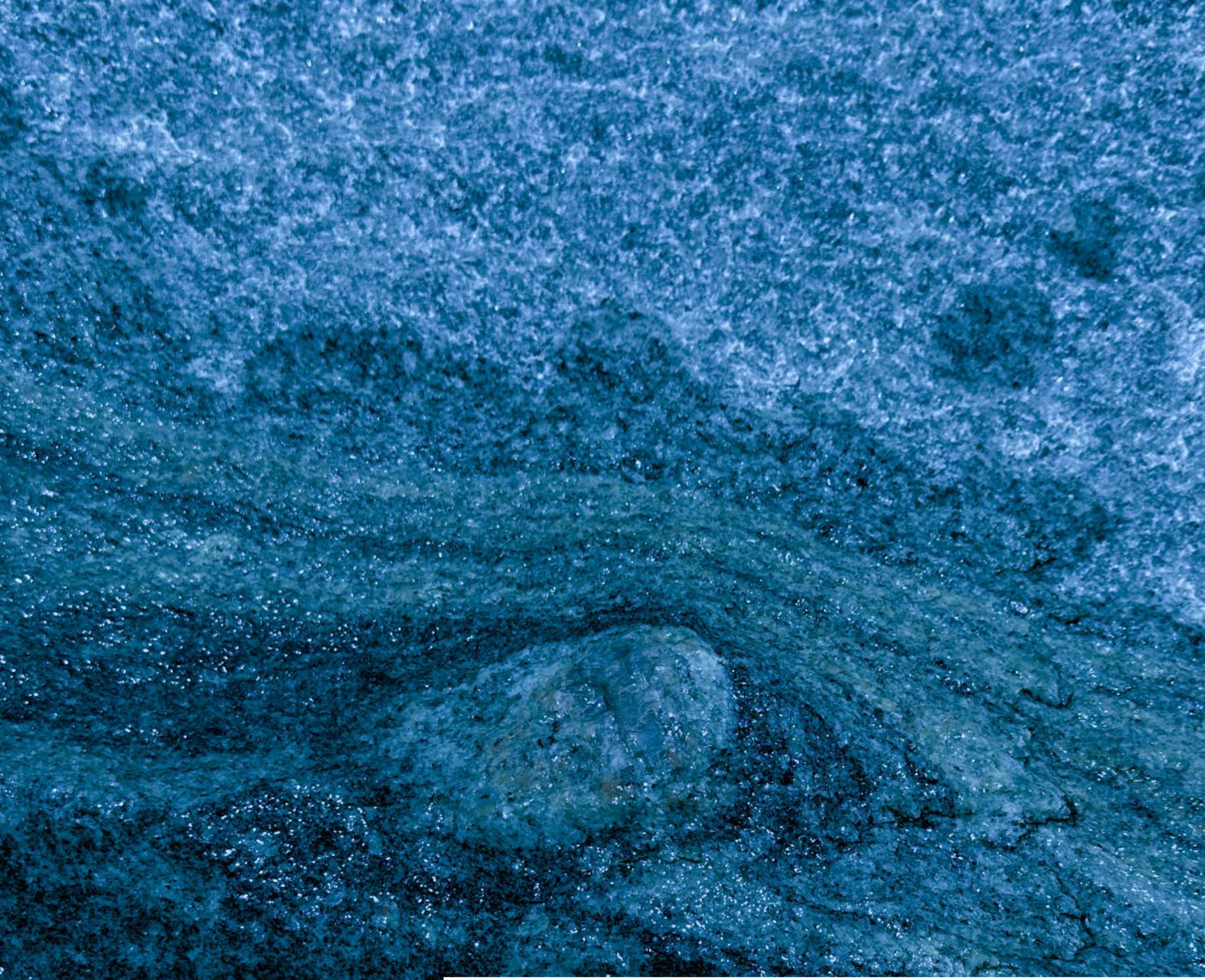

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Structural Geology in a Changing World:

Tectonics, Resources and Sustainable Transitions

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Guillaume Duclaux

From sandbox to supercomputer: a geologist's journey through computational tectonics and geodynamics

Guillaume Duclaux[1,2]

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Understanding how tectonic plates move, how mountain belts grow, and how the mantle convects over billions of years requires more than field observations and seismic data, it demands models. Geodynamic modelling provides a powerful tool to investigate processes in the Earth's crust, mantle, and core that are simply not directly observable, yet it comes with inherent assumptions, approximations, and epistemic limits that every practitioner must confront honestly.

This presentation will trace the intellectual and practical journey of computational tectonics from its conceptual roots to its current frontier. I will begin with analogue models, sandbox experiments, viscous fluids in rotating tanks, silicone putties mimicking crustal rheology, that allowed early geologists to test hypotheses about orogeny and subduction before computers were available. These physical models are automatically subject to all laws of nature, yet they remain notoriously difficult to scale, and key variables like internal stress and strain are nearly impossible to measure directly. This is precisely where numerical modelling steps in.

The discipline of computational tectonics and geodynamics took off alongside plate tectonic theory and the rise of computers in the 1960s. I will walk through the key epistemological transitions: from analytical and semi-analytical solutions to finite difference methods and their grid-based elegance, to finite element methods that handle complex geometries and multi-physics coupling. I will explain what physics actually lives inside modern geodynamic codes (*conservation of mass, momentum, and energy, non-linear viscous and elasto-visco-plastic rheologies, thermodynamic-based phase transitions, melt segregation, and surface processes*) and why every choice of governing equation is also a philosophical statement about which aspects of the Earth we consider knowable and worth computing.

The democratisation of computational tectonics and geodynamics through open-source software has been transformative. I will present a non-exhaustive overview of the landscape of community codes, discussing their respective strengths, numerical architectures, and the communities that sustain them. These tools now permit regional crustal deformation models below kilometre resolution, and global mantle convection models incorporating hundreds of millions of years of plate motion history, all running on high-performance computing infrastructure. The Earth is increasingly simulated in silico across every scale, from ore-deposit-forming fault zones to whole-planet thermal evolution.

