The Newsletter of the International Association of Sedimentologists

Issue 6, 2021

Dear IAS Members,

It was very nice to 'see' and chat to many of you at the 35th IMS, a fabulous meeting – I am sure that you all join me in congratulating the Organising Committee in doing an excellent job under very challenging circumstances.

Some of the highlights in this issue of the IAS Newsletter include the announcement of the venue for the 21st International Sedimentological Congress, a call for one of our ECS members to join the IAS Early Career Scientists Committee and the proposed IAS Bureau and Council for 2022-2026.

Enjoy!

Stephen Lokier, *General Secretary*

The 35th International Meeting of Sedimentology, Prague 2021

I think that we can all agree that the organisers of the 35th IMS did a fantastic job in bringing our community together (all be it, remotely) again this year. If there were any sessions that you missed or that you want to watch again then they will be available at the conference web site for one month.

A meeting report will feature in a future edition of the Newsletter.

Announcing the IAS' 21st International Sedimentological Congress, Beijing 2022

As those of you who attended the IMS will have learnt, the 21st International Sedimentological Congress will be held in Beijing between the 22nd and 26th August 2022. **Visit the website for full details.**

The International Sedimentological Congress (ISC) is organized every four years. The conference gathers participants from around the globe to discuss and share the most recent advances in the broad field of sedimentology. It offers oral and poster presentations in themed sessions, field trips and short courses.

Last call for registrations for the IAS sponsored International Conference of Fluvial Sedimentology – ICFS 2021

The IAS is proud to sponsor the ICFS again this year. This year's meeting will be held fully online with presentations from 16 invited speakers and two virtual field trips

The meeting will be hosted by **Seds Online**.

Registration is free but closes strictly on the 9th of July. **Register here**.

Apply now – Applications for the Judith McKenzie Field Work Award (Fall 2021 Session)

The **Judith McKenzie Field Work Award** aims to promote sedimentological field observations for the newest generation of Earth Scientists – MSc Students.

Up to 5 awards of €300 each, will be awarded twice per year to IAS student members. Since the award is only available for MSc students, proof of student status will be required. The awardee shall also receive a one-year IAS student membership, upon submission of their MSc thesis.

Applicants should apply for the Judith McKenzie Field Work Award via the **IAS website here**. The application requires submission of a grant proposal (written by the student) with budget and CV (template provided on the submission webpage), and a signed letter of recommendation from the student's supervisor.

Application deadline for the Fall 2021 Session is **31st September 24h00 Brussels Time (CEST, UTC+2).**

Join the IAS Early Career Scientists Committee!

Get involved!

The IAS Early Career Scientists Committee is seeking one new member! To apply, send a letter of introduction and a 2-page CV to Tracy Frank (glendonite@gmail.com) by August 31, 2021.

The Early Career Scientists Committee (ECSC) comprises early career scientists who represent the upcoming generation of sedimentologists, ensuring that their voice is heard in the IAS. An Early Career Scientist (ECS) is a scientist with no more than 7 years of full-time experience since completing their Ph.D. (excluding periods of parental or other care leave). ECSC members are active in sedimentological research as demonstrated by their publication record (minimum 3 research articles in peer-reviewed publications). The committee organizes activities for ECSs at IAS meetings and oversees the Post-Doctoral Grants Scheme. The appointed member will serve through to the end of the current term, the 2022 International Sedimentological Congress, and be eligible for reappointment to a second four-year term.

Proposed IAS Bureau and Council 2022 – 2026

As per the Statutes of the IAS, it is the duty of the current IAS Bureau to propose a list of nominated Members for election to the Bureau and Council for the succeeding four-year term. With this in mind, the Bureau are happy to announce that the following Members of the IAS are proposed to stand for election to the IAS Bureau and IAS Council for the period 2022-2026.

Name	Position	Affiliation
Cathy Hollis	President	University of Manchester, Manchester, UK
Stephen Lokier	General Secretary	Bangor University, Bangor, UK
David Van Rooij	Treasurer	University of Gent, Gent, Belgium
Daniel Ariztegui	Past President	University of Geneva, Geneva, Switzerland
Karoly Nemeth	Vice President	Massey University, Palmerston North, New Zealand
Chelsea Pederson	Vice President	Ruhr-Universität Bochum, Germany
Joanna Pszonka	Vice President	Polish Academy of Sciences, Krakow, Poland
Peir Pufahl	Vice President	Queen's University, Kingston, Canada
Mariana Tuchkova	Vice President	Russian Academy of Sciences, Moscow, Russia
Gonzalo Veiga	Vice President	University of La Plata, La Plata, Argentina
Alex Brassier	CE Sedimentology	University of Aberdeen, Aberdeen, UK
Peter Swart	CE The Depositional Record	University of Miami, Miami, USA
Elias Samankasou	CE IAS Special Publications	University of Geneva, Geneva, Switzerland
Council	**Position**	**Affiliation**
Marco Brandano	Council	University La Sapienza, Rome, Italy
Marc Aurell Cardona	Council	University of Zaragoza-IUCA, Zaragoza, Spain
Fulvio Franchi	Council	Botswana International University of Science and Technology, Botswana
Tracy Frank	Council	University of Connecticut, Storrs, USA
Monica Sanchez Roman	Council	Vrije University, Amsterdam, The Netherlands
Xiumian Hu	Council	Nanjing University, Nanjing, China

Members of the Association may propose alternative lists for a complete Bureau and Council, if any, to the Bureau up to 6 months before the 4-Yearly Annual General Assembly. Such an alternative list shall be signed by at least 50 Members Entitled to Vote and shall be approved in writing by the nominees mentioned therein. If no alternative list has been proposed, the list proposed by the Bureau shall be adopted by a simple majority of the votes cast by the Members present or represented. If an alternative list has been proposed, a vote shall be taken at the General Assembly and the list receiving the majority of the votes shall form the next Bureau and Council.

IAS Grant Reports

The IAS supports postgraduate and post-doctoral researchers via our various grant schemes.

At the end of this Newsletter you will find some of the latest grant reports received by the IAS.

You can also read recent and past Grant Reports from IAS members who have benefited from **Post-Doctoral** or **Post-Graduate** grants here.

Closing soon!
Are you our new IAS Executive Officer?

The IAS INPO is looking to engage an *Executive Officer* (EO) as a self-employed service provider. The EO will be the primary point-of-contact of the IAS INPO for the society and will serve as the interface between the *Treasurer* and *General Secretary*, on the one hand, and the IAS Members on the other. For the execution of his/her tasks, the EO can rely on the help of the IAS *Office Manager* and *Webmaster*, at the IAS "back office", located at Ghent University, Belgium.

Profile
The EO must be a sedimentologist holding a PhD. Candidates who have been long-term members of the IAS will be looked on favourably as will persons with previous experience of an active contribution to the activities of a sedimentology or related society. The EO should have strong interpersonal skills with a positive problem-solving attitude. The EO cannot combine his/her tasks with a decision-making mandate in the IAS Bureau, Council or Early Career Scientists Committee. The candidate must be highly proficient in spoken and written English. Proficiency in other languages is beneficial.

Tasks package
The EO's services will mainly be of an administrative nature, including frequent communication with and provide support for the society members and the Bureau. In order to be able to perform these services as efficiently as possible, the EO will be expected to attend all IAS Bureau Meetings. The range of EO services can be summarized under the broad themes of "member services", "bureau services", "web services" and "administrative services".

Service agreement
The EO will operate for the IAS INPO as a self-employed service provider under a service agreement. An annual evaluation of the collaboration between the parties is foreseen. The first term of the new EO position will start by Fall 2021 (or earlier) for a definite period to Summer 2024. The service agreement can be renewed for another period of 4 years.

The nature of the services are expected to take up approximately 20 hours of work per week on average, which the EO will be free to organise fully autonomously. Some activities however may require – during certain periods of time – an increased activity and presence of the EO; for example, a bureau meeting or a conference where the EO's presence will be required for the entire duration of such event. The compensation of the EO will be fixed at a daily rate under mutual agreement, to be detailed in the service agreement.

