Deep fresh groundwater resources in the Cubango Megafan, North Namibia

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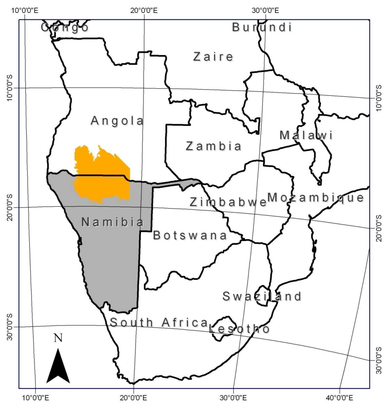
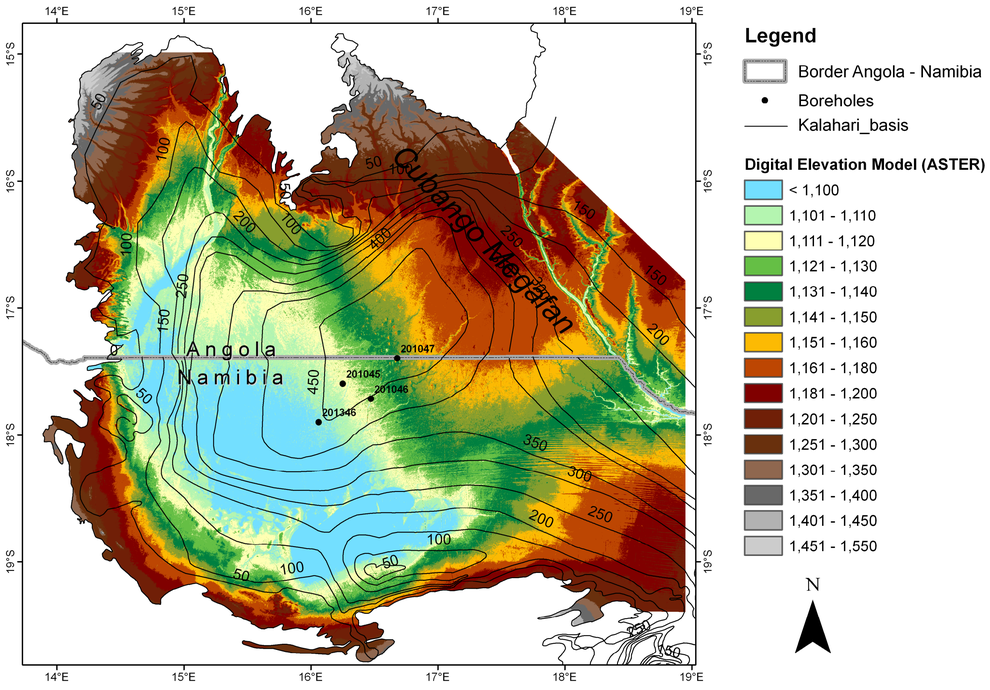


