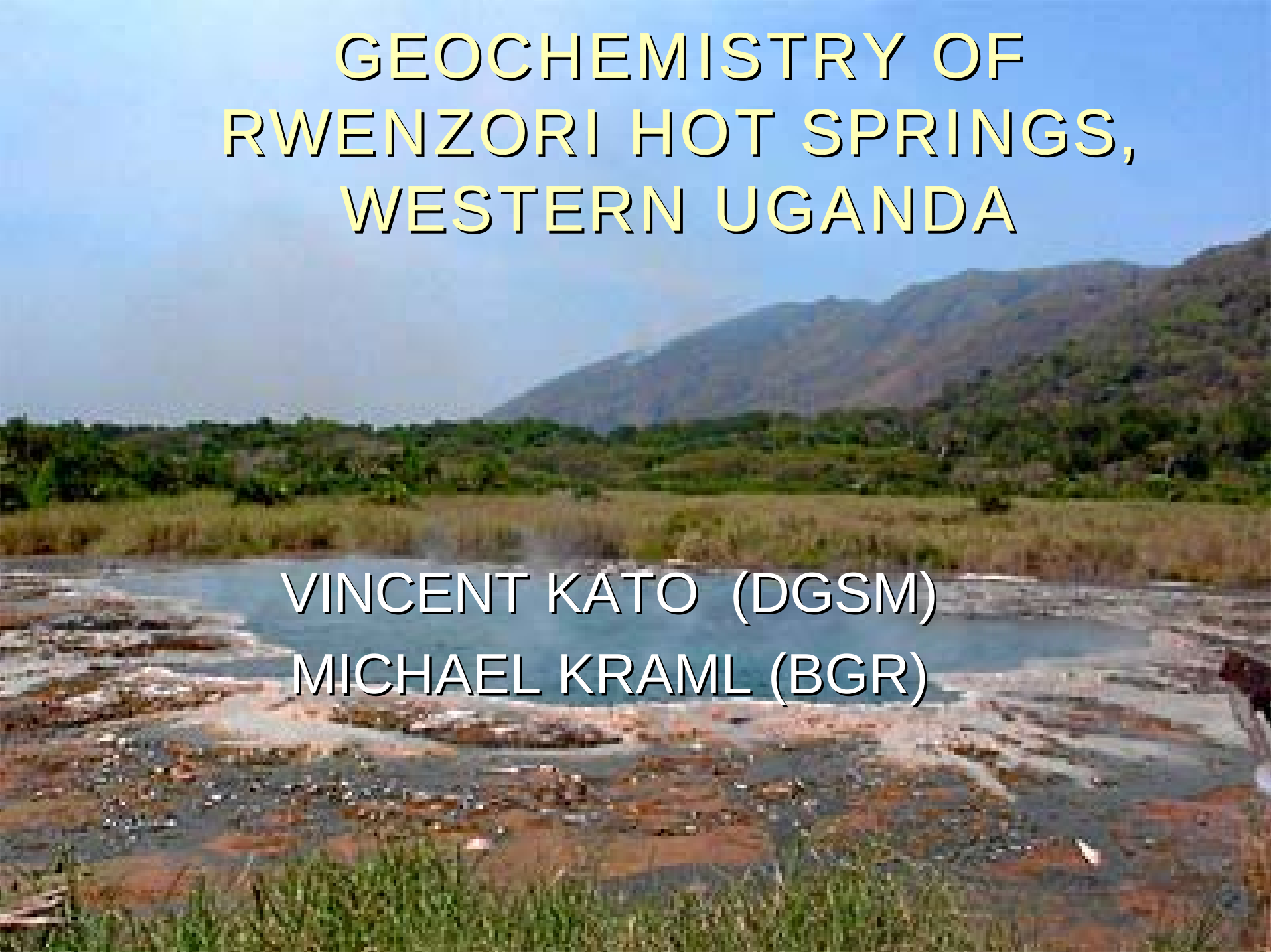
GEOCHEMISTRY OF RWENZORI HOT SPRINGS, WESTERN UGANDA



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GEOTHERM PROGRAMME

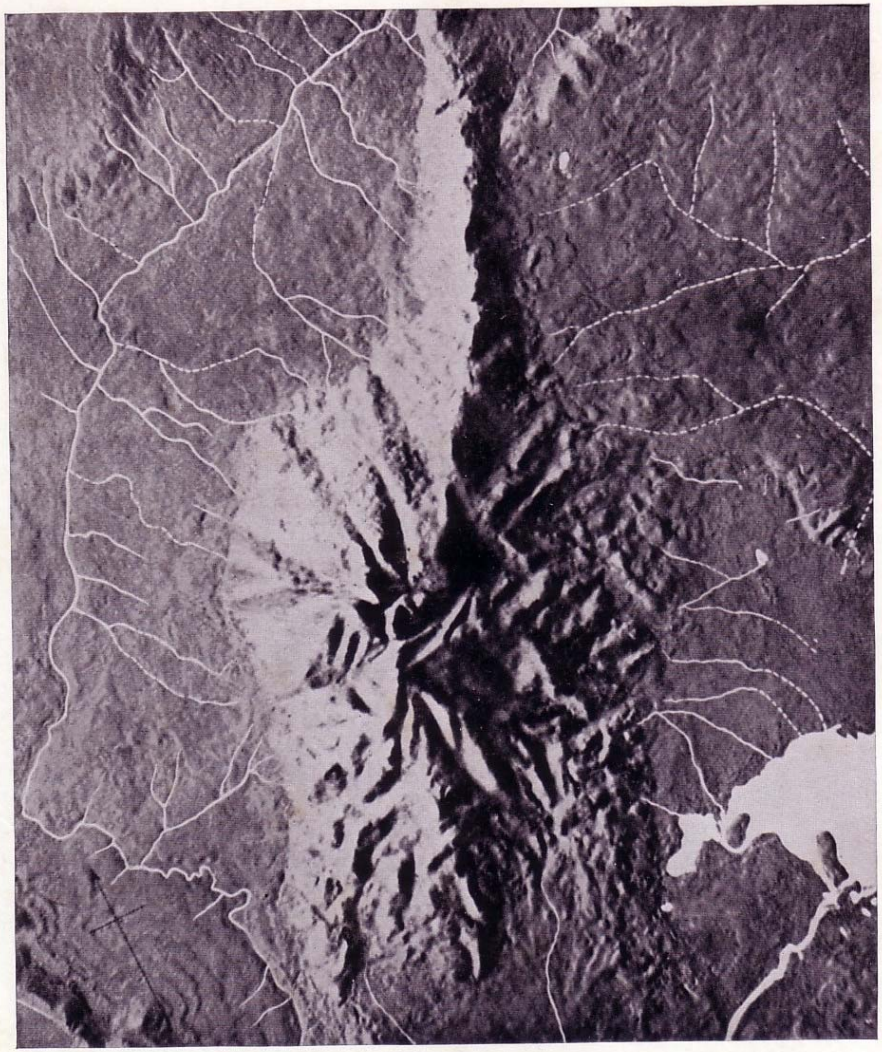
- Germany, Ministry for Economic Co-operation and Development - BGR
- Uganda, Ministry of Energy and Mineral Development - DGSM
- Detailed surface exploration of Buranga

