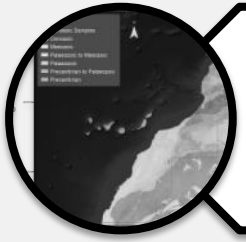
NARG Steering Meeting

17th September 2019 – TU Delft

***James Lovell – Kennedy**, Prof. Jonathan Redfern, Dr. Stefan Schroeder*

Outline

Zircon Meta-Analysis



Triassic Source to Sink

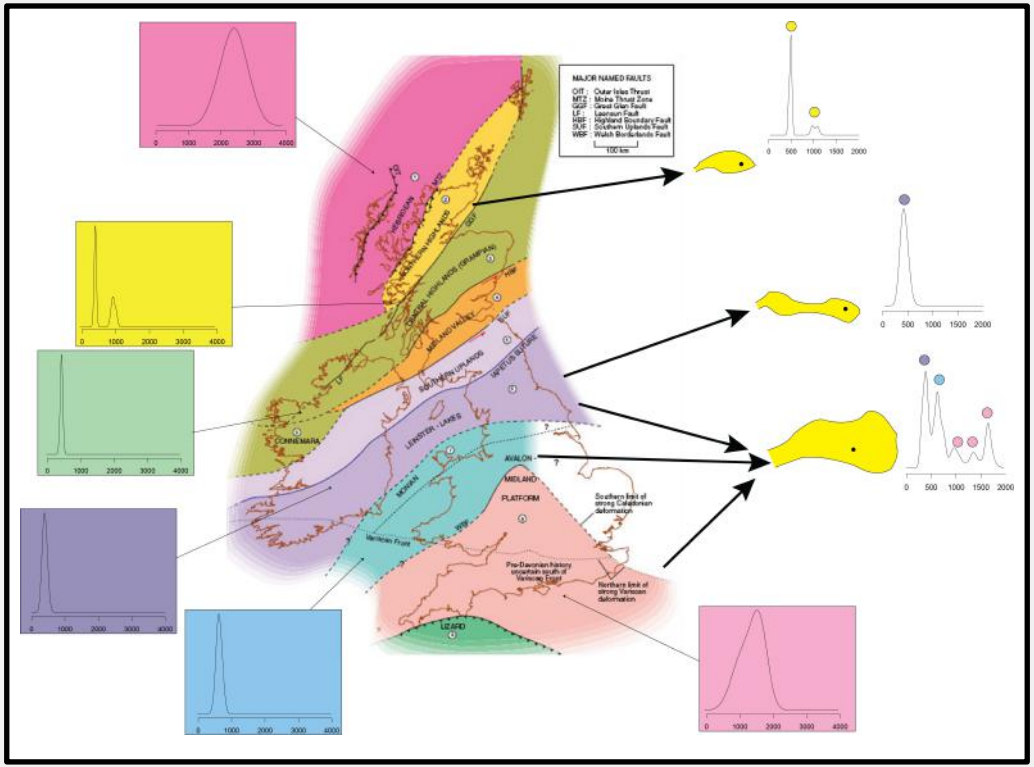
The High Plateaux

1. ZIRCON META - ANALYSIS

OBJECTIVES

- Identify provenance sensitive zircon populations
- Calculate the number of grains needed for a statistically reliable provenance study

Zircon as a Provenance Tracer



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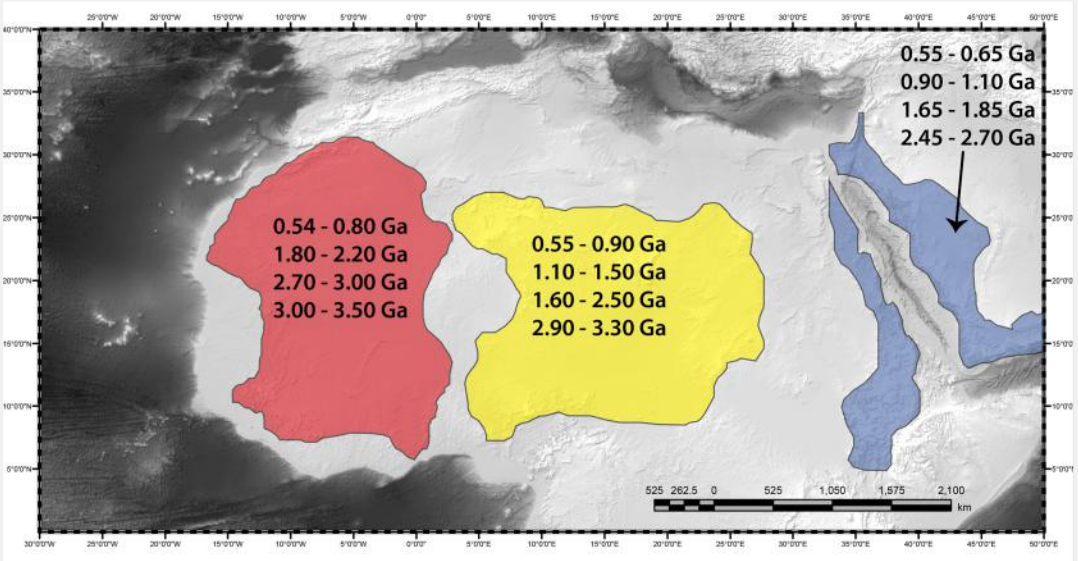
Previous Studies



- Previously studies have all suggest south to north sedimentary transport
- Major contributions from the W.A.C
- Minor contributuions from the other North African domains

Cautionary Tales

How many grains are needed for a provenance study?

Pieter Vermeesch*

What happens when *n*= 1000? Creating large-*n* geochronological datasets with LA-ICP-MS for geologic investigations†

Alex Pullen,*[ab] Mauricio Ibáñez-Mejía,[a] George E. Gehrels,[a] Juan C. Ibáñez-Mejía[cd] and Mark Pecha[a]

Use and abuse of detrital zircon U-Pb geochronology—A case from the Río Orinoco delta, eastern Venezuela

Mauricio Ibañez-Mejia[1*], Alex Pullen[2], Martin Pepper[3], Franco Urbani[4], Gourab Ghoshal[5], and Juan C. Ibañez-Mejia[6]

Successive sedimentary recycling regimes in southwestern Gondwana: Evidence from detrital zircons in Neoproterozoic to Cambrian sedimentary rocks in southern Africa

