



WAXI - West African Exploration Initiative

IXOA - L'Initiative d'Exploration Ouest Africaine

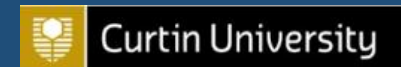


The West African Exploration Initiative (WAXI): *12 years of integrated research for development*

Mark Jessell & the WAXI Team*

**Centre for Exploration Targeting, The University of Western Australia*

**Institut de Recherche pour le Développement, University of Toulouse*





WAXI - West African Exploration Initiative

IXOA - L'Initiative d'Exploration Ouest Africaine

**Project Broker &
Coordinator**



**37 Industry &
Government Sponsors**



WAXI 1
WAXI 2
WAXI 3
2006-2018

**74 partners
over 12 years**

12 Sponsors in kind (Geological Surveys)



Liberia



Mali



Guinea



Niger



Burkina Faso



Ghana



Senegal



Togo



Sierra Leone



Mauritania



Minerals Commission



Côte d'Ivoire

Mauritania

Senegal

Guinea

Sierra Leone

Liberia

Côte d'Ivoire

Mali

Burkina Faso

Niger

Ghana

Togo

**24 Research and Capacity
Building Partners**



The WAXI project in numbers

12 countries

12 years

74 partner organisations over 12 years

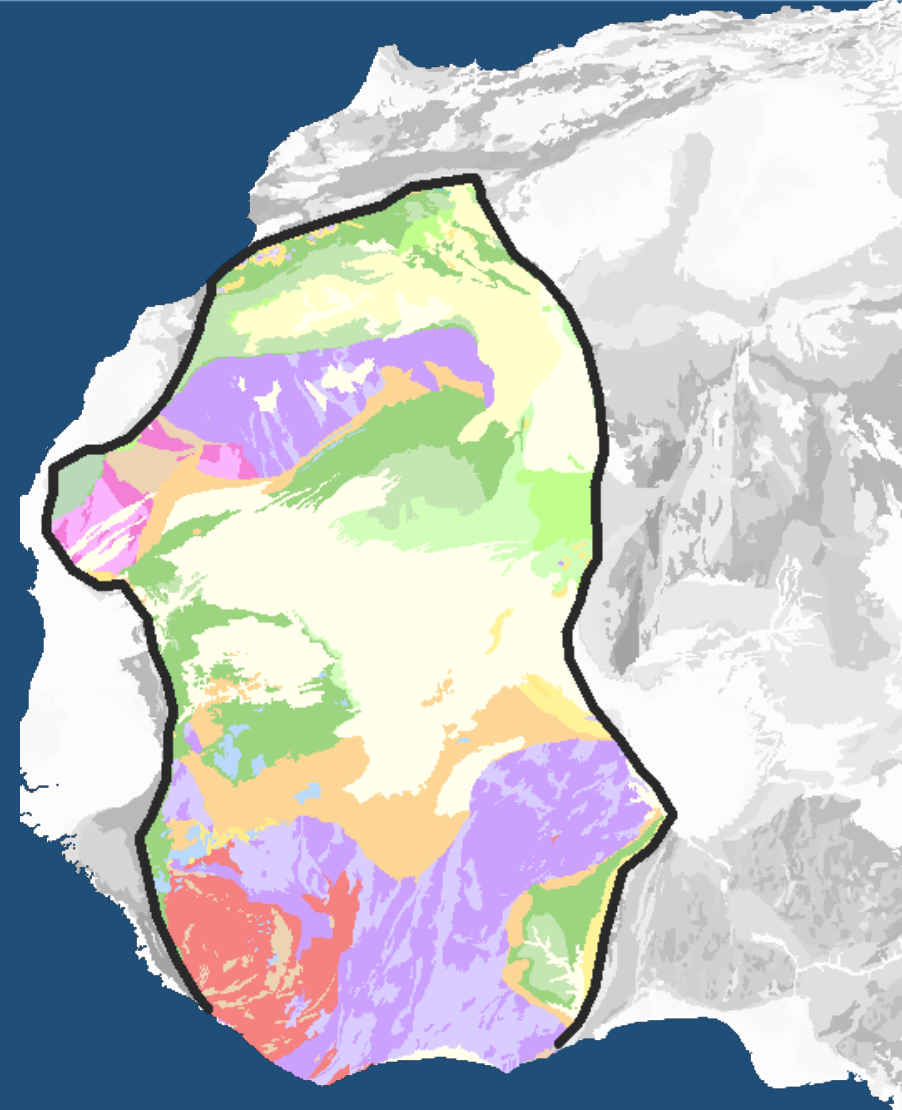
85 International Publications

94 Postdoc, PhD, MSc & Hons projects

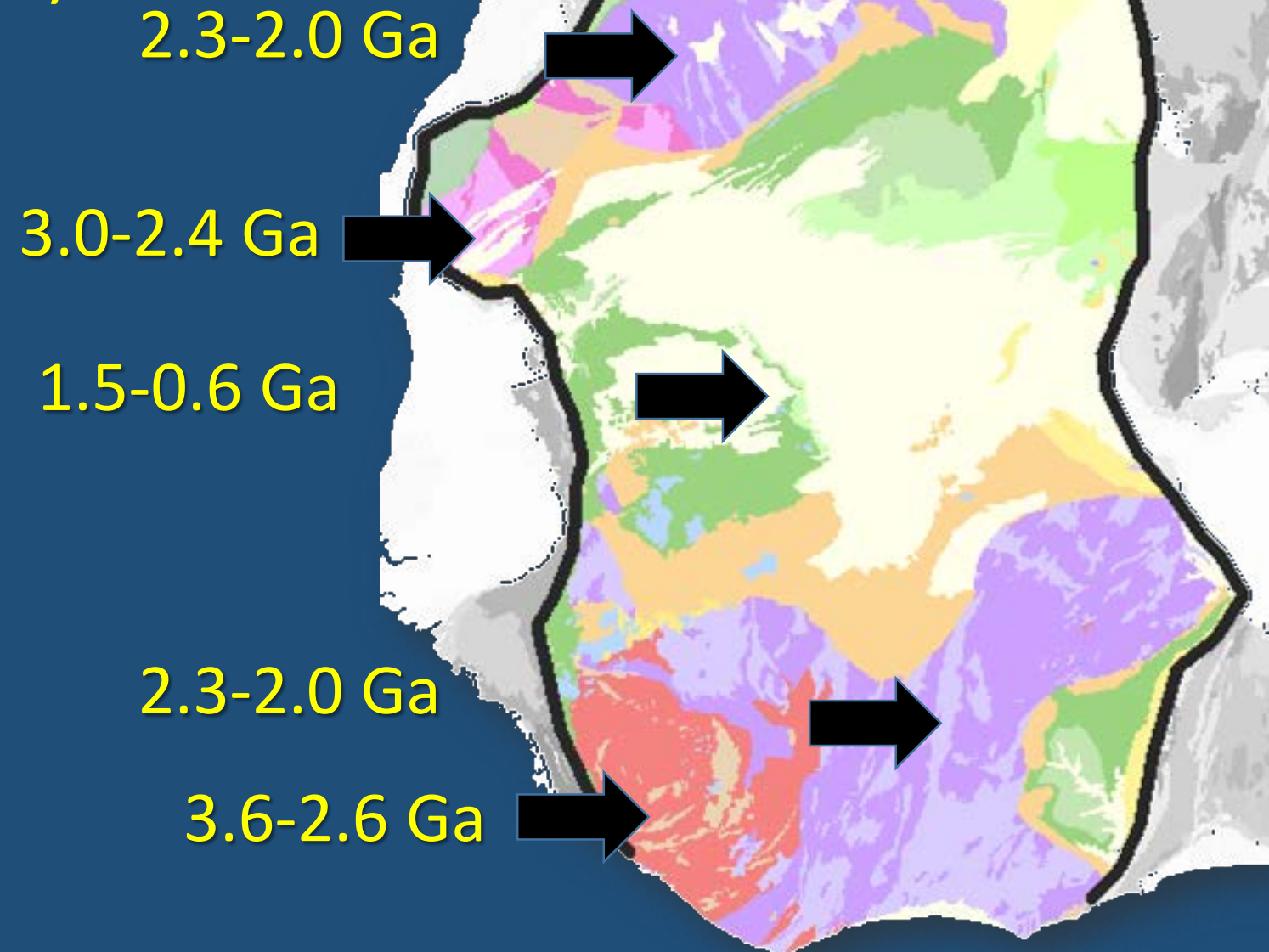
650 GB exploration geoscience database

1800 person-days of technical training in West Africa

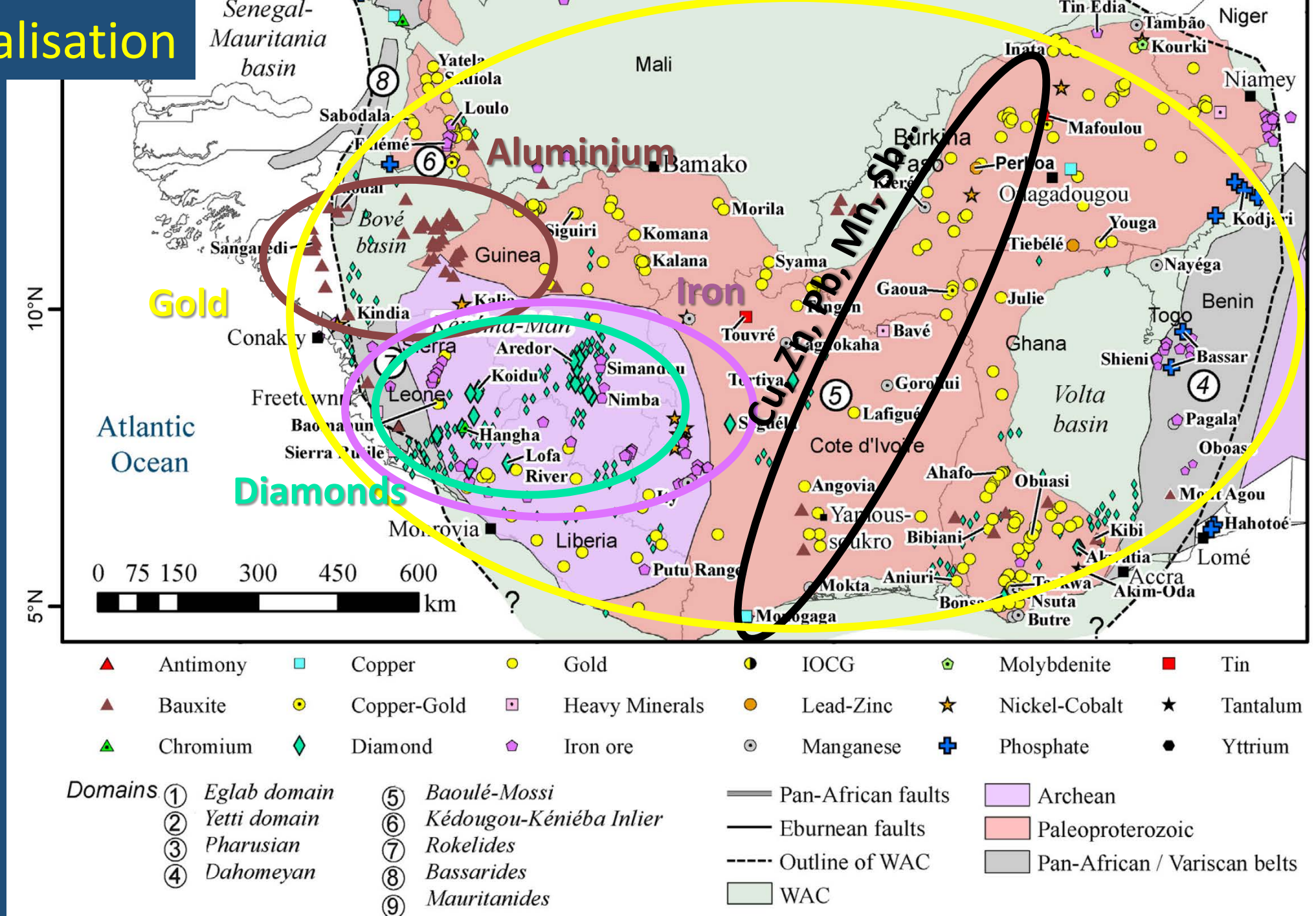
650,000 km² of geophysically-constrained geological mapping



The 2-slide tour of the West African Craton (WAC)



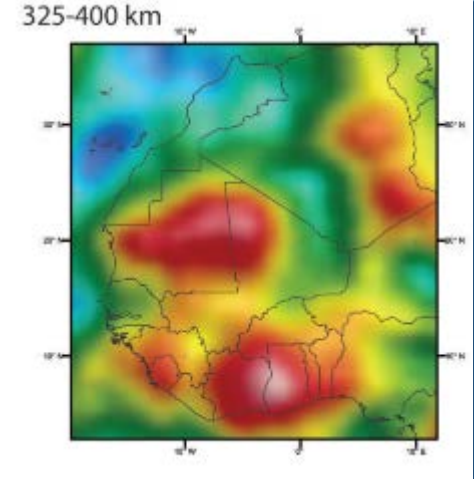
WAC Mineralisation



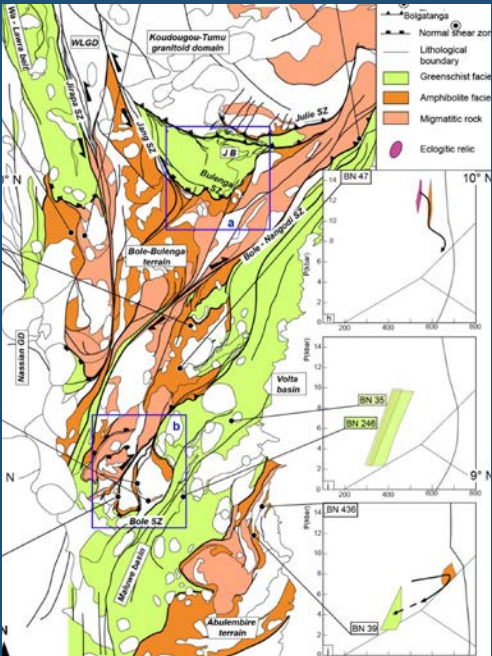
Markwitz
et al., 2016

Multiscale Analysis

Craton
Scale



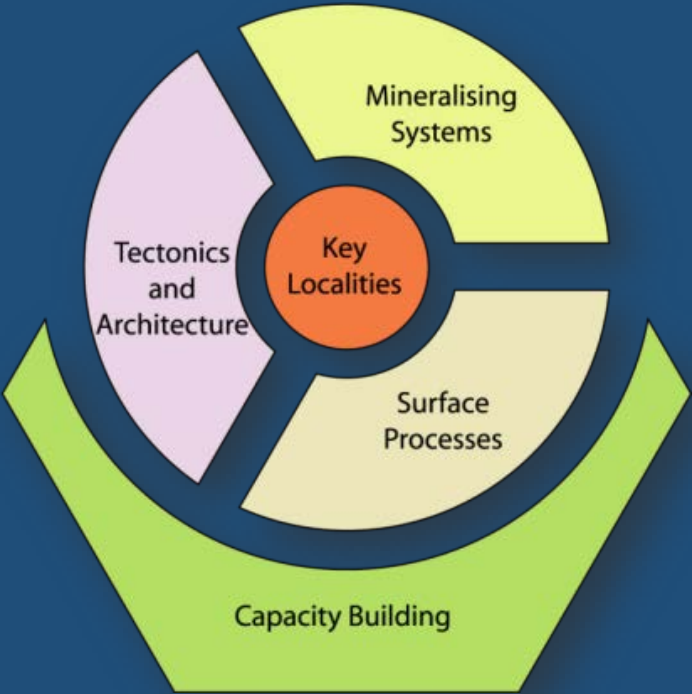
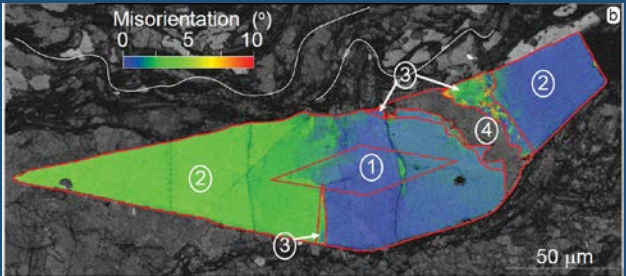
Belt
Scale



