सदस्य प्रसन राई को आँखा उपचारका निमित्त गरिएको सहयोग आहवान मार्फत प्राप्त ररकम बैङ्क शुल्क कट्टा पश्चात रू.२५९,९३१/- निजलाई हस्तान्तरण गरिएको थियो।

आ.व. ०७९/८० मा यस समाजको तिर्नु पर्ने दायित्तव कुल रू.१२,१७४.७१/- रहेको छ, जस अन्तर्गत २५ औँ कार्यसमितिको निर्वाचनमा आवश्येक भन्दा बढी उम्वेदवारी रकम दाखिला गरेको रू.२,५०० /-, अडिटर फि. रू. ७,८०५ /- , अडिट TDS रू. १०५/- एवम् Python Trainer Fee TDS रू.१,७६४.७१ /- रहेको जानकारी गराउँदछु ।

यस समाजको आर्थिक वर्ष ०७९/८० मा कुल रकम रू. ७०५,६०२.६९/-(अक्षरुपी सात लाख पाँच हजार छ सय दुई रुपैयाँ र उन्सत्तरी मात्र) प्राप्त तथा कुल रकम रू. ६६८,३१६/-(अक्षरुपी छ लाख अठसठ्ठी हजार तिन सय सोह्र रुपैँया मात्र) खर्च गरेको थियो । साथै यस समाजको २५ औँ कार्यसमितिको लागि पदभार हस्तान्तरण गर्दाका बखत समाजको खातामा रू.४७, ६९६.६९/- रहेको समाजको दायित्तव पूरा पश्चात रू. ३५,५२१.९८/- रहने छ ।

अन्त्यमा, समाजको आर्थिक प्रतिवेदनको पूर्ण पाठ यहाँ उपलब्ध गराईएकोमा यससँग सम्बन्धी कुनै प्रतिक्रिया र सुझावहरू भए सो को अपेक्षा राख्दै बिदा हुन चाहन्छु ।

धन्यवाद

२५औं कार्यसमिति अध्यक्ष राजन तिवारीको मन्तव्य

धन्यवाद कार्यक्रम संचालक ज्यू,

यस सभाका सभाध्यक्ष ज्यू, प्रमुख अतिथि, भूगर्भशास्त्र केन्द्रीय विभागका प्रमुख प्रा. डा. खुम नारायण पौडेल ज्यू, नव निर्वाचित साथीहरू, प्रिय सदस्यहरू, र सम्पूर्ण जियोलोजिकल समुदायमा मेरो नमस्कार !

नेपाल भौगर्भिक विधार्थी समाजले सफलता पुर्वक २५औं कार्यसमितिको गठन गरेको छ। यो ऐतिहासिक अवसरले हाम्रो समाजको प्रगति र विकासलाई अझ दृढ बनाउन मद्दत पुऱ्याएको छ। हाम्रो उद्देश्य भनेको वैज्ञानिक अनुसन्धान, प्रविधि र समाज सेवाको माध्यमबाट भौगर्भिक क्षेत्रको उन्नति गर्नु हो।

२३ औ र २४ औ कार्यसमितिलेकोभिड-१९ को महामारी झेल्नु परेको र त्यस माहामारिले सृजना गरेको चुनौतीका बाबजुद उहाहरुले अनलाइन र भर्चुअल कार्यक्रमहरूद्वारा निरन्तर रुपमा आफ्नो गतिविधि सञ्चालन गरेर समाजलाई अनलाइन प्लेटफर्ममा पनि सक्रिय गराउनुभएकोमा धन्यवाद दिन चाहन्छु।यद्यपि, महामारीले हाम्रो समुदायलाई निकै प्रभावित पारेको थियो, हामीले त्यसबाट सिकेर अगाडि बढ्न सकेका छौं। अब हामीले पुनः सामूहिक रुपमा कार्यक्रमहरू आयोजना गर्न थालिसकेका छौं।आशा गरौ, हाम्रो नया कार्यसमितिले यस्ता समस्याहरुको सामना गर्न पर्ने छैन र कार्यक्रमहरुलाई निरन्तर संचालन गर्न पाउने छौ ।

हाम्रो २५औं कार्यसमितिको प्राथमिकता भनेको विद्यार्थीहरूलाई नवीनतम ज्ञान र प्रविधिको पहुँचमा ल्याउनु हो। यसका लागि, हामीले विभिन्न सेमिनार, कार्यशाला, र प्रदर्शनीहरू आयोजना गर्ने योजना बनाएका छौं। यसै सन्दर्भमा, हामीले "Scientific Paper Writing" शीर्षकमा एक सम्मेलनको आयोजना गर्ने तयारीमा छौं। यस सम्मेलनमा सम्भवतः देश-विदेशका विज्ञहरूलाई आमन्त्रण गरिनेछ र उनीहरूले आफ्नो ज्ञान र अनुभव साझा गर्नेछन्।

विभिन्न स्रोतहरूबाट सङ्कलित थेसिस, रिपोर्ट, र पेपरहरूको डिजिटलाइजेसन गर्ने काम अन्तर्गत, विभिन्न क्षेत्रका कागजातहरूलाई अनलाइन पहुँचका लागि पुस्तकालयमा उपलब्ध गराउने प्रयास गर्नेछु । यी प्रयासहरूले अनुसन्धानकर्ताहरूलाई सजिलैसँग जानकारीमा पहुँच दिलाउनेछ। यस कार्यलाई सफलतापूर्वक सम्पन्न गर्न हामीले नयाँ उपकरणहरू र स्रोतहरूको प्रयोग गर्दैछौं, जसले गर्दा हामीलाई दिगो र प्रभावकारी रूपमा कार्य गर्न मद्दत पुऱ्याउँछ। अन्ततः, यस कार्यले भविष्यमा थप अनुसन्धानको लागि ठोस आधार निर्माण गर्नेछ।समाजका सदस्यहरूबीचको समन्वय र सहयोगलाई अझ सुदृढ बनाउन, हामीले नियमित अन्तरक्रिया कार्यक्रम, छलफल सत्र, र अनुसन्धान प्रस्तुतीकरण कार्यक्रमहरू आयोजना गर्नेछौं। यसले हामीलाई नयाँ नयाँ विचारहरू र प्रविधिहरूलाई आत्मसात गर्न मद्दत पुऱ्याउनेछ।

समाजको भविष्य उज्जवल छ र हामीले यो यात्रामा सबै सदस्यहरूको सहयोग र समर्थन अपेक्षा गरेका छौं। हाम्रा परियोजनाहरूलाई सफल बनाउन, हामीले सबैलाई आ-आफ्नो क्षेत्रबाट सक्दो योगदान दिन आग्रह गर्दछौं।

अन्त्यमा, म सबैलाई यो अवसरमा धन्यवाद दिन चाहन्छु। कुनै कार्य संचालन गर्न मेरो मात्र नभई सबै कार्यसमिति, उपसमितिहरु, सदस्यहरुको साथ आवश्यक पर्दछ। तपाईंहरूको साथ र सहयोगले नै हामीले यी सबै उपलब्धिहरू हासिल गर्न सक्नेछौ । हामी सबैको सामूहिक प्रयासले नेपाल जियोलोजिकल स्टुडेन्ट्स सोसाइटीलाई अझ प्रगतिको बाटोमा लैजानेछ भन्दै मेरो मन्तव्य यहि टुंग्याउन चाहन्छु ।

धन्यवाद।

राजन तिवारी

अध्यक्ष, २५औं कार्यसमिति

नेपाल भौगर्भिक विधार्थी समाज

BIJAY BARAL

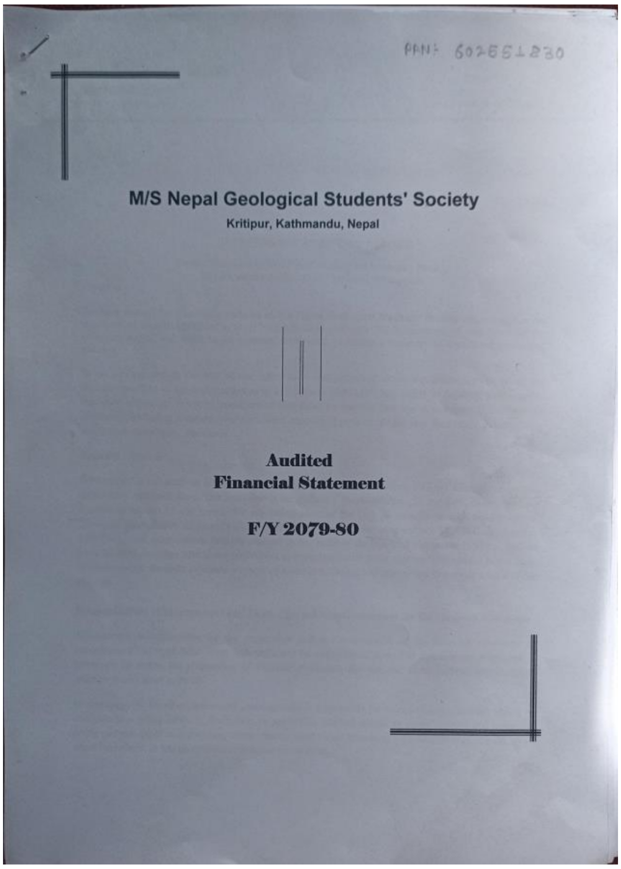
Vice- President (25th Executive Committee)

First and foremost, we express our profound appreciation to the Central Department of Geology. Your unwavering support and collaboration have been pivotal to our shared successes, and your expertise, resources, and guidance have enriched our endeavours. To the Central Department of Geology Faculty, we are deeply grateful for your unwavering dedication and commitment. Your passion for teaching, research, and mentorship has not only inspired us all but also laid a strong foundation for our growth and achievements. Your tireless efforts in nurturing the next generation of geologists are truly commendable and integral to our department's success. We are fortunate to have such a distinguished and supportive faculty. We also extend our sincere thanks to the department's non-teaching staff. Your crucial support behind the scenes ensures the smooth functioning of our activities, and your contributions are deeply valued. From administrative assistance to maintaining our facilities, your hard work and dedication are indispensable to our success. We are truly grateful for your efforts. Welcome to the new cohort of students, the NGSS family, Central Department of Geology! We are thrilled to have you as part of the NGSS family. Your arrival infuses our community with fresh energy, innovative ideas, and diverse perspectives. We eagerly anticipate the significant impact you will make in geology. As you embark on this exciting journey, we encourage you to actively engage in our activities, pursue knowledge, and contribute your unique talents. Your passion and dedication will undoubtedly shape the future of this discipline, making valuable contributions along the way. Your time with us will be a journey of personal growth, enriched knowledge, and meaningful connections. Welcome once again, and we look forward to the positive changes you will bring to our community.

To the outgoing batch of students, we extend our heartfelt congratulations on your remarkable achievements! As you transition to the next career chapter, we are excited to see the continued success and fulfillment that awaits you. Your hard work, dedication, and accomplishments during your time with us have been truly commendable. We are proud of each of you and look forward to seeing the positive impact you will make in geology and beyond. May the years ahead be filled with bright opportunities and continued success.

In closing, I extend my best wishes to everyone for a bright and prosperous future. Let us continue to strive for excellence, support one another, and contribute meaningfully to the advancement of geological sciences. Our collective dedication to this noble cause is what drives us forward and inspires us to achieve great things. Together, we can make a lasting impact on our world, knowing that our work is crucial and inspiring. Let's keep our commitment to the advancement of geological sciences alive and thriving.

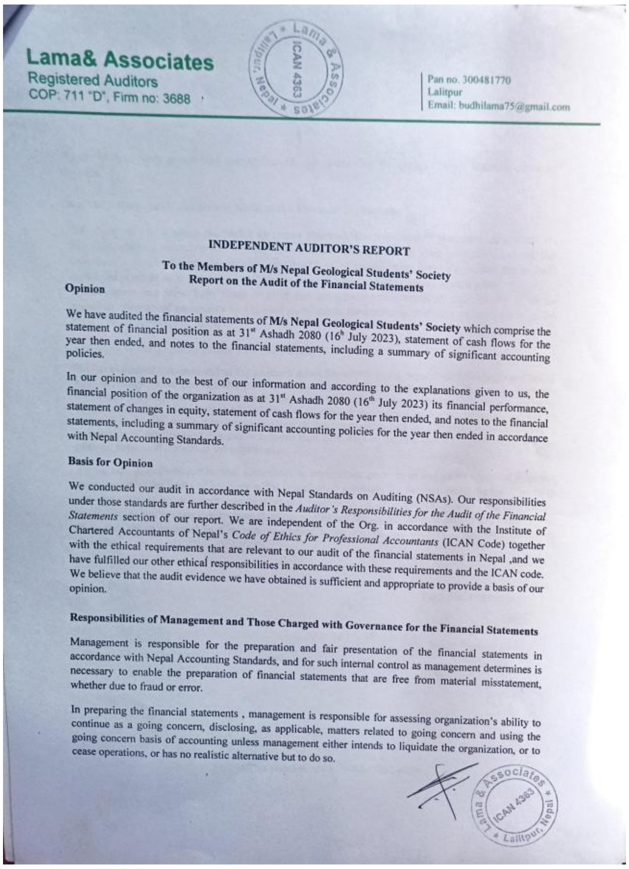
AUDIT REPORT 79/80



M/S Nepal Geological Students' Society
Kritipur, Kathmandu, Nepal

Audited
Financial Statement

F/Y 2079-80



Lama& Associates
Registered Auditors
COP: 711 "D", Firm no: 3688

Pan no. 300481770
Lalitpur
Email: budhilama75@gmail.com

INDEPENDENT AUDITOR'S REPORT

To the Members of M/s Nepal Geological Students' Society
Report on the Audit of the Financial Statements

Opinion

We have audited the financial statements of **M/s Nepal Geological Students' Society** which comprise the statement of financial position as at 31st Ashadh 2080 (16th July 2023), statement of cash flows for the year then ended, and notes to the financial statements, including a summary of significant accounting policies.

In our opinion and to the best of our information and according to the explanations given to us, the financial position of the organization as at 31st Ashadh 2080 (16th July 2023) its financial performance, statement of changes in equity, statement of cash flows for the year then ended, and notes to the financial statements, including a summary of significant accounting policies for the year then ended in accordance with Nepal Accounting Standards.

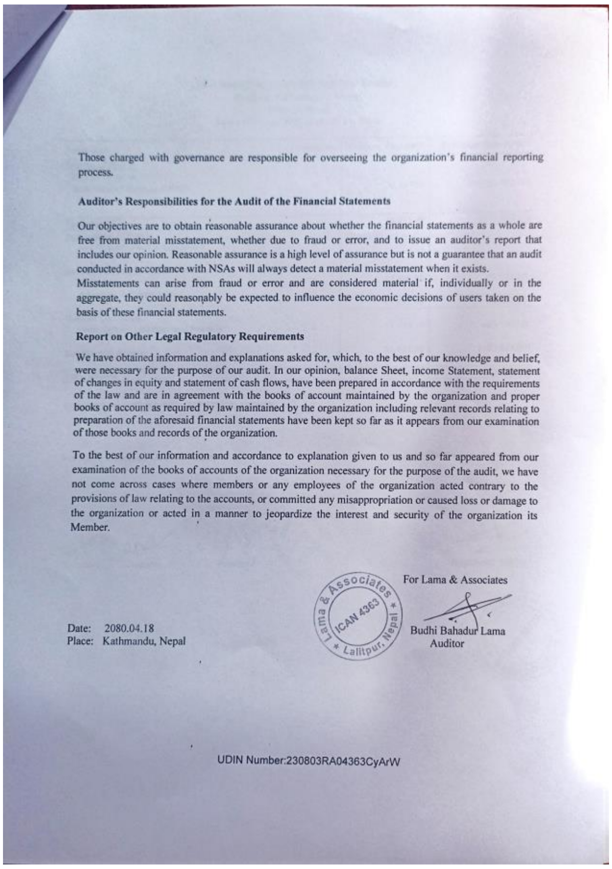
Basis for Opinion

We conducted our audit in accordance with Nepal Standards on Auditing (NSAs). Our responsibilities under those standards are further described in the *Auditor's Responsibilities for the Audit of the Financial Statements* section of our report. We are independent of the Org. in accordance with the Institute of Chartered Accountants of Nepal's *Code of Ethics for Professional Accountants* (ICAN Code) together with the ethical requirements that are relevant to our audit of the financial statements in Nepal ,and we have fulfilled our other ethical responsibilities in accordance with these requirements and the ICAN code. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis of our opinion.

Responsibilities of Management and Those Charged with Governance for the Financial Statements

Management is responsible for the preparation and fair presentation of the financial statements in accordance with Nepal Accounting Standards, and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements , management is responsible for assessing organization's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the organization, or to cease operations, or has no realistic alternative but to do so.



Those charged with governance are responsible for overseeing the organization's financial reporting process.

Auditor's Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance but is not a guarantee that an audit conducted in accordance with NSAs will always detect a material misstatement when it exists.
Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

Report on Other Legal Regulatory Requirements

We have obtained information and explanations asked for, which, to the best of our knowledge and belief, were necessary for the purpose of our audit. In our opinion, balance Sheet, income Statement, statement of changes in equity and statement of cash flows, have been prepared in accordance with the requirements of the law and are in agreement with the books of account maintained by the organization and proper books of account as required by law maintained by the organization including relevant records relating to preparation of the aforesaid financial statements have been kept so far as it appears from our examination of those books and records of the organization.

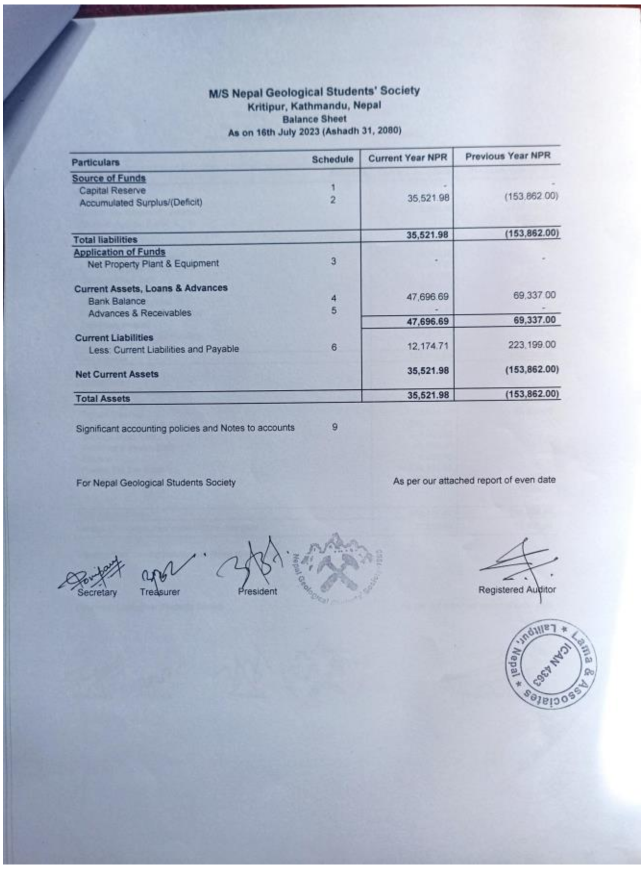
To the best of our information and accordance to explanation given to us and so far appeared from our examination of the books of accounts of the organization necessary for the purpose of the audit, we have not come across cases where members or any employees of the organization acted contrary to the provisions of law relating to the accounts, or committed any misappropriation or caused loss or damage to the organization or acted in a manner to jeopardize the interest and security of the organization its Member.

For Lama & Associates

Budhi Bahadur Lama
Auditor

Date: 2080.04.18
Place: Kathmandu, Nepal

UDIN Number:230803RA04363CyArW



M/S Nepal Geological Students' Society
Kritipur, Kathmandu, Nepal
Balance Sheet
As on 16th July 2023 (Ashadh 31, 2080)

Particulars	Schedule	Current Year NPR	Previous Year NPR
Source of Funds			
Capital Reserve	1	-	-
Accumulated Surplus/(Deficit)	2	35,521.98	(153,862.00)
Total liabilities		**35,521.98**	**(153,862.00)**
Application of Funds			
Net Property Plant & Equipment	3	-	-
Current Assets, Loans & Advances			
Bank Balance	4	47,696.69	69,337.00
Advances & Receivables	5	-	-
		47,696.69	**69,337.00**
Current Liabilities			
Less: Current Liabilities and Payable	6	12,174.71	223,199.00
Net Current Assets		**35,521.98**	**(153,862.00)**
Total Assets		**35,521.98**	**(153,862.00)**

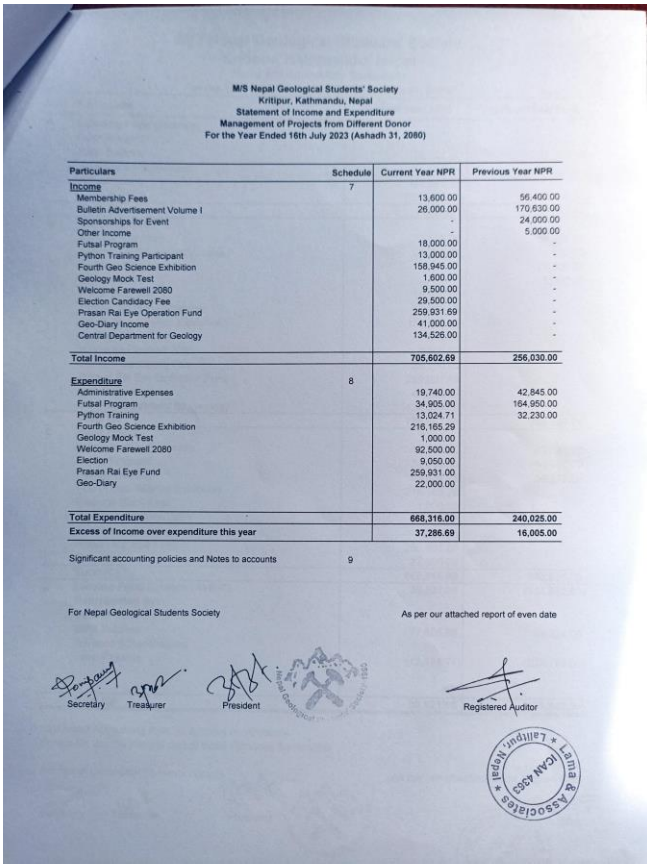
Significant accounting policies and Notes to accounts 9

For Nepal Geological Students Society

As per our attached report of even date

Secretary Treasurer President

Registered Auditor



M/S Nepal Geological Students' Society
Kritipur, Kathmandu, Nepal
Statement of Income and Expenditure
Management of Projects from Different Donor
For the Year Ended 16th July 2023 (Ashadh 31, 2080)

Particulars	Schedule	Current Year NPR	Previous Year NPR
Income	7		
Membership Fees		13,600.00	56,400.00
Bulletin Advertisement Volume I		26,000.00	170,630.00
Sponsorships for Event		-	24,000.00
Other Income		-	5,000.00
Futsal Program		18,000.00	-
Python Training Participant		13,000.00	-
Fourth Geo Science Exhibition		158,945.00	-
Geology Mock Test		1,600.00	-
Welcome Farewell 2080		9,500.00	-
Election Candidacy Fee		29,500.00	-
Prasan Rai Eye Operation Fund		259,931.69	-
Geo-Diary Income		41,000.00	-
Central Department for Geology		134,526.00	-
Total Income		**705,602.69**	**256,030.00**
Expenditure	8		
Administrative Expenses		19,740.00	42,845.00
Futsal Program		34,905.00	164,950.00
Python Training		13,024.71	32,230.00
Fourth Geo Science Exhibition		216,165.29	
Geology Mock Test		1,000.00	
Welcome Farewell 2080		92,500.00	
Election		9,050.00	
Prasan Rai Eye Fund		259,931.00	
Geo-Diary		22,000.00	
Total Expenditure		**668,316.00**	**240,025.00**
Excess of Income over expenditure this year		**37,286.69**	**16,005.00**

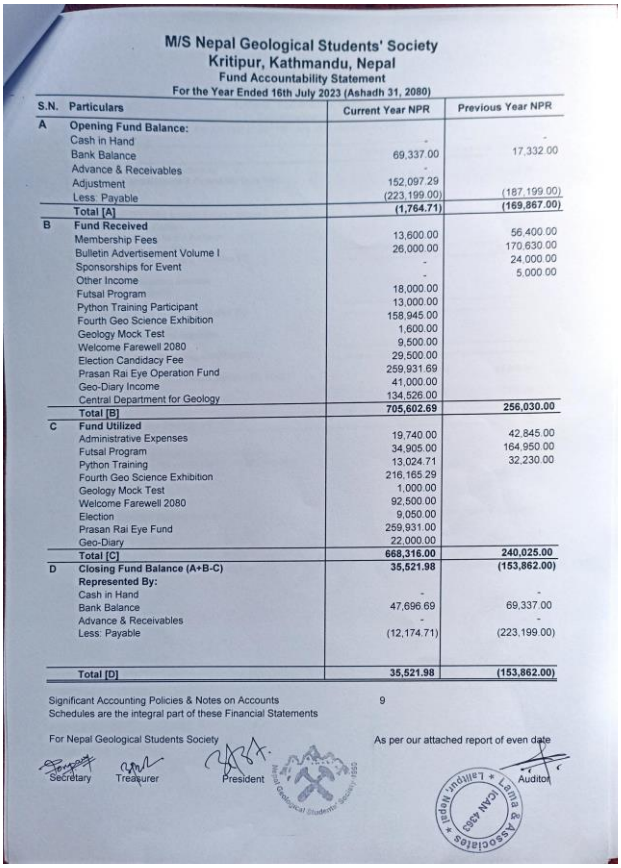
Significant accounting policies and Notes to accounts 9

For Nepal Geological Students Society

As per our attached report of even date

Secretary Treasurer President

Registered Auditor



M/S Nepal Geological Students' Society
Kritipur, Kathmandu, Nepal
Fund Accountability Statement
For the Year Ended 16th July 2023 (Ashadh 31, 2080)

