SHORT REPORT ON ATTENDANCE AND ACTIVITIES AT ISAES 2019, INCHEON, KOREA

By Dr. G.H. Grantham (SANC Earth sciences representative)

The conference was attended by 415 persons. South African delegates present were Dr. W. Nel (Fort Hare), G.H. Grantham (UJ), Mr. C Groenewald (CGS, UJ) and Dr. T. Dhansay (CGS). The presence of Dr. T. Dhansay from Council for Geoscience (Mapping Manager, CGS) was to facilitate and gain insights into Earth Science research in Antarctica and evaluation of a possible role for CGS going forward.

Presentations by SANAP researchers

Oral Presentations.

A072 Session05:

The Neoproterozoic to Cambrian Orogenies and their precursors in Antarctica and adjacent continental blocks.

THE CAMBRIAN UPLIFT HISTORY OF W. DRONNING MAUD LAND, ANTARCTICA : NEW 40AR/39AR AND SR AND ND DATA.

Geoffrey Grantham1 † , Jan Kramers1 , Bruce Eglington2 , Erasmus Burger3

1Dept. of Geology, University of Johannesburg, Auckland Park, South Africa, 2Saskatchewan Isotope Laboratory, Department of Geological Sciences, University of Saskatchewan, Saskatoon, Saskatchewan, Canada, 3Department of Geology, University of Pretoria, Pretoria, South Africa.

NEW GEOCHEMICAL DATA FROM CENTRAL DRONNING MAUD LAND: IMPLICATIONS FOR GONDWANA RECONSTRUCTION. Conrad Groenewald[1,2 †] , Geoffrey Grantham[2] , Petrus Le Roux[3] . [1]Council for Geoscience, Silverton, Pretoria, South Africa, [2]Department of Geology, University of Johannesburg, Auckland Park, Johannesburg, South Africa, [3]Department of Geological Sciences, University of Cape Town, Cape Town, South Africa, South Africa.

Poster Presentations

A223 Session05:

The Neoproterozoic to Cambrian Orogenies and their precursors in Antarctica and adjacent continental blocks The structural evolution of the Straumsnutane and western Sverdrupfjella areas, western Dronning Maud Land, Antarctica – implications for the amalgamation of Gondwana. Adam Bumby1 , Geoffrey Grantham2 † , Neogracious Moabi3 1Dept. of Geology, University of Pretoria, Pretoria, South Africa, 2Dept. of Geology, University of Johannesburg, Auckland Park., South Africa, 3Council for Geoscience, P/Bag X112, Silverton, Pretoria, South Africa

A439 Session05: The Neoproterozoic to Cambrian Orogenies and their precursors in Antarctica and adjacent continental blocks Sri Lanka - Correlation with N. Mozambique and Antarctica at the heart of Gondwana: North and South. Geoffrey Grantham1 † , Sanjeewa Malaviarachchi2 , Dilshan Bandara2 , Bruce Eglington3 , P. Dharmapriya2 1University of Johannesburg, South Africa, 2University of Peradeniya, Sri Lanka, 3University of Saskatchewan, Canada.

A074 Session13: Past Climate Variability of the Southern Ocean and its Global Teleconnections Classifying synoptic air circulation patterns over the Southern Indian Ocean: Observations from Marion Island on recent change and current landscape impacts.
Werner Nel1 †

Possible involvement in Indian Antarctica Geology Initiative

At the end of May, I received an invitation to express an interest in an Indian Antarctic Geology initiative. The initiative proposes an international collaborative program studying the geology within a ~400km radius of the two Indian Bases, Maitri and Bharati. From a SANAP perspective, the area within the sphere of access from Maitri is of geological interest in terms of the current Gondwana Amalgamation and Correlation Project. Initial discussions have indicated that international partners would be expected to fund access from Cape Town to Novolarevskaya where Maitri is located, after which the Indian Program would be responsible for logistics and support.

I submitted a proposal at the end of July (see attached), expressing interest in SANAP involvement and identified five priority areas and a proposed scientific approach to the study. A local conference in Goa, India, where the headquarters of the Indian Antarctica Program is located is planned for 20-22nd August, where discussions on the way forward are to be discussed. It was planned that I attend this, having submitted an abstract to the conference with a view to be present on 22nd August after the SANC and DST meetings in Cape Town on 19-20 August. Regrettably, my application for a visa was rejected. The rejection was a result of the application being submitted as for business. This avenue was chosen on the advice of the visa administration service, because I was not in a position to apply for a conference visa because the conference organisors had not acquired political clearance in India, the conference being directed predominantly for local Indian participants.

It has been indicated to the proposers of this initiative, that from a SANAP perspective, that an indication of formal procedures for potential involvement be provided in advance of the anticipated call for new proposals due next year.

Possible Future SCAR Research Program

In response to the presentation by the President of SCAR, Prof. Stephen Chown at the SCAR SANC meeting in Stellenbosch with regard to the potential for new SCAR research programs recognising that most of the current programs will terminate in 2020, informal discussions with a view to a new Earth Science program was initiated with Prof. Pant (India), following his distribution of a call for expressions of interest in "Development of a scientific program in campaign mode in east Antarctica".

Subsequently, discussions were held with Prof. J. Jacobs (Bergen University, Norway), leader of the CGG (Combining Geology and Geophysics) action group in SCAR, regarding a possible new SCAR research program.

The consequence of the above discussions was that an informal short meeting was convened on the last day of the ISAES 2019 meeting between scientists from USA, Russia, India, Italy, Germany, Norway, Australia, South Africa, Spain and Brazil as well as the group leaders for SCAR Geosciences Chief Officer: Jesús Galindo-Zaldivar and Deputy Chief Officer: Naresh C Pant and Professor Jerónimo López-Martínez (SCAR President 2012-2016). It was agreed that at the SCAR executive meeting held 30 July, 2019, in Bulgaria, the Geosciences Chief Officer would report on our intent to submit a proposal for a project planning group at the SCAR meeting in Hobart 2020. An initial document was compiled within the group and submitted by Prof. Jacobs to the Geosciences Chief Officer for SCAR, Jesús Galindo-Zaldivar for presentation and noting at the SCAR executive meeting held 30 July, 2019, in Bulgaria . The group has six months to prepare a document in support of a Program Planning Group for submission to the SCAR meeting in Hobart 2020.

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Dr. G.H. Grantham

17 August 2019

Proposal of a geology-geophysics based focussed mapping and research campaign around Maitri Base and surrounds, Schirmacher Oasis, and Bharati Base and surrounds, East Antarctica

Geological Background

Antarctica lies at the heart of the supercontinent Gondwana which fragmented ~180-200Ma to form the separate crustal blocks of Antarctica, India, Africa, Australia, Sri Lanka, Seychelles, Madagascar and South America; the latter three blocks not having had direct contact with Antarctica prior to continental breakup (Figure 1). Correlation of the geology between adjacent continental blocks along with ocean floor studies now provide a widely accepted configuration of Gondwana prior to breakup.

With the accepted configuration of Gondwana, attention can then be turned toward gaining an understanding of the evolutionary processes which resulted in the amalgamation of Gondwana, recognised as having occurred ~500-600Ma ago. Three orogenies have largely been inferred as contributing to the amalgamation during this time namely the Ross (Gunn and Warren, 1962), East African Antarctic (EAAO) (Stern, 1994, Jacobs et al., 1998) and Kuunga (KO) Orogenies (Meert 2003) (Figure 1).

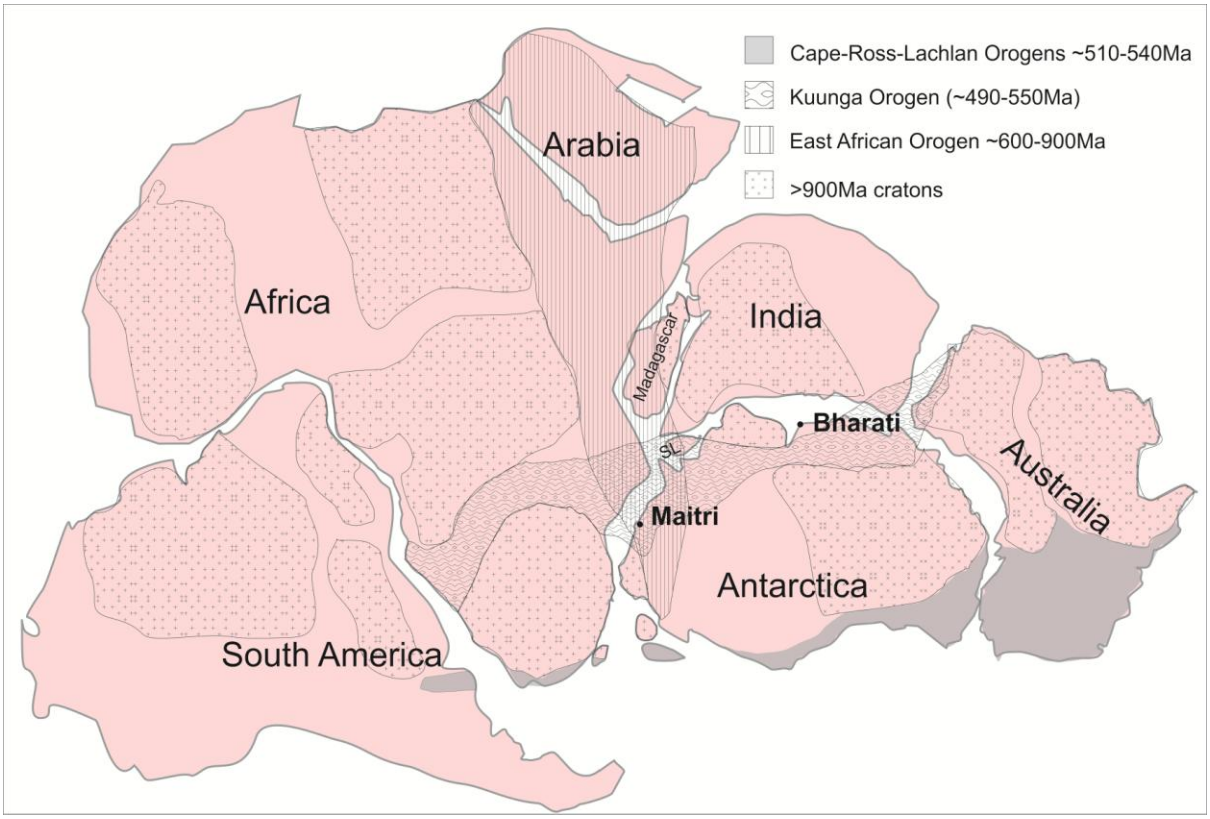

Figure 1. Reconstruction of Gondwana showing the broad distribution of the EAAO, KO and Ross Orogenic belts in Antarctica, as well as the location of Maitri and Bharati Bases in Antarctica.

