Geologist analysis

ReconAfrica

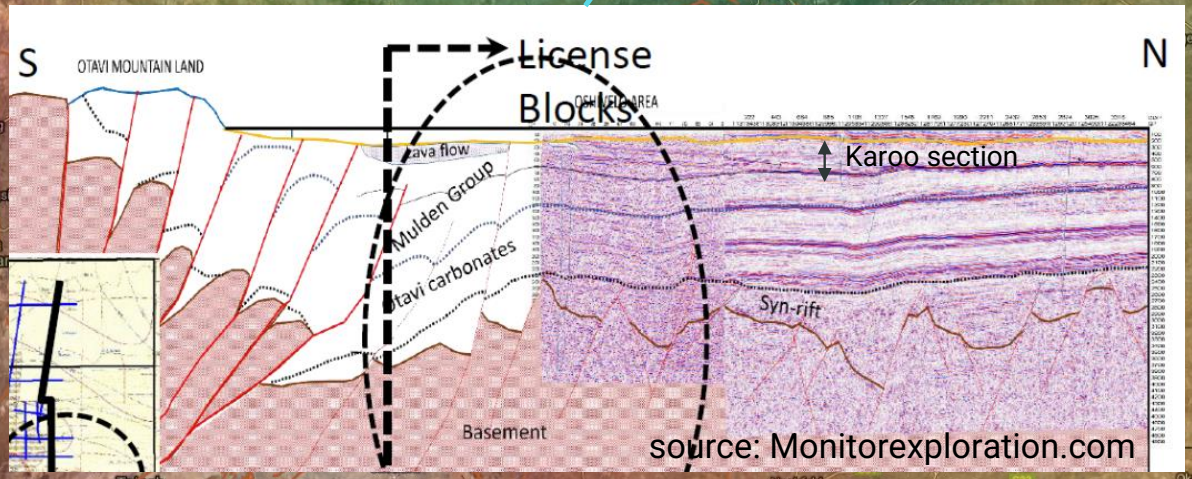
Disclaimer

- I am trained Exploration Geologist with proven track record of finding HC discoveries
- This is my personal view of the geology of Kavango
- Analysis is based on my own research and public sources
- Contributions and discussions are always welcome!

- I own stocks in the company

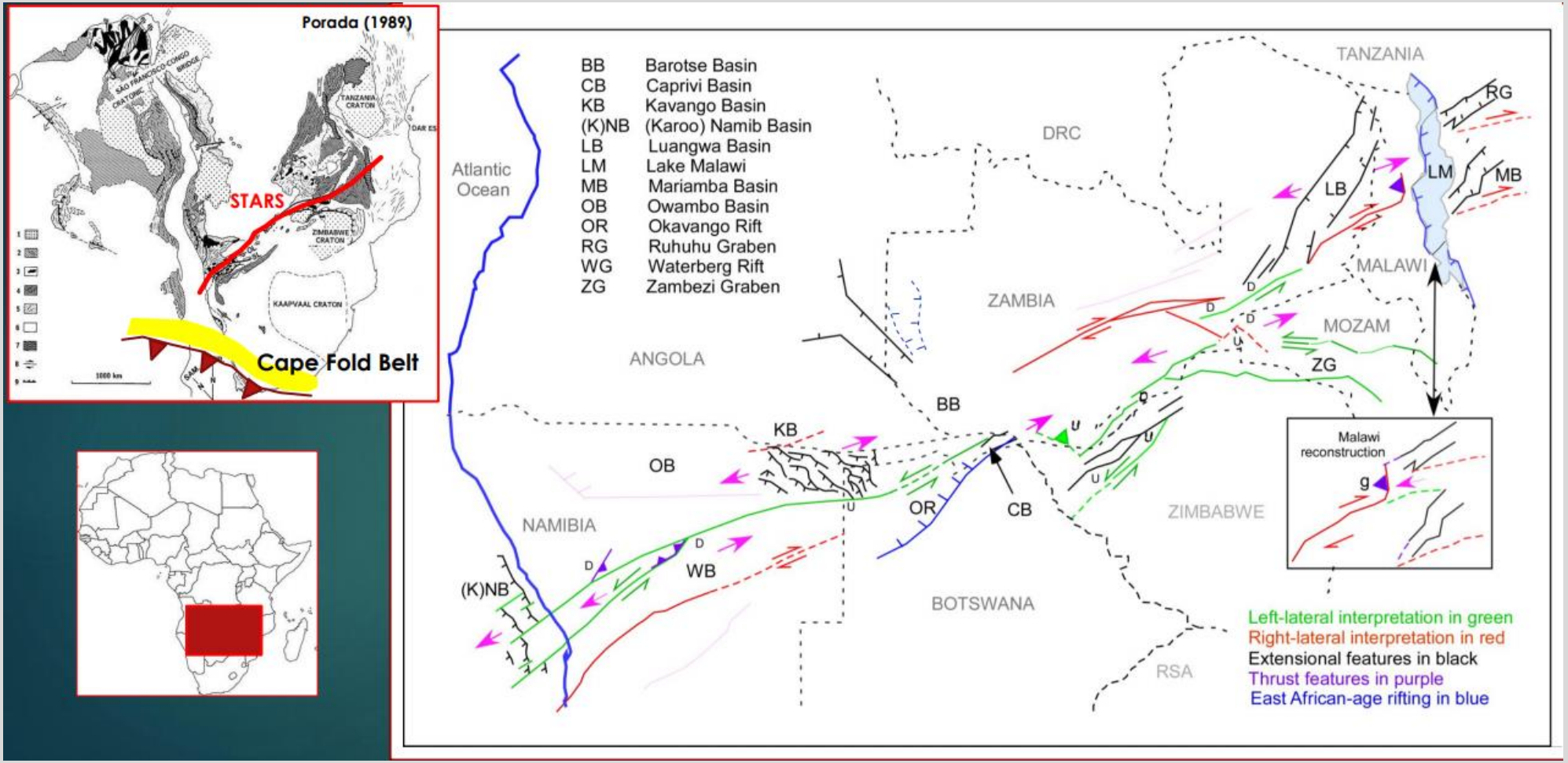
Kavango-Etosha

Seismic shows that the Owambo basin (MEL acreage) is not a Permian rift basin as the seismic package of Karoo appears to be post-rift.
How is it possible that Kavango is a Permian rift basin?



