Gliederung

- **Tracerhydrologie und Hydrochemie**
  - Grundlagen, Ansätze
  - Verfügbare Tracer
- **Künstliche Tracer und Markierverfahren**
  - Grundlagen
  - Tracergruppen / Eigenschaften
- **Natürliche Tracer**
  - Umweltisotope
  - Geogene Tracer
- **Versuchsplanung und –durchführung**
  - Einspeisemengenberechnung
  - Rahmenbedingungen
  - Auswertung / Interpretation

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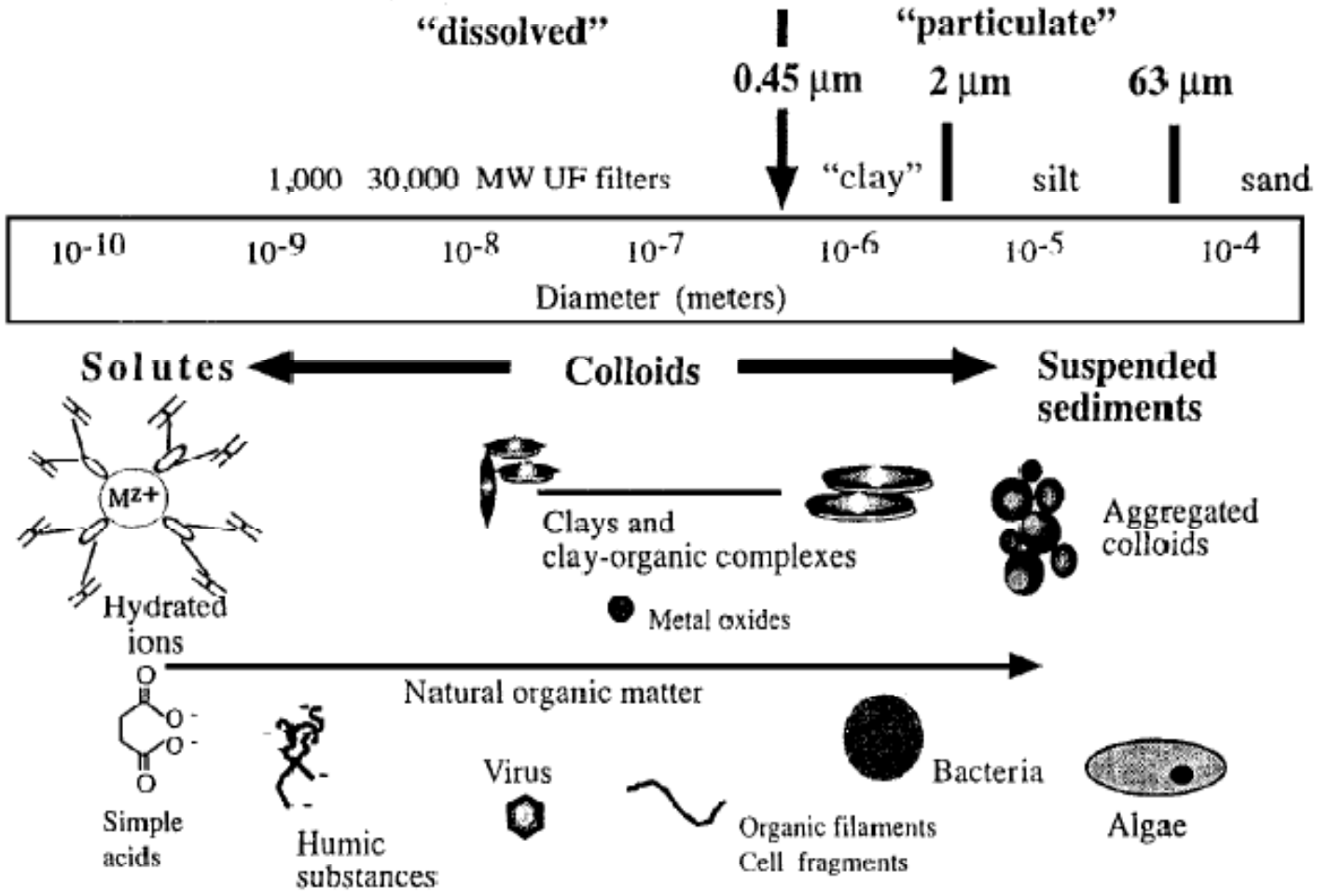
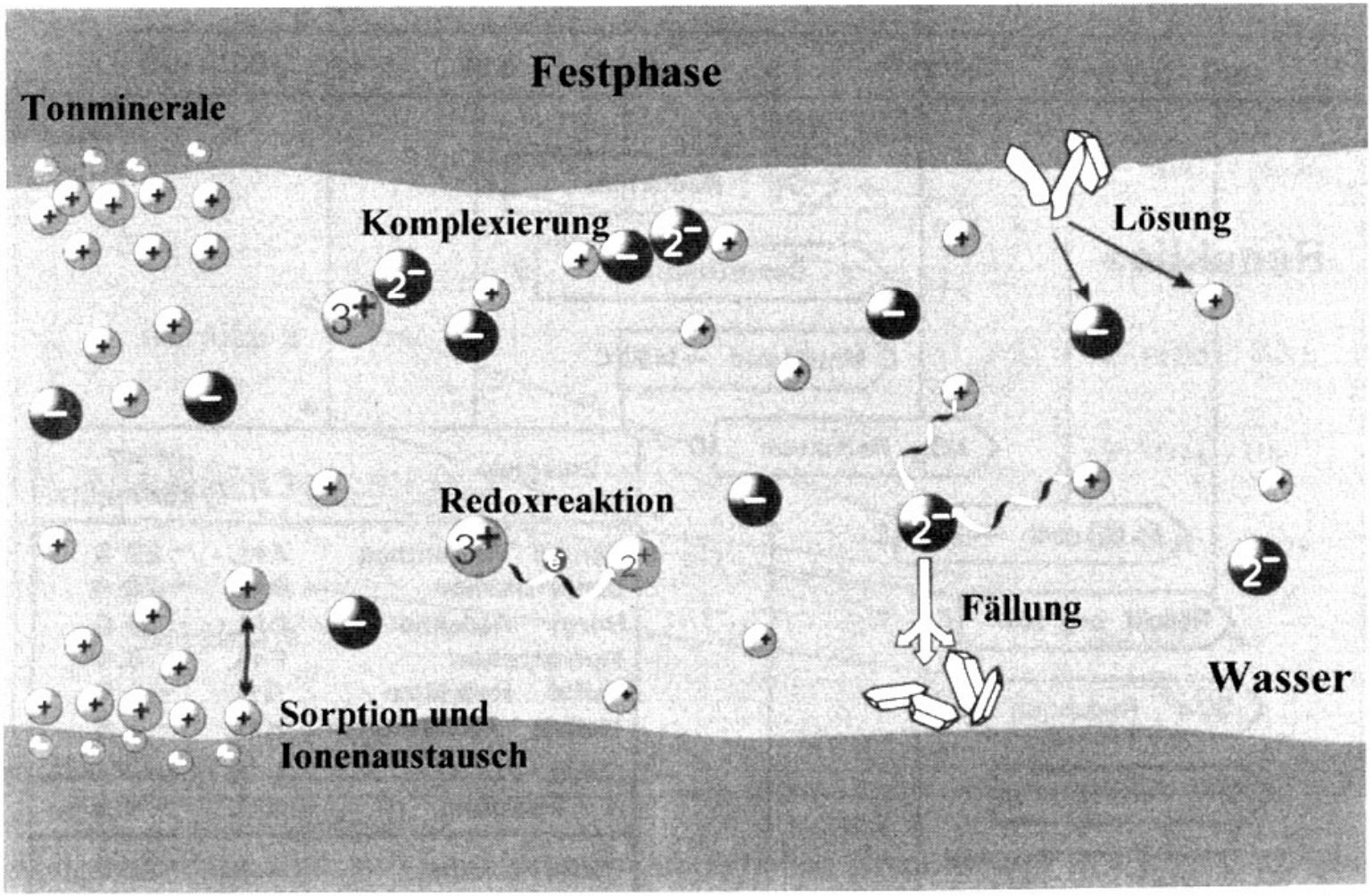
Literatur

