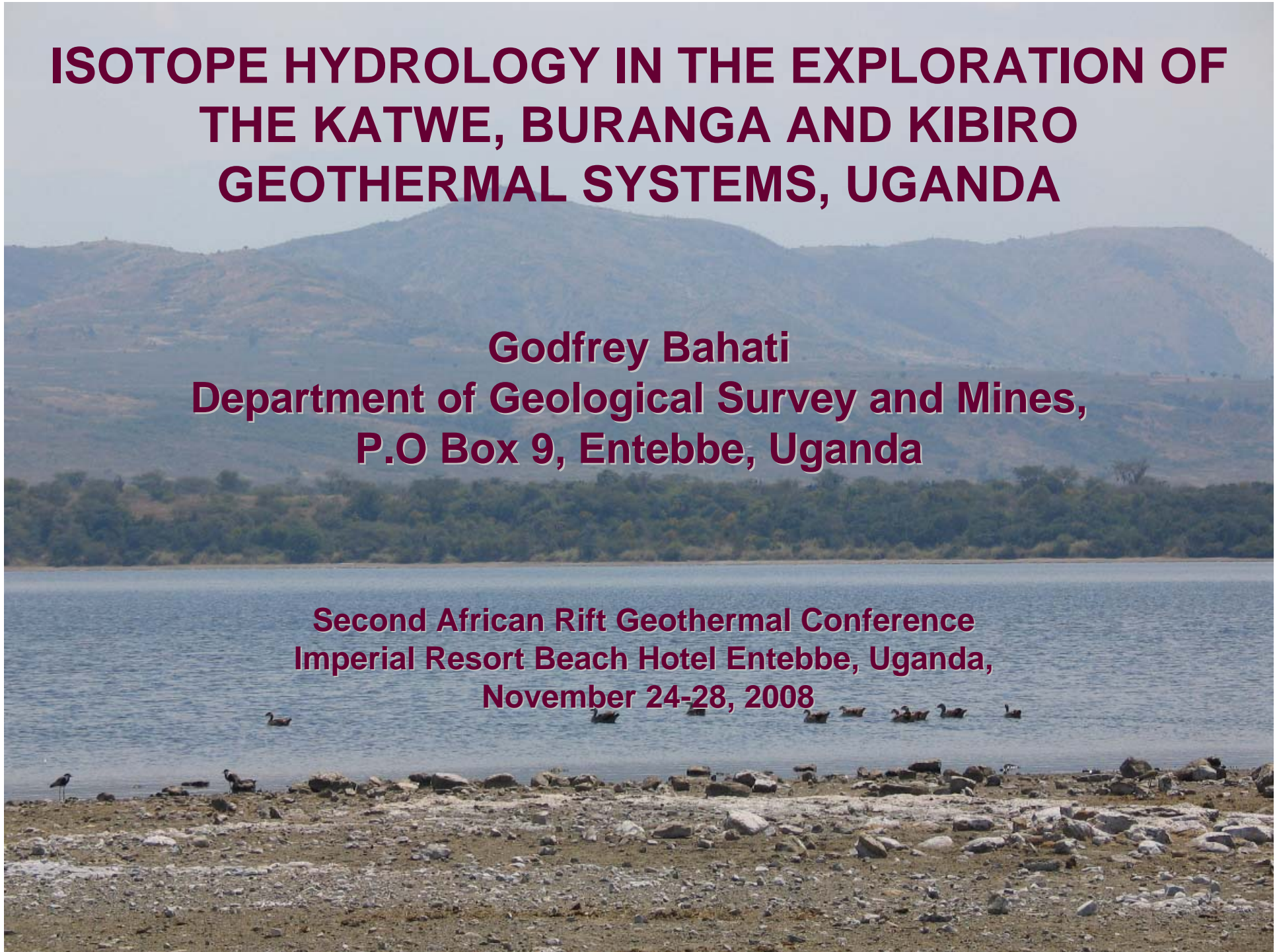


# **ISOTOPE HYDROLOGY IN THE EXPLORATION OF THE KATWE, BURANGA AND KIBIRO GEOHERMAL SYSTEMS, UGANDA**

**Godfrey Bahati  
Department of Geological Survey and Mines,  
P.O Box 9, Entebbe, Uganda**

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# *Outline*

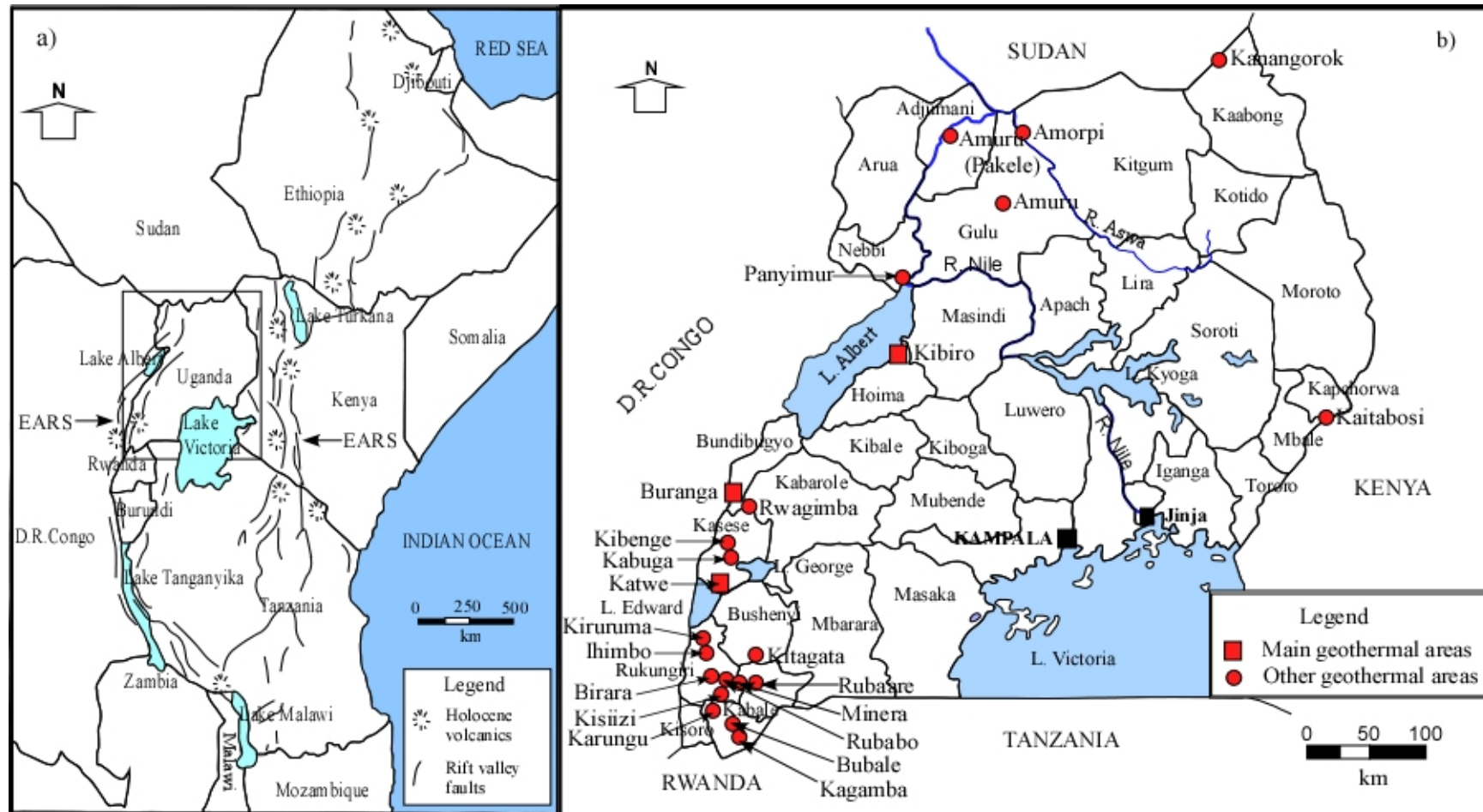
- Objectives of the study
- Study areas
- Methodology
- Geology of the western Rift Valley
- Sampling points
- Stable isotopes
- Tritium and mixing processes
- Sources of solutes
- Water–rock interaction
- Conclusions

## *Objectives of the study*

- To elucidate the origin of the geothermal fluids,
- identify the recharge mechanisms,
- estimate subsurface temperature using isotope geothermometry,
- trace the source of solutes,
- improve the conceptual geothermal models of the study areas.

# Study areas

Figure: a) East African Rift System (EARS), b) Locations of the geothermal areas of Uganda.