S.N.	Particulars	Current Year NPR	Previous Year NPR
A	**Opening Fund Balance:**		
	Cash in Hand	-	-
	Bank Balance	69,337.00	17,332.00
	Advance & Receivables	-	
	Adjustment	152,097.29	
	Less: Payable	(223,199.00)	(187,199.00)
	Total [A]	**(1,764.71)**	**(169,867.00)**
B	**Fund Received**		
	Membership Fees	13,600.00	56,400.00
	Bulletin Advertisement Volume I	26,000.00	170,630.00
	Sponsorships for Event	-	24,000.00
	Other Income	-	5,000.00
	Futsal Program	18,000.00	
	Python Training Participant	13,000.00	
	Fourth Geo Science Exhibition	158,945.00	
	Geology Mock Test	1,600.00	
	Welcome Farewell 2080	9,500.00	
	Election Candidacy Fee	29,500.00	
	Prasan Rai Eye Operation Fund	259,931.69	
	Geo-Diary Income	41,000.00	
	Central Department for Geology	134,526.00	
	Total [B]	**705,602.69**	**256,030.00**
C	**Fund Utilized**		
	Administrative Expenses	19,740.00	42,845.00
	Futsal Program	34,905.00	164,950.00
	Python Training	13,024.71	32,230.00
	Fourth Geo Science Exhibition	216,165.29	
	Geology Mock Test	1,000.00	
	Welcome Farewell 2080	92,500.00	
	Election	9,050.00	
	Prasan Rai Eye Fund	259,931.00	
	Geo-Diary	22,000.00	
	Total [C]	**668,316.00**	**240,025.00**
D	**Closing Fund Balance (A+B-C)**	**35,521.98**	**(153,862.00)**
	Represented By:		
	Cash in Hand	-	-
	Bank Balance	47,696.69	69,337.00
	Advance & Receivables	-	-
	Less: Payable	(12,174.71)	(223,199.00)
	Total [D]	**35,521.98**	**(153,862.00)**

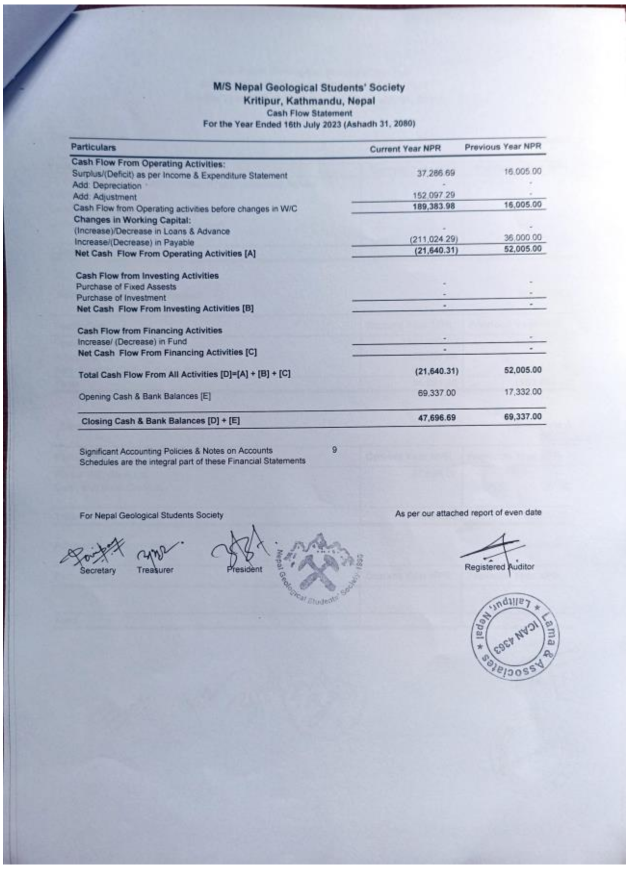
Significant Accounting Policies & Notes on Accounts 9
Schedules are the integral part of these Financial Statements

For Nepal Geological Students Society

As per our attached report of even date

Secretary Treasurer President

Auditor



M/S Nepal Geological Students' Society
Kritipur, Kathmandu, Nepal
Cash Flow Statement
For the Year Ended 16th July 2023 (Ashadh 31, 2080)

Particulars	Current Year NPR	Previous Year NPR
Cash Flow From Operating Activities:		
Surplus/(Deficit) as per Income & Expenditure Statement	37,286.69	16,005.00
Add: Depreciation	-	-
Add: Adjustment	152,097.29	-
Cash Flow from Operating activities before changes in W/C	189,383.98	16,005.00
Changes in Working Capital:		
(Increase)/Decrease in Loans & Advance	-	-
Increase/(Decrease) in Payable	(211,024.29)	36,000.00
Net Cash Flow From Operating Activities [A]	**(21,640.31)**	**52,005.00**
Cash Flow from Investing Activities		
Purchase of Fixed Assests	-	-
Purchase of Investment	-	-
Net Cash Flow From Investing Activities [B]	-	-
Cash Flow from Financing Activities		
Increase/ (Decrease) in Fund	-	-
Net Cash Flow From Financing Activities [C]	-	-
Total Cash Flow From All Activities [D]=[A] + [B] + [C]	**(21,640.31)**	**52,005.00**
Opening Cash & Bank Balances [E]	69,337.00	17,332.00
Closing Cash & Bank Balances [D] + [E]	**47,696.69**	**69,337.00**

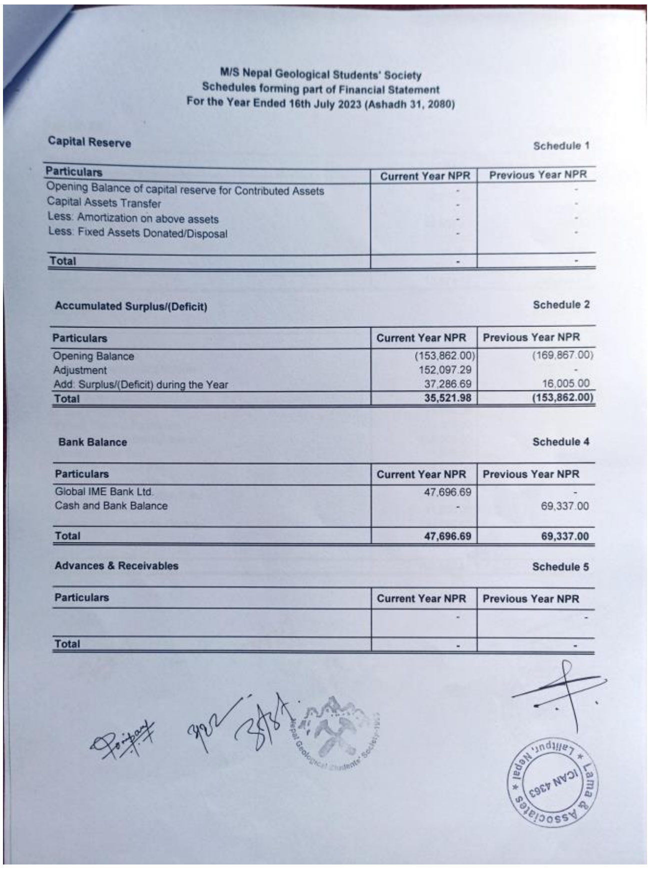
Significant Accounting Policies & Notes on Accounts 9
Schedules are the integral part of these Financial Statements

For Nepal Geological Students Society

As per our attached report of even date

Secretary Treasurer President

Registered Auditor



M/S Nepal Geological Students' Society
Schedules forming part of Financial Statement
For the Year Ended 16th July 2023 (Ashadh 31, 2080)

Capital Reserve Schedule 1

Particulars	Current Year NPR	Previous Year NPR
Opening Balance of capital reserve for Contributed Assets	-	-
Capital Assets Transfer	-	-
Less: Amortization on above assets	-	-
Less: Fixed Assets Donated/Disposal	-	-
Total	-	-

Accumulated Surplus/(Deficit) Schedule 2

Particulars	Current Year NPR	Previous Year NPR
Opening Balance	(153,862.00)	(169,867.00)
Adjustment	152,097.29	-
Add: Surplus/(Deficit) during the Year	37,286.69	16,005.00
Total	**35,521.98**	**(153,862.00)**

Bank Balance Schedule 4

Particulars	Current Year NPR	Previous Year NPR
Global IME Bank Ltd.	47,696.69	-
Cash and Bank Balance	-	69,337.00
Total	**47,696.69**	**69,337.00**

Advances & Receivables Schedule 5

Particulars	Current Year NPR	Previous Year NPR
	-	-
Total	-	-

M/S Nepal Geological Students' Society
Schedules forming part of Financial Statement
For the Year Ended 16th July 2023 (Ashadh 31, 2080)

PAYABLES — Schedule 6

Particulars	Current Year NPR	Previous Year NPR
Program Advance Received	-	36,000.00
Election Candidacy Refund	2,500.00	
Expenses Payable	-	179,289.00
Audit Fee Payable	7,805.00	7,805.00
TDS		
Audit fee	105.00	105.00
Trainer Fees	1764.71	-
Total	**12,174.71**	**223,199.00**

INCOME — Schedule 7

Particulars	Current Year NPR	Previous Year NPR
Membership Fees	13,600.00	56,400.00
Bulletin Advertisement Volume I	26,000.00	170,630.00
Sponsorships for Event	-	24,000.00
Other Income	-	5,000.00
Futsal Program	18,000.00	-
Python Training Participant	13,000.00	-
Fourth Geo Science Exhibition	158,945.00	-
Geology Mock Test	1,600.00	-
Welcome Farewell 2080	9,500.00	-
Election Candidacy Fee	29,500.00	-
Prasan Rai Eye Operation Fund	259,931.69	-
Geo-Diary Income	41,000.00	-
Central Department for Geology	134,526.00	-
Total	**705,602.69**	**256,030.00**

M/S Nepal Geological Students' Society
Schedules forming part of Financial Statement
For the Year Ended 16th July 2023 (Ashadh 31, 2080)

Expenses — Schedule 8

Particulars	Current Year NPR	Previous Year NPR
Administrative Expenses		
Audit Fee	7,910.00	7,910.00
Bank Expenses	500.00	
Office Expenses		500.00
Registration and Renewal	3,510.00	8,755.00
Printing and Stationery	2,820.00	22,080.00
Travel cost		1,600.00
Other Expenses		2,000.00
BSc Field Visit	5,000.00	-
Bulletin Expenses		164,950.00
Event Expenses		32,230.00
Futsal Program		
Playing Material	14,865.00	-
Printing And Stationery	1,020.00	-
Medical Expenses	3,205.00	-
Trophy Expenses	13,775.00	-
Khaja	2,040.00	-
Python Training		
Trainer Fees	11,764.71	-
Printing And Stationery	560.00	-
Khaja	700.00	-
Fourth Geo Science Exhibition		
Material Expenses	112,185.29	-
Khaja	43,200.00	-
Petrol	6,000.00	-
Printing and Stationery	50,680.00	-
Token of Love	4,100.00	-
Geology Mock Test		
Khaja	600.00	-
Printing and Stationery	400.00	-
Welcome Farewell 2080		
Flower	2,000.00	-
Khada	16,500.00	-
Khaja	29,750.00	-
Printing and Stationery	6,050.00	-
Material Expenses	19,950.00	-
Token of Love	18,250.00	-

M/S Nepal Geological Students' Society
Schedules forming part of Financial Statement
For the Year Ended 16th July 2023 (Ashadh 31, 2080)

Election		
Khana/ Khaja	2,850.00	-
Membership ID Card	5,600.00	-
Printing and Stationery	600.00	
Prasan Rai Eye Fund		
Medical Expenses	259,931.00	-
Geo-Diary		
Diary Purchases	20,500.00	-
Travel cost	1,500.00	-
Total	**668,316.00**	**240,025.00**

M/S Nepal Geological Students' Society

Schedule 3: Details of Fixed Assets

As on 16th July 2023 (Ashadh 31, 2080)

Assets	Rate	Opening Balance	Transfer Project	Transfer Amount	Addition Upto Poush	Addition Magh to Chaitra	Addition Baisakh to Ashad	Disposal/ Transfer to Project	Total	Depreciation	W.D.V as on Ashadh End 2080
Computer and Printer	25%				-	-	-	-	-	-	
Furniture and Fixture	25%				-	-	-	-	-	-	
Vehicle	20%					-			-	-	
Total		-	-	-	-	-	-	-	-	-	-

Nepal Geological Students' Society 1990

Lama & Associates * Lalitpur, Nepal * ICAN 4363

M/S Nepal Geological Students' Society

Kritipur, Kathmandu, Nepal

TDS Reconciliation Statement

Expenses	Project	Total Expenses	Revenue Code	TDS Paid	TDS Rate	TDS
Audit Fees	NGSS	7,910.00	11111	-	1.5%	105.00
Trainer Fees	Python Training	11,764.71	11111		1.5%	176.47
Total		**19,674.71**				**281.47**

Nepal Geological Students' Society 1990

Lama & Associates * Lalitpur, Nepal * ICAN 4363

M/S Nepal Geological Students Society
For the Year Ended 16th July 2023 (Ashadh 31, 2080)

"Notes to Accounts"

(Schedule forming part of Balance Sheet as at 16th July, 2023 (Ashadh 31, 2080)

Accounting Policy

The account of the M/S Nepal Geological Students Society has been maintained on accrual basis of accounting for expenses and on cash basis for grant receipts. For recognition of assets and liabilities is in historical cost convention basis. The significant accounting policies adopted, which unless otherwise stated are in consistence with the previous year as follows;

1. **Accounting of Program Activities**

M/S Nepal Geological Students Society has maintained for all programs/ projects implemented by M/S Nepal Geological Students Society either directly by its own source of fund or from donors finds in cash basis of accounting. All receipts and payments/ expenses are accounted in Nepalese Currencies Accounts and does not have any bank account in foreign currencies. Organization has maintained same bank account for different projects. All inventory items are accounted as expenditures under respective budget items/ Lines.

2. **Advances and Deposits**

Unsettled advances, deposits and payables for program activities and core program are shown as advances in the respective program.

3. **Fixed Assets**

a. The fixed assets have been stated at cost of acquisition plus expenses incurred which are incidental to such acquisition. Assets value of Balance Sheet is presented in Written Down Value (WDV) as on 31st Ashadh 2080.

b. The M/S Nepal Geological Students Society has adopted the policy of charging depreciation on fixed assets at the rate prescribed by Income Tax Act- 2058. No depreciation has been charged on assets additions during the year

c. Depreciation on assets is not charged to Income and Expenditure accounts but total deprecation on those assets which are capitalized/ received by the core fund from various program/ projects closed in or before this financial year are charged to Assets funds accounts.

4. **Regrouping of previous year's figure**

Previous year's figures have been re-grouped wherever necessary.

Nepal Geological Students' Society-1990

Lama & Associates * Lalitpur, Nepal * ICAN 4363

NGSS MEMBERSHIP LIST

Engineering Geology- 3rd Semester (2079)

S.N.	Full Name	Stream	Campus
1	Puspa Raj Poudel	Engineering Geology	Central Dept of Geology
2	Madan Sapkota	Engineering Geology	Central Dept of Geology
3	Shishir sharma	Engineering Geology	Central Dept of Geology
4	Hemanta Pokharel	Engineering Geology	Central Dept of Geology
5	Niraj Kumar Shrestha	Engineering Geology	Central Dept of Geology
6	Ashwin Duwadi	Engineering Geology	Central Dept of Geology
7	Bibhab Gauli	Engineering Geology	Central Dept of Geology
8	Shiksha Raut	Engineering Geology	Central Dept of Geology
9	Saru Paudel	Engineering Geology	Central Dept of Geology
10	Bhawana Khadka	Engineering Geology	Central Dept of Geology
11	Milan Acharya	Engineering Geology	Central Dept of Geology
12	Khushbu Lama	Engineering Geology	Central Dept of Geology
13	Sagar Bhattarai	Engineering Geology	Central Dept of Geology
14	Shyam Dangal	Engineering Geology	Central Dept of Geology
15	Manish Adhikari	Engineering Geology	Central Dept of Geology
16	Amit Sharma	Engineering Geology	Central Dept of Geology
17	Sushant Acharya	Engineering Geology	Central Dept of Geology
18	Janak Shrestha	Engineering Geology	Central Dept of Geology
19	Saugat Regmi	Engineering Geology	Central Dept of Geology
20	Chirayu Bohara	Engineering Geology	Central Dept of Geology
21	Anupama Marahatta	Engineering Geology	Central Dept of Geology
22	Ashish Baral	Engineering Geology	Central Dept of Geology
23	Durga kumara chhetri	Engineering Geology	Central Dept of Geology
24	Manjari Adhikari	Engineering Geology	Central Dept of Geology
25	Krishna KC	Engineering Geology	Tri-Chandra Multiple Campus
26	Manish Adhikari	Engineering Geology	Tri-Chandra Multiple Campus
27	Biplove Gauli	Engineering Geology	Tri-Chandra Multiple Campus
28	Tina Pantha	Engineering Geology	Tri-Chandra Multiple Campus
29	Aastha Koirala	Engineering Geology	Tri-Chandra Multiple Campus
30	Janaki khatri	Engineering Geology	Tri-Chandra Multiple Campus
31	Anju Tamang	Engineering Geology	Tri-Chandra Multiple Campus
32	Pratigya Bogati	Engineering Geology	Tri-Chandra Multiple Campus

Geology and Engineering Geology -1st Semester (2080)

S.N.	Name	Stream	Campus
1	Alija Dahal	General Geology	Central Dept. of Geology
2	Apekshya Lamichhane	General Geology	Central Dept. of Geology
3	Babina Mihata Shrestha	General Geology	Central Dept. of Geology
4	Bhawana Gurung	General Geology	Central Dept. of Geology
5	Bibek Chaudari	General Geology	Central Dept. of Geology
6	Binu Shapkota	General Geology	Central Dept. of Geology
7	Diwash Thapalia	General Geology	Central Dept. of Geology
8	Himani Basyal	General Geology	Central Dept. of Geology
9	Ishwor Timalsina	General Geology	Central Dept. of Geology
10	Kiran Vaidya	General Geology	Central Dept. of Geology
11	Kritika Sedai	General Geology	Central Dept. of Geology
12	Laxmi Pokharel	General Geology	Central Dept. of Geology
13	Leena Chongbang	General Geology	Central Dept. of Geology
14	Manjil Lamichhane	General Geology	Central Dept. of Geology
15	Manoj kumar yadav	General Geology	Central Dept. of Geology
16	Manoj Neupane	General Geology	Central Dept. of Geology
17	Mumina Miya	General Geology	Central Dept. of Geology
18	Namtinge Phudong Limbu	General Geology	Central Dept. of Geology
19	Nismata Sigdel	General Geology	Central Dept. of Geology
20	Prem Tamang	General Geology	Central Dept. of Geology
21	Puspa Dhakal	General Geology	Central Dept. of Geology
22	Sabin Rai	General Geology	Central Dept. of Geology
23	Samikshya Karki	General Geology	Central Dept. of Geology
24	Suman Khadka	General Geology	Central Dept. of Geology
25	Surakshya Gauli	General Geology	Central Dept. of Geology
26	Surendra Rokaya	General Geology	Central Dept. of Geology
27	Urbasi Baral	General Geology	Central Dept. of Geology
28	Yadav Bhatt	General Geology	Central Dept. of Geology
29	Yashoda Sharma	General Geology	Central Dept. of Geology
30	Aastha Poudel	Engineering Geology	Central Dept. of Geology
31	Alka Gyawali	Engineering Geology	Central Dept. of Geology
32	Ashim Dhakal	Engineering Geology	Central Dept. of Geology
33	Balaram Bhujel	Engineering Geology	Central Dept. of Geology
34	Jitendra Adhikari	Engineering Geology	Central Dept. of Geology

35	Md Faisal Rain	Engineering Geology	Central Dept. of Geology
36	Prajwal Panta	Engineering Geology	Central Dept. of Geology
37	Puja Simkhada	Engineering Geology	Central Dept. of Geology
38	Sagar Subedi	Engineering Geology	Central Dept. of Geology
39	Sandipa Dawadi	Engineering Geology	Central Dept. of Geology
40	Shanti Pandey	Engineering Geology	Central Dept. of Geology
41	Sishir Chaulagain	Engineering Geology	Central Dept. of Geology
42	Sumitra Bhattarai	Engineering Geology	Central Dept. of Geology
43	Sunny Chaulagain	Engineering Geology	Central Dept. of Geology
44	Susma Poudel	Engineering Geology	Central Dept. of Geology

LIST OF MEMBERS IN SUB-COMMITTEE

Sports Sub-committee	
Gaurav Sharma	Applied Geology(4th sem)
Nabin Poudel	Applied Geology(4th sem)
Nisha Bhatta	Applied Geology(4th sem)
Rabin Sapkota	Engineering Gealogy(4th sem)
Rubin Ranpal	General Geology(2nd sem)
Jeevan Thapa	General Geology(2nd sem)
Ram Dhakal	Engineering Geology(4th sem,T.C.)
Aashish Bhandari	Engineering Geology(4th sem, T.C.)
Anurag Bhattarai	Engineering Geology(4th sem, T.C.)
Anushka Gyawali	Engineering Gealogy(4th sem)
Scientific Sub-committee	
Bishal Poudel	Engineering Geology(4th sem)
Saroj Shrestha	Engineering Geology(4th sem)
Biswash Dhungana	Applied Geology (4th sem)
Aashish Giri	Mining Geology (4th sem)
Suruchi Bhatta	Hydrogeology (4th sem)
Rashmi Acharya	Hydrogeology (4th sem)
Subash K.C.	Engineering Geology (4th sem, T.C.)
Saru Poudel	Engineering Geology(2nd sem)
Ashwin Dawadi	Engineering Geology(2nd sem)
Saurav Koirala	General Geology(2nd sem)
Govinda Sharma	General Geology(2nd sem)
Bhupendra Mahata	General Geology(2nd sem)

LIST OF THESIS (2022/23)

Thesis Code in CDG Library	Title of Thesis	Name of Student	Copies	Year
622	Geological Study and Landslide Susceptibility Mapping of Dharan area Covering the sardu khola and the seuti khola watershed,Eastern Nepal.	Dilip Thapa	1	2022/ 79
623	Geologica Structures of the Tribeni-Pangcha area,,Eastern Nepal.	Prabin Pramod Khatiwada	1	2022
624	Geology and Structure of Shivnath - Salena,Baiadi,far -west Nepal with special Reference to Microstructure,Strain Analysis and Stress Regime.	Kabiraj Phiyal	1	2022
625	Lithostratigraphy Petrography,Paleontology and Mineral Resources of the Shivnath-Melauli-Salena area ,Lesser Himalaya in Baitadi District,Sudurpaschim Province,Nepal.	Madhusudan Sapkota	1	2022
626	Landslide Susceptibility Mapping of the Sakhare khola Watershed, lawa khola and Buwa khola area South- Eastern Nepal.	Prabin Kishor Bimali	1	2022
627	Comparison Between Two Bivariate Methods of Landslide Susceptibility Mapping at the Boundary Between Jajarkot and Karnali Nappe, Mid Western Nepal.	Yubraj Bikram Shahi	1	2022
628	Compressibility of Kathmandu City in Northwest Kathmandu Vaiiy.	Sweta Guragain	1	2022
629	Landslide Hazard and risk Assessment in Rubi valley Rural Municipality,Dhading ,Central Nepal.	Buddhi Lal Tamang	1	2022
630	Road cut l Slope Stability Assessment along Mid-Hill Highway from Lumle to Dimuwa, western Nepal.	Amit Bhusal	1	2022
631	Recogintion of Deep-Seated Landslide Topography and useto Forecast the Shallow Landslides.	Sudhan Kumar Subedi	1	2022
632	Geological Engineering Geological study and	Babita	1	2022

	Groundwater Potential Mapping of Bhalubang area,Dang,Lumbini Province.	Rupakheti		
633	Geological Study of Khairenitar area, Southern part of Pokhara valley with Emphasis to Stratigraphy and Mineral Resouces.	Suman Dhakal	1	2022
634	Locating the Main Boundary Thrust and Associated Engineering Geological Issuse in Between the Mechi river and kakur khola, Eastern Nepal.	Santosh Darji	1	2022
635	Sedimentary Environment of Punyamata khola , Kaver District, Central Nepal.	Swostika Goraju	1	2022
636	Geological and Hydrogelogical Assessment along the upper Reaches of the Budhi khola section, Province one, Easrern Nepal.	Anusha Dahal	1	2022
637	Mountain Hydrogeology in Bhimgethi-Devisthan Section of West-Central Nepal along Badi Gad Fauly.	Asmita Sapkota	1	2022
638	Prospecting Copper in the Jelban-Seram Section of the Rolpa District, Lumbini Province, western Nepal	Europe Paudyal	1	2022
639	Geology and Paleontology of the Siwalik Ground Around Arjun khola area ,Mid-west Nepal.	Anil Datta Chaudhary	1	2022
640	Geological Mapping and Landslide Susceptibility analysis of the Lakhandehi khola watershd of the Sarlahi District, Nepal.	Anup Neupane	1	2022
641	Geological Prospecting of Iron from Jelban-Seram section of Rolpa District,Western Nepal.	Uttam Sharma	1	2022
642	Seepage and soil Stability in Topographic Hollow of Tarebhir area, Kathmandu.	Ashok Kc	1	
643	Deterministic Landslide Hazard Assessment of Kushma-1,Parbat,Nepal.	Yuvaraj Poudel	1	2022
644	Mapping of the Main Boundary Thrust and Sensitivity analysis along the Kamala river to the Narayani river,Central Nepal.	Rhythm Lamichhane	1	2022
645	Geological and Hydrogelogical Studies and Geo-Hazard Assessment of the Khutti khola Watershed ,Siraha District, Easrern Nepal.	Sumitra Dhungana	1	2022
646	Study of Landslide in Thulolumpek-Juhan	Shushila	1	2022

	section of Gulmi District,Western Nepal.	Sanjel		
647	Geology, Deformation and Structural Setting at the Boundary Between Jajarkot Nappe and Karnali Nappe Himalaya, Western Nepal..	Sushma Kadel	1	2022
648	Tracing of the Main Boundary Thrust (MBT) in Between the Narayani and West Rapti Rivers,Nepal Himalaya.	Pramod Kattel	1	2022
649	Locating the Main Boundary Thrust as the Northern Limit of the Sub-Himalayan zonein Between the BHERI-Babai river to Mahakali river, Nepal.	Pradip Shrestha	1	2022
650	Seismicity Analysis to Delineate Different Seismogenic Zone in the Himalayan Region.	Bibek Khatiwada	1	2022
651	Evaluation of Rockfall Protection System road side Slopes Around Jalbire in Muglin-Narayangadh Road Section.	Bivek Ghimire	1	2022
652	Geologicalies of the Gurun khola Watershed on Emphasis with Groundwater and Geo-Hazad Assessment, Dang District,Lumbini Province, Nepal.	Sandeep Paudel	1	2022
653	Geological Mapping of the Southern Section of the Arun khola Watershed and Study of the Hupsekot Landslide of Chure -Dun Region,Gandaki Province, Nepal.	Roshan Neupane	1	2022
654	Geological Studies with Emphasis on Landslide Susceptibility Mapping Groundwater Potential Mapping and Geohazard Assessment of tha Upper Parts of Adhi khola Watershed, Syangja District.	Aashish Aryal	1	2022
655	Mineralization in Palung Granite and Its Adjacent areas Along Kalitar Section, Central Nepal.	Sujan Sapkota	1	2022
656	Geologial Mapping and Reserve Estimation of Cement Grade Limestone at Mankot, Baitadi District, Sudurpashchim Province.	Sajan G.C.	1	2022
657	Environmental Sedimentology of the Punyamata river, Kavrepalanchok District,Central Nepal.	Bijay Banstola	1	2022
658	Geological Study of the Pokhara Valley with	Dipesh	1	2022