- Appelo C.A.J. & Postma D. (1996) Geochemistry, groundwater and pollution. Balkema, 536 p.
- Hem J.D. (1992) Study and Interpretation of the Chemical Characteristics of Natural Water. USGS Water Supply Paper 2254, 263 p.
- Leibundgut, C., Maloszewski P. & Külls C. (2009): Tracerhydrology. Wiley & Sons, 432 p.
- Merkel B.J. & Planer-Friedrich B. (2002): Grundwasserchemie. Springer. 219 p.
- Stumm & Morgan (1996) Aquatic Chemistry. Wiley-Interscience, 1040 p.

Wasserinhaltsstoffe



… und deren Reaktionen



aus Merkel B.J. & Planer-Friedrich B. (2002): Grundwasserchemie. Springer. 219 p.

Natürliche Konzentrationen

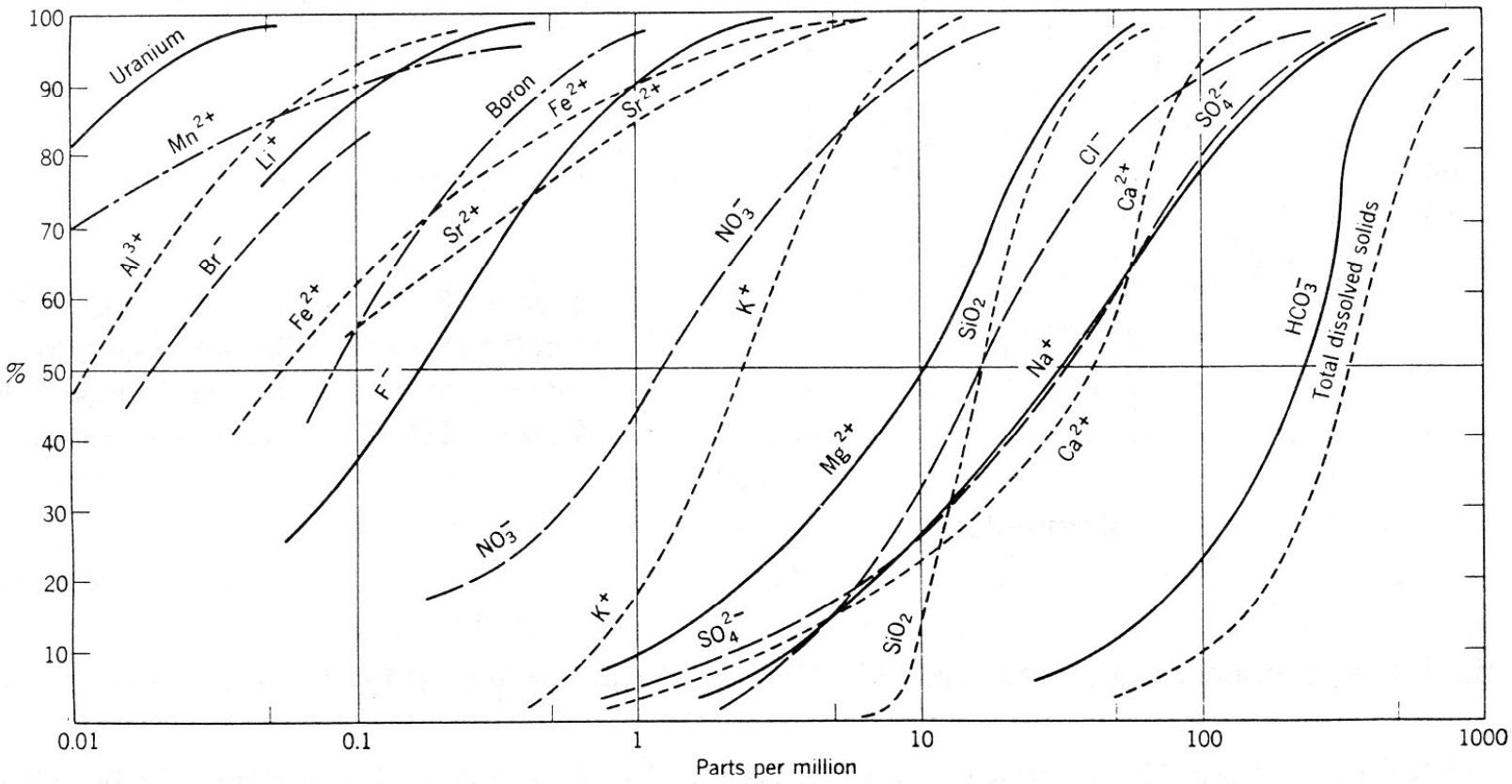


Figure 2.9. Concentrations of different solutions in terrestrial waters in the USA displayed in a frequency plot (Davies and De Wiest, 1966). Reprinted by permission of John Wiley & Sons, Inc.

Einfluss der Geologie

Constituents in mg/L	Precipitation	GW in unconsolidated deposits	GW in Igneous Rocks	GW in Sedimentary Rocks	GW in Carbonates	Seawater	Drinking water standards
Na^+	0.6	47	4	20	13	10560	200
K^+	0.4	3	1	2	3	380	---
Ca^{2+}	0.9	54	8	53	55	400	200
Mg^{2+}	0.2	15	2	19	28	1272	125
HCO_3^-	2.0	157	40	263	255	142	500
SO_4^{2-}	3.0	64	1	47	48	2560	250
Cl^-	0.4	21	1	12	14	18980	250
NO_3^-	0.3	0.6	n/a	2.7	n/a	<1	20
SiO_2	0.1	22	19	15	n/a	1 - 4	---
TDS	5.1	230	76	380	416	34378	500
pH	5.5	7.5	6.8	7.5	7.5	8.1-8.4	---