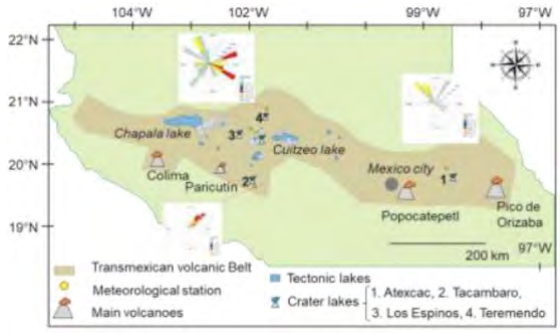
Location
Although the IAS Office operates from Ghent University, Belgium, the EO is free to choose where he/she will execute the services. However, for the proper execution of the services, the EO is expected to attend meetings or discuss matters in person with the office staff on a regular basis and whenever either of the parties would request so. Therefore, it may be favourable that the EO resides within the European Union. This will also allow the EO to work in the same time zone (CET-CEST) with the IAS Office.

Application procedure
All inquiries (e.g. *full list of services*) and applications should be addressed to Prof. dr. David Van Rooij, Treasurer of the IAS INPO, by E-mail through treasurer@sedimentologists.org. The application package should contain a motivation letter, Curriculum Vitae, and contact details of two persons serving as a character reference. The applications will close on **30th June 2021** at **18h00 CEST**.

Call: Post-doctoral fellowship in lacustrine sedimentology/geochemistry within the framework of the project Holmecl 2020-2025 funded by the Belgian research agency FNRS

Proposal summary:

HolMeCl will combine the acquisition and analysis of new accurately-dated sediment sequences from four crater lakes in Central Mexico. Central Mexico represents a highly sensitive area for the study of climate variability as it lies beyond the northern limit of the Intertropical Convergence Zone and in the southern part of the area influenced by the North American Monsoon. The chosen study area (see map below), i.e. the Trans Mexican Volcanic Belt, displays widespread crater lakes that are closed systems with good potential to record climatic variability in their sediment sequences.



The multisite approach will be combined with a multi-proxy approach to reduce the potential bias related to the climate sensitivity of a unique proxy. Short sedimentary sequences will be used to estimate the sedimentation rate and to determine the temporal resolution and also to validate the proxies by comparison with local meteorological data. The age model will be constrained by a combination of geochronometers, tephrostratigraphic markers and varves if present. Using the validated proxies the long sedimentary sequences will be interpreted in terms of paleo-ENSO records. The comparison of these new accurately dated long sequences with published paleo-ENSO records for the tropics would bring a more global picture of ENSO variability over the Holocene at a decadal or subdecadal resolution, if the sedimentary records are annually laminated.

Required expertise:

We seek a post-doctoral researcher in Earth Sciences with experience in lake studies to participate in a paleoclimate project on El Niño Southern Oscillation (ENSO) variability. The scientist would be a full-time earth science researcher with field experience in lake. He/she must demonstrate an expertise in sedimentology and/or geochemistry with practice in age model reconstruction, XRF-core scanner analyses & time-series analyses. The scientist would be responsible for the elaboration of the composite long cores using CT-scan and magnetic susceptibility profiles, he/she will construct the age-depth model, he/she will prepare and observe thin sections and count the laminations if any, he/she will conduct the time-series analyses & will be responsible for the paleo-record reconstruction, interpretations and comparison with regional paleo-records.

Conditions:

The proposal is a collaborative project between the University of Liege (ULiège, N. Fagel) and Brussels (ULB, N. Mattielli, K. Fontijn) in collaboration with Mexican partners (I. Israde, INICIT, Morelia). The scientist will work at the University of Liege for three years from the first January 2021.The salary corresponds to a fulltime researcher defined by the Belgian regulation (gross salary ~48000 EU/year, net salary ~2500 EU/month).

Application:

Any person who is interested by the present call must sent a full application file by email to Nathalie Fagel (nathalie.fagel@uliege.be) as soon as possible and before the 31th of August 2021. The retained candidate will be selected after an online interview in September. The application must include a scientific CV with a publication list, a letter of motivation and the names of two referees to be contacted.

Don’t miss out on all that the IAS has to offer RENEW TODAY!

The IAS is the home of Sedimentology.

We are very proud of our ability to keep our membership fees so much lower than most other professional societies.

You can find a complete list of the benefits of membership of the IAS **website**.

You may also consider becoming a full member for 5 years at a cost of only €100 – effectively getting one year’s membership for free. We also offer ‘lifelong’ membership for just €400.

The Journals of the IAS

For a quick overview of the latest issues of **Sedimentology, Basin Research** and **The Depositional Record**, follow these links:

- **Sedimentology**: directly at **Wiley** or via the **IAS website** (after login) for member access
- **Basin Research**: directly at **Wiley** or via the **IAS website** (after login) for member access
- **The Depositional Record**: directly at **Wiley** or via the **IAS website**

All of the journals of the IAS are active on Twitter. Stay up to date on the latest news and papers in @sedimentology by following the IAS journals: @JSedimentology, @DepositRecord, @BasinResearch.

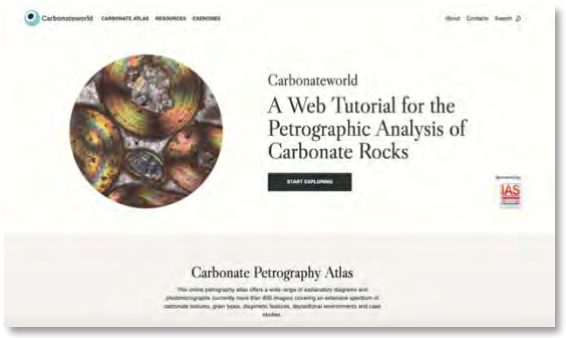
Apply Now – Applications for Institutional Grants (Fall 2021 Session)

Twice a year, IAS awards an **Institutional Grant** of maximum 10,000 Euro, which is intended to support capacity building initiatives in less developed countries (LDCs). Grants will allow earth science departments in LDCs to acquire durable sedimentological equipment for teaching and research, or tools that can be used by all geology students. The grant application should thus clearly demonstrate how the grant will increase the recipient's capacity to teach sedimentology at undergraduate level in a sustainable way.

Applications have to be submitted via the **IAS website**. Application deadline for the Spring 2021 Session is **31st September 24h00 Brussels Time (CEST, UTC+2).**

More information about the Institutional Grant Scheme and guidelines on how to apply can be found on your membership profile.

Check out these terrific free online resources proudly sponsored by the IAS….

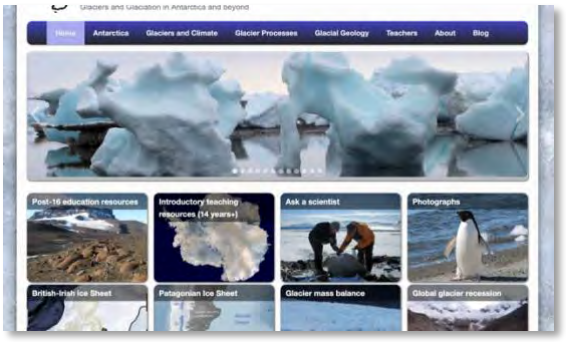


Carbonateworld is an online atlas containing more than 800 images covering an extensive spectrum of carbonate textures, grain types, diagenetic features, depositional environments and case studies. The images are organised in categories and subcategories (e.g., carbonate rock classification, skeletal grains, ooids, corals, burial diagenesis etc.) and are frequently updated with new material.
https://carbonateworld.com/

Seds Online is an free to access online initiative that provides an interactive, adaptable and accessible online platform for anyone with an interest in the field of sedimentology.

Seds Online welcomes members at any career stage, from both industry and academia!

https://sedsonline.com: Twitter @Seds_Online



The Antarctic Glaciers website is a fabulous resource for anyone interested in global glacial processes, landforms and sedimentology – despite the name, this site goes way beyond Antarctica!

www.AntarcticGlaciers.org

Follow the IAS on Social Media

Follow the IAS on Facebook, Twitter, WeChat and LinkedIn to keep up to date with all of the latest news, announcements and happenings.

@sedimentology and IAS沉积学之家

The IAS still pays the APC for papers accepted in The Depositional Record!

The Depositional Record is a fully open access journal publishing high quality articles from across the field of Sedimentology. The journal covers all timescales, from Ancient to Modern, and welcomes articles that emphasise the application of sedimentary processes to the study of paleoclimate, changes in the chemical environment, ocean acidification, extra-terrestrial sedimentology, and the application of genetic methods to understanding sedimentological processes.

Article publication charges are still fully covered by the IAS but this will have to change soon, so submit your paper today!

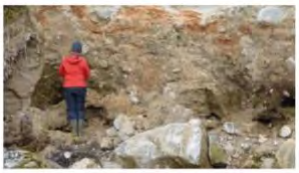
IAS Regional Correspondents

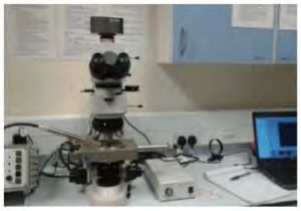
IAS Regional Correspondents are your local hotline to the IAS.