In a spatial sense, the Ross Orogeny is recognised along the “southern” margin of Gondwana and its extent is widely accepted as extending from South America, through South Africa, through the Transantarctic Mountains, to eastern Australia with the widely accepted plate tectonic setting of a continent-island arc subduction setting (Figure 1).

In contrast, the roles of the EAAO and KO in the amalgamation of Gondwana along its “northern” margin are still the source of significant debate, involving the alternatives of E-W collision between East and West Gondwana (EAAO) and N-S collision between North and South Gondwana respectively(Figure 1). Whereas the 600-900Ma East African Orogeny (Stern 1994) extending from Saudi Arabia to N. Mozambique, is widely accepted, its extension into western Dronning Maud Land is a source of debate. Meert (2003) defined the ~550Ma-490Ma Kuunga Orogeny on geochronological grounds and inferred its extent from the Damara Belt in Namibia, through the Zambesi Belt and Lurio Orogenies, through Sri Lanka and east Antarctica to western Australia (Figure 1). Both the EAAO and KO are inferred to have involved continent-continent collision plate tectonic settings. Both Indian Antarctic bases, Maiti and Bharati, are located within reasonable distance of key areas to understand aspects of the Kuunga Orogeny in Antarctica whereas the EAAO is accessible only from Maitri.

Recent developments over the last decade involving the acquisition, interpretation and publication of aerogeophysical and seismic data from Antarctica, combined with improved geochronological methods, have provided preliminary data which can be used to gain better insights into the sub-glacial geology of Antarctica, recognising that <1% of the bedrock of Antarctica is exposed at surface. Consequently research focussed on the geology of exposed areas, identified as being underlain by bedrock containing significant geophysical signatures, can contribute to an improved understanding of the broader bedrock tectonic units of sub-glacial Antarctica.

Indian Strategic advantage

The Indian bases are strategically located to access significant exposures in the Dronning Maud Land and Lambert Glacier area (Figure 2). Access to the area between 14°E (SE of Maitri) and 2°E (Troll Base) is particularly good within the 400km radius requirement in the call for expressions of interest, with extensive exposure evident.

The less accessible, by distance, portion of this area is perhaps the least well known area of considerable exposure in Antarctica with only the GeoMaud expedition providing the most recent and reliable information on the area. Knowledge of the area is summarised briefly below in a section detailing the available geochronology, whole rock geochemistry, metamorphic studies, structure and geophysics.

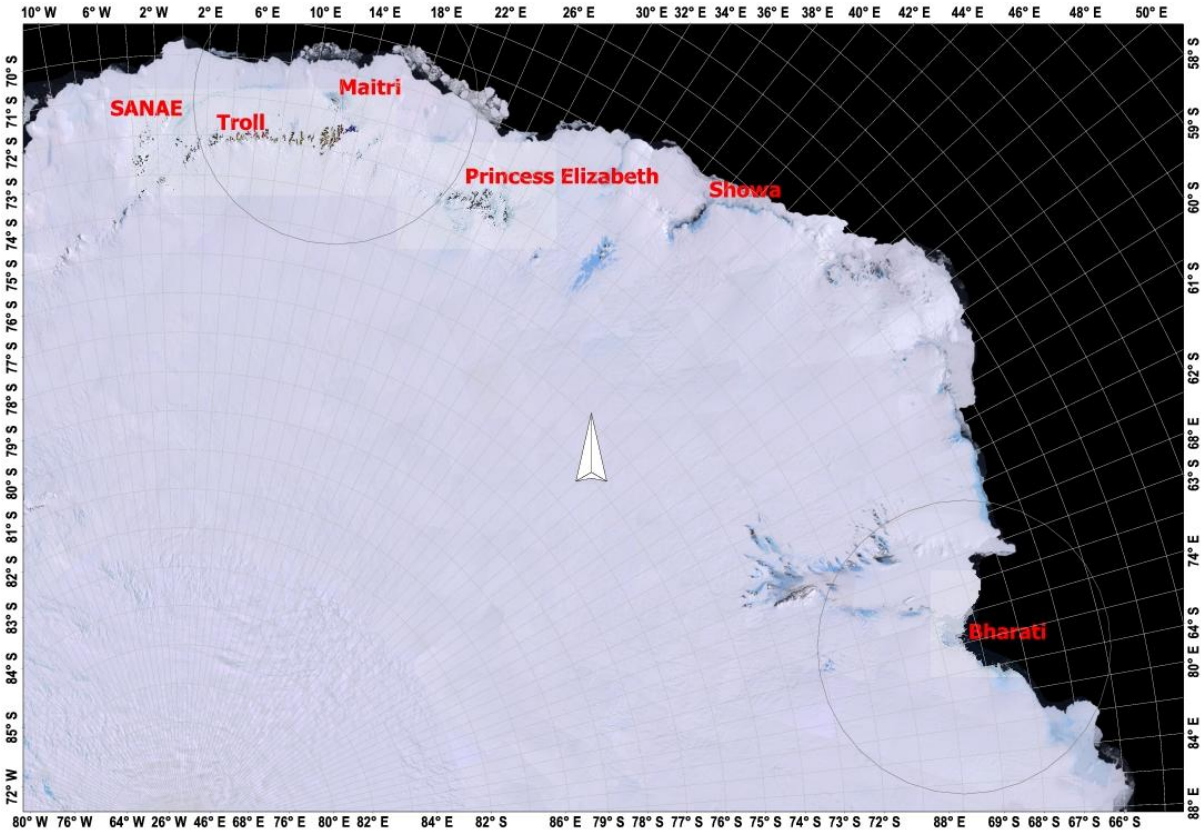

Figure 2. Map showing the locations of Maitri and Bharati bases in Antarctica with ~400km radius circles showing the areas of interest.

PROPOSAL – INVESTIGATION OF THE OROGENIC HISTORY OF DRONNING MAUD LAND, ANTARCTICA FROM MAITRI BASE - (EAAO and Kuunga Orogenies in Dronning Maud Land, Antarctica)

Introduction

The proposed focus area is located between 14°E (SE of Maitri) and 2°E (Troll Base). The reason for selecting this area is based on the following reasons:-

- The area has relatively easy access from, and includes the geology underlying, Maitri Base.
- A reasonable body of data comprising, geochronology and geochemistry (major and trace element and radiogenic isotopes) exists at the eastern and western ends, supported by aeromagnetic and aerogravity data over the whole area. Limited whole rock major, trace and radiogenic isotope data from granitoids in the centre of the area are also available (Roland 2004)
- Current knowledge of the geology shows that it is transected by the Orvinfjella Shear zone, whose possible extension to the south west is seen as the Forster Magnetic anomaly, linking Central Dronning Maud Land with Heimefrontfjella in the south

west. Possible extensions of this shear zone have been inferred as continuing as the Namama Shear Zone in Mozambique (Cadoppi et al., 1987; Grantham et al., 2003).

Brief review of existing tectonic models for the orogeny of the area

The two basic orogeny models comprise the East African Antarctic Orogeny and Kuunga Orogeny. Understanding and differentiating between these models is important to gain insights into the final amalgamation of Gondwana from ~650Ma to 450Ma.

East African Antarctic Orogeny

The East African Antarctic Orogeny (EAAO) was originally proposed by Jacobs et al. (1998, 2003a and b) and supported by many co-workers. Its fundamental basis involves a continent-continent collision between East and West Gondwana extending from Saudi Arabia in the north to Heimefrontfjella in the south (Figure 1). It is an extension of the EAO, originally proposed by Stern (1992) who described it as a ~600-900Ma Wilson cycle event, geographically located between Saudi Arabia and N. Mozambique. Jacobs et al. (1998, 2003 a and b) extended it to Heimefrontfjella and broadened the time range to ~500Ma. Support for the EAO has also been described by Roy et al., 2018. The Wilson cycle inferred in the EAO involved initial breakup of Rodinia between ~900-1000Ma involving the opening of the Mozambique Ocean and its subsequent closure in the amalgamation of Gondwana 650-450Ma. Fundamental to this model is the extension of the Mozambique Ocean from Saudi Arabia to through Heimefrontfjella. This extension beyond the Lurio Belt of northern Mozambique to Heimefrontfjella is questioned by various authors including Grantham et al. (2008, 2013), Hokada et al., (2019) and Collins and Pizarevsky (2005).