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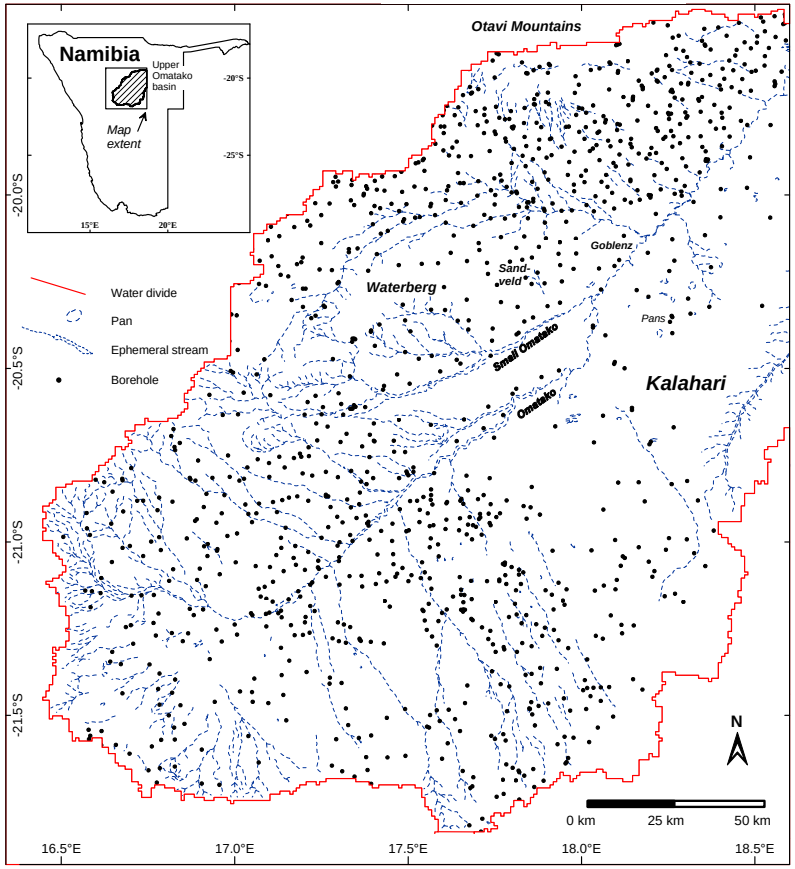
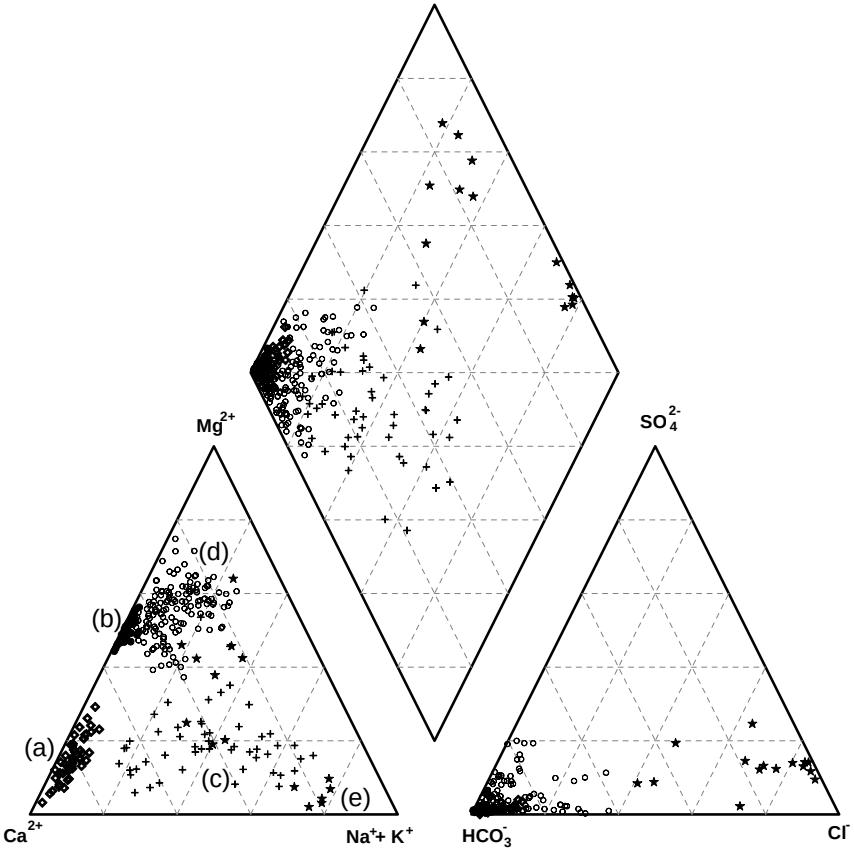
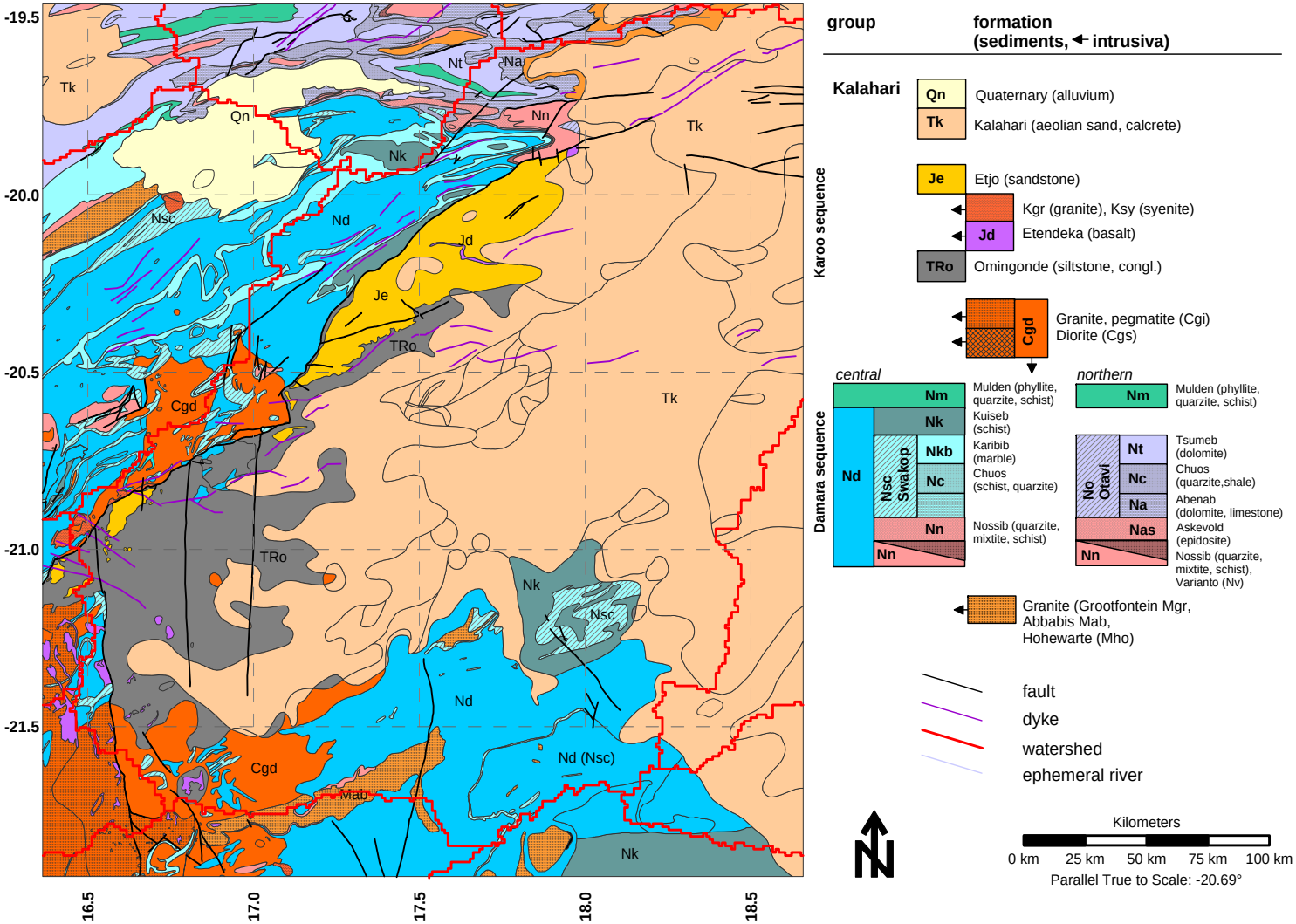
Hydrochemie kann Herkunft zeigen