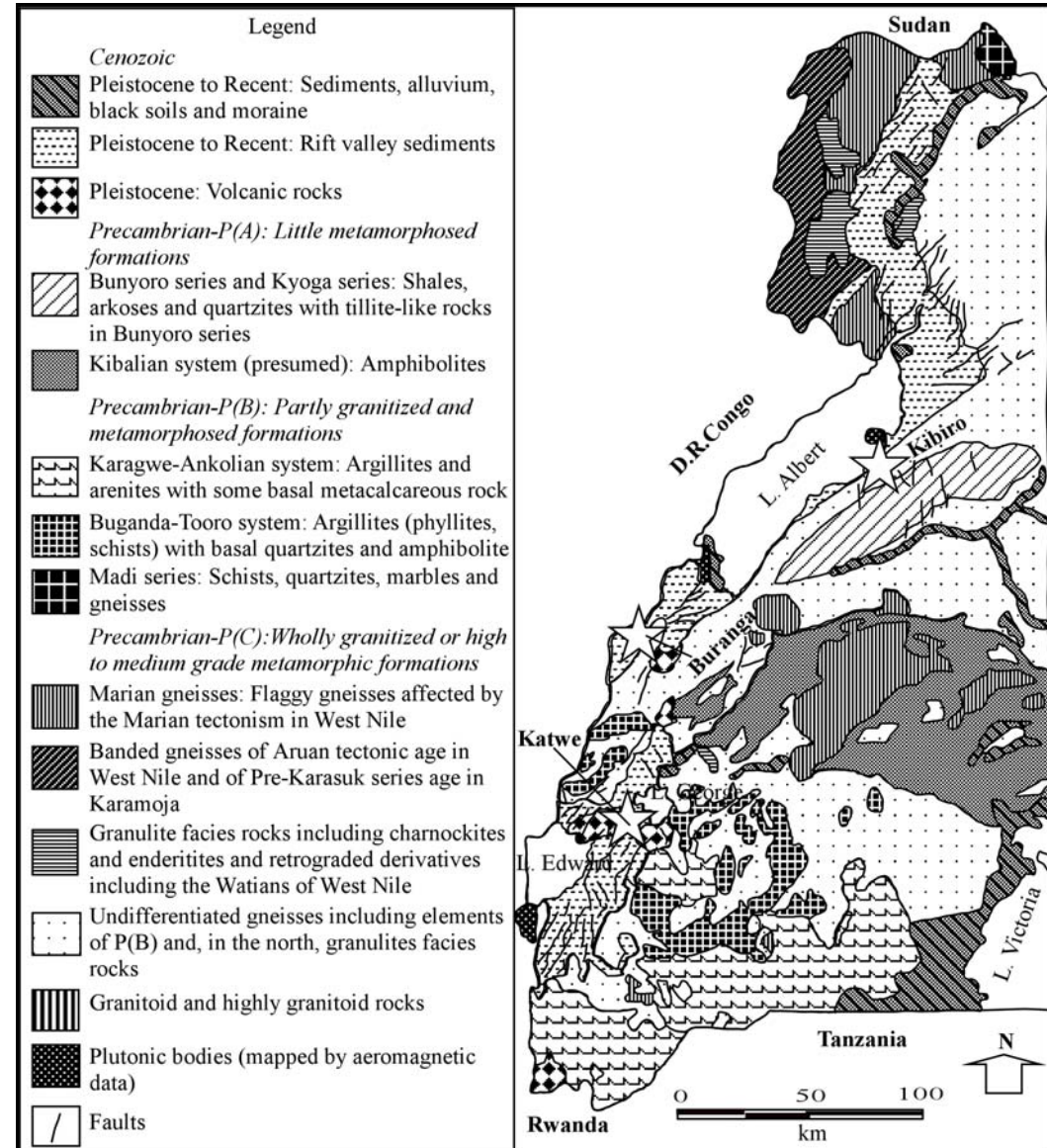


## *Methodology*

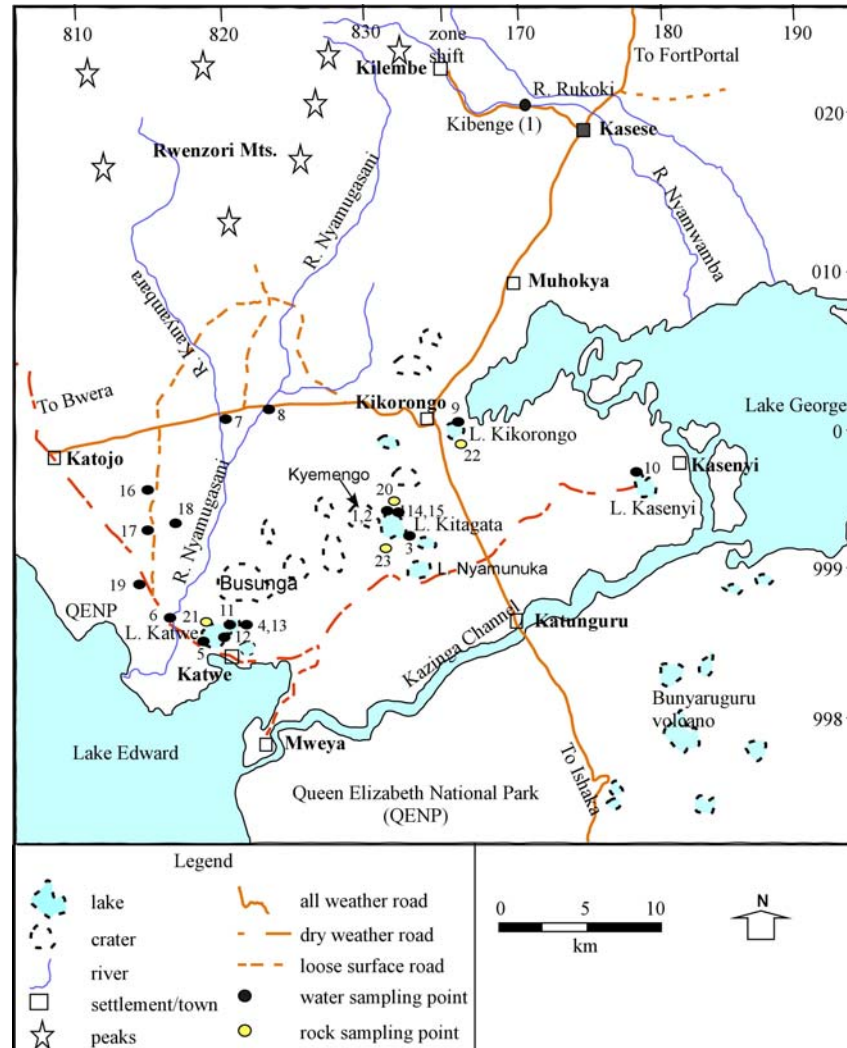
- 118 water samples from hot and cold springs, dug wells, rivers and lakes,
- 13 samples from surface outcrops of different types of rocks,
- Samples analyzed for chemical and isotopic compositions.
- Isotopes analyzed included hydrogen ( $\delta D$  and tritium), Oxygen ( $\delta^{18}O$  in water and sulphate), sulphur ( $^{34}S$  in sulphate), and strontium ( $^{87/86}Sr$  in water and rock).

