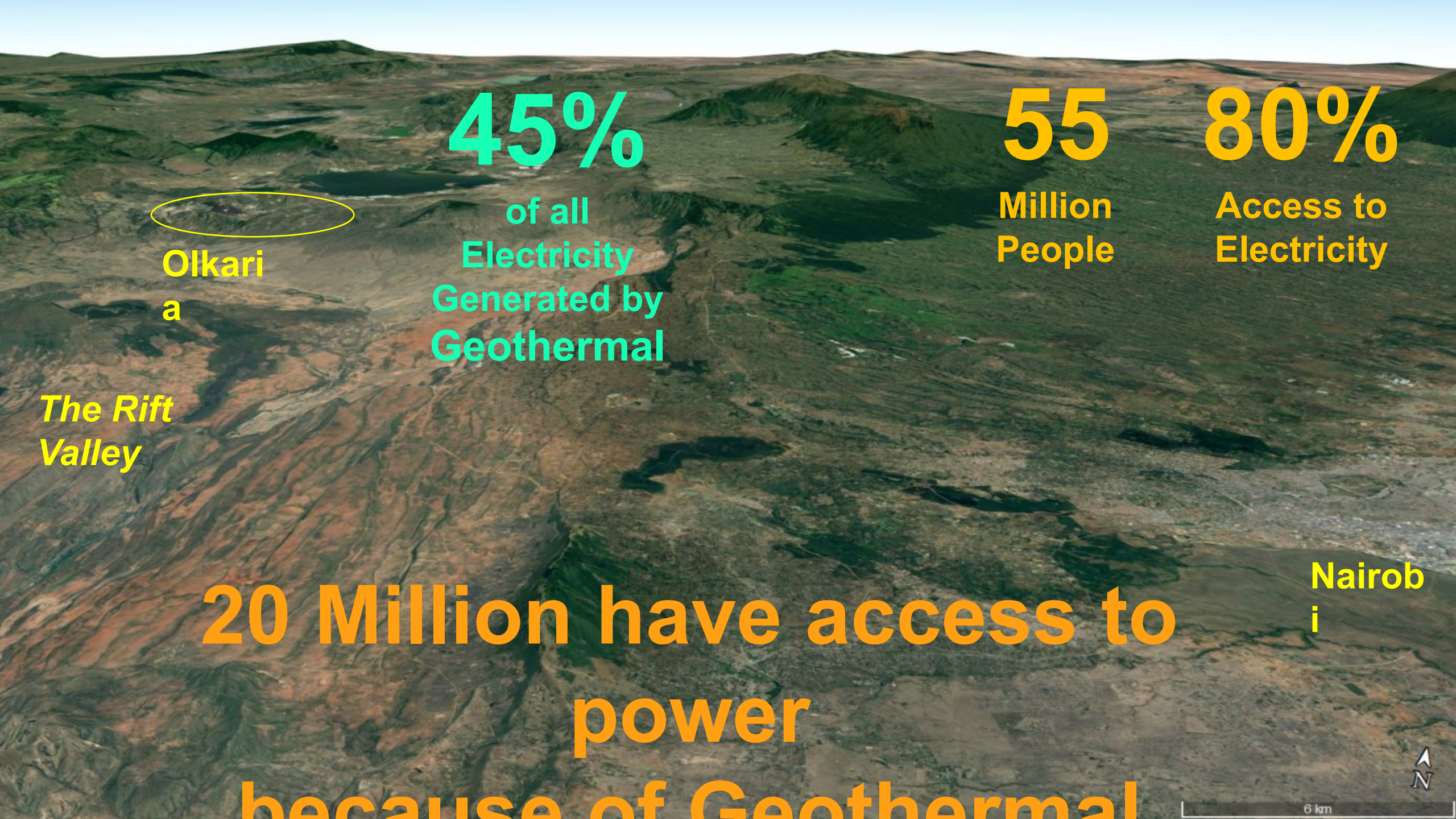
Growing international capability: delivering geothermal training programmes overseas

July 2023
New Zealand Geothermal Association
Winter Workshop

Greg Ussher (Geothermal Specialist, Jacobs)
Matthew Sophy (Senior Engineer, Contact Energy)

The Kenya story..


45%
of all
Electricity
Generated by
Geothermal
55
Million
People
80%
Access to
Electricity
Olkaria
The Rift
Valley
Nairobi
20 Million have access to
power
because of Geothermal
N
6 km


Olkaria
II
105 MW
Olkaria
IAU
223 MW
Ormat
140 MW
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Years

Olkaria
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140 MW

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1 km

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

Olkaria
II
105 MW

Olkaria
IAU
223 MW

Olkaria
V
158 MW

Ormat
140 MW

Olkaria
I
45 MW

Ngati Tahu

contact

N

1 km

2019 – 21 KenGen drilling in Ethiopia : private sector

NEW ZEALAND
FOREIGN AFFAIRS & TRADE
Aid Programme

The AGF Program

African Union

The African Geothermal Facility (AGF)

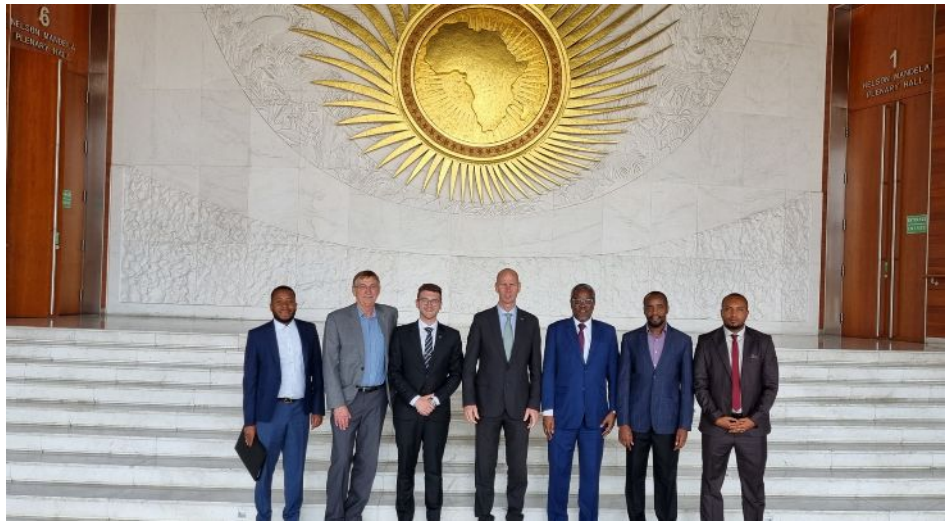
In collaboration with the African Union Commission

