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Geothermal Energy Resource Assessment of the EAR basins in SW Tanzania

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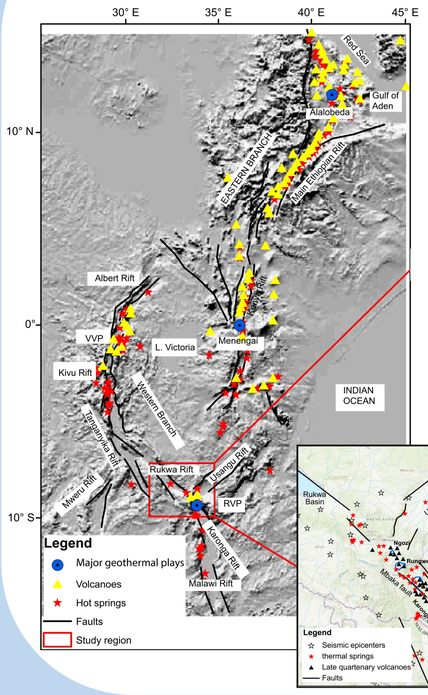
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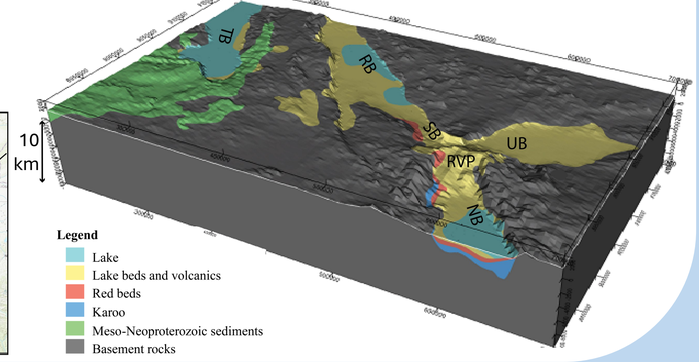
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1. INTRODUCTION

The Rungwe Volcanic Province (RVP) in SW Tanzania, characterized by high heat flows and high reservoir temperatures, is considered an important prospective area for geothermal energy. However, until now only permeable fault zones have been considered as fluid pathways for exploitation. Hot sedimentary aquifers (HSA) could be another interesting geothermal resource.

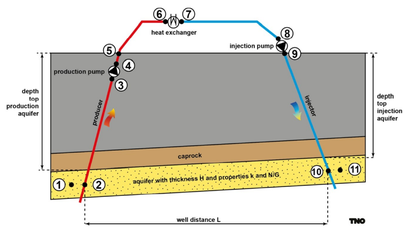
The geothermal resource potential and the costs for direct heat utilization, cooling, and power generation from faults and HSAs have been analysed using a quantitative techno-economic assessment method and new 3D geological and thermal crustal models.





2. METHOD AND DATA

Design of a geothermal doublet system for hot sedimentary aquifers (HSA) and fracture aquifers (Van Wees et al., 2012)



Produced net power P [W]:

$$P = \eta * C_p * \Delta T * Q$$

with η the conversion efficiency [-], which is different for ach type of energy conversion system:

- Direct heat
- Chill
- Electric power (ORC)

Q is the flow rate of a doublet [m3/s]:

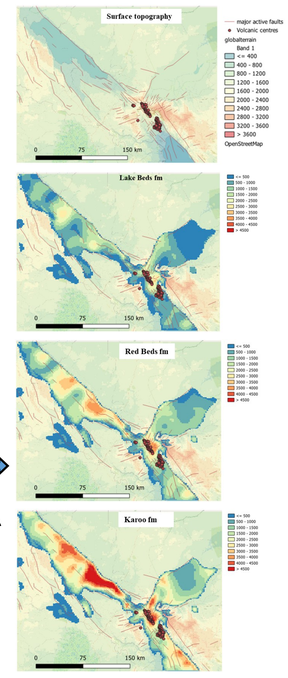
$$Q = \Delta p \frac{2\pi\, k\, H}{\mu\left(\ln\left(\frac{L}{r_w}\right) + S\right)}$$

Geological input parameters for a HSA and permeable fault zones are obtained from seismic and borehole data, stratigraphic depth maps, crustal temperature models,

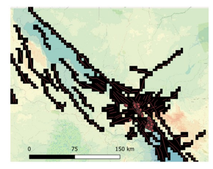
The techno-economic performance of a doublet is maximised in an automated way by:

- Enhancing energy production via optimisation of aquifer depth, aquifer permeability, well distance at aquifer depth, and pump pressure
- Minimising costs by performing a cost-benefit analysis, i.e. calculating the CAPEX and OPEX for the economic lifetime of the doublet system.