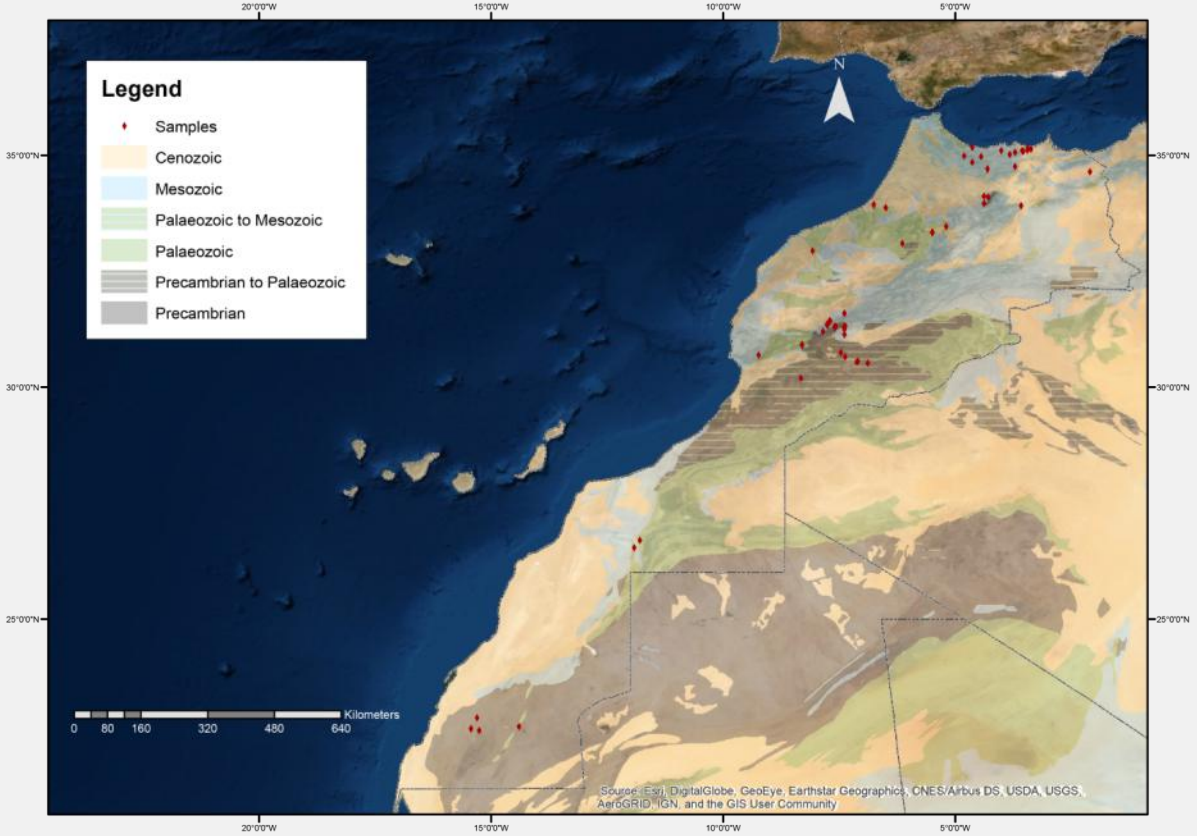
Tom Andersen[a,b,*], Marlina A. Elburg[b], Herman S. van Niekerk[b], Henriette Ueckermann[b]

[a] *Department of Geosciences, University of Oslo, PO Box 1047, Blindern, Oslo N-0316, Norway*
[b] *Department of Geology, University of Johannesburg, PO Box 524, Auckland Park, Johannesburg 2006, South Africa*

How far can we trust provenance and crustal evolution information from detrital zircons? A South African case study

Tom Andersen [a,b], Magnus Kristoffersen [a], Marlina A. Elburg [b]

Zircon Meta-Analysis



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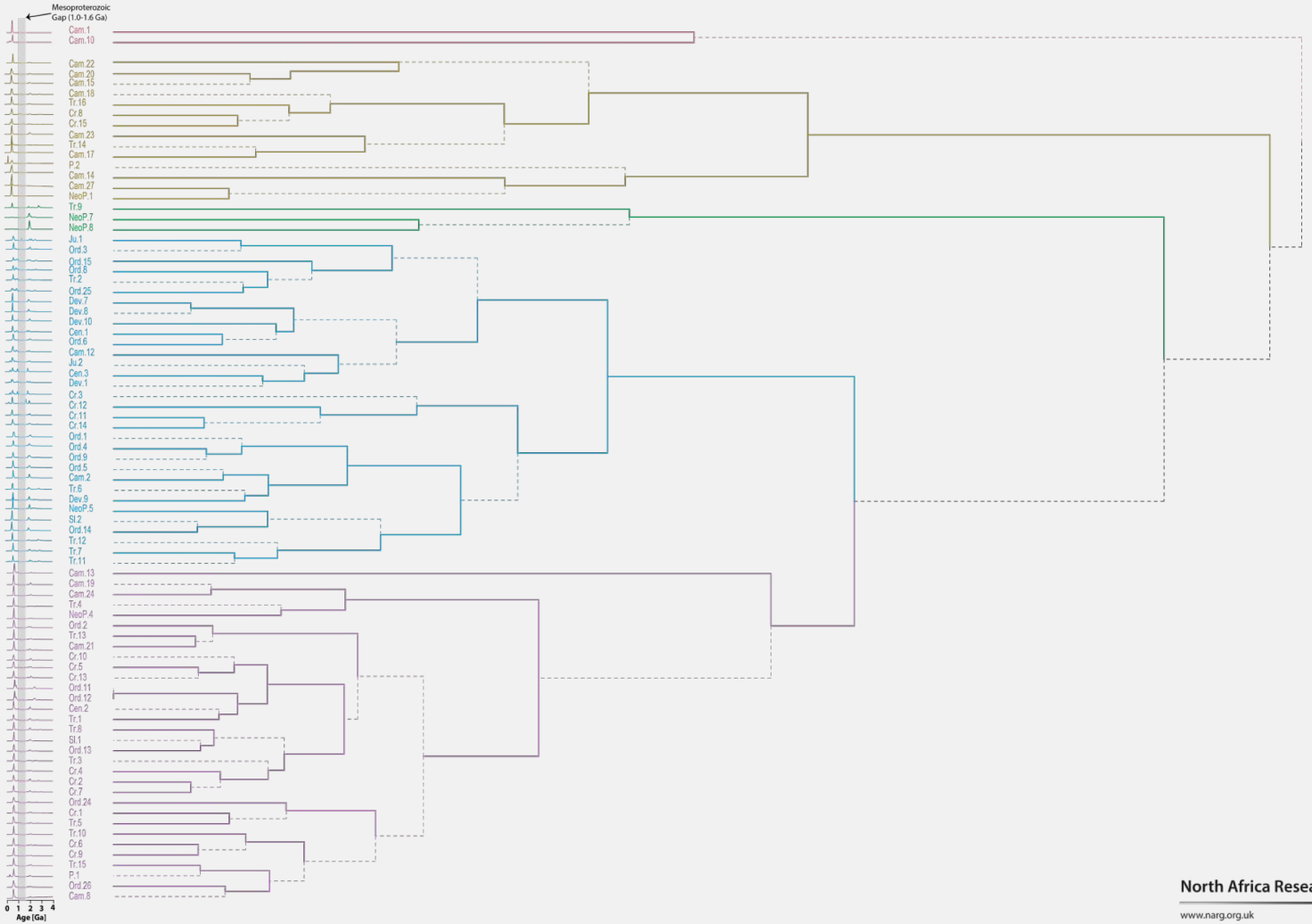