NEW ZEALAND
FOREIGN AFFAIRS & TRADE
Aid Programme

African Union Commission is joint sponsor

African Union

- Training programs in association with AGCE
- Assist GRMF funding applications
- Supporting O&M at Menengai
- Support during drilling for 3 partners



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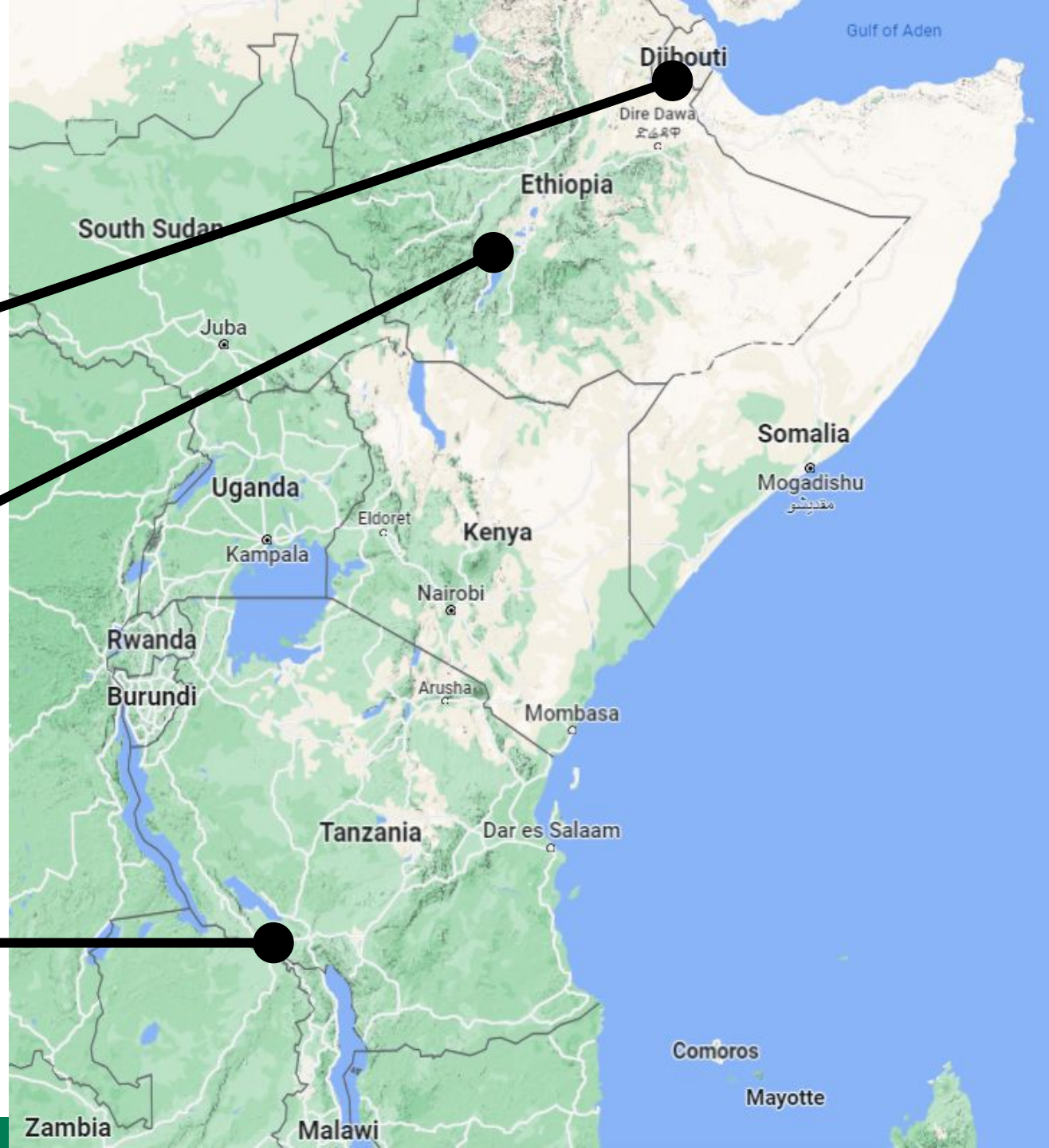
Aid Programme

Present focus areas for drilling assistance

- Djibouti (ODDEG)
  - The Assal area (Gale le Koma)
    - Drilling has started
- Ethiopia (EEP)
  - Aluto
    - Drilling of 12 wells, nearly complete
- Tanzania (TGDC)
  - Kiejo-Mbaka and Rungwe areas
    - Rungwe ready to drill
    - Mbaka surveys completed



Scope of support for drilling programmes

- Technical review on request
- Mentoring and peer support
- Capacity development
- Technical support for resource assessment and drilling plans
- HSE advisory

- NOT
  - Directing, planning, reporting

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Finding our way…
Training or capacity building

Experience & Lessons Learned

Trying new teaching methods – the Bill Cumming concept model course

- Step by step discovery of a system
  - Geology -> Chemistry -> Geophysics
  - Exploration drilling -> Delineation
- Learning by doing
  - Decision making
  - Results revealed
- Realistic data set
  - Initially based on San Jacinto
  - Now a nicely synthesised model
- Many involved
  - Irene Wallis, Steven Sewell, Nick Hinz, Ryan Libby, Jonathon Clearwater and many more

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Trying new teaching methods – the Bill Cumming concept model course

- Fantastic Positives
  - Structured hands-on learning
  - Can be run with larger groups
  - Trainers get familiar with material and become “Experts”
  - Quite universal – adapted for different regional system types
  - Reference model is simplified and follows the rules
- What it misses
  - Material that is directly relevant to attendees
  - A sense of urgency / importance about the outcomes

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Trying new teaching methods – taking a leap using local data

NEW ZEALAND FOREIGN AFFAIRS & TRADE Aid Programme

- 2019 – Concept model training in collaboration with AGCE
  - University of Auckland
  - Seequent
  - Contact Energy
  - Jacobs
- @ Olkaria
- 3 Countries attended