Check out the News Feed to see what is happening in your local community. At this link you will also be able to select your correspondent and even elect to receive information from multiple correspondents.

IAS Regional Correspondents are IAS Members who have volunteered to act as a representative between sedimentologists in their region and the IAS. If you know of any sedimentology events going on in your region, then please get in touch with your Regional Correspondent and let them know. Similarly, if your region lacks a Regional Correspondent (see the map here) and you would like to propose an IAS Member (Full or Student), or yourself, for this position then please send an email to the General Secretary.

Apply Now – Applications for Post-Graduate Research Grants (Fall 2021 Session)





Up to 10 research grants, each to a maximum of €1,000, are awarded twice a year to **IAS Post-Graduate Student Members**. This grant scheme is designed to support PhD students in their studies and research. Post-Graduate Research Grants can be used to (co-)finance fieldwork, acquisition and analysis of data, visits to other institutes to use specialized facilities, etc.
Applications must be submitted via the IAS website. Application deadline for the Fall 2021 Session is **31st September 24h00 Brussels Time (CEST, UTC+2).**
More information about the Post-Graduate Grant Scheme and guidelines on how to apply can be found on your membership profile.

Apply Now – Applications for IAS Post-Doctoral Research Grants (Fall 2021 Session)

IAS Post-Doctoral Research Grants are intended as a seed to a assist Early-Career post-doctoral researchers in either establishing a proof of concept, in order to support applications to national research funding bodies, or to fund areas of a project that were not included in the original project scope.

Up to 4 grants, each to a maximum of €2,500, are awarded twice per year to Early Career IAS members.

The application requires submission of a research proposal with budget and CV (template provided on the submission webpage, and a letter of support from the researcher's supervisor, line manager or Head of School. More details about the application procedure can be found on your membership profile.

Application deadline for the Fall 2021 Session is **31st September 24h00 Brussels Time (CEST, UTC+2).**

Eligibility:
· Applicants must be full members of the IAS.
· Applicants must have secured their Ph.D. within the previous 7 years.
· Applicants can only benefit from a Post-Doctoral grant on one occasion.

IAS POSTGRADUATE GRANT SCHEME REPORT, 2nd Session 2020 (Autumn Session)

Exploring the underlying controls for changing provenance character of a fluvial to overlying marine deposit: The Neogene Siwalik Succession, Eastern Himalayan Foreland Basin

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Introduction

This research is planned in the eastern Arunachal Pradesh most proximal part of the probable Yalu-Brahmaputra paleodrainage system carrying the Transhimalayan detritus into the Siwalik Foreland Basin (SFB). My present work on the lithostratigraphy and board depositional environment from the Siwalik succession of the Likabali area, eastern Arunachal Pradesh reveal the marine influence at two different levels (Debnath et al., 2021). The lowermost part of the succession, from 0 to ~270 m, Lower Siwalik Dafla Formation consists of fine to medium grained sandstone beds of dm- to several meters thick alternating with mudstone beds of dm thick; rarely mudstone beds attain a thickness up to 7 meters, represents a shallow marine depositional environment (Debnath et al., 2021). Between 270m to ~3300m, the succession dominated by thicker amalgamated fine to very coarse grained sandstone beds (thickness up to 20m) with rare mudstone beds (thickness 10-30cm) is the Subansiri Formation, interpreted as a deposit of an axial braided river like present day Brahmaputra (paleo Brahmaputra) (after Taral et al., 2019, Chakraborty et al., 2020; Debnath et al., 2021). Around 850m thick succession overlying the Subansiri Formation, which is characterised by the repetitive occurrence of meter-

scale thick tabular sheet like mudstone-siltstone heterolithic beds regularly alternating with fine to coarse grained sandstone beds is the Siji Formation. Less frequently decimeter- to meter thick, pebbly sandstone and conglomerate beds also occur within this formation. The Siji formation is interpreted as shallow marine fan deltaic deposit (Chakraborty et al., 2020; Debnath et al., 2021). The Uppermost Kimin Formation (~750m thick) is characterized by typical conglomerate dominated (bed thickness 2-13m) unit with subordinate proportion of pebbly sandstone and fine to coarse grained sandstone (bed thickness 15-60cm) units, represents a deposit of alluvial fan system (Lang et al., 2016; Debnath et al., 2021).This present proposed research work aims to determine how the relative contribution of the Transhimalayan and Himalayan sediments changes from the Middle Siwalik Subansiri fluvial deposit to the overlying marine succession of the Siji Formation. The decrease in the contribution of the Transhimalayan sediment has been reported by the previous workers but has not been interpreted properly in conjunction with the depositional processes and paleocurrent pattern. There may be multiple reasons for this change in the provenance signal either related to the change in the depositional regime or tectonic factors affecting transportation from a particular provenance terrain. The principal aim of the proposed work is to document the change in the provenance contribution and to explain the reason for this change.

Methodology

Five hundred grains from each of 57 thin sections from the Siwalik Group of the Siji River section were point counted using the Gazzi-Dickinson method under the petrographic microscope using automated stepper stage (Ingersoll et al., 1984; Zuffa, 1985). Sandstones were classified according to their main components (Q = quartz; F = feldspars; L = lithic fragments), considered only where QFL exceeds 10% and listed in order of abundance (e.g., in a feldspatho-quartzose sand Q > F > 10% QFL > L) (Garzanti 2016). All counted grains were grouped into six categories according to the classification scheme of Dickinson and Suczek (1979): monocrystalline quartz (Qm), polycrystalline quartz (Qp), plagioclase feldspar (P), potassium feldspar (K), sedimentary lithic fragments (Ls), metamorphic lithic fragments (Lm), and volcanic lithic fragments (Lv). The following calculations are performed: Q=Qm+Qp, L=Ls+Lm+Lv, and Lt (total lithic fragments) =L+Qp. The point counting results, i.e., the modal compositions, were plotted on Q_t-F-L and Qm-F-Lt ternary diagrams to explore the tectonic setting of the

provenance areas and to show changes in the tectonic setting among different formations of the Siwalik Group. In addition, for deriving the Metamorphic Index (MI) value for each sandstone sample, every metamorphic lithic fragment during point counting process is classified following the methodology described by Garzanti & Vezzoli (2003) for better understanding of erosional history hinterland. For qualitative assessment of tHM-suites transparent heavy minerals were identified during petrographic study of sandstone samples under microscope.

Conglomerate clast counts were conducted on the conglomerate beds of the Subansiri Formation and the Siji Formation. We selected clear outcrops with areas of 1m×1m to perform clast lithology counting following the method of described by Najman et al., 2009 and a minimum count of 100 clasts (>1cm in diameter) was performed at each site. The clasts are assigned to one of eight categories: quartzo-feldspathic gneiss, schist, mafic volcanic clast, mafic igneous clast excluding volcanic rock, quartzite, clastic sedimentary clasts excluding quartzite, granite and coal clast. Only those clasts clearly identifiable as igneous by the presence of acicular crystals, phenocrysts, or clearly identifiable interlocking igneous textures, are assigned to igneous category.

Attitude of foresets of planar cross beds and *ab*-plane of imbricated clasts were considered for paleocurrent measurement. Since the Siwalik Group is a gently plunging folded succession (plunge amount ~20°), paleocurrent data were corrected by two consecutive rotations, first for plunge and again for the tilt of the rotated bedding plane (cf. methodology described by Potter and Pettijohn, 1977).

Results

Sandstone petrography

Subansiri Formation

The Subansiri sandstones are fine to coarse grained moderately sorted feldspatho-litho-quartzose to litho-feldspatho-quartzose with abundant mica(biotite>muscovite), medium to high grade metamorphic, numerous volcanic/metavolcanic and granitic rock fragments. In Q_tFL tectonic provenance discrimination ternary diagram all samples of the Subansiri sandstone fall within recycled orogen. Whereas in Q_mFL_t ternary diagram most of the samples concentrate within mixed source domain with few within quartzose recycled to dissected arc domain. Recalculated proportion of metamorphic (48.39±9 %), volcanic (15.79±8.6%), sedimentary (26.24±10.3%) and plutonic (9.58±4.2%) rock fragments are characteristic of varied rock fragment population of

the Subansiri sandstone (Fig. 2). Metamorphic index of the Subansiri sandstone varies from 227 to 323 (Fig. 3). A moderate to rich amphibole, garnet dominate tHM suite with kyanite, sillimanite and pyroxenes characterizes the Subansiri sandstone.