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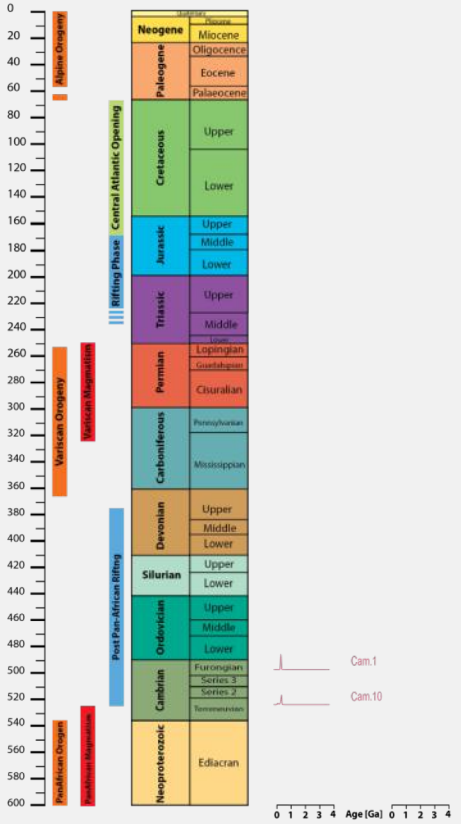
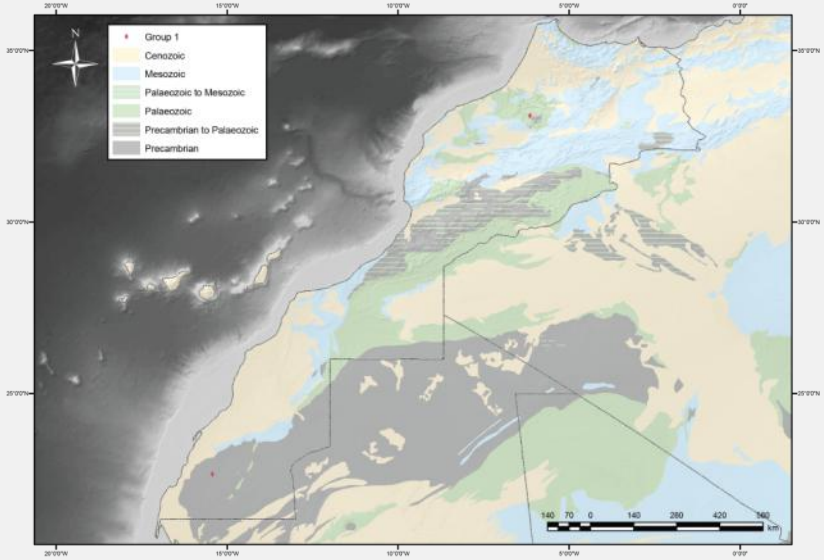
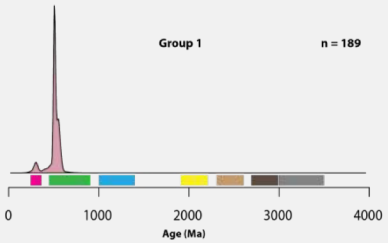
Group 1







Orogenic Events of North West Africa

- Variscan Orogenic Cycle (250-370 Ma)
- Pan-African Orogenic Cycle (500-900 Ma)
- Kibaran - Grenvillian Orogenic Cycle (1000 - 1400 Ma)
- Eburnean Orogenic Cycle (1900-2200 Ma)
- Unknown Tectonothermal Event (2300-2600 Ma)
- Leonian Orogenic Cycles (2700-3000 Ma)
- Liberian Orogenic Cycle (3000 - 3500 Ma)

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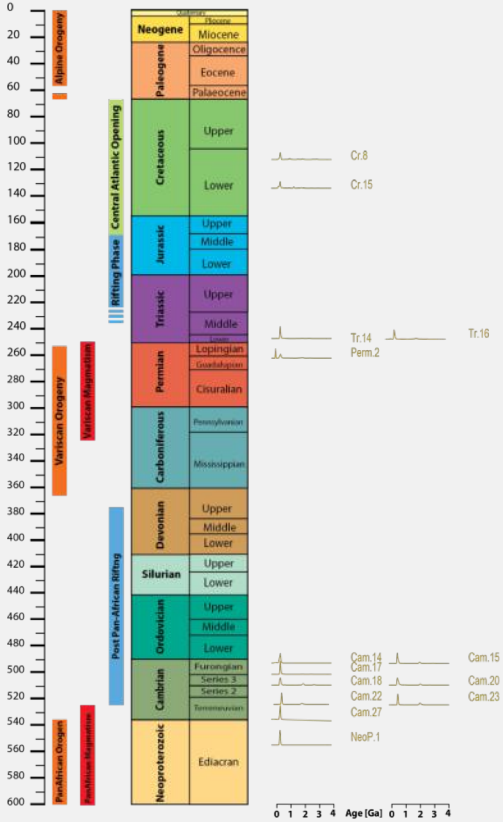
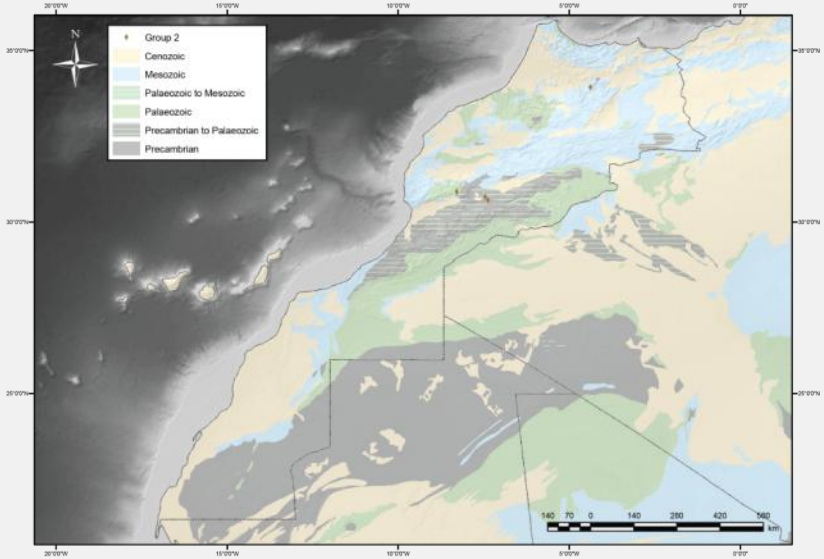
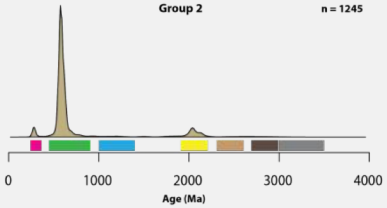
Group 2







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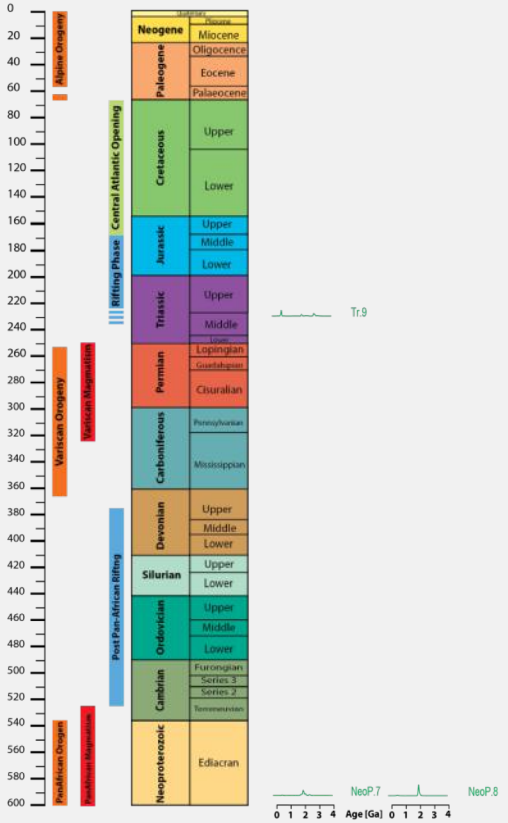
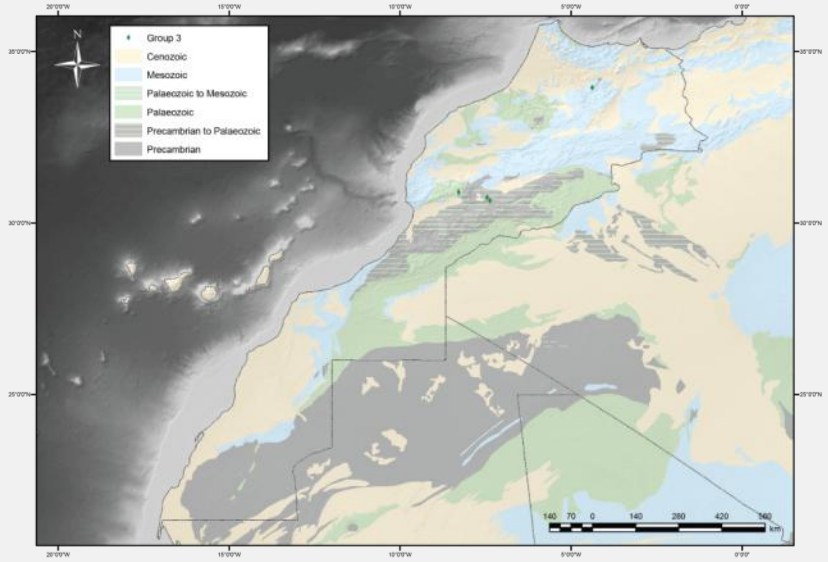
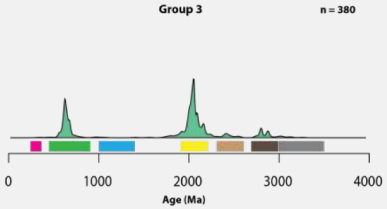
Group 3