Kuunga Orogeny

The Kuunga Orogen was initially proposed by Meert (2003), based on a study of available geochronology. Meert suggested that in northern Mozambique the East African Orogeny was overprinted by a marginally younger event between ~500-600Ma, extending from the Damara in Namibia, through the Zambesi belt into Mozambique comprising the Lurio Belt, continuing through Sri Lanka and Droning Maud Land, Antarctica and through to western Australia. Grantham et al., (2008), in a correlation exercise between southern Africa, Dronning Maud Land and Sri Lanka, inferred a collision model involving a mega-nappe structure with collision between N and S Gondwana, with N Gondwana in the hanging wall. Grantham et.al. (2008) compared lithological, structural, geochronology and metamorphic P-T aspects in developing the model. A critical component of this model is the recognition of erosional klippen comprising (from East to West) the Naukluft Nappes (Namibia), Urungwe Klippen and Mavhuradona Complex (Zimbabwe), Monapo and Mugeba Complex (Namibia) and Kataragama Klippen (Sri Lanka).

Proposed focus of this study on dissecting the EAAO and KO in Dronning Maud Land, Antarctica.

Besides improving insights into the geology of the proposed study area involving basic mapping and sampling for geochemistry, geochronology, petrology and structural studies, recognising the time frame involved in Gondwana of ~450-650Ma, it is proposed that a special focus of this study should involve structural kinematics and associated chronology, chemistry and source charactersitics of magmatism during this period. This need for this approach is apparent from the summary of existing knowledge described below.

<u>Summary of existing knowledge</u>

Geology, Structure and Geophysics

The geology of the area between ~4°E and ~14°E is dominated by medium to high grade metamorphic rocks of Neo- to Mesoproterozoic age which are intruded by Neoproterozoic anorthosites in the Gruber Berge (Wolthardt Massif) in the east and by granitic and charnockitic syenitic intrusions dominantly of Cambrian age (Figure 3). In addition localised subordinate intrusive metagabbroic and lamprophyres are seen. Two significant shear zones are recognised namely the sinistral Orvinfjella Shear Zone between 8-11°E and the Gjelsvikfjella Thrust in the west (Jacobs et al., 1998; Baba et al., 2008, 2015). The Orvinfjella Shear Zone may be an extension of the Forster Magnetic Anomaly (Figure 3, Figure 4).

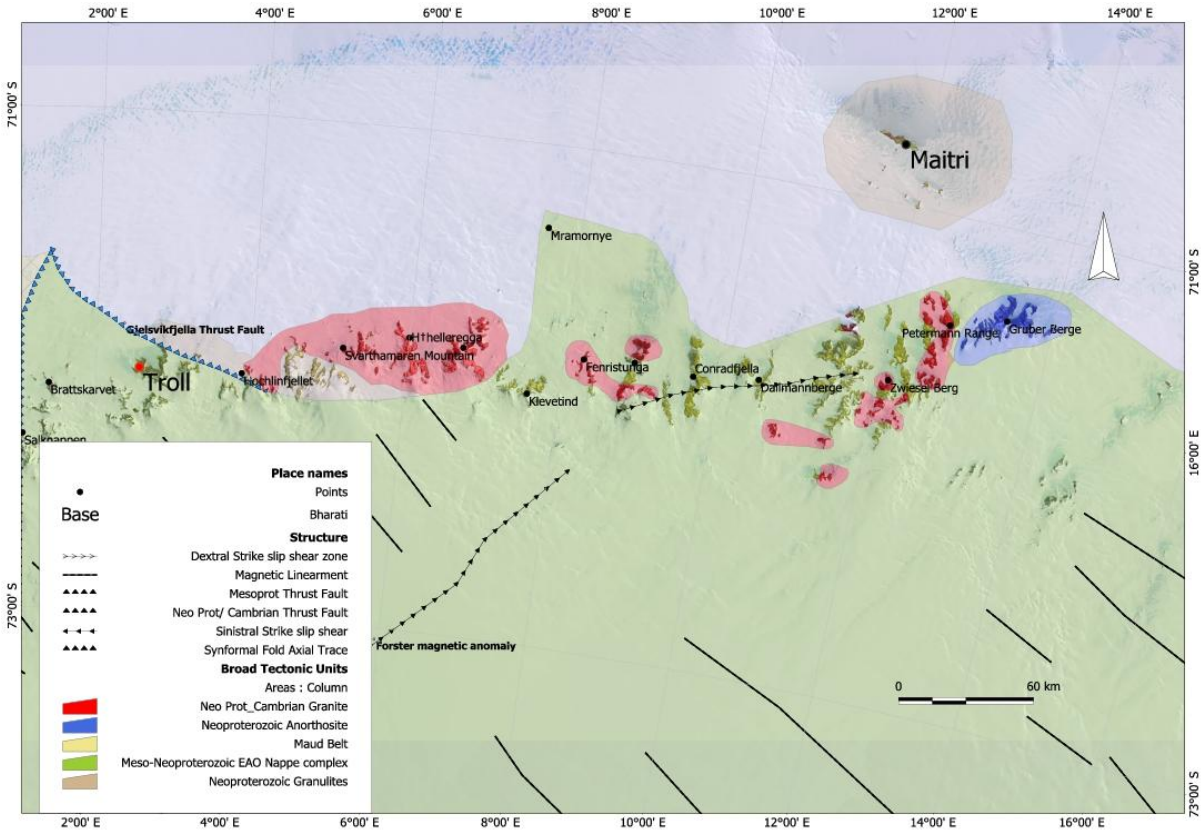

Figure 3. Simplified geological map of central Dronning Maud Land showing the lithological and structural units.

Comparison of the broad geological units in Figure 3 with the available aeromagnetic and aerogravity geophysical data shown in Figures 4 and 5 permit the following conclusions.

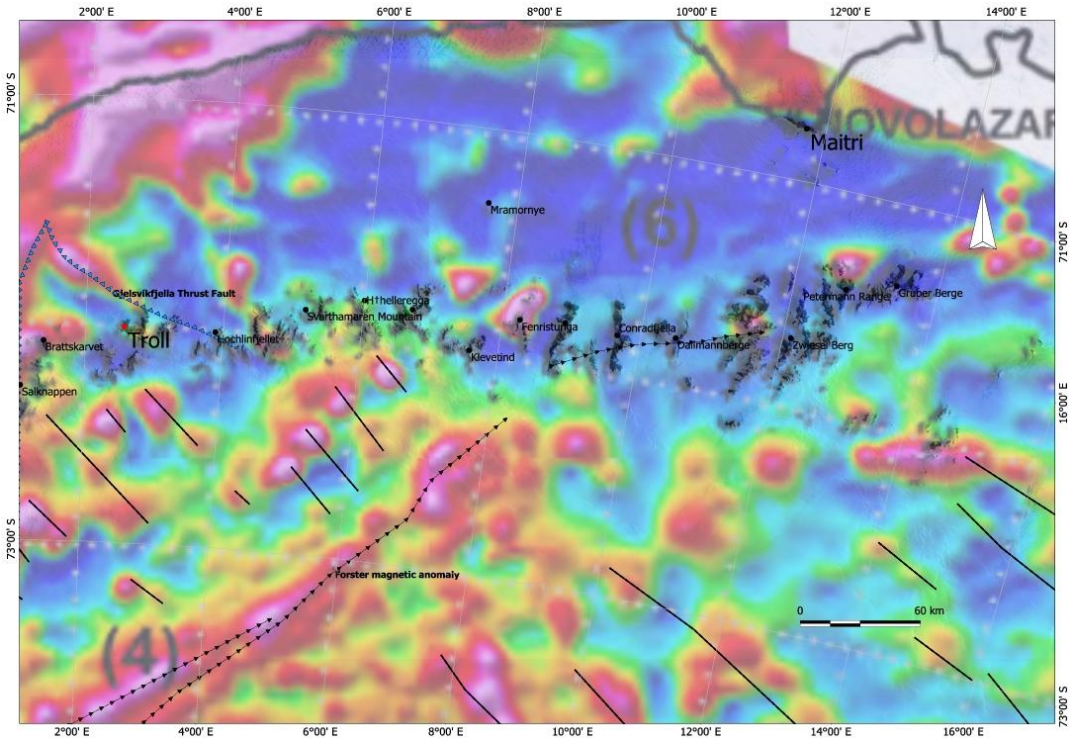

Figure 4. Aeromagnetic anomaly map from Riedel et al. (2012) over central Dronning Maud Land.