	Emphasis on Quaternary Stratigraphy and Facies Categorization.	Thapa		
659	Stratigraphy and Mineral Resources of Jajarkot Klippe and Karnali Klippe,Jajarkot District, Western Nepal	Aneeta Thapa	1	2022
660	Geological Study of Baletaksar-Thulolumpek Section of Gulmi District,Lesser Himalaya	Pratiksha Dhungana	1	2022
661	Geology of Mushikot-Burtibang Section of Baglung-Gulmi District with Emphasis to Microstructures,Western Nepal.	Durga Bolakhe	1	2022
662	Stope Stability Issues in Engineered Slope at Khanikhola- Pipalmood Section of Tribhuvan Rajpath, Dhading, Central Nepal	Tushal Acharya	1	2022
663	Quality Assessment of Dolomite and Limestone for Construction Material and Industrial use at Patal Bhumeshowar to Sinkelek area, Baitadi District	Lekhman Bhujel	1	2022
664	Application of Self-Potential Method ot Infer Groundwater Flow Direction, Recharge and Discharge Zone and Characterize sub-Surface Structure in Golaghat,Chitwan.	Indrajeet Kohar	1	2022
665	Geological Study of Northern part of the Pokhara Valley with Emphasis to Geological Structures and Metamorphism.	krishna Gotame	1	2022
666	Geological Study with Emphasis on Stuructures and Microtectonice Around Khairenitar area,Southern part of Pokhara valley.	Pramod Gautam	1	2022
667	Geological Study of Northern Section of Pokhara Valley with Emphasis to Lithostratigraphy and Mineral Resources.	Mahesh Joshi	1	2022
668	Geological and Hydrogeological Studies and Geo-Hazard Assessment of the Bhada khola Watershed, Bardiya District, Lumbini Province, Nepal.	Niraj Baral	1	2022
669	Lithostratigraphy and Metamorphism of the Barahakshetra- Dummana area, Eastern Nepal.	Rupak Gyawali	1	2022
670	Delineation of Groundwater sub-Basins and Groundwater Potenial Zones in Chitwan Valley	Ayushma Rana Magar	1	2022

671	Groundwater Potential Mapping Water Quality Assessment and Characterization of Factors for Groundwater Occurrence in Madi Valley,Chitwan District.	Alisha Aryal	1	2022
672	Hydrogeological Issue Related to Leaky Aquifer and Its Detection Through Geoelectrical Method in Northern Belt of Chitwan Valley.	Sujata Acharya	1	2022
673	Assessing Water Scarcity Using the Water Poverty Index and Delineation of Groundwater Potential at Lower Reaches of the Manahari khola Watershed, Makwanpur District.	Anjana Paudel	1	2022
674	Land use and Land Covre Chance Mapping and Landslide Risk Mapping in Upper Region of Babai River at Dang,Nepal.	kiran pandey	1	2022
675	Geological and Petrographic Studies of the Sundarijal Kageshwori area.	Sushant Pudasaini	1	2022
676	Landslide Susceptibility Mapping and Application Rusle Model to Assess Soil Erosion,Bakaiya Watershed.	Bibash Bhandari	1	2022
677	Geology and Microtectonics of Boundary Region of Jajarkot Klippe and Karnali Klippe,Jajarkot District,Western Nepal.	Pawan Kumar Acharya	1	2022
678	Geology and Structure of Rumjhatar -Lamidanda area, Okhaldhunga Tectonic Window, Eastern Nepal.	Takman Kumal	1	2022
679	Hydrogeomorphic and Structural Approach for Groundwater Assessment on Lothar Khola	Prativa Dhakal	1	2022
680	Analysis of Aquifer Characteristics in Dang Valley MID-Western Region ,Nepal.	Dharma Raj Pandey	1	2018
681	Evaluation of Engineering Properties of Kathmandu Clay of Northern Part of Kathmandu Valley.	Ranju Sharma	1	2022
682	Assessment ofEngineering Properties of Kathmandu Clay in Southern Part of Kathmandu Valley.	Anjita Paudel	1	2022
683	The Geomorphology and Paleoseismology of the Dhorpatan Fault Western Nepal.	Manoj Kafle	1	2022
684	Analysis of Deformation Behaviour at the	Mukunda	1	2022

	Underground Cavern of Upper Trishuli-1 Hydropower Project,Nepal.	Dhungana		
685	Analysis of Deformation Behaviour of Underground Powerhouse Cavern of Tanahu Hydroelectric,Damauli.	Prakash Pokharel	1	2022
686	Engineering Geological and Landslide Hazard Level Classification Mapping of Gorsyang-Dangsing road ,Tarkeshwor Rural Municipality, Nuwakot.	Suman Senden	1	2022
687	Analysis of Support and Deformation Characteristice of Headrace Tunnel Section of Tanahu Hydroelectric Project, Tanahu.	Udaya Raj Sodari	1	2022
688	Hydrogeological Assessment of Sangla khola ,Kathmandu District.	Nirajan Lamichhane	1	2022
689	Hydrogeological Assessment of Sheshmati khola,Kathmandu Distric.	Sudiptee Acharya	1	2022
690	Geology and Stratigraphy of Dolalghat- Tatopani Section of Central Nepal	Gaurab Gyawali	1	2023
691	Geology and Water Chemistry of springs in mayang Khola Watershed Syangja District, Nepal	Prabin Budhathoki	1	2023
692	Geology and Mineral Resources of Malarani-Jhimruk Section of Western Nepal, Lesser Himalaya	Sameer Luintel	1	2023
693	Geology and Mineral Resources of Tamghas-Dhurkot Section of Gulmi District,Lesser Himalaya	Yubraj Subedi	1	2023
694	Geological Mapping for Locating the Main Central Thrust (MCT) along Barhabise-Tatopani area,Sindhupalchowk Distrct,Central Nepal.	Arjun Budhathoki	1	2023
695	Geological Study of Kerabari-Rajarani area, with Emphasis on Structure and Strain Analysis of MCT, Dhankuta Eastern Nepal.	Kailash Rai	1	2023
696	Spring Water Resources Assessment in the Dharan Sub-Metropolitan City,Koshi Province, Nepal.	Kusum Niroula	1	2023
697	Geology and Mineral Resources in Holbang-Burtibang Section of Western Nepal, Lesser	Anita Pandey	1	2023

	Himalaya			
698	Geological Study and Landslide Susceptibility Mapping Using Bivariate Statistical Approach in Chauda Khola Watershed in Makawanpur-Sindhuli District.	Anita Dallakoti	1	2023
`699	Monitoring and Analsis of Ground Vibration Induced by Blasting and Its Impact on Structures.	Mohan Raj Shrestha	1	2023
700	Satellite-Based Rainfall Thresholds for Landslide Initiation in Bagmati Province, Nepal.	Sabin Bhattarai	1	2023
701	Study of Rock Fragmentation in Dolomite Rock with Respect to Rock Mass Properties and Blast Design Parameters in the Dam Side of Tanahun Hydro- Electric Project.	Sanjaya Dahal	1	2023
702	Impacts on Drill Bit Ascribed by Various Properties of Different Rocks.	Sujan Neupane	1	2023
703	Study of shear Strength of Rock Mass by Direct and Indirect Methods.	Bibek Dhakal	1	2023
704	Compressibility of Banepa Clay,Central Nepal.	Deb Raj Badal	1	2023
705	Deterministic Landslide Hazard Assessment in Daunne-Dumkibas area,Nepal.	Nimesh Bhattarai	1	2023
706	Characteristics of Doon Soil as Shallow Foundation in Bharatpur Metropolitan City,Central Nepal.	Samina Khatun	1	2023
707	Deformability Analsis of Rock Mass by Plate Jacking Method A Case Study of Nalgad Hydroelectric Project.	Surendra Timilsina	1	2023
708	Effect of the Bedding Plane of Rock Mass on the Propagation of Blast Induced Ground Vibration and Its Impact on Surface Structure.	Sudip Kattel	1	2023
709	Geological and Structural Evolution of the Lesser Himalaya in Pokhara-Ghandruk area,Western Nepal.	Sanjeeb Pandey	1	2023
710	Artificial Recharge Zone Delineation Along the Manohara River of Kathmandu Valley,, Central Nepal.	Prativa Pokhrel	1	2023
711	Influence of Blastiong Design and Geotechnical Propertoes on Shape and Size Distribution of	Pratikshya Paudel	1	2023

	Blast Fragment in Tanahu Hydropower Project.			
712	Insitu in Assymentric Deformation of Large Underground Cavern of Tanahu Hydropower Project.	PrativaGhimire	1	2023
713	Study of Geo-Mechanical Structures of Holbang-Burtibang Section of Lesser Himalaya,Western Nepal..	Antim Kandel	1	2023
714	Morphometry and Morphodynamics of Bakiya River ,BaraDistrict Center Nepal.	Kishor Rimal	1	2023
715	Geological Mapping and Microstructural Analysis of Bhutekoshi Watershed, Central Nepal.	Subash Chaudhary	1	2023
716	Fluvial Morphomentry and Morphology of the Sayali Gad Basin,Doti District, Nepal Lesser Himalaya.	Sita Ram Ojha	1	2023
717	Study of Sands As natural Resource of Glass and Fine Construction Aggregates from the Karra River area,Makawanpur District,Central Lesser Himalaya	Saroj Pun	1	2023
718	Assessment of Quaternary Alluvial Pan Quartzite Gravel as Natural Resource for Concrete Pavement Aggregates from the Karra khola Basin,Makawanpur Districe,sub-Himalaya Central Nepal.	Suraj Aryal	1	2023
719	Study of Engineering Properties of Quartzites for Concrete Pavement Aggregates,Suparitar-Nubuwatar area,Central Nepal,Lesser Himalaya	Shiva Ram Maharjan	1	2023
720	Geology and Mineral Resources of Dolalghat - Kodari Section of Sindhupalchok District,Central Nepal.	Ronit Paudel	1	2023
721	Engineering Geological Investigation of Makwanpur Gadhi Landslide Along Kanti Rajpath, Central Nepal.	Samir Ghimire	1	2023
722	Hydrochemical Parameter Distribution of Springs in Khani Khola Watershed,Syangja Districe, Nepal.	Santosh Pokhrel	1	2023
723	Investigation of Springs and their Water Quality in Tilagupha Municipality of Kalikot	Dhirendra Prasad	1	2023

	District,Karnali Province Nepal.	Pandey		
724	Study of Engineering Properties of Fine Aggregates for Mortar of the Kali Gandaki River,form Beni to Devghat area.	Yamu Bhusal	1	2023
725	Study of Sands form the Lower part of Karnali River for Mortar.	Ganesh Sapkota	1	2023
726	Study of Relationship Between Slake Durability Index and Point Load Strength Index of Limestone form the ChandragiriLimestone ,Thankot- Chandragiri area,Central Nepal.	Rojina Chimouriya	1	2023
727	Impact of Industrial Effluent to tha Groundwater Quality in Gondrang area,Chitwan District, Nepal.	Sujata Koirala	1	2023
728	Study on the Relationship Between Point Load Strength Index and Los Angeles Abrasion Value of Limestones from the Chandragiri Limestone,Along Chandragiri-Chitlang Section, Central Nepal,Lesser Himalaya.	Sadhana Kharel	1	2023
729	Study on the Relationship Between Point Load Strength Index and Los Angeles Abrasion of Metasiltstone and Metasandstone from the Tistung Formation, Phulchauki Group of , Central Nepal,Lesser Himalaya.	Pranisha Karkee	1	2023
730	Assessment of Spring water resources and Water Security Condition of Biruwa Rural Municipality, Syangia Nepal.	Mahendra Thapa	1	2023
731	Study of Geological Structures in Malarani-Jhimrukh Section of Lumbini Province, Western Nepal.	Nirajan Pandey	1	2023
732	Groundwater Potential Mapping and Hydrogeochmical Assessment of Deumai Khola Watershed, Ilam, Eastern Nepal.	Dharmendra Angdembe	1	2023
733	Geological Study of the Pokhara valley and Adiacent Regions	Usha Dhungana	1	2023
734	Assessment of Soil Loss Using Gis and Rusle Model in Bakiya Khola Watershed Central Nepal.	Sujan Bista	1	2023
735	Groundwater Potental Mapping Characterization	Pratik Dangi	1	2023

	and Discretization of Factors for Groundwater Occurrence and Hydrogeological Study of the Phakphokthum Watershed, Ilam Eastern Nepal.			
736	Study of Recent River Sands for Engineering Properties Relevant to Suitability Analsis of Fine Aggregates from the Arun-Koshi River, Eastern Nepal,Terai- Lesser Himalaya.	Prashan Chamling Rai	1	2023
737	Estimation of Resource of sand and Gravel Deposits from Southern Karra khola Basin,Makawanpur District, Central Nepal Sub-Himalaya.	Amit Bhandari	1	2023
738	Analsis of Blast Vibration Effects on Cut Slope by Displacement: A Case Study of Right Bank Cut Slope of Main Dam Tanahu Hydropower Project.	Prithvi Bir Thapa	1	2023
739	A Comparative Assessment of Frequency Ratio Model and Analytical Hierarchy Process for Landslide Susceptibility Mapping of Dharan Sub- Metropolitan, Sunsari, Nepal.	Manish K.C	1	2023
740	Spatial Variation on Hydrogeochemical Parameter in the Hetauda Valley,Central Nepal.	Devaki Kafle	1	2023
741	Morphological Change Analysis of the East Rapti River Using Remote Sensing and GIS	Shiksha Khatiwada	1	2023
742	Hydrogeology of the Central Hetauda Valley with Emphasis on Groundwater Flow.	Urusha Gautam	1	2023
743	Deforamtion of Hydropower Tunnel Emphasis on Squeezing; A case Study of Gharkhola Hydroelectric Project, Myagdi, Nepal.	Mahendra Acharya	1	2023
744	Doon Soil Strength Using Dynamic Cone Penetration Test and Feasibility Study for the Urban Planning in Prithivinagar, Nawalpur.	Prakash Bhusal	1	2023
745	Predicting Subsurface Groundwater Inflow in Tunnel Through Surface Hydrogeological Assessment with Special Reference to Headrace Tunnel of Upper Trishili-3B Hydroelectric Project.	Shristi Mishra	1	2023
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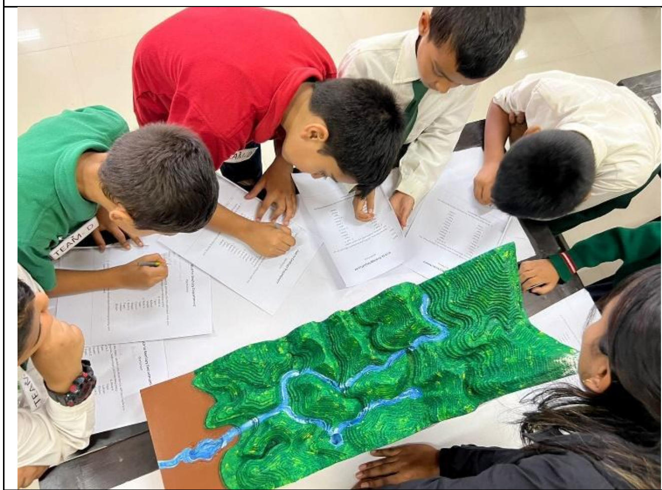
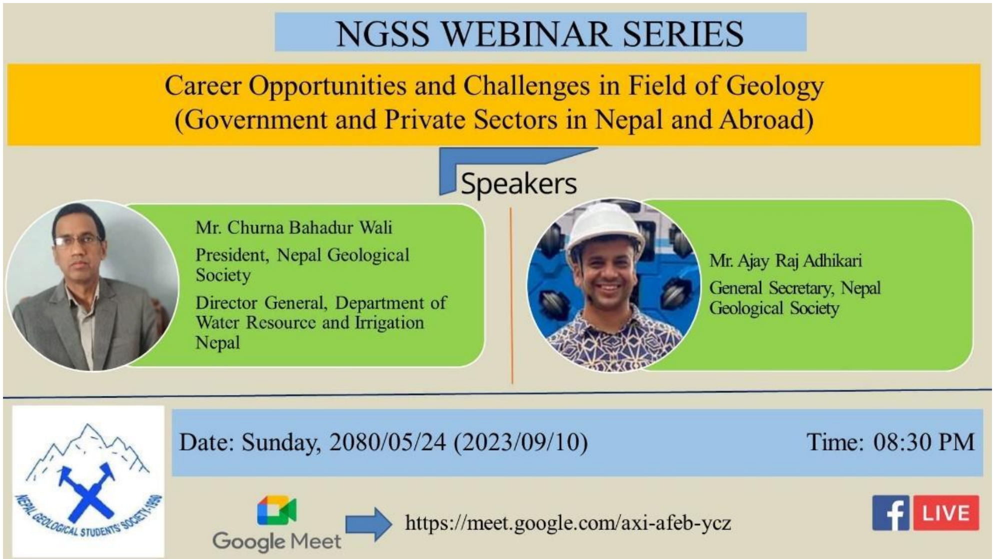
747	Assessment of the Engineering Properties of Banepa Clay.	Keshav Bhattarai	1	2023
748	Landslide Susceptibility Assessment in the Rapidly Urbanising Northern Kathmandu Valley.	Ankit Dhakal	1	2023
749	Morphological Change Analysis of the Narayani River Using Remote Sensing and GIS	Samiksha Sapkota	1	2023
750	Characterization of Seasonal Variation of Spring in the Central Part of Dhulukhel Municipality,Kabhrepalanchok District.	Sachina Neupane	1	2023
751	Geological amd Geophysical Study of Haku Landslide, Rasuwa Nepal.	Hari Ram Dangi	1	2023

NEPAL GEOLOGICAL STUDENTS' SOCIETY 25TH COMMITTEE PROGRAMS

1 एकदिवशिय भूविज्ञान परिचयात्मक प्रदर्शनी

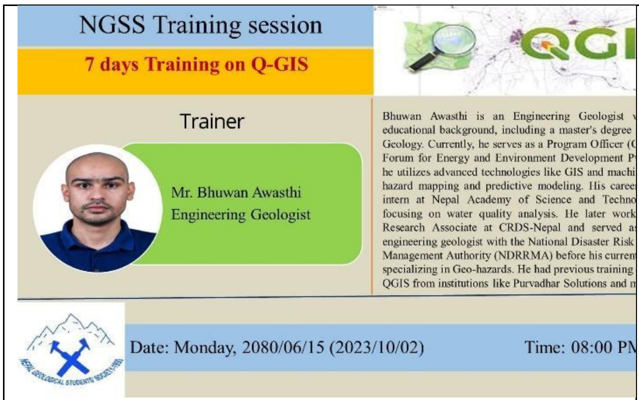


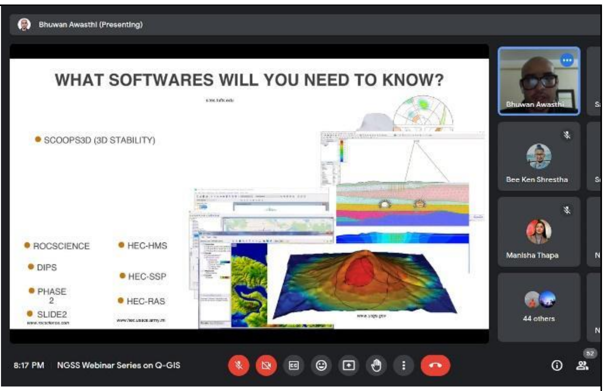
2 Career Opportunities and Challenges in Field of Geology (Government and Private Sectors in Nepal and Abroad)

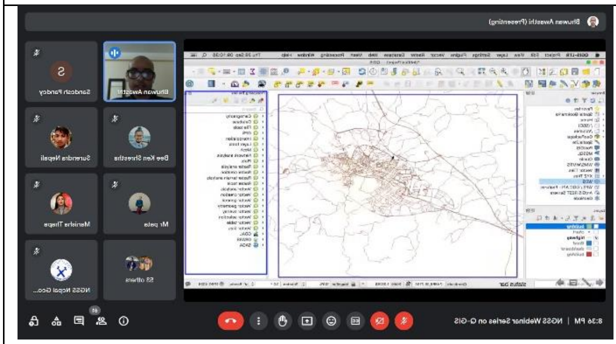


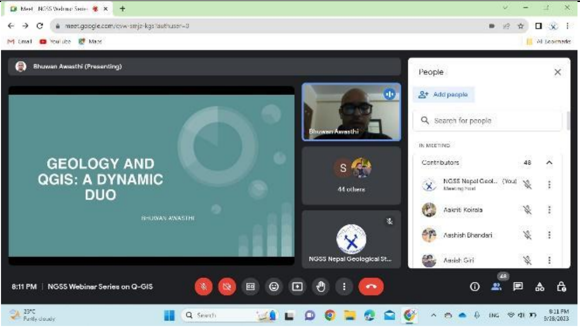
3 Program on Scientific Paper Writing Skills

4 An Introduction to QGIS

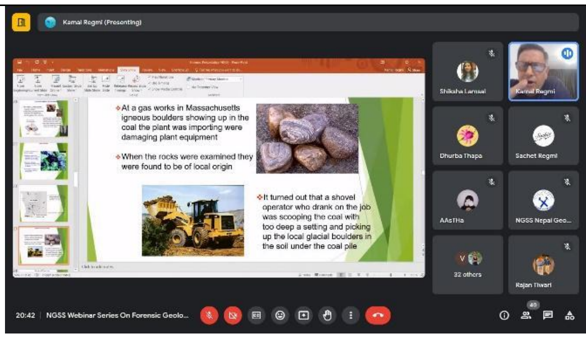


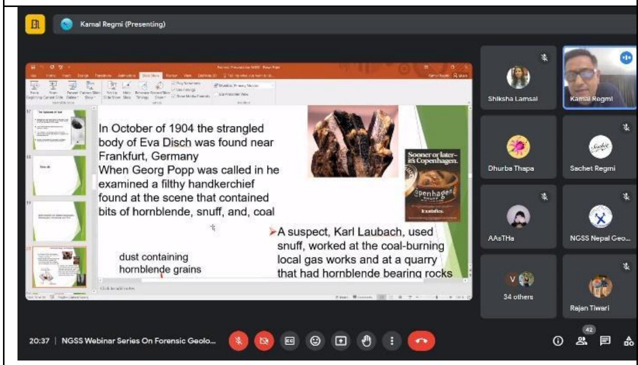






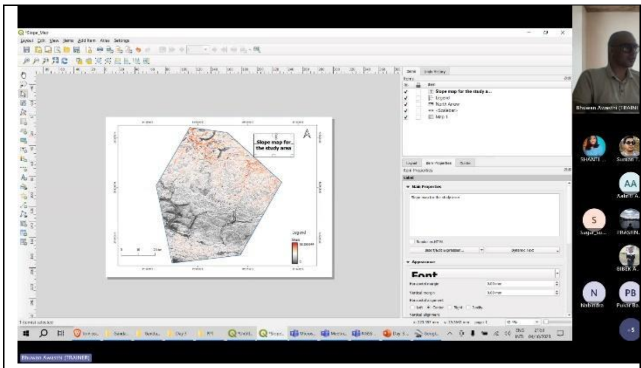
5 Forensic Geology-An Introduction

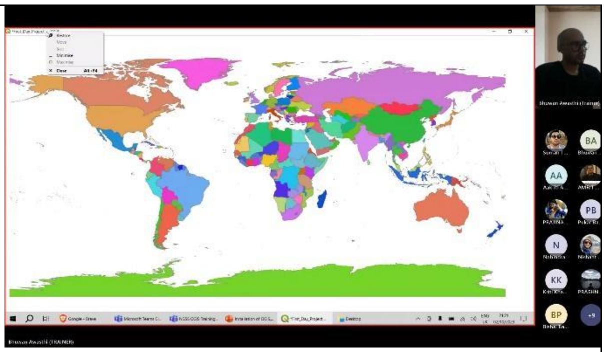


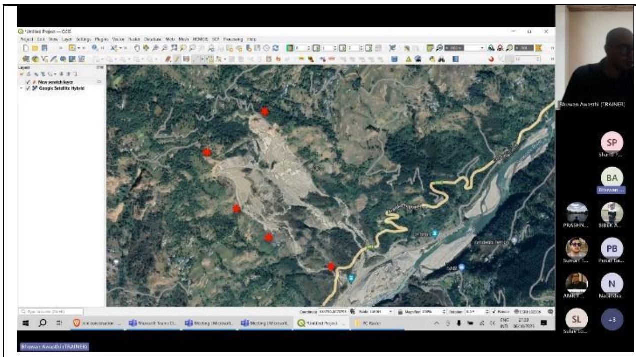


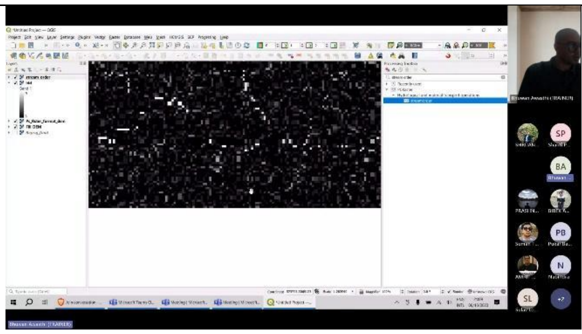
6 Student Awareness Program on Geology and Natural Disaster