Methods applied

- Ground geophysics (gravity, geo-electrics [Schlumberger, dipol/dipol, SP], TEM, micro-seismicity)
- Geochemistry (fluids, gases and sinters)
- Geology (Remote sensing & ground truthing of identified structures)

Mount Rwenzori (topography)

- Length of 115 km
- Width of central part 48 – 64 km
- Highest peak >5000 m



Model of Ruwenzori. After British surveys.

Mount Rwenzori

- Ice cap (glaciers)
- High elevated lakes
- Melt water streams

Geological overview

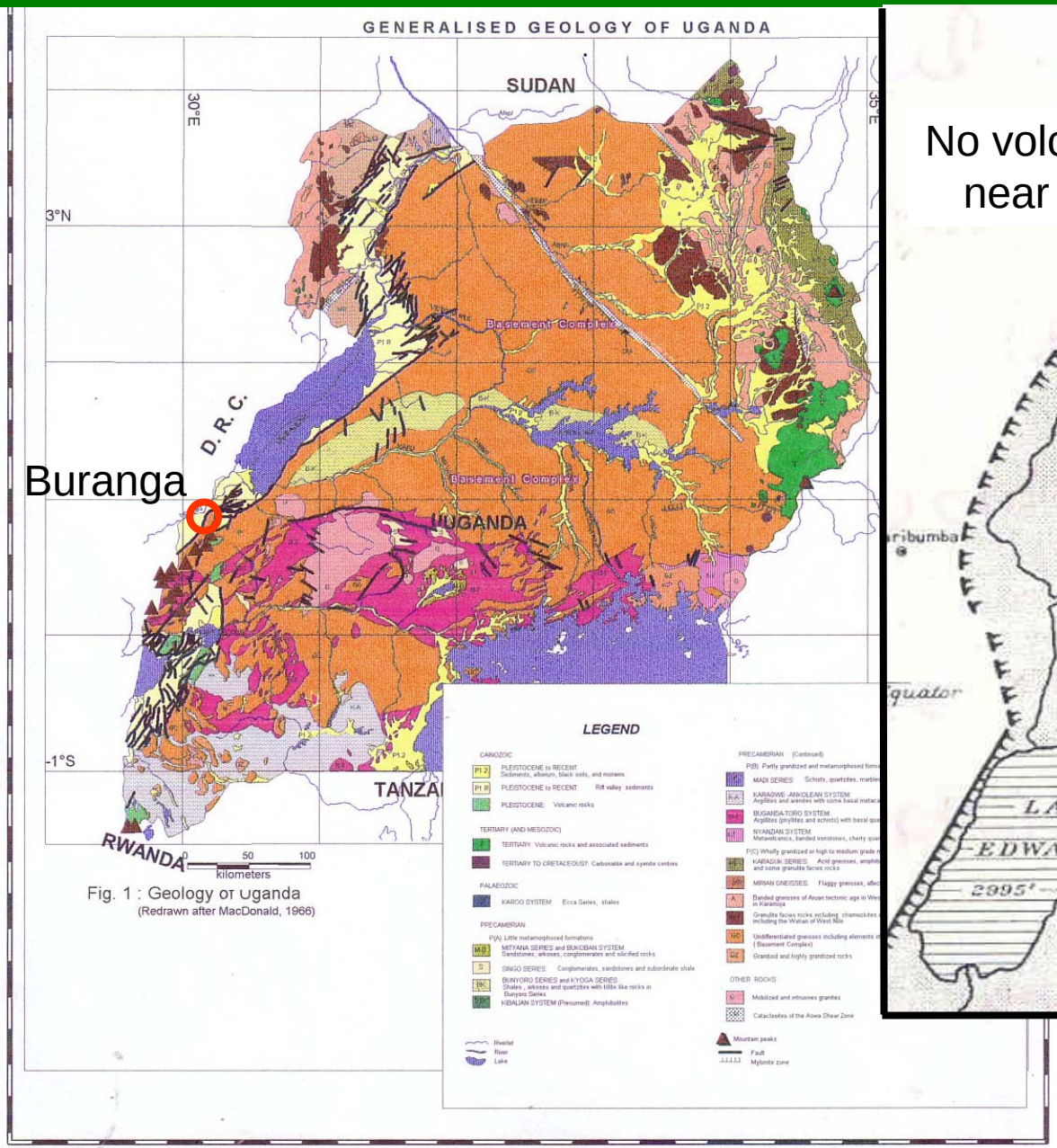
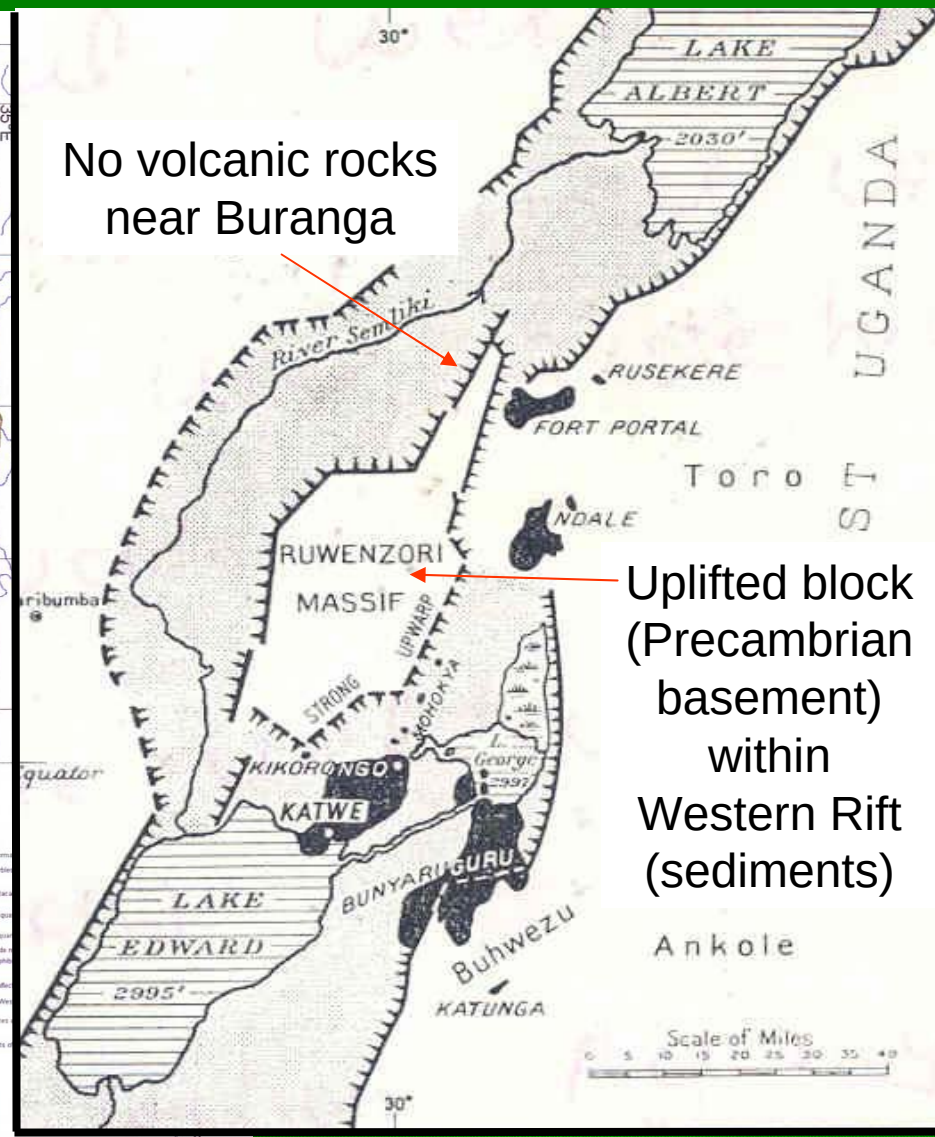