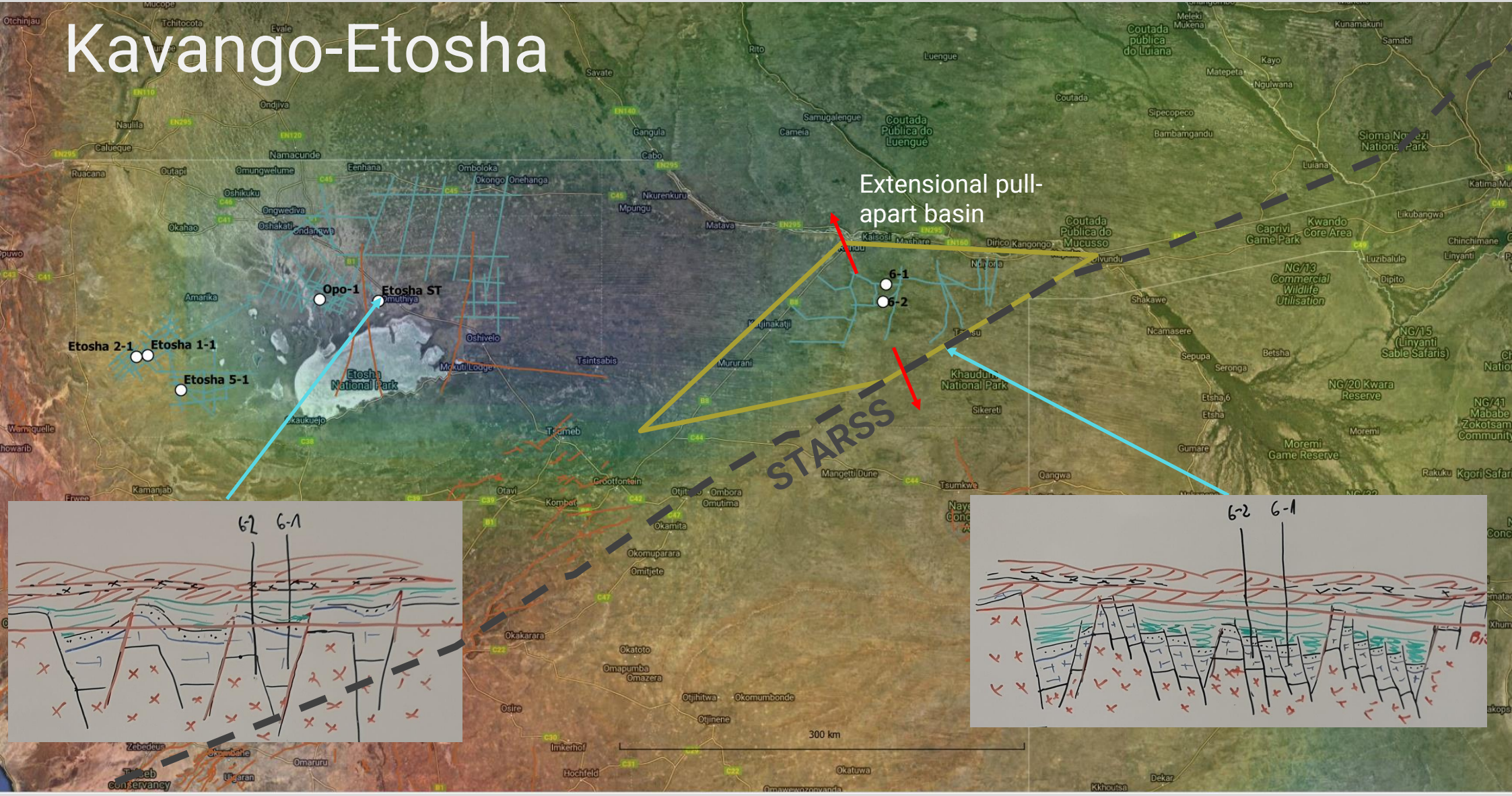
source: Monitorexploration.com

Southern Trans African Rift and Shear System

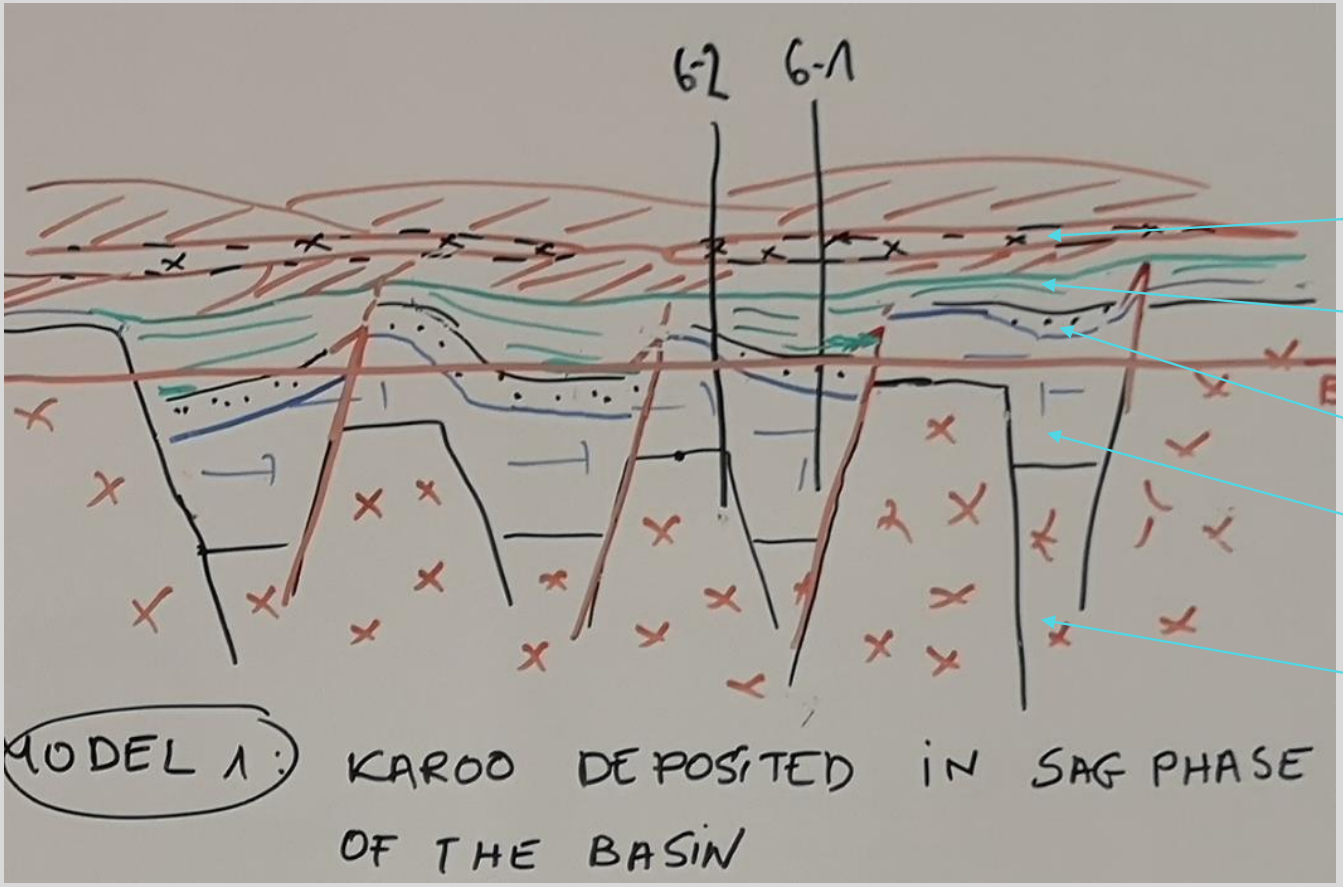


source: ReconAfrica.com

Kavango-Etosha



MODEL 1: If Permian rift is not proven in Kavango this is how the basin model could look like