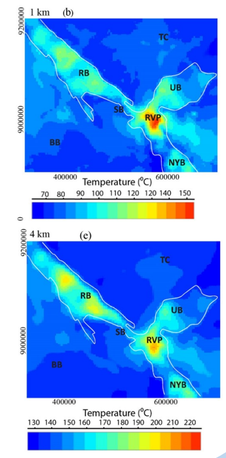
Depth and thickness of aquifers are obtained from a topographic map and depth maps of the base of the Lake Beds, Red Beds and Karoo formations.



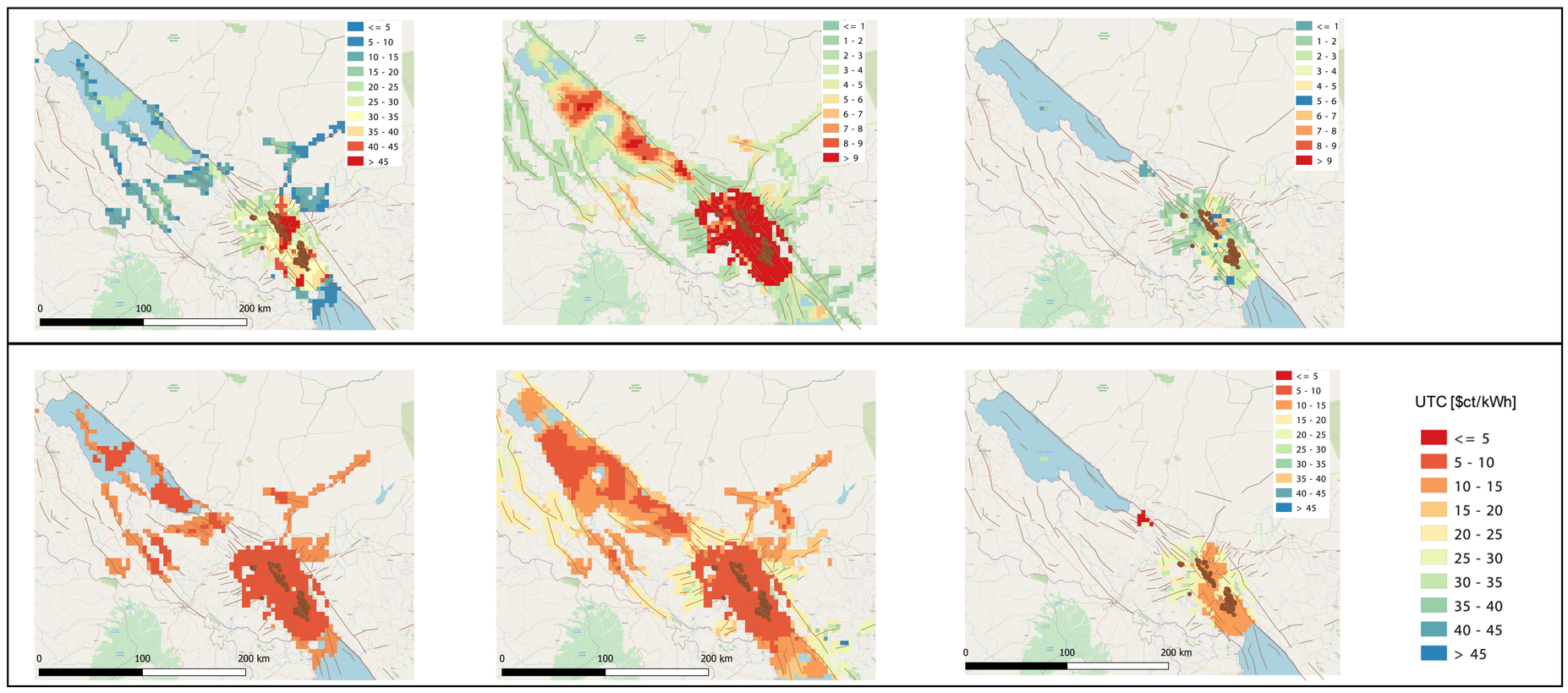
Raster discretisation (5x5km) of permeable fault zones based on the location of active faults.



Aquifer temperatures are derived from 3D upper crustal thermal models.