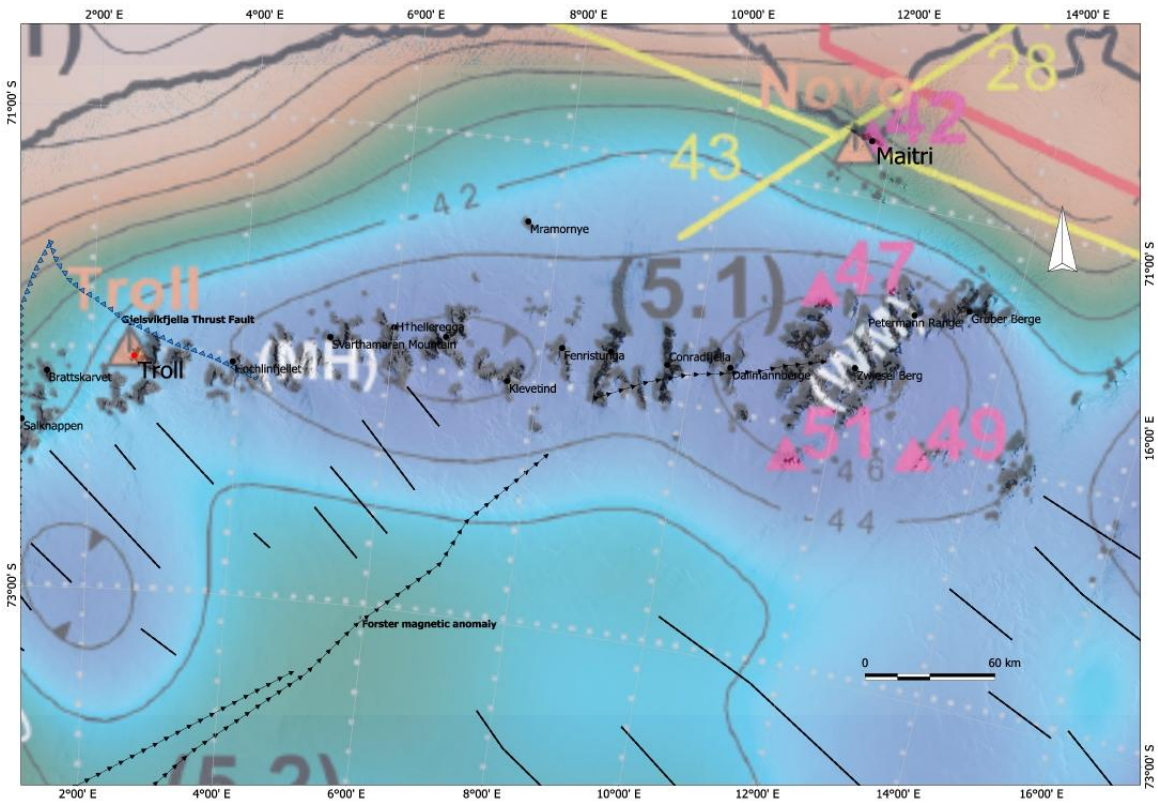

Figure 5. Aerogravity map over central Dronning Maud Land. Data from Riedel et al., (2013). Note the contours indicating thick crust > 44km over the whole area.

Most of the area of interest is characterised by low magnetic intensity with occasional near circular high anomalies in the south, the sources of which are not clear. Low magnetic intensities are typical of high grade metamorphic terrains in which metamorphism typically results in the consumption of Fe^{2+} into silicate lattices as Fe^{2+} which are typically less magnetic than more oxidised magnetite- bearing medium grade assemblages. Strong linear magnetic anomalies are seen in relation to the Gjelsvikfjella Shear zone and the Sverdrupfjella Thrust Fault belt (not shown) to the east of Gjelsvikfjella. In Sverdrupfjella, extensive retrogressive hydration of high grade assemblages is inferred (Groenewald, 1995), resulting in the strong magnetic anomaly. This observation, by analogy, may be used to infer that the Forster Magnetic anomaly has similarly resulted from shearing. In addition the ice covered area south of the area of interest here, is transacted by numerous linear anomalies with orientations similar to that of the Gjelsvikfjella Thrust in the east which may also suggest that they are tectonically related, potentially separating thrust fault slices of different age, analogous to the Cabo Delgado Nappe complex of northern Mozambique (Viola et al,2008 ; Bingen et al., 2009).

A significant feature of the aerogravity map (Figure 5) is the thickness of the crust inferred over the whole area of interest. The crustal thickness inferred over this area is >~44km. This is particularly significant in that, metamorphic P-T studies over this whole area mostly indicate isothermal decompression paths from relatively great depths of ~10-14kb indicating that a substantial volume of rock has already been removed, post metamorphic equilibration in the studied assemblages, with a substantial thickness remaining. This is consistent with a continent-continent collision setting. An aim of this project should be to identify the origin of the extraordinary thick crust in the area which extends to the Gamburtsev Mountains.

Geochronology

A reasonable body of existing zircon geochronological data is available from most of the area with a significant gap evident between ~4°E and 7°E (Figure 6). The range of crystallisation ages varies between ~1200Ma in the east in Sverdrupfjella to ~490Ma. It is evident that ages between ~600Ma - ~800Ma are restricted to the east except for one sample in the west at Hogstabben.

Recognising the emphasis on the timing of Gondwana amalgamation, the areas with crystallisation ages between 400-650Ma are shown in Figure 7 from which it is apparent that ages between ~535 and 650 Ma are largely restricted to the east with one sample in the west from Hogstabben.

A reasonable body of existing metamorphic zircon geochronological data is available from most of the area with a significant gap evident between ~4°E and 7°E (Figure 8). Metamorphic zircon ages vary typically between ~520Ma and ~1100Ma. The latter older ages are largely restricted to the western end of the area of interest with one age reported from the east near Conrad Berge (Figure 8).

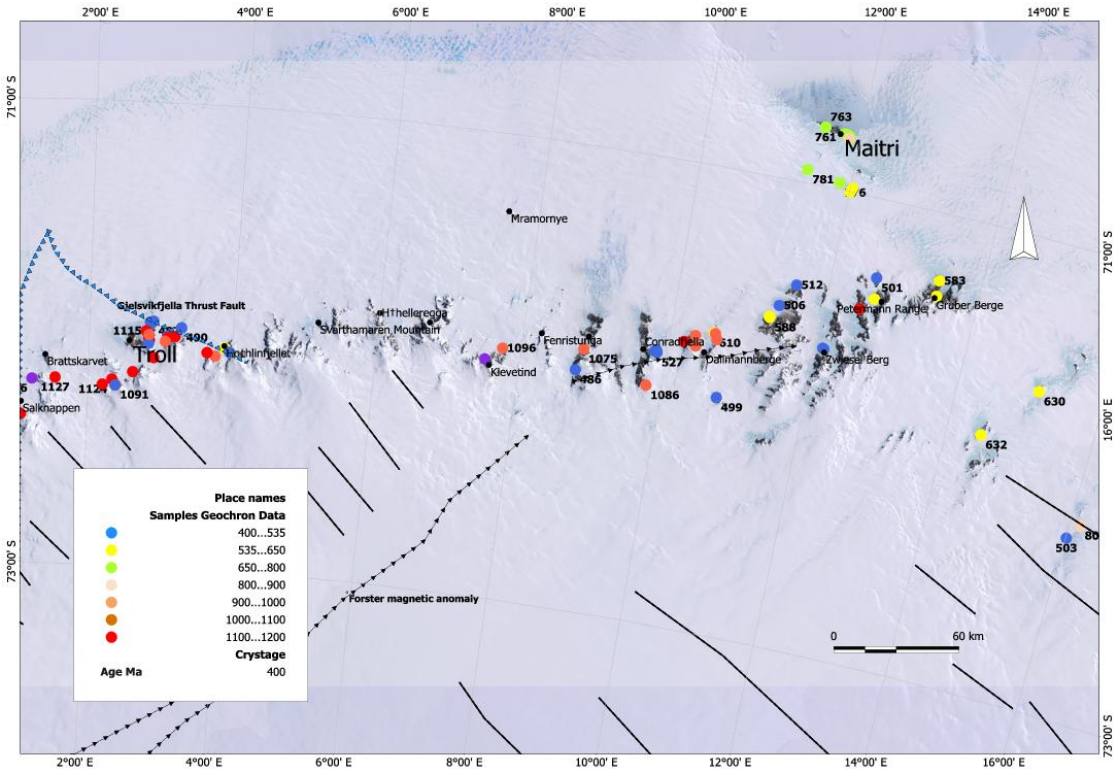

Figure 6. Summarised available crystallisation ages geochronology over central Dronning Maud Land.

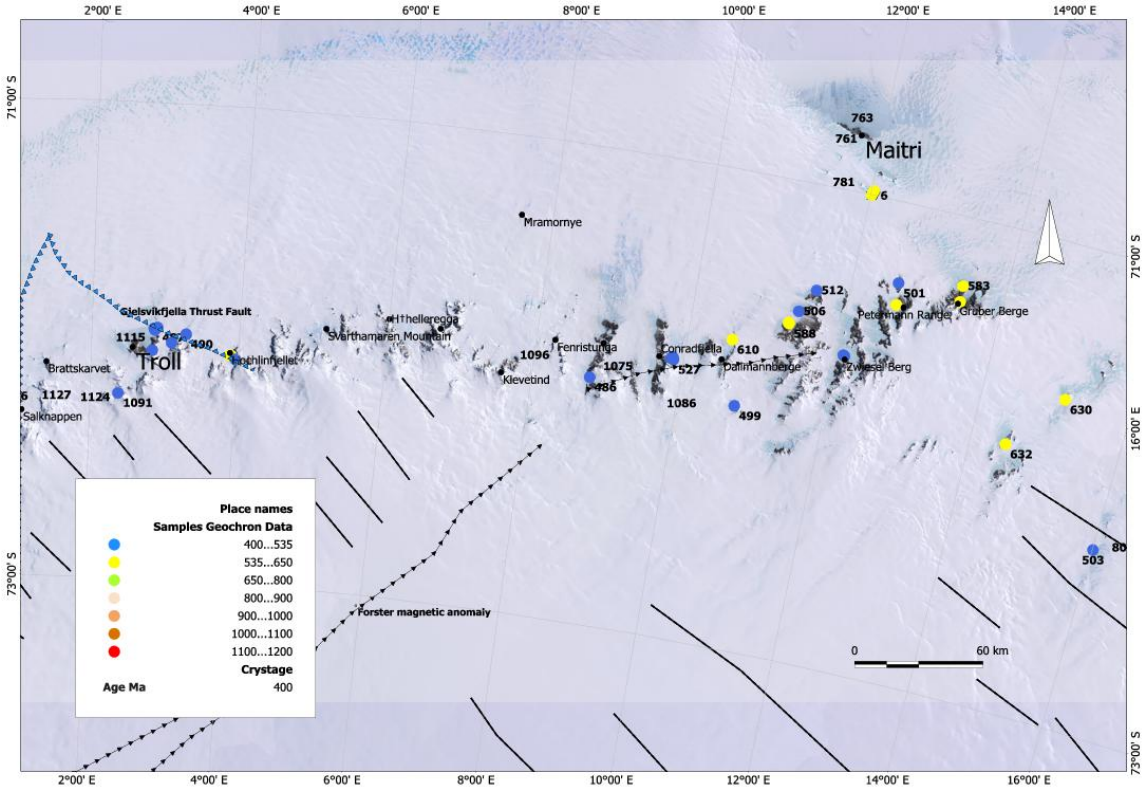

Figure 7. Summarised available crystallisation ages between 400-650Ma over central Dronning Maud Land.