Siji Formation

The Siji sandstones are fine to medium grained moderately well to moderately sorted lito-quartzose to litho-feldspatho-quartzose with very low to low grade metamorphic and sedimentary/metasedimentary rock fragments. In Q_tFL tectonic provenance discrimination ternary diagram all samples of the Siji sandstone fall within recycled orogen. Whereas in Q_mFL_t ternary diagram the samples share both the mixed source and quartzose recycled domain. Recalculated proportion of metamorphic (58.23±8 %), volcanic (1.99±1.7%), sedimentary (38.80±9.7%) and plutonic (0.99±2.1%) rock fragments are characteristic of the Siji sandstone (Fig. 2). Metamorphic index of the Siji sandstone varies from 156 to 234 (Fig. 3). A poor to moderately poor amphibole, epidote. tourmaline dominated tHM suite with few garnet characterizes the Siji sandstone.

Clast lithology

Conglomerate clast composition in upper part of the Subansiri Formation is relatively more variable than the Siji Formation and mainly consists of clasts of quartzite (48.5-59%), volcanic rock particularly basalt (7.8-13%), quartzo feldspathic gneiss (4-10.6), schists (8-14.9%), granite (3-11%) with few mafic plutonic rocks and mudstone clasts. Most of the clasts are sub rounded to well rounded (Fig. 4). A number clasts >10 cm long axis length (largest 17 cm), with modes consistently between 2 to 4 cm. Whereas conglomerate clast composition of the Siji Formation is simple and mainly consists of clasts of quartzite (55-67.3%), sedimentary rocks particularly fine grained sandstone and few mudstone (12.3-25%), schists (3-22.5%) with few quartzo feldspathic gneissic clast (0.9-5.4%), volcanic clast (1.2-3.8%) and coal clast (1.5-3.6%) (Fig. 4). Granite and mafic plutonic rock as conglomerate clast is also occurred rarely within the Siji conglomerate. Generally, long axis length of clasts of the Siji conglomerate is higher than the Subansiri conglomerate, with modes between 3 to 8 cm and length of the largest clast is 27 cm.

Paleocurrent

Overall a unidirectional paleoflow towards south to southwest indicate an axial river system during deposition of the Subansiri Formation. Again in the Siji Formation paleocurrent pattern shows a high dispersion with strong bipolar bimodal component (Fig. 1).

Conclusion

A more varied rock fragment population Subansiri sandstones (age ~ 7to 3.5 Ma after Debnath et al., 2021 and reference therein) where volcanic/ metavolcanic and granitic rock fragments are frequently recorded in significant amount with sedimentary and metamorphic rock fragments (Fig. 5). Lower proportion of sedimentary rock fragment, higher proportion of high grade metamorphic rock fragment (lm4~19.5% and Rm5~11.5%) (Fig. 6), increase in plagioclase mineral (maximum up to 11.8%) content and abundant presence of high-grade metamorphic minerals such as kyanite and sillimanite in amphibole dominate tHM suite are the evidence of the Greater Himalaya as major source terrain during deposition of the Subansiri sediment. Significant proportion of granitic (maximum up to 17.6%) along with k-feldspar content (maximum up to 17%) and volcanic/metavolcanic (maximum up to 34.3%) rock fragments is implying that the Transhimalayan Gangdese arc and Abor Volcanics also had a major contribution in association with the Greater Himalayan rocks during deposition of the Subansiri sediment. Further, presence of higher proportion of <300 Ma aged zircon within the Subansiri sediment than the Dafla sediment (from average 15% to ~42%) (Lang et al., 2014) also indicate that the Transhimalayan Gangdese arc was a major source terrain during deposition of the Subansiri sediment. Overall unimodal paleocurrent pattern with dominant SW to W directed component is in conformity with this inference. Presence of significant proportion of granite, volcanic rock particularly basalt, quartzo feldspathic gneiss as framework clast in conglomerate beds of upper part of the Subansiri Formation also represents the Transhimalayan arc, Abor Volcanics and the Greater Himalaya as source terrain.

A sudden increase in very low to low grade metamorphic rock fragments (lm1~30% and lm2~51%) (Fig. 6) and increase in sedimentary rock fragment proportion as well as decrease in volcanic and plutonic rock fragments characterize the overlying Siji Formation (age <3.5 Ma after Debnath et al., 2021 and reference therein). The sharp decrease in MI value from 276 to 192 and rapid fall in plutonic and volcanic rock fragments percentage from the underlying Subansiri Formation (from 15.8% to 1.9% and from 9.5% to 1% respectively) certainly marks the shift of provenance from the Greater Himalaya and Transhimalaya arc dominated source terrain during deposition of the Siji sediment. Increase in sedimentary rock fragments in the Siji sandstone from 26.2% to 38.8% than the Subansiri sandstone, rapid increase in very low to low grade metamorphic rock fragments and epidote amphibole dominated tHM suite; all of these evidence

suggest exhumation of the outer lesser Himalaya Gondowana Group as major source terrain during deposition of the Siji sediments. Sudden fall in volcanic and plutonic rock fragment proportion indicate that there was a very little contribution of the Transhimalayan and Abor volcanics during deposition. This inference suggests that the drainage system through which significant amount of sediment from the Transhimalayan arc and Eastern syntaxsis transferred to the Siwalik basin was not exist during deposition of the Siji sediment.

A decrease in proportion of <300 Ma aged zircon within the Siji sediment than the Subansiri sediment (from 35% to ~20%) (Lang et al., 2014) also corroborate this inference. But there is an increase in ~0.5 Ga aged zircon proportion from 15% to 30%(Lang et al., 2014) within the Siji Formation. This fact is also marked by Govin et al., 2018 from Remi river section, further east of our study area. In the eastern Himalaya, 500 Ma zircon U-Pb populations have been characteristic of the Miri Formation of the outer Lesser Himalaya Gondwana Group (Bracciali et al., 2015; DeCelles et al., 2016). So our interpretation of exhumation of the outer Lesser Himalaya Gondowana Group during deposition of the Siji Formation based on our petrographic study is also corroborated by analysis of published detrital zircon U-Pb age spectra. Polymodal paleocurrent pattern with strong S directed component supports this interpretation.

Increase proportion of fine grained sandstone, schist and presence of coal clast as framework component of conglomerate beds of the Siji Formation also signify the exhumation of the Gondwana Group as major source terrain.

Acknowledgement

I thank IAS for assisting my field work which forms important part of my doctoral thesis. Without aid of IAS, I would not have been able to carry out fieldwork at all. I convey my deepest and sincere gratitude for the same. I also assure I will mention funding support by IAS in future publications from this work and in my doctoral thesis as well, I will send the copy same to IAS as well.