Finally, I will reflect honestly on the interdisciplinary skill set this work demands: geological intuition to formulate meaningful hypotheses; physical and mathematical literacy to translate processes into equations; computational proficiency for model design, parallelisation, and diagnostics; and rigorous scientific communication to convey what models can and cannot tell us. Drawing on my own experience as a geologist turned numerical modeller, I will argue that the field is not the domain of coders who happen to be geoscientists, nor of geoscientists who happen to code, but rather of practitioners who have genuinely integrated both ways of thinking.

The goal is not to simulate reality. The goal is to ask better questions of it.

Delores Robinson

New Advances in Fold-Thrust Belts

Delores M. Robinson and Nadine McQuarrie

University of Alabama and University of Pittsburgh

Balanced cross sections are interpretations that adhere to all available subsurface and surface data that are retrodeformable. However, each is an interpretation with multiple solutions. Give the same data to 5 different geologists and you will obtain 5 different interpretations. Which brings up the question – which interpretation is correct? To determine this answer, one must use several disciplines in combination. Sedimentology and magnetostratigraphy can yield the age of synorogenic sedimentary rocks in the foreland basin, which can be used to interpret which rock units are at the surface at a particular time. This provides constraints on the flexure of the crust and development of the foreland basin. High temperature and pressure data help us interpret the depth that a rock unit was buried prior to deformation. New advances in geochronology, using U-Pb in calcite, can directly date faults. However, one needs calcite developed in the fault to use this technique. Using low-temperature thermochronology, one can determine the time at which a rock passed through the closure temperature of a chronometer. If one obtains multiple low temperature thermochronologic ages from different chronometers on the same rock sample, the path of that rock sample through the earth can be obtained. We assume that rocks are brought to the surface on faults in a fold-thrust belt.

If these data exist along a balanced cross section, the interpreter must adhere to the data. Thus, the number of possible interpretations is dramatically decreased. Further, using a balanced cross section reconstruction program in combination with a 2D advection model, one can obtain a balanced cross section that has very few interpretations, yielding a more correct interpretation. We have conducted such data collections and interpretations along multiple cross sections in Nepal and Bhutan. These studies yield balanced cross sections that have the most correct interpretations currently possible and a visualization of the evolution of the Himalayan fold-thrust belt. What is emerging is an accurate 4D model of the evolution of the Himalaya with pulsed deformation and variable slip rates.

Abderrahmane Bendaoud

Structure and geodynamic evolution of the lithosphere beneath the Hoggar Shield: Constraints derived from petrological, geochronological and geophysical studies

Abderrahmane Bendaoud

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The Hoggar Shield of southern Algeria, which forms the central part of the Tuareg Shield within the Trans-Saharan Belt, is one of the most significant Precambrian lithospheric domains in Africa. Preserving a geological record that spans more than three billion years, it provides a unique natural laboratory for investigating the long-term evolution of the continental lithosphere.

The combined analysis of petrological, geochronological and geophysical data reveals a complex geodynamic history marked by several major stages. These include: (1) Archean crustal growth and greenstone-belt development between 3.3 and 2.5 Ga; (2) a Paleoproterozoic arc-to-UHT thermal evolution between 2.1 and 1.75 Ga, reflecting a long-lived and slowly cooling orogenic regime; (3) Neoproterozoic subduction, arc accretion, continental collision and large-scale strike-slip terrane amalgamation during the Pan-African Orogeny (ca. 850–570 Ma); and (4) a much younger Cenozoic phase of lithospheric reactivation accompanied by intraplate volcanism, superimposed on the inherited Precambrian architecture.

Geophysical investigations, including magnetotelluric surveys, aeromagnetism, gravity modelling and seismic tomography, demonstrate that the present-day structure of both the crust and mantle beneath the Hoggar is a direct consequence of this prolonged and polyphase evolution. These studies also emphasize the strong control exerted by lithospheric structures on the distribution of mineral resources. The Hoggar contains major gold and uranium deposits together with a well-developed province of rare-metal granites, while its potential for platinum-group elements (PGE), rare earth elements (REE) and hydrothermal mineralization remains only partially explored.

Together, these observations provide an integrated geodynamic framework linking deep lithospheric processes to the metamorphic, magmatic, volcanic and metallogenic evolution of the shield. More broadly, they contribute to our understanding of how the continental lithosphere evolves through time, from early crustal stabilization and cratonization to later episodes of intraplate reactivation driven by mantle dynamics.

Nicolas Thébaud

Radiogenic Isotopes as tool to peer into the crustal growth, tectonic evolution and metal fertility of continental masses

Nicolas Thébaud, Quentin Masurel, Julien Perret and WAXI 1-3 team
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Crustal growth underpins Earth's tectonic history, involving the thickening, cooling, and chemical differentiation of the crust and upper mantle that produce stable continental masses over billions of years (Condie, 1998; Rudnick, 1995). Most models invoke a two-stage process: extraction of basaltic magma from the mantle, followed by fractional crystallization or partial melting of its metamorphosed products (Rudnick, 1995). The progressive maturation of mafic lower crust into felsic continental crust varied through time and between cratons, with crust formation rates generally faster in the early Earth owing to secular cooling (Hawkesworth and Kemp, 2006). Most estimates place the bulk of continental crust extraction (~50–70%) in the Archean and earliest Proterozoic (Belousova et al., 2010; Dhuime et al., 2012). This period also marks the transition from stagnant- or sluggish-lid tectonics to a mobile-lid, modern plate-tectonic regime (Lenardic et al., 2008). Identifying the geodynamic engine(s) of crustal growth is, however, often hindered by the protracted tectono-thermal evolution of Precambrian terrains. Combined U-Pb and Lu-Hf isotopic systematics in zircon provide a reliable record of these processes, distinguishing juvenile additions from reworked crust (e.g. Belousova et al., 2010). In this contribution we review the crustal growth and geodynamic evolution of the West African Craton using whole-rock geochemistry and the U-Pb and Lu-Hf record of zircon from plutonic rocks. We show that crustal growth in the southern West African Craton during the late Siderian and most of the Rhyacian (~2350–2060 Ma) was driven by the opening and subsequent closure of a large oceanic basin that fragmented the Neoarchean continental lithosphere. This evolution involved two orogenic cycles, the Eoeburnean (~2285–2120 Ma) and Eburnean (~2120–2095 Ma) orogenies, each marked by distinct pulses of juvenile magmatism and crustal reworking. Beyond constraining the processes that stabilized the continental crust during the Rhyacian, this evolution provides a framework for understanding the metallogenic record of the region.