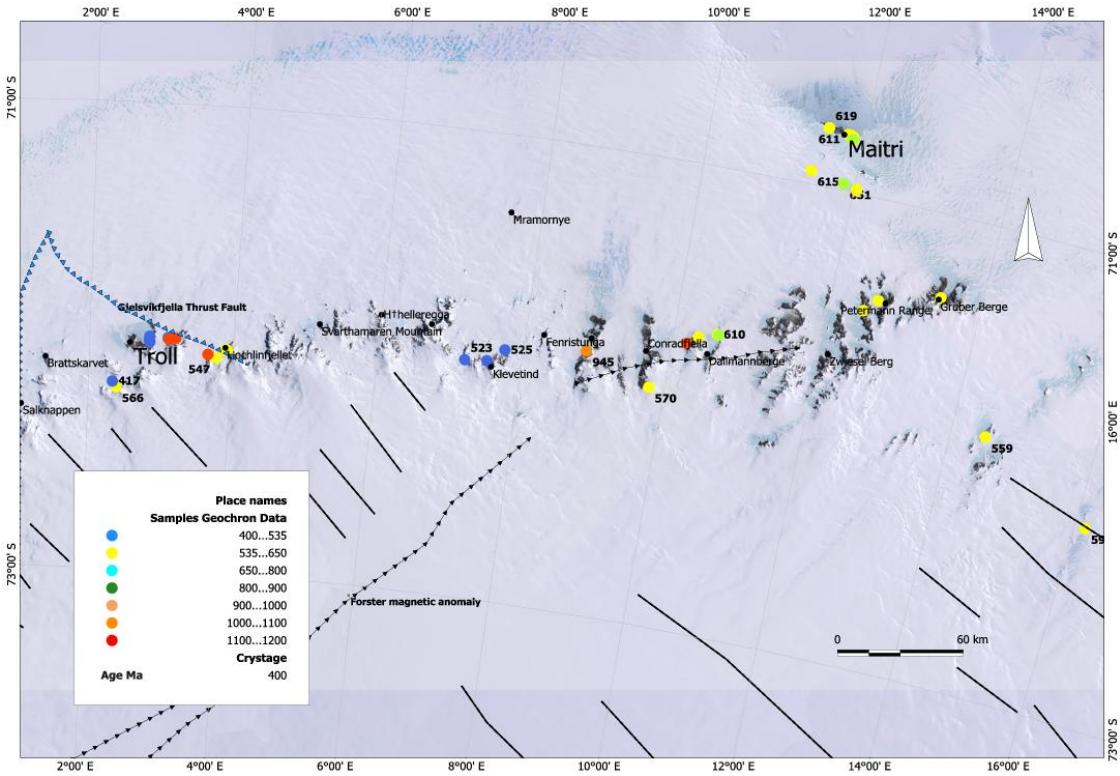

Figure 8. Summarised metamorphic ages over central Dronning Maud Land.

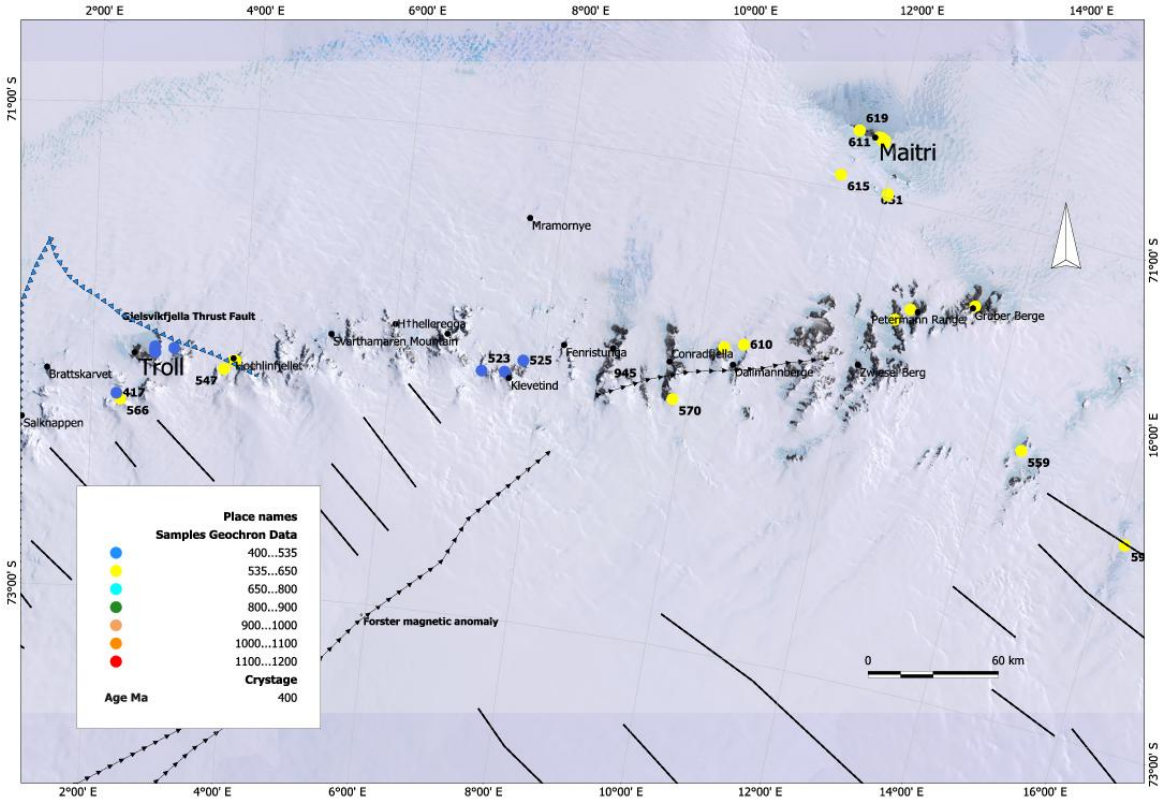

Figure 9. Summarised metamorphic ages 400-650 Ma over central Dronning Maud Land.

Metamorphic ages between 400Ma and 650Ma show that the marginally younger ages are only seen in the center to western part of the area with marginally older ages seen largely in the east with subordinate samples in the west (Figure 9).

Besides the metamorphic geochronology described above, a number of P-T and to a lesser extent P-T-t studies have been described from the broad area of interest. Almost all the studies describe isothermal decompression loops (ITD) from relatively high pressures of ~10-14GPa/Kbar at relatively high temperatures bordering in Ultrahigh temperature conditions >950°C. Most of these studies could be improved with temporal and structural constraints, recognising the time window of 400-650Ma involved in Gondwana amalgamation. A well constrained P-T-t loop is described by Pauly et al., (2016) from Brattskarvet, marginally west of the area of interest. Pauly et al., (2016) describe an ITD loop with peak pressures of ~1.5GPa and temperatures of ~850-900°C at ~570Ma followed by rapid uplift to ~0.7GPa/750-800°C at ~540Ma. Similarly Palmieri et al., (2018) report P-T estimates of 1-5.1-7Gpa at ~950°C from central Dronning Maud Land.

Gaps of current knowledge in relation to distinguishing between the EAO and Kuunga Orogeny

A critical aspect necessary to distinguish between the EAO and Kuunga Orogenies is related to determining what deformational trajectories were involved during the specific time of interest – namely ~600Ma to 450Ma. Whereas geochronological data and P-T-t studies from the broad area of interest are individually available along with descriptions of whole rock chemistry and lithologies, none of the published studies integrate structural studies. Various levels of deformational interpretations are described from the area of interest but geochronological constraints on the deformation episodes are absent. These are critical in that such late deformation phases from ~600-450Ma should be structurally consistant with either an E-W amalgamation (EAO orogeny) or a ~N over ~S collision (Kuunga Orogeny). Syn tectonic magmatism which is structurally constrained, geochronologically constrained and chemically characterised with major and trace element as well as radiogenic isotope chemistry are the necessary tools to distinguish between the EAO and Kuunga Orogenies. The radiogenic isotope chemistry of the phases is essential to understand the sources of the various young magmatic events recognising that juvenile magmatic underplating is inferred in EAO models in contrast to partial melting in an older nappe complex footwall is inferred in a collisional Kuunga model.

Insights from adjacent areas in Gondwana

Mozambique

Recognising that northern Mozambique, specifically the Nampula Terrane, was juxtaposed against Dronning Maud Land prior to Gondwana breakup, useful insights into the evolution of CDML can be gained from the available geochronological data from northern Mozambique. These are summarised below in Figures 10 - 13. Figures 10 and 11 show crystallisation ages with figure 10 summarising all the available data and Figure 11 only the data with ages between ~400-650Ma.

An aspect apparent in Figure 10 is that ages >1100Ma are largely confined to the area south of the Lurio Belt. In Figure 11, it is apparent that crystallisation ages between ~535Ma are largely confined to the area N of the Lurio Belt whereas ages between 400-650Ma are distributed throughout the area. Similarly, Figures 12 and 13 show that older metamorphism >~1000Ma is restricted to the Nampula Terrane south of the Lurio Belt. In addition metamorphism ~535Ma is mostly confined to the areas north of the Lurio Belt and in the Monapo and Mugeba klippen.