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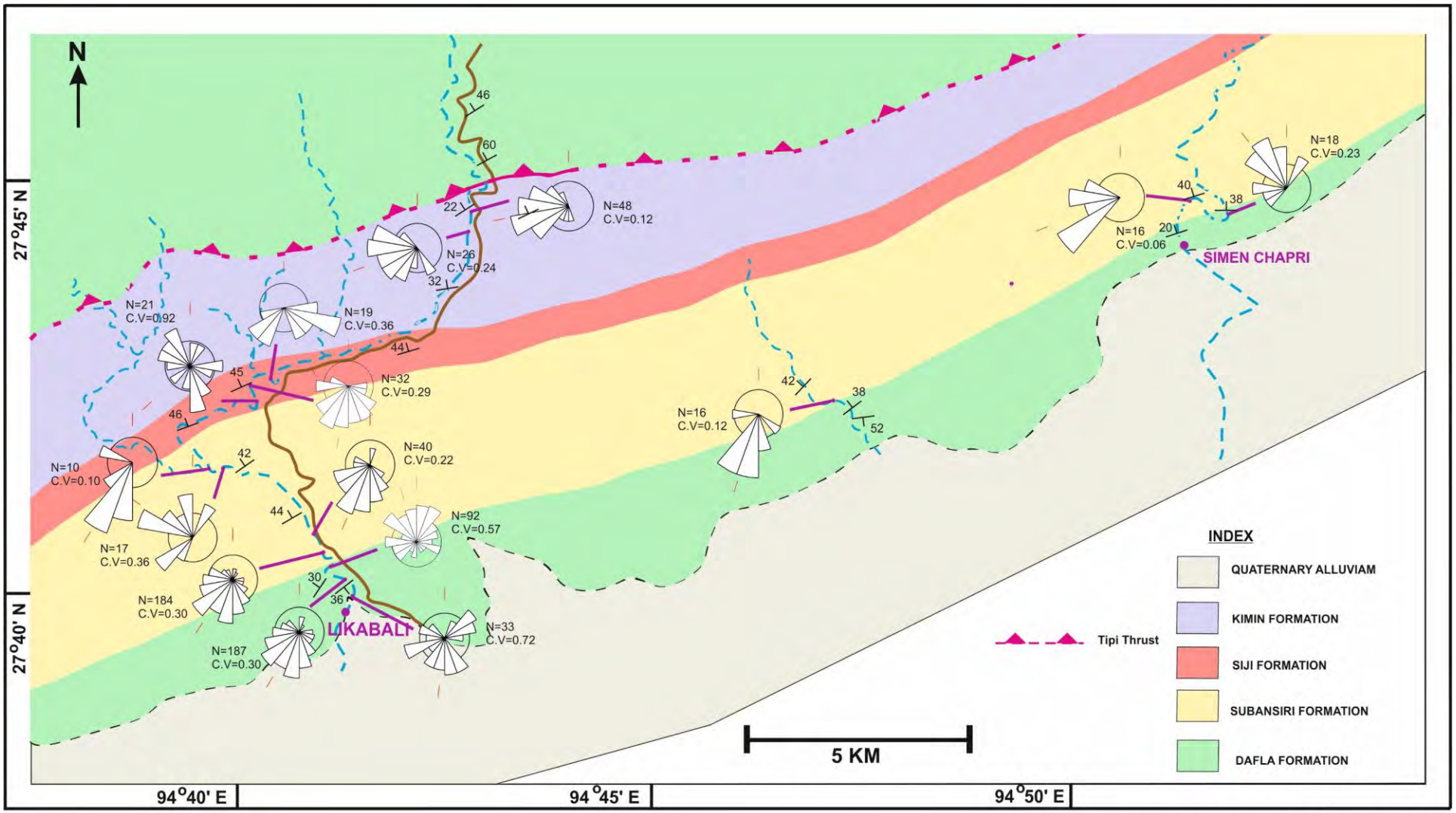


Map modified after Lang et al.,2016

Fig. 1 Geological map of the Siwalik Group around Likabali, eastern Arunachal Pradesh, paleocurrent pattern of different formations are presented.

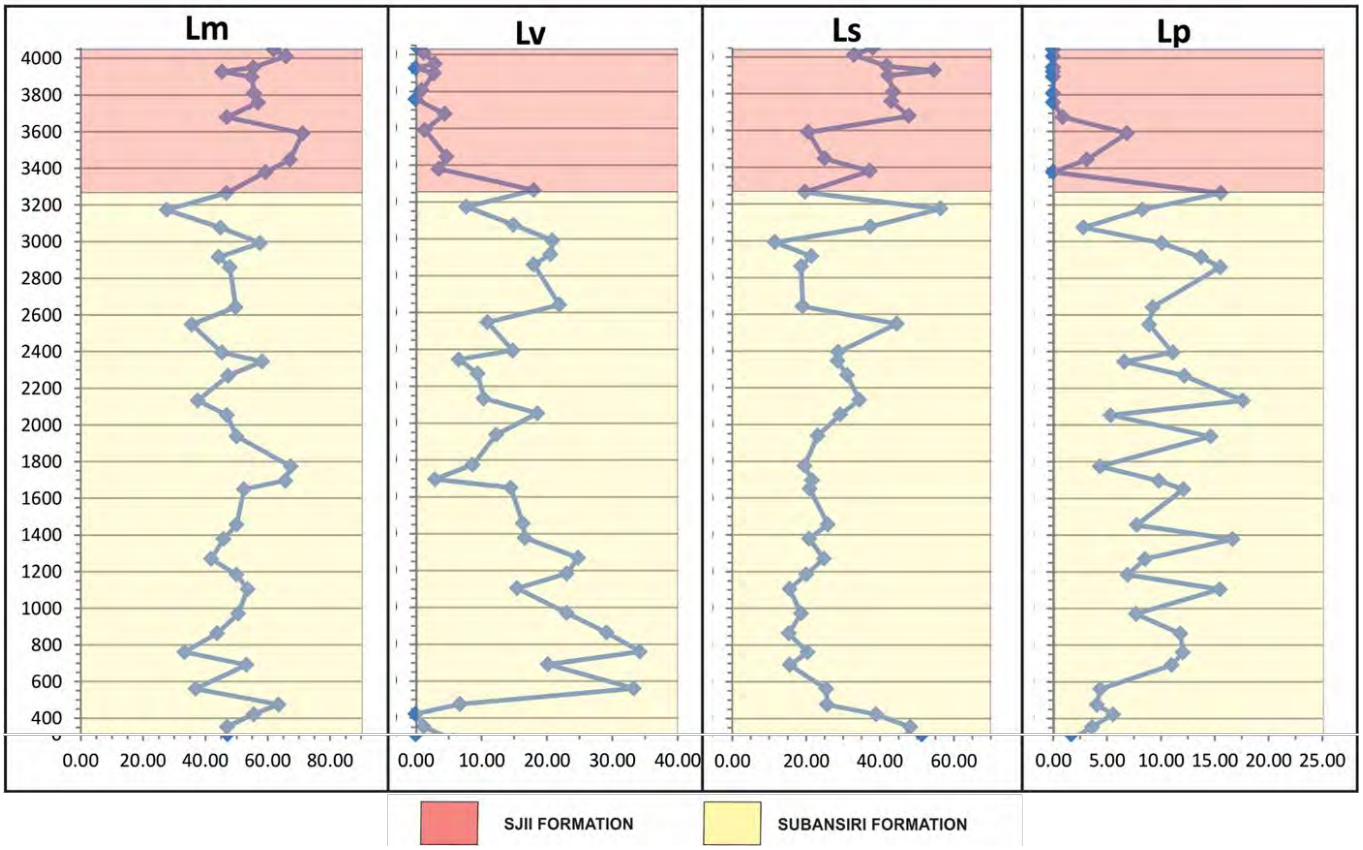


Fig. 2 Stratigraphic variation of different rock fragments. Lm- Metamorphic rock fragment, Lv- Volcanic rock fragment, Ls- Sedimentary rock fragment, Lp- Plutonic rock fragment

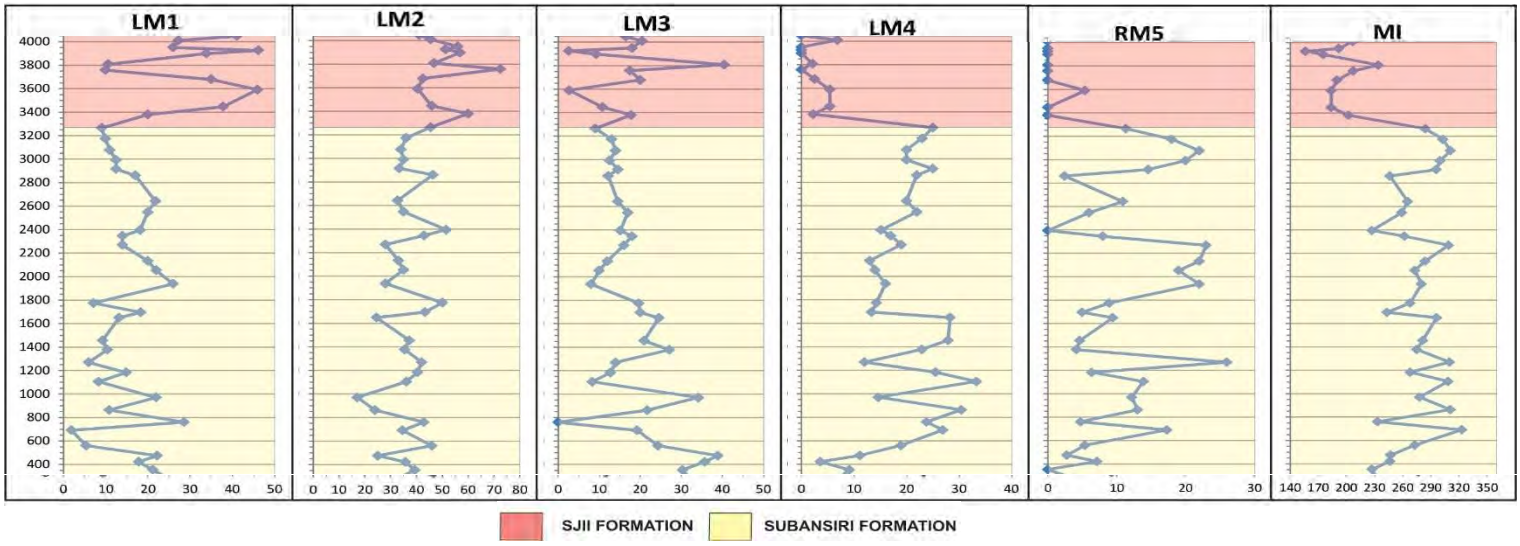


Fig. 3 Stratigraphic variation of different grade of metamorphic rock fragments. MI- Metamorphic Index