Belousova, E.A., Kostitsyn, Y.A., Griffin, W.L., Begg, G.C., O'Reilly, S.Y. and Pearson, N.J., 2010. The growth of the continental crust: Constraints from zircon Hf-isotope data. Lithos, 119(3–4): 457–466.

Condie, K.C., 1998. Episodic continental growth and supercontinents: a mantle avalanche connection? Earth and Planetary Science Letters, 163(1-4): 97–108.

Dhuime, B., Hawkesworth, C.J., Cawood, P.A. and Storey, C.D., 2012. A Change in the Geodynamics of Continental Growth 3 Billion Years Ago. Science, 335(6074): 1334–1336.

Hawkesworth, C.J. and Kemp, A.I.S., 2006. Evolution of the continental crust, Nature, pp. 811–817.

Lenardic, A., Jellinek, A.M. and Moresi, L.N., 2008. A climate induced transition in the tectonic style of a terrestrial planet. Earth and Planetary Science Letters, 271(1-4): 34–42.

Rudnick, R.L., 1995. Making Continental-Crust. Nature, 378(6557): 571–578.

Tolulope Olugboji

Africa Reassembled: AI and Seismic Algorithms Map the Hidden Lithosphere: Using machine learning to decode Africa's crustal structure, lithospheric stratification, and tectonic evolution.

Department of Earth and Environmental Sciences, University of Rochester, Rochester, NY, USA

Despite their importance for understanding Earth's evolution, seismic models of Africa's lithosphere often lack fine-scale details. To address this, we harness ambient noise and scattered waves to reconstruct Africa's hidden structure. Our approach leverages innovative AI frameworks, AkiNet and iRADNET, which combine machine learning with wave propagation physics. This enables high-resolution imaging of Africa's lithosphere, revealing new insights into crustal taxonomy and lithospheric stratification. By doing so, we shed light on the continent's billion-year history of evolution and stability.

Uwe Kirscher

Global palaeogeographic evolution in the Palaeoproterozoic: pushing the limits to better understand the formation of major mineral deposits during a first phase of global plate tectonics *(the new roles of palaeomagnetism)*

Uwe Kirscher Earth Dynamics Research Group, School of Earth and Planetary Sciences, Curtin University, Australia

Palaeomagnetism is evolving towards in-situ measurements opening possibilities in research and mineral exploration with three main areas: **Magnetic remanence:** aeromagnetic data are among the most widely used exploration datasets, yet their interpretation usually assumes that rocks are magnetised parallel to the present field; where remanence is strong this distorts anomalies and can send drill holes past their targets, especially for complex anomaly shapes. **Palaeogeography:** the inclination of a stable remanence fixes the palaeolatitude at which a deposit formed, predicts the direction of later overprints, and places the deposit in its plate-tectonic and metallogenic context. **Rock characterisation:** the magnetic mineralogy that governs a geophysical response can be identified and mapped. All three have long been held back by the same limitations — too few remanence measurements, too few independent palaeogeographic models, and bulk magnetic data that cannot separate coexisting phases.

What changes the picture is a step-change in instrumentation. For more than fifty years no fundamentally new palaeomagnetic instrument appeared; now diamond-based quantum sensors measure magnetisation in situ, grain by grain. The **Quantum Diamond Microscope (QDM)** uses nitrogen-vacancy centres, read by optically detected magnetic resonance, to map both the remanent and the induced magnetisation of a sample at micrometre scale (Figure 1). This bypasses overprints, opens new palaeomagnetic targets in rocks once thought unsuitable, and resolves phases that bulk measurements blur — such as the pyrrhotite polytypes whose contrasting magnetic behaviour disrupts processing in gold systems.

The Palaeoproterozoic — Earth's first sustained phase of global plate tectonics — is where these ideas have their most significant implications for palaeogeography, because primary data and reliable reconstructions thin rapidly beyond about 1.8 Ga. In-situ mapping of magnetisation during standard palaeomagnetic procedures extends the method to more difficult rocks, such as carbonatites and weakly metamorphosed lithologies. One example is presented in which this approach led to a new tectonic framework for carbonatite formation in the Palaeoproterozoic. Applied more broadly, it could sharpen the palaeogeographic record of this interval and, by placing ore deposits directly on the reconstructed continents, strengthen the predictive power of palaeogeography — an opportunity that is especially important for the dominantly Palaeoproterozoic West African Craton and its world-class mineral deposits.

Together these advances can deliver more remanence data, better palaeogeographic models and novel grain-scale characterisation — three converging ways in which palaeomagnetism can help de-risk mineral targeting.