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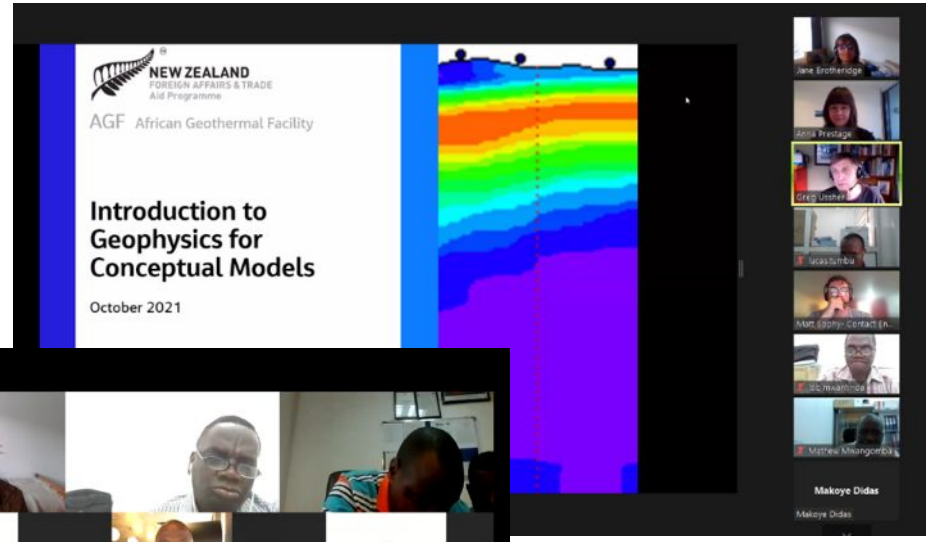
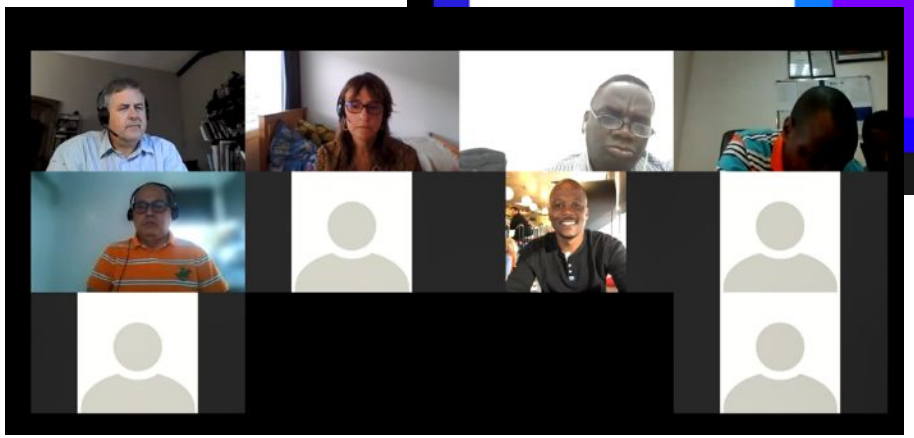
Covid – going online

- Online system
  - Setting up a host of webinars
  - Online storage so that materials are searchable
  - Build up the libraries
- Zoom + Teams
  - Relationships developed –slowly
  - Sometime 10 people in a room, no camera
  - Many late nights !!
  - Many good sessions, some difficult
- But ..
  - Hard to know what they know
  - Quite one directional





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Travelling again !! 2022 face to face training

- Ralph Winmill ran the Hagen + Ralph drilling course
- Clinic assessments of geoscience and well planning
- Recognizing gaps and planning next visit
  - Need to work with their data

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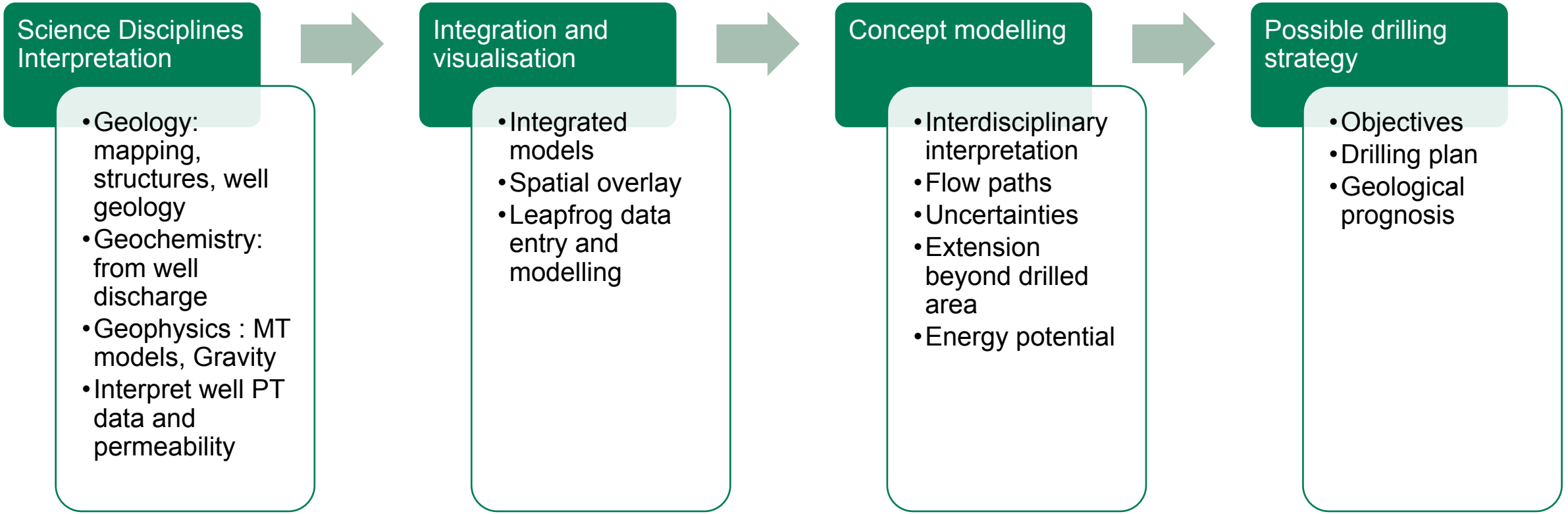
The live data workshop

We follow the typical workflow of an exploration project



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Typical daily workflow..

Presentation

- Introductions
- Overview of discipline
- What we normally do to process the data
- How we interpret this type of data
- Typical data issues / limitations
- Q&A

Working session (In teams)

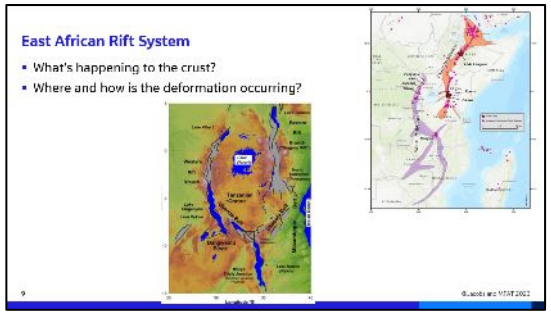
- Compile data
- Critical review of data and quality
- Interpretation / analysis
- Input to integrated interpretation
- Prepare results for presentation

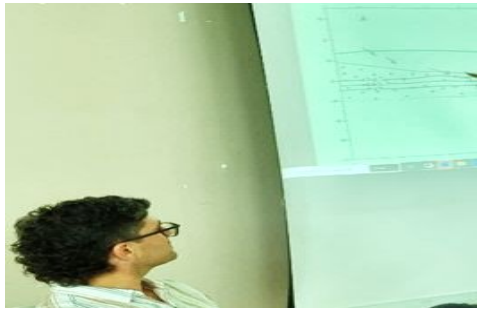
Present Results (in teams)

- Present Key results / maps or sections
- Interpretation
- Recommendations
- Q&A

Round up

- General discussion
- Things we can do better
- The plan for tomorrow





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Common workflow issues and improvements

- Data interpretation and management- database resolutions
- Non-uniform technology access to staff- cloud based workflow
- Not trusting own interpretations, over-reliance on consultants

Tools we use:

- Excel (basic databases as example for future work)
- QGIS- open source mapping software
- Leapfrog- 3D visualization, temperature models
- A cheap colour printer and lots of paper

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Learnings

What works?