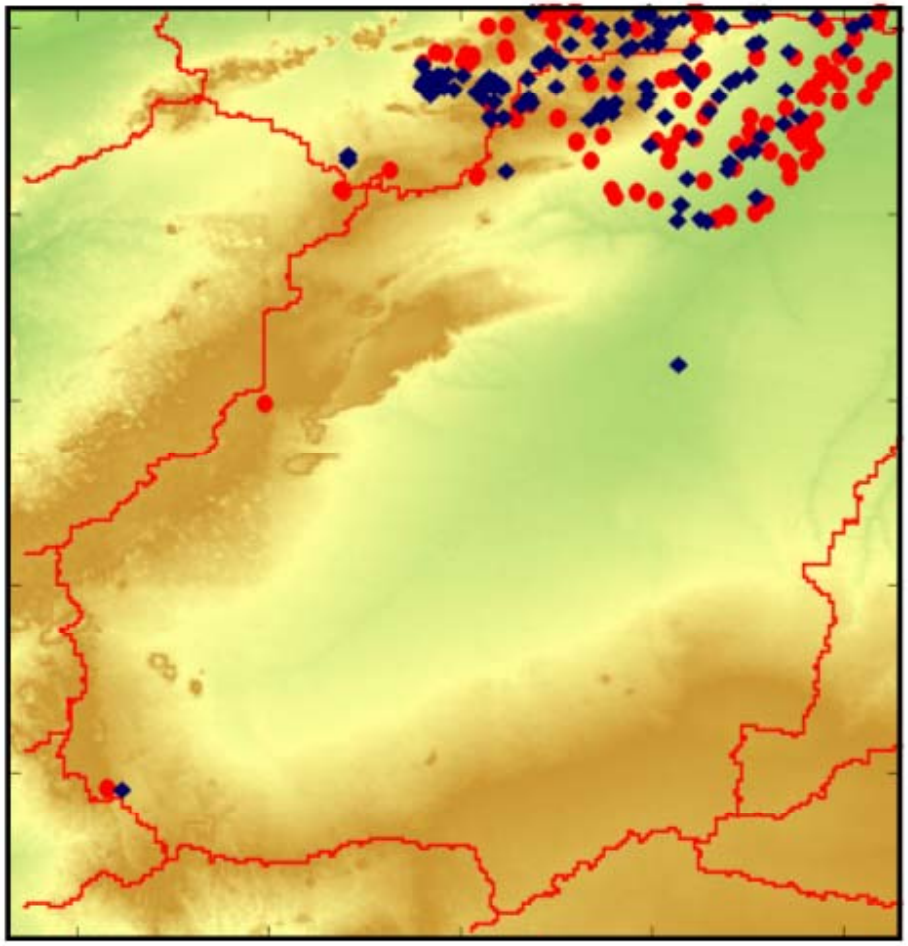




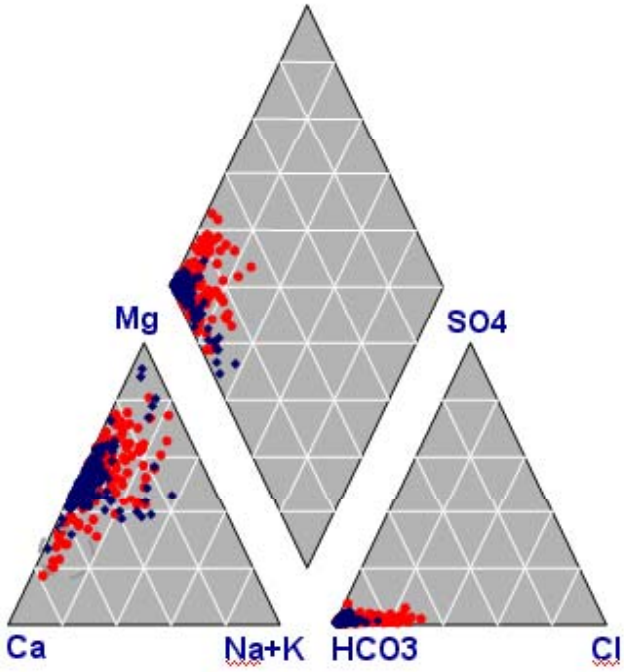
Lithographie



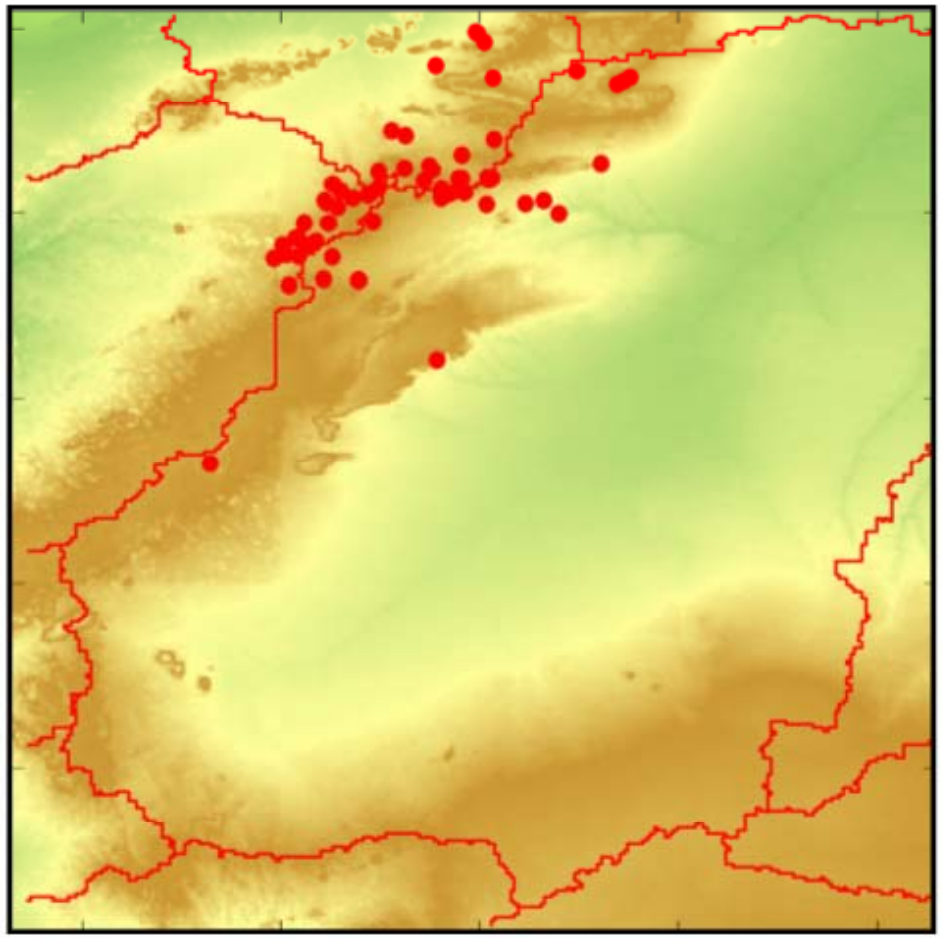