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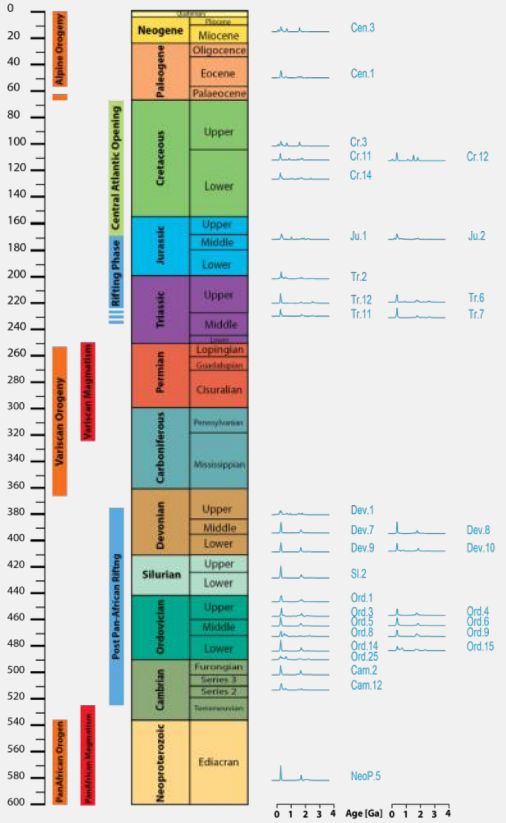
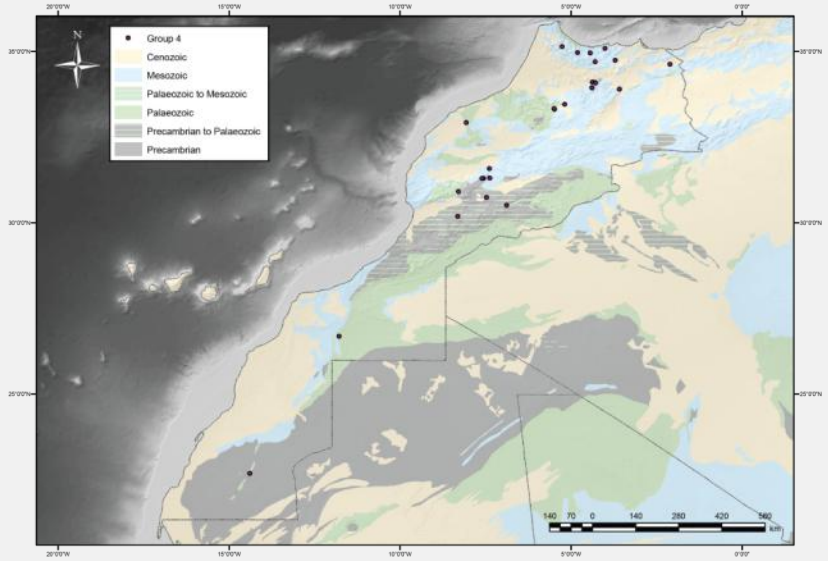
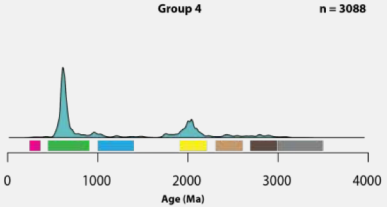
Group 4







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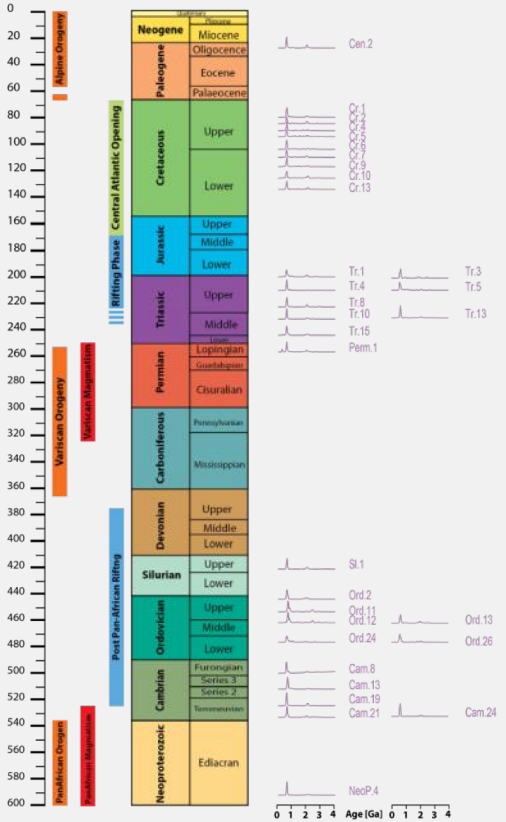
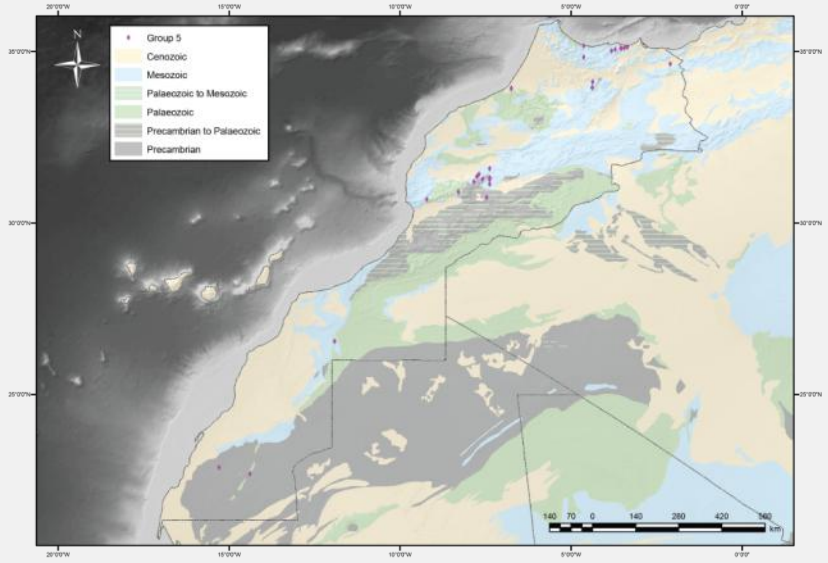
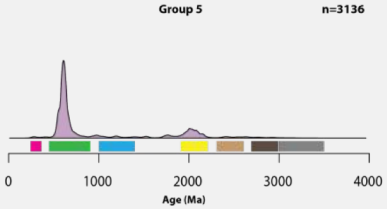
Group 5