Fig. 1 : Geology of Uganda
(Redrawn after MacDonald, 1966)



No volcanic rocks near Buranga

Buranga

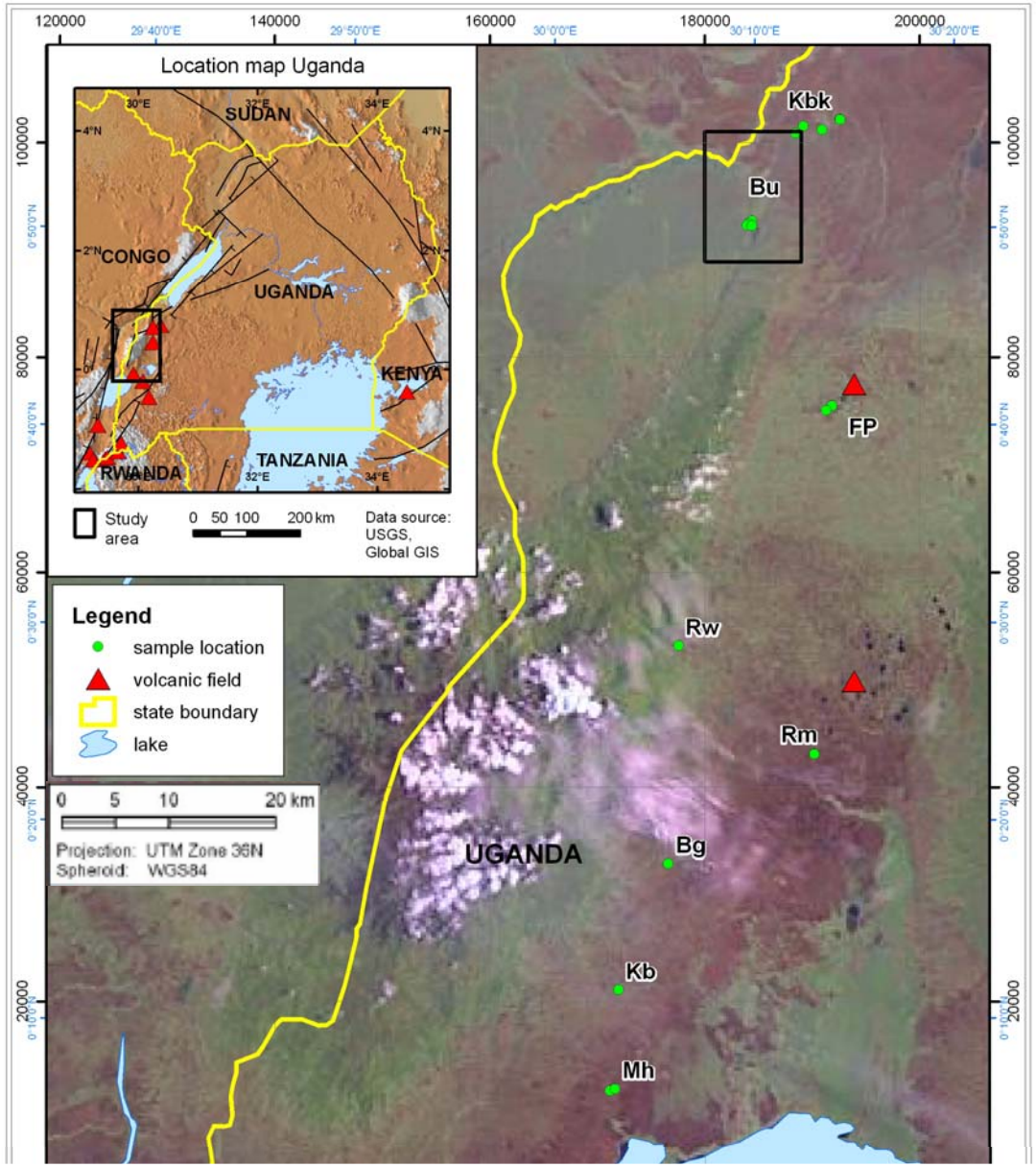
Uplifted block (Precambrian basement) within Western Rift (sediments)

Surface manifestations

- Hot springs > 50°C
- Warm springs 26-50°C
- Travertine deposits
- Gaseous emissions / bubbling pools
- Hot pools, spouting springs
- Seepages into rivers
- Geothermal grass