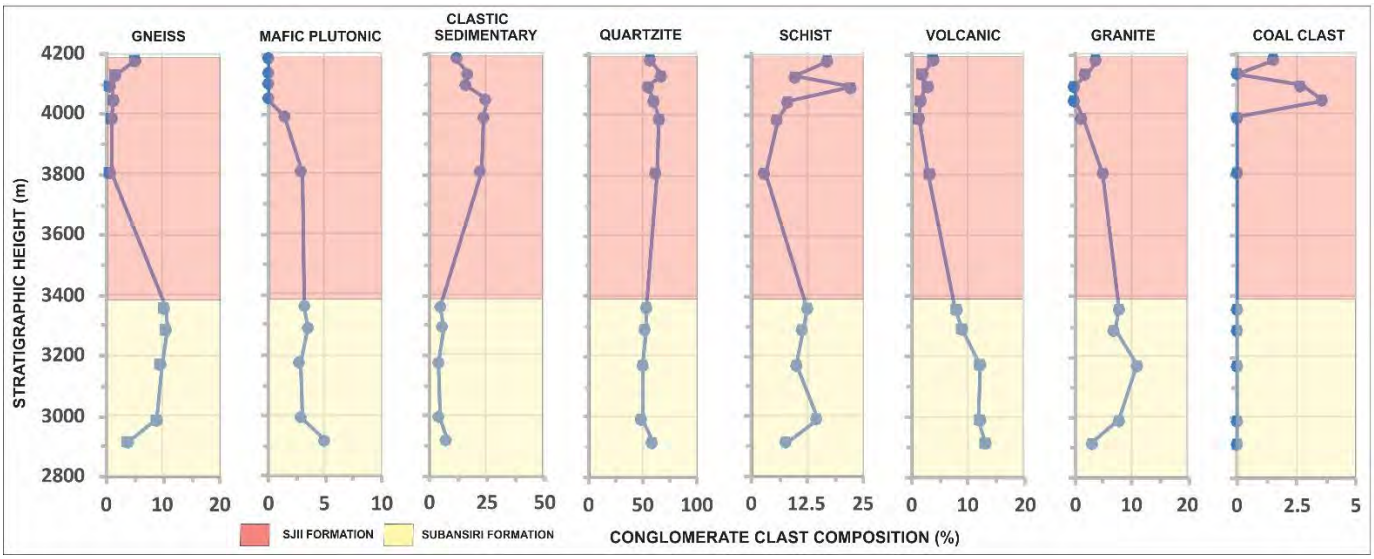


Fig. 4 Stratigraphic variation of conglomerate clasts classified according to their lithology.

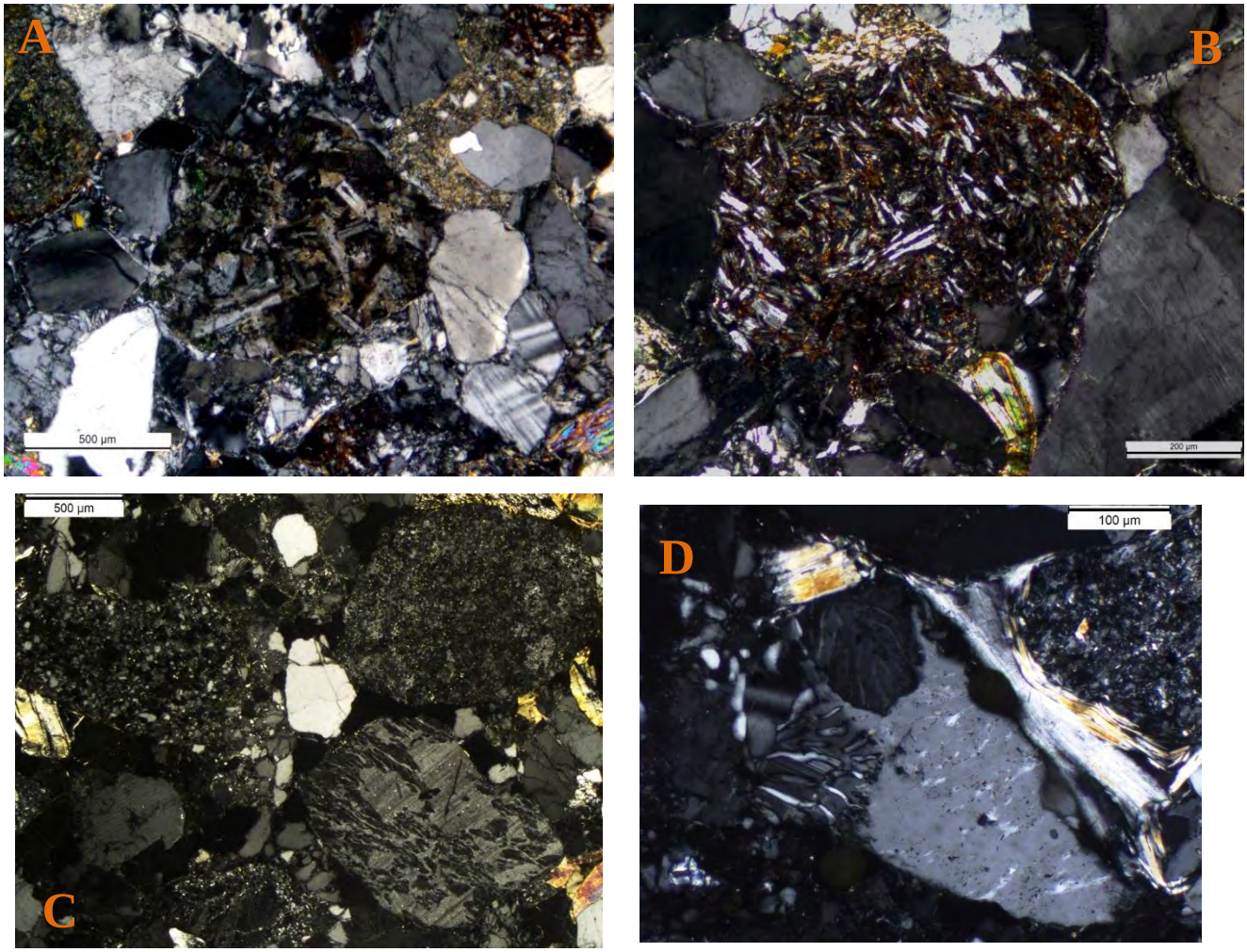
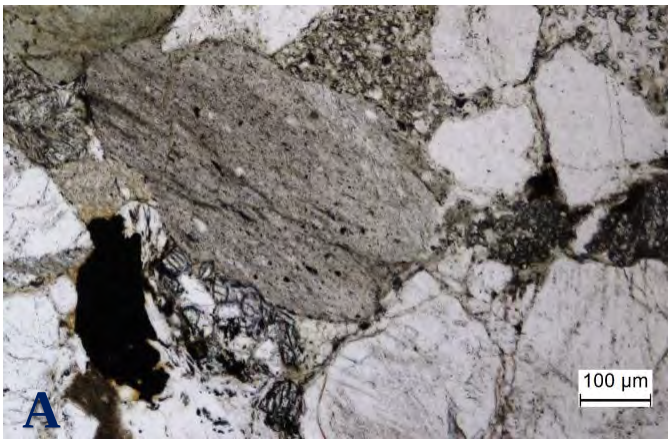
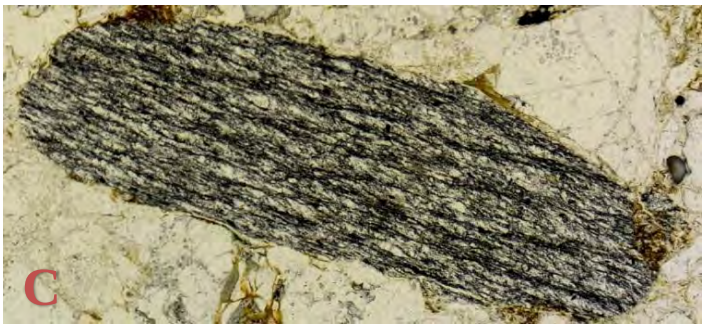
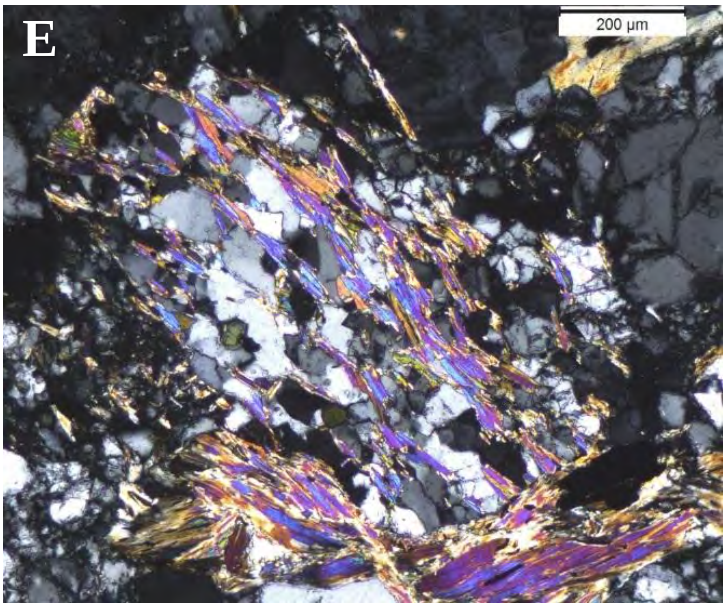
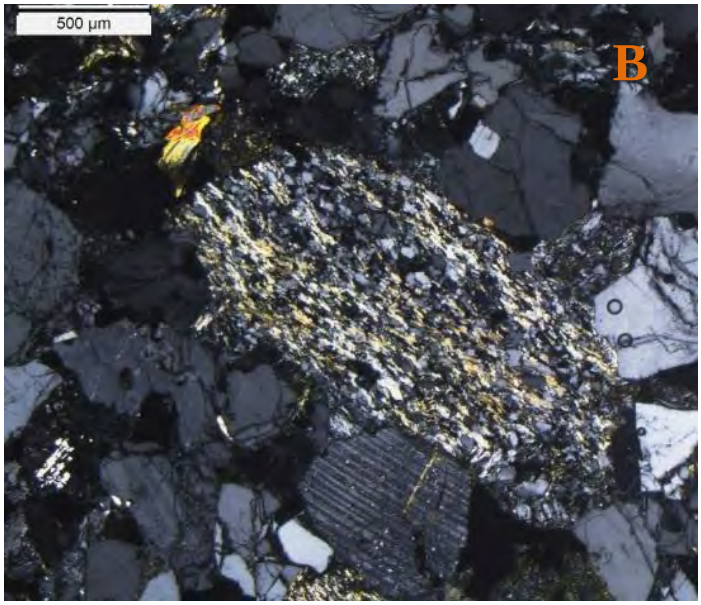