7 Training: The Fundamentals of Q-GIS and Remote Sensing

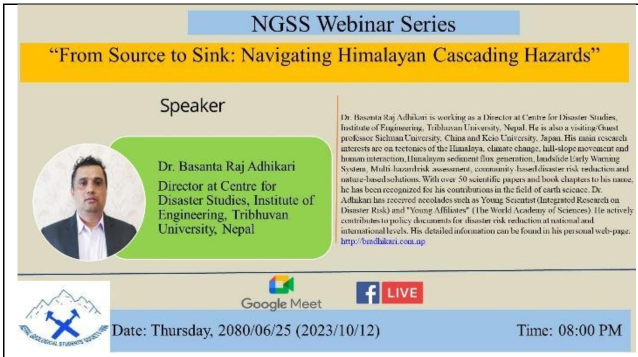


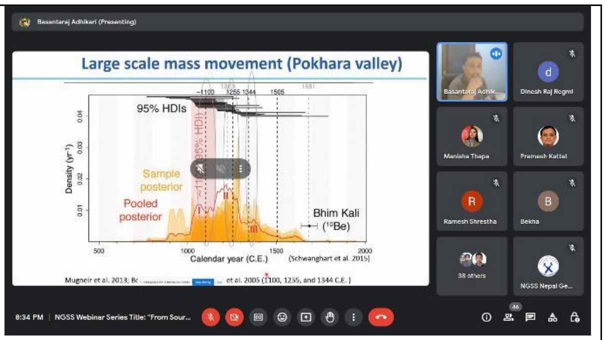


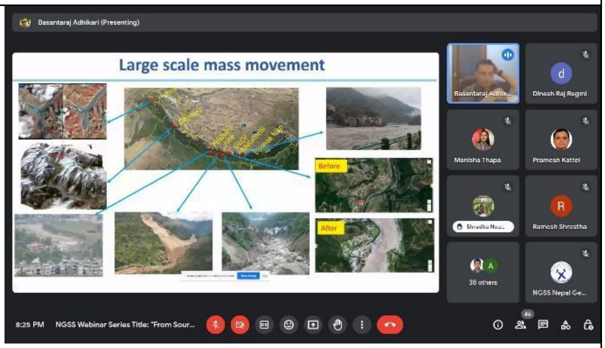




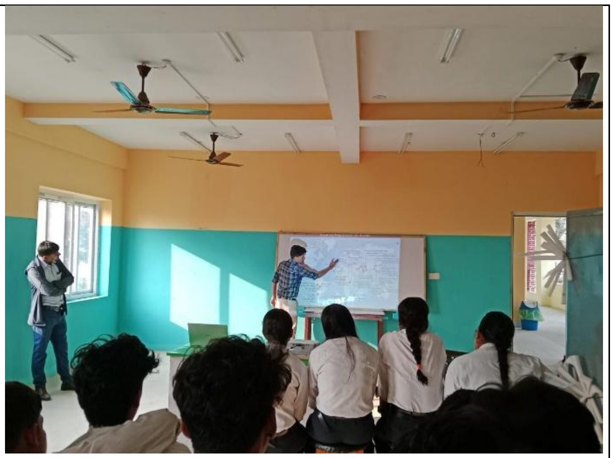
8 From Source to Sink: Navigating Himalayan Cascading Hazards







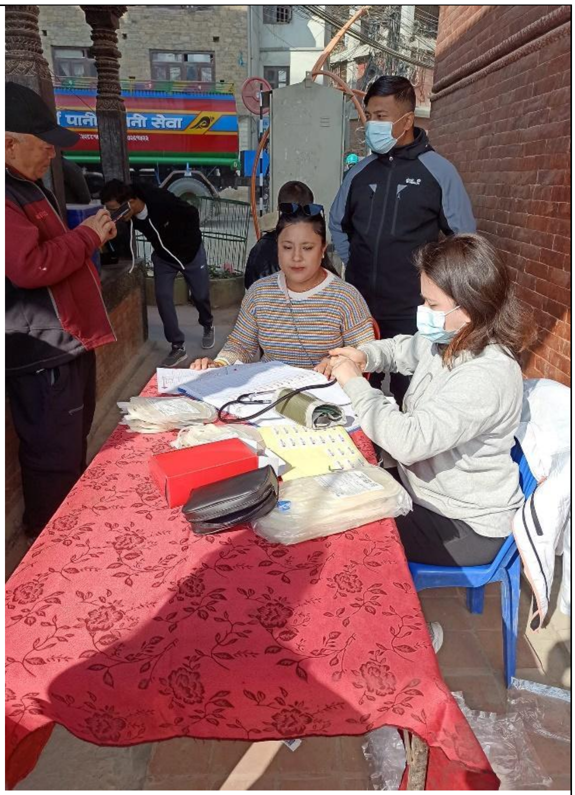
9 Frequent earthquake reoccurrence in Nepal, it's Causes and Prevention



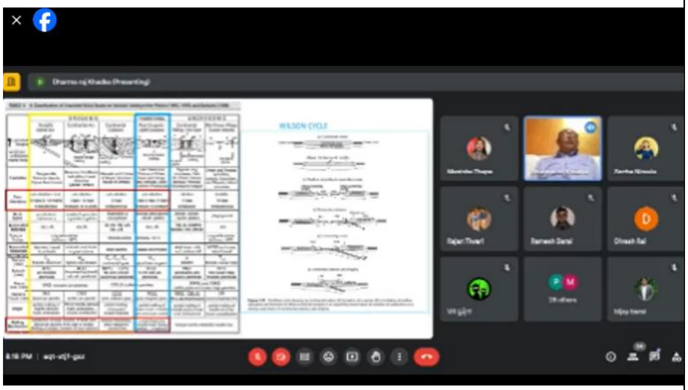
10 'Understanding earthquakes: Causes, Effects and Safety Measures

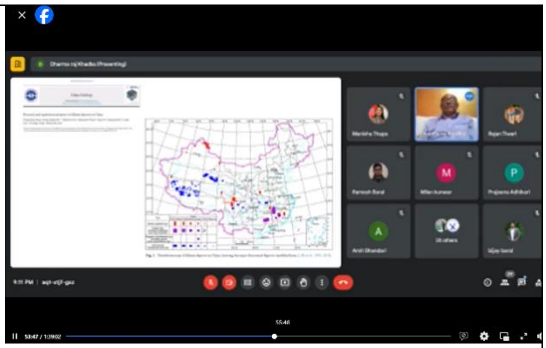
11 Natural Disasters in Nepal, it's Causes and Prevention

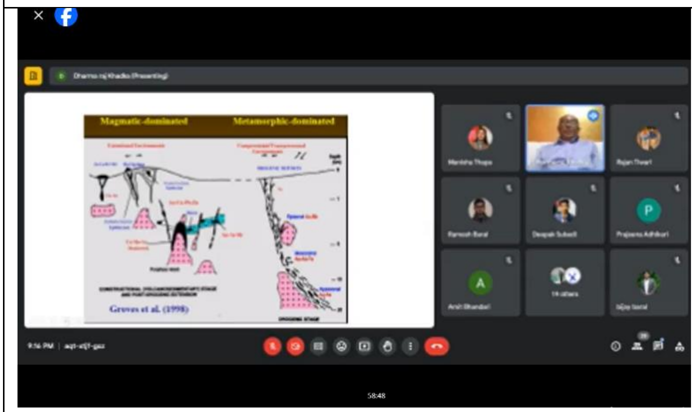
12 10TH LATE RTR. SACHIN MEMORIAL NATIONWIDE BLOOD DONATION PROGRAM



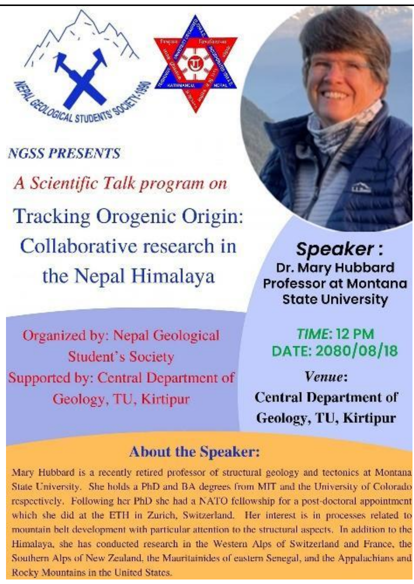
13 Critical Aspects of Mineral Exploration Targeting





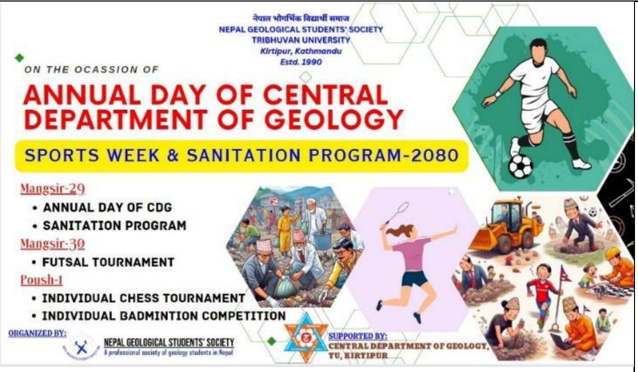


14 Tracking Orogenic Origin: Collaborative research in the Nepal Himalaya



15 ANNUAL DAY CELEBRATION OF CENTRAL DEPARTMENT OF GEOLOGY: SANITATION PROGRAM, FUTSALL TOURNAMENT, INDIVIDUAL CHESS TOURNAMENT AND INDIVIDUAL BADMINTION COMPETITION

SANITATION PROGRAM


नेपाल भौगर्भिक विद्यार्थी समाज
NEPAL GEOLOGICAL STUDENTS' SOCIETY
TRIBHUVAN UNIVERSITY
Kirtipur, Kathmandu
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Mangsir-29
• ANNUAL DAY OF CDG
• SANITATION PROGRAM
Mangsir-30
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16 Physical Mock Test

NGSS Physical Mock Test Result	
General Geology and Engineering Geology	
Symbol NO:	Obtained Marks
25	38
21	49
31	45
43	40
2	42
35	56
8	52

17 Earthquake Awareness Program organized by Chandragiri Municipality

२६औं भूकम्प सुरक्षा दिवस
Earthquake Safety Day

प्रशंसा-पत्र

श्री नेपाल भौगर्भिक विद्यार्थी समाज

२६औं भूकम्प दिवसको अवसरमा मिति २०८० माघ २ देखि ३ सम्म चन्द्रागिरि नगरपालिका-१४ नैकाप फुटबल मैदानमा आयोजित **भूकम्प सुरक्षा प्रदर्शनी** मा सहभागी हुनु भएकोमा यहाँको सक्रिय सहभागिताको कदर स्वरुप स-धन्यवाद यो प्रशंसापत्र प्रदान गरिएको छ ।

मिति : २०८० माघ ३ गते, मंगलबार
स्थान : नैकाप फुटबल मैदान, चन्द्रगिरि नगरपालिका १४

घनश्याम गिरी
नगरप्रमुख तथा मूलसमारोह समिति
सभापति
चन्द्रगिरि नगरपालिका

18 On behalf of the 25th Executive Committee Congratulations to the newly appointed Department Head

19 Saraswoti Puja Celebration, Welcome Programme for Newly Admitted Students


त्रिभुवन विश्वविद्यालय
भूगर्भ शास्त्र केन्द्रीय विभाग
TRIBHUVAN UNIVERSITY
CENTRAL DEPARTMENT OF GEOLOG

20 Election Of 26th Committee of NGSS

21. Farewell for 2076 batch and handover program

ARTICLES

AN OVERVIEW ON SELENOLOGY

Anushka Gyawali*

Central Department of Geology, Tribhuvan University, Kritipur, Kathmandu Nepal

*Corresponding Author E-mail: iamanushkagyawali@gmail.com

ABSTRACT

This article deals with the geology of the moon and its ongoing studies to find out the surface and subsurface characteristics of this celestial body. This articlefocuses on lunar stratigraphy, about the moon's physiographic division; the volcanism on the moon which led to the deposition of the materials that form the surface materials from the history to the present and causes that relate to moonquakes. The Moon has been a witness to the history of the Solar System for more than 4.5 Ga, making it essential to understanding planetary dynamics on Earth and in our Solar System.

Keywords: *Volcanism, Rifts, Moonquakes, Tidal Stress, Seismometer, Stratigraphy,*

1. Introduction

The geology of the lunar surface has always fascinated the mankind over and over, over the years. Its complex geology has been a talk of decades and never fails to astonish the scientists. This article gives an account of some of the researches that were done about this celestial body relating to the volcanism and quakes. A brief history for the basis of the formation of stratigraphic units in the moon is discussed later on the article.

2. Objectives

The major objectives of this article are:

- To learn about the rifts that has formed in the moon due to volcanism.
- To know about the causes of moonquakes.
- To study the stratigraphy of the moon.

3. Methodology

This article is entirely based on the secondary research. Various papers, books, web articles, newspapers and internet were used to meet the proposed objectives. The ideas were then assembled together.

4. Result

4.1 Volcanism on the moon

The moon seems to have a volcanic history of about 4600 million years. Various rifts on the lunar surface have been observed. The largest lunar mare, "Oceanus Procellarum" (Fig: 1) which spans through the NW quadrant of moon's near side was originally supposed to be an asteroid impact which occurred over than three billion years old. For years' this hypothesis was into account.

However, according to the data used by researchers from NASA's Gravity Recovery and Interior Laboratory (GRAIL) mission which ended later in 2012, gave an astonishing result which reflects data of the gravity maps from a pair of satellites that revolved around the moon about 34 miles high from the surface, showed the area that was flooded by extensive rift system. The Oceanus Procellarum a relatively flat mare with its width stretching up to 1800 miles and the volcanism is dominated by basaltic lava.

The analysis of the data given by GRAIL's twin spacecraft, and recent mapping on its edges, suggests that it is bounded by extensive rift system which is 3 billion years of age and has produced outpouring of lava that flooded the area of Oceanus Procellarum to produce a relatively smooth surface that it has today. (Nature, October 1 2014).

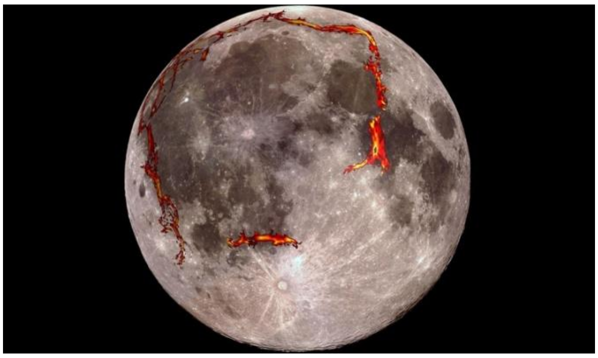

Fig: 1 Oceanus Procellarum [Source: The journal 'Nature']

4.2 Moonquakes

4.2.1 Early analysis of the moonquakes

After analyzing the data from Apollo missions 11, 12, 14, 15, 16(the Apollo 11 seismometer had operated only for three weeks. However, the other four are still working). As per their data, 28 shallow moonquakes were recorded from 1969- 1977 where the tremors ranged from 2- 5 Richter scale. The scientists from Max- Planck Institute for Solar System Research, have mentioned 210 tremors that were previously unknown, have been uncovered by analyzing the data from the Apollo missions (Daily mail, September 25 2015). Since the cause and source of the tremors that have been recorded are different, the quakes in moon highly differ from that of the Earth. The moonquakes have been divided into four different categories according to the depth of the areas where tremors are felt.

a. Deep: This kind of moonquakes, occur at the depth of about 700 km from the surface. This is caused by the influence of surficial tides as per the result of its link with the Earth, around its orbit.
b. Meteoroids: This second type of moonquake is mainly caused by the crashing of meteorites that acts as a leading agent of vibrations within the surface of the moon by any external agent.
c. Thermal: After every two weeks of lunar nights and deep freeze temperature, the morning sun causes the expansion of moon's crust materials which leads to the cracking on the crust.
d. Shallow: This type of moonquakes occurs at shallow depths of about 20-30 km from the lunar surface.

Among these four types, the first three are examined to be mild whereas the fourth one is the type which resulted to 5.5 scaled quakes. Then, after almost two years, the same newspaper journal published a new in August 31 2017, stating that the strange events of quakes on the moon followed a specific timing. The timing of the moon to orbit the Earth. Thus, the researchers deduced, for the origin of the quakes, the sole reason was 'tidal stresses'. When the researchers placed the results of two different Apollo mission for the study in the Journal of 'Journal of Geophysical Researches: Planets', they found some strange findings about the seismic activates going on around the moon. The result gave a total of 13000 quake records on the moon. Since 1977, these many tremors ranging from minute ones to 5.5 Richter scale have been recorded on the seismometers.

So, this concluded that the prime cause of the quakes was 'tidal stresses'. The tidal force causes Earth to bulge on the side closest and farthest from the moon. Similarly, the same force causes some sort of distortion on the moon which eventually leads to cracks or faults which rubs against each other with each successful built up of tidal stress and results in moonquakes.

4.2.2 Recent studies about the moonquakes

The recent studies about the ongoing tremors about the moon quakes, have a different story to tell about the moon and the activities that are ongoing on the lunar surface. Although the universe is getting vast and broader every day, the moon has been evident to prominent shrinking because of its interior cooling as published by NASA in May 13 2019. The researchers proposed that the moonquakes, supposedly were the result of some prominent lunar thrust fault scraps (Fig: 2) because some minor areas of these fault scraps were near the tremor region during the quake. The researchers discovered that around 25% of the moonquakes were likely generated by released energy from these faults, rather than by asteroid impacts or activity deep inside the moon, the scientists reported. "You don't often get to see active tectonics anywhere but Earth, so it's very exciting to think these faults may still be producing moonquakes," co-author Nicholas Schmerr, an assistant professor of geology at the University of Maryland, said in a statement.

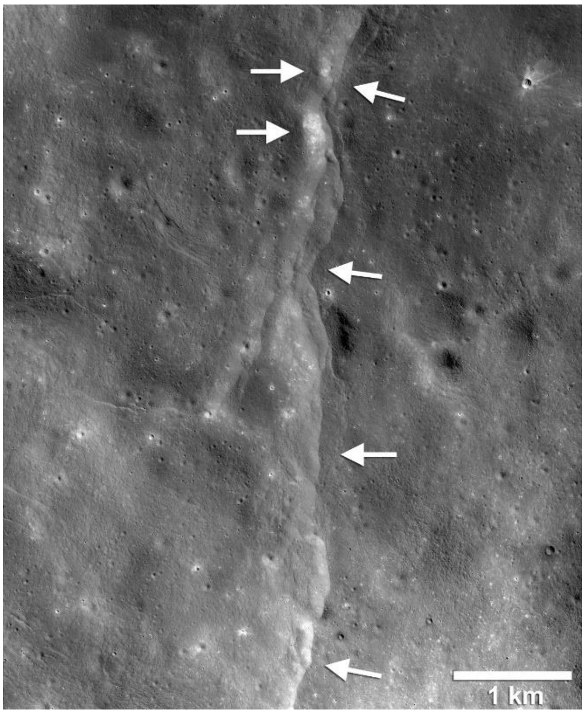

Fig: 2 This prominent lunar lobate thrust fault scarp is one of thousands discovered in Lunar Reconnaissance Orbiter Camera (LROC) images [Source: NASA]

4.3 Stratigraphy of the moon

As suggested by Galileo in 1610, there are two divisions of landforms in the moon. The mare and the terra. The Apollo mission15, 16 and 17 were sent on the mare which are the lowlands. These lowlands do not have the same altitude throughout the surface of the moon. For e.g.: Mare Crisium and Mare Smythii are extremely lowlands about -5 km but Oceanus Procellarum is only about -3 to -2 km low from its surrounding highlands.

History of the proposed stratigraphy of the moon:

On the earlier studies, the craters that ranged from few micron pits to giant crates of the size of Imbrium basin (a mare basin on the lunar surface) were used to stratigraphically classify the moon and the lunar deposits. After the course of time, there were few assumptions made by some of the professionals which are as follows:

- Gilbert (1893) realized that the circular Imbrium basin was an impact generated by a radially disposed and sculpted ejecta blanket. Now, this is which was made a basis for the stratigraphy of the moon during the time.
- Barrel (1927) proposed that the superposition in the moon could be established as the means of lunar stratigraphy.
- Spurr (1944- 1949) and Khabakov (1960) collectively gave the idea of lunar time divisions. Spurr studies the structural, Igneous and depositional events on the moon and Khabakov studied the topographic differences on the surface to give a unified proposed basis for stratigraphy.
- Shoemaker and Hackman (1962) gave the basis of the stratigraphy of the moon which exists till now. Their study is based on the south of the mare Ibrium basin to the vicinity if a crater Copernicus where the stratigraphic relations among various ejecta blankets are clear. They thereabout identified five stratigraphic units on the moon, which in decreasing order of their geologic ages, are given below:
    - Pre- Imbrian material: The main Pre-Imbrian units are undivided materials on the lunar crust in raised arecs concentric with mare basins, complex units in interbasin areas and crater materials.
    - Imbrian system: The topography on the Imbrain is unique and it is the oldest and widely exposed stratigraphic unit in the Copernicus region. It is gently a rolling surface studded in most spaces with close- spaced low hills and interventing depressions generally ranging from 1 to 4 km across.
    - Procellarium System: This system in the Copernicus region, forms the relatively smooth dark floors of the

Oceanus Plocellaru, Mare Imbrium and Sinus Aestuum and rests stratigraphically on the Imbrium System.

- Erathosthenian System: This system comprises the rim deposits surrounding the Eratosthenes, Reinhold, Landsberg and a number of small craters and the material that occupies the floors of these craters.
- Copernican System: The Copernican System is the stratigraphically highest system in the Copernicus region includes several mappable units. The most extensive units of this system are rays and rim deposits of the crater Copernicus and rays of several small craters.

5. Discussion

The result of the research suggests that the physiography of the moon as similar to the Earth and its interior, has shown some behavior that resembles many other celestial bodies that embark on the solar system. The only difference in the activities could be the intensities of which an action takes place in the Earth and the Moon.Some of the important findings of this research were as follows:

- Volcanism has produced some of prominent domes on the moon. Marius Hills is the largest volcanic dome which is a part of Oceanus Procellarum.
- Since the cause and source of the tremors that have been recorded are different, the quakes in moon highly differ from that of the Earth.
- Even though the Earth and the Moon were formed in different geological time frame, the method of stratigraphical division of moon units are somehow similar to the Earth where, on both cases, the stratigraphical units are separated by the difference in age of the formation of these very areas.

8. Conclusion

This article gives a pinch of idea about the plate tectonics and quakes that have been found to exist on the surface of the moon. Also, the lunar surface has been divided into various stratigraphic units according to the physiographical age of the formations. Various researches are being done now and then to find some strong supporting statements for all the proposed theories that could also help for colonization of the moon which seems rather impossible in course of the recent studies.

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ASSESSMENT OF RAW MATERIALS USED FOR A CERAMICS TILE BODY COMPOSITION AND THEIR AVAILABILITY IN NEPAL HIMALAYAS

Samyog Khanal*, Kulmani Parajuli

Central Department of Geology, Tribhuvan University, Kritipur, Kathmandu Nepal

*Corresponding Author E-mail: *samyogkhanal2017@gmail.com*

ABSTRACT

There are various types of tiles available in the Nepalese Market with different prices according to their quality. The theme of this paper is to list the raw materials used for tile body composition and their availability in the Nepal Himalayas. In other words, investigate the probable formations for the availability of raw material in the Nepal Himalayas. The required raw materials like plastic raw materials, flux raw materials, and inert raw materials were available in the different zones of the Nepal Himalayas. Plastic raw materials are present in the Siwalik, flux raw materials are present in some igneous intrusion form, and inert raw materials are available in the Lesser Himalaya zone of Nepal. The material color, water absorption, shrinkage, loss of ignition, and their chemical compound play an important role in the quality of raw materials.

Key Words: *Plastic, flux, and inert raw materials, Physical Properties*

Introduction

A tile body is defined as a mixture of composition of different inorganic materials originating from minerals present in raw materials (Bertolotti, 2014). The commercial classification is described as white and red burning bodies for making wall and floor tiles (Bertolotti, 2014). In Nepal, tiles are used for multiple purposes, deeply ingrained in contemporary and traditional architectural practices. The cultural motifs and religious symbols were used in showcasing Nepali homes and temples adorned with intricately crafted tiles. In today's generation tiles are integral parts of modern construction, employed in flooring, roofing, and wall cladding. The tourism industry benefits from the use of tiles in hotels and resorts, adding to Nepal's allure as a destination rich in cultural heritage and architectural splendor. Tiles in Nepal not only serve practical functions but also contribute to the country's aesthetic and cultural identity.