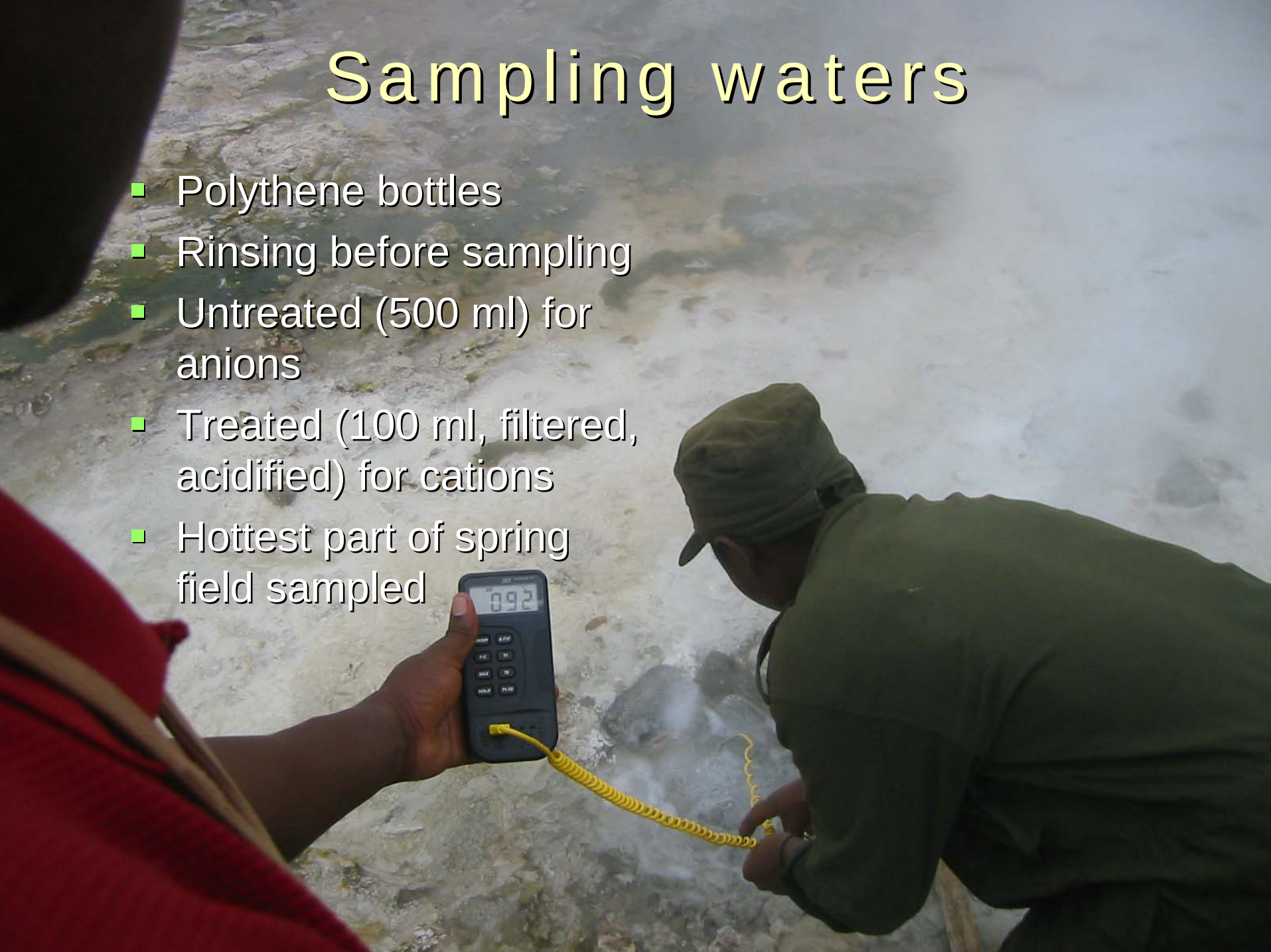
Sample locations

- Buranga (95°C)
- Rwagimba (65°C)
- Rwimi (26°C)
- Bugoye (25°C)
- Kibenge (43°C)
- Muhokya (41°C)