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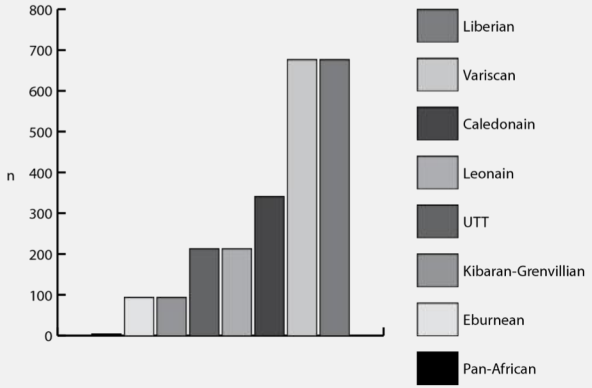
Takeaways

Orogenic Events	*Population Size (%)*	*Rank*	*# of grains for detection at 95% confidence*
Pan-African (540-900 Ma)	60	4 - Large	n = 4
Eburnean (1900-2200 Ma)	21	3 - Major	n = 20
Kibaran - Grenvillian (1000 - 1400 Ma)	6	2 - Minor	n = 94
Unknown Tectono-Thermal Event (2300 - 2600 Ma)	3	1 - Accessory	n = 213
Leonian (2700 - 3000 Ma)	3	1 - Accessory	n = 213
Caledonain (400 - 480 Ma)	2	1 - Accessory	n = 341
Variscan (250 - 370 Ma)	1	1 - Accessory	n = 677
Liberain (3000 - 3500 Ma)	1	1 - Accessory	n = 677
Other	4	1 - Accessory	N.A.

Ranking Scheme from Andersen 2005 - Table 3
Sample sizes calculated using the R - provenance package

n values for identifying a given orogeny based on previously publiushed data

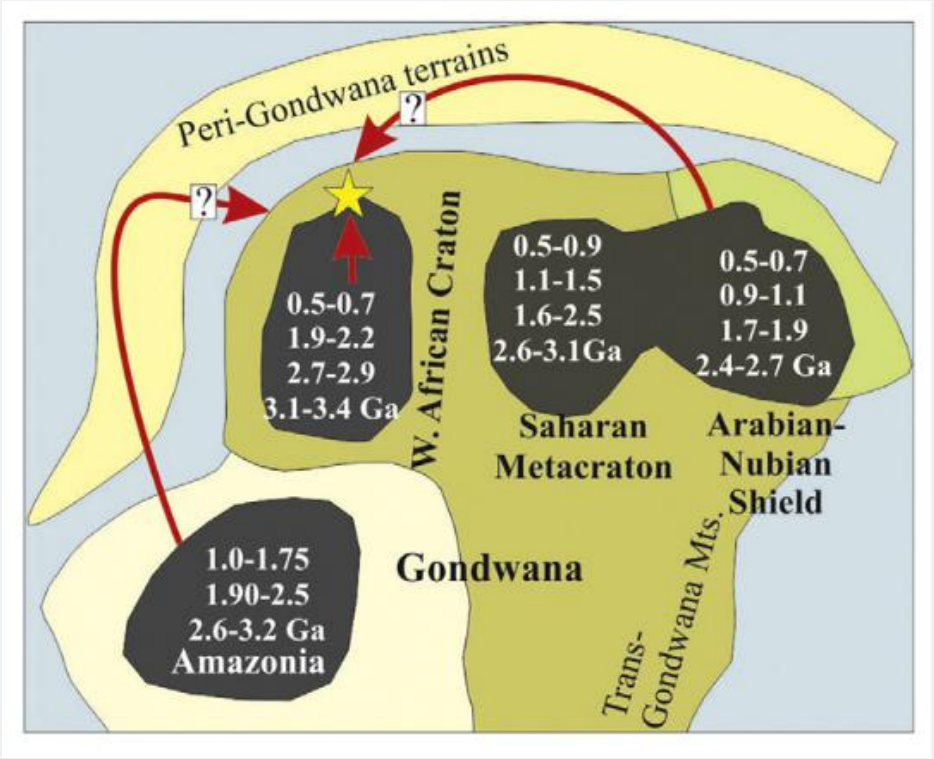


Why does this matter

Proterozoic to Mesozoic evolution of North-West Africa and Peri-Gondwana microplates: Detrital zircon ages from Morocco and Canada

Marzoli et.al. 2017

- 5 Morocco samples, 53 grains per sample
- 95% confident that every population > 10% is identified
- 80% confident that every population >7.5% is identified

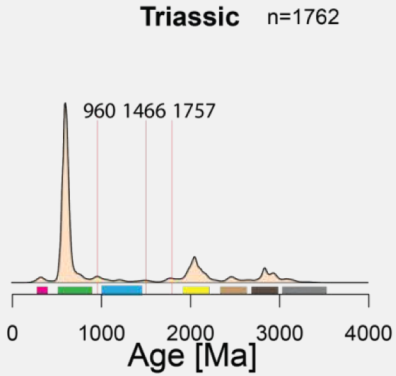


2. TRIASSIC SOURCE TO SINK STUDY

OBJECTIVES

- Develop Triassic source to sink models for Morocco
- Utilise these models to understand distribution of reservoir facies in for the Triassic play in Morocco

Triassic Provenance Studies



(Marzoli et al. 2017; Domènech et al. 2018; Perez et al. 2019)

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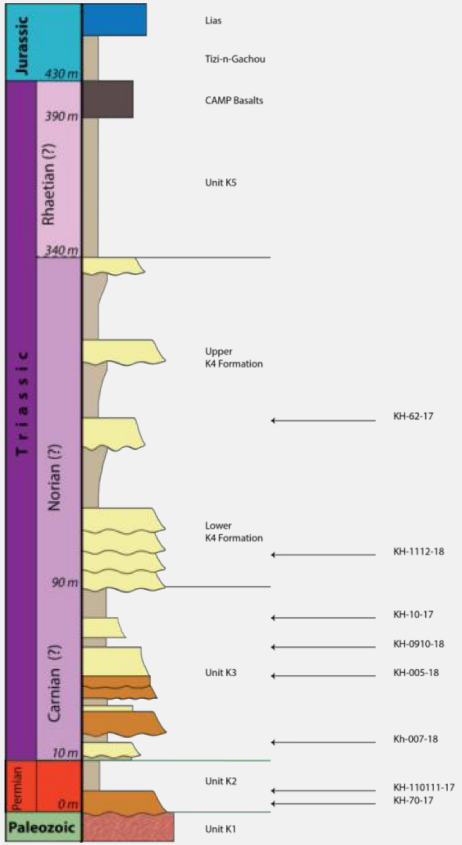
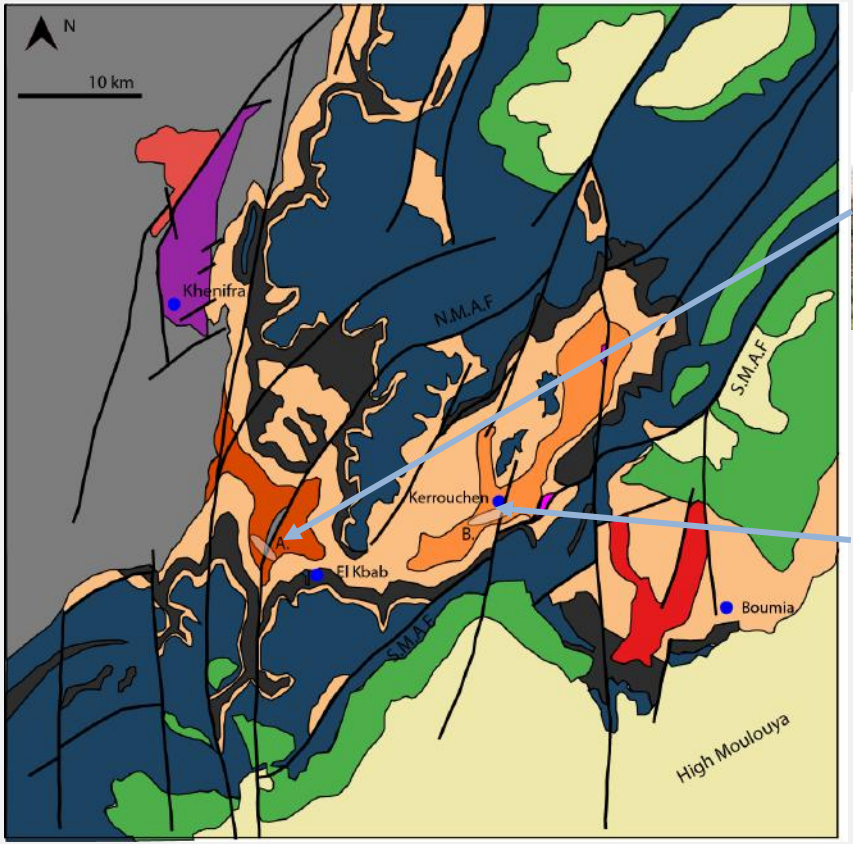
Sample Location