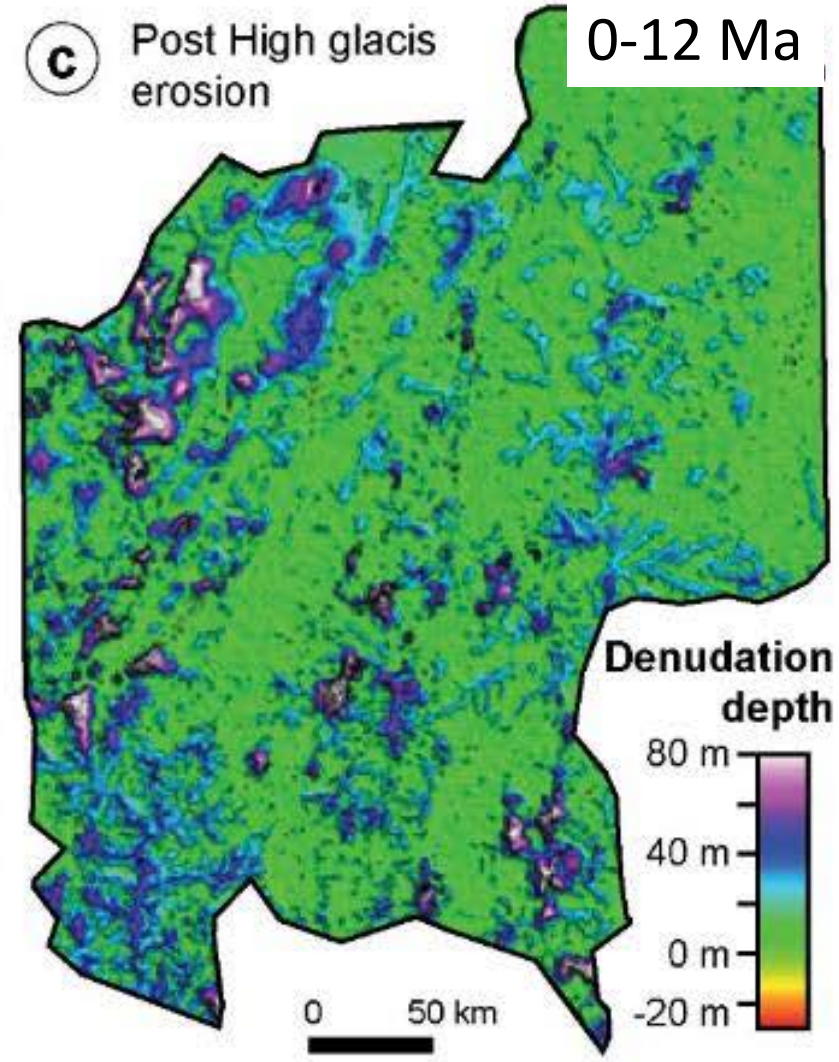
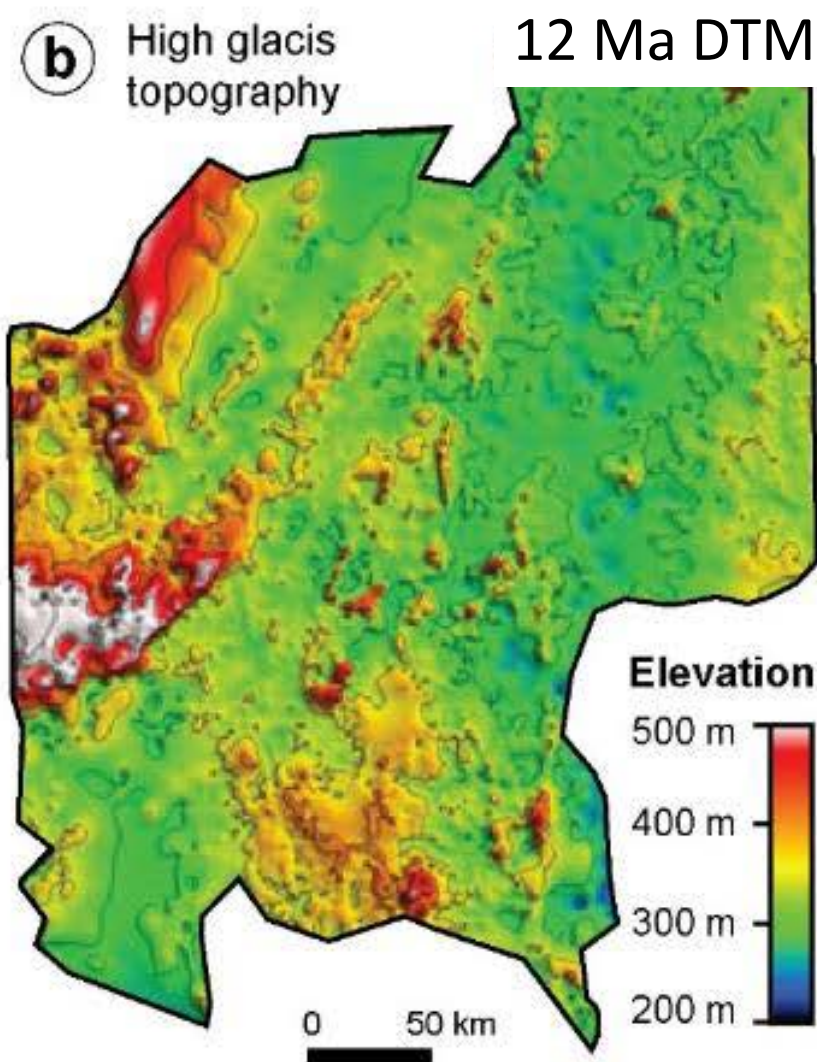
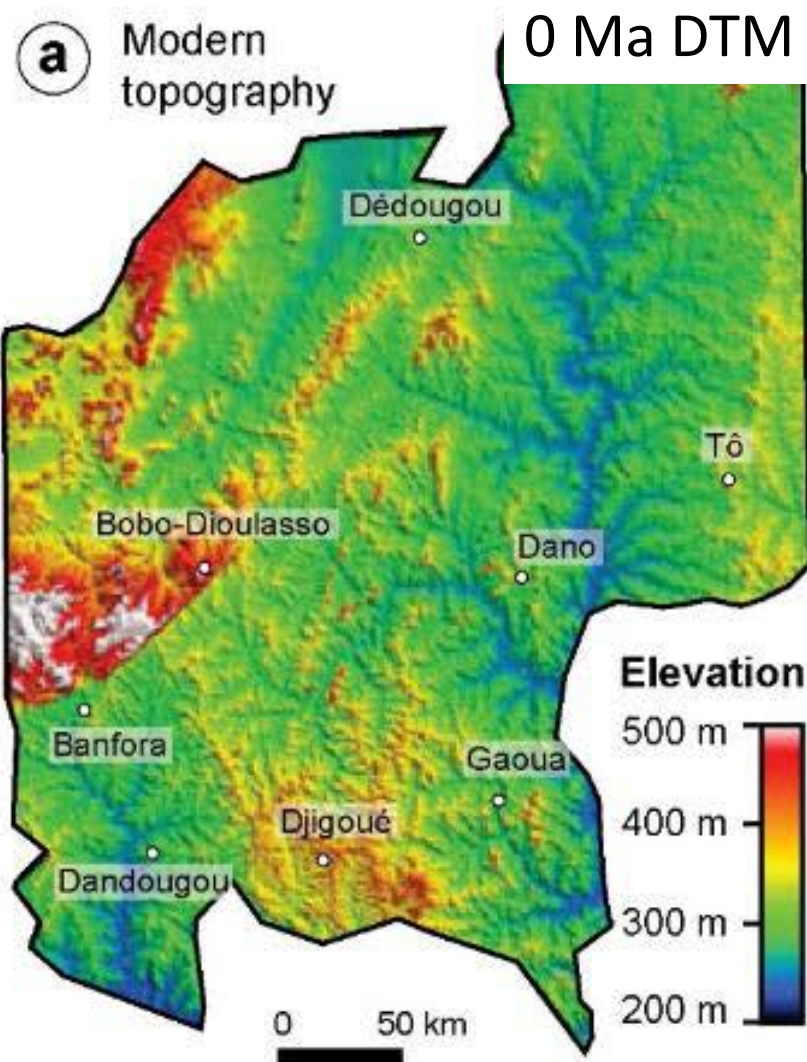
Deposit Scale



Grain Scale



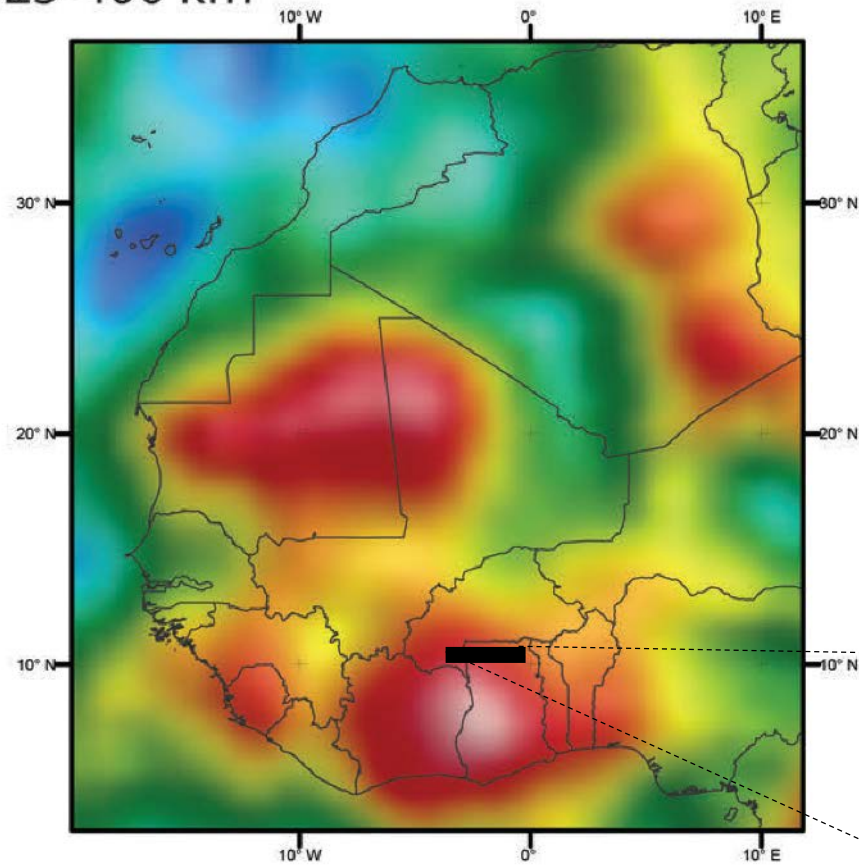
Training



Regolith and landform analysis reveals
paleo-landscapes (SW Burkina Faso)