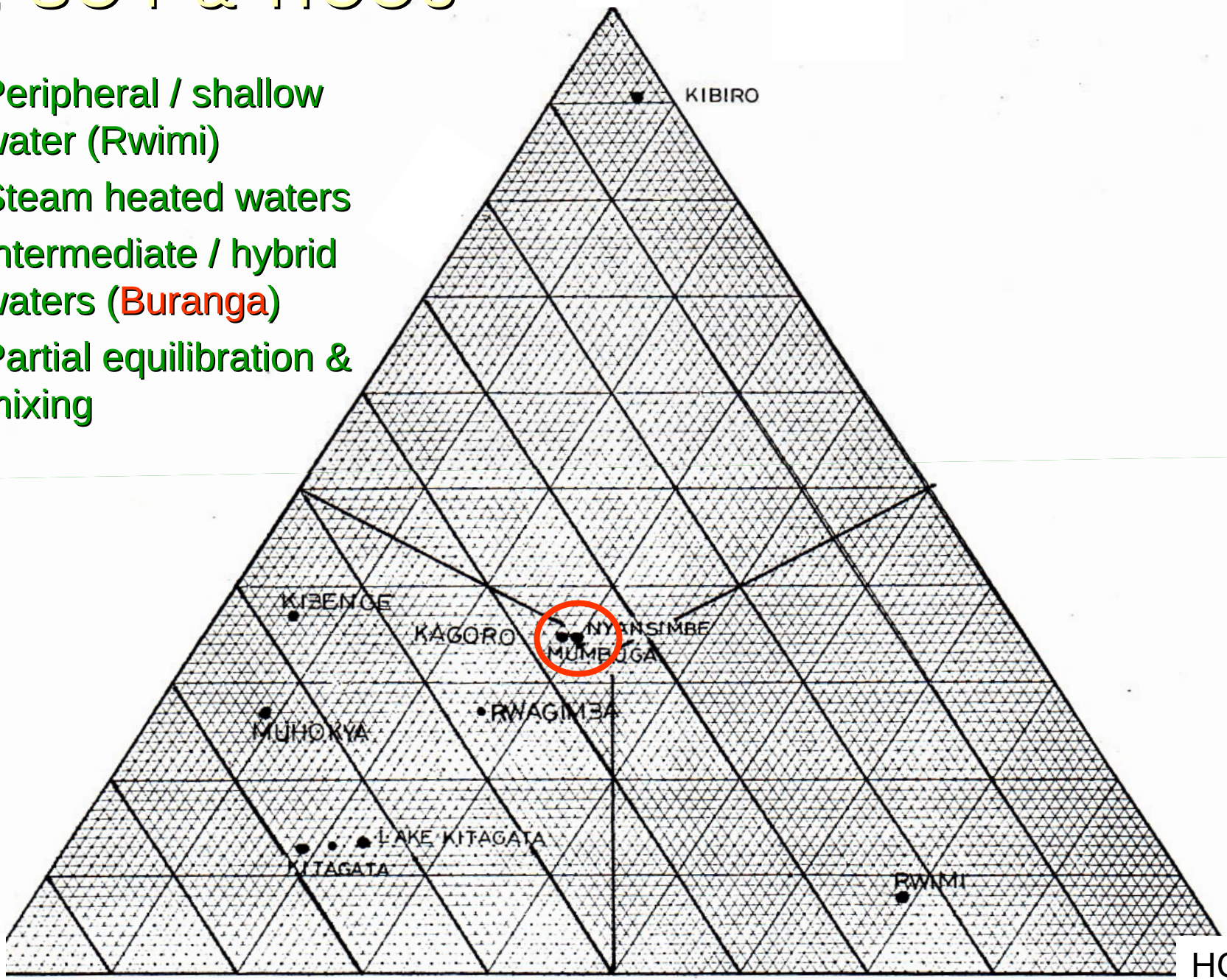
Sampling waters

- Polythene bottles
- Rinsing before sampling
- Untreated (500 ml) for anions
- Treated (100 ml, filtered, acidified) for cations
- Hottest part of spring field sampled

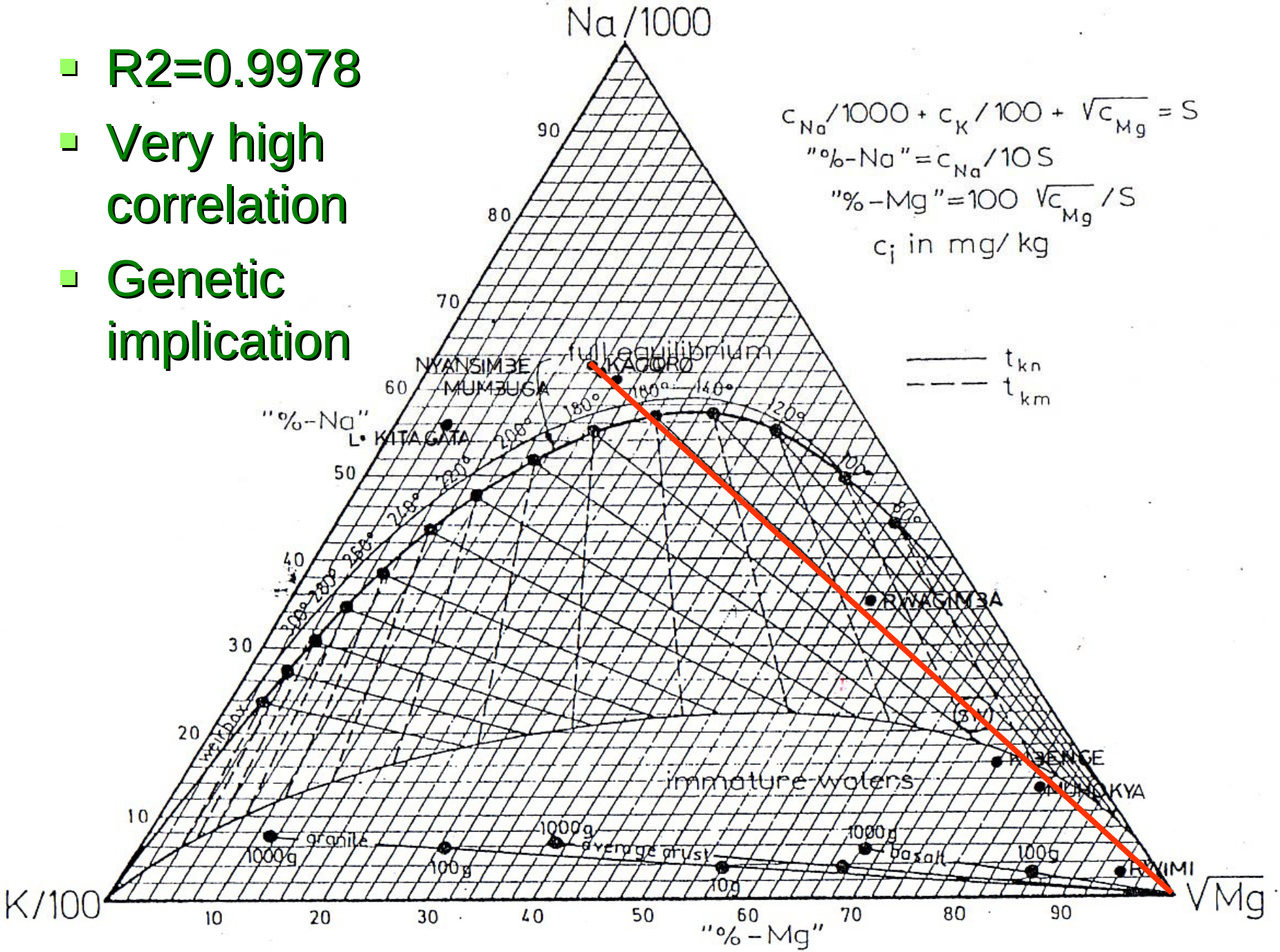


Cl, SO4 & HCO3

- Peripheral / shallow water (Rwimi)
- Steam heated waters
- Intermediate / hybrid waters (Buranga)
- Partial equilibration & mixing