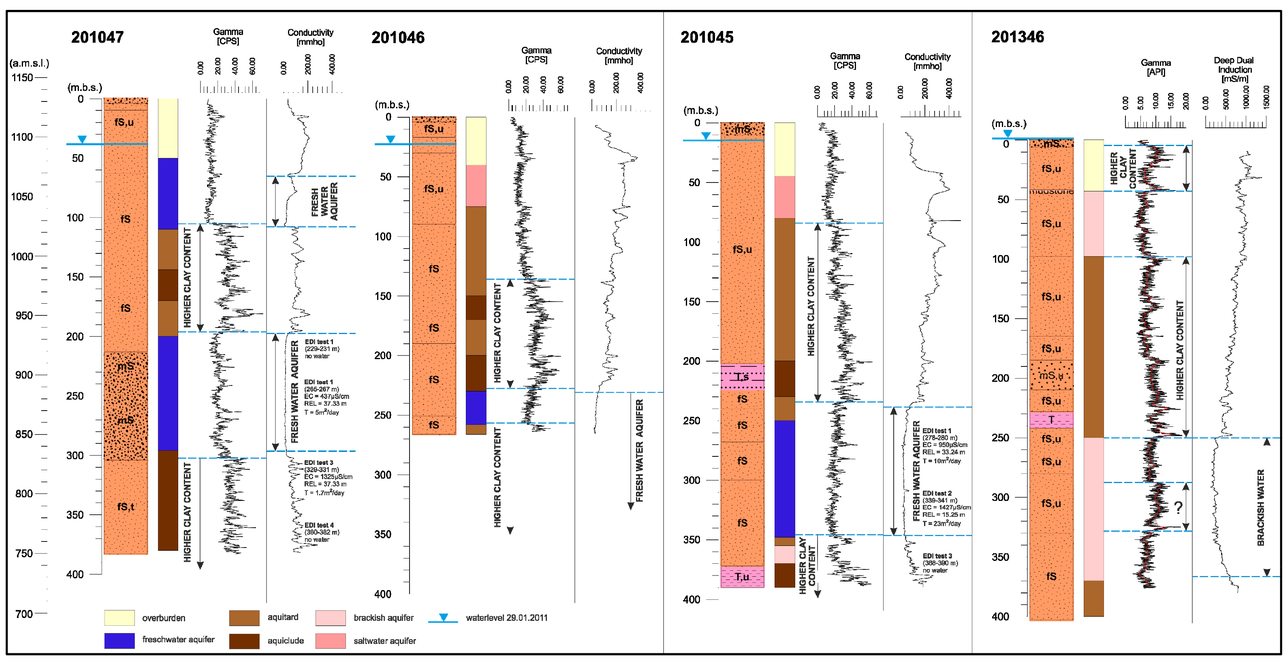
Location: Distribution of Kalahari Sediments in Angola and Namibia within the Cuvelai-Etosha Basin.

1) Introduction

Namibia and Angola share the large endoheric Cuvelai-Etosha Basin (CEB). Its fresh groundwater resources are found in the Cenozoic Kalahari Sediments. To answer upcoming pressure from rising water need, deep seated aquifers in the so called Cubango Megafan are currently explored and prepared for sustainable exploitation.



Cubango Megafan in the CEB and position of exploratory drill sites. The CEB is cut by Cunene River in the west and bordered by Okavango tributary in the east. Topolines show depth of Kalahari Sediments.



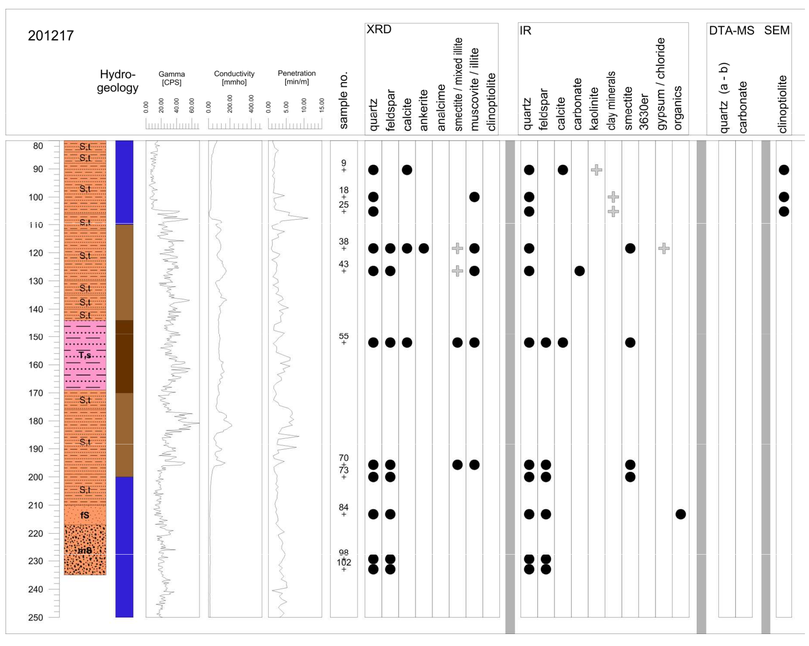
East-west profile of exploratory drill sites, upper aquifer gets brackish before lower aquifer does.

2) Approach

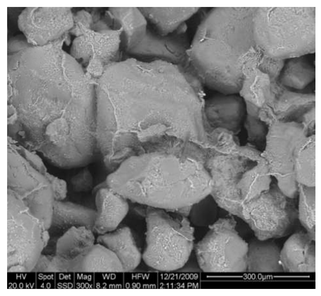
A geophysical exploration survey that covered large parts of the Namibian CEB used the Transient Electromagnetic Method (TEM). Exploratory drilling includes the first core drills made on the Cubango Megafan. A unique set of samples is currently investigated on paleontological and mineralogical content (light and heavy minerals). Three-dimensional subsurface models help to identify hydrogeological structures that will be used for numerical reservoir balancing.