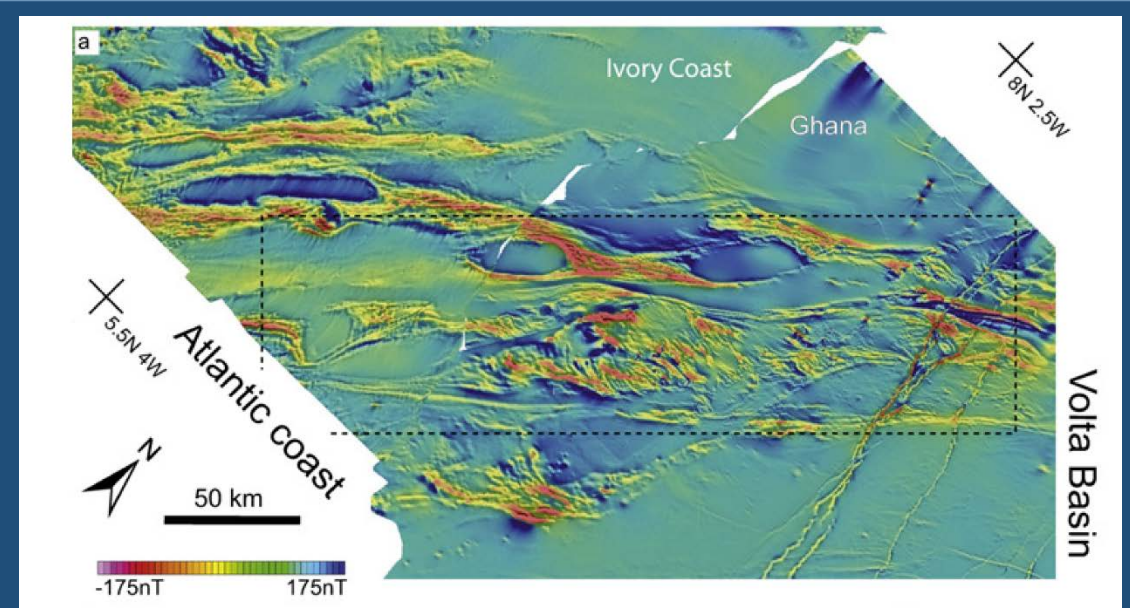
Grimaud et al. 2015, Geomorphology

325-400 km Jessell et al., 2016, PR

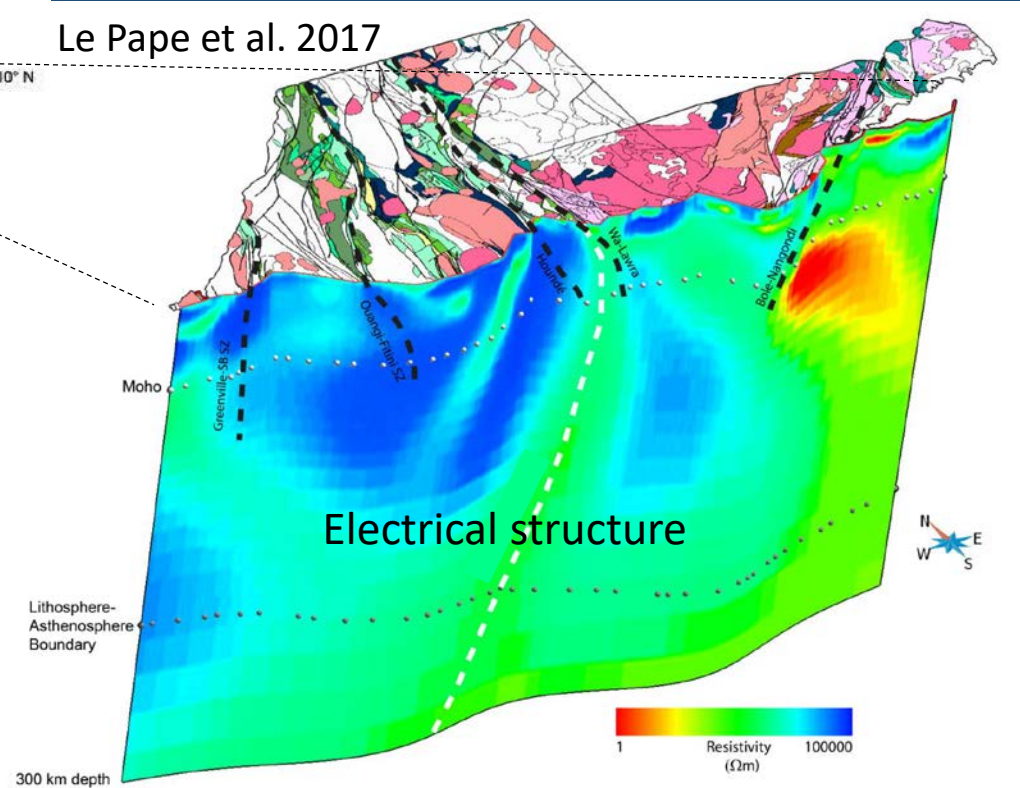


S-wave velocity structure

Definition of
major craton-
scale structures

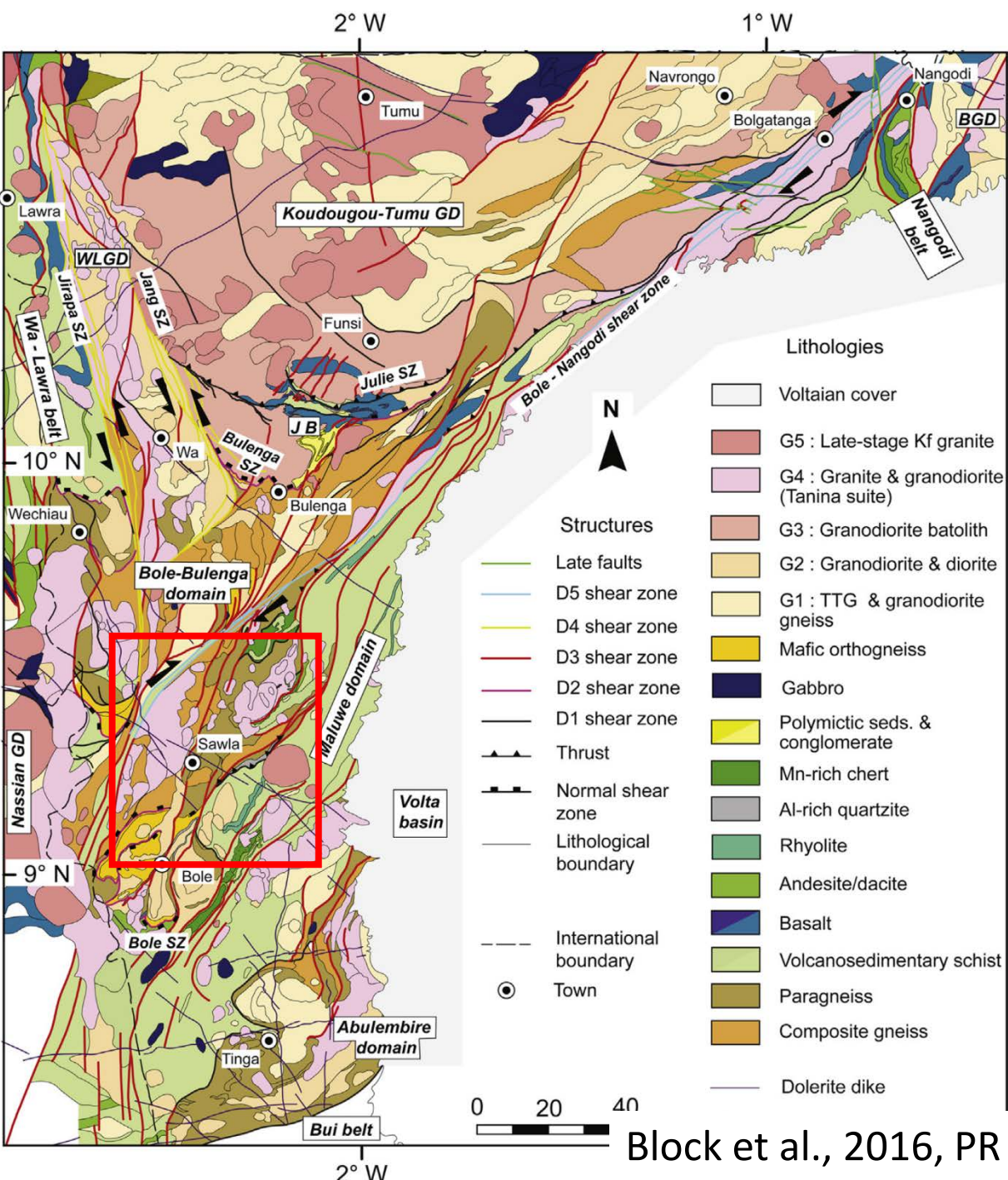
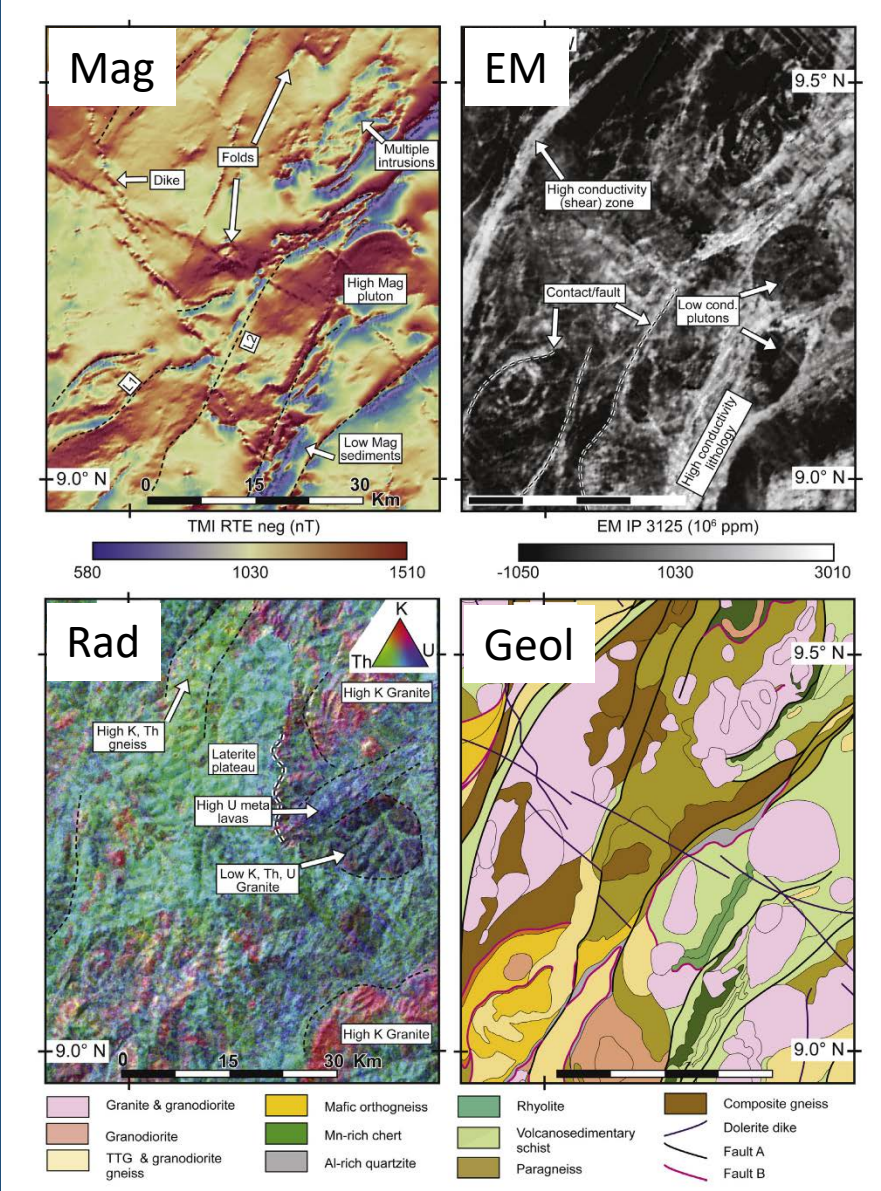


Le Pape et al. 2017



Jessell et al., 2012, PR

Integrated structural and geophysical mapping (NW Ghana)



Siguiri, Guinea
(>7 million ounce)



Komana, Mali



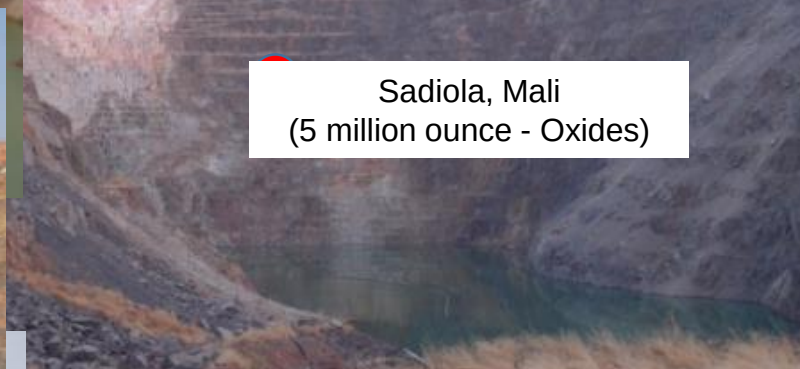
Mana > 2 million ounces
Burkina Faso



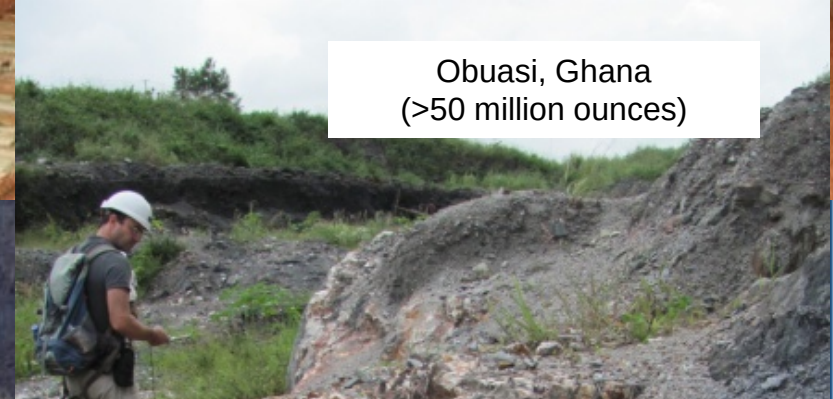
Morila, Mali
(7 million ounce)



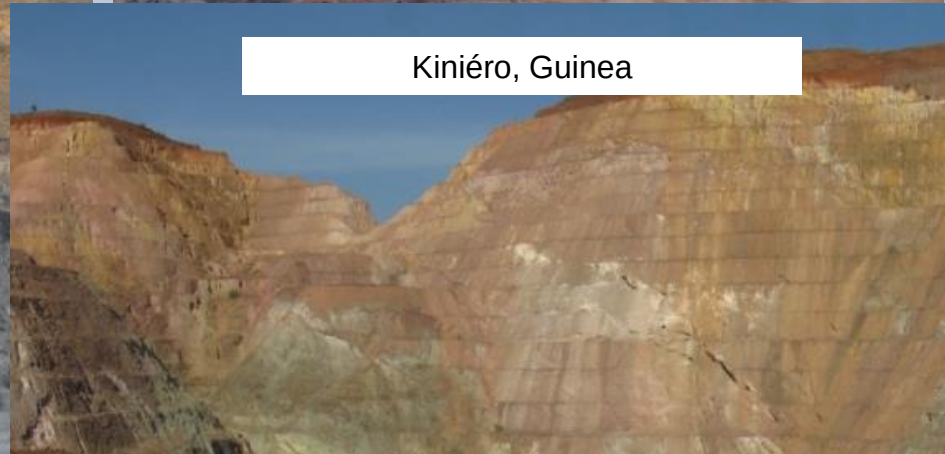
Sadiola, Mali
(5 million ounce - Oxides)



Obuasi, Ghana
(>50 million ounces)



Kiniéro, Guinea



Bogoso, Ghana (5 million ounces)



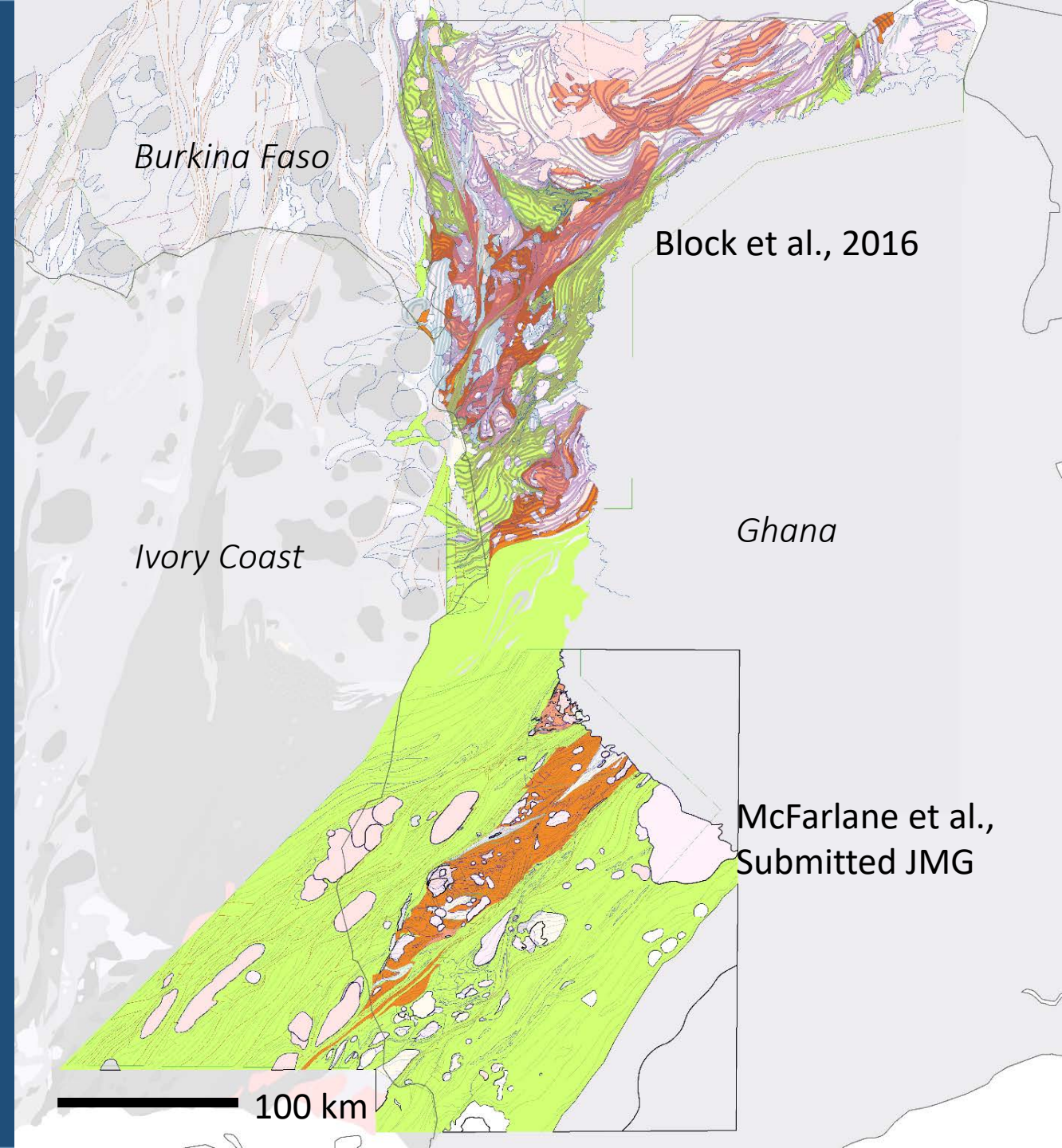
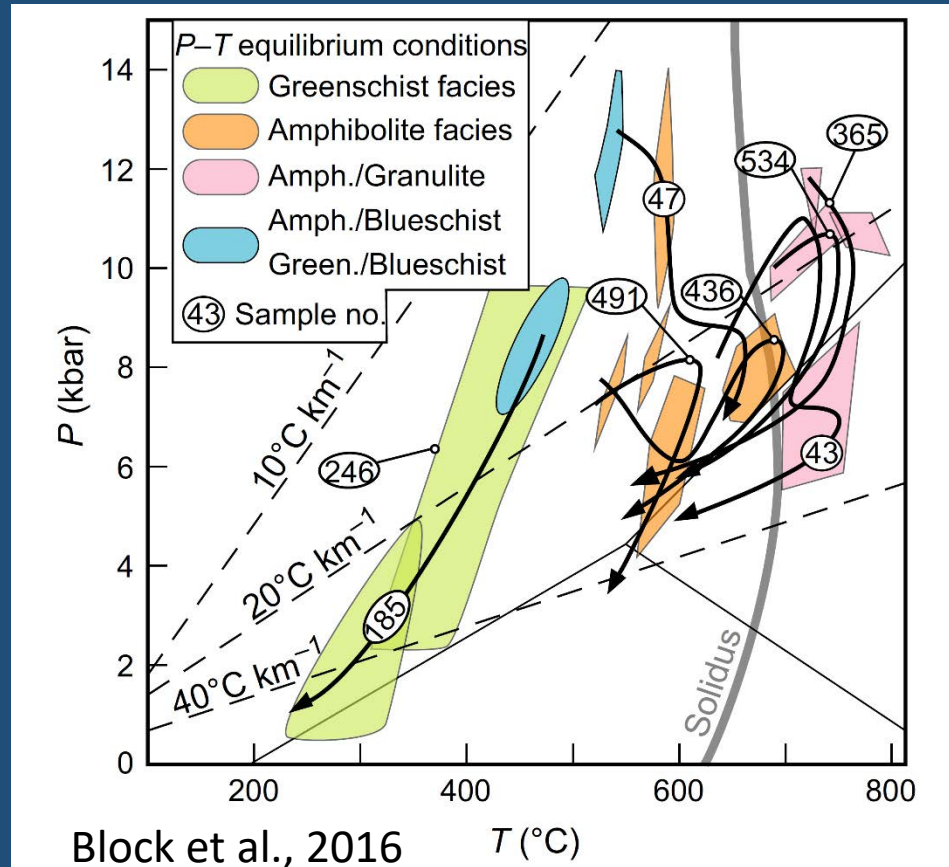
Syama, Mali
(5 million ounce)