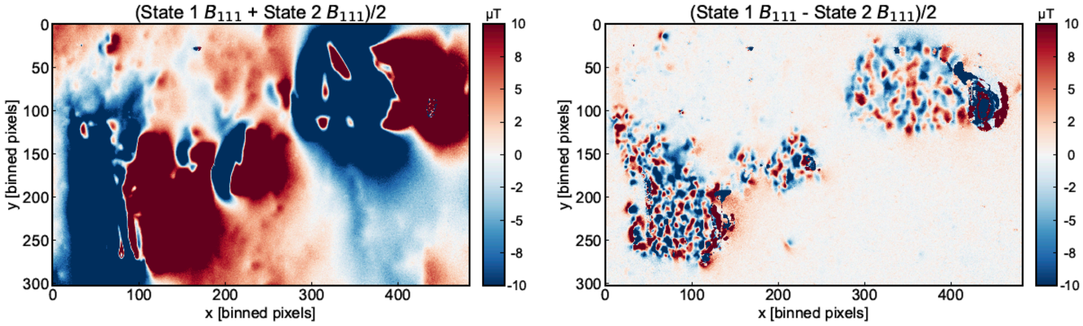

Figure 1. *Quantum Diamond Microscope magnetic-field maps of magnetite grains: remanent magnetisation as the sum of two magnetisation states (left) and induced magnetisation as their difference (right). Warm and cool colours denote opposite vertical field; axes are in binned sensor pixels (Areas are 1x1.5 mm).*

Lenka Baratoux

Tectono-metamorphic evolution of the West African Craton

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Tectono-metamorphic style of the Paleoproterozoic West African Craton (WAC) is passionately debated in the literature, representing one of the youngest examples of ancient Archean type tectonics for some, and one of the oldest examples of the modern tectonics for the others. The Paleoproterozoic Eburnean orogeny is described as polyphase by most of the authors. Several studies suggest an important switch in shortening direction from the ca. N-S oriented shortening direction in early stages of the orogeny towards ca. E-W oriented shortening with dominant pure-shear fabrics at peak stages of the orogeny, which evolved into transcurrent regime characterized by deep-seated regional scale high strain and shear zones at the late stages of the Eburnean orogeny. The contact of the Archean Kenema-Man domains and the Paleoproterozoic Baoulé-Mossi domain is interpreted as an accretionary/collisional zone limited by the N-S trending sinistral Sassandra shear zone at the eastern side of the Kenema-Man domain and by the WNW-ESE trending sinistral Kankan-Odienné shear zone at the northern side, operating after c. 2100 Ma. Archean crustal lenses have also been found in the Sassandra-Cavally collisional zone in the SW of Côte d'Ivoire.

Metamorphic conditions in the Paleoproterozoic rocks of the West-African Craton were traditionally, except for few localities, described as regional greenschist facies, while amphibolite facies and rare migmatites are restricted to the pluton contact aureole, all related to the Eburnean Orogeny (2.2-2.0 Ga). However, recent studies realized in the framework of WAXI project several domains of regional polyphase high-grade metamorphism were discovered. The early metamorphic phase M1 associated with D1 deformation is often characterized by HP-MT conditions and cold metamorphic gradients (15-20°C/km) suggesting burial down to 50 km followed by rapid exhumation during tectonic accretion. Medium to high pressures (5-10 kbar) and medium apparent thermal gradients

(25-40°C/km) followed by decompression and heating are common for the M2/D2 cratonwide event, which would correspond to the thermal relaxation of the orogenic belt followed by tectonic exhumation. In many areas, the peak to late LP-LT greenschist facies metamorphic conditions during the M2 and M3 metamorphism is contemporaneous with later deformation phases, associated mostly with regional scale transcurrent shear zones. This cratonwide tectono-metamorphic synthesis shows a heterogeneous and diachroneous distribution of metamorphic conditions, associated with geodynamic settings evolving spatially and temporally during the Eburnean orogeny.

The oldest metamorphic U-Pb ages of monazites dating the peak of metamorphic conditions in northwest Ghana give 2137 ± 8 Ma for the early metamorphic stages and 2127 ± 7 Ma for the decompression/heating phase. A younger period of regional metamorphism has been documented in the Kedougou-Kenieba Inlier at c. 2095-2085 Ma for peak P stages and c. 2060-2050 Ma for decompression/heating stages (U-Pb on monazite, Sm-Nd on garnet). Similar metamorphic ages have been found in Ghana, ranging between 2095 ± 34 Ma and 2063 ± 9 Ma. The youngest U-Pb monazite metamorphic ages have been reported in western and southwestern Côte d'Ivoire, where they show several age peaks at 2050-2030 Ma, 2000 Ma and 1900-2000 Ma, corresponding to later prograde and retrograde metamorphic events. Metamorphic units from different locations in the craton show similar clockwise P-T paths, however, the timing metamorphism demonstrates a diachronic character with ages spreading between c. 2130 and 1900 Ma. These ages also alow dating of deformation phases linked to each metamorphic event. The structural, metamorphic and geochronological data are consistent with tectonic burial and exhumation during collisional stages of the Eburnean orogeny, which occurred at different time periods across the craton.

Abigail Enyonam Ayikwei

Manish Mamtani

Multiscale Fabric Data from Deformed Rocks - Meso to Nano Scale Analysis

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Structural Geology is a "*Game of Scales*". Whilst field based studies remain at the very core of most structural geology investigations, there has been considerable focus to incorporate microstructural studies and relate large scale deformation with processes that operate at the microscopic scale. The last few decades have also seen increasing use of SEM-EBSD studies that helps decipher crystallographic preferred orientation (CPO) of mineral phases and its relation to deformation temperatures and kinematics. Progress has also been made in last few years to look at nanostructures under TEM and relate them to large scale deformation and kinematics. During the past two decades, the author has integrated field, anisotropy of magnetic susceptibility (AMS), SEM-EBSD and TEM studies to analyse deformation fabric and kinematics in rocks at different scales – from the mesoscopic (field) to the nano scale (dislocations in the crystal lattice). This experience is shared through the present lecture. The following aspects are highlighted:

a. Importance of kinematic reference frame (XZ section of strain ellipsoid).
b. Identification of the kinematic reference frame from AMS studies.
c. SEM-EBSD studies and kinematics.
d. Identification of region of interest (ROI) for TEM analysis.
e. TEM studies in oriented thin films and nano kinematics.