- Students trained in Japan, Iceland – basic skills
- Multi-disciplines working together
- In person training more effective than on-line sessions
- Cloud based software and data exchange
- NZ/African code for geothermal drilling fit for high enthalpy resources
- Demonstrating teamwork by doing.. The delivery team and their team

What can be improved?

- Exchange programs with developers
- Continue building relationships with in-person visits
- 1:1 mentoring i.e. Women in STEM roles, discipline specific training
- Access to software and data across teams
- Low temperature resource drilling and reservoir engineering support (NZ Drilling Code does not really fit)

Some ideals

- Work/study program exchange between African partners and New Zealand academia and private sector
- Exchange with other countries that have NZ connections – Indonesia (Just starting)

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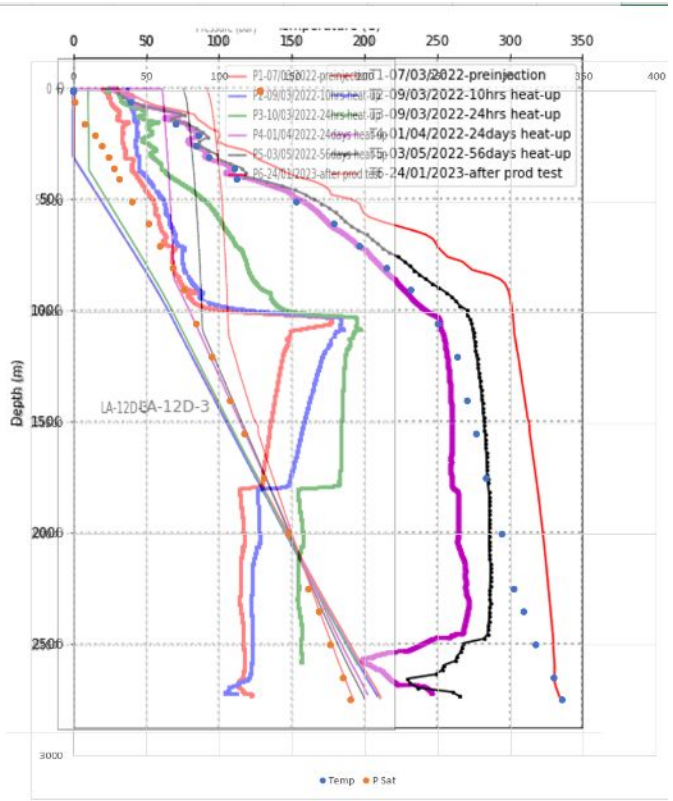
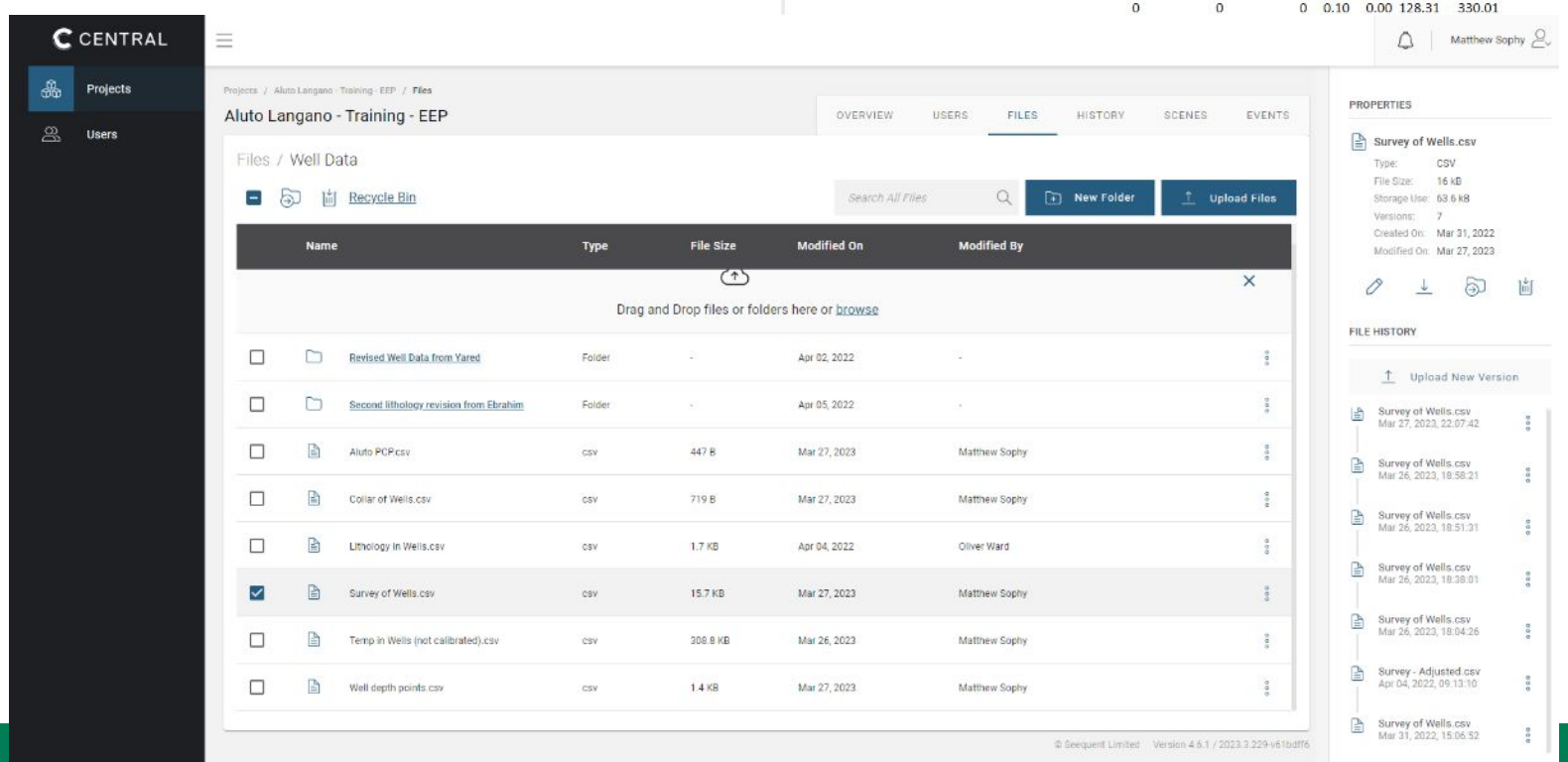
Databases