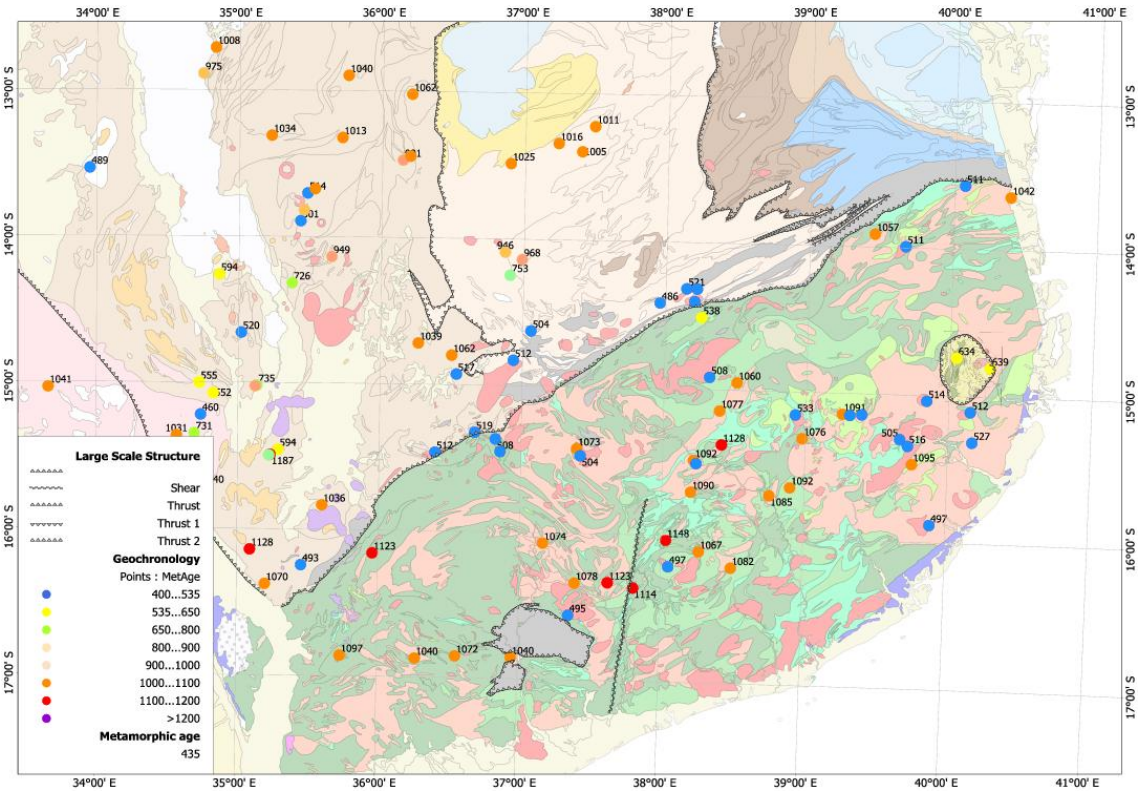

Figure 10. Map of distribution of zircon crytallisation ages in northern Mozambique.

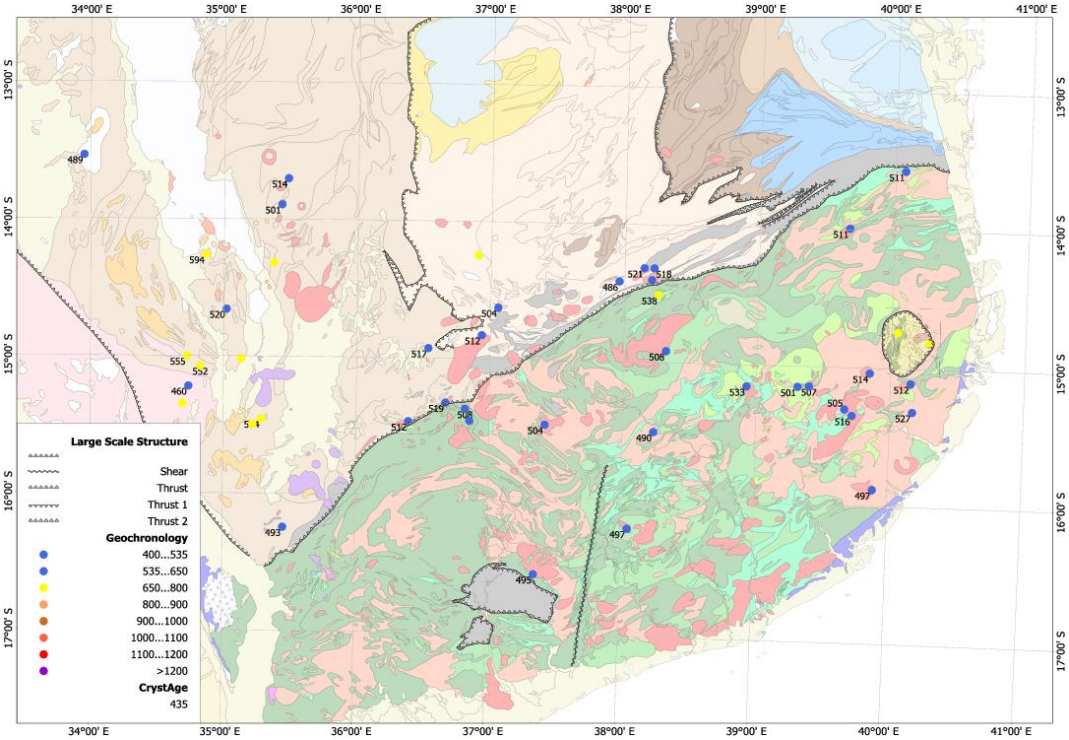

Figure 11 Map of distribution of zircon crytallisation ages between 400 and 650Ma in northern Mozambique

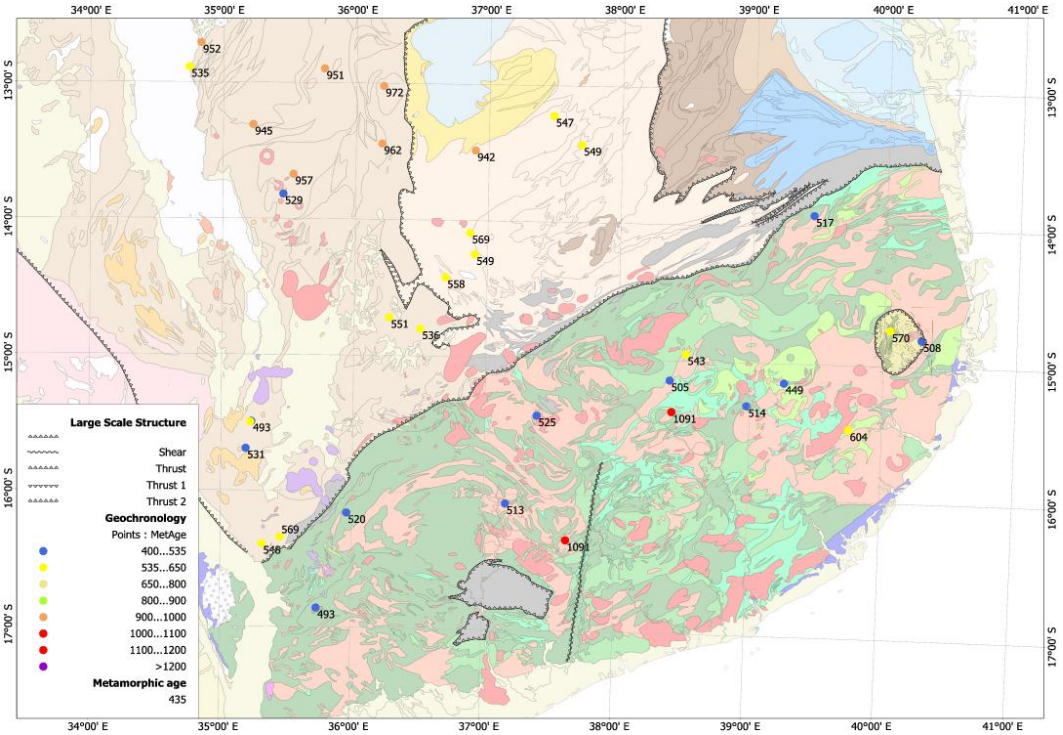

Figure 12 Map of zircon metamorphic ages from northern Mozambique.

Comparison of the age patterns described in Figures 6-13, shows that in the area of proposed focus in this document in CDML, are comparable to the area north of the Lurio belt in northern Mozambique with which Grantham et al. (2008, 2013) and Ravikant et al.,

(202, 2004, 2007, 2018) have reported apparent correlations. These observations are in contrast to Sverdrupfjella, western Dronning Maud Land, described below.