Deposit Scale (>60 reports & pubs)

Metamorphic mapping reveals major extensional episodes

80 new P-T estimations and over 300 P-T estimations gathered from the literature

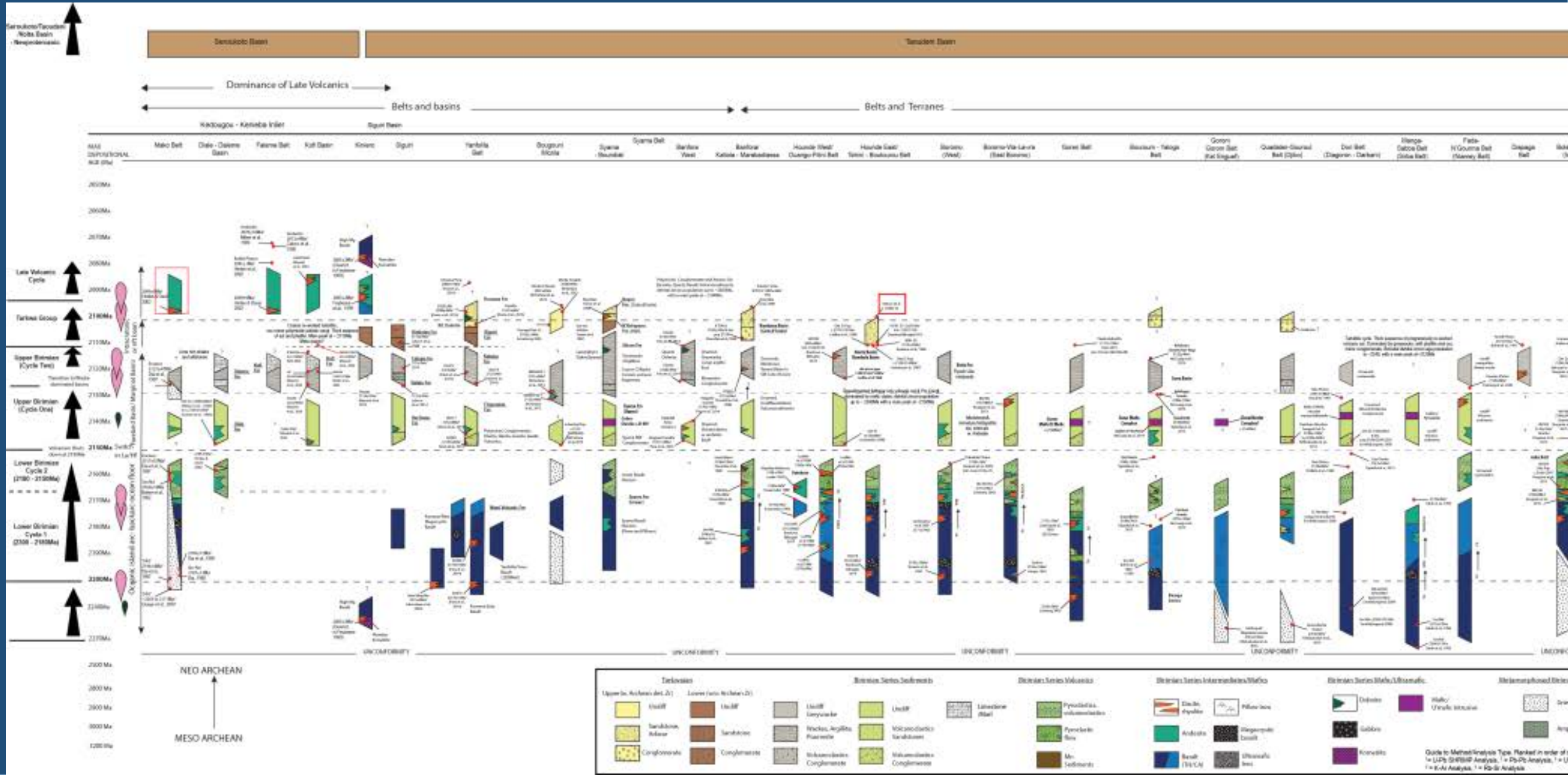


Miller et al. In prep.

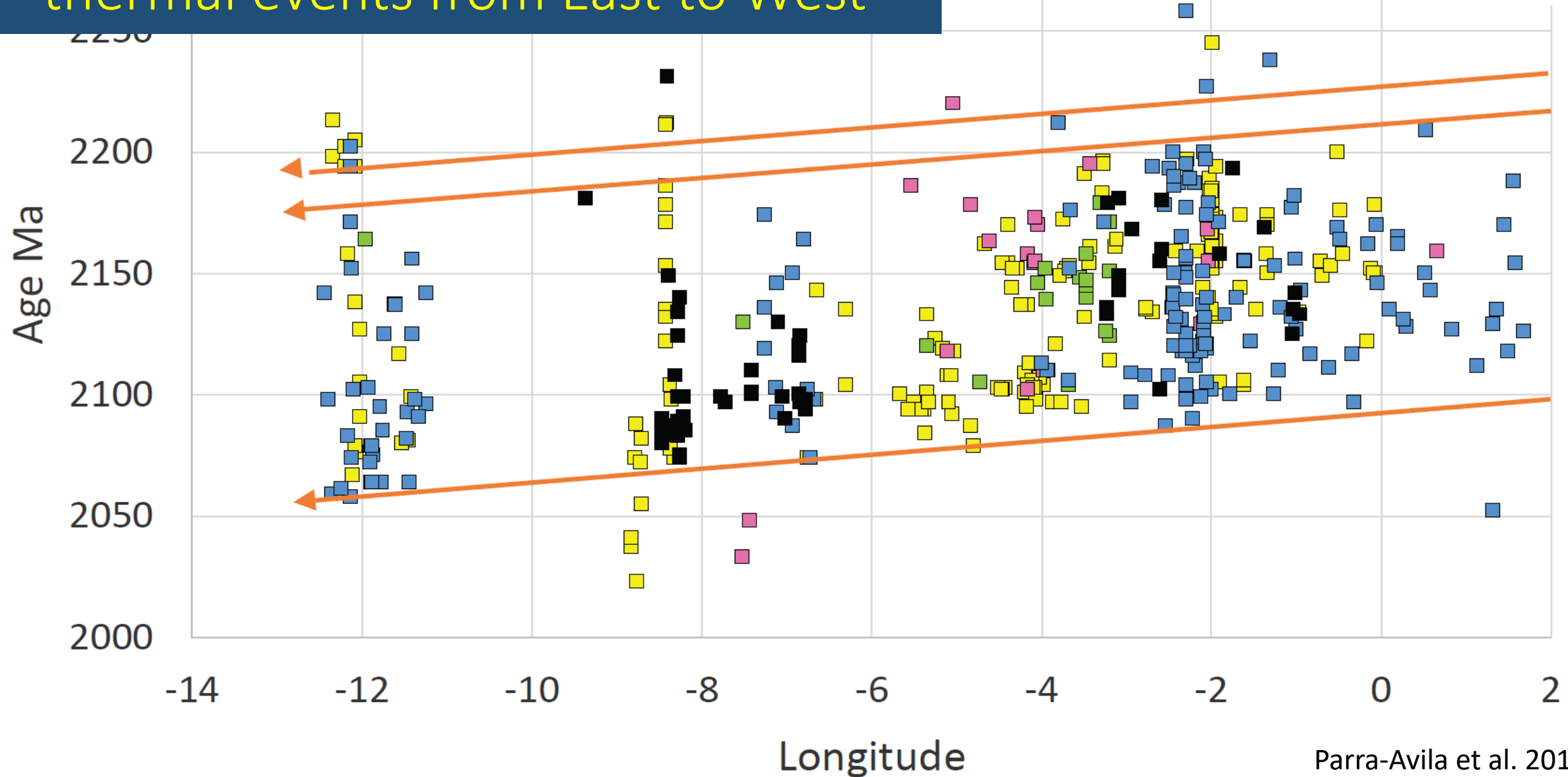


Stratigraphic Synthesis of sWAC

Davis et al. In prep



50 Ma variation in the timing of major thermal events from East to West

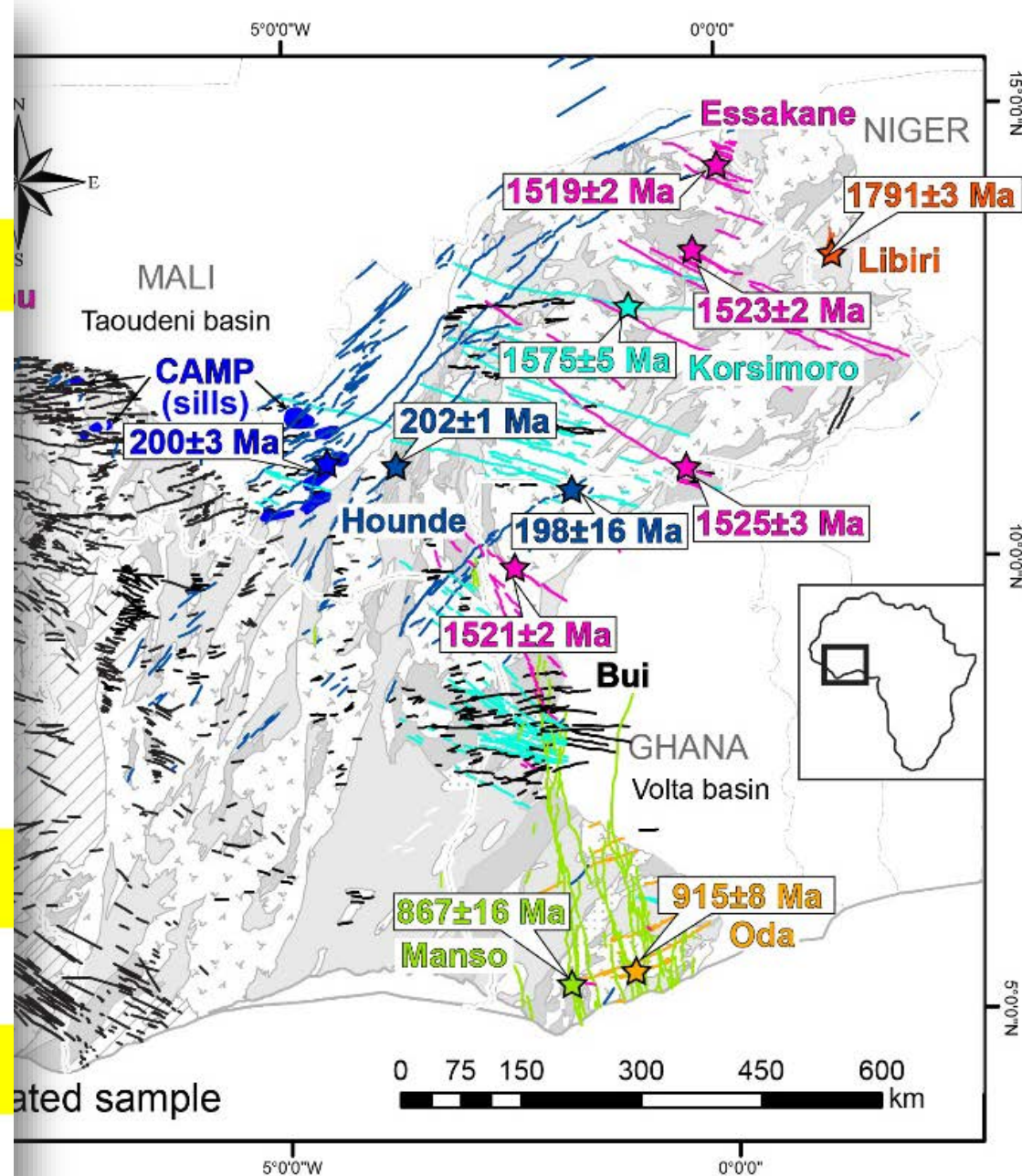
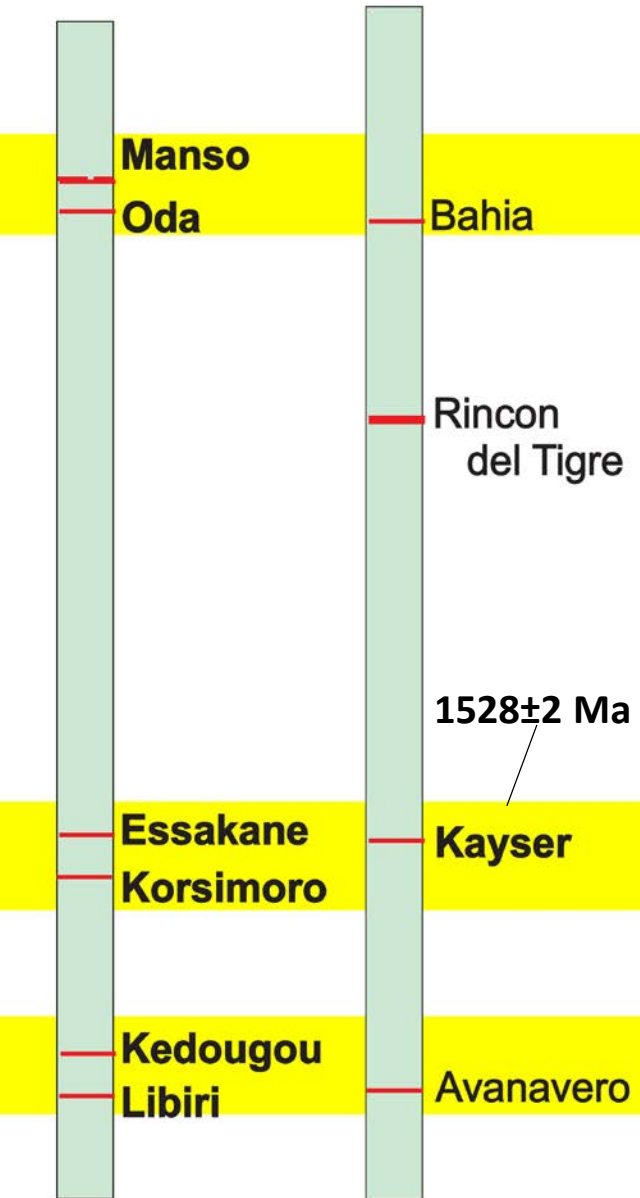


Mafic dyke mapping and dating

Baratoux et al. in press 2018

southern
WAC

Amazonia



New baddeleyite ages

198 ± 16 Ma

200 ± 16 Ma

202 ± 1 Ma

867 ± 16 Ma

915 ± 8 Ma

1519 ± 2 Ma

1521 ± 2 Ma

1521 ± 3 Ma

1523 ± 2 Ma

1525 ± 3 Ma

1575 ± 5 Ma

1764 ± 4 Ma

1791 ± 3 Ma

CAMP

Manso

Oda

Essakane

Korsimoro

Kededougou

Libiri

Integration of Multiple Datasets

- Exploration Geoscience GIS
 - Harmonised Map
 - 3D Synthesis
 - Geodynamic Atlas

Data Delivery: WAXI GIS

Scope:

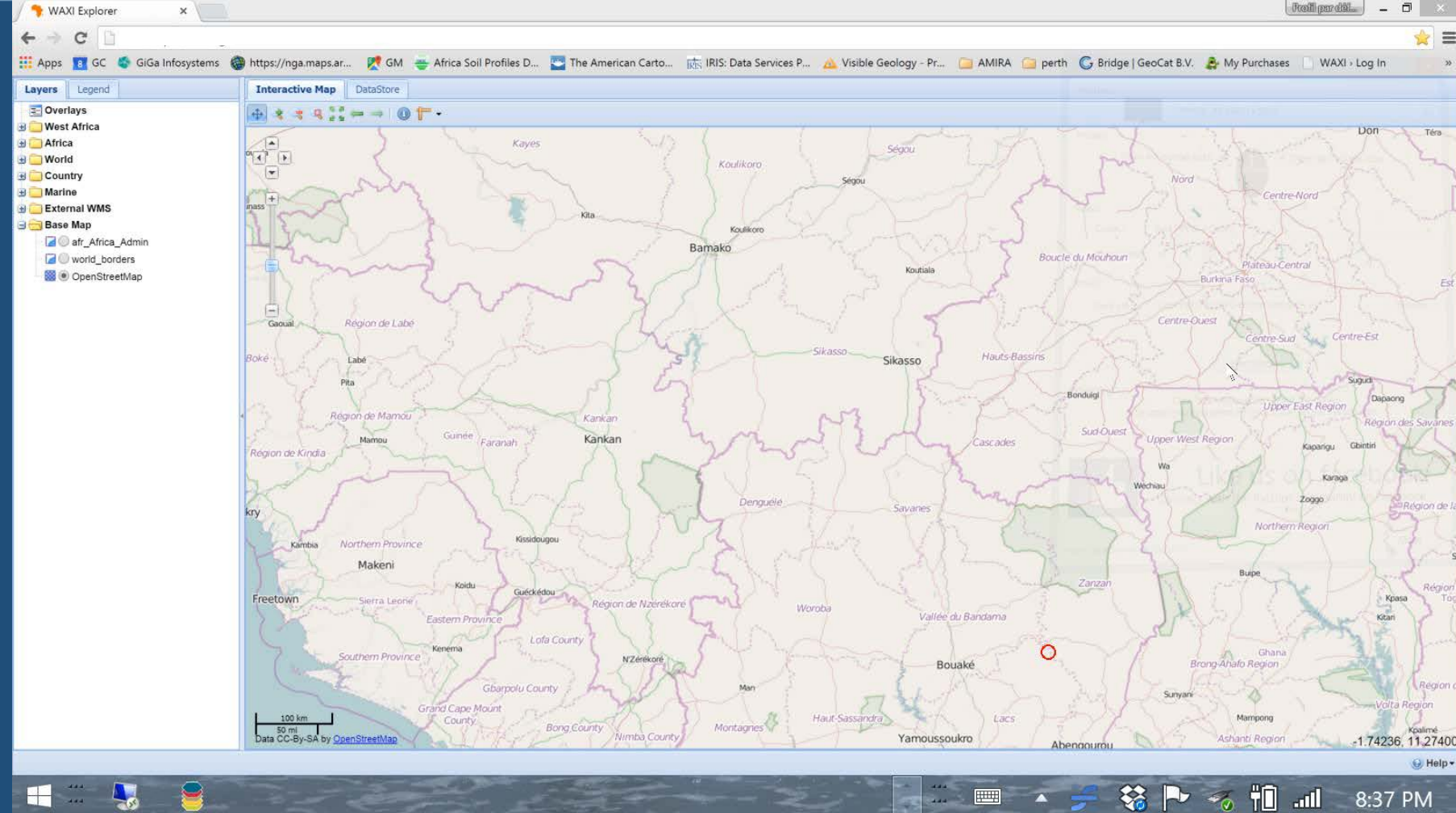
- ❖ Country
- ❖ West Africa
- ❖ Africa
- ❖ Global
- ❖ Marine

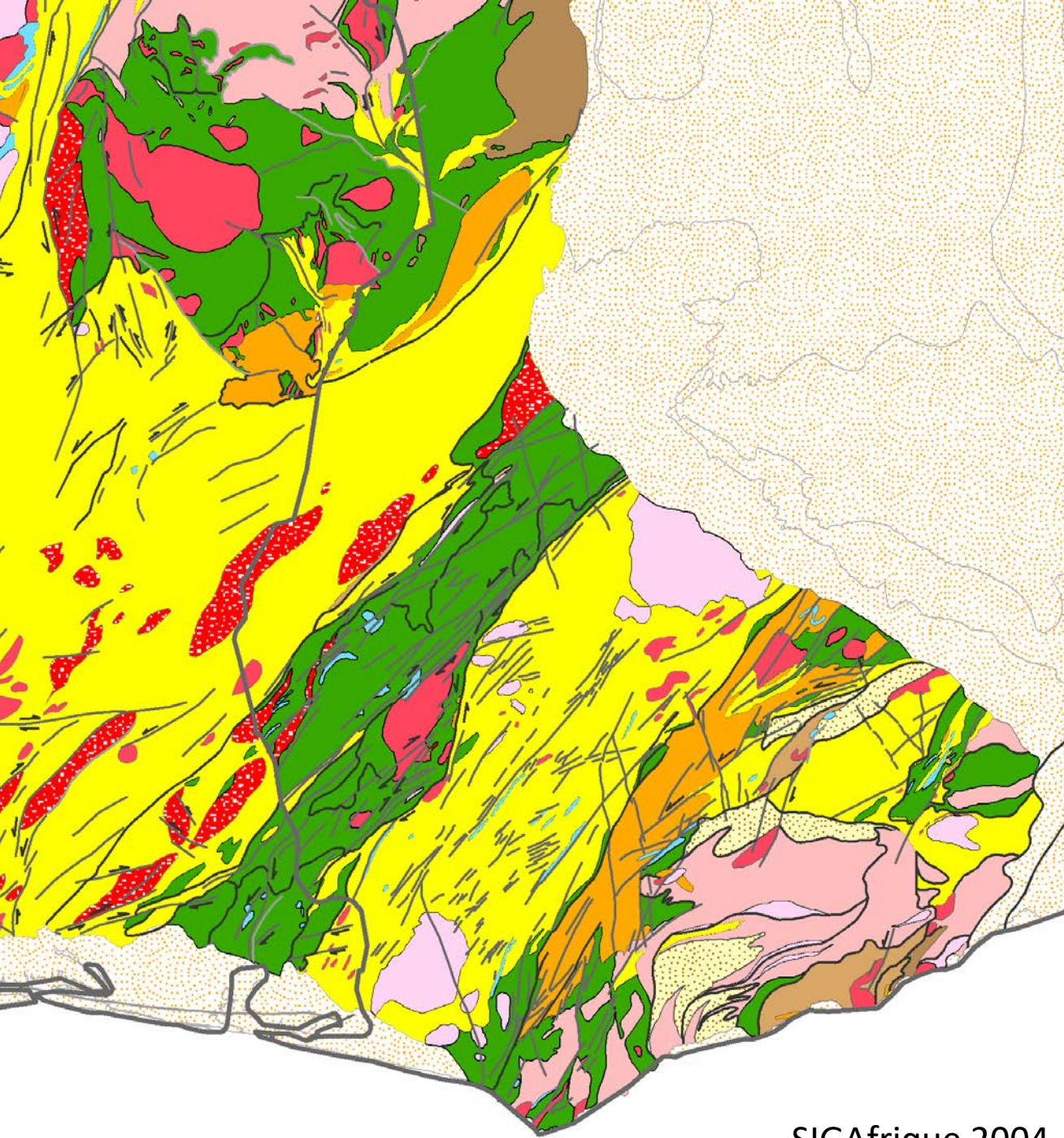
Themes:

- ❖ Geography
- ❖ Geology
- ❖ Geophysics
- ❖ Mineralisation
- ❖ (Tectonics)

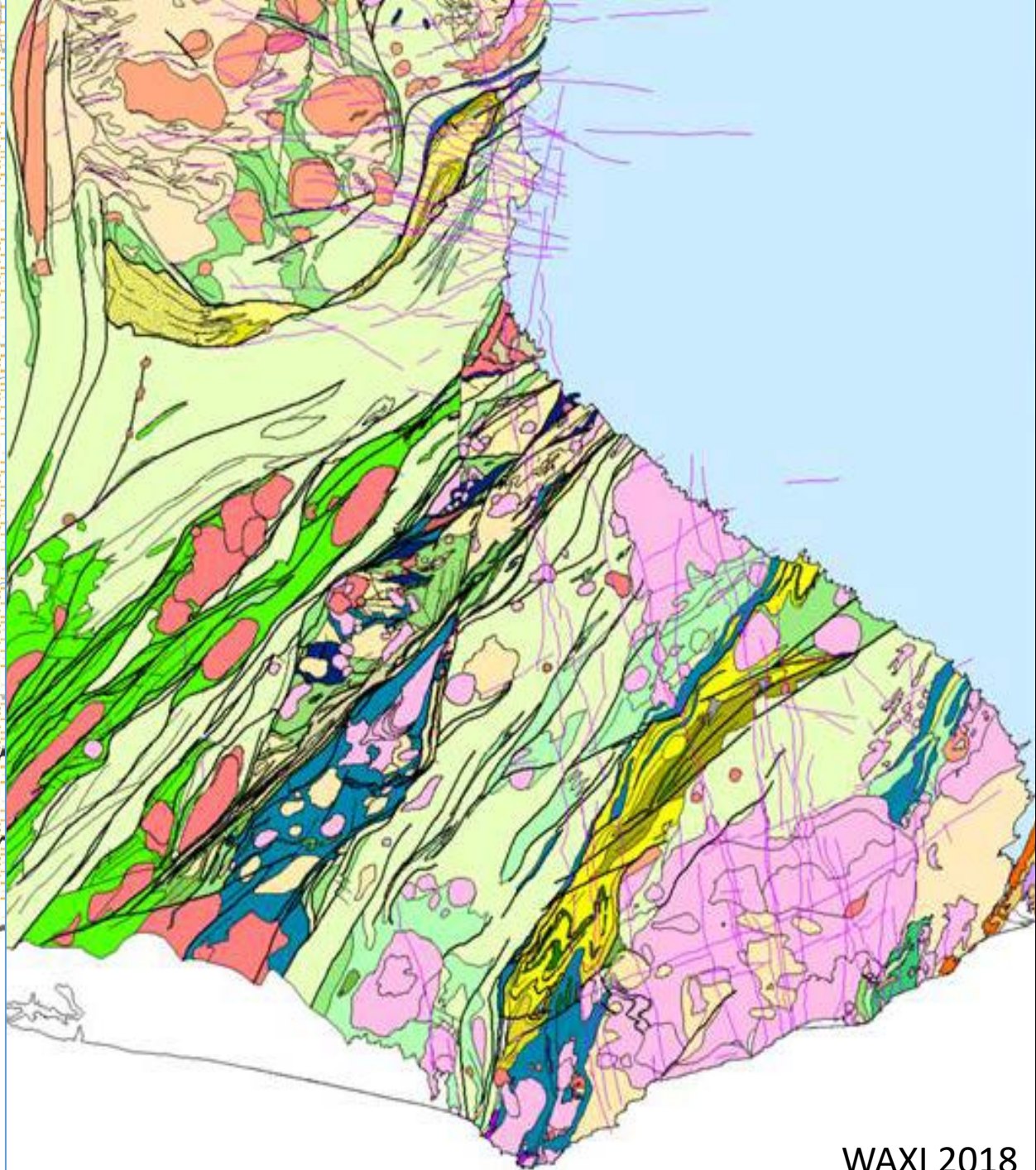
Format:

- ❖ On-disk and on-line
- ❖ 280 layers
- ❖ 85 layers unique to WAXI
- ❖ 650 Gb
- ❖ ArcMap and MapInfo