- Digitize temperature and pressure data in Excel
- Uploading to Central (cloud based server for Leapfrog 3D modelling)

Hole ID LA-12D3-Interp 2 Water Level 1820 masl

Depth	Average of Temp C	Average of z	Depth	Temp	Z	dp / m	dp	P Sat	BP T	
50	39	1830	50	39	1830	0.097	0.00	1.00	101.59	10.3377858
150	71	1752	150	71	1752	0.096	6.54	7.54	165.86	10.4094754
200	86	1674	200	86	1674	0.095	7.41	14.95	195.86	10.4728435
250	84	1625	250	84	1625	0.096	4.74	19.69	209.39	10.4651314
300	93	1575	300	93	1575	0.095	4.78	24.47	220.73	10.5118193
350	110	1539	350	110	1539	0.094	3.32	27.79	227.66	10.6198769
400	112	1497	400	112	1497	0.094	3.96	31.75	235.14	10.631401
500	153	1405	500	153	1405	0.091	8.36	40.11	248.87	11.0098436
600	179	1275	600	179	1275	0.088	11.42	51.54	264.47	11.3450714
700	197	1186	700	197	1186	0.086	7.67	59.21	273.53	11.626469
800	215	1075	800	215	1075	0.084	9.26	68.47	283.36	11.9664457
900	232	984	900	232	984	0.081	7.44	75.91	290.54	12.3271611
1050	250	878	1050	250	878	0.078	8.26	84.17	297.91	12.7874899
1200	263	734	1200	263	734	0.076	10.92	95.09	306.86	13.1760784
1400	270	566	1400	270	566	0.075	12.58	107.67	316.26	13.3971809
1550	276	437	1550	276	437	0.074	9.49	117.16	322.81	13.5954076
1750	283	251	1750	283	251	0.072	13.43	130.59	331.42	13.8438167
2000	294	16	2000	294	16	0.070	16.45	147.03	341.10	14.2586762
2250	302	-193	2250	302	-193	0.068	14.31	161.34	348.88	14.5985682
2350	309	-302	2350	309	-302	0.067	7.31	168.65	352.65	
2500	317	-420	2500	317	-420	0.065	7.75	176.40	356.51	
2650	330	-560	2650	330	-560	0.063	8.74	185.14	360.72	
2750	335	-639	2750	335	-639	0.061	4.82	189.96	362.98	
			0	0	0	0.10	#####	128.31	330.01	
			0	0	0	0.10	0.00	128.31	330.01	
			0	0	0	0.10	0.00	128.31	330.01	
			0	0	0	0.10	0.00	128.31	330.01	
			0	0	0	0.10	0.00	128.31	330.01	
			0	0	0	0.10	0.00	128.31	330.01	
			0	0	0	0.10	0.00	128.31	330.01	
			0	0	0	0.10	0.00	128.31	330.01	





- They all need GeoData Manager !
- Raw data is a fundamental asset

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Group discussions of Aluto-Langano prospect, Ethiopia with EEP

- Temperature modelling in Leapfrog using data dating back to the 1980s

- Leapfrog enables comparison of temperatures, resistivity, lithology and permeable zones
- New perspectives on old data
- Some EEP staff studied in New Zealand