- R2=0.9978
- Very high correlation
- Genetic implication

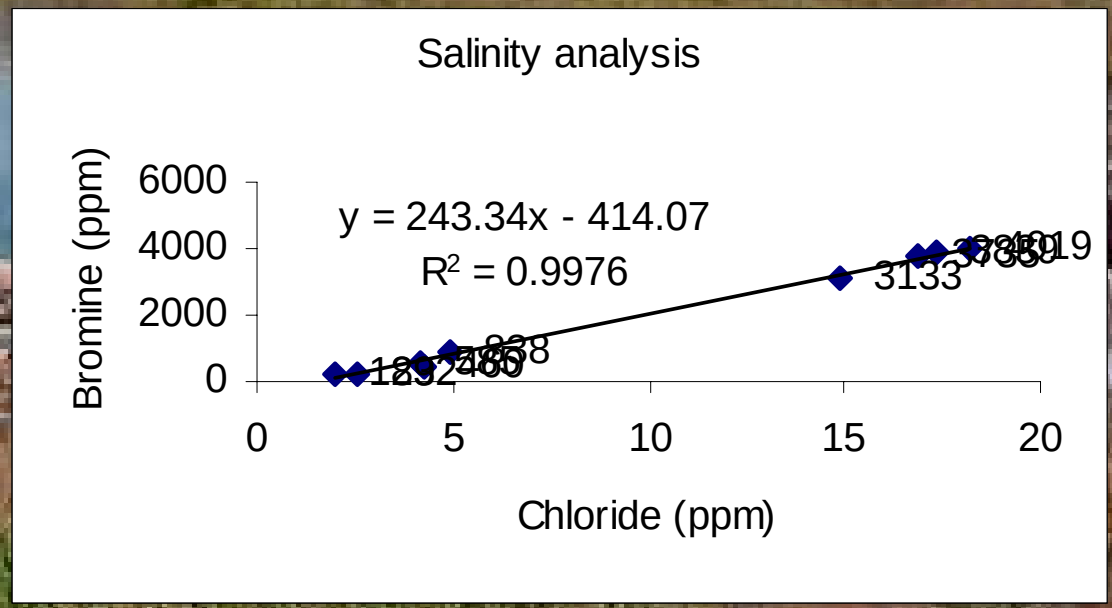


Solute Geothermometry

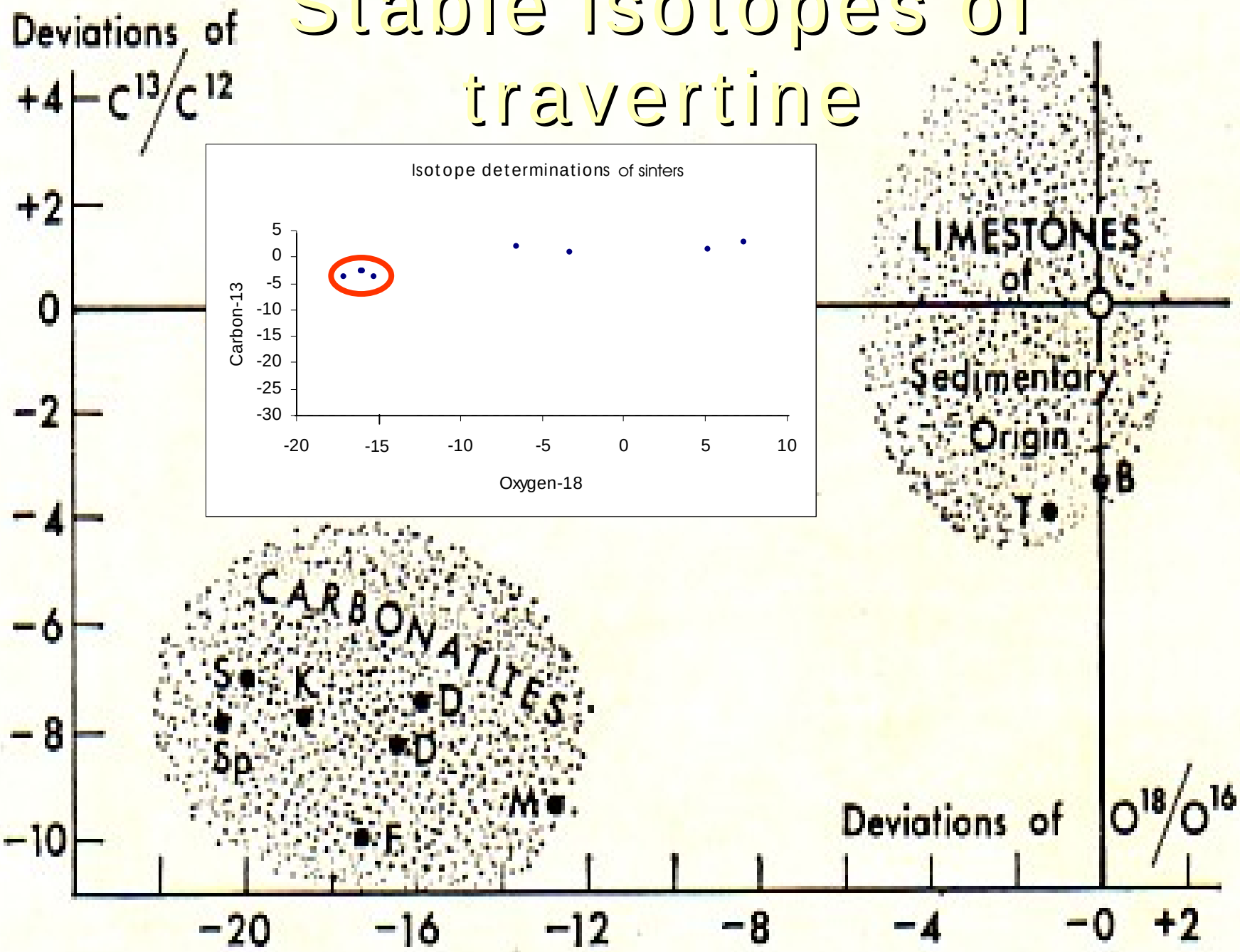
- Immature waters (Kibenge, Muhokya, Rwimi)
- Travertine deposits
- Not justified (not even partial equilibrium)
- Lower temperature (~150°C) typical of environments created by the absorption of CO2-rich vapors into groundwater at the periphery of a system.

Chloride salinity

- The Br/Cl ratios fall in a range 0.00451 to 0.01120.
- Seawater (typically 0.00347) Cl=19000mg/l, Br=65mg/l.
- Silicate rock-water interaction / fluid inclusion leaching