SIGAfrique 2004

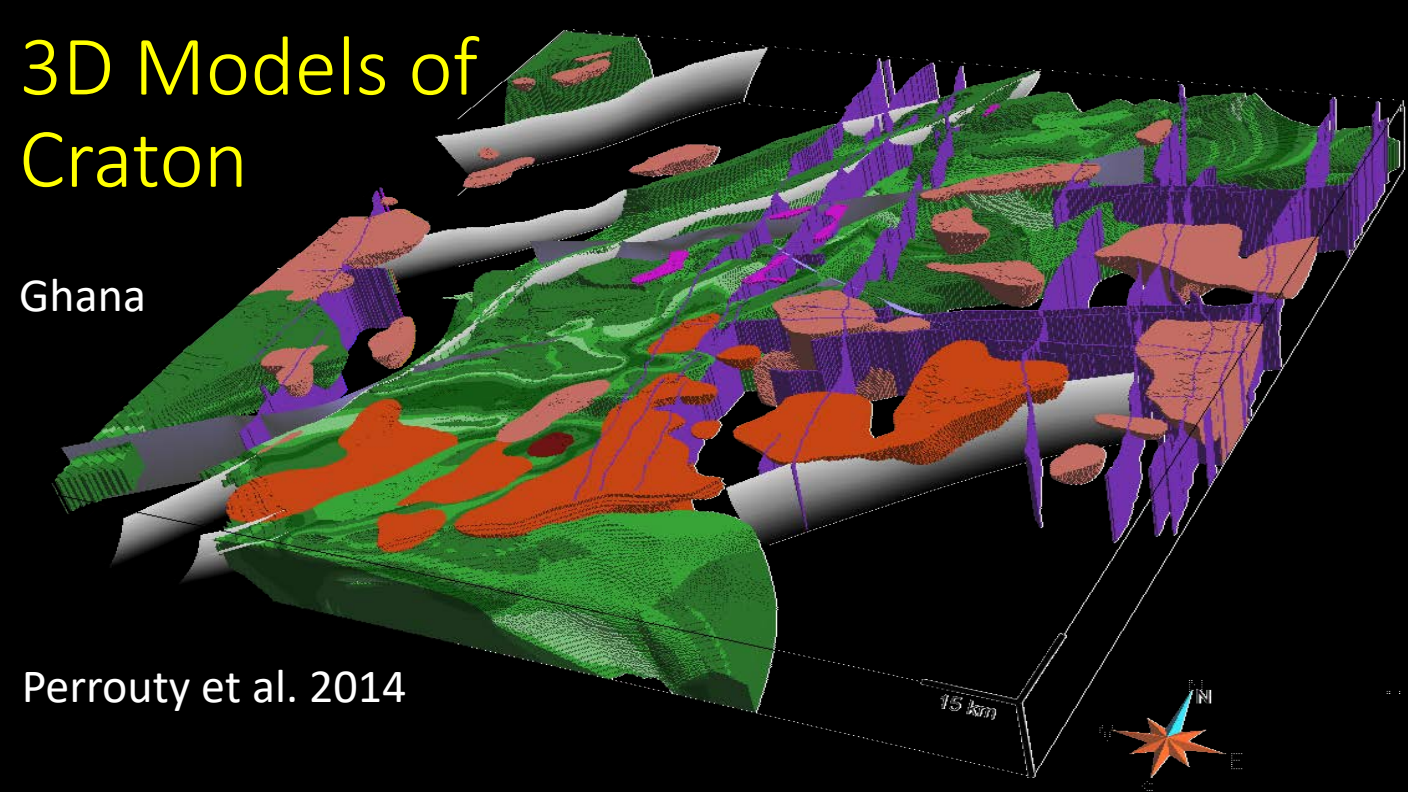


WAXI 2018

3D Models of Craton

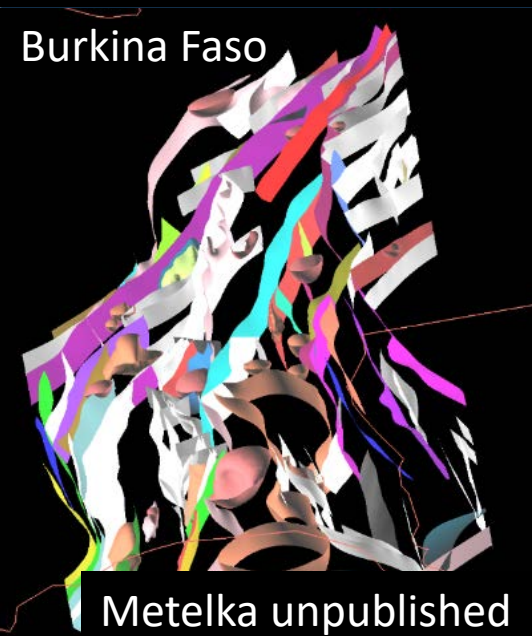
Ghana

Perrouy et al. 2014

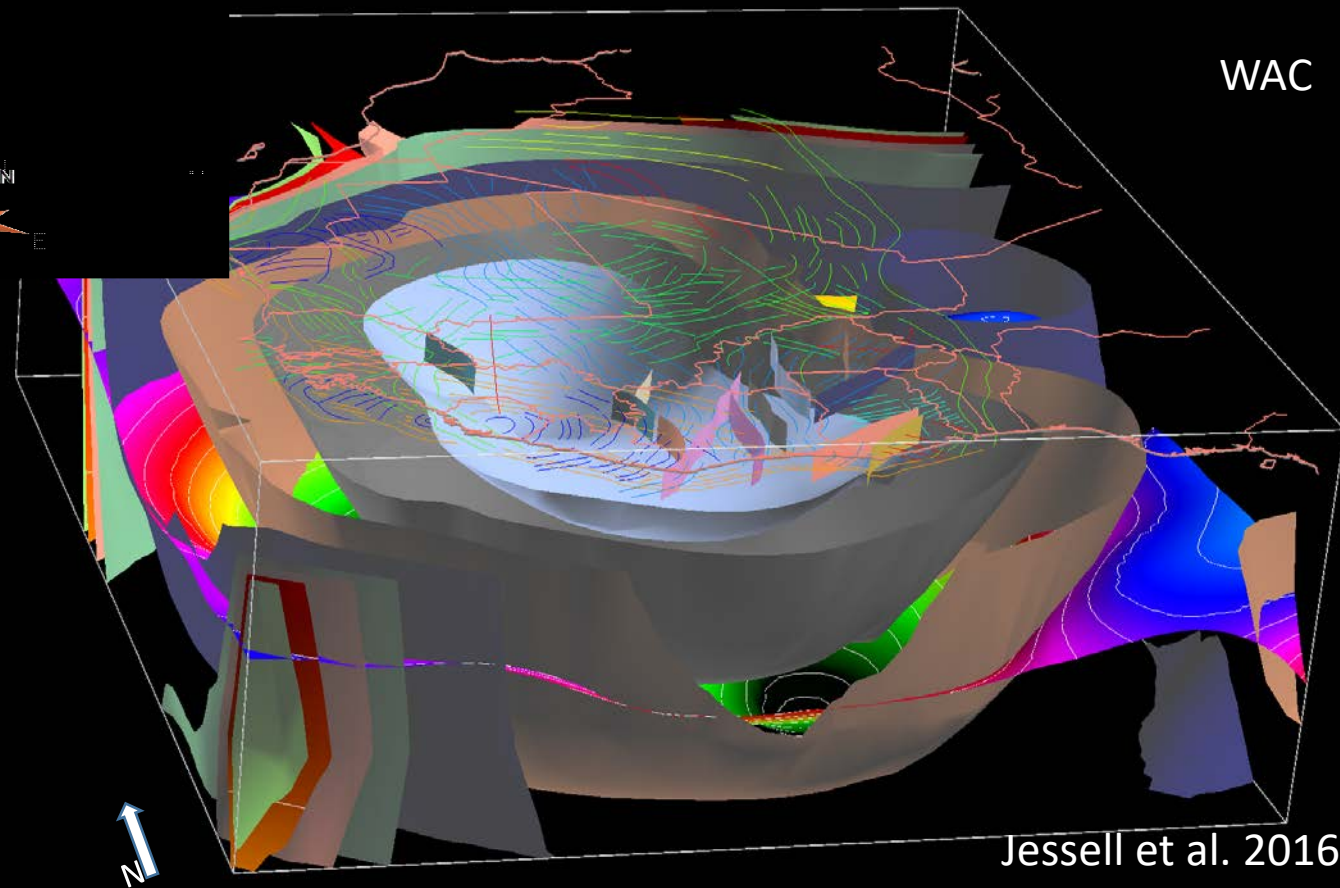


Burkina Faso

Metelka unpublished



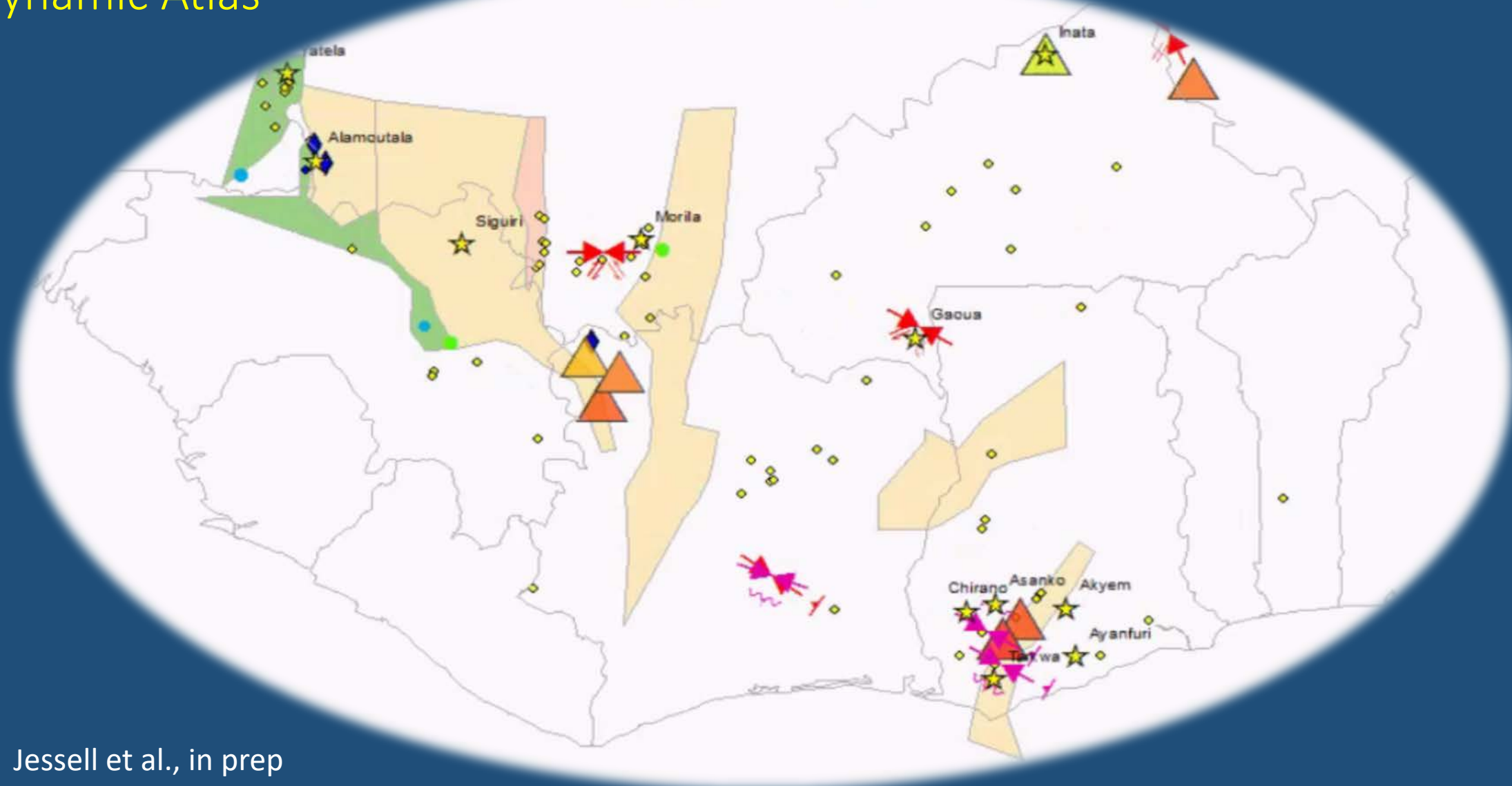
WAC



Jessell et al. 2016

Geodynamic Atlas

2093 to 2098 Ma



Jessell et al., in prep



Knowledge Delivery: Research Training Courses



**Exploration
Geochemistry**



**Applied Structural Geology in
Mineral Exploration and Mining**

**Annually
3-4 WAXI Courses**

**Total of > 200
participants &
> 1800 person-days**



**Field Structural
Mapping**



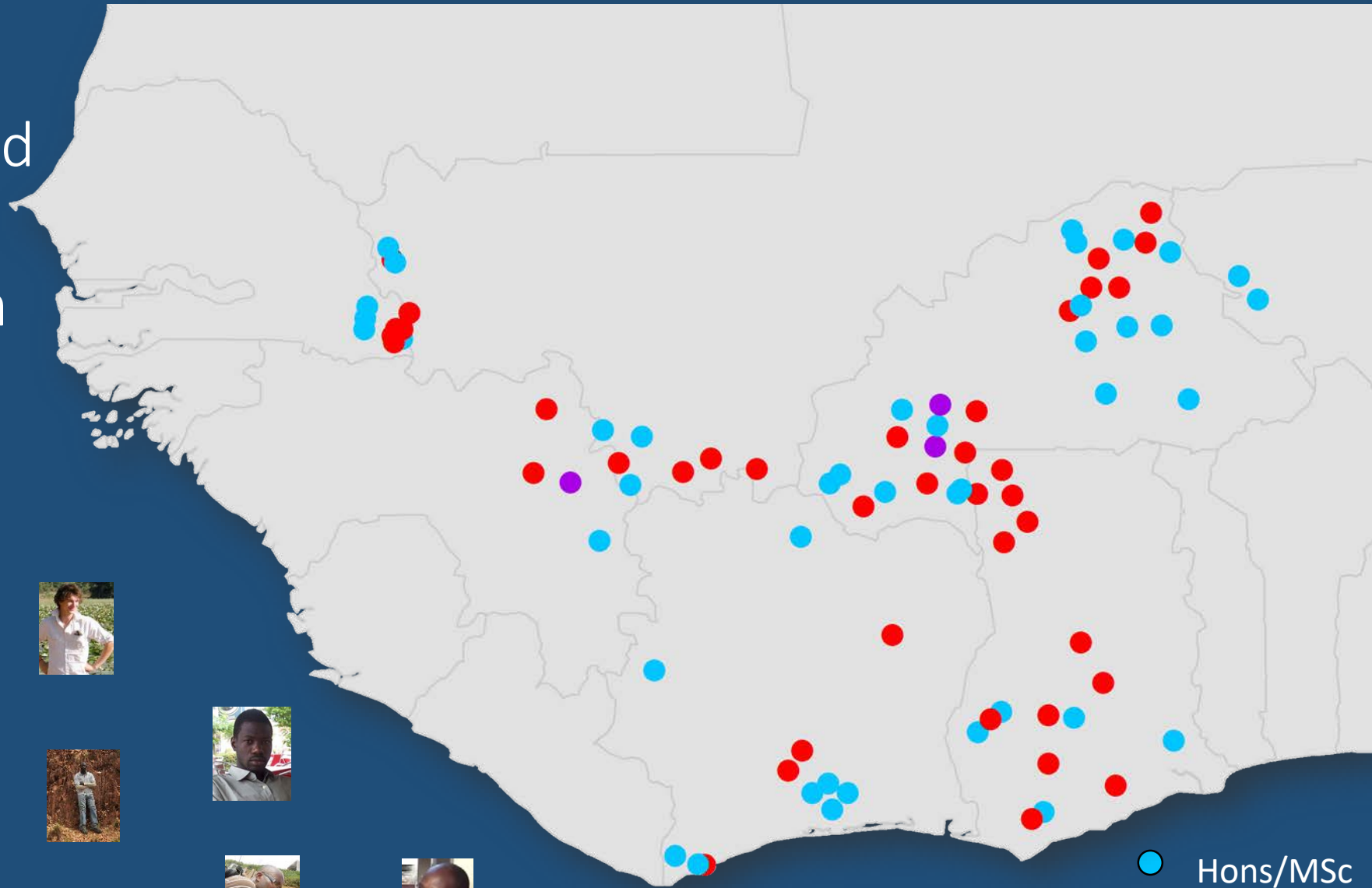
**Structural
Geophysics**

OUTCOMES

A new pool of qualified geoscientists applied to mineral exploration in West Africa

94 MSc, PhD and Postdocs

60% of whom are African



- Hons/MSc
- PhD
- Postdoc



How is WAXI Different?

- Partnership between **Industry + Government + University + Non-govt** Organisations
- **Regional** scope
- **Multi-scale**
- Integrated **professional training** and **training-by-research** programs

The strength of the WAXI project comes from the recognition of the **different drivers** of the diverse partner organisations, who share **common interests** in improving the research capacity and knowledge base for West Africa

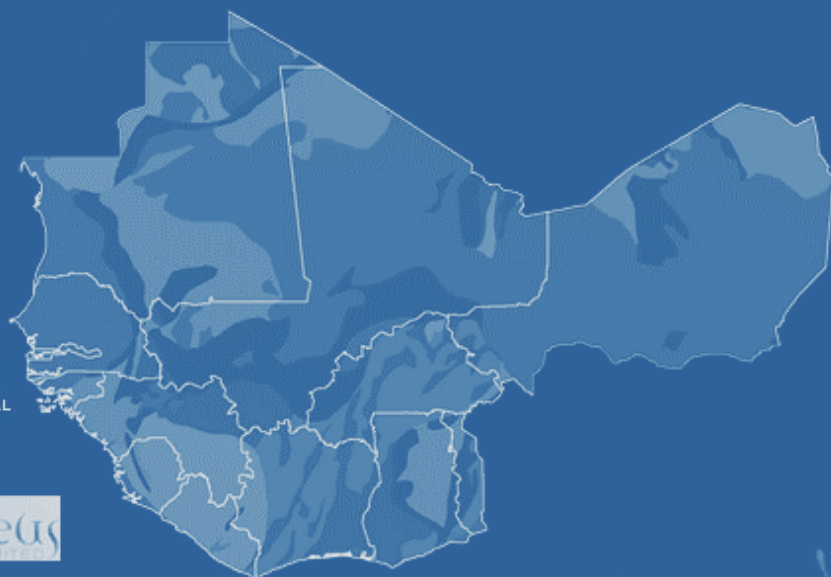
Project Broker & Coordinator



37 Sponsors



- Archean
- Paleoproterozoic
- Mesoproterozoic-Neoproterozoic
- Palaeozoic
- Mesozoic-Cenozoic



WAXI 1
WAXI 2
WAXI 3

12 Sponsors in kind (Geological Surveys and similar)



24 Research and Capacity Building Partners



WAXI People: Abigail Ayikwei, Abdoulaye Ouedraogo, Abraham Traore, Adama Sangare, Adama Yameogo, Adele Seymon, Adja Ndoye, Alain Kouamelan, Alan Jones, Alex Woolfe, Amara Fofana, Anathase Nare, Andile Mkentane, Anicet Beauvais, Anne-Sylvie André, Arnaud Fontaine, Asinne Tshibubudze, Augustin Yao Koffi, Aurélien Eglinger, Bohdan Kríbek, Bosh, B.R. Kouassi, T. Campbell McCuaig, Caswell Lehong, Catherine Zimmermann, Charlotte Magnette, Clare Desplats, Colin Hogg, Corinne Debat, Dan Apau, Daniel Asiedu, Daniel Stacík, David Baratoux, Denis Fougrouse, Didier Béziat, Dominique Chardon, Doria Aitadjedou, Daouda Traore, Edmond Dioh, Elodie Le Mignot, Emmanuel Arhin, Emmanuel Baah-Danso, Eric Gloaguen, Erwann Lebrun, Eva Geršlová, Fabrice Traore, Ferdinand Majiba Misakabu, Florian Le Pape, Fortune Tulombe, Francois Ndiaye, František Laufek, František Veselovský, Frederic Sea, German Velasquez, Gloria Senyah, Goran Boren, Graham Begg, Guillaume De Boyer, Helen Mcfarlane, Ibrahima Labou, Ilja Knésl, Irvin Matsheka, Irvin Matsheka, Jacques Kone, James Davis, Jan Duda, Jan Jehlicka, Jan Malec, Jaroslav Hak, Jean Fossou, Jean Haba, Jean-Louis Grimaud, Jelena Markov, Jennifer Agbetsoamedo, Jérôme Ganne, Jirí Zacharias, Joe Cucuzza, John Miller, Julie Carcone, Kim Hein, Kinane, Kwame Boamah, Laurent Aillères, Laurie Reisberg, Lenka Baratoux, Luc Siebenaller, Luis Gallardo, Luis Parra Avila, Luke Peters, Mahamadene Diene, Mahamadou Diallo, Makhoudia Fall, Mamadou Yossi, Marie Lefebvre, Mariette Miningou, Marieke van Lichtervelde, Mark Jessell, Martin Lompo, Martin Mihaljevic, Mathieu Benoit, Matt Hill, Mikael Grenholm, Mokobo Mohale, Monié, Morou Francois Ouedrago, Nicolas Kagambèga, Nicolas Meriaud, Nicolas Thebaud, Noziwe Simoko, Nuru Saïd, Olivier Bruguier, Oumar Sangare, Ousman Wane, Ousmane Bamba, Pascal Ouiya, Patrick Hayman, Patrick Ledru, Peter Ndibewu, Philippe Calcagno, Prince Amponsah, Pulane Sehloho, Quentin Masurel, Radislav Skoda, Ramabulana Tshifularo, Raymond Sagna, Renaud Caby, Saga Sawadogo, Seta Naba, Stanislav Ulrich, Stanislav Vrána, Stefano Salvi, Stéphane Perrouty, Sylvain Block, Thomas Fullgraf, Todani Funyufunyu, Vaclav Metelka, Vanessa Markwitz, Vera Jelíková, Vera Zoulková, Villa Ramos, Vincent Bouchot, Vladimir Majer, Xiaojun Feng, Yann Itard, Yolande Traore and Yu Chen.