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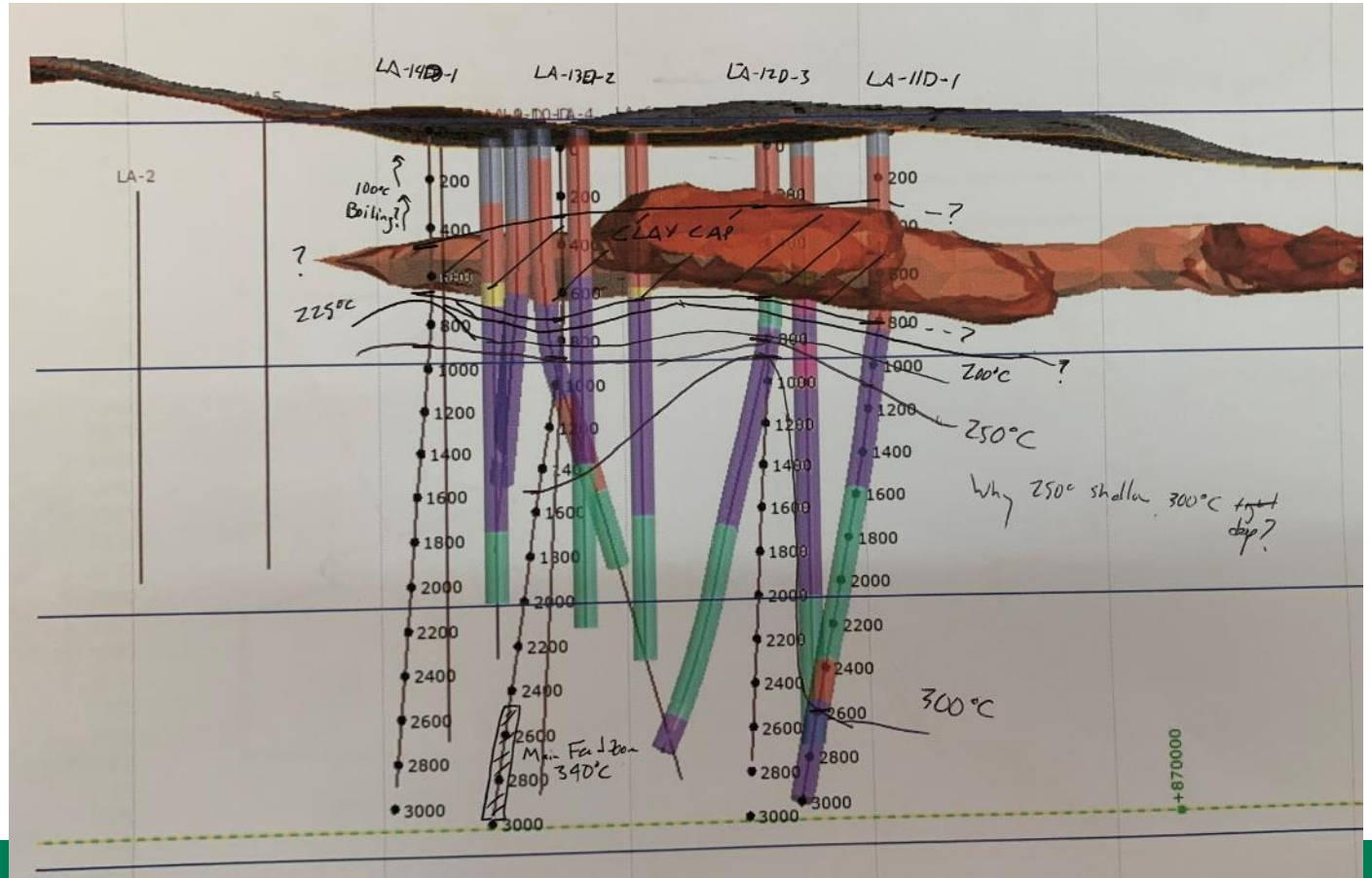
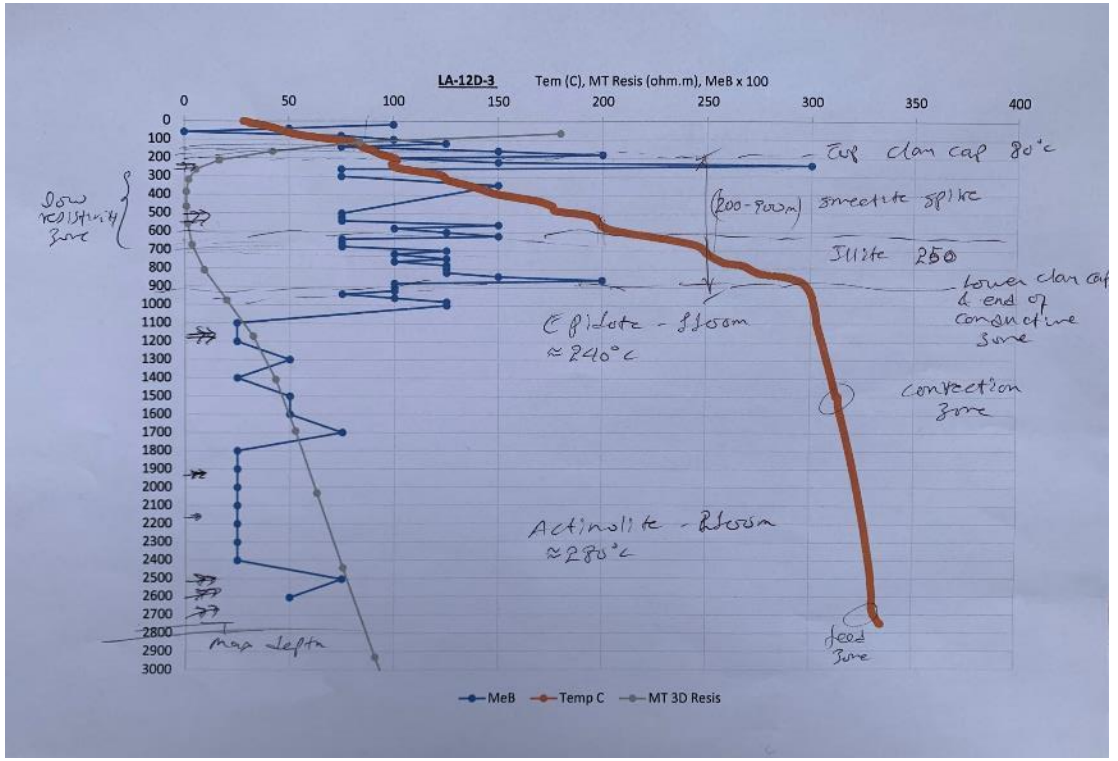
Multi-discipline exercise: Aluto, Ethiopia

- Analysis of methylene blue data from new wells to identify extent of smectite hydrothermal clay alteration
- Base of 200C isotherm from temperature logs





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Group work in Djibouti with ODDEG

- Hot, structurally controlled, saline geothermal resources
- New team keen to help their country obtain energy independence
- Pragmatic review of data and exploration strategy moving forward

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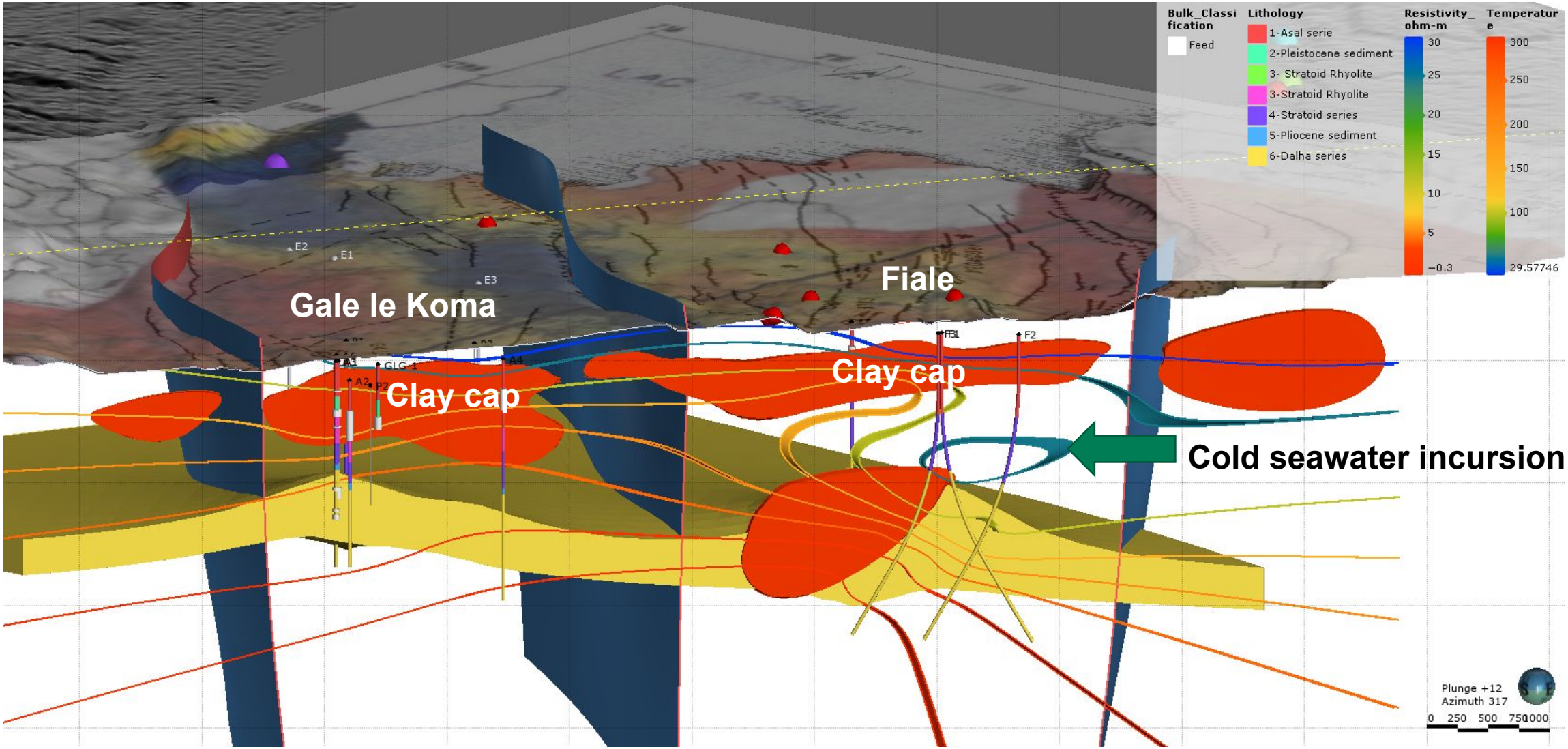
Assal region, Djibouti: Leapfrog for visualizing multiple data sets