Eventually, the importance of incorporating data from X-ray micro CT, petrophysical measurements and fluid flow with the study of rock textures, microstructures and fracture networks is highlighted. It is envisaged that such an approach has a bearing on addressing societal needs by applying structural geology fundamentals to topics dealing with mineralisation, hydrocarbon exploration, geothermal energy, carbon capture and storage, deep seated nuclear waste disposal as well as engineering geology applications.

Sandra Piazolo

Challenges and Opportunities of Sustainable Geoenergy Solutions:

A case study of geothermal energy and storage

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One of the main pillars of the urgently needed decarbonisation of energy is the use of geothermal energy from shallow to deep. In addition, in a changing climate towards extreme weather and, for example, the necessity of cooling data centres, the use of the subsurface to store thermal energy gains importance. While there is a whole array of potential geothermal energy and storage solutions at our disposal, uptake of geothermal energy and storage remains surprisingly low and slow across the world.

Main challenges include, but are not restricted to, poor knowledge of the subsurface, competition for subsurface use, public perception including resistance to subsurface interventions, national, regional and local policies, regulations and environmental restrictions, and the lack of investors. While it is crucial for any feasibility assessment of a geothermal energy/storage solution to have a sufficiently good knowledge of the subsurface in terms of subsurface structure, fracture network, matrix permeabilities and porosities, the main challenge is to gain this knowledge at low cost and fast, so that the subsurface can be integrated into energy planning. Methodologies developed over the last 50 years in the oil and gas industry can be utilized and tailored to the specific sites to investigate, however many aspects of the methodology are too costly to be implemented in the realm of geothermal energy solution assessments. Hence, we need to become smarter i.e. more cost-efficient in our assessments such as using legacy data requiring open data sharing across sectors and regional/national boundaries.
Besides the geological challenges, socioeconomic barriers are at the core of the lack of geothermal energy solution uptake. Since 2020, the interdisciplinary Geosolutions Leeds team has been working closely with the local university, hospitals, and rural and industrial communities to identify main barriers, explore solutions and implement demonstrator sites for geothermal energy/storage solutions. Working across sectors has highlighted that it is crucial for the geoscientists to not only provide expert knowledge, but to communicate their science efficiently and continuously to relevant parties. It is essential that communication starts very early in the process of energy planning and not just happens as an afterthought. Close and continuous collaboration with policy makers, local communities and investors is also important. This therefore calls for geoscientists to acquire additional skillsets outside their immediate field of expertise such as the ability to communicate geological data, uncertainties and risks to the non-specialist, to listening actively to the public and to identify and collaborate with key players early.

Caroline Tiddy

NAVIGATING YOUR CAREER TO BE THE GEOSCIENTIST YOU WANT TO BE

Caroline Tiddy[1,2], Sanjeewa Perera[2] and Shruti Sardeshmukh[2]

1. Future Industries Institute; 2. Adelaide University, South Australia.

When you look at someone further along in their career, it can be easy to assume they followed a clear path to get where they are today. However, in reality career paths are far more complex than they may appear.

This talk explores the hidden complexity of geoscience careers through research into how Australian geoscientists perceive their own career journeys (Tiddy et al. 2026). Drawing on interviews and questionnaires from 75 early-, mid- and late-career geoscientists across industry, government and academia, the study used visual metaphors (i.e., an image, picture, movie, movie role or cartoon character) to capture the complex structure of careers that are often difficult to describe in words.

Metaphors revealed that geoscientists perceive their careers as having varied pathways, using visuals such as squiggly or loopy lines, roads/paths/doors with various options, winding paths, and meandering rivers. Early-career participants often described optimism and growth (*"something of a small seeding of a plant that is going to grow bigger"*), while mid-career participants spoke about hazards, complexities and plans that unexpectedly change. Late-career metaphors were more reflective (*"A mountain and a little person not at the top, but with a lot of stuff to carry but they are quite happy to be achieving nearly the top"*). Metaphors were dominated by elements of careers being challenging (*"Wile E. Coyote… you never quite get the prize"*). Others expressed elements of hope, determination, and progressing, but acknowledge the tests ahead ("*Someone that comes into their career quite excited and bright-eyed and bushy tailed and ready to start new opportunities and then you get knocked down a few times"*). Some reflected feelings of frustration, a lack of control, or questioning progress (*"Walking around with a blindfold on"*). Only a handful of participants described a sense of achievement (*"a bit of chaos to it… but also it's all worked"*).

Using the lens of Social Cognitive Career Theory, this talk will discuss how self-efficacy, or our belief in our ability to succeed, and positive outcome expectations strongly influence career decisions, satisfaction and long-term retention in geoscience. Importantly, these factors are not fixed traits. They can be strengthened through the choices we make, the people we surround ourselves with, and the environments we help create, change or that align with our values.

Furthermore, there is no single "correct" career pathway. Careers are dynamic, complicated and individual. Regardless of background, discipline or current situation, you can make choices that increase your confidence, uphold your standards and place you in environments where you can thrive. Rather than aiming for a perfect career path, this talk encourages geoscientists to focus on building careers that are meaningful, sustainable and authentically their own.

Tiddy, C., Perera, S., Sardeshmukh, S. R. & Andrahannadi, U. 2026. Using metaphors to explore the influence of career perceptions on gender diversity in the Australian geosciences. Journal of Women and Minorities in Science and Engineering 32, 23-48.

Tarryn Cawood

How Deformation Affects the Distribution of Battery Metals: From the Regional to the Micro Scale

Dr. Tarryn Kim Cawood
Department of Earth and Environmental Sciences, University of British Columbia – Okanagan, Kelowna, British Columbia, Canada

Lithium-ion batteries play a crucial role in reducing greenhouse gas emissions, by storing the energy generated by intermittent renewable sources (wind, solar), and powering electric vehicles. However, rising global demand for batteries means that improved exploration strategies are needed for the metals needed to make them - metals such as lithium, cobalt, nickel, and copper. Understanding what controls the distribution of these metals allows us to predict where they may be found, and improve exploration success. In this talk, we will explore how deformation of the Earth's crust controls the distributions of the key battery metals lithium and cobalt, from the regional- to the micro scale.