# Geology of the western Rift Valley

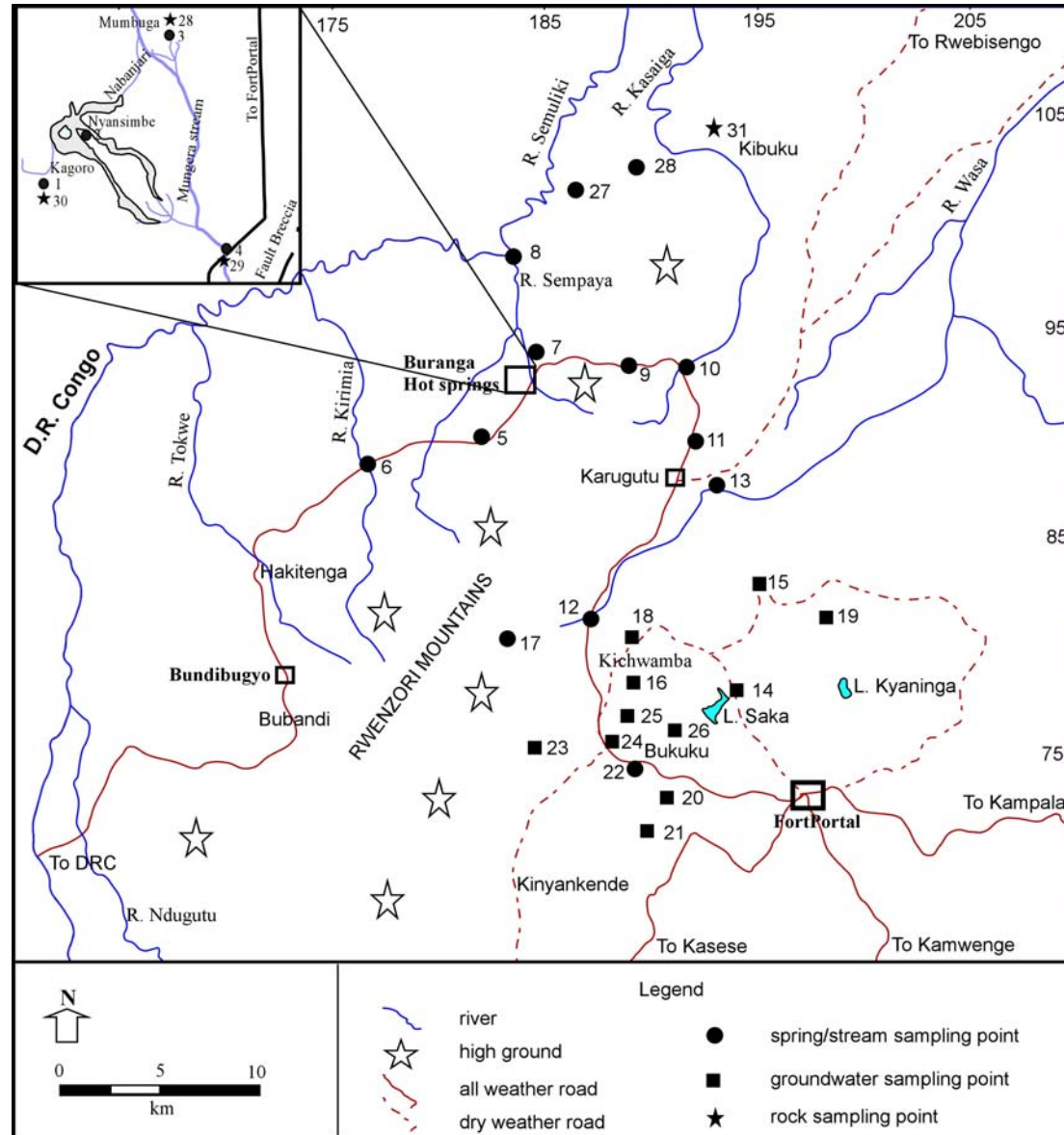
- Katwe: Volcanics
- Buranga: Sedimentary environment
- Kibiro: sedimentary west of the escarpment and crystalline environment east of the escarpment (granites/gneisses)