P1061A SAXI-

South American eXploration Initiative:

The Tectonics, Architecture and Metallogeny of the Proterozoic of North-East South America

Initial target countries:

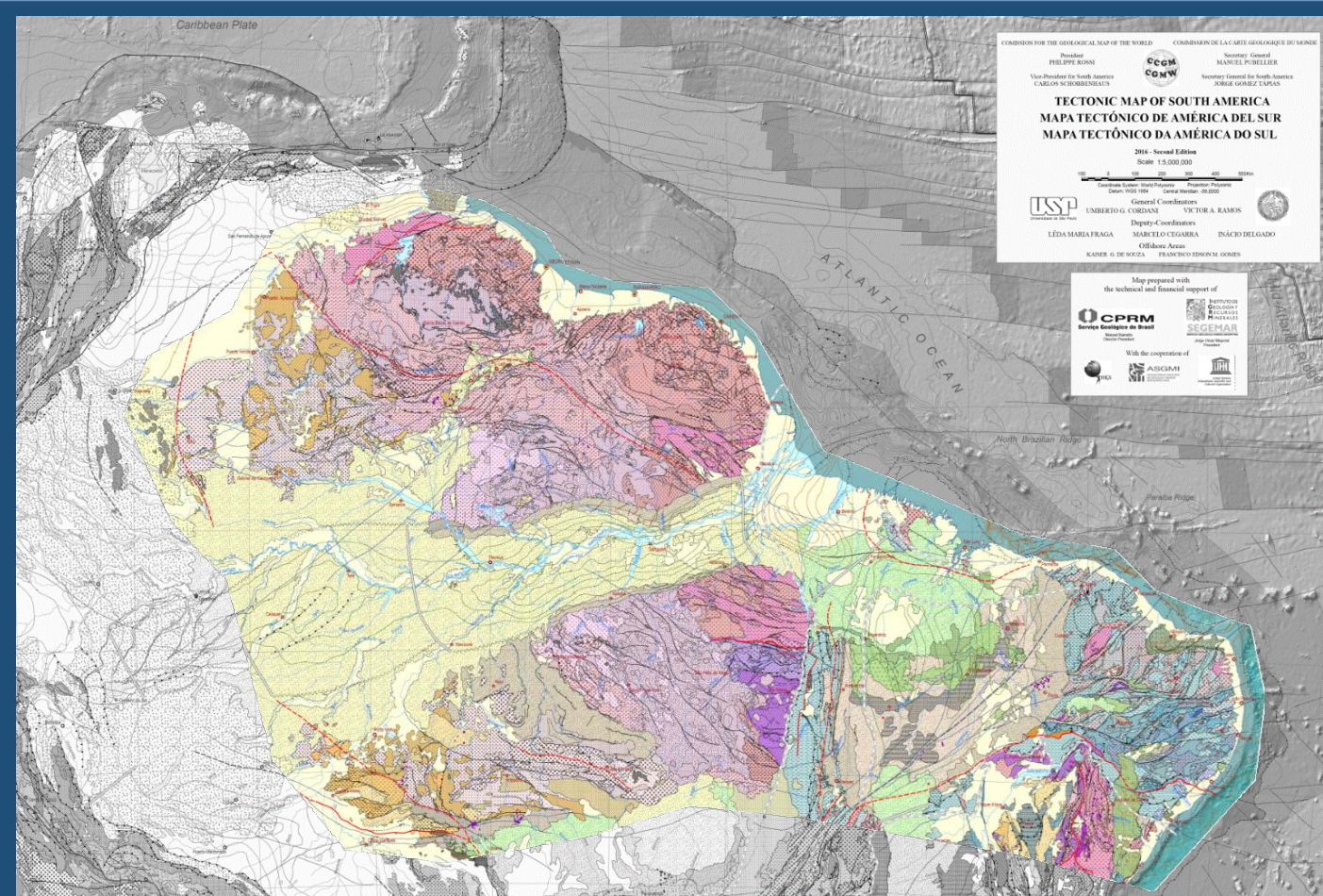
- Venezuela
- Guyana
- Suriname
- La Guyane
- Brazil

CET Personnel:

- Mark Jessell
- Steffen Hagemann
- Jean-Paul Bout
- Sandra Occhipinti

Duration (Stage 1):

- 12 months



Associated Researchers

- Anne-Sylvie Andre-Mayer (Uni Lorraine, working in French Guiana)
- Lenka Baratoux (IRD, Toulouse & West Africa)
- Aurelien Eglinger (Uni Lorraine, working in French Guiana)
- Olivier Vanderhaeghe (University of Toulouse, worked in French Guiana)
- Germán Velasquez (Universidad de Chile)
- Lydia Lobato (Federal University of Minas Gerais at Belo Horizonte, Brazil).
- Stephane Perrouy (Laurentian University, worked in Ghana)

P1061 SAXI- South American eXploration Initiative

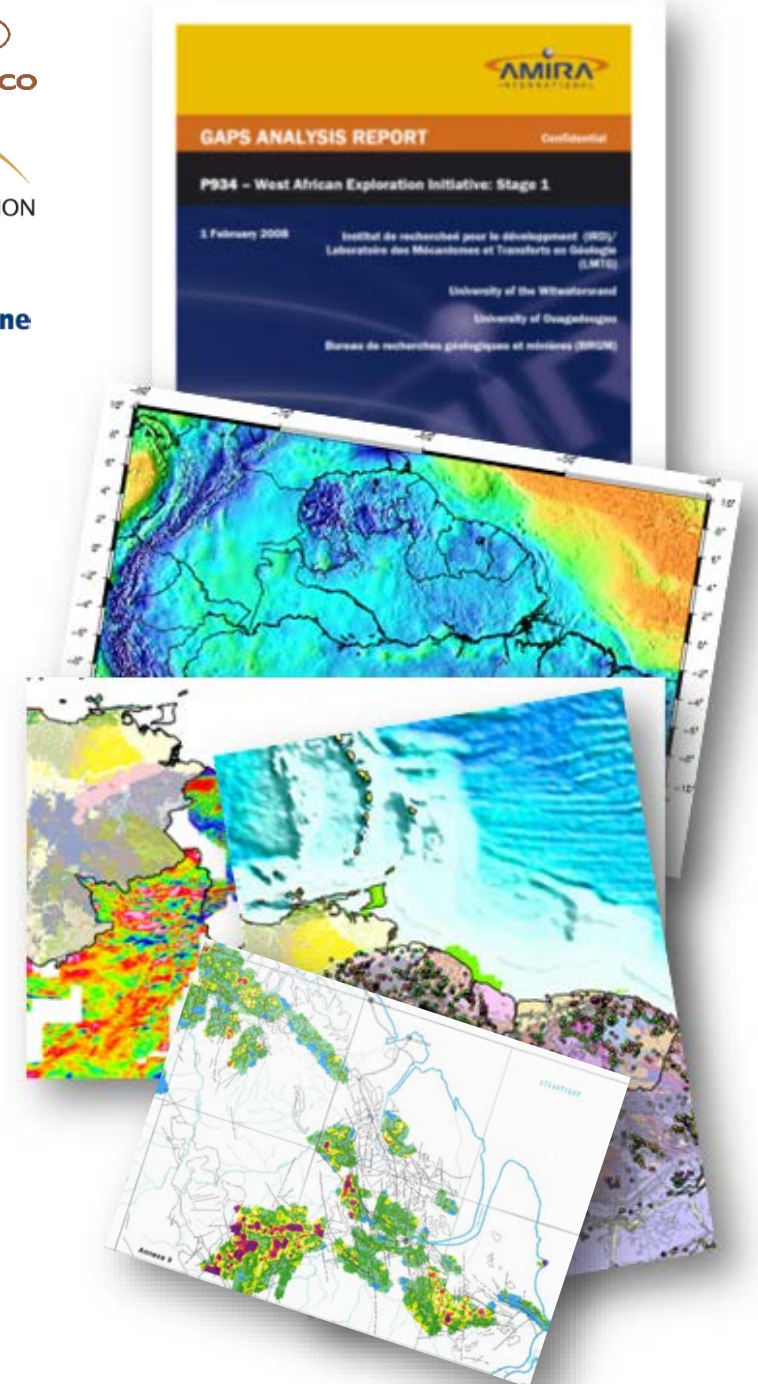


GOLDCORP

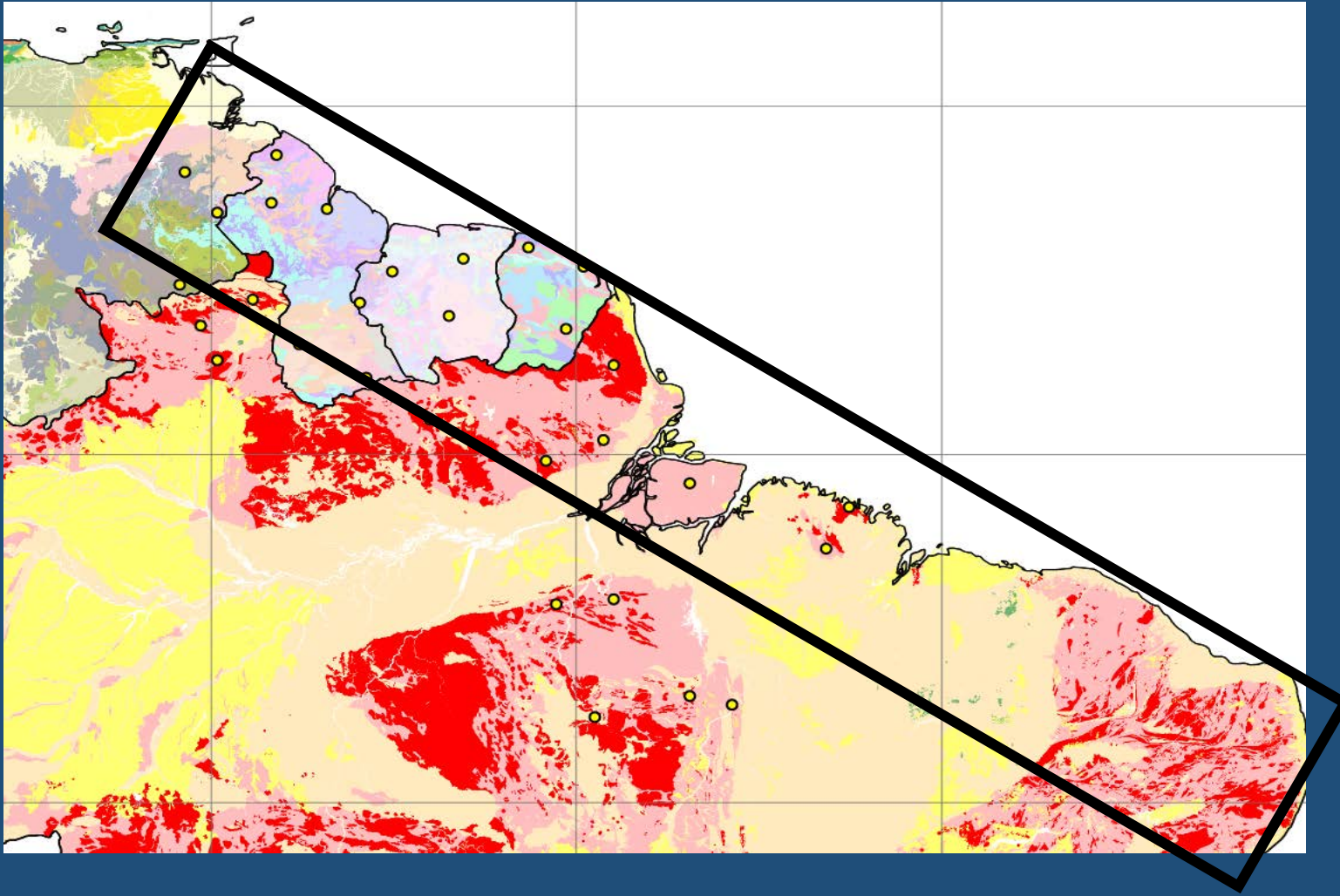


Stage 1 Work program

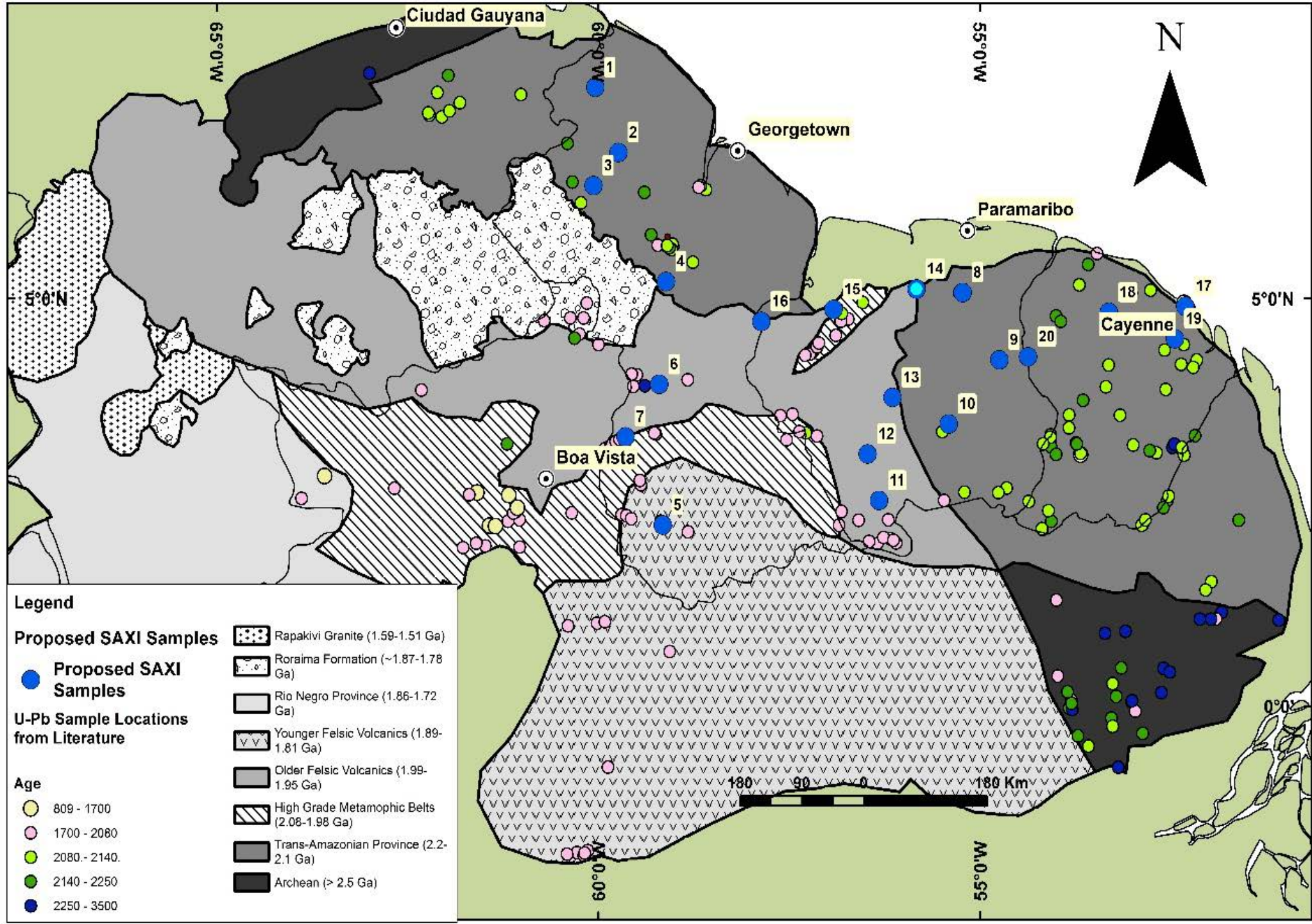
1. Exploration geoscience gap analysis leading to Exploration GIS, integrating with WAXI 2 West African data
2. Targeted geochronological studies
3. Craton-scale structural interpretation of geophysical data
4. Seminar and workshop for potential stakeholders with training course leading to draft Stage 2 project proposal (Feb 2019)