Damar orogeny inverts the structures resulting in anticlinal traps

Etendeka volcanics and Kalahari sediments

Karoo sediments

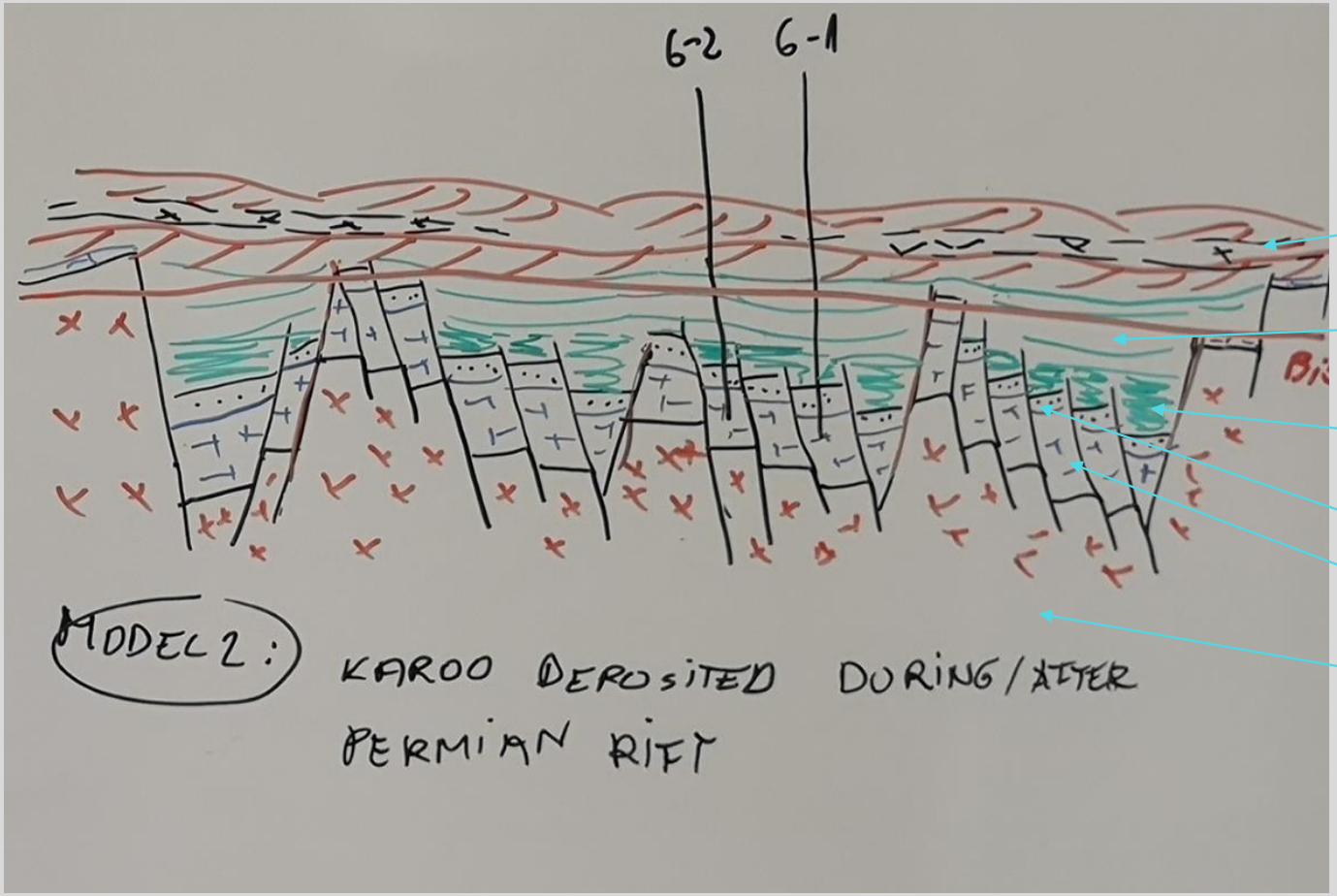
Mulden clastics

Otavi carbonates

Basement

We would need older source rocks than Karoo to produce HCs due to Karoo burial depth.

MODEL 2: If Permian rift is proven in Kavango basin this is how the basin model could look like



Permian rifting results in the basin stretch and rotated fault blocks develop

Etendeka volcanics and Kalahari sediments

Karoo sediments

Mature Karoo source rocks?

Mulden clastics

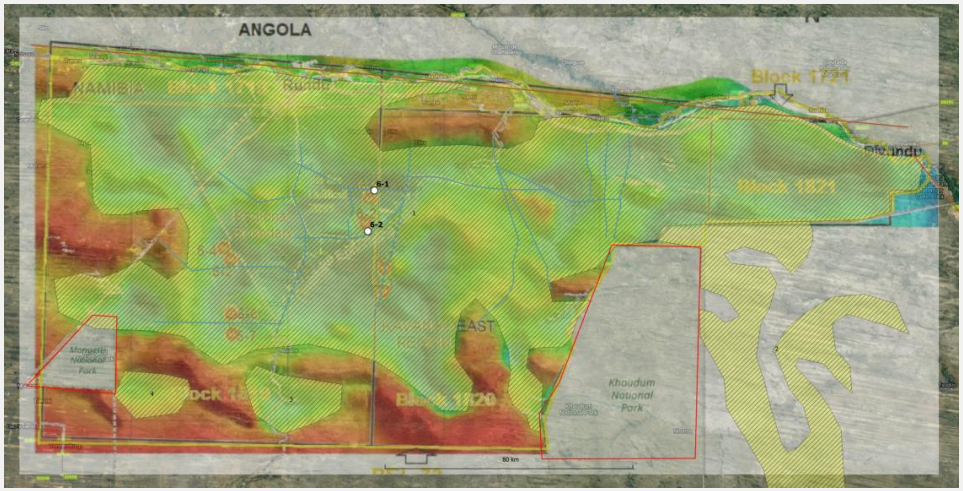
Otavi carbonates

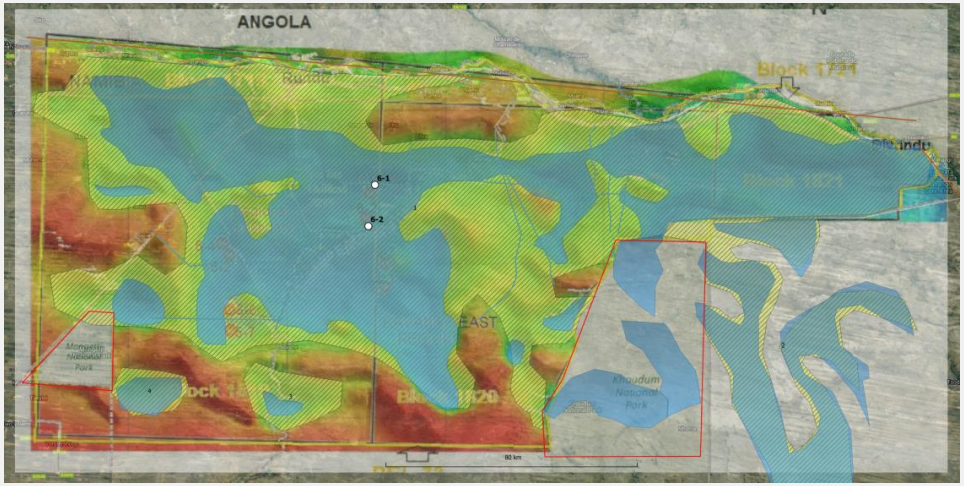
Basement

Based on Recon model

And now into the volume calculations

Calculations focus only on trapping potential. I leave the calculations of how much HCs can be produced to skilled geochemists.