Therefore, the production of tiles in Nepal holds significant importance. It supports the construction industry, homes, and commercial spaces, and drives economic growth (Budhathoki et al., 2018). The production of local tiles reduces the import dependency, promoting self-sufficiency and bolstering the domestic industry. Tile production preserves Nepal's rich heritage and promotes cultural identity by incorporating traditional craftsmanship and cultural motifs (Gautam et al., 2016).

Raw Materials

The main raw materials used in the tile production can be divided into the following classes:

a) Plastic raw materials

Clays and Kaolins are plastic raw materials that help ceramic products shape and give enough cohesion to the body during production.

b) Flux raw materials

Feldspars, Feldspathic sands, and Feldspathoids are flux raw material that permits glass phase formation and accelerate chemical and physical transformation during the firing process. At lower temperatures, they act as inert structural materials.

c) Inert raw Materials

Silica sand and quartz are inert raw materials that help to reduce body plasticity and help to control shrinkage of the products, during firing together with clays, giving structure to the ceramic body.

d) Other raw Materials

Talc, Dolomite, and, calcite work as corrective components to reach body-specific characteristics.

Kaolinite Plastic Clays

Kaolinite plastic clays are also called Ball clays. These are clays in which kaolinite clay minerals are prominent. They are generally dark grey until black in the unfired state because of organic impurities, but burn white or light colored. It has a large portion of Kaolinite but also contains an illite and impurities in small amounts. These are sedimentary clays that originated from the weathering of pre-existing kaolinized rocks. They are derived from the transportation and deposition of these sediments, mixed with other clay minerals, and, gravels, and organic materials, in lake or delta basins. 30-50% kaolinite, 25-35% illite/mica, and 15-35% quartz are three dominant minerals obtained from the ball clays. The particle size distribution is generally fine, so interestingly plastic behavior can be expected. Ball clays are used in whiteware production to make the body more plastic and workable.

Light-burning plastic clays

They are generally white-burning illitic-kaolinit clays. They are similar to the ball clays but contain lower kaolinite content. 30-50% kaolinite, 25-40% illite/mica, and 10-25% quartz is the mineral composition. The color after firing is light when Fe_2O_3 and TiO_2 content is lower than 1.5%.

Light-burning medium-low plasticity clay

These are non-carbonaceous, silicious clay with low to medium plasticity with good bending strength values after pressing. The mineral composition in these clays includes 20-40% illite/mica, 15-30% kaolinite, and 35-55% quartz.

Kaolins

Kaolins are also called China clay. It is a white plastic clay primarily consisting of kaolinite associated with small quantities of minerals like feldspar, mica, and quartz. It generally consists of a loose aggregation of randomly oriented stacks of kaolinite flakes. Kaolins are deposited by the process of alternation, or kaolinization of feldspar-rich rocks such as granite or gneiss by the hydrothermal and/or weathering process. The mineralogical and chemical composition of the kaolins depends on the nature of the parent rock and the type of alternation process. These clays are white firing under oxidizing conditions. The refining treatment is being commercialized for the kaolin deposits to meet users' requirements.

Figure 1: Kaolin developed from the weathering of feldspar.

Thus, chemical and mineralogical treatment is done for the kaolin deposits. The treatment process includes reducing the possible accessory minerals such as quartz, feldspars, and other impurities to increase the material’s kaolinite content. Kaolins play an important role in increasing the percentage of alumina in the ceramic body.

Red-burning plastic clays

They are clays that contain enough flux to fire at comparatively low temperatures between 1100 to 1150° C. They are plastic so they don’t show too much shrinkage after firing. These are carbonate-free materials. They show a red to brown color after firing. These materials give plasticity to the body composition with good bending strength values after pressing, after drying, and after firing.

Red-burning middle–low plasticity clays with carbonates

These materials show illite-chlorite and sometimes illite-kaolinite with also the presence of montmorillonite mineralogical associations. Carbonate content in the material is variable and it can also reach very high values sometimes. The main plasticity of the body is provided by these materials. Due to the presence of iron minerals after firing they present an orange-hazel colour.

Feldspar and feldspar sands

Chemically, feldspar is a silicate of aluminium, containing sodium, potassium, calcium, iron, barium, or a combination of these elements. The minerals of which the composition between Albite and Anorthite are known as the plagioclase feldspars, while those comprised between Albite and Orthoclase are called the alkali feldspar.

Feldspar is abundant in igneous rock like granite, which contains up to 50 or 70% of alkali feldspar. A whole range of rocks geologically connected to granite are usually used in ceramic production. The two properties that make feldspar very useful for the ceramic industry are their alkali and alumina content.

The feldspar helps in the formation of the vitreous phase and accelerates the chemical and physical transformation of the particles during the firing process. At lower temperatures acts as an inert structural material structure and facilitates the effusion of the volatile compounds that arise during firing. It also helps to reduce and control the thermal expansion coefficient of a ceramic body.

Figure 2: Feldspar developed from the weathering of granite.

Quartz and silica sand

To facilitate the effusion of the volatile compounds that arise during the firing quartz and silica sand are introduced into the composition as a filler. Quartz is used for adjusting the thermal expansion coefficient, which increases proportionally to the quantity present.

Figure 3: Quartzite contains more than 90% of silica.

Carbonates

Calcite and dolomites are fundamental materials for the tile bodies used to control the shrinkage of porous products. Especially particle size distribution before and after grinding plays an important role. Very fine particle sizes favor both decarbonation reactions and, at a later stage, the synthesis reaction with residues of original clayey minerals. Very important are decarbonation kinetics and especially the complete ejection of the gas (CO_2), before softening of the surface glaze.

Talc

Talc added in a limited percentage in the body composition less than 5%, favours the eutectic reactions of the body acting as an energetic flux in low water absorption bodies fired at high temperatures.

Parameters affecting the quality of raw materials and a tile body composition

The simple method to control quality is to compare small samples of the raw materials with the standard quality firing them in an industrial kiln or if available in a muffle kiln. The following parameters affect the quality of the tile body:

a) Colour

Special laboratory equipment is available to compare and evaluate the color and ton of the fired material, the simple way is to compare with the standard one. A darker color with the same shrinkage and water absorption means that iron and titanium content is higher than the standard.

b) Loss on ignition

The samples are weighed, properly milled dried, and then fried in a muffle kiln at 1100̊C for 1 hour at the maximum temperature. The weight difference before and after firing (P2) divided by the initial weight (P1) and multiplied by 100 gives the loss of ignition(Hamisi et al., 2014).

L.O.I [%] =100*(P1-P2)/P1

c) Shrinkage

The samples are measured only after being fired and the shrinkage is calculated on the difference in dimension about the die cavity(Das et al., 2005).

S [%] = 100*(D1-D2)/D1

Where,

D1= die cavity dimension

D2= Dimension of tile after firing

d) Water absorption

The tiles are weighed, immersed in water, and boiled for a two-hour time; afterward, they remain in the water for a further four hours and are successively wiped with a damp cloth and weighed again. The formula to calculate the percentage of water absorption is:

E [%] = 100*(P2-P1)/P1

Where,

P2= final weight of the tile (after absorption)

P1= starting weight of the tile (before absorption)

e) Moisture content

Weight the amount of powder to be checked to the nearest 0.1 g (A). Dry the sample in a drying oven for at least 4 hours until a constant weigh is reached, then weigh it again as quickly as possible, to the nearest 0.1 g (B). Calculate the percentage of free moisture, on the dry-mass weight and to the nearest 0.1 percent as follows:

Free Moisture % = [(A-B)/A] *100

Availability In Nepal Himalaya

The Himalayan region, including Nepal, is known for its diverse geological formations, which can include various types of clay, kaolins, feldspars, feldspathic sands, feldspathoids, quartz, silica sands, calcite dolomite and talc. However, specific information about the availability of raw materials in Nepal's Himalayan region might require more detailed geological surveys or studies conducted by experts in the field.

a) Plastic raw materials

Clay deposits are often found in sedimentary rocks and can be formed from the weathering and erosion of various types of rocks, including granite, shale, and volcanic ash. Kaolin, a type of clay known for its use in ceramics and other industries, is typically found in areas with specific geological conditions, such as regions with weathered granites. Igneous intrusion areas and shales and mudstone from Siwalik are probable sources for the plastic raw materials.

b) Flux Raw Materials

Feldspar minerals including feldspathoid minerals, are commonly found in various geological formations in the Himalayan region of Nepal. These minerals are important components of many types of rocks, such as granite, gneiss, and pegmatite. Igneous granite intrusion and gneiss of the higher Himalayas are probable sources of flux raw materials. Feldspar minerals can also form through the metamorphism of existing rocks. Intense tectonic forces have caused the regional metamorphism of sedimentary and igneous rocks, leading to the formation of metamorphic rocks such as gneiss and schist, which may contain feldspar minerals.

c) Inert raw Materials

Inert raw materials like quartz, and silica sands were present in metamorphic rocks formed through the alternation of the pre-existing rocks due to heat, pressure, and chemical processes. Rocks like quartzite, schist, and gneiss, which are prevalent in the Himalayas, often contain high concentrations of silica. The Nepal Himalayas are complex geological regions where various processes contribute to the presence of silica in different forms.

Conclusion

In assessing raw materials for ceramic tile production in the Nepal Himalayas, common constituents like clay, silica, feldspar, and fluxed are essential. The region boasts abundant clay deposits, particularly in river valleys and terraces, providing a stable source for tile production. Silica, typically sourced from quartz, is also important in the Nepal Himalayan region. Feldspar, essential for fluxing, might require some exploration but is likely available. The Nepal Himalayas offer ample clay, silica, and feldspar for ceramic tile manufacturing, further exploration and potential importing of certain flux materials might be necessary to ensure a comprehensive and sustainable supply chain for the industry in Nepal.

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BIOENGINERRING IN THE CASE OF NEPAL'S TOPOGRAPHY

Saurav Koirala*

Central Department of Geology, Tribhuvan University, Kritipur, Kathmandu Nepal

*Corresponding Author Email: koiralasaurav061@gmail.com

ABSTRACT

In Nepal, bioengineering has shown to be successful in stabilizing soil and decreasing erosion on slopes of hills and riverbanks through the integration of biological, mechanical, and ecological principles. This method is especially useful for shallow-seated landslides. Since the beginning of the 1980s, this method for constructing using material and plants has been employed on several notable projects, such as the Dhankuta highway with international backing, the Lamosangu- Jiri highway, and the Dharan- Dhankuta road. While bioengineering techniques like jute netting, turfing, bamboo planting, shrub and tree seeding, brush layering, and live check dams are effective for shallower slides, they are often necessary for deep-seated landslides, which call for civil engineering solutions. These techniques improve soil stability by binding the soil with plant roots and stems, enhance infiltration, and reduce runoff. Regular upkeep and monitoring are necessary for successful bioengineering projects. This includes inspections, vegetation control, removal of invasive species, and performance monitoring with tools such GIS and remote sensing.

Keywords: Bioengineering, Soil stabilization, Erosion control, Shallow-seated landslides

Introduction

Bioengineering is the application to achieve stability of soil mass and erosion on hill slopes and river banks. It's the combination of biological, mechanical, and ecological concept to reduce the erosion, protect soil and stabilize slopes using vegetation and construction materials (Allen & leech, 1997). Bioengineering is not an alternative structure it is a concept that goes hand in hand to address slope stability problem. In deep seated landslides, where the earth mass separates from deep inside the ground and the volume of the landslide is significantly large, civil engineers measures large supporting wall, extensive drainage measures and technological stability to unstable slope to make the slope more stable whereas shallow-seated landslide which make up 80 percentage of those in Nepal are treated largely with vegetation (Poudyal,2007).Generally, such types of landslides formed on encroachment of the natural slope and environment by human activities and drastically road-cut section to widen the roads. Some of the notable bio engineering measures that have been applied in Nepal so far are: (Poudyal, 2007). The concept of bioengineering in applied in Nepal at mid -1980s on the road section of Dharan – Dhunkuta road project.

It’s was later implement of the lamosangu Jiri highway in the central Nepal, with is built by the Swiss government. With the help of the British government, the UK-based Transport Research Laboratory engaged significantly in the introduction of bioengineering on a large scale on the Dhankuta highway in the eastern Dhara. They then made it easier for Nepali individuals and organizations to get the technology.

Photo: Krishna Bhir landslide along Prithvi Highway

The DOR is currently laying the groundwork for roadside slope bioengineering. Nowadays, bioengineering is employed by DOR's division offices throughout Nepal for the construction, maintenance, and upgrading of all highways, especially in the hilly and mountainous regions. Some examples of successful landslide restoration projects completed by the DOR are the Masot Khola stretch of Lamahi- Tulsipur road in the country's mid-west, the Dang-Surahi section of the East-West highway, and the Krishnabhir and Mungling- Narayanghat highway in central Nepal.

Importance of Bio-engineering Measures:

Bio engineering cannot treat all causes of slope failure. If possibility of slip is slight, vegetation can be planted. Some of the slope should require the civil engineering prospective to stabilize the failures. Bioengineering on slope to reduce the probability of failure by physically binding the soil by plant stems and roots. The flora absorb water and increase the properties of infiltration capacity of soil to reduce the runoff and flow velocity during high precipitation and increases the biological activities in the soil leading to better soil structure.

Some of the bio engineering techniques appropriate to Nepal are: (Howell, 1999)

Jute neeting

Trufing

Planting bamboo

Shrub and tree seeding

Bursh layering

Live check dam

Maintenance and measured

Bioengineering projects to be viable and successful over the course of time, maintenance and tracking are necessary. In bioengineering, soil, living plants, and other resources from nature are used to control runoff, stabilize slopes, and stop erosion. The following are essential elements of bioengineering project maintenance

Regular Inspections: Perform routine examinations to spot any indications of malfunction or damage. Conduct an inspection to determine the impact following major weather occurrences, such as storms or a lot of rain.

Vegetable Management: Make sure that plants grow healthily by providing the necessary amounts of water, fertilizer, and compost. Eliminate invasive species that have the potential to harm or out complete desirable plants. Trim vegetation to promote strong growth and preserve structural integrity.

Monitoring

Performance Monitoring: Track the effectiveness of bioengineering solutions in controlling erosion and stabilizing slopes. Use benchmarks and performance indicators to assess success over time.

Environmental Monitoring: Monitor environmental conditions, such as soil moisture, temperature, and nutrient levels, to ensure optimal conditions for plant growth. Track water quality parameters if the bioengineering project is designed for storm water management or riparian restoration.

Biodiversity Assessment: Assess the diversity and health of plant and animal species in the bioengineered area. Monitor for the establishment of native species and the control of invasive species.

Data Collection: Collect data on plant growth rates, root development, and overall vegetation health. Use remote sensing, drones, or GIS technology to gather comprehensive data over large areas.

Reporting and Documentation: Maintain detailed records of maintenance activities, inspection results, and monitoring data. Produce regular reports to document progress, identify issues, and guide future maintenance efforts.

Community and Stakeholder Engagement: Involve local communities and stakeholders in monitoring efforts to promote stewardship and gather additional observations. Educate stakeholders about the benefits and maintenance needs of bioengineering projects.

Challenges of Bio engineering

Although bioengineering is a successful technique for stabilizing soil and preventing erosion, its application and performance are impeded by a number of issues. These include the following: environmental challenges (climatic variability, invasive species and natural disasters), financial constraints, high initial costs, ongoing maintenance costs, and skill gaps; social challenges (community engagement, land use conflicts, and cultural perceptions); and technical challenges (need for site-specific solutions, skill gaps, and difficulties in harsh environments). A multidisciplinary strategy comprising technical training, community education, and sustained finance is needed to overcome these challenges. Including bioengineering into more comprehensive plans for disaster risk reduction and sustainable land management requires addressing these problems.

Conclusion

By combining biological, mechanical, and ecological principles, bioengineering presents a viable method for soil stability and erosion control on hill slopes and riverbanks. Its implementation in Nepal has proven successful through important initiatives financed by international collaborations, especially for shallow-seated landslides. But in order for bioengineering to succeed in the long run, it will need to overcome a number of obstacles. These include technical site-specific requirements, environmental factors like climate variability and invasive plants and animals, financial constraints like expensive initial expenses and ongoing maintenance, and social issues like land use conflicts and community engagement. A multidisciplinary strategy involving technical training, community education, and sustained finance is required to overcome these obstacles. By addressing these problems, bioengineering can be more successfully applied to more comprehensive plans for disaster risk reduction and sustainable land management in Nepal and beyond

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CHANNEL SAMPLING METHOD FOR EXPLORATION OF LIMESTONE MINE IN NEPAL HIMALAYA

Ashok Dhakal*, Roshan Neupane

Central Department of Geology, Tribhuvan University, Kritipur, Kathmandu Nepal

*Corresponding Author Email: ashok.01dhakal7@gmail.com

ABSTRACT

Channel sampling is a method of collection of samples from the rock exposure by making a channel. In geology, channel sampling procedure plays the vital role for qualitative and quantitative investigation of rock / minerals. Channel sampling is carried out in the exploration phase of mine to determine the chemical composition and grade of the minerals. Nepal lunch different limestone mine for cement production and that is initiates by prospecting phase followed by exploration. Collected samples are used for the estimation of calcium carbonate and magnesium carbonate of the deposit. Channel sampling also gives the relative thickness of the deposit which is applicable for reserve estimation. The average wide of channel is about 0.1 m. Preparation of bench for excavation of deposit is organized from the channel sampling.

Keywords: *Channel Sampling, exploration, Limestone, calcium carbonate*

Introduction

Nepal Himalaya is the world youngest mountain range extending for 2400km from east to west. The continent- continent collision of Indian and Tibetan plate (Deway and Bird 1970; Powell and Conaghan 1973) formed the Himalaya which has resulted large scale faulting and folding along with local structure. Nepal Himalaya can be tectonically divided into the Indo Gangetic Plain, the Sub Himalaya (Siwalik), the Lesser Himalaya, the Higher Himalaya and the Tibetan Tethys Himalaya from South to North (Gansser 1964). These tectonic units are separated by major intra crustal thrusts namely the Himalayan Frontal Thrust (HFT), THE Main Boundary Thrust (MBT), the Main Central Thrust (MCT) and the South Tibetan Detachment System (STDS) from south to north respectively. Nepal Himalaya is the potential area for the mineral resources in the earth. As we are at the very preliminary stage of mineral exploration, there are metallic deposits existed on the different parts of the country. The Department of mines and geology has carried out the mineral prospecting and exploration all over the Nepal. Nowadays some private institution also carried out the mining activities. DMG reported metallic, non metallic, industrial and gem mineral in different location of Nepal (DMG 2017). Department of mine and geology reported the limestone deposit in Lesser Himalaya region. The deposit is studied in Tanahun, Dhadhing, Syangja, Palpa, Pyuthan, Makawanpur, Dang with other surrounding areas. Limestone is used as construction materials to prepare cement in Nepal. So, most of the deposit are under the mining stage. Prospecting and exploration of limestone deposit is also continuing. Sampling is the major procedure of exploration of limestone deposits in Nepal Himalaya. Sampling is the process of collecting representative samples of rocks, minerals, soils or drill core form a target area, either on the surface or underground. Mineral deposits are sampled for resources evaluation, determination of physical and chemical characteristics of materials. There are various sampling procedures to collect representative sample for the further analysis. Major sampling procedures are bulk sampling, channel sampling, trench sampling, sampling from drilling, crusher product sampling etc. Channel sampling is a technique used by geologists to collect small chips of rock over a specified linear interval. The objective is to cut a linear channel across the vein or ore body for the most representative samples possible over the designated interval. Channel sampling is important because it allows for a representative sample to be acquired, which is not biased. Channel samples are typically collected in succession along a sample line that is laid out in advance using a measuring tape. The sample line is designed to cross the area of interest. Channel samples can be collected along surface trenches, floors or walls of underground working. The breadth of the channel is around 5-10 cm and depth is about 2-3 cm. Limestone deposit in Nepal Himalaya is the major sources of non metallic mineral specially used for cement production (DMG 2004). The exploration of the limestone deposit applied channel sampling for the analysis of the minerals which become cheap and easy then drilling. The Lesser Himalayan limestone is dominantly used for cement production. The major research question is that what is the procedure of the channel sampling? How channel sampling gives the quality and quantity of the deposit?

Methodology

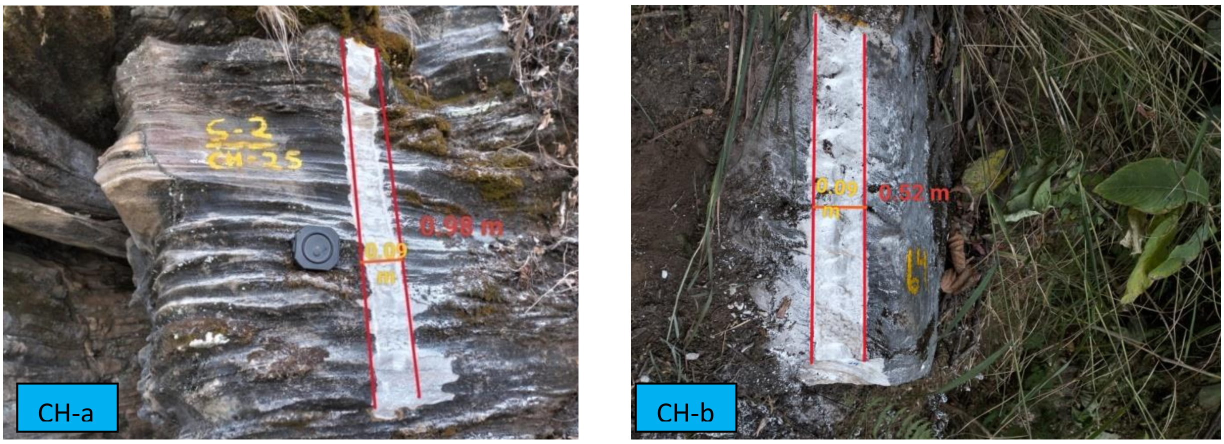
Channel sampling is carried out by the manual methods. Channels are created with 8-12 cm wide which are perpendicular to the strike. The outer layer of the rock exposure is removed because of its weathering condition. The instruments used during the channel sampling are chisels, hammers, geological compass, meter tape, GPS, enamel, sampling bags, sample holders etc. Safety measure is the major concern during the sampling process.

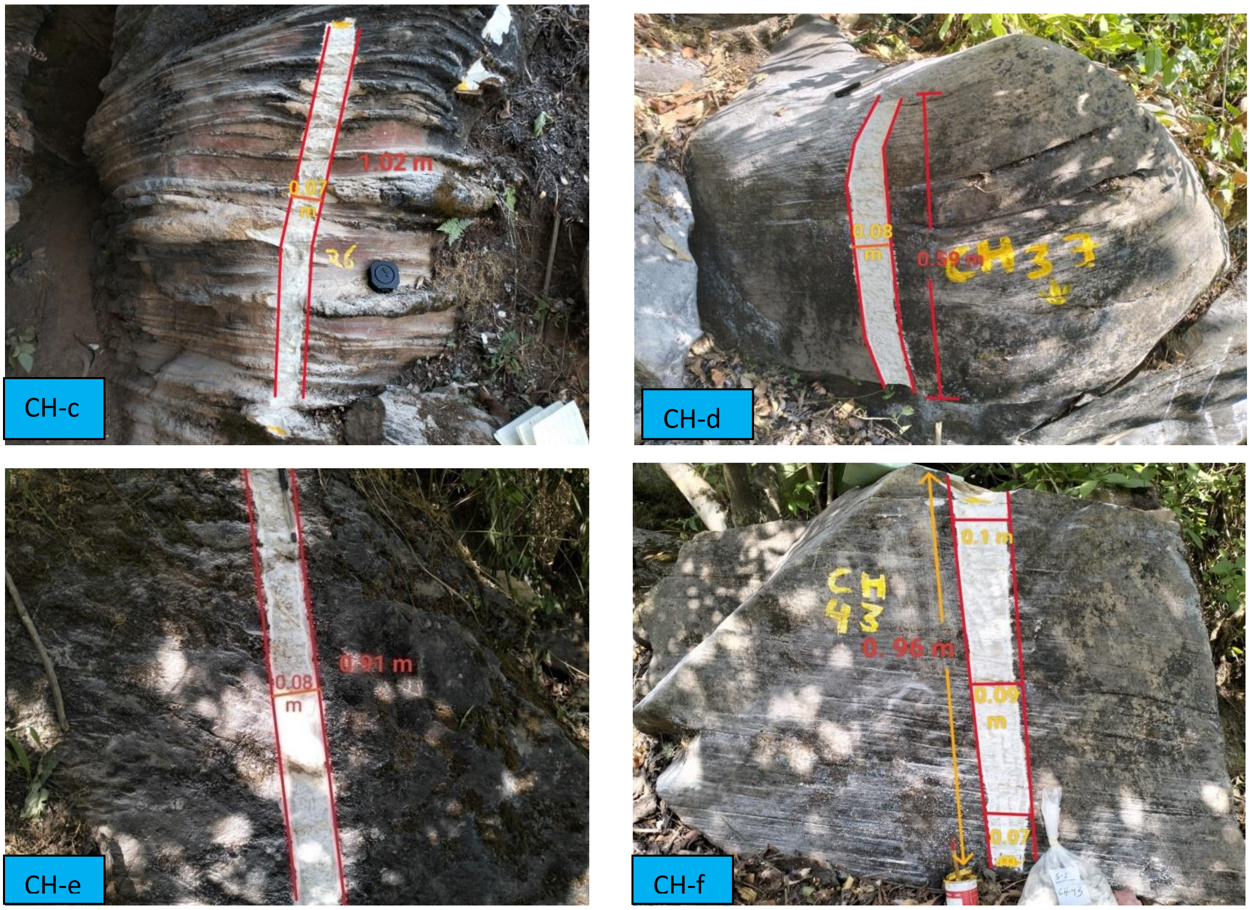
Photograph 1: Process of channel sampling a) Mark the channel b) extracting the chips from channel c) Packing of the samples in the sample bags d) Marking the channel no. and location

Results

Geometry of channel

The channel samples are taken from creating the feasible channels. The length of channels is depends on the strata thickness. The channels are formed just perpendicular to the strike and samples were taken from top, middle and bottom of the channel. The width of the channel must be 0.07 to 0.12 m. For the study, 6 channels are used. The geometry of each channel is different.