Namibia: Karst (Otavi-Dolomit)



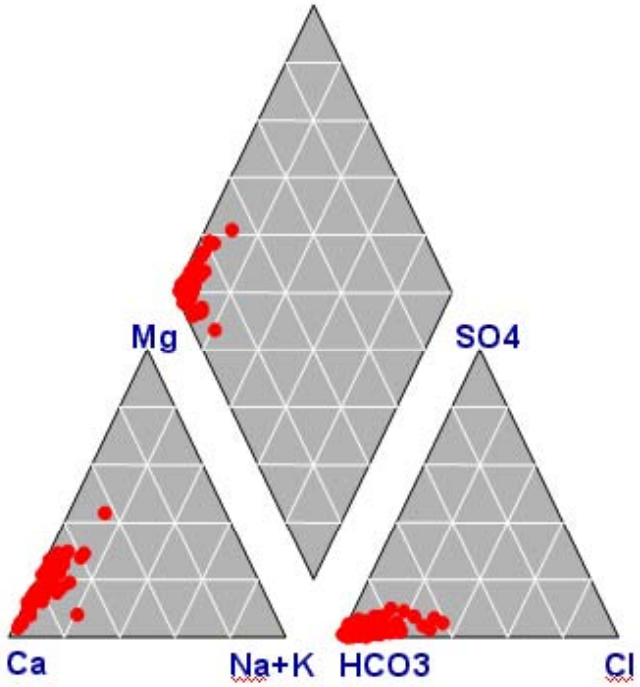
The dolomite groups



Namibia: Kalkstein (Otavi)