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Methodology

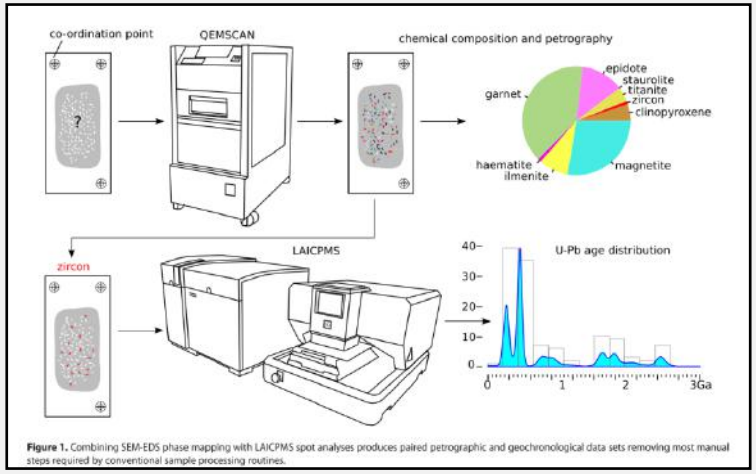


Figure 1. Combining SEM-EDS phase mapping with LAICPMS spot analyses produces paired petrographic and geochronological data sets removing most manual steps required by conventional sample processing routines.

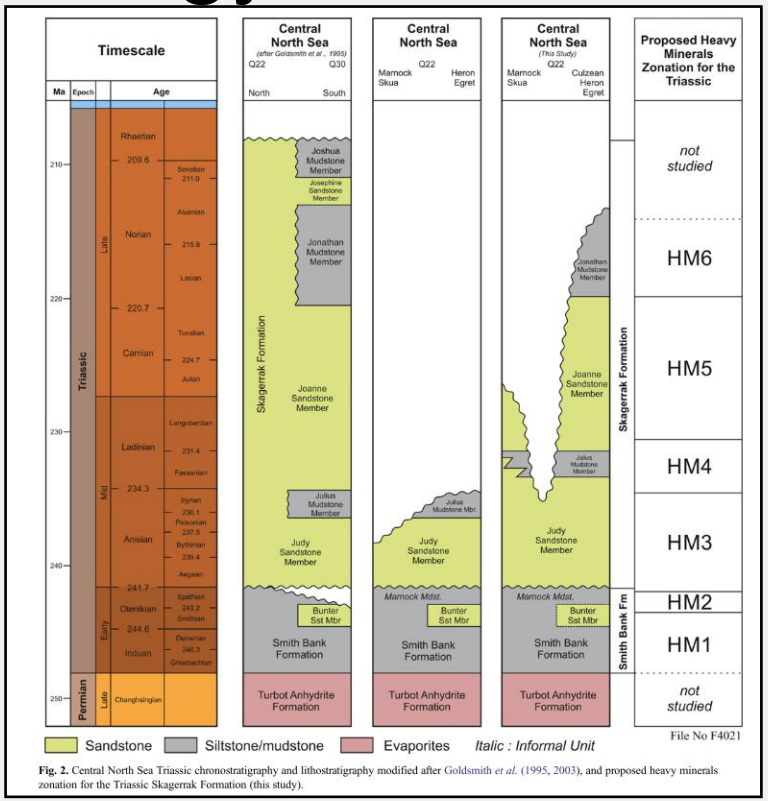
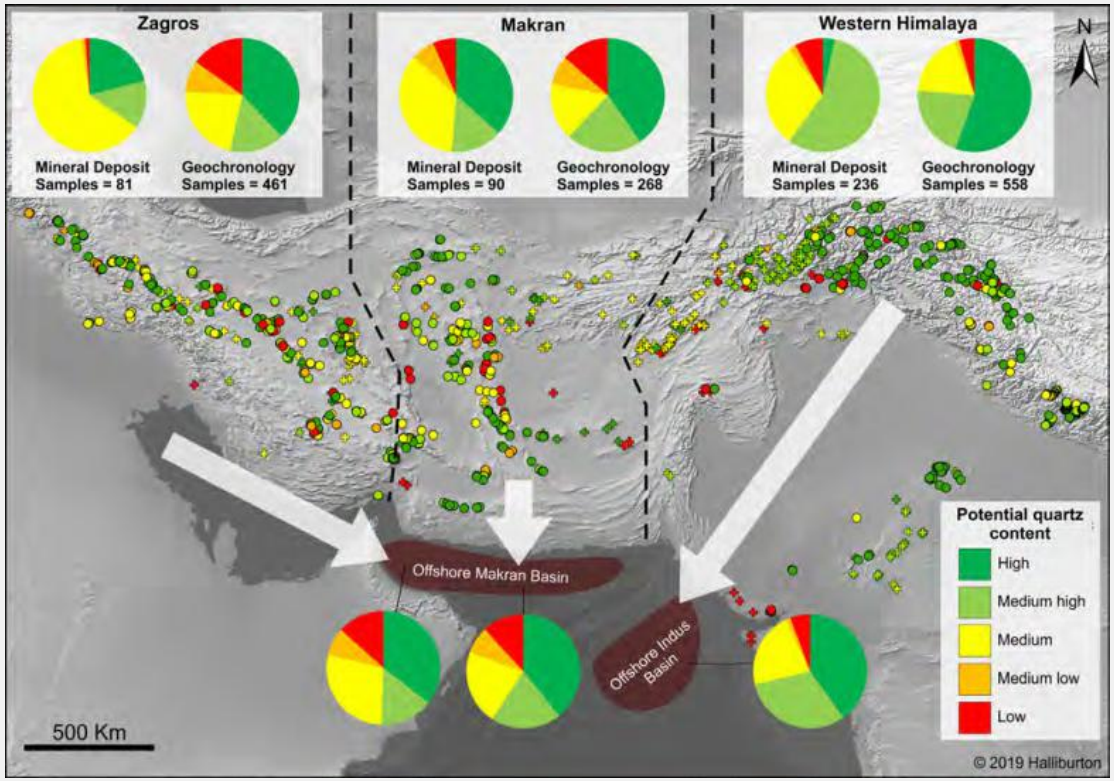


Fig. 2. Central North Sea Triassic chronostratigraphy and lithostratigraphy modified after Goldsmith *et al.* (1995, 2003), and proposed heavy minerals zonation for the Triassic Skagerrak Formation (this study).