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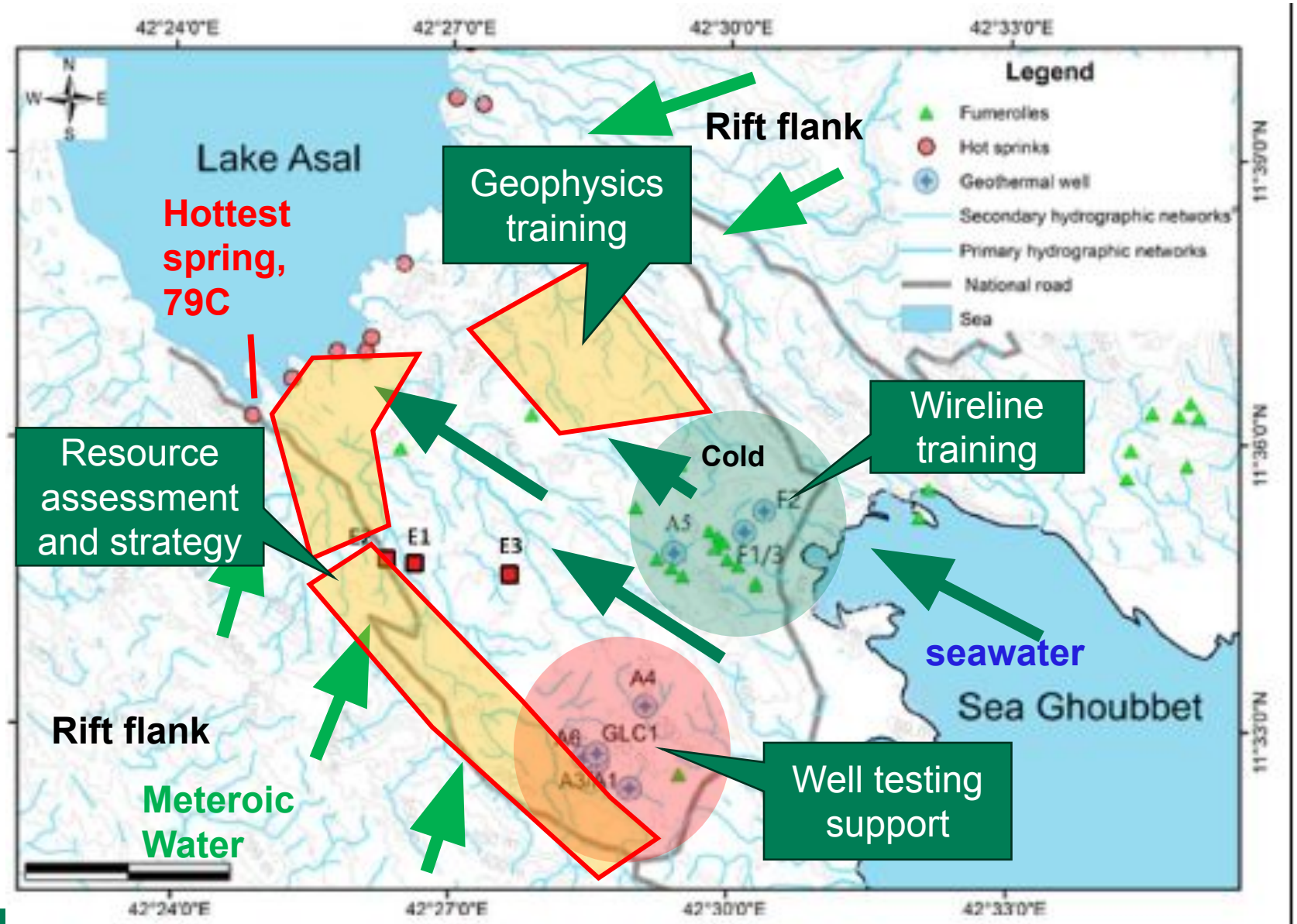
Assal region, Djibouti: capacity building areas through exploration