The carbonate/ marble groups



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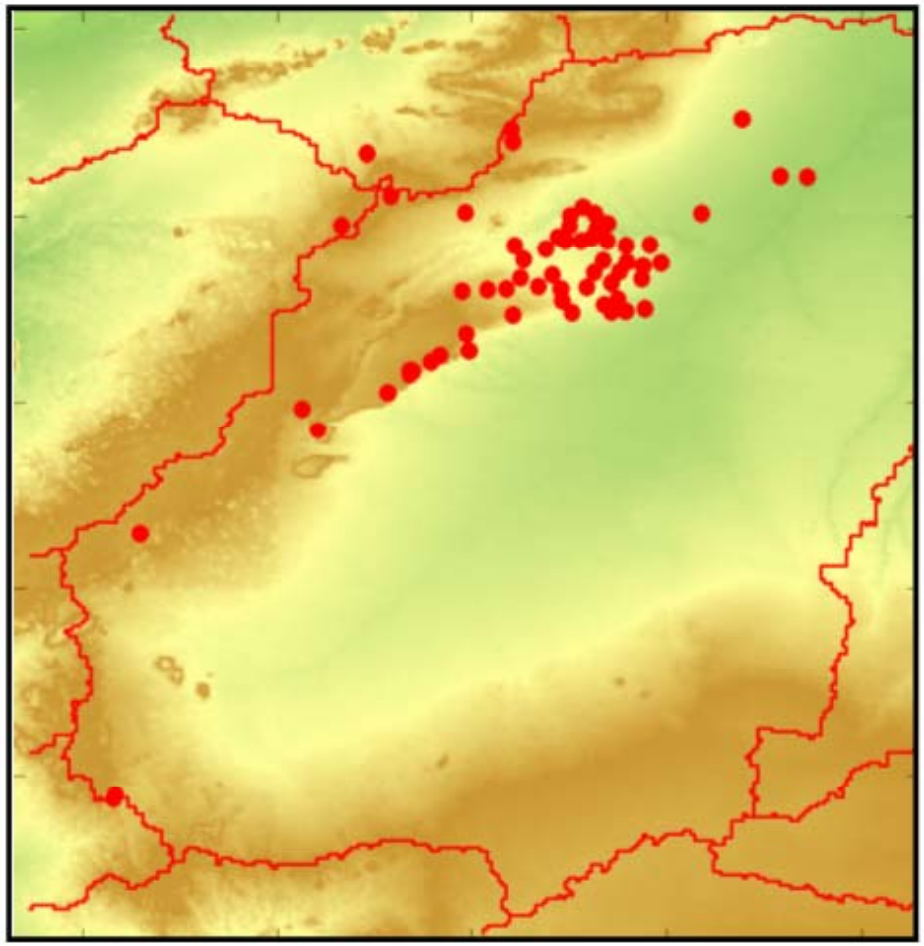
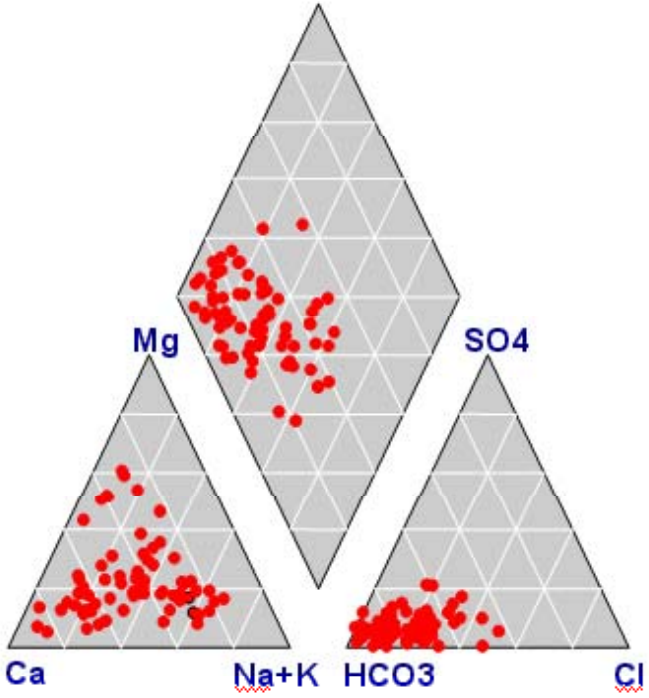
Kristallin