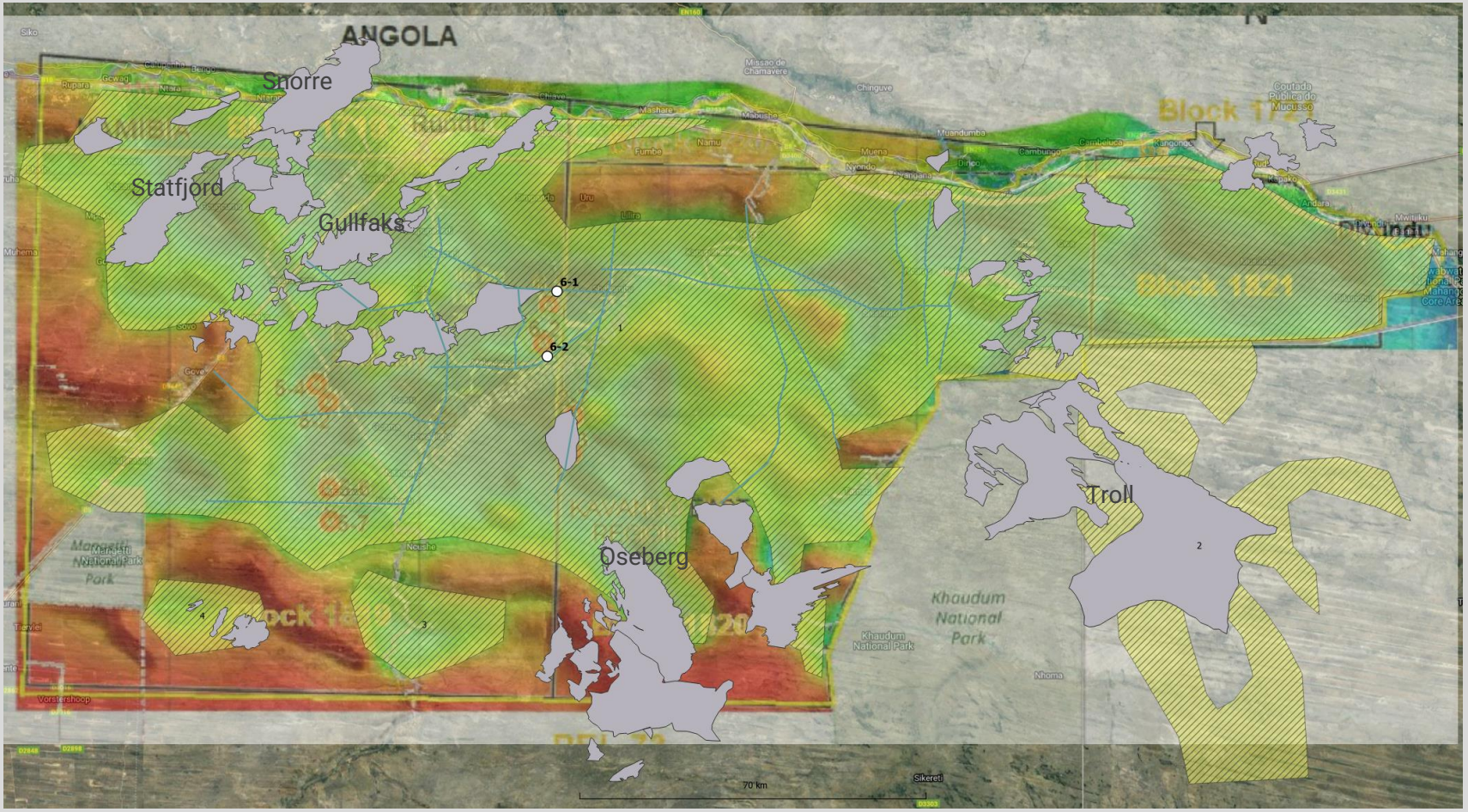




Permian Rift (Model 2)

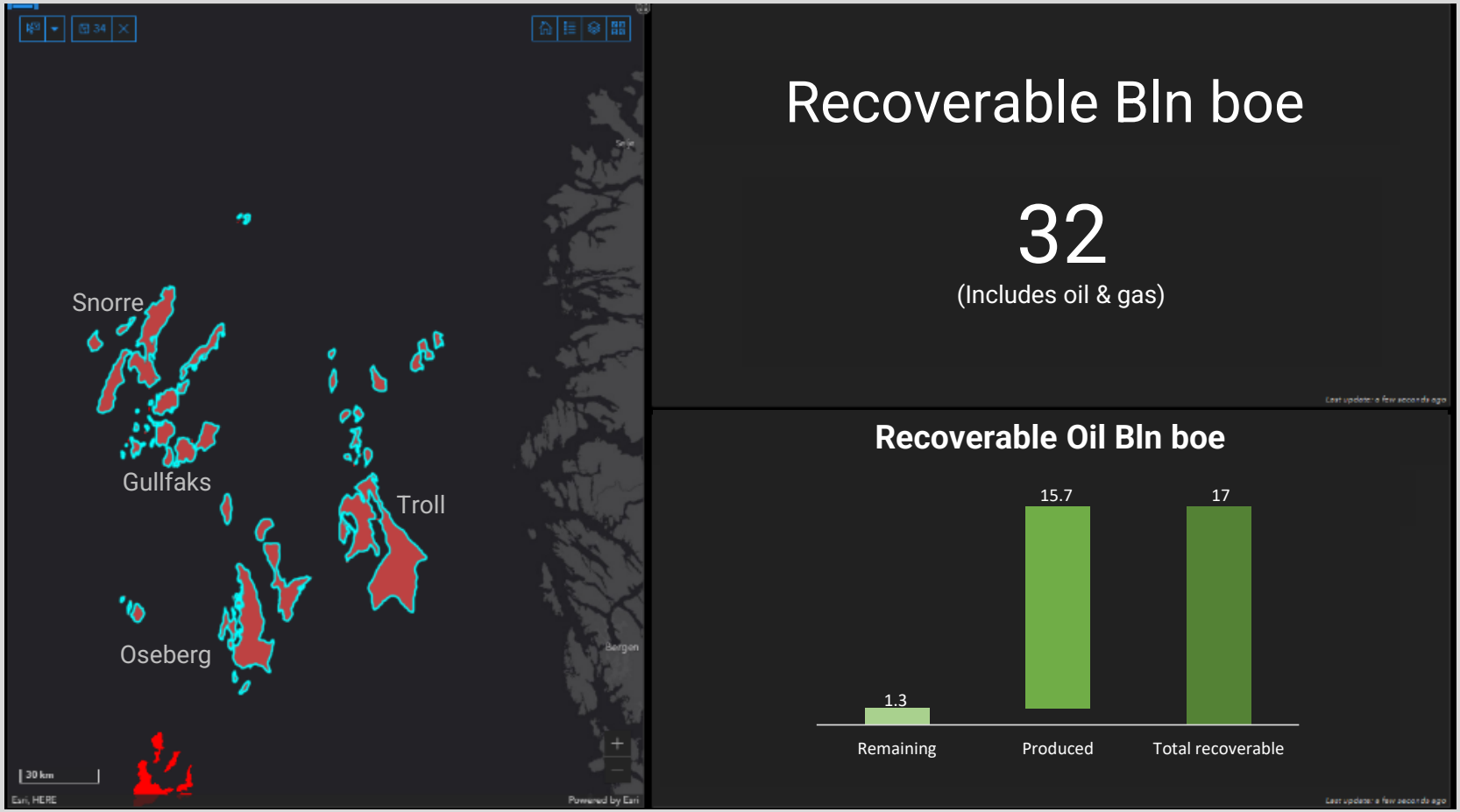
- Model based on ReconAfrica presentations
- Permian rifting results in the basin stretch and rotated fault blocks develop (page 7)
- Yellow area highlights maximum extent of the rotated fault block traps that lie below biodegradation depths
  - From Lithothec slides (Recon) the red areas on the maps represent the highs that are at risk of being within biodegradation window. They are excluded from volume calculation.
- The yellow shapefile is then multiplied with P90-P50-P10 of 0.1-0.2-0.3, which corresponds to fraction of this area that would constitute HC fields
- The blue area is mapped source rock extent (conceptual)