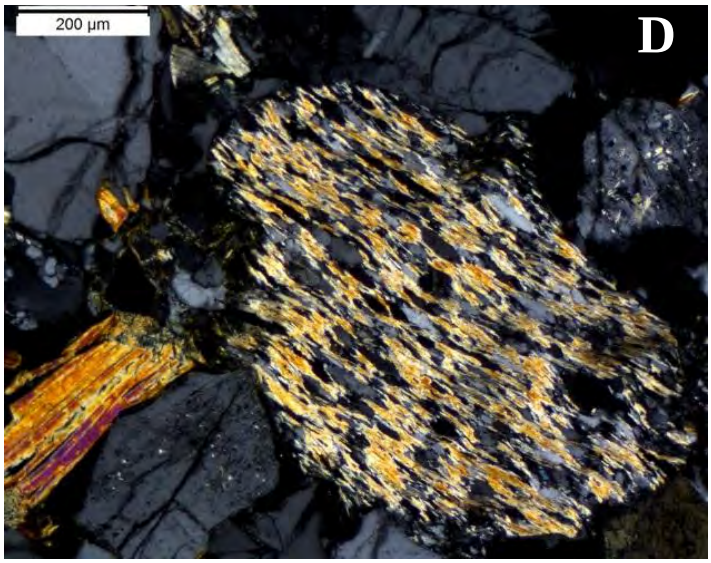
Fig. 5 A, B Photomicrograph of Volcanic rock fragment from the Subansiri Formation, 5 C, D Photomicrograph of plutonic rock fragment showing perthetic and myrmeketic texture respectively from the Subansiri Formation.











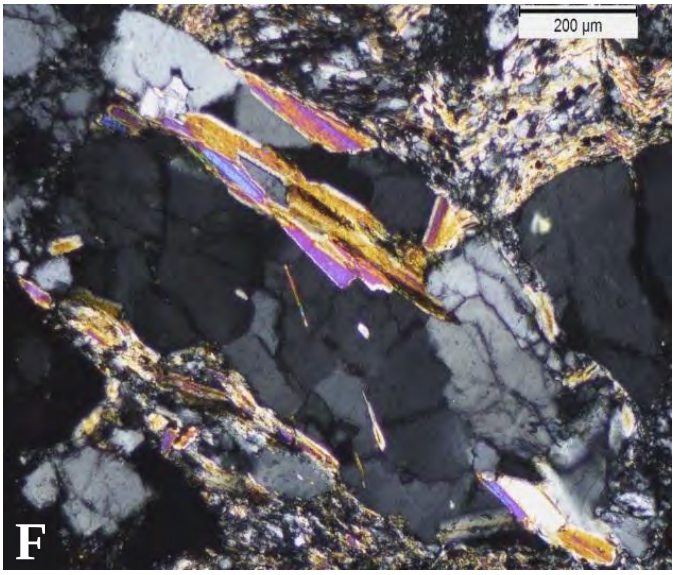


Fig. 6 photomicrograph of different grades of metamorphic rock fragments used in this study to identify grade of metamorphism in source terrain. A- Siltstone, B- Lm1, C- Lm2, D-Lm3, E-Lm4, F- Rm5

Magnetic Susceptibility of type-Maastrichtian chalks at ULiège: Methodology and High-Resolution Measurements with Future Perspective on the Application of Cyclostratigraphy

Acknowledgement

As outlined in the initial proposal for the Judith McKenzie Field Work Award, it was envisioned to carry out high resolution sampling of the CBR-Lixhe quarry near Hallembaye which would not only to allow for correlation between other, already sampled quarries in the vicinity around Maastricht (e.g. Kreco quarry near Hallembaye), but also to further develop cyclostratigraphic studies in scope of the Maastrichtian Geoheritage Project and my master dissertation.

Due to the ongoing Covid-19 pandemic, we – the Maastrichtian Geoheritage Project team – were initially forced to postpone the planned field work. Over time, in light of more flexible social distancing rules, the initial field work plans were slightly adjusted towards a more "corona-friendly" version. But, as the Covid-19 pandemic increased in strength once again and the deadline for my master dissertation (and graduation) came closer, we were forced to cancel the field work campaign altogether.

As foreseen in the initial proposal, magnetic susceptibility measurements were planned to be carried out at Liège University under supervision of prof. Dr. Anne-Christine da Silva. Luckily, in spite of the ongoing Covid-19 pandemic, we were able to proceed with these plans and were able to analyze priorly sampled chalks.

I would like to express my utmost gratitude to the IAS bureau, Judith McKenzie and David Van Rooij for their understanding and the continued support towards my project and master dissertation.

Introduction

Magnetic Susceptibility (MS) measurements allow for a quick, relatively cheap determination of a material's bulk low field magnetic susceptibility, originating from magnetic minerals present in sedimentary rocks [1]. Whenever the MS signal reflects input of detrital material (e.g. aeolian dust, fluvial input of clays) in sedimentary carbonate successions, it can be used as a proxy for paleo-environmental and paleoclimatic changes and can serve in cyclostratigraphic studies [2], [3].