# Katwe: sampling points

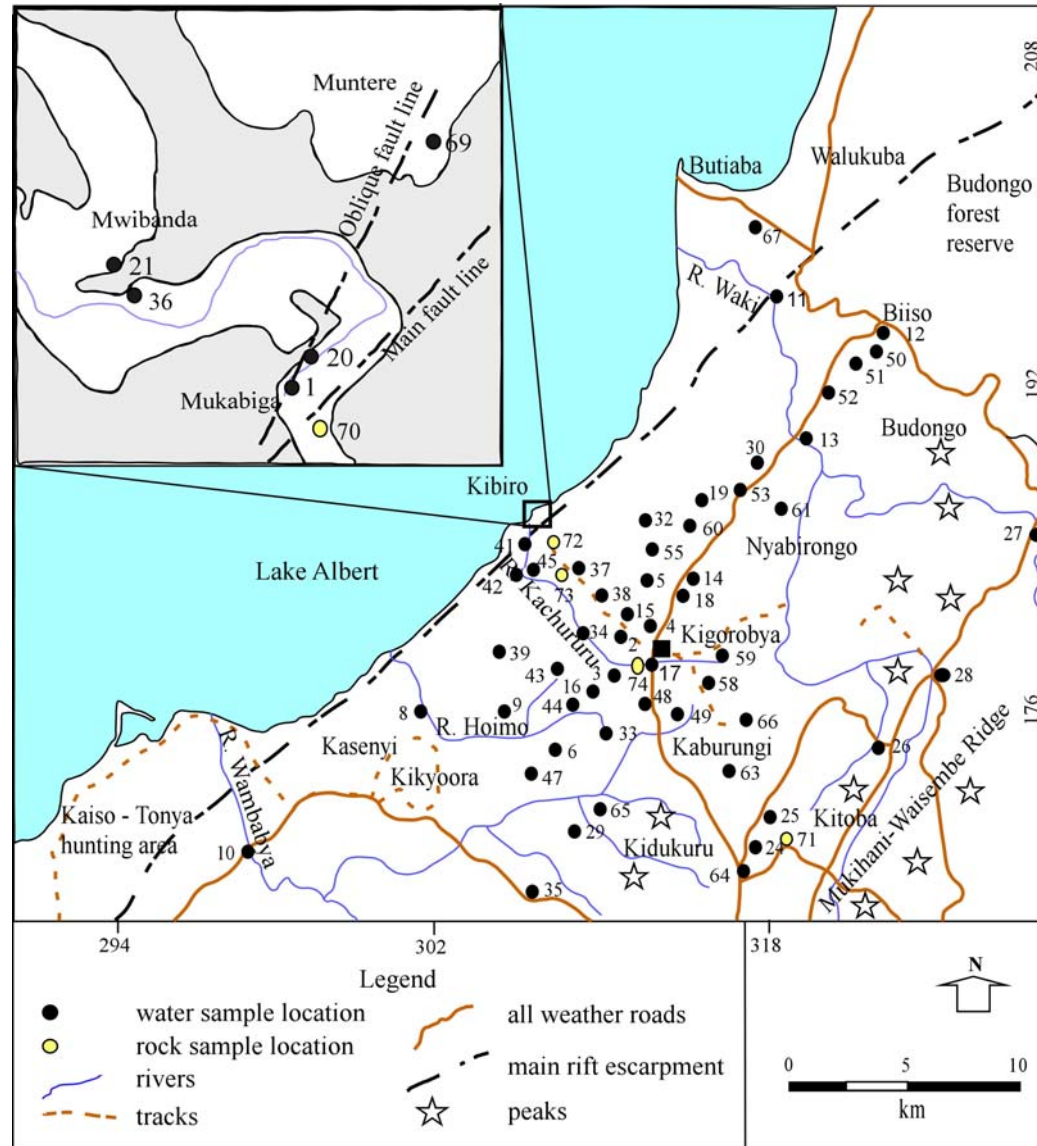


# Buranga: sampling points