About half of the world's lithium is obtained from pegmatites, which are typically emplaced along or near major crustal-scale shear zones, during the late stages of orogeny. Based on their timing and structural settings, many pegmatites formed during delamination and/or orogenic collapse. Slab breakoff and/or delamination drives asthenospheric upwelling, with the associated heat pulse inducing partial melting of fertile source rocks to form pegmatites. This scenario may explain the lithium-bearing pegmatites of the southern Benin-Nigeria shield. Subsequent orogenic collapse involves rapid tectonic exhumation of hot, deep crust, leading to decompression melting and the formation of another generation of pegmatites, while the extensional regime and associated faults and shear zones enable melt mobility and emplacement in the mid- to upper crust. In many instances, collapse is accompanied by a transition to transform tectonics, and strike-slip faults provide additional transport pathways and structural traps for the pegmatite-forming melts. This scenario may fit the Orange River Pegmatite Belt in South Africa. At the regional scale, orogenic belts therefore provide a first-order control on pegmatite distribution.

At the kilometer-scale, major long-lived ductile shear zones play an important role in trapping multiple pulses of pegmatite-forming melt, allowing large to giant pegmatites to form (such as the giant Manono-Kitolo pegmatite in the DRC, and the PAK and Big Whopper pegmatites in Canada). Large to giant pegmatites are therefore likely to be found along major ductile shear zones exhumed from mid-crustal levels, whereas smaller (but potentially still economically valuable) pegmatites may be found at shallower crustal levels and/or greater distances from the main fault or shear zone.

Deformation is also key for the accumulation of battery metals at the micro scale. For example, cobalt at the Windy Craggy VMS deposit in Canada occurs in primary hydrothermal pyrite and pyrrhotite, as well as metamorphic pyrite overgrowths and syn-deformational cobaltite. Mechanical remobilization of pyrrhotite (by dislocation creep and dynamic recrystallization) did not affect its cobalt contents, whereas pyrite incorporated additional cobalt during local dynamic recrystallization. As such, no cobalt was lost from major cobalt-bearing phases within the deposit during tectonism, and the additional cobalt (to form the Co-rich metamorphic pyrite overgrowths and cobaltite) was likely derived from mafic and ultramafic host rocks. During formation of the deposit, hot (~350-380°C) hydrothermal fluids leached cobalt from mafic and ultramafic rocks in the underlying upflow zone, providing the cobalt that was incorporated into the original hydrothermal pyrite and pyrrhotite. During subsequent deformation and metamorphism, which occurred at similar temperatures (~370°C), metamorphic fluids extracted cobalt from a broader region of previously unaltered mafic and ultramafic rocks. These fluids were channeled along localized faults, and where these structures intersected the Windy Craggy deposit, additional cobalt was added in the form of the metamorphic pyrite overgrowths and discrete cobaltite grains.

Linda Iaccheri

Magma and Metals: Applying mineralogy to better understand petrological challenges

Linda Iaccheri (Wits University)

Mineralogical textures, lithological contacts, and geochemical variations are often oversimplified in mine-scale models to facilitate easier understanding and communication during mining operations, ensuring accessibility for all personnel, including those without a background in geology. In particular, in aging mines and/or mines that have been active for a long time, lithological variations and textural differences are often overlooked, with more attention paid to ore grade and location of the “reef”. However, detailed characterization of mineralogy and textures is fundamental for reefs that exhibit large vertical and lateral variability in grade, such as the Merensky Reef of the Bushveld Complex. The Merensky Reef hosts one of the largest PGE resources globally. Since its discovery in 1924 in the Eastern Limb of the Bushveld Complex, this tabular pyroxenite reef has been traced for hundreds of kilometers along strike and mined in several operations in both the Eastern and Western limbs. Yet, its origin remains unresolved and highly debated.

In this presentation, we discuss the detailed petrographic, mineralogical, and geochemical mapping of samples collected from a potholed pillar of the Merensky Reef at the Modikwa Mine, Eastern Limb of the Bushveld Complex. This study revealed distinct types of pyroxene and plagioclase crystals, characterized by their texture and grain size. The presence of pothole structures in the Merensky Reef presents a challenge for mining, as the grade diminishes and the hanging-wall lithologies replace the tabular reef layer. However, for an enthusiastic geologist, these pothole structures provide a valuable opportunity to document magmatic contacts and unravel the magmatic sequence.

Mapping the igneous lithologies of the Merensky Reef and the associated pothole structures offers insights into magmatic events and allows us to define eight subsequent magmatic stages:

1. Intrusion and crystallization of the Merensky Reef feldspathic orthopyroxenite.
2. "Reheating" of the feldspathic orthopyroxenite, leading to the formation of clinopyroxene exsolution lamellae and rims in orthopyroxene, resulting in what is commonly known as Merensky Reef pyroxenite.
3. Introduction of volatiles and/or magmatic vapor, which originated during reheating and fractional crystallization. This upward movement within the pyroxenite layer triggered the alteration of interstitial plagioclase, replacing it with biotite, quartz, and sulfides at the top of the reef.
4. Injection of pegmatoidal pyroxenite as both hanging wall and foot wall.
5. Injection of mottled anorthosite as potholes, affecting both the footwall and interfingering the side of the reef from the west.
6. Formation of hybrid melano-norite through the interaction of the pothole mottled anorthosite and the Merensky Reef feldspathic pyroxenite.
7. Formation of chromitite stringers.
8. Intrusion of pegmatitic dykes.

This mapping process provides critical insights into reef formation, as a combination ot magmatic and hydrothermal processes.