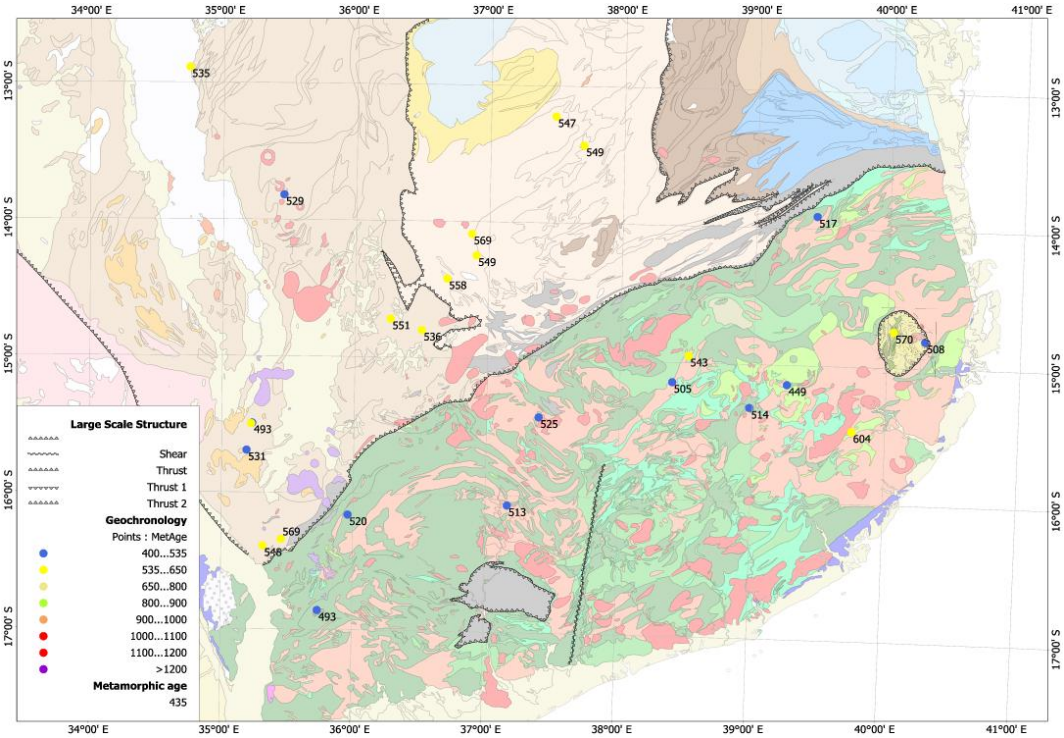

Figure 13 Map of zircon metamorphic ages between 400 and 650Ma from northern Mozambique.

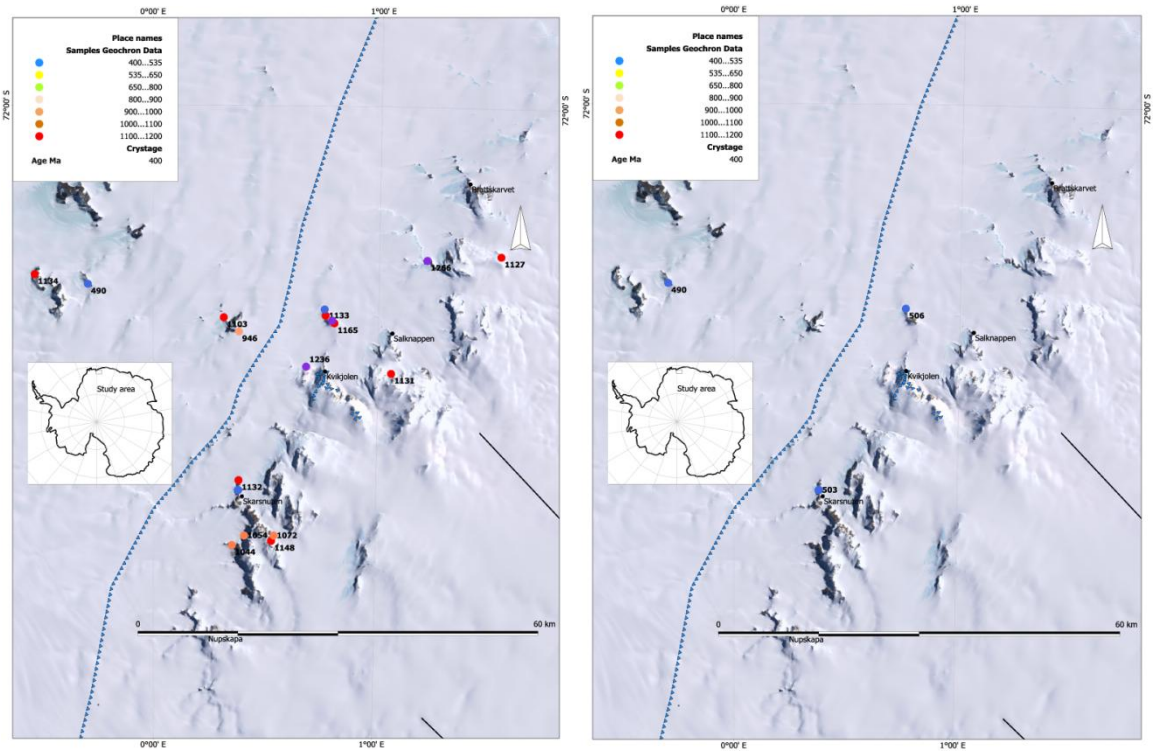

Figure 14 Zircon crystalisation ages from Sverdrupfjella (left) and zircon crystallisation ages between 400 and 650Ma from Sverdrupfjella (Right).

Western Dronning Maud, Land (Sverdrupfjella)

The available published crystallisation and metamorphic ages from Sverdrupfjella, west of the area of interest are summarised in Figures 14 and 15 above and below. Crystallisation ages are dominantly between ~1200-1000Ma and ~400-535Ma. It may be significant that ages in the ~535Ma-1000Ma are absent. These limited data suggest that CDML and northern Mozambique, are dissimilar to western Sverdrupfjella, possibly indicating a crustal boundary between W. Sverdrupfjella and E. Sverdrupfjella + Gjelsvikfjella.

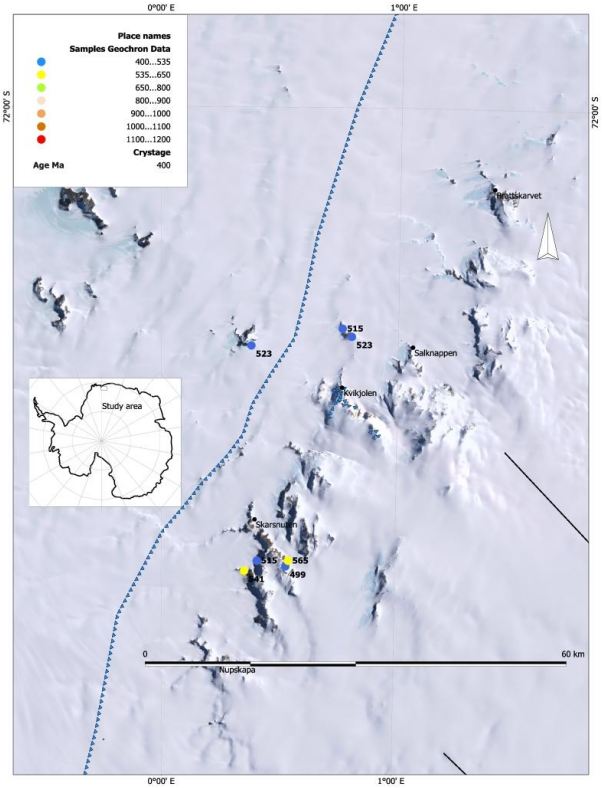

Figure 15. Zircon metamorphic ages from Sverdrupfjella

<u>Proposed Scientific Program for this study.</u>

Besides conducting basic geological mapping (lithology distribution and relationships, structural observations and measurements, sample collection for rock composition and age determinations) within the priority areas, a focus on those structures and lithologies related to the orogenic amalgamation of Gondwana are proposed. Much of the data sought are related to syn-tectonic intrusions of varying ages. Examples of this are shown below. In Figure (16) below from Bucher and Frost (2006, J. of Petrol), a number of vein phases hosted in ~550Ma granite are seen on which the chemistry is described but no geochronology and related structural analysis. The veins, hosted in a ~550Ma granite, provide insights into processes related to Gondwana amalgamation. All veins depicted in the figure are of significance, but the most significant are inferred to be the youngest alkali-feldspar granites because of their inferred age at ~490Ma, inferred structural geometry and their syntectonic nature, evident from displacements in relation to other veins.