Photograph 2: Prepared channel taken for the observation. The channel were taken from the Dadakharka deposits, Makawanpur GPS (27° 39' 47 N/ 84° 54' 35" E)

Geological data of channels

The attitude of rock exposure must necessary for the channel preparation. The lithological information is taken after the sampling. The thickness of bed / foliation, mineralogical composition, texture, grain size, color of exposure and weathering condition of the exposure is noted. The GPS and elevation of each channel should be noted.

Table: Lithology of the strata for channel sampling

CH/CP	Length of Channel (m)	Lithology of the strata
CH- a	0.98	Bluish white- grey, fine to medium grained, micaceous marble.
CH- b	1.02	Bluish white- grey, fine to medium grained, micaceous marble.
CH- c	0.59	Grey- dirty white, fine to medium grained marble.
CH- d	0.52	White- yellow, fine to medium grained marble.
CH- e	0.91	Dirty white- brown patches, fine to medium grained marble.
CH- f	0.96	Milky white, medium grained, micaceous marble.

Chemical Analysis

Table 2: Percentage of CaO and MgO of samples after chemical analysis (Table 1)

S.N	CH/CP	CaO (%)	MgO (%)
1	CH- a	33.16	3.96
2	CH- b	42.78	4.76
3	CH- c	42.73	2.61
5	CH- d	31.67	1.73
6	CH- e	42.94	1.95
7	CH- f	33.59	3.80

The channels are prepared according to the exposure attitude, which covered all the strata and foliation. Grade control during mining is carried out on the basis of channel sampling data. Benching during excavation has prepared.

Discussion and conclusion

Lesser Himalaya is the best destination for limestone mining. Exploration of the limestone deposit is not easiest because of the geography and vegetation. Channel sampling is the vital methods of sampling of rock and minerals in geology. The geological information included latitude and longitude, elevation, attitude of rock and lithological description. The grade of the rock is estimated by the chemical analysis of the samples.

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IGNEOUS AND ORTHO-METAMORPHIC ROCKS FROM NEPAL HIMALAYA

Arun Shrestha* and Kabi Raj Paudyal

Central Department of Geology, Tribhuvan University, Kritipur, Kathmandu Nepal

*Corresponding Author Email: arunshrestha2310@gmail.com

ABSTRACT

Igneous rocks form from molten rock crystallizing and solidifying, and are classified into intrusive, extrusive, and hypabyssal based on where they solidify.Ortho-metamorphic rocks form from pre-existing igneous rocks undergoing metamorphosis.Nepal's Himalayas lack current volcanic activity due to continental collisions, but prehistoric igneous rocks are exposed at the surface.This study examines the distribution and characteristics of these rocks in Nepal.Dolerite sills in the Sub Himalaya and various granite intrusions in the Lesser and Higher Himalayas are significant.The Dwar Khola intrusions exhibit tholeiitic characteristics akin to continental flood basalts. Age dating of dolerite ages ranging from 2110 to 1310 Ma. The significant formation in Nepal Himalaya include the various magmatic bodies. The Precambrian mafic rocks, Precambrian alkaline rocks, Permain basalts, tertiary granites and Precambrian felsic rocks. The precambian mafic rocks includes the Greenschist and amphibolite intruded in Nawakot Group. The Precambraina felsic rocks comprise the granitoids and syenite distributed in Lesser Himalayan crystalline thurst schist, MCT zone and Higher Himalaya. The Permian Aulis volcanics (Basalt) found in Lesser Himalaya. The granite belts are distributed in four parallel belts in the Himalaya; Lesser Himalayan thrust sheet, Higher Himalaya, Northern Himalaya antiform and Transhimalaya (Beyond Suture zone).Historical geological events have left a record of igneous intrusions, despite the region not being volcanically active today.

Keywords: *Igneous Rocks, Granite, Ortho-metamorphic rocks*

Introduction

Igneous rocks (from the Latin word for fire) form when hot, molten rock crystallizes and solidifies. The melt originates deep within the Earth near active plate boundaries or hot spots, then rises toward the surface. Igneous rocks are divided into intrusive, extrusive and hypabyssal, depending upon where the molten rock solidifies. Intrusive igneous rock forms when hot magma gets trapped deep inside the Earth. Over time, it cools down slowly and hardens. The minerals inside it have a lot of time to grow, so they change to big grains.E.g. granite, diorite, gabbro, and peridotite etc. Extrusive igneous rock forms when magma comes out onto the Earth's surface and cools quickly. The hot liquid rock, called lava, turns solid almost instantly when it touches the cooler air. Because it cools fast, the minerals in the rock don't have time to grow big, so it has a smooth or glassy texture and bubbly look. E.g. Basalt, andesite, Obsidian and rhyolite etc. Hypabyssal rock is a type of rock that forms from magma cooling below the Earth's surface, not too deep down. These rocks cool faster than the ones deep down but slower than the ones on the surface. They have a texture that's usually medium to fine-grained. Examples include rocks like diabase and dolerite. Ortho-metamorphic rock, also called igneous rock, is a type of metamorphic rock formed from pre-existing igneous rock. E.g. orthogneiss, metabasite, amphibolite etc. when the acidic rocks are metamorphosed it changes to metaacidic rocks. Eg. Granite, gneiss etc. Similarly, basic rocks metamorphosed changes to metabasic rocks. E.g.Amphibolite, green schist, nepheline syenite etc. The geology of the Nepal Himalaya is not conductive for volcanic activity. Due to continental-continental collision and they are thrusting upon each other, there is no space of magma to rise upso collision formed building the higher mountain. In Nepal Himalaya, the prehistoric igneous rock trace can be found exposed to surface.

Objectives

The main objectives of the work are to access the igneous rocks and metamorphic equivalent of igneous rocks forms in Nepal Himalaya.

Literature Review

The studies and research is carried out by several scholars and scientists that are relevant to the current research topic are relevant in this section.

In the Higher Himalaya sequence of Nepal, early to middle Miocene Leucogranite (Hein and Gansser1939; Gansser 1964; Hagen 1969; Le Fort 1975) occurs carious plutons, many dikes, and veins. These igneous rocks are concordant towards the top of the migmatitic gnesis in Tibetan Slab. (P Le Fort et al., 1987). (Patrick Le Fort, 1975) divided the Higher Himalaya, central Nepal into three units as Formation I, Formation II and Formation III. Formation II consists the calcareous Gneisses. The succession of banded gneiss about 1600m appears above the calcareous gneisses. Banded gneiss is characterized by very fine and dark band of biotite with less than cm thick band. Formation III consist the Augen Gneiss observed at upstream of Ghasa. The thickness is 3000m. The contact between the Augen gneiss about the succession of sandstone, calcareous sandstone and calcareous schist is perfectly concordant. According to Stöcklin (1980) the Robang Formation, the uppermost unit of Upper Nawakot Group, associated with both phyllites and Quartzites occurs chloritic and Amphibolites metadibases showing the synsedimentary relationships as well more massive, gabbroic or dioritic bodies showing the intrusive contacts. (Harutaka Sakai, 1983), divided the geology of lesser

Himalaya of West Central Nepal into Kaligandaki Super-Group and Tansen Group. The Tansen Group of predominantly clastic sedimentary rock from lesser Himalaya. The Tatlung Formation of Tansen Group contains the fluvial conglomerate, sandstone, shale with upper Gondawana plan fossil and basaltic lava (Aulis Trachyte). The most of the Charchare Conglomerate is made of packed and well sorted pebbles and cobbles. Whereas, 75% of them are well rounded to rounded and they are overwhelming by the volcanic and quartzites. The Aulis volcanos are associated with the lower member of Tatlung Formation. (ESCAP Atlas, Vol.9, 1993) indicated that granites bodies that occurs in Lower Himalaya are corderite granite with muscovite, biotite and tourmaline, largely restricted to the synclinal klippe. The Rb/sr whole rock isochrones of the Palung , Sinchaur, and Dadeldhura granites indicate they belong to the Ordovician age. According to the (Amatya, 1995), three types of acidic are recognized in different tectonic setting ; weakly foliated to gneissic granite commonly known as augen gneiss, two-mica granites with crystalline klippe and Tertiary granites of Higher Himalaya. In the Northern part of Lower Himalaya in Central. And Eastern Nepal, locally thick but discontinuous augen gneissess (Ulleri and Melung Gneiss).

According to (Dhital, 1995), Nepheline syenite intrusions are found near Harmi Bhanjya Ampipal, Chanp Bjanjyang, Bhulbhule Khar, and Luintel Bhanjyang villages within the Kuncha Formation. Additionally, two distinct bodies are located where the Masel Khola and Dharaundi Khola rivers meet the nepheline syenite bodies are intruded in the Kuncha Formation displays distinct and irregular contacts boundary with the surrounding rocks. There are intersected by dykes and at times, evidence of contact metamorphism affecting the surrounding rocks can be detected. Moreover, The Nepheline syenites exhibits the foliation and lineation pattern similar to those found in a country rock. Hence, it can be inferred that these intrusions occurred prior to the formation of foliation and lineation in the Kuncha Formation. (Upreti, Rai, Sakai, Koirala, & Takigam, 2003) states that Taplejung Formation, Mitlung Augen Gneiss, and Linkhim Schist are the three main stratigraphic units of Lesser Himalayan Sequence of the Taplejung Window of far western Nepal. Major igneous bodies intruded in Talejung Formation; Amarpur Garnite, Kabeli Khola Granite, and Tamor River Granite. The granite bodies are discordant to sub concordant relationship with the country rocks. The granite mainly consists of Quartz, alkali feldspar, plagioclase, muscovite, biotite and tourmaline. The petrographic analysis and Q-A-P triangular diagram of the granites indicate that they have a granitic composition and are peraluminous. The Kabeli Khola Granite suggests that its magmatic age, determined using the 40Ar/39Ar method, is over 1.6 Ga and can be correlated with Ulleri Gneiss of Central and Western Nepal of Lesser Himalaya. Both the granite and the Mitlung Augen Gneiss contain xenoliths of phyllite and metasandstone, providing evidence for their magmatic origins.

(Dhakal & Ghimire, 2006) described that Palung Granite is intruded into quartzite, schist and calcareous rocks and dipping toward north. Two two types of granite are identified on the basis of grain size and the predominance of biotite or muscovite (1) medium grained Muscovite-Tourmaline Granite (MTG) and (2) coarse grained Biotite-Tourmaline Granite (BTG). The Palung Granite intruded at periphery of Simbhanjyang along the East-West running Mahabharat Lekh. Whereas, most of the area covers the Tistung Formation in southern part, east -west ridge is occupied by granite known as lpa Granite whereas the northern slope · consists of marble, known as Markhu Marble. The granite is porphyritic, medium to coarse grained, light grey in color. Paudyal & Paudel (2011) worked at the Muglin- Baspani area and observed the thick lenses of light green greenschist and amphibolite (5 to 20m thick) at different stratigraphic level of the Kuncha Formation. In the Norupul Formation the presence of Amphibolite and Greenschist is noted. The sub member of Norupul Formation i.e the Purebesi Quartzite, contains the massive deep green green amphiboles and greeschists are found. In Labdi Khola Carbonate also some band of greenschist (17m) are found.

Paudel and Paudyal (2012) conduct the Geochemical analysis of 12 Metabasites (5 along Kali Gandaki Valley and 7 along the Modi Khola Valley) found within the Precambrian Nawakot Complex rocks of the Lesser Himalayan indicates that the Metabasites are sub-alkaline basalts or andesites with tholeiitic nature. According to Paudyal (2012) the dark green, coarsely crystalline metabasic rokcs are formed concordant with host rock. Labdi Member of the Nourpul Formation. Deposited in the intermediate depth to shallow depth and short term aerial exposure as well.According to Paudyal, Adhikari, Maharjan, & Paudel (2013) the Bagar Khola Amphibolite bodies are mapped within the Labdi Khola Member. The amphibolite is dark green due to some acicular minerals like actinolite and tremolite. It is massive and granoblastic with distinct mineral lineation. The lineation is due to the presence of actinolite and tremolite. No any xenoliths and country rock inclusions are observed. (Sakai, Takigami, Orihashi, & Terada, 2013) state that The Sub Himalaya (Siwalik) Dwar Khola section, Dwar Khola dolerite intrusions exhibit tholeiitic characteristics akin to continental flood basalts. Age dating indicates detrital muscovite and zircons around 1742-1727 Ma, with dolerite ages ranging from 2110 to 1310 Ma. Correlation with the Lesser Himalaya's Naudanda Formation suggests similar depositional and tectonic settings during the rifting of the supercontinent Columbia, driven by mantle plume-induced volcanic activity. This study enhances understanding of the Siwalik belt's complex geological history and its relationship with surrounding formations.

Dhital (2015) stated that in the Kuncha Formation sporadic granular and pebbly phyllites with stretched clasts and amphibolite bands, such as those found south of Manakamana. Amphibolite bands reaching 10 m in thickness infrequently alternate with up to 20 m thick white quartzite bands.According to (Baral, Ding, Dhital, Kumar, & Li, 2022), the Aulis volcanics in the Lesser Himalaya possess a highly complex remanent magnetization, with multiple components stemming from numerous magnetization or remagnetization occurrences, alongside recent magnetization. These distinct magnetic aspects seem to stem from different mineralogical phases formed chemically from the original titanomagnetite during the rocks' initial cooling. Addressing these components necessitates an integrated cleaning technique such as AF-followed-TH demagnetization. According to (Searle & Cottle, 2023), the field mapping of Mansslu Leucogranite in Nepal is a composite intrusion formed from the diverse migmatite melt source at depth. The formation of leucogranite along the top of the GHS due to the crustal thickening led to partial melting, from earlier muscovite dehydration to later biotite dehydration melting over time. However, the granite was not intruded across the STD. The Nar-Phu detachment, exhibiting both ductile and brittle behavior, encircles the upper portion of the Manaslu leucogranite and terminates all leucogranites situated in the footwall. U-Th/Pb monazite dating from the Manaslu leucogranites indicates two primary phases of intrusion occurring at 22.5 million years ago (referred to as the Larkela phase) and 19.5 million years ago (termed the Bimtang phase). Frictional heating along the Main Central Thrust (MCT) did not contribute to the formation of the Himalayan leucogranites located approximately 15–20 kilometers higher in the geological structure.

Methodology

All of the accessible books, articles, and research papers on Igneous and Ortho-metamorphic rocks from Nepal Himalaya have been carefully examined and analyzed in order to prepare this article. Additionally, the internet based sources are also used in order to prepare this article.

The flow chart below outline the methodological procedure used to prepare this article.

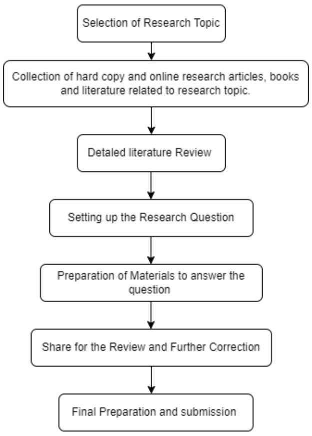

Figure 4: Flowchart showing the methodology for the preparation of this research article.

Results

The igneous and orthometamorphic rock are intruded in different places of Nepal Himalaya. The Sub Himalaya (Siwalik) Dwar Khola section, numerous dolerite sills intrude into the orthoquartzite and quartzose sandstone beds and its maximum thickness attains 400 m and extending over 6 kilometer..40Ar-39Ar dating of dolerite sills show 1723±19 Ma and 1656±8 Ma, and Sm-Nd model age of the dolerite ranges from 2110 to 1310 Ma. The plagioclase and clinopyroxene within the dolerite often appear fresh, and the original igneous textures remain well-preserved despite the presence of Mid-Proterozoic rocks in the area. *In the Lesser Himalaya the igneous rocks are intruded in different location from East to West extension.* The Granites intrusion observed in different location of Nepal Himalaya. In Lesser Himalaya (Midland Group) of Precambrain Ulleri Augen Gneiss and Lesser Himalayan crystalline Nappes whereas In Higher Himalaya of Cambro-Ordovician augen Gneiss of Formation II and III. Oligo-Miocene Higher Himalayan Leucogranites.

In the Lesser Himalyan Granite i.e. Paleozoic Granite which is exposed only in Nappes of Kathmandu and Dadeldura. Which shoes the Porphyritic texture and coarse grained. The mineral composition includes quartz, feldspar, corderite, two mica, garnet tourmaline, andalusite. It is dark igneous enclaves like amphibolite. Age of the granite intrusion is around 470-507Ma. Which was formed by the large scale melting of continental crust with heating and injection of mantle. The lower Proterozoic Ulleri Augen Gneiss composed of Minerals quartz, feldspar, biotite and Muscovite. Ulleri gneiss in the MCT zone is the thickest band in the Himalaya (about 1500 m thick) and extends to entire length of the Himalaya, often associated with granites and pegmatites.In the Kuncha Formation of Nawakot Complex the Nepheline syenite intrusions are found near Harmi Bhanjya Ampipal, Chanp Bjanjyang, Bhulbhule Khar, and Luintel Bhanjyang villages.The Nepheline syenites exhibits the foliation and lineation pattern similar to those found in a country rock. In the West Central Nepal, The Tatlung Formation of Tansen Group contains the fluvial conglomerate, sandstone, shale with upper Gondawana plan fossil and basaltic lava (Aulis Trachyte). The most of the Charchare Conglomerate is made of packed and well sorted pebbles and cobbles. Whereas, 75% of them are well rounded to rounded and they are overwhelming by the volcanic and quartzites. In the Upper most of the Robang Formation showing Amphibolites metadibases showing the synsedimentary relationships as well more massive, gabbroic or dioritic bodies showing the intrusive contacts. In the Muglin-Baspani area the thick lens of light green greenschist and amphibolite at different stratigraphic level of Kuncha and Nourpul Formation noted. In the Kuncha Formation sporadic granular and pebbly phyllites with stretched clasts and amphibolite bands, such as those found south of Manakamana. Amphibolite bands reaching 10 m in thickness infrequently alternate with up to 20 m thick white quartzite bands.

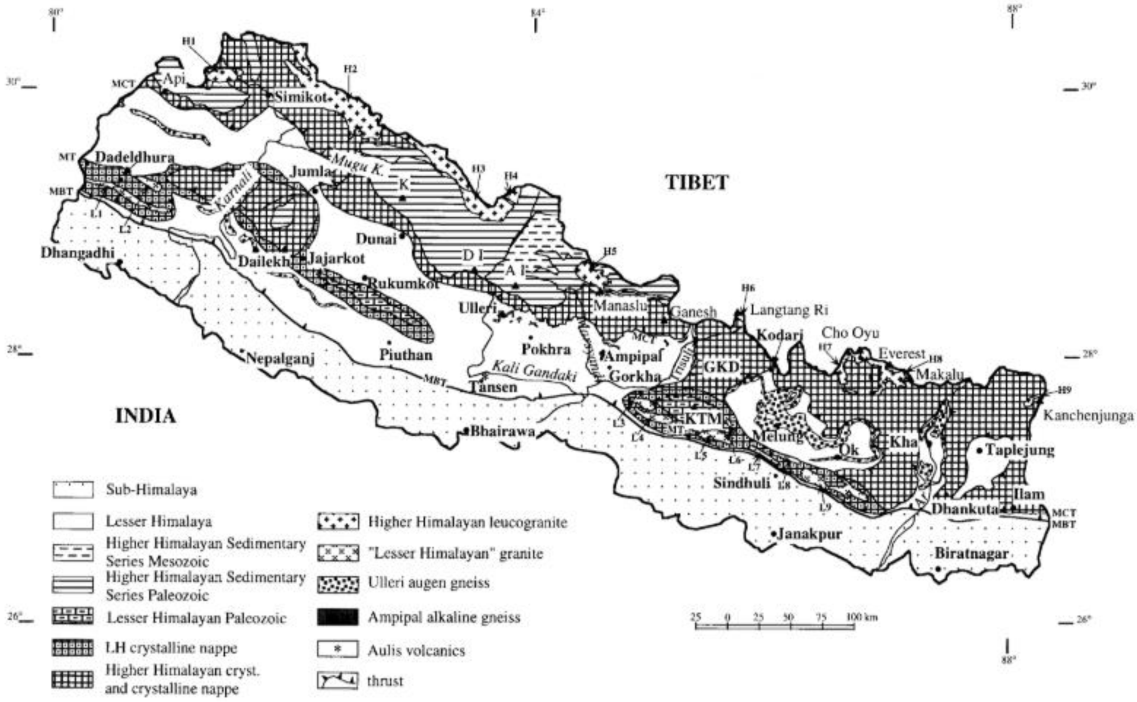

Figure 5: Geological sketch map of Nepal showing the main occurrences of felsic magmatism. The Higher Himalayan leucogranite and ``Lesser Himalayan" granite plutons are respectively numbered H and L from west to east: H1: Yari; H2: Gorakh Himal; H3: Mugu-Dolpo; H HH4 Mustang; H5: Manaslu; H6: Langtang; H7: Rolwaling; H8: Everest-Makalu; H9: Kanchenjunga. L1: Dadeldhura; L2: Khaptad; L3: Simchar; L4: Palung; L5: Ipa-Arkaule; L6: Timaldanda; L7: Narayan Than; L8: Sindhuli Gari; L9: Udaipur; L10: Dobare-Thumka. The Aulis volcanics located near the town of Tansen are too small to be drawn on this map; they are just located with a star (). Sub-Himalayan zone (Terai, Duns and Siwalik) is grouped; Lesser Himalayan metamorphic sedimentary formations are left blank. Ar: Arun river, A I: Annapurna I; D I: Dhaulagiri I; GKD: Gosainkund; K: Kanjiroba; Kha: Khandbari; KTM: Kathmandu; MBT: Main Boundary Thrust; MCT: Main Central Thrust; MT: Mahabharat thrust.

Figure 6: Ignous Intrusion at Near Marsyagdi Hydropower Dam

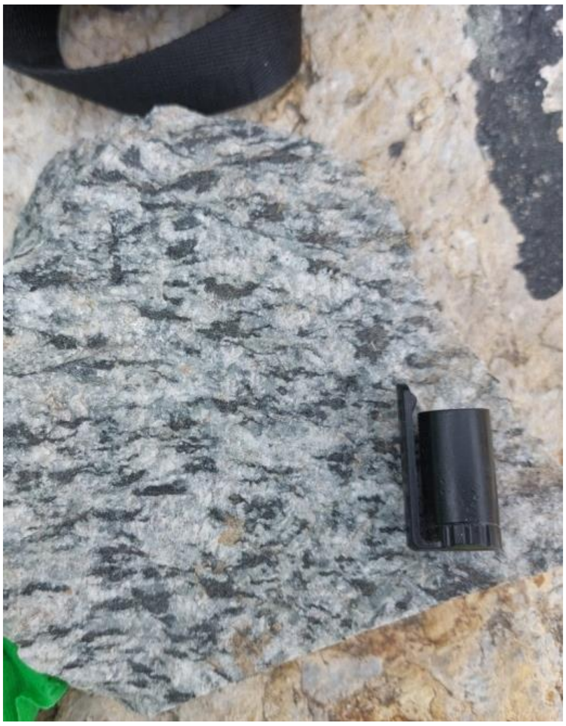

Figure 7: Handsample of Nepheline Syenite observed at Aampipal, Gorkha

Figure 8 Handsample of Metabasic Rock exposed at Jugedi area.

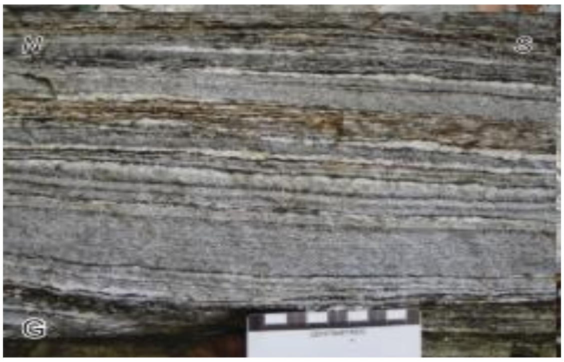

Figure 9Migmatitic quartz + feldspar + biotite gneiss near the Tama Kosi village of Bedding.

Figure 10 leucogranite melt from Langtang valley, Nepal.

Figure 11 Augen Gneiss Observed at Formation II of Higher Himalaya

In the Higher Himalaya sequence of Nepal early to middle Miocene Leucogranite occurs carious plutons, many dikes, and veins. The Higher Himalaya central Nepal divided in three units in which the Formation II consist the calcareous

Gneisses. Formation III consist the Augen Gneiss respectively. In the Formation III consists of Augen Gneiss (old Granite) highly shread and comprise minerals of qurartz, feldspar,biotite, muscovite, siliminite, garnet, tourmaline. The age of the intrusion was 513-550Ma. The Oligo-Miocene Leucogranite exposed in Higher Himalaya/ Tethys Himalaya. Which comprise the minerals quartz, feldspar, muscovite and tourmaline. The fine grained texture and age of the granite is 25-15Ma.