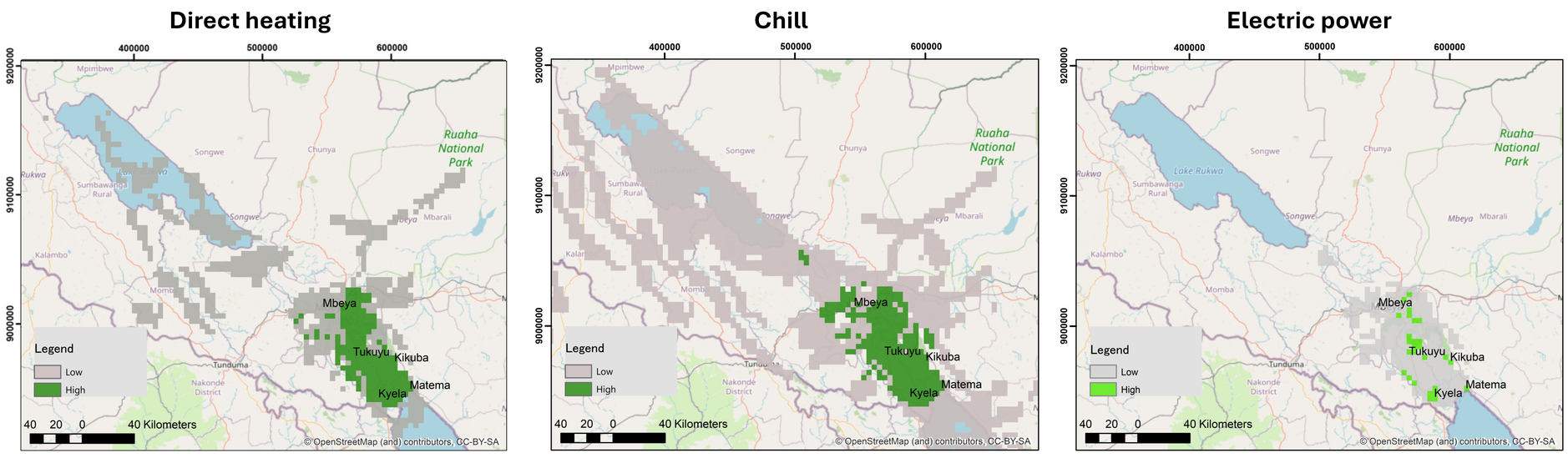


3. KEY PERFORMANCE INDICATORS FOR 3 ENERGY CONVERSION SCENARIOS: DIRECT HEAT, COOLING AND (ORC) ELECTRIC POWER



4. GEOTHERMAL ENERGY POTENTIAL MAPS FOR DIRECT HEAT, COOLING AND POWER APPLICATIONS IN SOUTHWEST TANZANIA

Integration of net power and LCOE to identify areas with the greatest potential for economic exploitation of geothermal energy.



5. DISCUSSION AND CONCLUSIONS

- The findings indicate significant direct heating capacities of up to 45 MW. For cooling, the Runge Volcanic Province (RVP) offers more than 9 MW. The electricity generation potential is modest, with most basins under 2 MW, except for the RVP which can reach up to 8 MW.
- The estimated levelized cost of energy (LCOE) for direct heating and cooling are notably lower, especially in the RVP, with costs mostly under 5 $ct/kWh. The LCOE for electricity generation is significantly higher everywhere, except for the Songwe Basin.
- The findings indicate that direct heating and cooling applications offer the largest geothermal potential in SW Tanzania. Direct heating and cooling are not only cost-effective but also require less infrastructure and can be used locally, providing immediate benefits to communities near the geothermal sources. Electric power generation is only the best option in the RVP.
- The results underline the significance of incorporating net power, LCOE and demand for geothermal energy in geothermal energy resource assessment.

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This research was financed by NUFFIC (NICHE TZA 26) under Dutch Energy Capacity Building (TDECB) project and by the EU Horizon 2020 LEAP-RE project (Grant 963530). The presented findings are part of the Ph.D. doctoral thesis of Dr. EG. Mtabazi. We would like to extend our sincere thanks to Dr. John Limberger and Dr. Eszter Békési for their help with the GeoModeller software.

REFERENCES

Limberger, J., Boxem, T., Pluymaekers, M., Bruhn, D., Manzella, A., Calcagno, P., Beekman, F., Cloetingh, S., Van Wees, J.D.: Geothermal Energy in Deep Aquifers: A Global Assessment of the Resource Base for Direct Heat Utilization, *Renewable and Sustainable Energy Reviews*, ***82***, (2018), 961–975, doi:10.1016/J.RSER.2017.09.084.

Mtabazi, E.G.: Lithosphere structure and thermal characterization of southwest Tanzania: Implications for geothermal resource exploration, *Utrecht University doctoral thesis*, (2025), pp. 139.

Mtabazi, E.G., Beekman, F., De Bresser, J.H.P., Van Wees, J.D.A.M., Boniface, N.: Integrated 3D geological model of the East African Rift basins and upper crust in SW Tanzania—Implications for geothermal resources. *Global and Planetary Change, **257**,* (2026), 105250.

Van Wees, J.-D., Hofstra, J., Veldkamp, H., Van Unen, M., Beekman, F., Mos, J. : *Geothermal* Atlas for Africa: From Resource Mapping to Performance Indicators, *LEAP-RE WP9 Geothermal Atlas for Africa, report D9.4*, (2024), pp. 30.

Van Wees, J.-D., Kronimus, A., Van Putten, M., Pluymaekers, M.P.D., Mijnlieff, H., Van Hooff, P., Obdam, A., Kramers, L.: Geothermal aquifer performance assessment for direct heat production—Methodology and application to Rotliegend aquifers, *Netherlands Journal of Geosciences*, **91(4)**, (2012), 651-665.