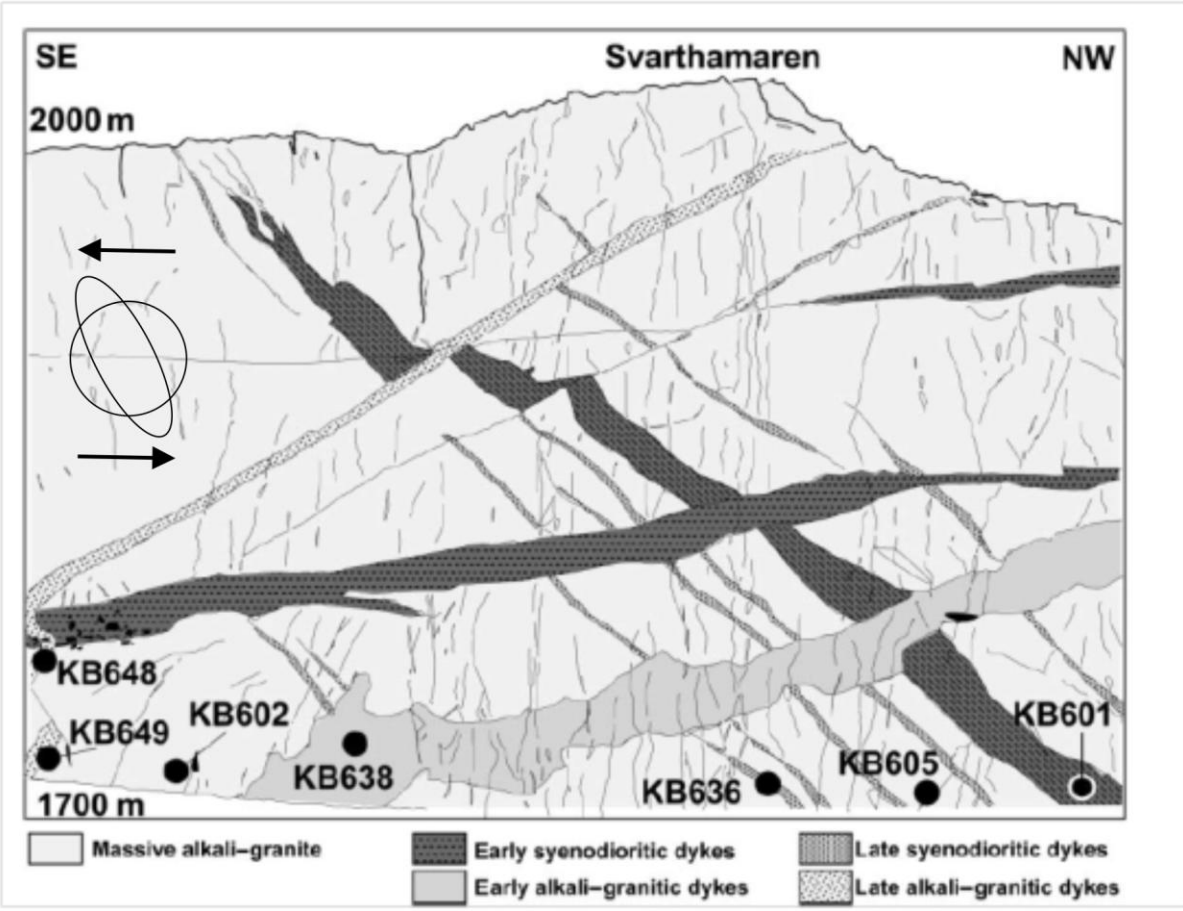

Figure 16. Copy of image from Bucher and Frost (2006) from Swarthameren, CDML showing variably oriented vein arrays. The strain ellipse is schematic and refers to an inferred relative strain in relation to the orientations and displacements along the youngest late –alkali granite veins dated at ~490Ma in Gjelsvikfjella to the east, providing a top to SE displacement.

Similarly, in Figure (17) below from Salknappen, Sverdrupfjella, two generations of veins are seen, an earlier ~520Ma pegmatite phase, discordant to gneissic layering, cut by layer parallel ~490Ma granite (in red in image at right). It is apparent that extensional top-to-the-SE displacement has occurred syntectonically along the younger veins. Radiogenic isotope chemistry shows that the younger veins are sourced in older basement with TDm ages >2.0Ga in contrast to the younger veins with TDm ages <1.8Ga and similar to their host gneisses. Older ~1140Ma basement with similar old radiogenic isotope chemistry is exposed to the west in western Sverdrupfjella. These data support an interpretation of tectonic stacking in which younger veins are generated in the footwall of an older mega nappe structure.

Figure 17. Two generations of granitic veins at Salknappen. Person at lower right for scale.

Specific localities of interest for field study components

Five priority field areas are suggested and numbered 1 to 5 in Figure 18 below.

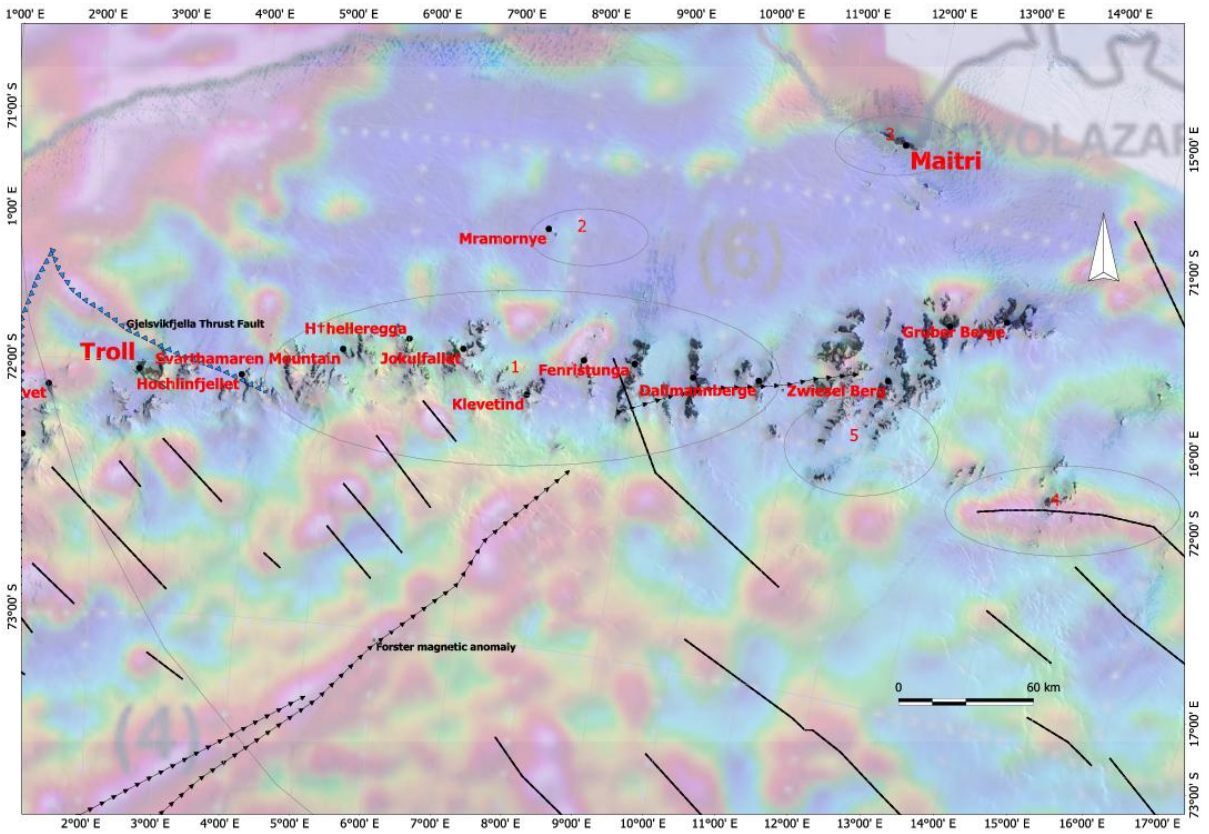

Figure 18 . Map of the area of interest showing the 5 priority interest areas.

Priority area 1 - central CDML

This area is the largest and is given a high priority because virtually no geochronological, lithological and structural data are available from it. Limited data suggest it is largely underlain by granites with subordinate basement gneisses. The focus in this area would

largely focus on the age, whole rock major and trace element chemistry and radiogenic isotope chemistry of the granites as well vein intrusive phases into the granites. This approach recognises the strain regime recorded by the veins represents the strain during the timing of Gondwana amalgamation with earlier structures not being present in the granites, assuming their age is ~530- 550Ma, as suggested by limited data from adjacent areas. The eastern edge of this priority area is also transacted by the Orvinfjella Shear Zone. The nature of the shear zone is uncertain. Speculation is that it is an extension of the Forster Magnetic Anomaly and in Mozambique, it continues in the Namama Shearzone. Further speculation is that it represents the boundary between the Kalahari Craton at depth (west/north of the shearzone) and juvenile metamorphic terranes to the east. Radiogenic isotope chemistry of appropriate phases can provide insight into these considerations.

Priority area 2 - Mryamorne nunataks

The Mryamorne nunataks have been mapped in detail during the GeoMaud expedition however no geochronology from the strongly sheared gneisses are available, recognising the geographical location of area. The area is underlain by strongly sheared gneisses intruded by some pegmatites. Significantly, rocks at this locality, dip northwards, similar to rocks in the hanging wall of the Gjelsvikfjella Thrust in the west. Small late granitic intrusions are reported and their structure, age and chemistry should be determined.

Priority area 3 – Maitri environs

A significant body of lithological, petrological and geochronological (whole rock and single zircon) data are available from the Maitri area, with crystallisation and metamorphic ages reported typically in the range of ~600Ma to 800Ma with these rocks being correlated with similar rocks in northern Mozambique. The ages largely predate the amalgamation of Gondwana however maps of the Maitri area, show pegmatitic veins which cut the gneisses and granulites. No age data or structural data from the younger intrusions are available. Such data will provide insights to the timing and kinematics of younger intrusions and potential insight into Gondwana amalgamation processes.

Priority area 4- Payer mountains

This area, the Payer Mountains, is located over a linear magnetic high anomaly. Investigation of the rocks overlying the anomaly will provide insight into the potential cause of the anomaly, to ascertain if it is perhaps shear related. Limited geochronology is available from the rocks SE of Maitri. Consequently systematic mapping and sampling of these nunataks will provide valuable new data and insight into the different orogenic models for the area.

Priority area 5 – southern Zwiesel Mountains.

This area is prioritised due to the paucity of information on it with regard to lithology, geochronology and structural geology in the literature.

Anticipated outcomes of the project

1. Improved knowledge of the basement geology of the area will contribute to the GeoMap intiative.
2. Improved knowledge over these mostly poorly studied areas in relation to their geophysical characteristics may establish the relationship between geology and geophysics, contributing to the CGG SCAR action Group and planned SCAR Research program.
3. Understanding the geophysics along with new combined structure, geochronological and magmatism studies will contribute to distinguishing between the EAO and Kuunga Orogenic events, particularly with a focus on features generated in the 400-650Ma time period, similar to those shown above from Swartharen (CDML) and Salknappen, Sverdrupfjella.
4. Correlation of the information gained described in 1-3 above, will facilitate correlation with structures and geology in adjacent continental blocks in southern Africa and Sri Lanka.

Potential Participants from South Africa

Dr. G.H. Grantham and Dr. H. van Niekerk (University of Johannesburg)

Personnel from Council for Geoscience (Geological survey of South Africa)

Prof. M. Satish-Kumar (Niigata University, Niigata, Japan).

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