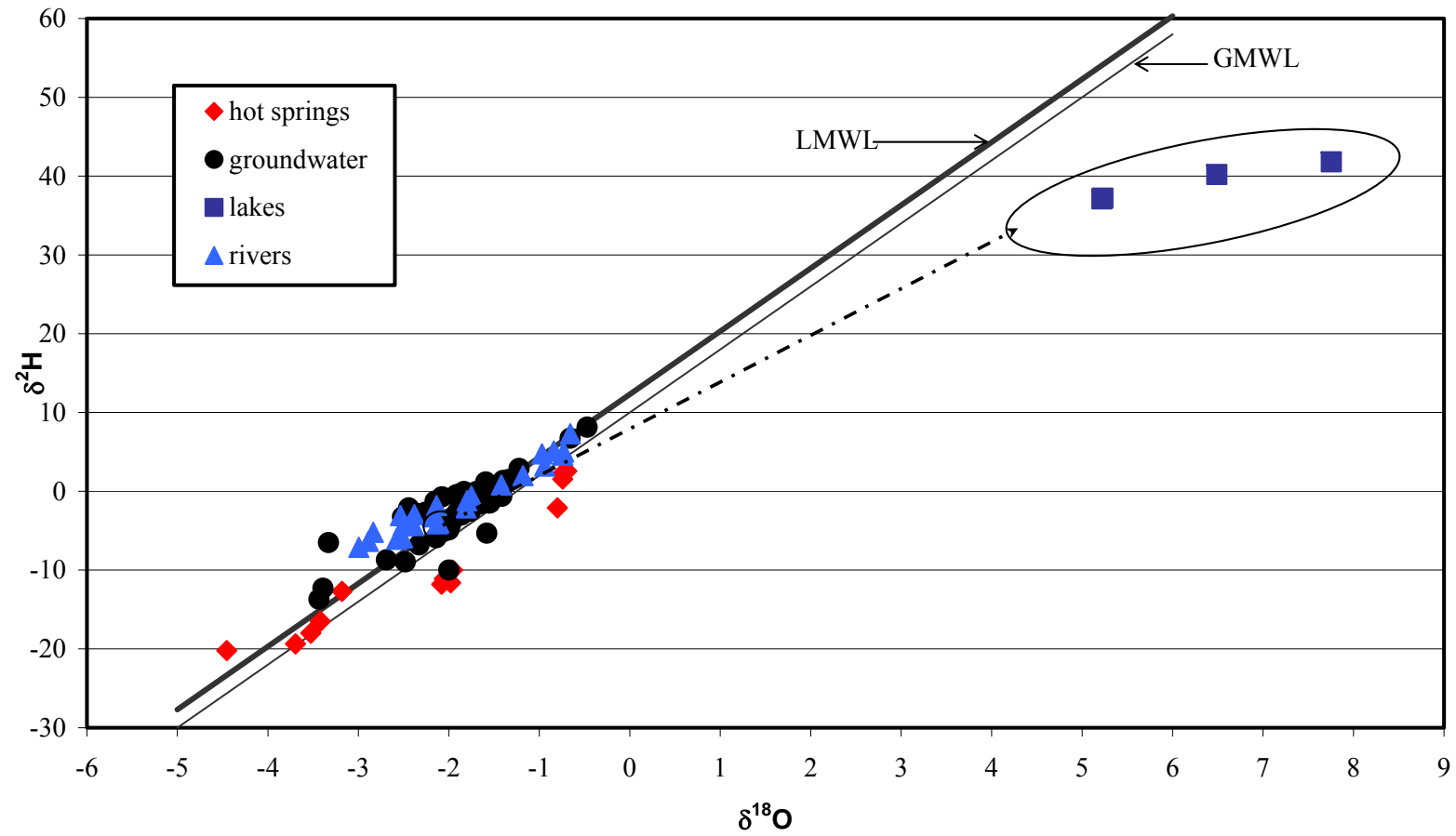




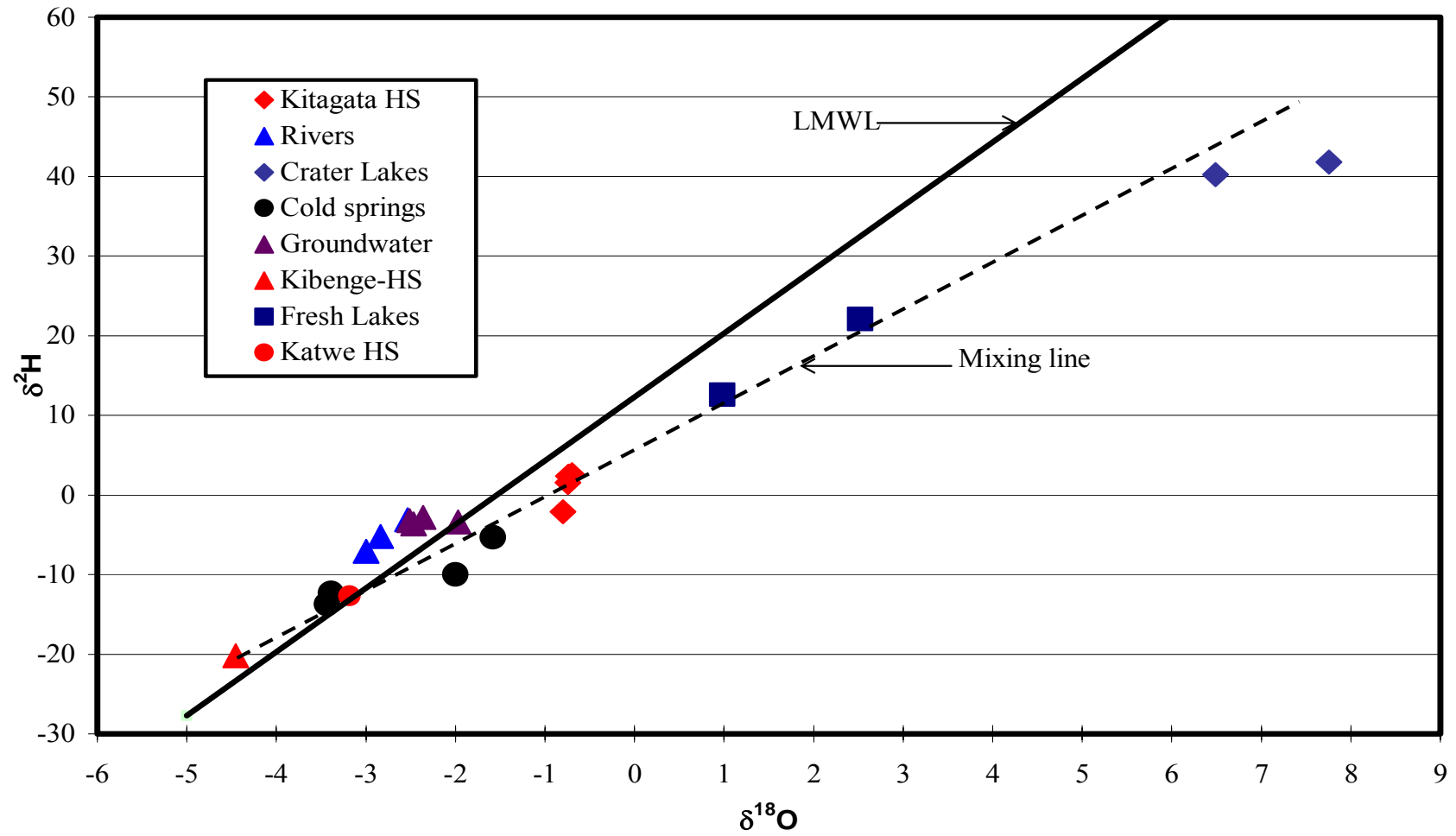
# Kibiro: sampling