Analogue basin Norwegian Northern North Sea (NNS) displayed on top of Kavango basin



Same scale Kavango basin and Northern North Sea (Norway) oil & gas fields

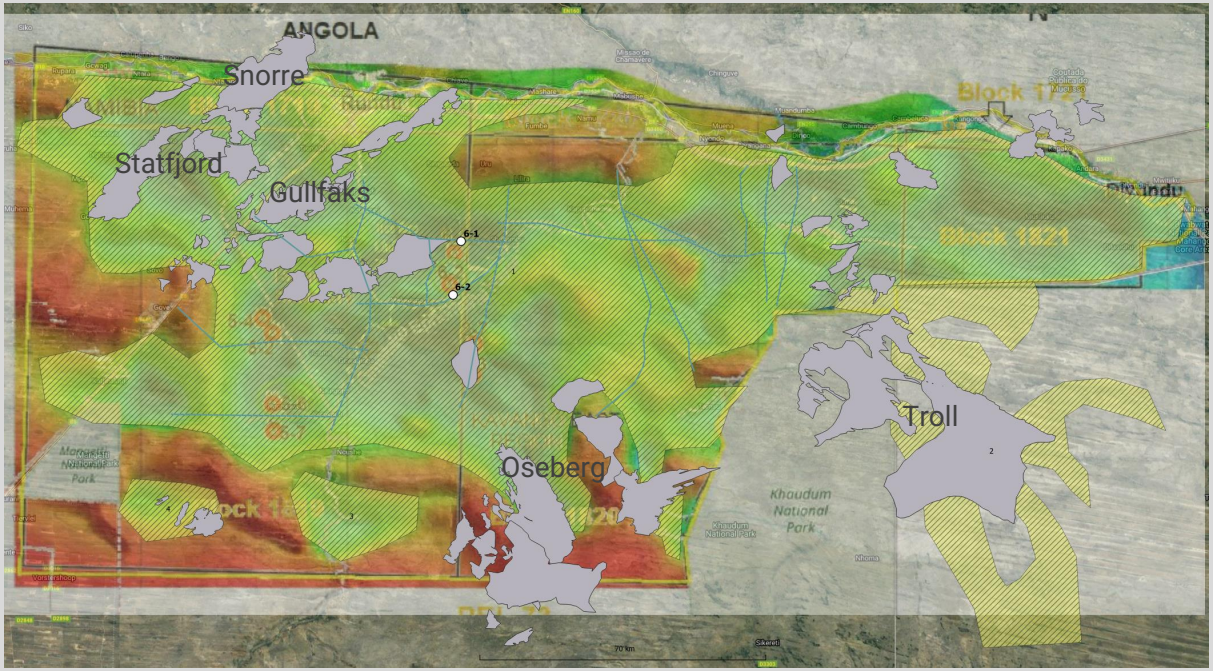
Recoverable volumes from the NNS (Norway) oil & gas fields



Recoverable volumes from selected (blue outline) Norwegian fields

Kavango ReconAfrica license vs Norwegian North Sea

- **<u>Sense check for the volumes calculation!</u>**
- Northern North Sea (NNS) fields (Norway) projected on top of Kavango basin. NNS is a rift basin with high quality marine source rock with thickness of up to 600m in the basin depocenters and 50-100 m on the basin flanks
- 32 Bln barrels of recoverable oil equivalents are estimate in the <u>producing fields</u>
- Why is the field density low? Large areas without fields are present in the NNS. The traps in these areas are located below commercial depths (HPHT, tight reservoirs, gas) and have not been focus of exploration efforts
- **Using North Sea as analogue we can "guesstimate" P90-P50-P10: 10-30-60 Bln boe recoverable in Kavango**
- higher field density on P10, lower field density on P90 than the NNS
- In the Norwegian NNS c. 200-500 mmboe in commercial discoveries were added in the last 5 years and are not included in 32 Bln boe estimate. Basin continues to deliver after 40 years of production! One of them is my discovery ☺