From left to right: Vermeesch et.al. 2017, Mange et.al 2005, Mouritzen et.al. 2017

Outcomes



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- Integrate with previously published uplift maps
- Regional source to sink maps
- Identify sediment fairways
- Prediction of reservoir distribution across Morocco

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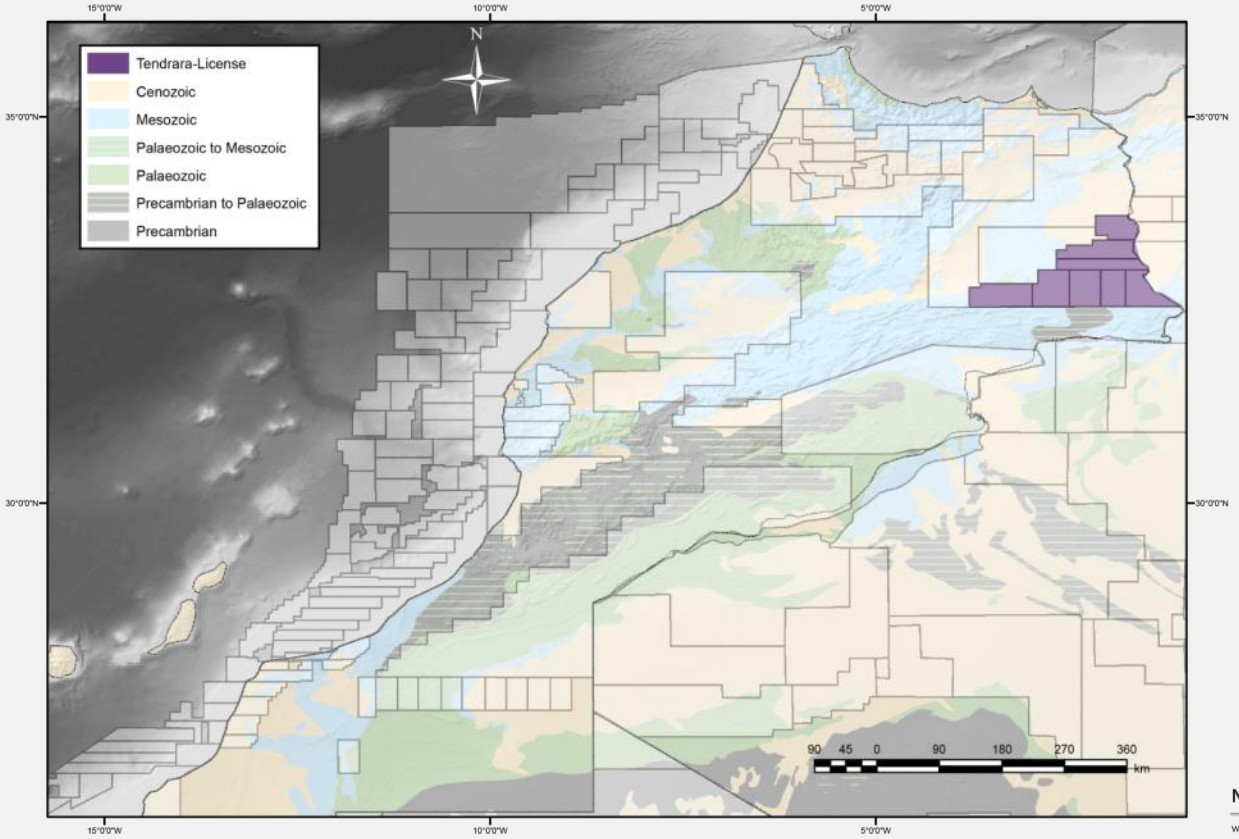
3. THE EVOLUTION OF THE HIGH PLATEAUX

OBJECTIVES

- Develop source to sink models for the High Plateaux Basin
- Utilise this model to screen reservoir distribution and quality in the Tendrara Field

The High Plateaux



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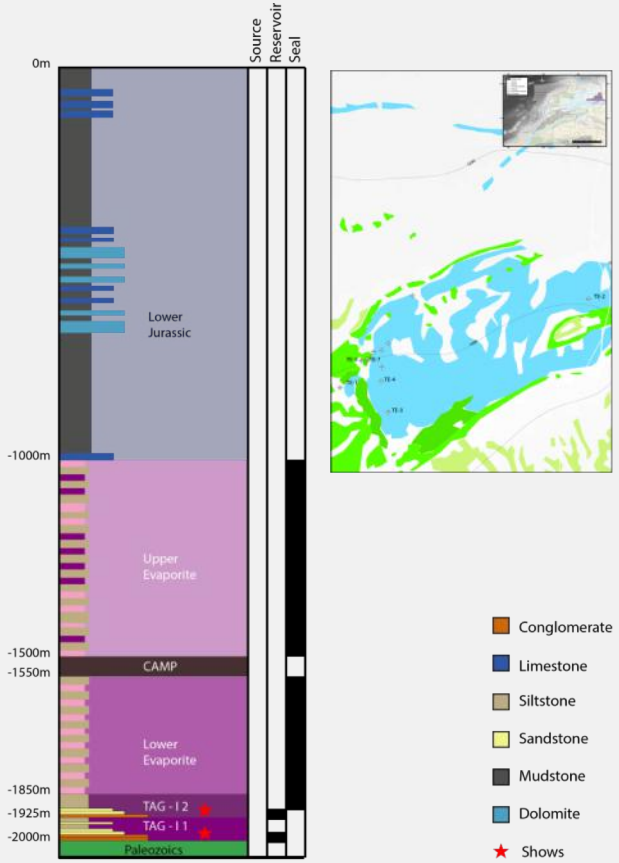
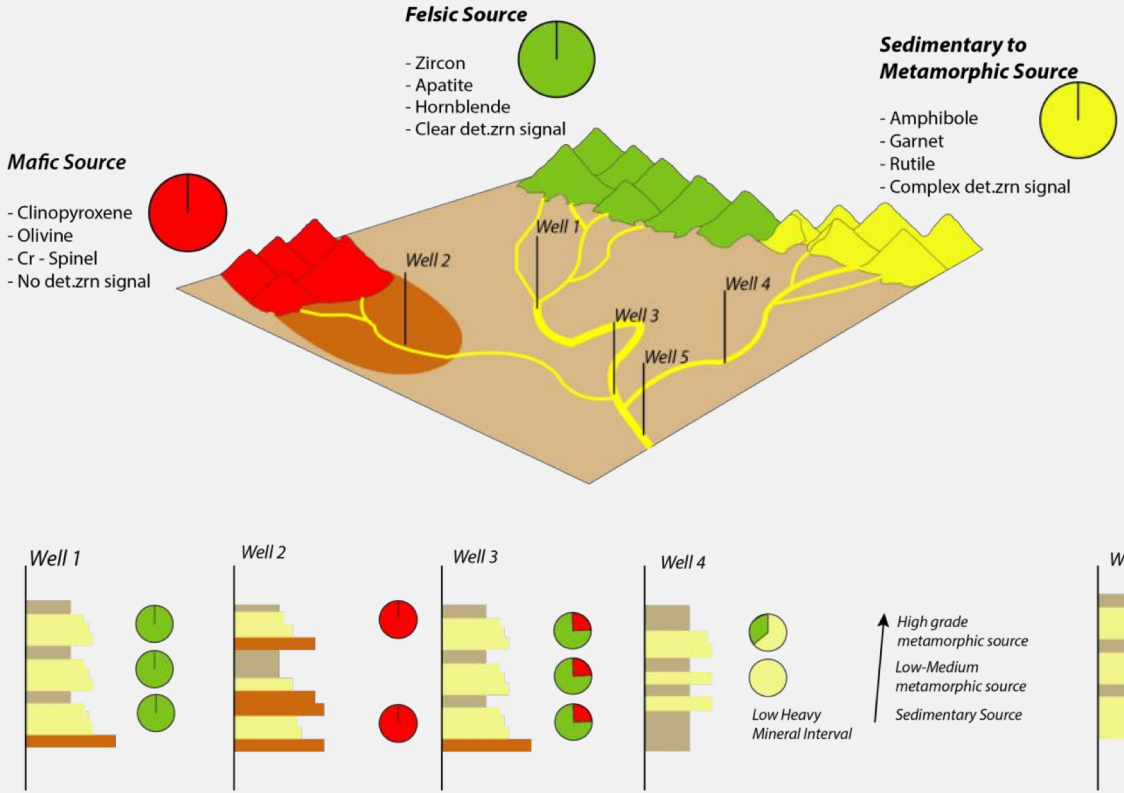
Challenges within the Tendrara Field