Mark Lindsay

The importance of structural geology through the mineral value chain: From the mineral belt to the conveyor belt.

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Mineral systems models are holistic descriptions of multi-scale aspects of ore formation that aim to guide explorers in locating economic mineralisation. These models are holistic, recognising similar observable characteristics among ore deposits, with these similarities indicating processes that led to the formation of many deposits around the globe. Scale is crucial to understand. Trans-crustal shear and fault networks are conspicuous large-scale structural examples that transport hydrothermal fluids and magmas, and have been used to explain the spatio-temporal distribution of diverse commodities such as Au, Ni, and Cu, as well as other base metal exploration regions. Such structures are linked to smaller-scale mafic and ultramafic rocks that act as sources for the commodities listed above. At even smaller scales, fault networks create 'damage zones' that inhibit the flow of metal-rich fluids, hosting mineralisation rather than acting as fluid pathways. We needn't limit the mineral systems concept to ore generation. Mineral systems also apply to the characterisation, mining and processing of ore deposits. As the explorer descends the scale from regional exploration to camp- and prospect-focused work, the importance of datasets changes. Regional-scale geophysics is less useful simply due to data resolution. Geochemistry increases utility as data is collected at resolutions appropriate to camp and prospect scales and from rocks 'vectoring' to mineralisation.

The importance of structure is consistent across all scales. The geometry of an ore body, the rocks that host it and the geological relationships that lead to discovery are all unveiled by the principles of structural geology. Structural understanding is crucial for feasibility studies. Resource estimates rely on understanding the distribution of metals and the internal architecture of the ore body. Deciding on an optimal mining schedule requires a detailed understanding of orebody geometry. Structure is key to ensuring operations are safe and effective through geotechnical analyses. Structural geology even extends to the beneficiation and comminution stages, where textural and rock-mechanics information guides the setup of a grinding circuit. Such observations are reflected in structural observations made at larger scales and in earlier value chain phases, but are not recognised at that point as useful for mineral processing. This presentation argues that structural geology can have a profound impact on how we effectively acquire metals, from conceptual models of mineralising systems through to mineral processing. Finally, a look at future mining scenarios will demonstrate how structural understanding will be key to unlocking automation, robotics and in-situ recovery to create an industry with a smaller environmental footprint.

Yan Bourassa

Daniel Apau

Discovery History of the Giant Obra Gold Deposit and its Structural Setting, Asante Gold Mine, Ghana- Unlocking a Long-Life Underground Gold Mine

Daniel Apau

Asante Gold Corporation

The Obra deposit, located within the Chirano District of southwest Ghana, is one of the principal gold deposits hosted within the Paleoproterozoic Sefwi Belt of the West African Craton along the Chirano Shear Zone (CSZ). Gold mineralization was initially delineated through systematic soil geochemistry, geological mapping, trenching, reverse-circulation drilling, and diamond drilling.

Subsequent drilling demonstrated that mineralization is within northeast trending brittle-ductile structural corridors associated with the Obra Fault. These structures developed as dilational zones during late Eburnean transpressional deformation, providing favourable pathways for quartz-carbonate-pyrite vein emplacement and gold deposition. Mineralization is hosted predominantly within altered mafic volcanic rocks and tonalitic intrusions affected by pervasive carbonate, sericite, albite, silica, and chlorite alteration with disseminated pyrite. Despite the successful delineation of open pit resource, mining ceased in early 2014 after initial underground concept drilling failed to identify down-plunge extensions of the ore shoots. This outcome highlighted an incomplete understanding of the structural controls on mineralization.

A comprehensive structural reinterpretation was undertaken between 2018 and 2019 focusing on litho-structural modelling, alteration characterization, and systematic structural analysis. The revised geological model identified previously unrecognized high-grade mineralized shoots controlled by the interaction of the Obra Fault with other structures. This significantly improved the ability to predict ore shoot continuity both along strike and down plunge.

The revised structural model directly led to the discovery of the Obra Underground deposit in 2021/2022. The UG deposit currently hosts more than 1.5Moz of gold (resources and reserves) with mineralization remaining open at depth. The deepest drillhole intersect in 2026 returned grades exceeding +5 g/t Au, demonstrating the long-term potential of the shoot. This presentation will showcase how a robust structural geological understanding can transform an exhausted deposit into one of the flagship underground assets within Chirano Mine. Obra provides an excellent example of an orogenic gold system in which structural architecture is the primary control on mineralization and demonstrates how integrating structural geology can significantly improve exploration targeting and extend mine life along major shear zones.

Chris Hilgers

Global Challenges, Geological Solutions and Aspects of Reservoir Quality

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Abstract

The major societal and environmental challenges of the twenty-first century are closely linked to geology. Many of the United Nations Sustainable Development Goals (SDGs) depend directly or indirectly on geological resources and expertise. Groundwater remains the principal source of drinking water, irrigation water, and industrial process water in many regions of the world. Global food security relies on fertilizers derived from mineral resources and natural gas, while modern technologies, infrastructure, and digital transformation depend on a wide range of mineral and metal commodities.

Future demand for energy and raw materials is expected to increase due to continued population growth, technological innovation, urbanization, and rising living standards. Consequently, the sustainable provision of groundwater, energy resources, critical minerals, and construction materials will remain a key responsibility of the geoscience community. Geological expertise is equally essential for the safe storage of waste, remediation of contaminated environments, assessment of geological hazards, and evaluation of resource supply chains within an increasingly complex geopolitical framework.

This contribution highlights the central role of geology in addressing global challenges and discusses how geological knowledge bridges natural sciences, engineering, and socio-economic decision-making. Particular attention is given to reservoir quality research, focusing on the processes controlling porosity, permeability, fracture development, and fluid-rock interaction. These processes govern fluid storage and transport in the subsurface and therefore influence the performance of groundwater reservoirs, geothermal systems, hydrocarbon accumulations, and emerging subsurface energy-storage solutions, including hydrogen storage.