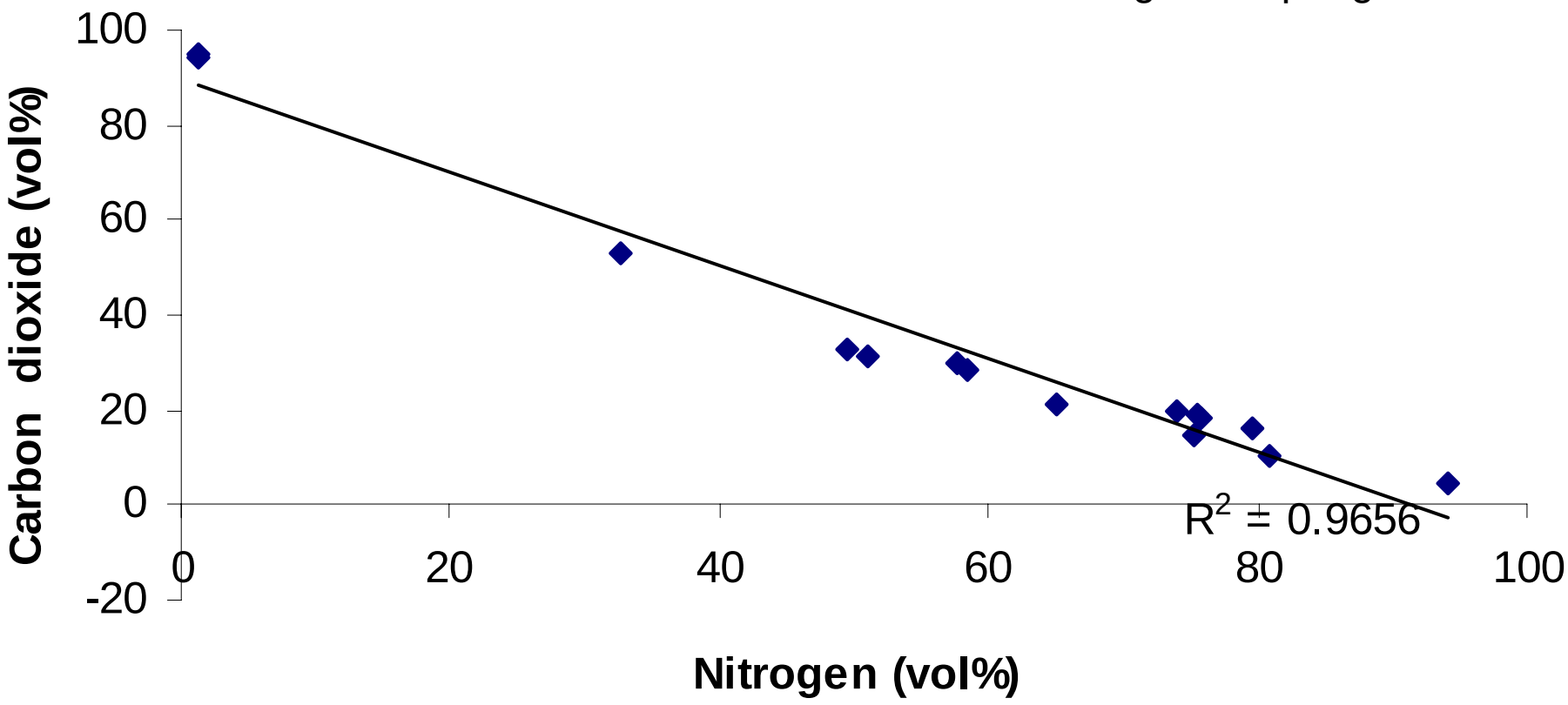


Stable isotopes of travertine

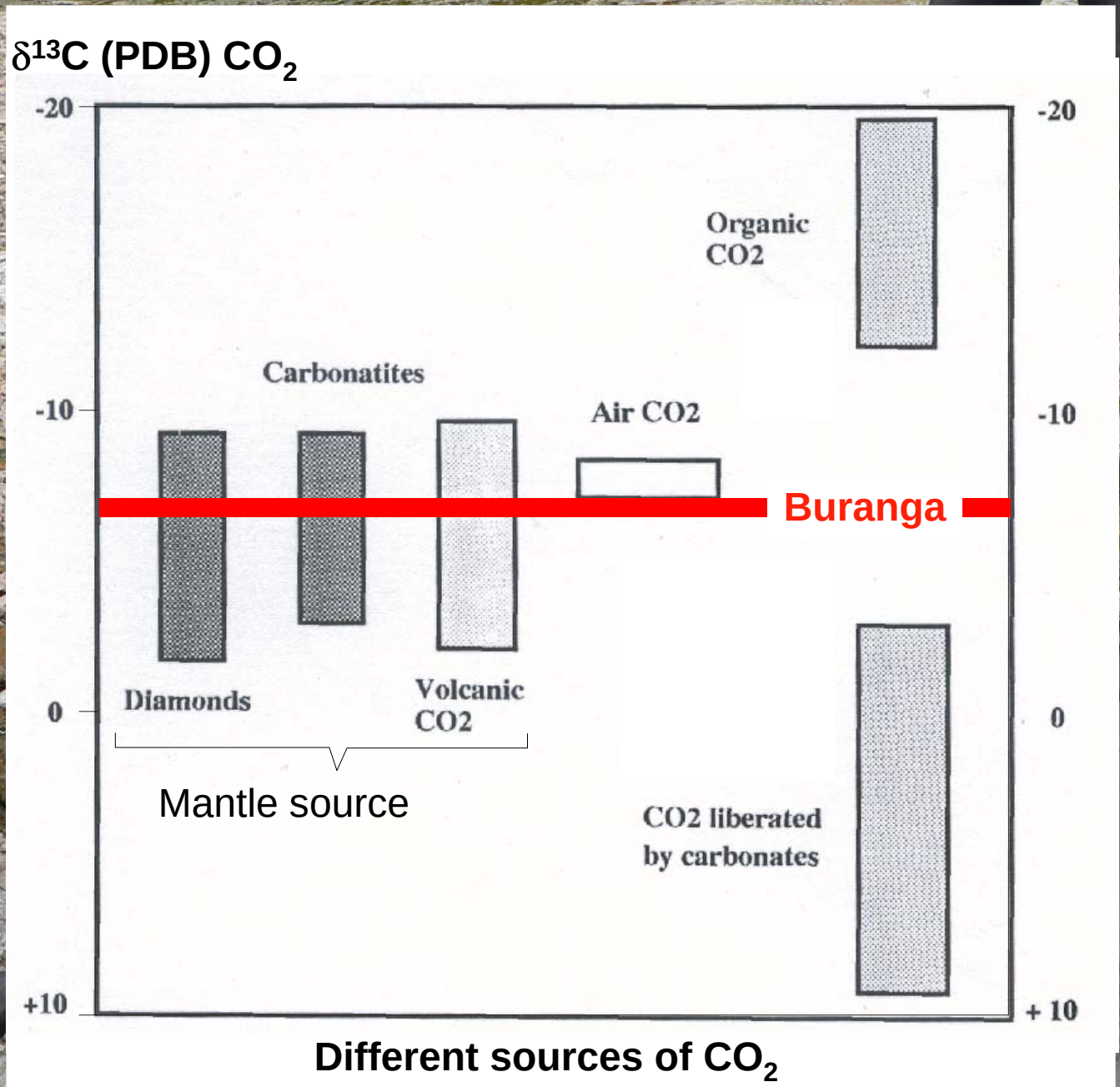


Gas geochemistry

Methane/ethane gas geothermometer in agreement with solute geothermometry for Buranga hot springs