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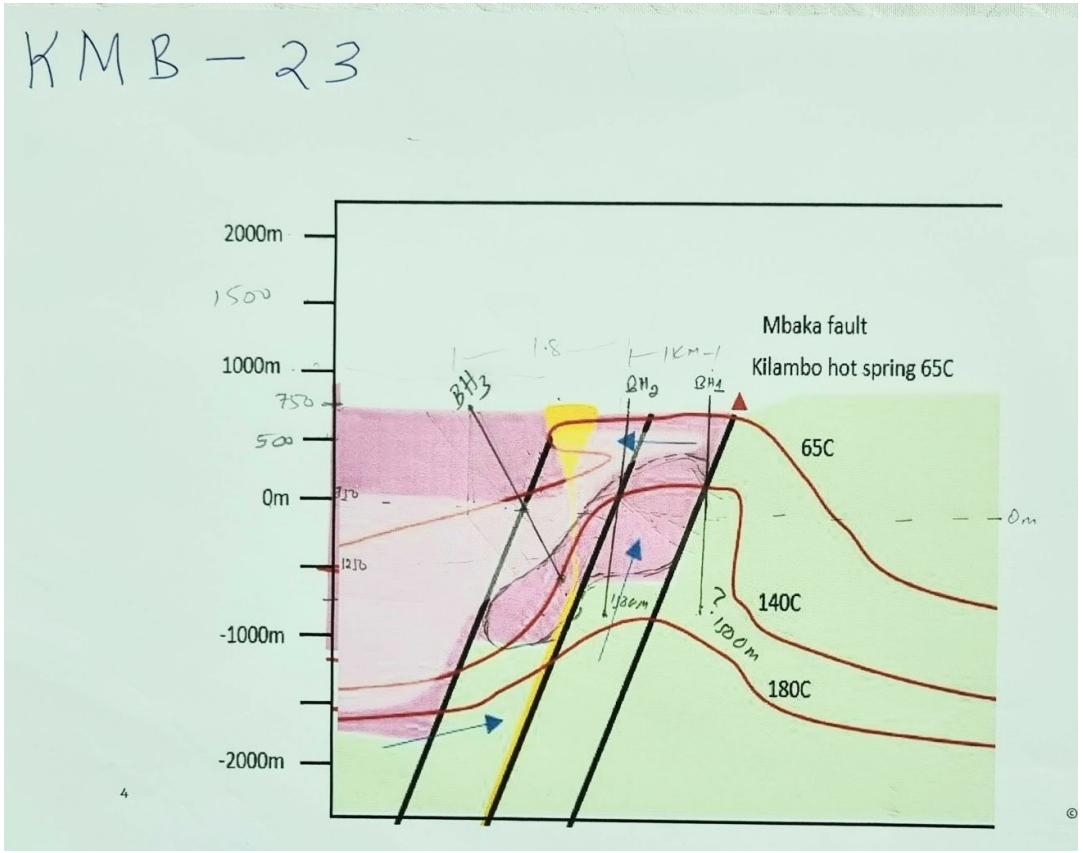
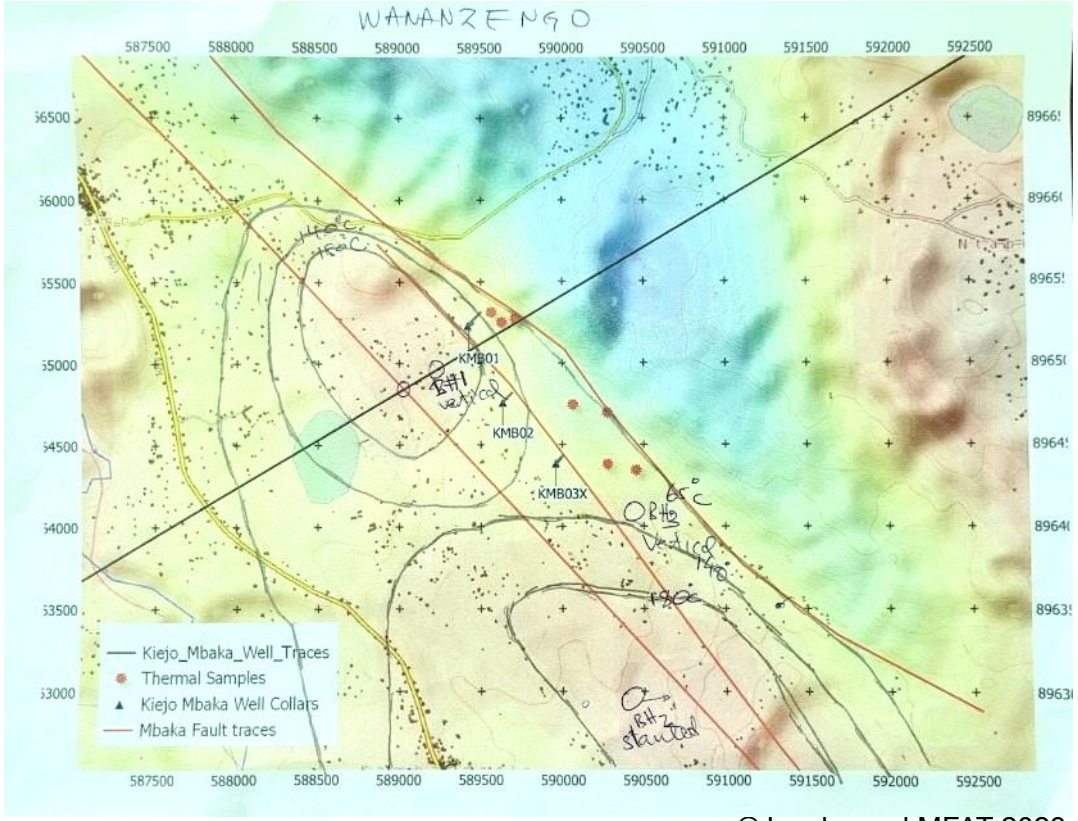
Kiejo-Mbaka prospect, Tanzania conceptual model

- Low temperature prospect <150°C but indications of permeability
- Team building confidence in making their own decisions
- Exploration portfolio approach, high and low enthalpy prospects





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Professional development

- Doing things the “Kiwi way”
- Working safe, tolerance, pragmatism
- Comfort with team to ask questions at any level-**inclusion**, building **trust** amongst the team and how to pay it forward
- Need for team discussion and consensus on data interpretation
- Team focus emboldened by national pride and desire for energy independence

- Weekly lunch seminar series where the resource team discuss latest exploration results or a team member presents an interesting research topic related to geothermal exploration
- Succession planning and mentoring
- Involvement with professional organizations like WING and NZGA, Geothermal Rising, network with other African geothermal developers and attend/present papers at conferences

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It’s about people

Tanzania

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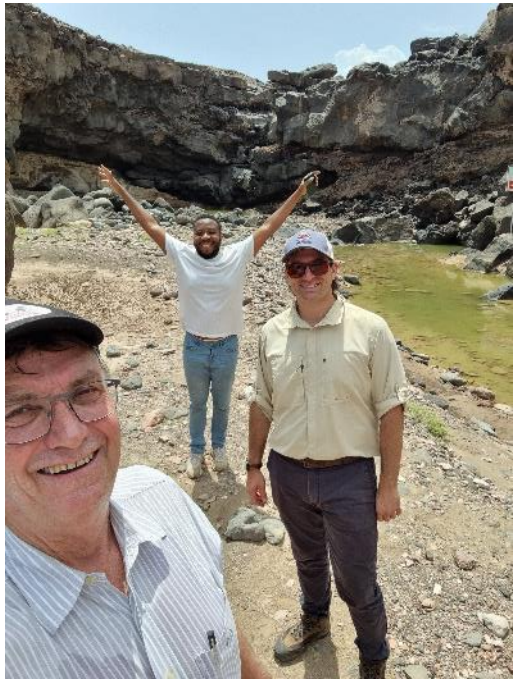
Djibouti



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Ethiopia

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It comes with a responsibility

Rwanda

Fiale - Djibouti

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Thank You

Q & A Session

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Challenging today.
Reinventing tomorrow.