points



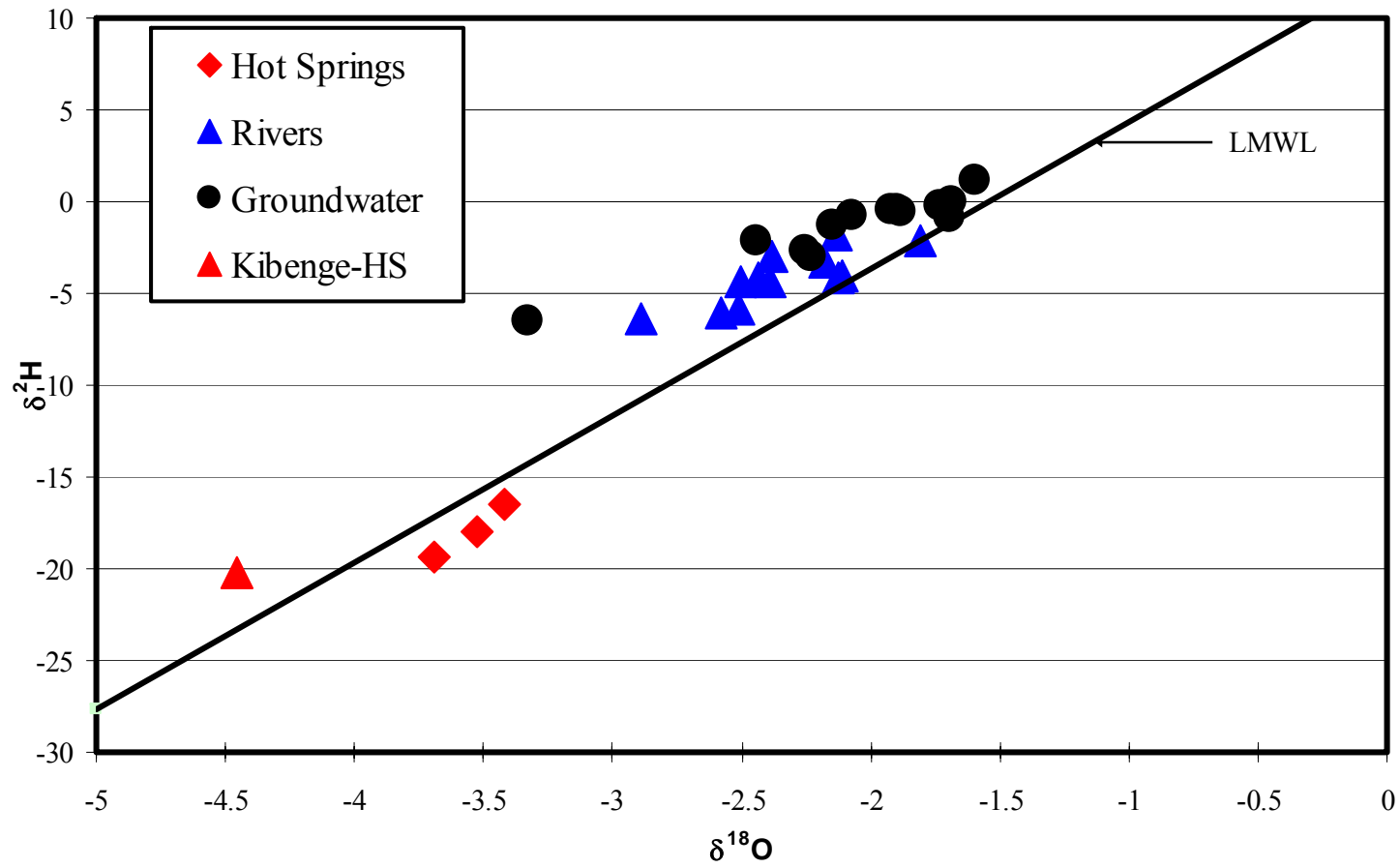
# Stable isotopes in water



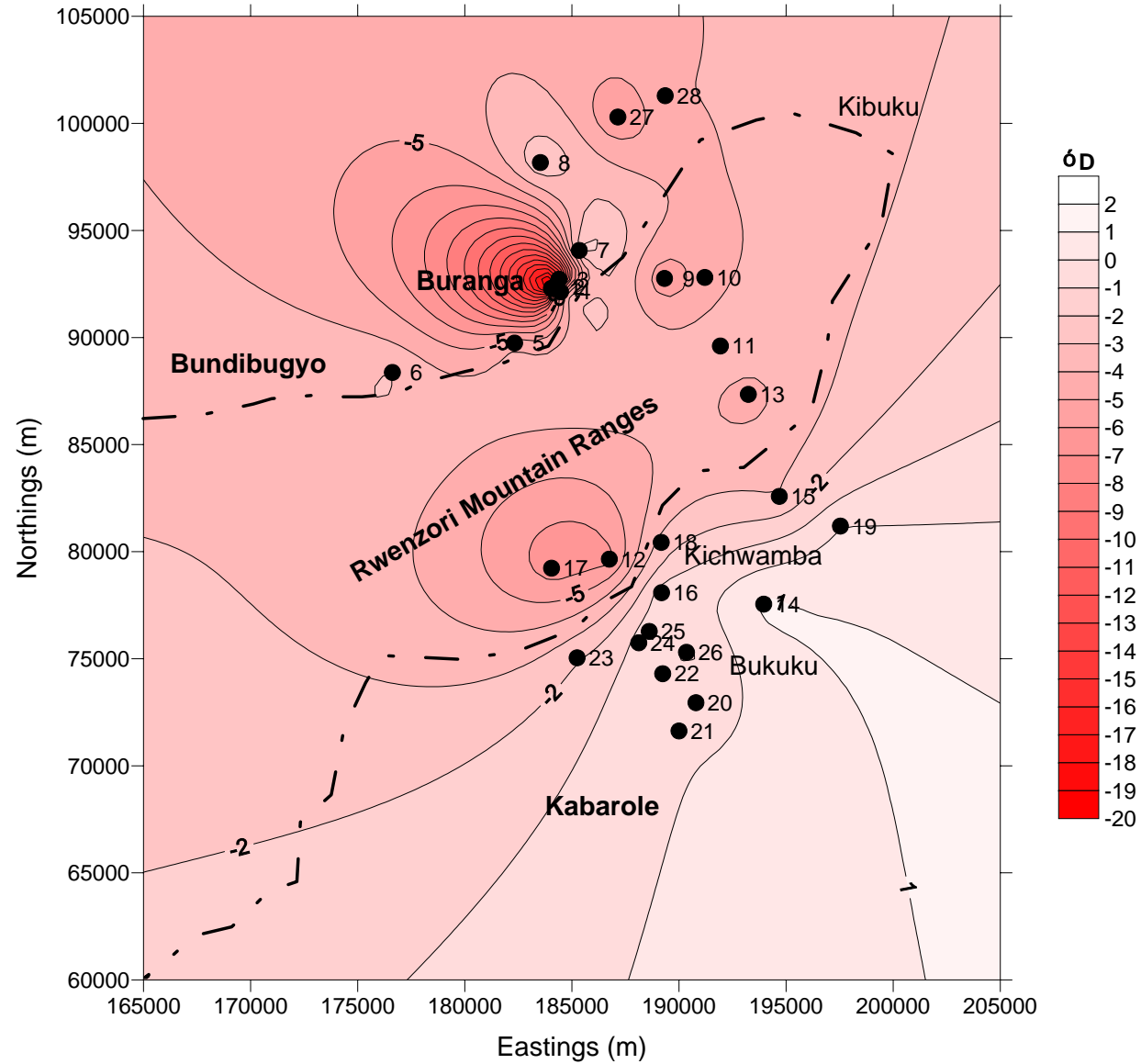