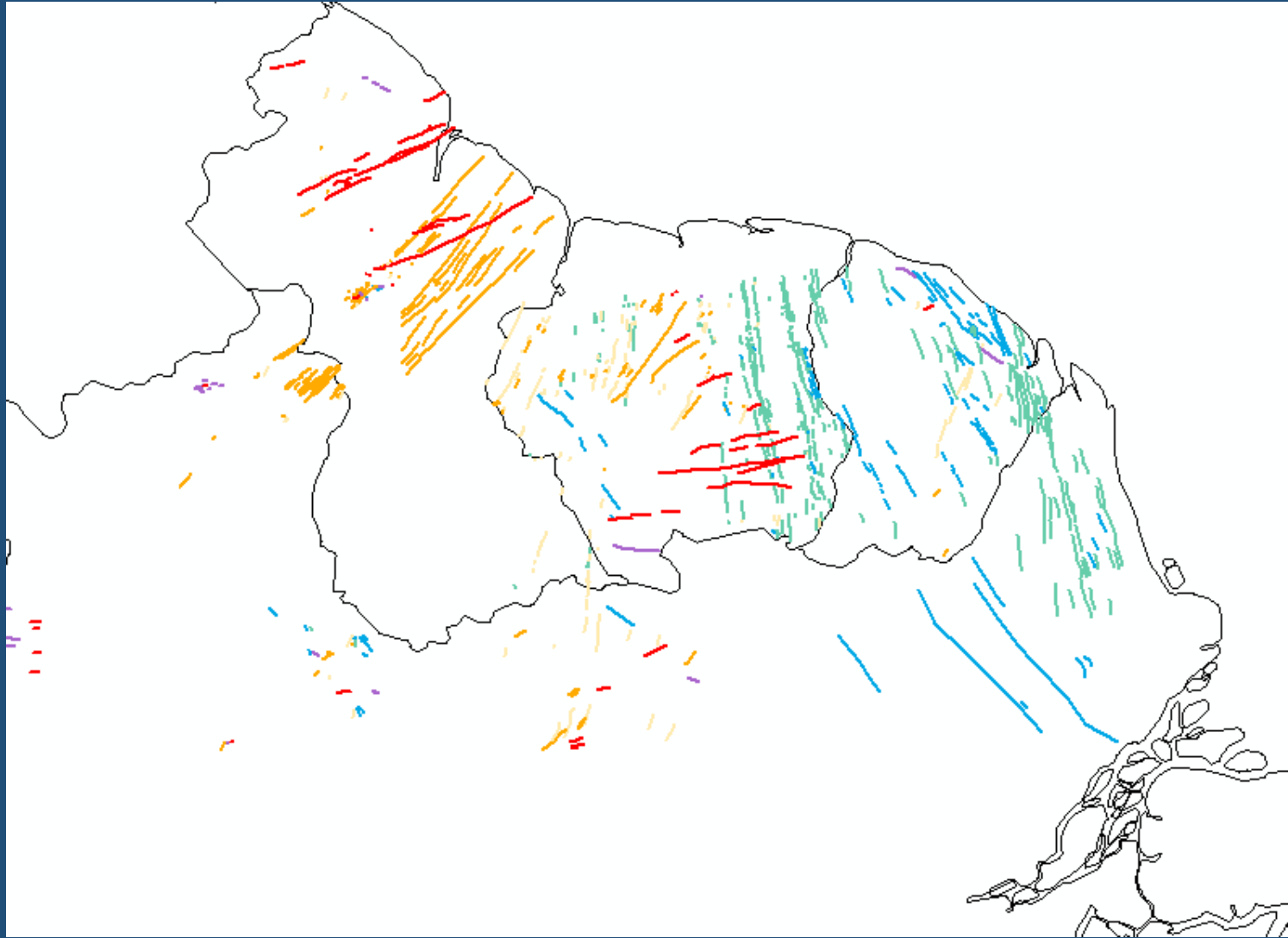
Felsic intrusive sampling program



- Zircon UPb + LuHf + δO
- New sampling or add-on LuHf + δO for existing mounts
- ~ 20 samples
- Nicolas Thebaud, Lydia Lobato, Steffen Hagemann, Orestes Santos

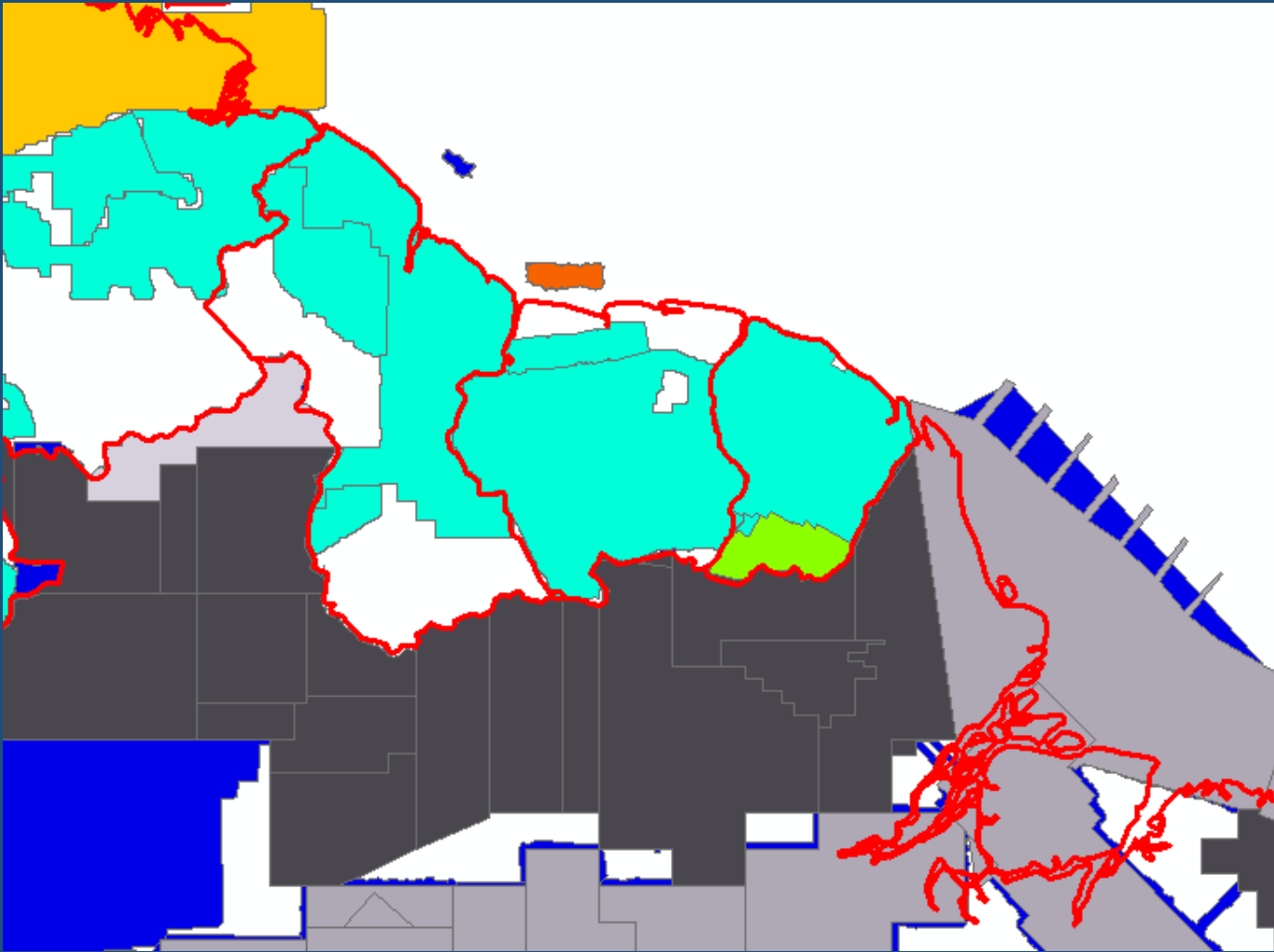


Opportunistic mafic intrusive analysis



Collaboration with Supercontinents Consortium to undertake Badelleyite/Zircon dating

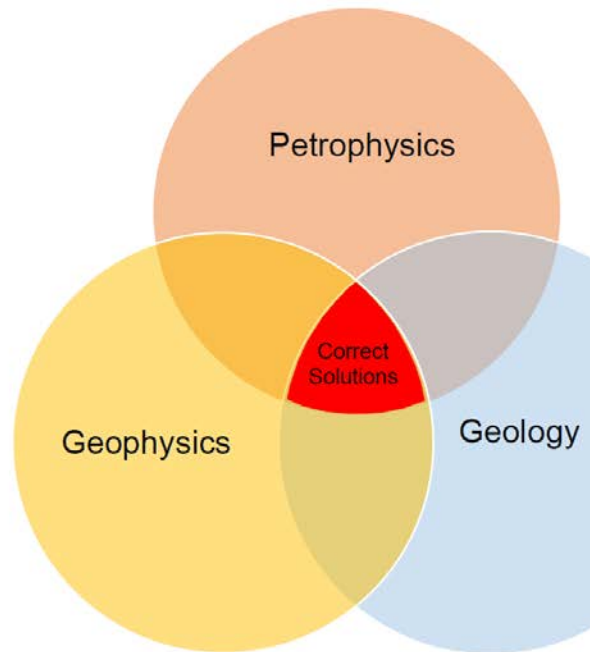
First order structural interpretation of geophysical data



Manuel de la Géophysique Structurale Manual of Structural Geophysics

Section 1

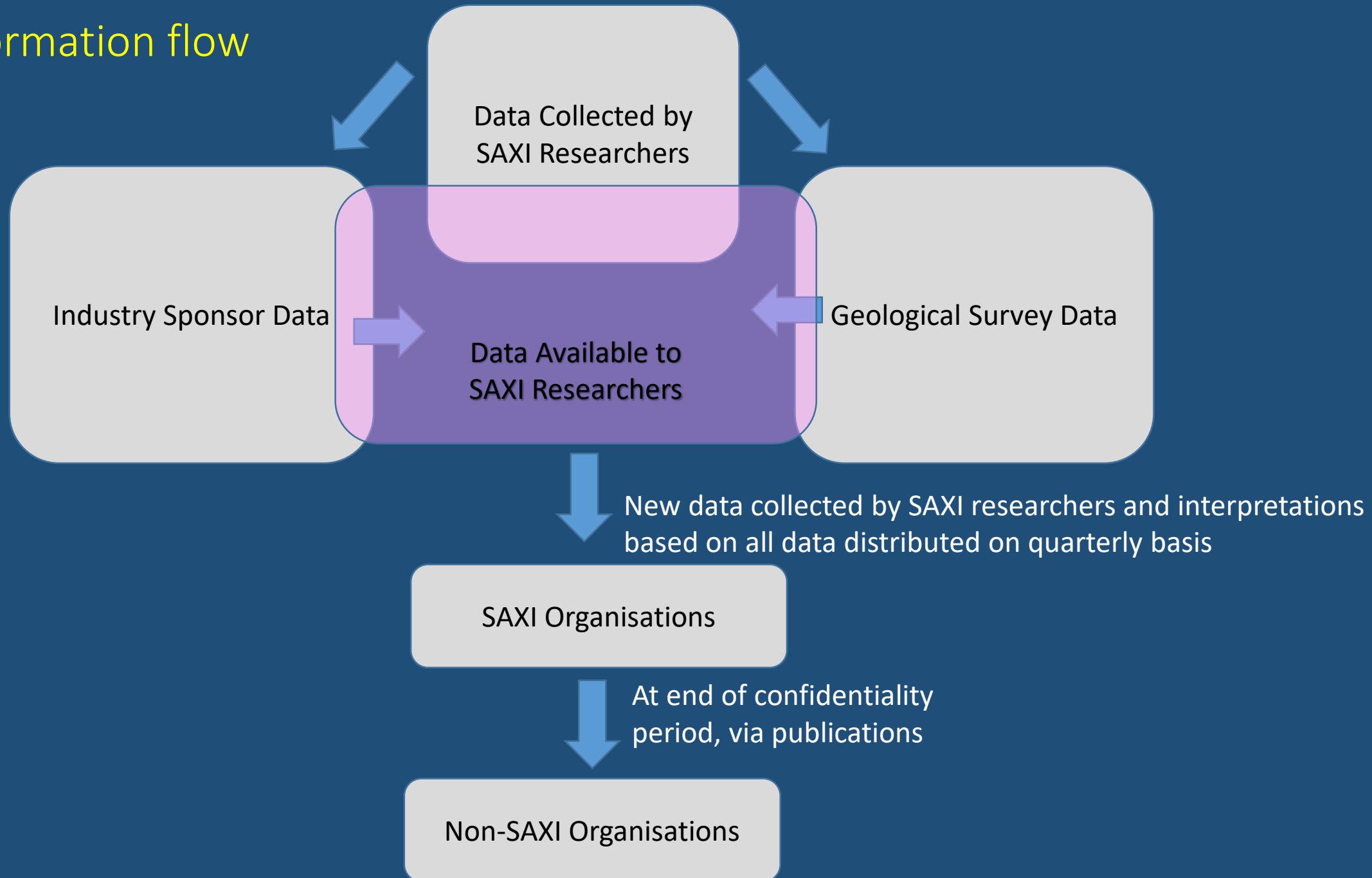
L'introduction Introduction



Mark Jessell

SB_interp	Your Interpretation	Us the Id code to distinguish contact types
Outcrop_db	Outcrop database	
B2_DEM.jpg	Digital Terrain Model (DTM)	
B2_DEM_sh.jpg	Shaded DTM (from NW)	
B2_KTh.jpg	K/Th ratio	
B2_KThU.jpg	KThU ternary Radiometrics	
B2_PCA324.jpg	Principal Components Radiometrics	
B2_TMI.jpg	Total Magnetic Intensity	
B2_INVRTE.jpg	Negative of Reduced to Equator Image	
B2_TMI_AS.jpg	Analytical Signal	
B2_INVRTE_vd1_grey.jpg	First Vertical Derivative of Neg RTE	
B2_INVRTE_vd1_agc_bw.jpg	Automatic Gain control of 1VD Neg RTE	

Data & information flow



Benefits to Ministries and Geological Surveys

- Fully-funded support to attend
 - technical training
 - sponsors' meeting
 - attend project conference
- Annual delivery of new data for internal use
- Opportunity to collaborate with neighboring countries

WAXI Research Themes and Modules as an example

1. Regional Field-Based Studies Theme

1.1 Structural geology
of crustal scale
structures
(Tshibubudze, Hein)

1.2 Sedimentology,
Stratigraphy and
Volcanology
Synthesis (Miningou,
Hayman)

1.3 Magmatic
systems &
Geochemical
Synthesis
(Benoit)

1.4
Metamorphism
(L. Baratoux)

1.5 Geochronology of
Magmatic Events
(Thebaud)

1.6 Synthesis -
Tectonic evolution
(Jessell, Miller)

2. Mineralisation Theme

2.1 Multiscale
architecture of
mineral systems
(Miller)

2.2 Timescales of
mineral systems
(André)

2.3 Multiscale
footprints of
mineral systems
(Beziat, Salvi, Van
Lichervelde)

4. Surface Theme

4.1 Regolith Mapping
and landscape
evolution (Chardon)

4.2 Chemical
dispersion in the
regolith (D. Baratoux)

4.3 Gold Solubility
in Interstitial
Waters of Saprolite
Soils (Ndibewu)

3. Geophysics Theme

3.1 Geophysical
Characterisation of
the SCLM using
Magnetotellurics
(Jones)

3.2 3D Craton-scale
models (Jessell,
Ailleres)

3.3 Petrophysics
(Naba)

3.4 Feasibility
study for Seismic
Tomography
Experiment
(Jones)