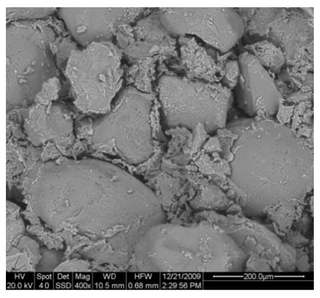
3) Results

- TEM Campaign resulted in a three dimensional distribution of salt and freshwater below brackish aquifers. The border towards the brackish basin is approximately parallel paleo shorelines of the Paleolake Etosha
- Sedimentological investigation revealed sand with clay contents of 10-20 wt%. Authigenic smectites and smectite gels clog pores and function as aquitards. Abundance of authigenic zeolites.
- Only geophysical borehole logs (gamma and conductivity) can identify aquitards and aquifers.
- Paleontology shows freshwater sponge spicules and diatom valves for lake condition and phytoliths for delta condition.
- Hydraulic tests give low to very low hydraulic conductivities for aquitards (hc: 10^{-8} to 10^{-13} m/s) and a good yield for deep aquifers (hc: 10^{-5} m/s).

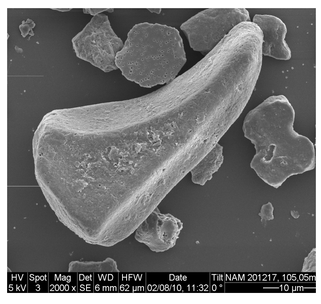


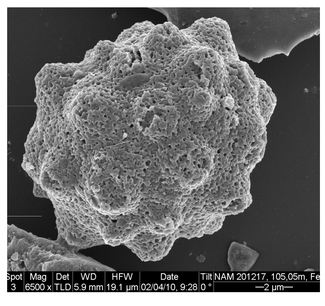
Smectite content and gamma log show distinct difference between aquifer and aquitard, but lithological log and grain size distribution don't.



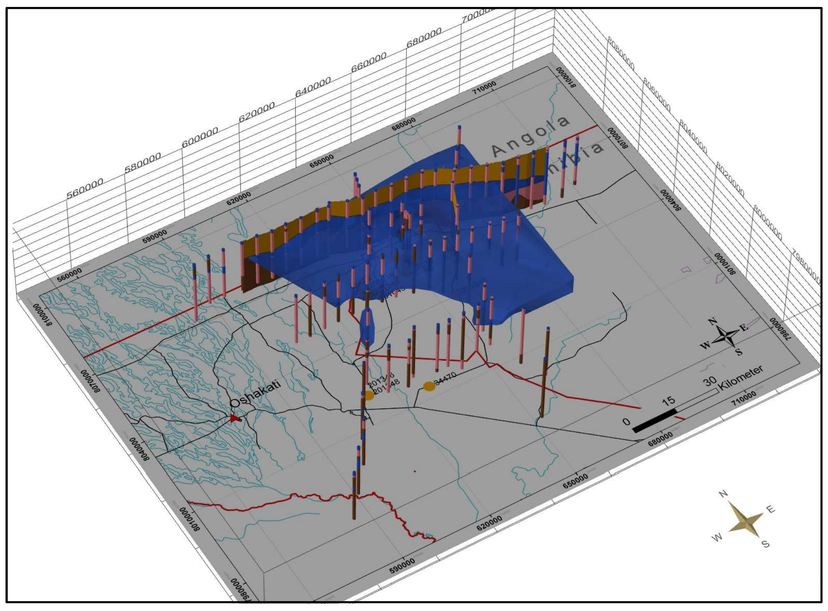


REM pictures:
top: dried smectite gel
bottom: smectite in pores





Grass and tree phytoliths



Model derived from TEM soundings shows freshwater – body. The southwest border directed to Paleolake Etosha is a salt-freshwater border.

4) Conclusion

The combination of geophysical, sedimentological and paleontological approaches coupled with hydrogeological structure modeling give insight to the fascinating setting of the endoheric CEB!

Refer to: Dill, Kaufhold, Dohrmann, Lindenmaier, Ludwig, Botz: submitted to Geologische Rundschau.

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