# *Katwe: stable isotopes in water*



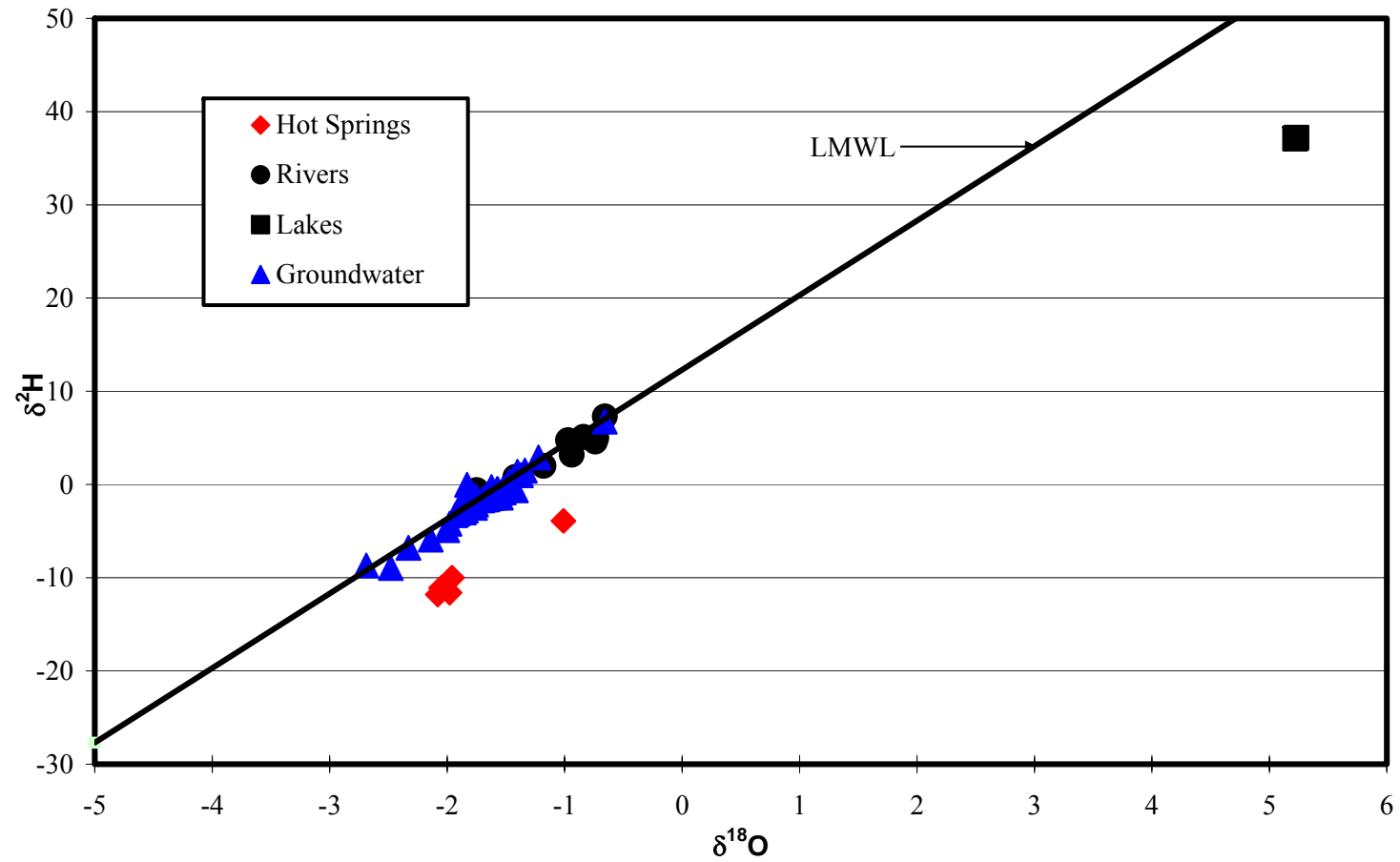