Same scale Kavango basin and Northern North Sea (Norway) oil & gas fields

Volume calculation

Model	Trap style	Reservoir type	Bln boe recoverable (unrisked)			Bln boe recoverable (Risked - 70% traps succesful*)			Bln boe recoverable (Risked - 50% Traps succesful)		
			P90	P50	P10	P90	P50	P10	P90	P50	P10
Permian Rift (Model 2)	Rotated fault blocks	Clastic reservoirs	1.0	60	1026	0.7	42	718	0.5	30	513
	Rotated fault blocks	Carbonate reservoirs	0.1	8	570	0.0	6	399	0.0	4	285

*) 75% is a technical success rate for emerging plays in rift basins for global dataset from 2008 to present. Some of the discoveries are sizeable 100-200 mmboe, but uncomercial due to water depth/ lack of infrastructure.
**) 55% is a commercial success rate for emerging plays in rift basins for global dataset from 2008 to present.

- Simple Excel calculation
- Models are based on the trapping potential in Kavango basin and do not consider volumes of HCs generated and lost during migration
- Recovery factor used for clastic reservoirs: 0.1-0.3-0.6
- Recovery factor used for carbonate reservoirs: 0.1-0.2-0.3
- To fully fill the clastic reservoirs in all rotated fault block traps on P50, 300 Bln boe would have to be generated and successfully migrated into the traps (60 Bln boe recoverable/0.3 recovery factor = 200 Bln boe in place)

Inputs to the model

P90-P50-P10

- Area of traps
- Geometric factor
- Reservoir thickness
- NG
- Porosity
- Recovery factor
- Oil saturation
- Bo

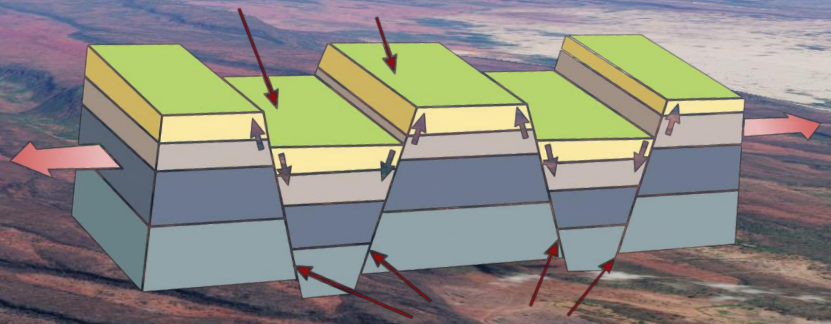
I will update the volumes as more information arrives. The distributions are wide and are based on analogue basins.

Key uncertainties

- Is Permian rift basin model correct
- How effective is the top seal? How much column height can it hold
- How are reservoirs distributed laterally
- Is the main reservoir carbonates or clastics or both
- Source rock potential
- Etendeka volcanics, what is their effect on Petroleum System
- Could the source rock be older than Permian