Table 1 some dated Cambro-Ordovician granites, granitoids, and gneiss of Nepal

Locality	Age in Ma	Method
Dadeldura Granite	475±506	Rb-Sr
Augen Gneiss, Foramation III, Tibetan Slab, Central Nepal	517±62	Rb-Sr
Gosaikunda Orthogneiss	486±9	U-Pb
Simchaur Granite	466±40 511±55	Rb-Sr
Palung Granite	486±10	
Palung and Simchaur Granite	493±11	
Paragneiss, Mt. Lhotse, Mt Everest Region	449±56	Rb-Sr
Migmatitic Orthogneiss, Dudh Koshi Valley	550±16	
Barun Migmatite, East Nepal	525±20	
Barun and Irkhua Gneiss, East Nepal	512±20	
Biotite granite of Malekhu	160Ma	
Biotite Granite Panchmane	173Ma	
Tourmaline Granite of Trisuli River	126Ma	
Granite of Daman	51±6	
Pegmatite lamagaon	17±5	
Granite of Kerabari	17±7	
Granite of Jingwa Khola	15±1	

6. Discussion and Conclusion

Studying rocks from the Nepal Himalaya helps us learn about how the mountains formed. We looked at two types: igneous rocks, which form from melted rock, and metamorphic rocks, which change under heat and pressure. In the Nepal Himalaya, various location the igneous and Orthometamorphic bodies are exposed. The available literature and related article are studied and most of volcanic rocks are acidic in nature expect the Aulis trachyte, Dolerite and Amphibolite. Which are basic in Nature. The metabasic rocks, Dolerite are metamorphic equivalent of plutonic igneous origin. The Higher Himalayan also the igneous bodies are exposed in different parts. The Cambro-Ordovician augen gneiss which was intruded 1.7Ga. and the Oligo-Miocene Leucogranite is fine grained texture and intruded 25Ma. Which was due to contact metamorphis around the pluton. Historical geological events have left a record of igneous intrusions, despite the region not being volcanically active today.

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IMPACT OF URBANIZATIO IN GROUNDWATER IN KOHALPUR MUNICIPALITY

Gaurav Sharma*

Central Department of Geology, Tribhuvan University, Kritipur, Kathmandu, Nepal

*Corresponding Author Email : gaurav.shrma528@gmail.com

ABSTRACT

Urbanization is a noticeable phenomenon in the developing parts of the world, which is also evident in different parts of Nepal. Urbanization is a major geomorphic process affecting both surface and groundwater systems. The development of cities inevitably increases paved surfaces and roofs (termed impervious cover) and storm drains. The main aim of this research is to introduce that urbanizing the developing cities rapidly and in unorganized way is affecting the water beneath the earth surface (groundwater). Major physical changes to the groundwater system include changes in water table elevation, altered permeability field created by construction. Kohalpur city a center market in Kohalpur Municipality in Banke District is not only rapidly but haphazardly urbanizing area. Due to urbanization and high discharge rate groundwater system is not getting recharge properly which may lead to problem like drought in wells and hand pump in Kohalpur.

Keywords: *Urbanization, geomorphic process, ground water*

Introduction

About 1% of the water on Earth is groundwater. Water that is found in the pore cracks and fissures of rocks and sediments below the surface of the Earth is known as groundwater. It enters the groundwater system through the rocks and soil after beginning as snow or rain. In Kohalpur municipality, groundwater provides 99% of the drinking water and is crucial for irrigation.

The primary geomorphic agent influencing Earth’s land surface is human activity. Currently more than 50% of people on Earth resides in cities, and by 2025 that number is predicted to rise to over 67% (Ramsey, 2003). In Kohalpur Municipality, Banke District the household data were 15,483 with 70,647 population (CBS 2068), for CBS 2073 the houses were increased to 17,689 with 87,300 people and the household increases to 24,183 with population 101,667 (CBS 2021).

Objectives

The major objectives of this research article are: to study the effect of urbanization in ground water in Kohalpur Municipality and to find out the recharge and discharge.

Research Question

Does this increase in number of houses and population affect the groundwater system (recharge and discharge)?

What will be the consequence of rapid urbanization in the distribution of groundwater?

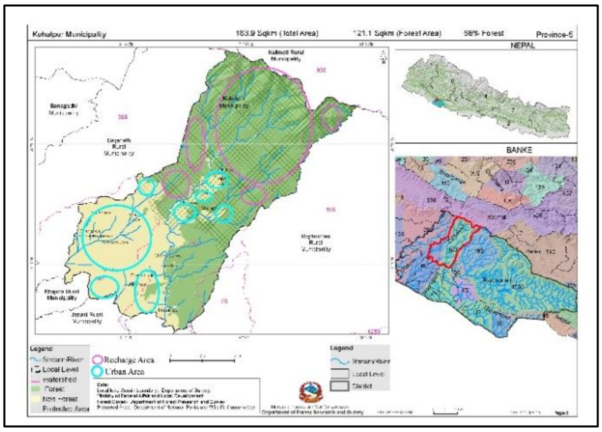

Figure 12: Study area map with recharge and urban area (Source www.dfrs.gov.np)

Result

The primary source of groundwater recharge in this zone is both lateral recharge from Bhabar Zone and direct infiltration of rainfall. Subterranean inflow and seepage losses via rivers and streams also contribute significantly to groundwater replenishment.

Infiltration rate of bhabar zone is 31.1% and other terai is 18.8%(0.188)(Duba 1982). Average annual rainfall of kohalpur is 1312mm per year(1.312meter per year) (Köppen and Geiger). Total house only in 2068 B.S. were 15,483(CSD) which covered about 20127900square meter area. After 5 years there were 17,689 houses with area 22995700 square meter and 24,183 houses with an area 31,437,900 square meters.

To find the recharge rate (Q) = area (A)*infiltration rate*annual average rainfall

Now from above given, for years 2068B.S

Q=20127900*0.188*1.312

Q=4964667.30cubic meter per year

=4.96 MCM/year

Again for year 2073B.S,

Q=22995700*0.188*1.312

Q=5672027.38cubic meter per year

=5.67MCM/year

Similarly for year 2021

Q=31437900*0.188*1.312

= 7754346.66 cubic meter per year

= 7.75MCM/year

Discussion

As the world's population is increasing, a rising number of people are moving from rural areas to more urban settings. This global phenomenon is called urbanization. Urbanization is a major geomorphic process affecting both surface and groundwater systems.Due to urbanization and high discharge rate groundwater system is not getting recharge properly which may lead to problem like drought in wells and hand pump.

Conclusion

From year 2068-2073 B.S, area from where groundwater used get recharged were getting lesser. Recharge rate was decreased by 707360.079 cubic meter per year in between five years. Discharge rate were increased with increase in population and their daily demand of water. To maintain the groundwater system equilibrium water recharge and discharge should be equal but the ratio of recharge is very low in comparison to discharge. With increasing urbanization activities groundwater system is being altered by not getting recharge properly. The only recharge measure for this area is by rainwater on the forest and protected area. This may lead to serious problem like drought in wells and hand pumps which may lead to problem in drinking and irrigation in near future.

Acknowledgement

I am very much thankful to Central Department of Geology for the encouragements and suggestions provided in preparing the manuscript as well as the Kohalpur Municipality for the support.

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SLOPE STABILITY ANALYSIS BY GEOSTUDIO

Aakriti Koirala* [1], Samyog Khanal [1], Samikshya Acharya [1], Mahesh Acharya [2], Samikshya Khanal [3]

[1] Central Department of Geology, Kritipur, Kathmandu Nepal

[2] Geo Testing and Construction Pvt. Ltd. Butwal-12, Rupandehi

[3] Institute of Forestry, Hetauda campus, Makwanpur

Corresponding Author Email: aakritikoirala111@gmail.com

ABSTRACT

The present study is related to the stability analysis done for the slope of the Hetauda Churiyamai area, Makwanpur District, Nepal. In this area slope failures are reported due to improper geometry. Slope stability analysis by finite slope methods namely Morgenstern price method, Spencer method, Sarma method, Bishop method, Janbu method, and ordinary method is done by using GeoStudio software for the failure slope. The factor of safety value calculated highest as 0.717 and 0.696 as the lowest value.

Keywords: *GeoStudio, Slope Stability, Finite Slope, and Factor of Safety*

Introduction

Slopes can be man-made or made by natural activities. These may be below the ground level as cuttings or above ground level as embankments. Instability-related problems in engineering and natural slopes are common challenges to researchers and professionals. Rainfall may result from instability by increasing the groundwater table and change in stress conditions. Similarly, natural slopes that have been stable for many years may suddenly fail due to changes in geometry, loss of shear strength, and external forces.

In addition, the weathering and chemical characterization are also associated with long-term stability that may reduce the shear strength. In such conditions, evaluating slope stability becomes a primary concern. When a mass of soil has an inclined surface the potential of slope to slide from a higher level to a lower level always exists. The primary aim of slope stability analysis is to contribute to the safe and economic design of excavation.

To perform the stability analysis of finite slopes, different approaches are available such as the Morgenstern price method, Spencer method, Sarma method, Bishop method, Janbu method, and ordinary method based on the limit equilibrium approach (Budania et al., 2016).

In this paper, stability analysis is carried out for a slope of churiyamai. This region is very prone to instability as the area is covered by soil up to a depth of 10m. In this region, failures are reported due to the excavation in improper geometry of the slope. The height of the slope is 35 m and the width are about 20m. Analysis of the problem is done by all the above-mentioned methods using GeoStudio software and results are discussed here.

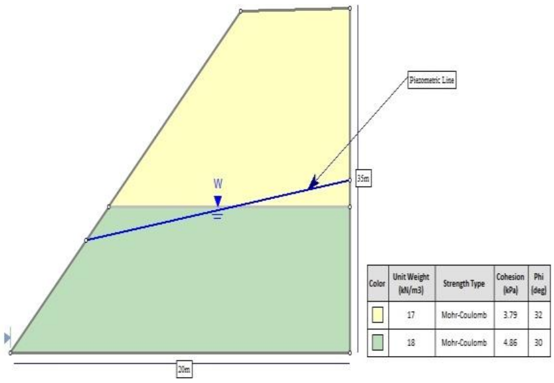

Figure 13: Field Dimension of the slope.

Slope Stability Analysis

The main aim of slope stability is to provide the safe design of human-made or natural slopes and the equilibrium conditions. Slope stability is defined as the resistance of the inclined surface to failure by sliding or collapsing. The main themes of the stability analysis are finding endangered areas, investigating potential failure mechanisms, determining the slope sensitivity to different triggering mechanisms, designing the optimal slopes concerning safety, reliability, and economics, and designing possible remedial sources. The following finite slope stability analysis methods are used in the present study.

Morgenstern – Price method

Spencer Method

Bishop Method

Janbu Method

Ordinary Slices Method

Sarma Method

GeoStudio Software

GeoStudio(Pushpa et al., 2016) is modern limit equilibrium software useful for handling complexity within an analysis. It is now possible to deal with complex stratigraphy, highly irregular pore water pressure conditions, various linear and nonlinear shear strength models, almost any kind of slip surface shape, and concentrated loads.

Stability Analysis of Slope

Slope stability analysis of the churiyamai slope is analyzed for the unreinforced conditions by all the above-mentioned methods of finite stability analysis. The factor of safety for the different methods is calculated by messing of 0.5m. The factor of safety values shows little variation as calculated by the above-mentioned method. Half sine specified function is used in the calculation method. 9.810 KN/M^3value is used for the pore fluid unit weight. The details of the facto of safety calculated by different methodsare shown in **Error! Reference s**

ource not found.. The calculated factor of safety by the Morgenstern-Price method is shown in figure 2.

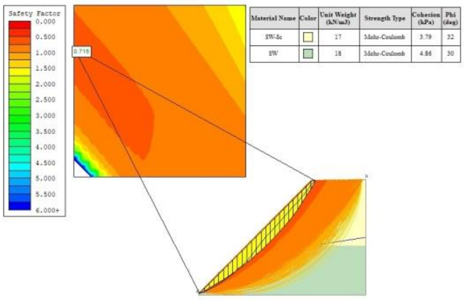

Figure 14: Calculated factor of safety of slope by Morgenstern-price method.

Table 2: Factor of Safety Comparison of different methods.

Methods	Factors of Safety
Morgenstern-Price Method	0.715
Spencer Method	0.717
Bishop Method	0.723
Janbu Method	0.698
Ordinary Slices Method	0.696
Sarma Method	0.718

Discussion

The factor of safety for the churiyamai slope of the Hetauda is studied by different methods. The calculated factor of safety value calculated as 0.715, 0.717, 0.723, 0.698, 0.696, and 0.728 from the methods Morgenstern - Price method, Spencer method, Bishop Method, Janbu method, Ordinary Slices Method, and Sarma Method. The calculated value shows that the factor of safety is calculated high from the Bishop method and low for the Ordinary method of slices. The factor of safety values shows that the slope is in critical condition and progresses towards failure.

Conclusion

The present study in GeoStudio-based stability analysis of the churiyamai slope in static conditions. Based on observation following conclusions are made:

Slope is in critical condition and progress towards the failure.

The factor of safety value calculated by different methods is nearly related to each other.

A stabilization method is needed to keep the slope stable.

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THE POSSIBILITIES OF ESTABLISHING URANIUM MINE IN NEPAL

Shraddha Neupane

Department of geology Trichandra Multiple Campus Ghantaghar Kathmandu, Nepal
Email: shradha840617@gmail.com

Abstract

Nepal's complex geology hold promising uranium deposits, particularly in Upper Mustang and regions like the Siwalik Hills. While extracting this valuable resource, Nepal could boost the economy, environmental and social concerns grow large. This study analyzes the potential and challenges of establishing a sustainable uranium mining industry in Nepal. The uranium mining in Nepal goes up with responsible practices, community engagement, and attachment to non-proliferation safeguards. Recommendations for future research focus on detailed geological exploration, socio-economic impact assessments, robust policy frameworks, and technological advancements. Ultimately, Nepal's decision to work on its uranium potential attach on balancing economic gains with environmental responsibility and social justice.

Keywords: Economy Extraction Minning

Background

Nepal is a country with 83% mountainous terrain between China and India in the north and west respectively. Younghusband, F. (1896). The geology of Nepal is very complex because of the continuous geodynamics process in the Himalayan region that resulted in many faulting folding thrusting and suffered from magmatism and metamorphic events in the geological past thus helping in the formation of huge amounts of minerals. (Kaphle 2020). Geological investigation and mineral exploration activities carried out mainly by DMG since its establishment in 1961 till the present and partly by DMG/UNDP(1969-1972), UNDP/DMG/MEDP project (1964-1968). Kaphle 2020). To present about 69 mineral commodities are reported and most of them appear to be potential for the nation which includes 22 metallic mineral commodities 21 non-metallic industrial Rock and minerals 10 gemstones 10 decorative dimensions stone construction materials (DMG,2011). In Nepal, the occurrence of uranium mineralization has been recorded from granitic and gneissic rock of higher Himalaya, late Tertiary rock succession of sub-Himalayan, thakkhola-mustang garben, and banku quartzite bhimphedi group of the lesser Himalaya, far western Nepal. Within the siwalik rock in Central Nepal visible showing of uranium mineralization has been recorded from the upper middle Siwalik and basal and lower part of upper siwalik in buka khola, chiruwa khola, chandi khola, tinbhangale khola, mardar Khola, and panpa khola area (kaphle and khan 1990,2003). Uranium is the source of radium as it emits alpha beta and gamma ray. Uranium is mainly used as nuclear fuel in atomic power plant nuclear arms and medical diagnosis and Treatment. And Nepal holds some potential for uranium deposits, geologically. (Kaphle 2020). Through relevant research that was studied, there seems to be a gap in the research showing potential along with identification of the challenge to start uranium mining in Nepal with the sustainable method which is tried to be addressed in this research article.

Objectives

1. To study the future possibilities of Uranium resources in Nepal.
2. To find out the challenges to establish Uranium mining industries in Nepal
3. To find out the best way to make the Uranium mining extraction sustainable.

Material and methods

The study is based completely on careful evaluation and interpretation of secondary sources like books, previously published articles, journals, papers, international and national reports, and the map published by DMG. The sources that were relevant to the research were chosen, meta-analysis and a systematic review were done and the results were presented systematically and scientifically.

Result

The analysis focused on identifying the possible uranium resources where exploration can be carried out in the future. There haven't been any large-scale commercial uranium mining ventures in Nepal yet, but there have been several promising discoveries across the country.

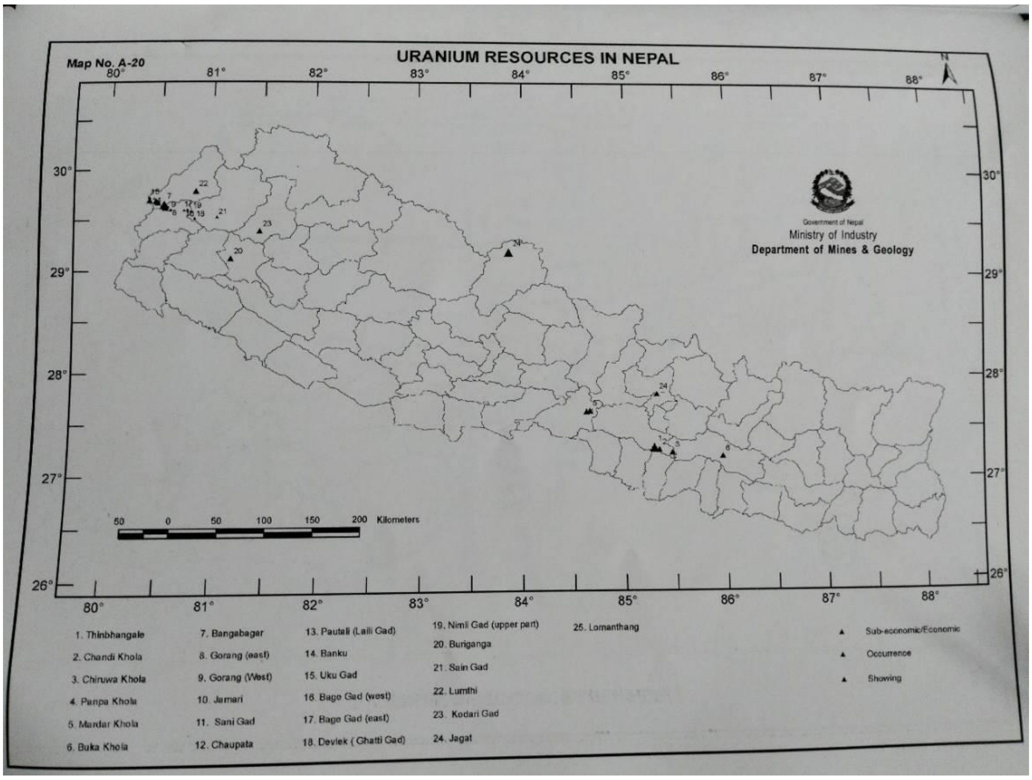

Fig: Uranium Deposits in Nepal (DMG 2017)

Nepal's Uranium Potential: Confirmed Deposits and Areas for Exploration

Nepal holds promise for uranium resources, with both confirmed deposits and areas with exploration potential. The confirmed uranium deposits in Nepal are primarily found in the Tansen Group of the Lesser Himalayan association, specifically in the Amile Formation, as indicated by detrital zircon U-Pb dating and petrographic analysis. (Neupane and Zhao 2018). These deposits show a shifting provenance from south to north, with the detritus in the Amile Formation being entirely sourced from India, transitioning to a mixture of Asian and Indian affinities in the Bhainskati and Dumri Formation. In Upper Mustang, a sizeable medium-grade deposit stretching 10 kilometers by 3 kilometers was identified in 2014. The Nepal Army even deployed in 2016 to secure this area. Beyond confirmed deposits, various regions show potential. The Siwalik Hills in the south have notable discoveries in Dang Deukhuri and Sunsari districts. Similarly, the Mahabharat Range in the central region has reported findings in Dhading and Tanahun districts. Even the Pokhara Valley in the west, Karnali River Valley in the west, Churia Hills in the north, and the Kathmandu Valley itself have shown traces of uranium in specific districts. (Neupane2023). Uranium have been identified in various districts of Nepal such as Sindhuli, Makwanpur, Chitwan, Kathmandu, Baitadi, and Mustang. These minerals are commonly found in granitic terrains like granite, gneiss, and pegmatite in regions like the Tethys, Higher and Lesser Himalayas, and the upper Middle Siwalik sandstone.

Table1: Uranium and Thorium Contents of Different Prospects (DMG)

Prospects	**U ppm**	**Th ppm**	**K%**	**Dose rate uGY/hr**	**RI cps**	**Total Samples**
1. Tinbhangale	Av. 140.9 Max 929.5	Av. 17.44 Max 66.5	Av. 3.39 Max 13.2	Av. 97.46 Max 615,7	200-4300	29
2. Bangabagar-Baggoth	Av. 136.03 Max 1052	Av. 55,6 Max 242.4	Av. 1.66 Max 9.67	Av. 101.72 Max 557.2	100-5800	34
3. Gorang	Av. 257,9 Max 1482	Av. 50,14 Max 114.9	Av. 3.15 Max 17	Av. 179.79 Max 978		29
4. Lomanthang Upper Bed	Av. 179,07 Max 790.6	Av. 27.3 Max 68,4	Av. 4.7 Max 8.5	Av. 523.1 Max 1260.43	100-5000	80
5. Lomanthang Lower Bed	Av. 327.26 Max 2047	Av. 34.08 Max 155.4	Av. 6.8 Max 24.2	Av. 224.28 Max 1400		30

Table2: Uranium and Thorium Contents of Different Prospects (DMG)

Prospects	**Strike Length (m)**	**Average Thickness (m)**	**Dip Depth (m)**	**Specific Gravity**	**Ore Resource (T.) NEA/IAEA**	**Metal Resource (T.)**
1. Tinbhangale	1400	2.2	50	2.2	338800 Prognosticated	U= 140.9ppm 47.73 ton Th 17.44ppm 5.9 ton
2. Bangabagar-Baggoth	2000 200	3	100	2.6	1560000 Prognosticated	U=136.03ppm 212.2 ton Th= 55.6 ppm 86.73 ton
3. Gorang		2	50	2.6	52000 Prognosticated	U= 257.9ppm 13.41 ton Th= 50.34ppm
4. Lomanthang Upper bed	4000	Upto 30	150	2.2	39600000 (Prognosticated)	2.61 ton U = 179.07ppm 7091.17 ton Th=
5. Lomanthang Lower bed	4000	Upto 20	100 (Up to 2000m ?)	2.2	17600000 (Prognosticated) Speculative	27,3 ppm U= 1081.08 ton 5759.776 ton 327.26ppm Th= 34.08599ppm 808 ton

Challenges:

While Nepal's uranium deposits hold promise, developing a mining industry presents several challenges. Firstly, the true extent and quality of these deposits remain largely unknown. Limited exploration and evaluation are crucial to determine their commercial viability, requiring significant investment in further research. Secondly, Nepal currently lacks the infrastructure and expertise for large-scale uranium mining and processing. Specialized facilities and a skilled workforce would necessitate substantial technology transfer and training. Perhaps the most significant challenge lies in balancing potential benefits with environmental and social considerations. Uranium mining carries inherent risks of land and water pollution, radioactive waste disposal, and potential health hazards for nearby communities. Responsible mining practices and social impact assessments are essential to mitigate these risks. Nepal's non-membership in the Nuclear Non-Proliferation Treaty raises international concerns about potential misuse of extracted uranium. Robust international safeguards and cooperation would be better to ensure responsible development of this resource. Despite these findings, the exact grade and tonnage of the uranium prospects in Nepal have not been definitively confirmed through exploration drilling, highlighting the ongoing nature of research and exploration in this field

Considerations:

While the challenges of developing a uranium mining industry in Nepal are significant, the potential economic benefits cannot be ignored. Uranium is a valuable resource used for nuclear power generation, and its extraction and sale could bring substantial revenue to Nepal, fueling economic growth and development. However, responsible resource management and ensuring fair distribution of these benefits are crucial. Before any development is considered, Nepal needs to establish robust policies and regulations that prioritize responsible mining practices, environmental protection, and social justice. Open communication and transparency throughout the decision- making process, with engagement from local communities and the public, are vital to ensure a well-informed path forward.

Achieving sustainable uranium mining requires a delicate balancing act. Economic benefits must be weighed against environmental responsibility. Clean mining practices, land reclamation efforts, and utilizing renewable energy sources are crucial to minimize the environmental footprint. Local communities should be actively engaged throughout the process, ensuring fair compensation and prioritizing worker safety. Resource-efficient methods and embracing new technologies can further reduce environmental impact. Transparency throughout all stages of exploration, development, and mining is essential. Finally, adhering to international non-proliferation safeguards and collaborating with other countries is paramount to ensure responsible development of this resource, prioritizing environmental protection and social justice.

Discussion

Uranium's high global demand presents Nepal with a potential economic changer. These minerals fuel various industries beyond nuclear power, including clean energy, electronics, and aerospace. A domestic uranium industry could position Nepal as a major supplier, creating significant economic benefits. Extracting uranium could boost the economy through revenue generation for the government, funding public services, and creating new jobs in mining and processing. This diversification would lessen dependence on traditional sectors like agriculture and tourism. Responsible exploration and low-dilution priorities for in-situ leach govern a sustainable uranium mining practice. In such environmentally sensitive areas, the developer must perform impact assessments and establish mitigation of impacts. Permitting must be accompanied by strict regulations and reclamation bonds. Operations should have the least environmental impact following best practices and a judicious use of resources. These mistakes ought to be answered by safer storage of waste - preferably with eventual reprocessing and long-term surveillance. Reclamation plan must be extensive and ongoing for permanent land restoration with emphasis on community involvement and friendships. The monitoring and reporting must be done in a continuous pattern which ensures the level of transparency during mining cycle.

Conclusion

Nepal's geology suggests significant uranium deposits, particularly in Upper Mustang. However, developing a uranium mining industry is a complex issue. Limited exploration, weak infrastructure, and environmental concerns require careful consideration. Sustainable development hinges on balancing economic benefits with responsible practices. Protecting the environment, engaging communities, and adhering to non-proliferation safeguards are paramount. This research acknowledges limitations and the need for further exploration of the social and political landscape. Ultimately, Nepal's uranium resources present a double-edged sword – economic opportunity intertwined with environmental challenges. Moving forward, robust policies, responsible practices, and informed decision-making are crucial to ensure any potential resource extraction benefits the nation and its people. Future research should prioritize field studies to understand the resource potential and environmental impact, analyze social and economic effects, and develop frameworks for sustainable uranium mining that put environment, communities, and responsible resource management first. By addressing these points, future research can guide Nepal towards a sustainable future where potential benefits from uranium are balanced with environmental and social well-being.