The Waterberg sandstone groups



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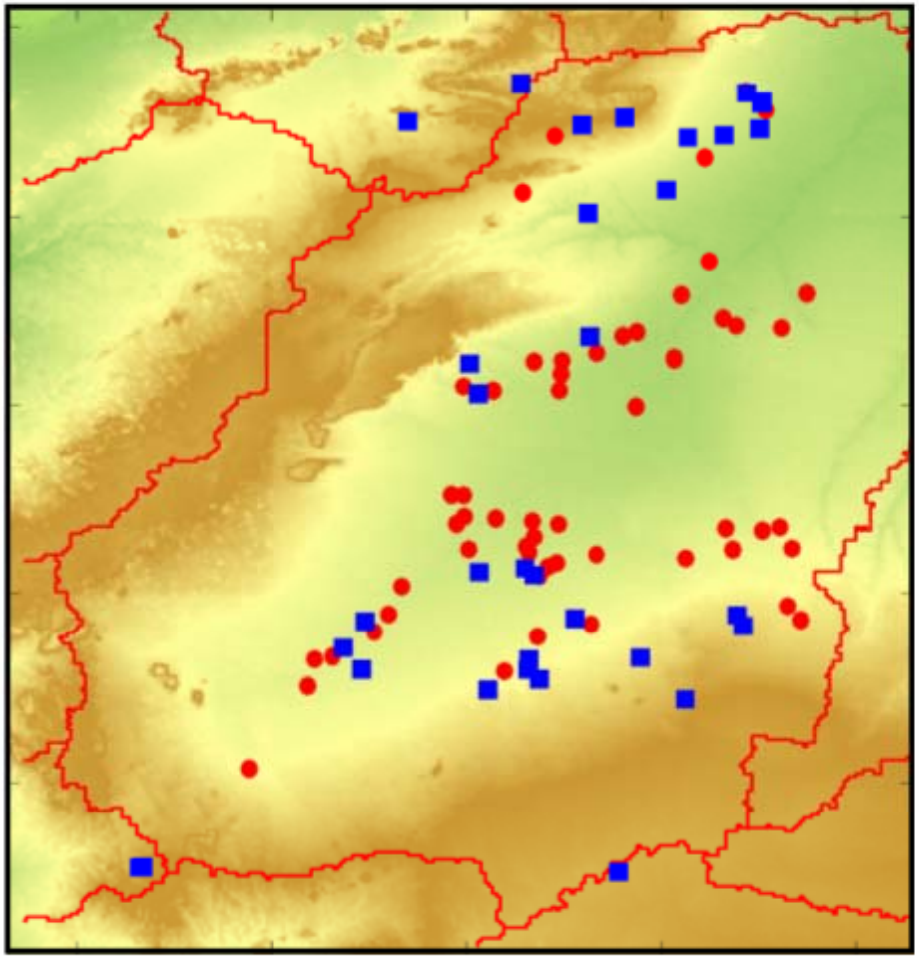
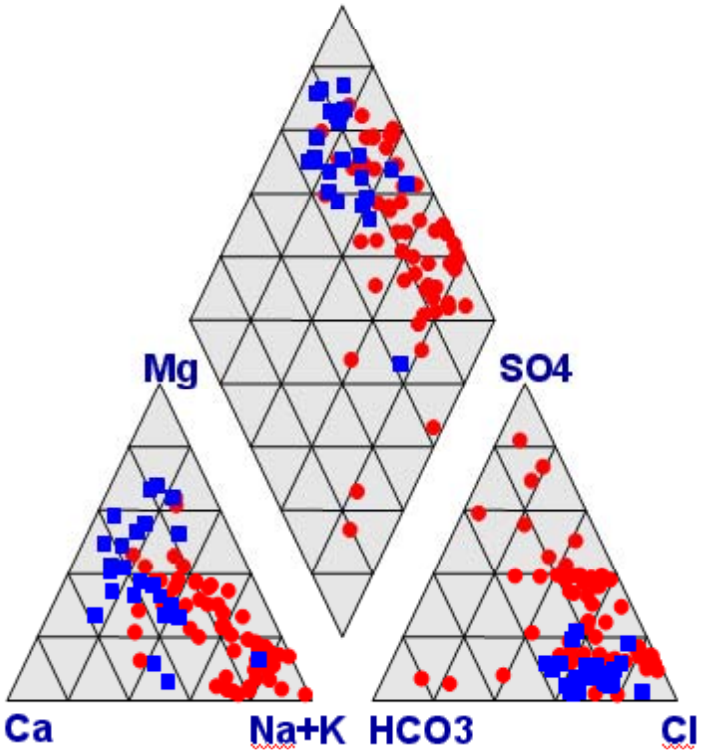