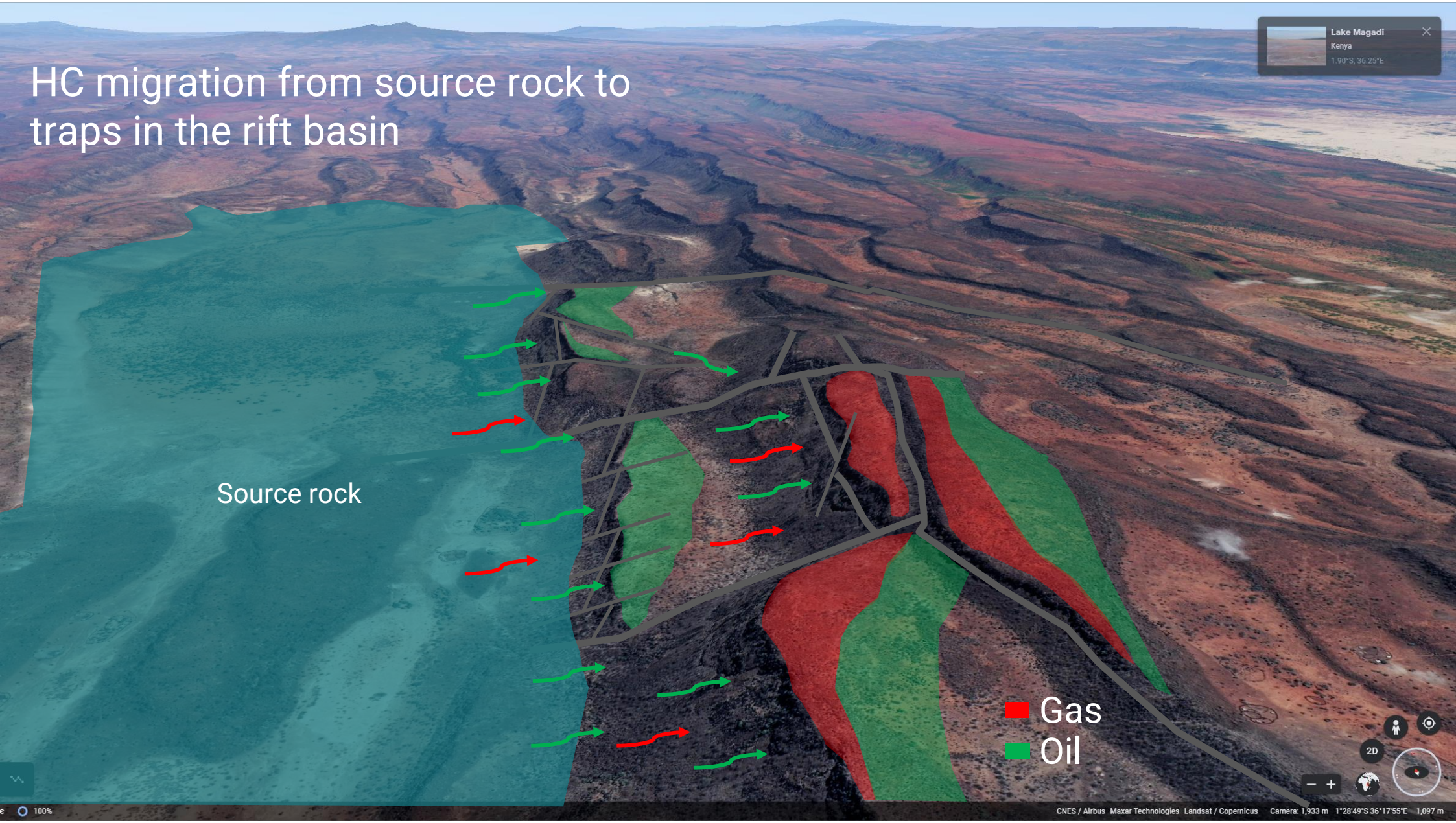
Additional slides

This is how rotated fault blocks look like in exposed rift basin of East African Rift

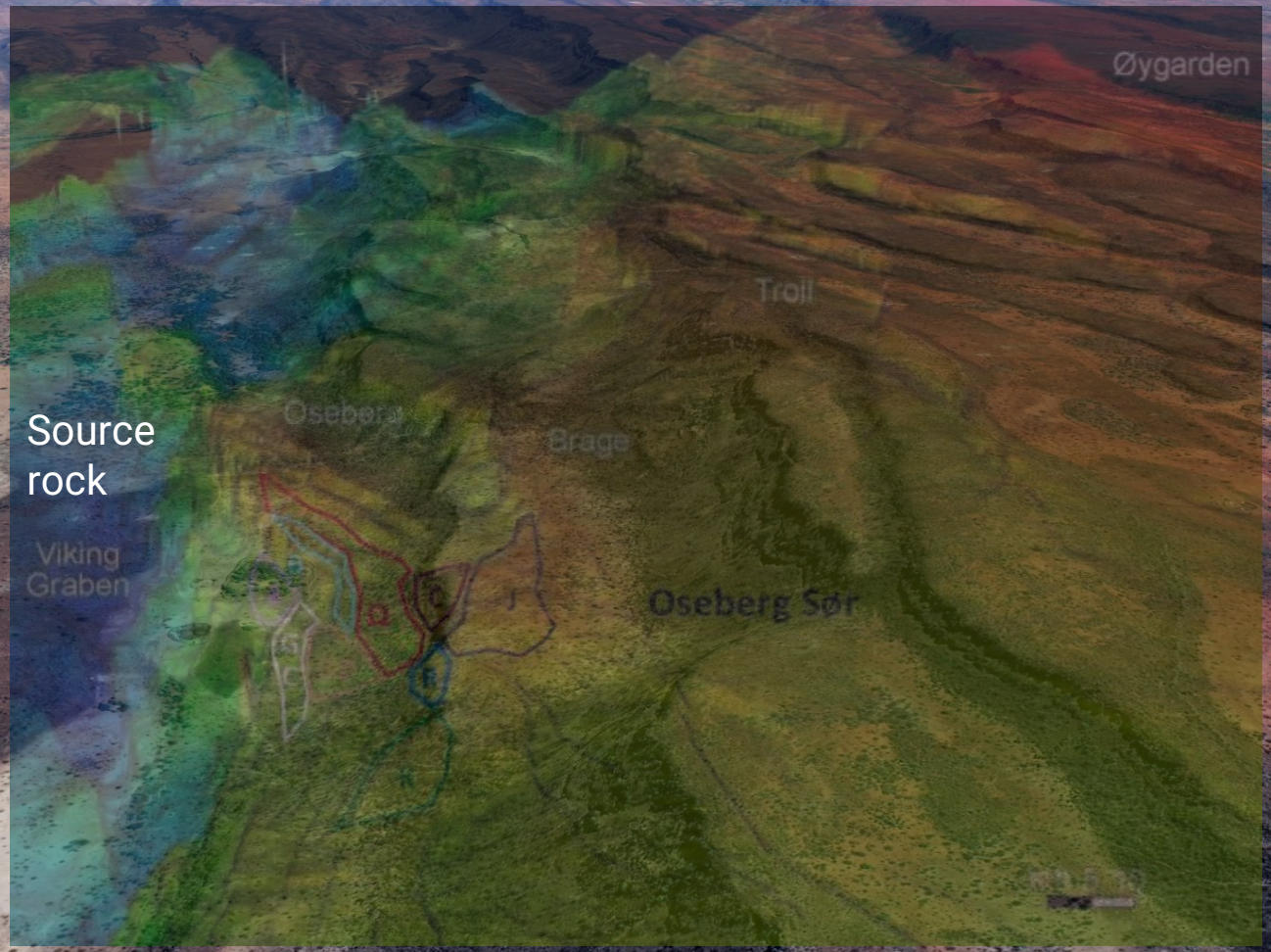


Lake Magadi
Kenya
1.90°S, 36.25°E

North of Lake Magadi, Kenya


HC migration from source rock to traps in the rift basin
Source rock
Gas
Oil
Lake Magadi
Kenya
1.90°S, 36.25°E
2D
CNES / Airbus Maxar Technologies Landsat / Copernicus
Camera: 1,933 m 1°28'49"S 36°17'55"E 1,097 m

Overlay of North Sea rift basin on top of East Africa Rift
Some of the largest fields in Norway are shown



Stratigraphic chart