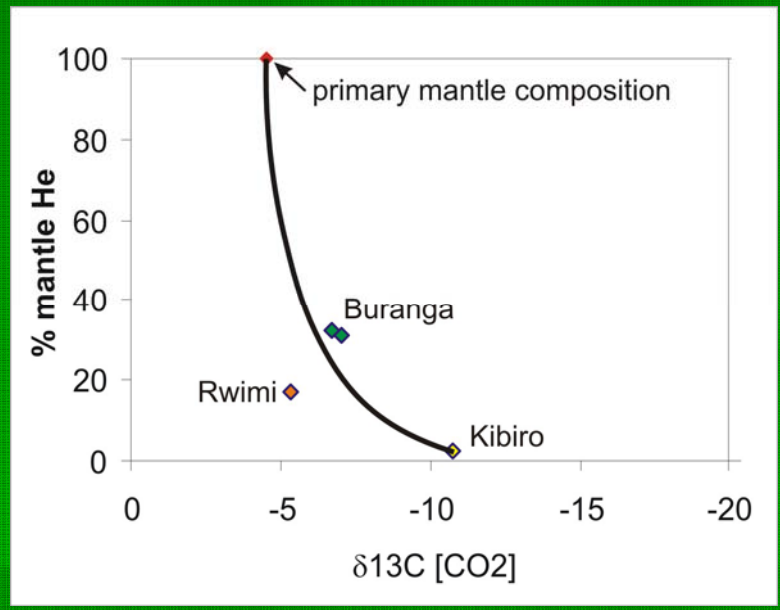
Carbon isotopic composition of CO2



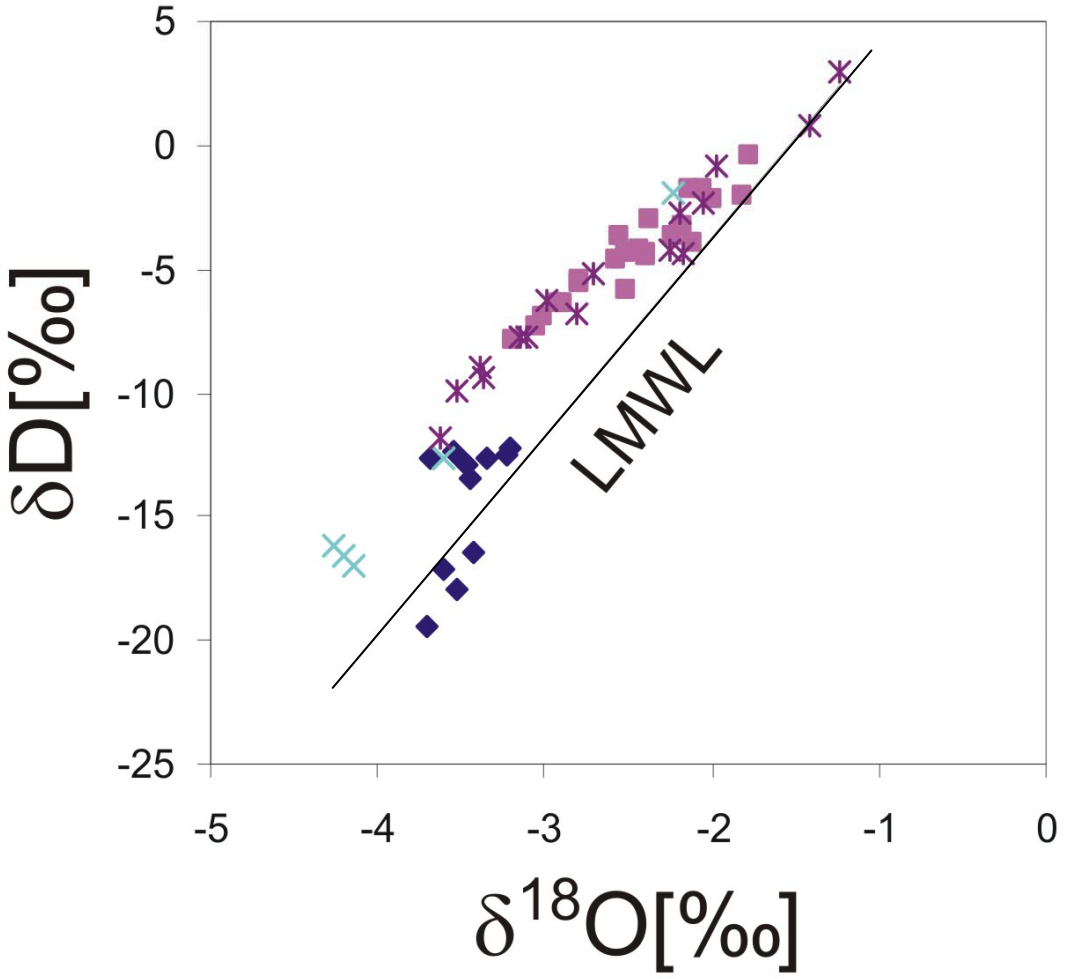
Different sources of CO_2

Noble gas geochemistry

- R/Ra: Kibiro 0.2 => nearly pure radiogenic He (crustal He, i.e. no volcanic heat source)
- R/Ra: Rwimi 1.5 => <20% mantle He (spring located at southern end of Kyatwa or Ndale volcanic field)
- R/Ra: Buranga 2.8 => >30% mantle He, i.e. still hot actively degassing magma body below Buranga area



Stable isotopic composition of waters



Pre-bomb Tritium (IAEA 2000)

- Buranga hot spring waters
- River water west of Rwenzori
- Hot springs east of Rwenzori
- River water east of Rwenzori

- Recharge by meteoric waters
- No Oxygen-shift
- Higher altitude

Conclusions

- Reservoir temperatures would allow electricity production (binary power plant)
- Existence of a magmatic heat source below Buranga area
- Recharge from south to the north (high Rwenzori; relatively long residence time)
- Hydrological connection / Genetically related (single hot water reservoir?)
- Buranga is more proximal to up-flow zone
- Together with geophysics and structural geology (fault controlled system) we will be able to locate a target area for exploration drilling


THANK YOU !