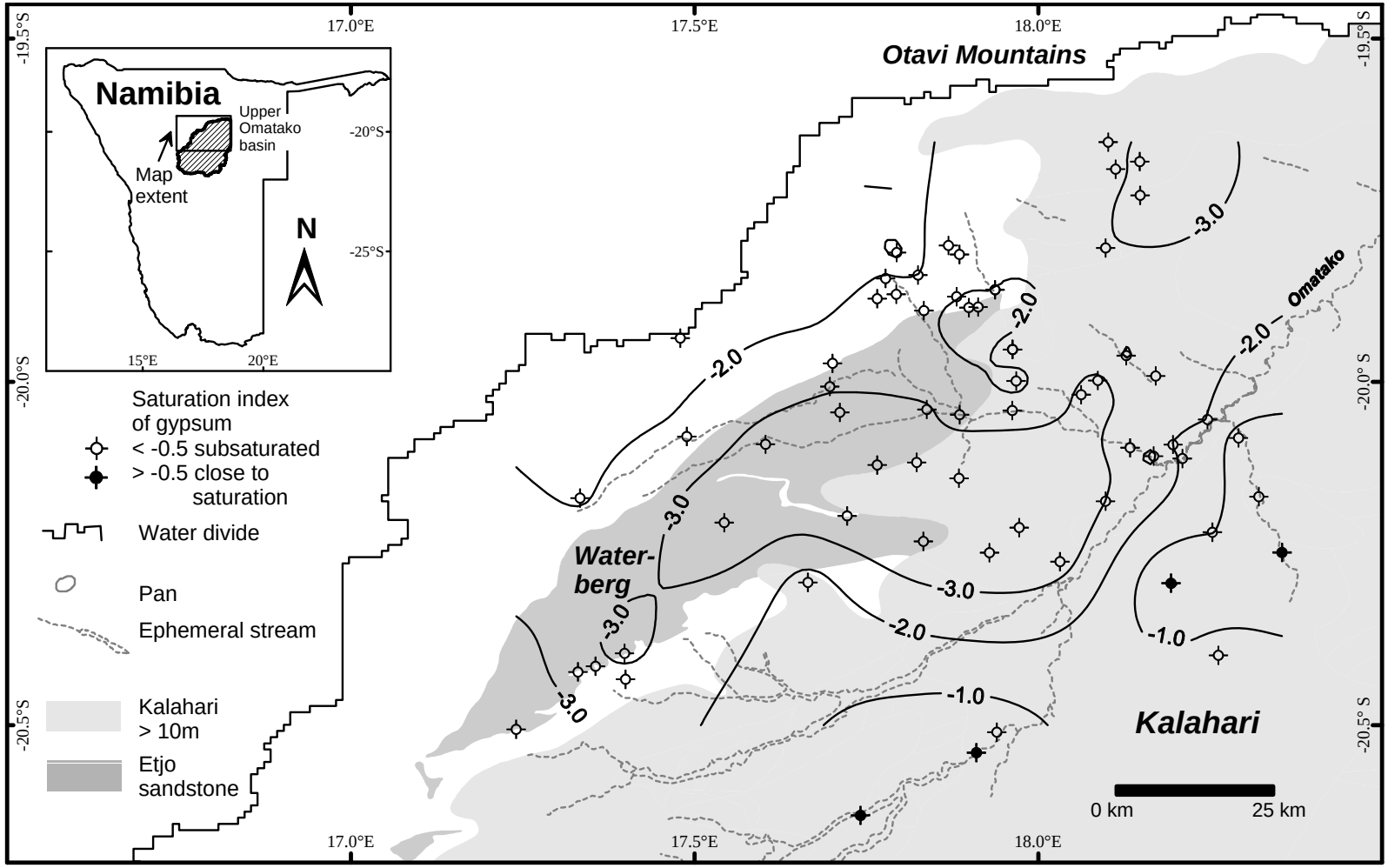
Salziges Grundwasser





Ursache Lösung-Fällung-Thermodynamik



Quantitative Auswertung