Objectives

As a first step in the assessment of the suitability of low field bulk MS measurements on type-Maastrichtian chalk from the Kreco quarry near Hallembaye and the subsequent use thereof as a proxy reflecting astronomical forcing, 2 main objectives were laid out:

- Methodological assessment for evaluating suitable experimental parameters, such as sample nature (bulk rock versus powdered sample), approximate required sample mass, amount of measurements required for good statistics.
- Given geochemical elemental data was already available for a large part of the chalks sampled at the Kreco quarry, a second objective was to compare the MS signal to elemental concentrations as determined by µXRF on powdered chalks for (1) one-meter low sampling resolution for the complete section ranging from 0.50 m to 49.50 m and (2) a selected 5-cm high sampling resolution for a stratigraphic height ranging from 18.50 m to 22.45 m.

Realization

Low field alternating current (AC) bulk magnetic susceptibility measurements were carried out at Liège University, Pétrologie sédimentaire, B20 under supervision of prof. Dr. Anne-Christine da Silva using the MFK2 Kappabridge laboratory instrument (see Fig.1 below).

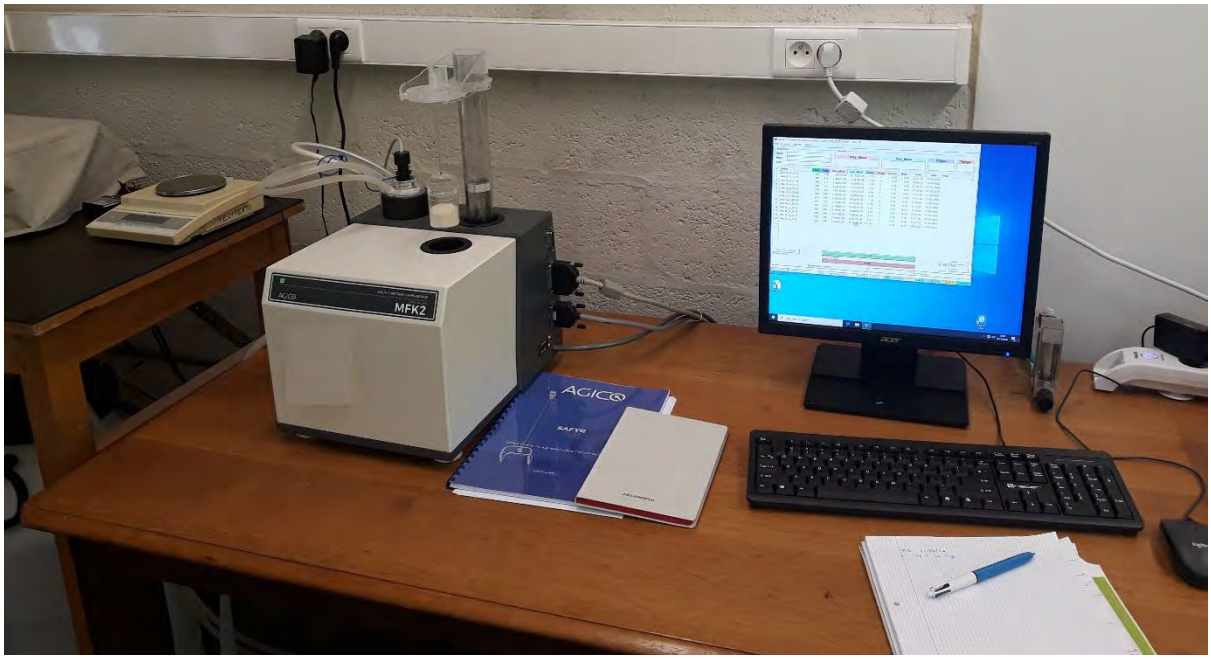


Fig.1: ULiège Kappabridge MFK2 used for MS measurements, powdered chalk ready to be lowered in the equipment, control computer and software, as well as the Sartorius balance (top left) used for measuring sample masses.

A one-day trial for the methodological assessments was carried out on August 25th, 2020 under additional supervision of Dr. Johan Vellekoop. Consistency between rock and powdered samples was verified at low- and high sampling resolution and the effect of sample mass was assessed. Additional attention was paid to potential drift by thorough remeasuring of some hand-picked samples. All experiments were completed, allowing for an updated experimental design – fit for type-Maastrichtian chalks – as well as planning of the next series of experiments.

The second campaign to Liège University was organized on September 17th and 18th, 2020. As planned based on the one-day trial, a total of 768 measurements were carried out on 127 powdered chalk samples over the course of 2 days.

Results

Initial results of the one-day trial were insightful and allowed for a suitable methodology to be determined: at least 5.00 g of powdered chalk sample (for sufficient strength of the MS signal) was to be measured 6 consecutive times. Consistency in sample nature was needed, as significant differences between rock and powdered samples were observed. In order to avoid potential unknown inclusions that could be present in the bulk rock samples, powdered samples were preferred for the bulk MS measurements.

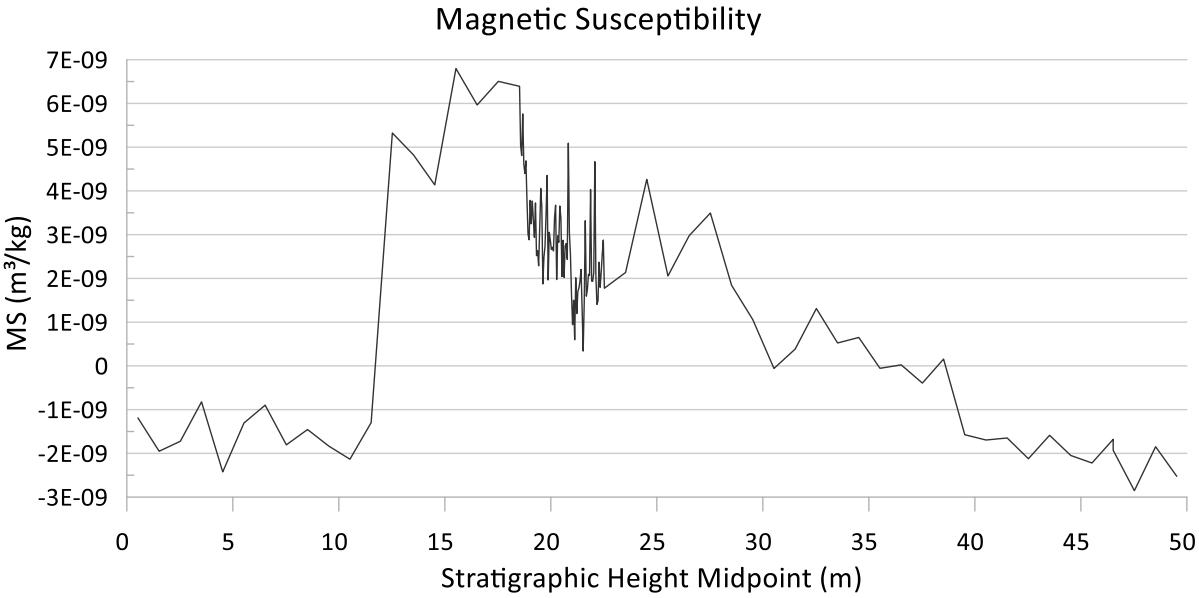


Fig.2: Low field, bulk MS results. High-resolution interval from 18.50 m to 22.45 m (platted using Grapher).

Looking at 1 m low-resolution, order of magnitude MS values seem to correspond with field work observation made during sampling of the chalks; lower MS values match whitish chalk, higher MS values correspond to greyish chalk. Preliminary 5 cm high-resolution results seem to indicate that the MS signal displays trends similar to Al, Ti, K and is in especially good agreement with the Fe elemental signal.

Conclusion and Closure

Magnetic Susceptibility measurements on type-Maastrichtian chalks from the Kreco quarry near Hallembaye provided valuable insight and are in-line with visual observations and preliminary geochemical elemental concentrations. The developed methodology and initial measurements paved the way for future work to be carried out on type-Maastrichtian chalks using MS. Lastly, if the origin of the MS signal can be determined and a link to paleoclimate and/or paleoenvironmental changes can be established, MS would serve as a suitable proxy for the application of cyclostratigraphy. For this reason, the MS measurements were of vital importance to this research and my master dissertation, which will be handed in this semester and forms the basis of a future publication.

To be given the opportunity to expand my (scientific) horizon by visiting ULiège, learning how to carry out MS measurements was very valuable, not only for my personal development but also with regards to my master dissertation. Even in times of a global pandemic with limited opportunities for traveling and meeting people, I was able to explore a technique new to me by carrying out a methodological study and measuring the magnetic susceptibility signal of a large set of samples from the Maastrichtian Geoheritage Project.

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