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THE CATASTROPHIC 2012 SETI RIVER FLASH FLOOD IN NEPAL: CAUSES, IMPACT, AND LESSONS LEARNED

Bijay Baral*

Central Department of Geology, Tribhuvan University, Kritipur, Kathmandu Nepal

*Corresponding author Email: bijaybaral68@gmail.com

ABSTRACT

The Himalayan mountain ranges, characterized by dynamic geological and climatic conditions, are highly susceptible to natural disasters such as landslides and flash floods. The Seti River flash flood in Nepal in May 2012 is a poignant illustration of the catastrophic ramifications of such occurrences on local communities and infrastructure. This review article deliberates on the root causes, repercussions, and insights from the 2012 flash flood, underscoring the criticality of early warning systems and comprehensive preventative measures. Precipitated by intense rainfall and ensuing landslides, the flood led to the loss of 72 lives, displacement of numerous families, and substantial devastation of property and livelihoods. The study accentuates the pressing necessity for enhanced disaster preparedness and management strategies in the Himalayan region, encompassing improved land-use planning, resilient infrastructure, community awareness, and proactive disaster response tactics to alleviate the repercussions of future flash floods.

Keywords: *Flash floods, Himalayas, Landslides, Natural Hazards*

Introduction

The Himalayan region, spanning several countries, including Nepal, is one of Earth's most geologically active areas. The steep topography, unstable geological structures, frequent seismic activity, and intense seasonal rainfall make the region highly prone to natural hazards such as landslides and flash floods (Dahal& Hasegawa, 2008; ICIMOD, 2007). The complex climate, with significant seasonal rainfall, exacerbates these risks, making the region a cause for concern. Flash floods, in particular, are rapid and unpredictable, often causing extensive damage to life and property (Barredo, 2007).

Flash floods, the sudden and devastating consequences of intense rainfall, glacial lake outbursts, or landslide dams, are a recurring nightmare and a harsh reality in the Himalayas. These flash floods annually pose significant risks to thousands of people and critical infrastructure, from massive mountain-scale events to minor slope failures. With the specter of climate change looming large, these threats are projected to escalate, underscoring the urgent need for effective disaster management strategies.

An instance of such devastation unfolded on May 5 2012, when a glacial-fluvial surge struck the Seti River near Pokhara, Nepal. The flood, which swiftly engulfed Sadal Village and Kharapani, resulted in the tragic loss of 72 lives, displacement of numerous families, and obliteration of infrastructure and livelihoods. Despite the stark reality of such risks, Nepal has yet to establish comprehensive flash flood forecasting and management systems. This paper delves into the Seti River flash flood, its causes, impacts, and potential implications for similar regions, such as the need for improved early warning systems, better land use planning, and enhanced disaster response capabilities.

Study Area

The Seti River originates from the Annapurna Himalaya range and flows through the vulnerable Pokhara Valley, known for its landslide susceptibility (Poudel et al., 2020). Enriched with calcium from the surrounding calcareous landscape, the river is a vital resource for the local economy. However, it poses significant flood risks due to settlements along its fragile corridor (K.C., 2012). The Seti River is perennial in Nepal, renowned for its origins in the Annapurna Himalaya range and its susceptibility to disasters like landslides. Characterized by its three snow-fed tributaries and rich calcium content, the river holds religious and economic significance, featuring picturesque gorges and valuable construction materials. However, settlements and sand and stone extraction along the river have significantly increased the risk of flood hazards, posing a severe threat to human life and property.

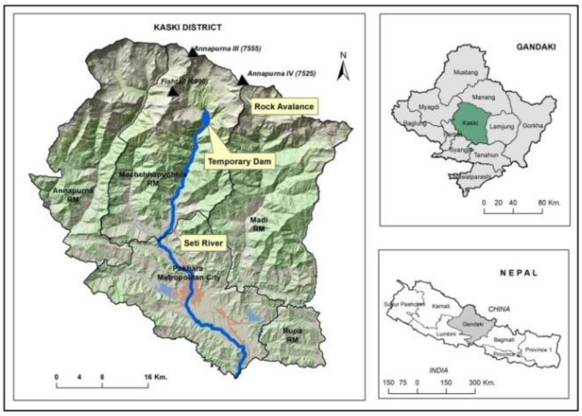

Figure: Location of the study area

Methods and Materials

Gathering information on the causes, impacts, and responses to the 2012 Seti River flash flood through a comprehensive analysis of existing studies, reports, and data. Identifying common factors and differences by comparing the 2012 incident with other flash flood events.

Findings and Discussions

Causes of the Flash Flood

A combination of natural and anthropogenic factors triggered the Seti River flash flood. Unusually heavy rainfall led to landslides, which blocked river flow and created temporary natural dams. The eventual breach of these dams released massive amounts of water and debris downstream, causing the flash flood.

Figure: Flooding at Seti River

Impact on Human Life and Property

The devastating deluge had catastrophic consequences for the communities nestled along the banks of the Seti River. According to reports, 72 lives were tragically lost, and five individuals were injured, leaving behind a profound sense of grief and loss. The relentless waters swept away many of the deceased, leaving heartbreak and devastation in their wake. As a result, many children were left without parents to care for them. The floodwaters also inflicted heavy losses on vital agricultural resources such as livestock and crops, further compounding the suffering of the residents. Furthermore, the destructive force of the floodwaters decimated residential structures, businesses, and crucial infrastructure, including suspension bridges, roads, and essential electric poles. The economic impact was devastating, especially for those who depended on farming and small businesses along the riverbanks to sustain their livelihoods.

Socio-Economic Profile of the Affected Areas

The affected area, the Seti River Flood Disaster Area (SRFDA), includes several villages and parts of Pokhara Metropolitan City. The SRFDA had a population of 289,358 residing in 76,556 households as of the 2011 census. Out of these, 810 households were within 50 meters of the river, highlighting the high risk these communities face. The unusual flooding in the Seti River devastated the life and property along the river corridor. It has affected many human lives, livestock and poultry, land, houses and physical infrastructures, and social and economic aspects. Many children became orphans, which brought the uncertainty of their upbringing. In addition to the loss of lives and their social consequences, flash floods annually lead to substantial economic damages in various regions worldwide.

Figure: Cultivable Land converted into Flood Plains after Flood

Similarly, the Seti flash flood devastated Kharapani's financial life, destroying local economic activities. People suffered losses to their businesses, employment opportunities, and physical assets, leaving many survivors without jobs. Before the tragic event, Kharapani was a thriving small business centre catering to tourists and residents from nearby villages. The town's attractions, including a hot spring, open spaces, and a beautiful natural landscape, drew in many domestic and international tourists for activities such as enjoying hot baths, engaging in sports, picnicking, and

sightseeing.

Figure: Affected Kharapani Area

Conclusion

The Seti River flash flood constituted a catastrophic event resulting in the loss of 72 lives and substantial destruction of physical assets. The disaster inflicted economic repercussions and profoundly impacted the social and environmental fabric. However, it also served as a stark reminder of the importance of continual monitoring and implementing comprehensive preventive and protective measures. The accelerated urbanization observed in the Pokhara Valley has given rise to settlements along the Seti River basin, notably susceptible to such calamities. Consequently, it is imperative to exercise vigilance over these settlements, and if their vulnerability is ascertained, relocation measures to safer areas should be initiated. Additionally, mitigating damage resulting from such events could have been minimized by establishing early warning systems. Regrettably, the absence of effective early warning mechanisms compounded the magnitude of the losses incurred, highlighting the need for their immediate implementation.

Furthermore, the text underscores the importance of heightening awareness and knowledge regarding flash floods at all strata of society, including communities, practitioners, and policymakers and empowering communities to assume a pivotal role in managing flash floods. This involvement encompasses preparedness, adaptation, and mitigation measures. The text highlights the necessity of a comprehensive, proactive approach to mitigate the impacts of flash floods, encompassing geological considerations, urban planning, early warning systems, public awareness, and community empowerment.

Recommendations

- **Early Warning Systems**: Implementing advanced monitoring and early warning systems to deliver timely alerts to at-risk communities.
- **Land-Use Planning**: The development and enforcement of land-use policies to restrict settlement and construction in high-risk flood zones. These policies should also promote the use of flood-resistant building materials and techniques.
- **Community Awareness and Preparedness**: Regular implementation of community education programs focusing on disaster preparedness and response strategies.
- **Infrastructure Resilience**: Investment in resilient infrastructure capable of withstanding natural disasters, including reinforced bridges and flood-resistant housing.

Future Research

Further research should emphasize long-term recovery and resilience-building strategies for high-risk communities in the Himalayan region. Additionally, studies should be conducted to explore the impacts of climate change on the frequency and intensity of flash floods in the area.

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UNDERSTANDING THE DEBRIS FLOW

[1]Amrit Marasini*, [2]Rajan Tiwari

[1]*Department of Geology, Tri-Chandra Multiple Campus, Tribhuvan University, Kathmandu, Nepal*
[2] *Central Department of Geology, Tribhuvan University, Kirtipur, Kathmandu, Nepal*

*E-mail: amritmarasini@gmail.com

ABSTRACT

Debris flows are hazardous geological events characterized by the rapid downslope movement of water-saturated, loose material. These flows, comprising a mixture of clay to boulders, can travel at velocities between 5 to 50 km/h or more. Debris flows initiate in areas with unconsolidated material, often triggered by intense rainfall, rapid snowmelt, volcanic activity, or earthquakes. They are categorized into hillslope, channelized, debris avalanches, and debris torrents based on their formation and movement patterns. Understanding the dynamics and hazards associated with debris flows involves numerical modeling, which can predict flow paths, volume, and velocity. Mitigation strategies, such as avoiding hazardous areas, controlling erosion, constructing protective structures, and implementing warning systems, are critical for reducing the impact of debris flows. Effective management and planning require detailed hazard maps and risk assessments to safeguard infrastructure and communities in vulnerable regions.

Keywords: *Runout, Transport, Numerical Model*

INTRODUCTION

The movement of rock, earth, or debris masses down a slope is a landslide (Cruden 1991). A Debris flow is a type of landslide in which mass is saturated or oversaturated with water, thus forming a slurry that flows down the slope. It is an intermediate form between a landslide and a sediment-laden flood, with the characteristics of mixed loose solid material. Landslides are made up of a coherent block of material that slides over surfaces. Debris flows, by contrast, are made up of "loose" particles that move independently within the flow. Debris flows are differentiated from floods by the higher unit weight of flow (>1.3 tons/m3) and gradient (>1%).

Table 1: *Classification of Landslide by Varnes (Varnes 1978)*

Type of moveme nt	**Type of Materials**		
	Engineering Soil		**Bed Rock**
	Predominately Fine	*Predominantly Coarse*	
Fall	Earth fall	Debris fall	Rockfall
Topple	Earth topple	Debris topple	Rock topple
Slide (rotation al/transl ational)	Earth slide	Debris slide	Rock slide
Lateral spread	Earth spread	Debris spread	Rock spread
Flow	Earth flow	Debris flow	Rock flow
Complex	Combination of two or more principal types of movement		

Flow: A flow contains a high proportion of unconsolidated, saturated material suspended in water which carries various material ranging in shape and from clay particles to boulders size and may also contain wood and plant debris. According to the material they contain and the speed of flow the types are characterized, including earth flows, mudflows, debris flows, creeps, and debris avalanches. The rate of flow may vary from 5 km/hr. to 40–50 km/hr. or even more in some extreme cases and cover several kilometers.

The flow initiates when unconsolidated material becomes saturated and can be triggered by intense rainfall, glacial melting, and earthquakes and precipitated by shallow landslides or in some cases by the collapse of a riverbed. Debris flows are most common in steep mountain areas with high rainfall or the regions that gain extreme rain burst within a short span of time.

TYPES OF DEBRIS FLOW

Debris flows are classified based on topographic and geological characteristics in following types:

1. **Hillslope Debris Flows**

It's also called open-slope debris flow as they form their own path down the valley slopes as tracks or sheets (Cruden and Varnes, 1996) before depositing material on lower areas with lower slope gradients or where the flow rates are reduced. The deposition area may contain channels and levees. The flow starts as sliding detachment of the material initiated during heavy rainfall, which subsequently breaks down into a disaggregated mass. The failure mass usually combines with surface water flow, which typically results in high mobility and run out.

2. **Channelized Debris Flows**

The debris flow occurs in the existing channel like valleys, gullies, depressions, hollows and others. Such flow has higher density, 80% solids by weight (Cruden and Varnes, 1996), and has a consistency equivalent to that of wet concrete (Hutchinson, 1988). Thus, giving them energy to transport boulders of significant diameter. The flow debris because of the mobilization and entrainment of sediments by extreme flows confined within stream valleys, which may include the collapse of natural landslide dams that may have partly or completely blocked channels and stream valleys for some period prior to the event

3. **Debris avalanches**

Debris flows in the inter-basins were mostly debris avalanches and, occasionally rockslides or soil-slips. They originated from the thin cover of colluvial deposits present on very steep (>45°), forested slopes. The catchment areas were generally limited to a few tens or few hundreds square meters. This suggests that the hydrogeological conditions prone to the failure of debris avalanches were extremely localized, and therefore quite difficult to detect with certainty.

4. **Debris torrents**

Debris torrents initiated in gorges or narrow valleys and caused by the failure or breaching of landslide dams, debris flow or snow avalanche blockages, and alternatively by the failure of embankments, check dams, or bridges, that released in sudden bursts, the accumulated debris. The flowing mass carried large boulders and blocks up to 3 m in diameter and delivered large volumes of debris, and organic material to the alluvial fans at the outlet of the main drainage channels.

DEBRIS FLOW GEOMETRY

1. Source Area / Initiation Zone

The source area is the origin of the debris flow where the initial movement of material occurs due to a triggering event such as intense rainfall, rapid snowmelt, volcanic activity, or an earthquake. The source area is typically located on steep slopes or in areas with loose, unconsolidated material and the area has a high rate of water infiltration which reduces soil cohesion. The size and characteristics of the source area determine the initial volume and composition of the debris flow, thus identifying source areas helps in hazard mapping and risk assessment.

2. Transport Zone

The transport zone is the pathway along which the debris flow travels from the source area to the deposition zone. This zone can be a natural channel, ravine, or valley that guides the flow downhill. Transport zone contains channels or ravines that confine and direct the flow direction. If the flow gains high velocity and energy, it enables the flow to pick up additional material and increase in volume, which can cause significant erosion and channel modification. The geometry and characteristics of the transport zone influence the speed, volume, and potential impact area of the debris flow, thus understanding the transport dynamics is critical for predicting flow paths and potential impact zones.

3. Deposition Zone

The deposition zone is the area where the debris flow loses energy and deposits the transported materials. This typically occurs when the slope flattens out, reducing the flow's velocity. Deposition zones are often found in valley bottoms, alluvial fans, or flat areas at the base of slopes (Fig 1). The deposition zone contains a mixture of sediments, from fine particles to large boulders and can cover large areas with thick deposits of debris. The extent and thickness of the deposition zone indicate the flow's potential impact on infrastructure, agriculture, and habitats, thus mapping deposition zones helps in planning and implementing mitigation measures.

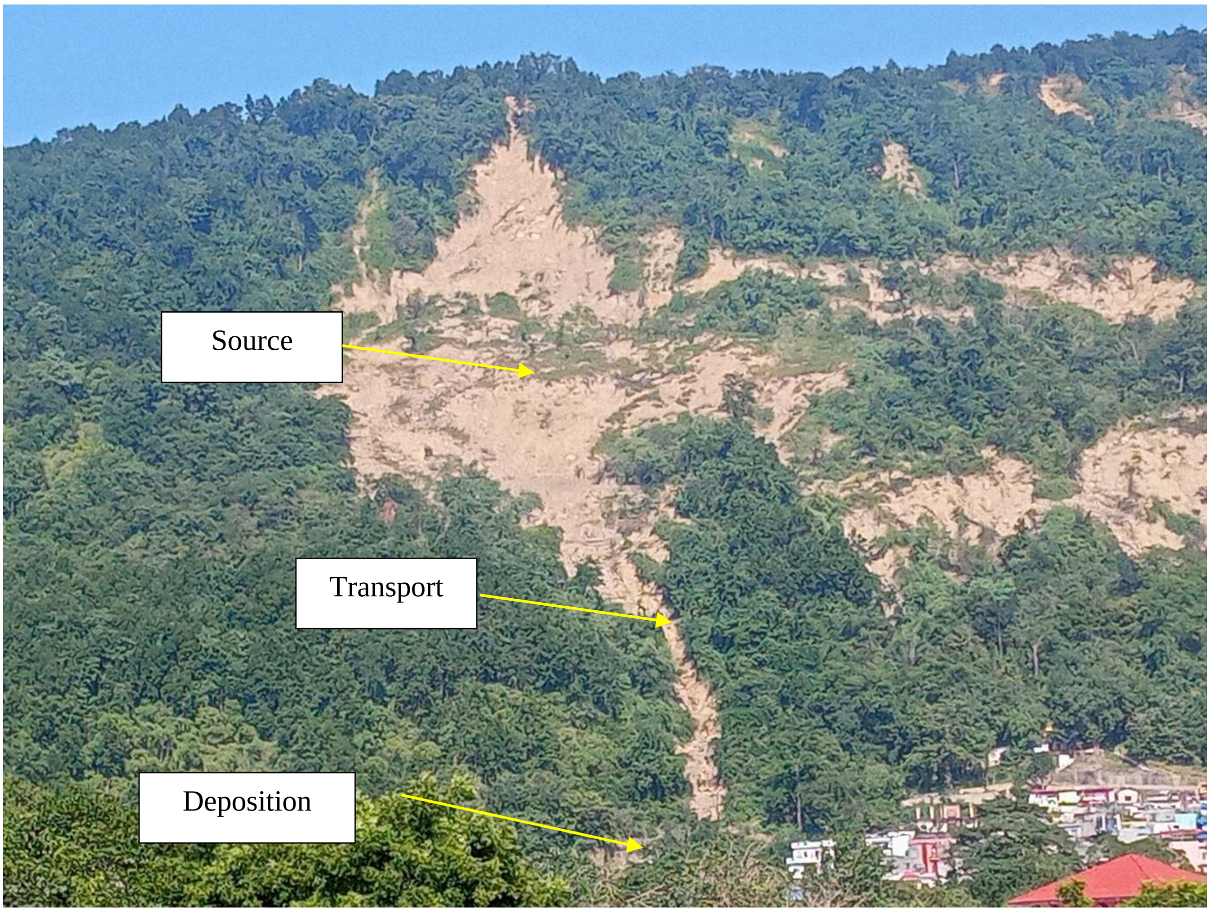

Fig 1: Parts of Debris flow observed in a landslide at Butwal, Rupandehi district, Nepal

DEBRIS FLOW MOVEMENT

A debris flow typically begins when a slope becomes unstable due to intense rainfall, rapid snowmelt, volcanic activity, or an earthquake. The force of gravity pulls the saturated material downhill. The steepness of the slope plays a critical role in initiating and sustaining the movement. Steeper slopes generally result in faster and more forceful flows.

Water infiltrates the soil and rock, increasing the pore water pressure, reducing the friction between particles, and making the material more prone to flow. The presence of water acts as a lubricant, allowing the debris to flow more easily. The mixture of water and sediment can behave like a fluid, enabling it to travel long distances. As the debris flow moves, internal shear forces cause the material to mix and shear. Larger particles and boulders are carried along with finer sediments, creating a heterogeneous flow. Depending on the concentration of solids and water, debris flows can exhibit both viscous and turbulent flow characteristics. Higher water content produces more fluid-like behavior, while lower water content leads to more friction and slower movement. Once initiated, debris flows often become confined to natural channels, ravines, or gullies. The confinement increases the flow's speed and erosive power. As the flow moves through the channel, it can pick up additional debris from the channel bed and banks, increasing its volume and mass. As the slope decreases or the flow reaches flatter terrain, the debris flow loses energy and begins to deposit the carrier material. During deposition, the flow sorts of materials by size and density, with larger particles settling first and finer particles traveling further.

DEBRIS FLOW DYNAMICS

Debris flow dynamics involves comprehending the complex processes and interactions that govern debris flows' initiation, movement, and deposition. This understanding is crucial for predicting their behavior, assessing risks, and developing effective mitigation strategies. Here are the critical aspects of debris flow dynamics:

Numerical models simulate debris flows' initiation, movement, and deposition, capturing the complex interactions between water, soil, and rock. By varying parameters such as slope angle, water content, and material properties, models help understand how different factors influence debris flow behavior.

Types of Numerical Models for Debris Flow

1. **Empirical Models:** This model is based on observation, where the empirical relationships derived from observed data are utilized to predict debris flow behavior. Empirical models are often more straightforward and faster to run but may require more detailed physical processes.
2. **Deterministic Models:** These models take a mechanical approach, utilizing physical equations to simulate the processes governing debris flow initiation, movement, and deposition. They provide more accurate and detailed predictions but require more computational resources and detailed input data.
3. **Probabilistic Models:** Probabilistic models account for the uncertainty in input parameters and model outputs using probabilistic methods. They are most valuable for risk assessment because of the probability of different debris-flow scenarios and their potential impacts.

Key Components of Numerical Models for Debris Flow

1. **Initiation Module:** It simulates the conditions that lead to debris flow initiation, such as slope stability analysis under different rainfall or seismic conditions.
2. **Transport Module:** It models the movement of the debris flow, including the effects of gravity, friction, and fluid dynamics.
3. **Deposition Module:** It simulates debris deposition as the flow loses energy, accounting for factors like slope angle and material properties.
4. **Hydrological Module:** It Incorporates the effects of rainfall, infiltration, and surface runoff on debris flow initiation and movement.

Examples of Numerical Models for Debris Flow

1. **SHALSTAB (Shallow Landsliding Stability Model):** This model predicts the potential for shallow landslides and debris

flows based on topography and hydrological conditions.

2. **DAN (Dynamic Analysis of Landslides):** It simulates the initiation, movement, and deposition of landslides and debris flows using a combination of empirical and mechanistic approaches.
3. **FLO-2D:** It's a two-dimensional hydraulic model that simulates the movement of debris flows over complex terrain.
4. **RAMMS (Rapid Mass Movements Simulation):** A model that simulates rockfalls, debris flows, and avalanches, providing detailed predictions of flow dynamics and impacts.

HAZARD ASSESSMENT AND RISK ANALYSIS OF DEBRIS FLOW

Predicting the flow path of debris flows requires numerical models to determine the likely paths and identify at-risk areas. Additionally, estimating the flow volume and velocity is crucial, and it can be achieved through various models that calculate the volume, speed, and runout distance of potential debris flows and these are critical factors for risk assessment. Once the path, volume, and velocity are predicted, it is vital to map the hazard zones by simulating different scenarios; these models can generate hazard maps that highlight the area's most likely to be affected by debris flows.

DESIGN OF MITIGATION MEASURES

Mitigation methods for debris flows refer to strategies and measures designed to reduce the risk, impact, and damage caused by debris flows. These methods aim to prevent debris flows from occurring, control their movement, protect people and property, and improve emergency response. Costa (1984) identifies four main categories of debris flow mitigation measures: avoidance of hazardous areas, grading control, clearing, drainage, protective structures, and warning and evacuation.

1. **Avoidance of Hazardous Areas:** Due to favorable conditions, the development of alluvial fans has been expected, but debris flow risk identification and mitigation are underdeveloped compared to water floods. Most studies focus on site-specific hazard assessments rather than regional analyses, leading to potential underestimation of debris flow risks on a larger scale.

2. **Control of Grading, Clearing, and Drainage:** Techniques to reduce erosion and control mobilized material include check dams, channel linings, revegetation, regrading of gully walls, and diversion dikes. However, check dams require maintenance; if not maintained, their failure can release more debris than natural torrents.

3. **Protective Structures:** These are necessary when hazardous areas cannot be avoided. Their purpose is to stop, slow, or divert debris flows. Unlike water flood measures, debris flow structures like canals often become blocked. Effective structures include steel or reinforced

concrete fences, open-work dams, and retaining and deflecting walls, commonly used in the Alps.

4. **Warning and Evacuation:** Providing direct warnings and evacuations for debris flows is challenging due to their sudden occurrence and high velocities. For rainfall-triggered debris flows, systems based on rainfall thresholds can warn and evacuate people, as implemented in the Lombardy Region.

DISCUSSION AND CONCLUSION

Debris flows are complex natural events that present considerable dangers to human life, infrastructure, and the environment. Their rapid onset and destructive power make them one of the most challenging landslides to predict and manage. Understanding the dynamics of debris flows requires a comprehensive approach that considers the geological, hydrological, and climatic factors contributing to their initiation and movement.

The classification of debris flows into hillslopes, channelized debris avalanches, and debris torrents highlights the diverse environments in which they occur. Each type has distinct characteristics and behaviors, necessitating tailored mitigation measures. For instance, hillslope debris flows form their paths and is often initiated by heavy rainfall. In contrast, channelized debris flows are confined to existing channels, leading to higher densities and transport capacities.

Numerical modeling is essential for predicting debris flow. There are three types of models: empirical, deterministic, and probabilistic. Empirical models give quick estimates based on observed data. Deterministic models use physical equations to create detailed simulations. Probabilistic models consider uncertainties, making them helpful in assessing risks.

Mitigation measures must combine avoidance, control, protective structures, and warning systems. Avoidance of hazardous areas is ideal but often impractical due to existing developments. Grading, clearing, and drainage control can reduce erosion and stabilize slopes. Protective structures like check dams, retaining walls, and deflection barriers are essential where avoidance is impossible. Warning and evacuation systems, though challenging to implement due to the sudden nature of debris flows, can save lives if effectively integrated with rainfall monitoring and early warning thresholds.

Debris flows are a significant geohazard that requires a detailed understanding of their initiation, movement, and deposition processes for effective management. Numerical models are indispensable tools for predicting potential debris flow paths, volumes, and velocities, aiding in creating hazard maps and risk assessments. Mitigation strategies should avoid high-risk areas, implement erosion control measures, construct protective infrastructure, and develop reliable warning systems. Integrating these approaches and reducing the impact of debris flows on communities and infrastructure is possible, enhancing resilience against these devastating natural events.

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