- Thickness and N: G of the reservoir
- Distribution of the reservoir within the basin
- Reservoir Quality – low porosity and permeability
- Well to well correlation

Source to solution?



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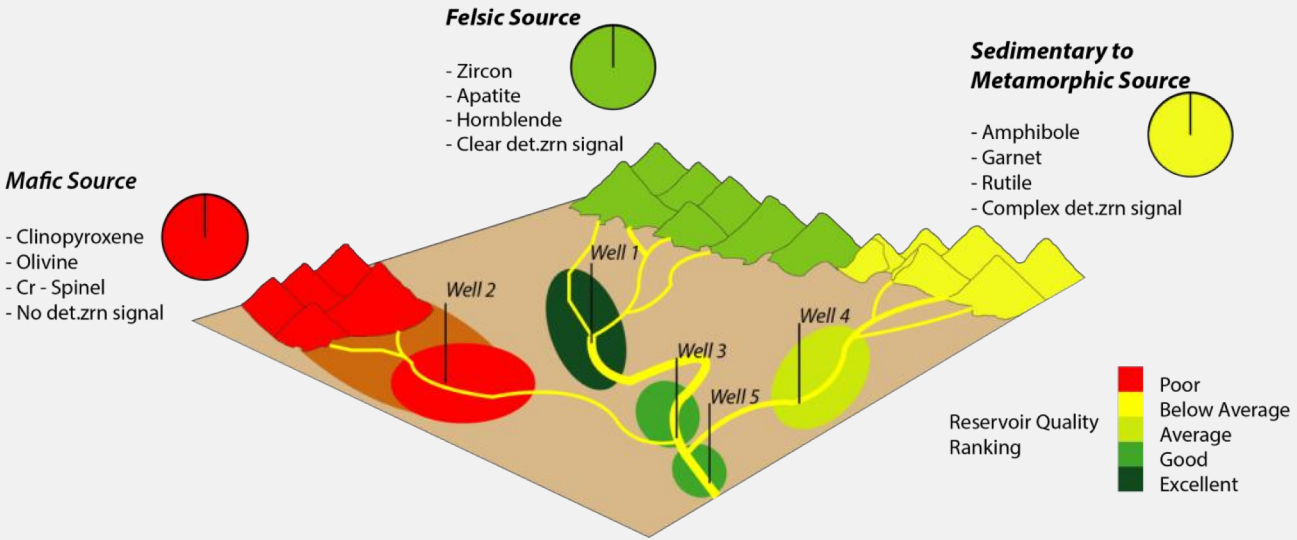
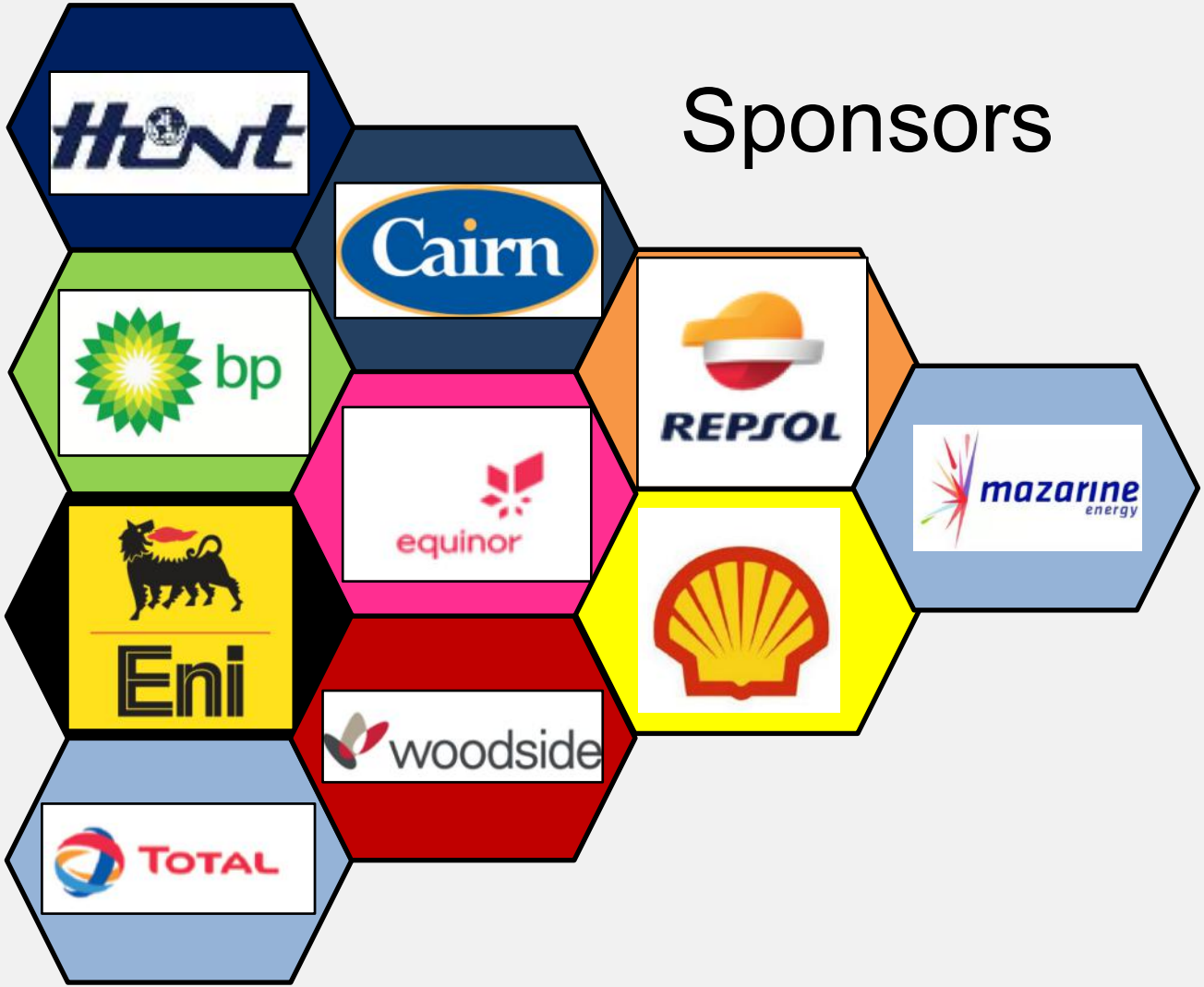
Source to solution?



Sponsors



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