Selected research results illustrating fracture and pore evolution, diagenetic alteration, and their impact on reservoir properties are presented. Improved understanding of reservoir quality contributes to more efficient and sustainable management of subsurface resources and supports the transition toward resilient energy and resource systems.

Keywords: Sustainable Development Goals, geosciences, reservoir quality, porosity, fractures, groundwater, geothermal energy, hydrogen storage, sustainability.

Gerald Adda

Taking Ghana to the next level: advancing oil and gas exploration and production – a regulator's perspective.

Gerald W. Adda - Head, Geology, Petroleum Commission

Ghana's upstream oil and gas history dates back to nearly a century. Exploration for petroleum commenced in the onshore basins and gradually extended to offshore shallow water and later into deepwater with advancements in upstream technology such as the advent of offshore seismic data acquisition and well drilling.

The early exploration efforts resulted in the discovery of oil and gas both offshore and onshore, including the Seago 10-1 discovery which was later developed into the Saltpond Field. Despite these successes, most of the discoveries were either non-commercial or marginally commercial at best.

The discovery of the Jubilee Field in 2007 became the turning point for Ghana's oil and gas industry. On the heels of the Jubilee Field discovery, three additional deepwater fields, the Tweneboa-Enyenra-Ntomme (TEN), Sankofa-Gye Nyame (SGN) and Pecan Fields have been discovered in the Tano Cape Three Points Basin. Presently, the Jubilee, TEN and SGN Fields are in production while the Pecan Field has been approved for development.

In the last few years, production from the three producing fields has declined and exploration activities to discover new fields and replace the depleting reserves have been minimal.

The Petroleum Commission, as manager of Ghana's petroleum resources has the responsibility to ensure that the upstream oil and gas sector remains attractive, competitive and capable of sustaining exploration, development and production activities over the long term

This presentation examines Ghana's upstream oil and gas history; the status of the exploration and production activities and the steps being taken by the Petroleum Commission to attract investment into the sector.

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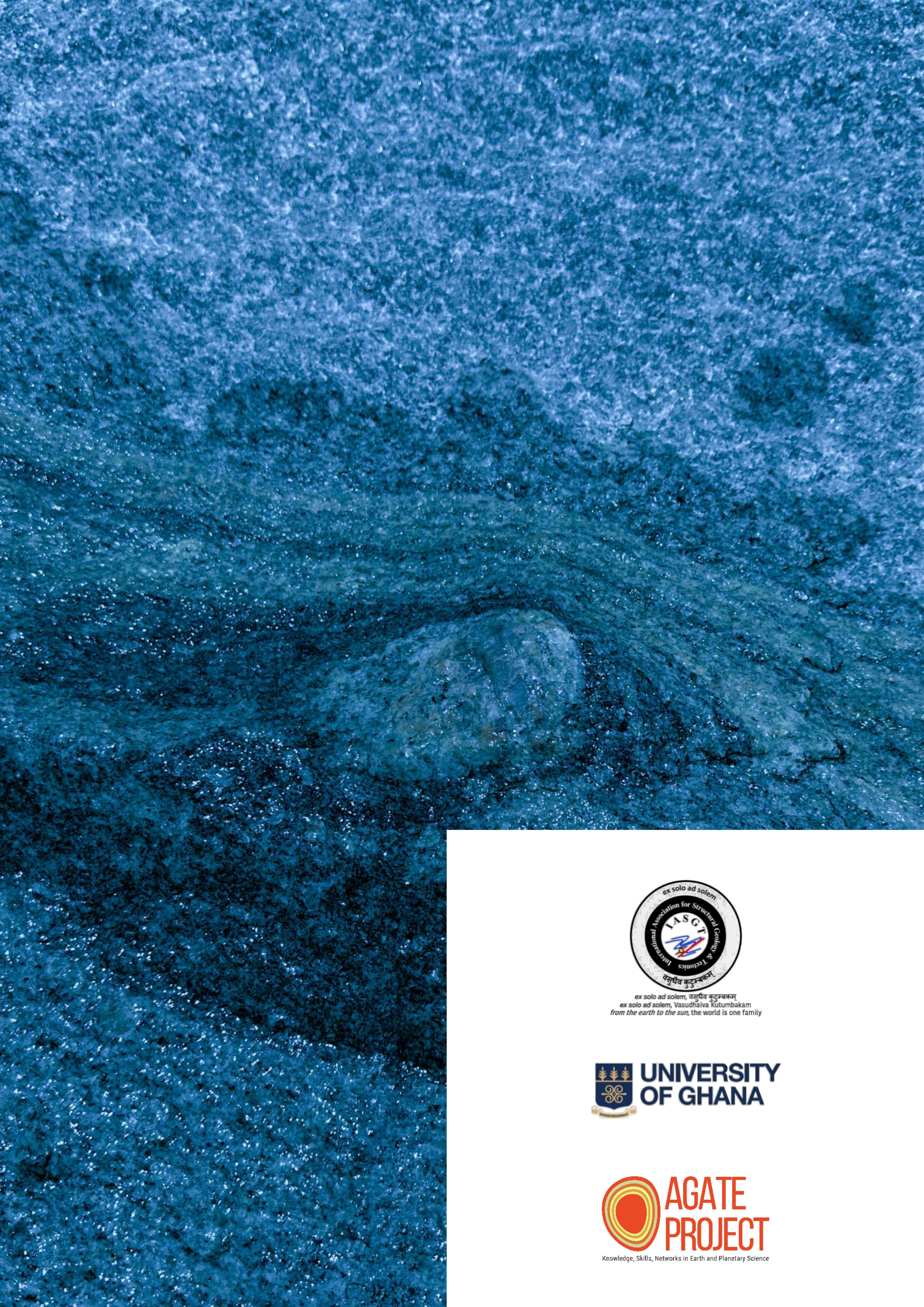

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