# *Buranga: stable isotopes in water*



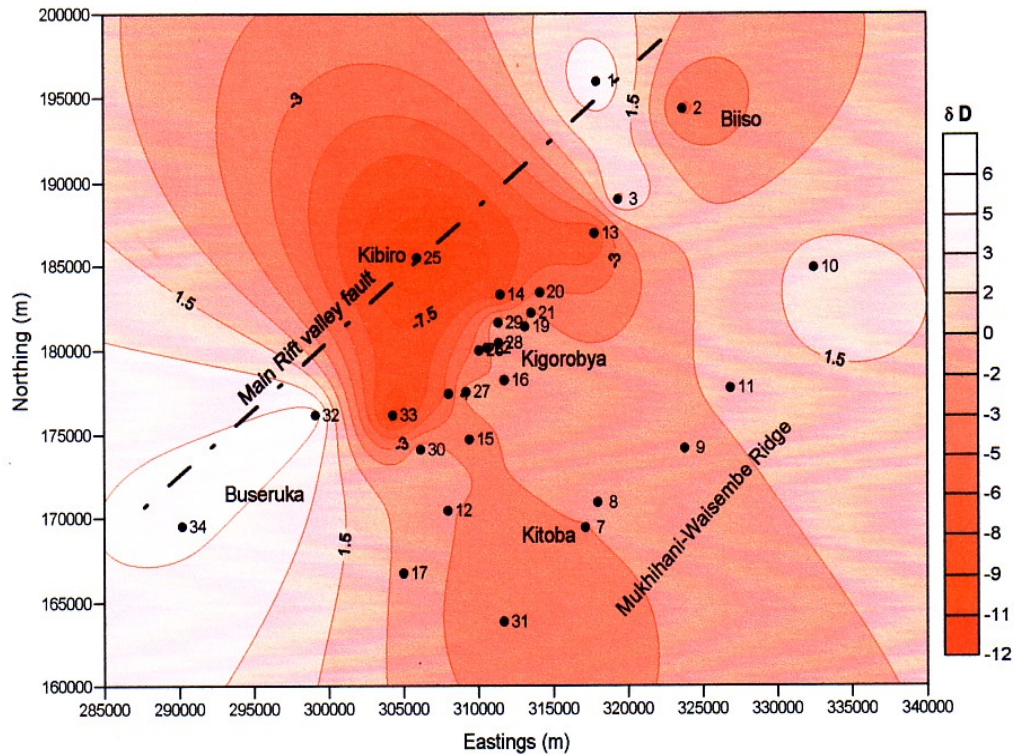
# Buranga: deuterium concentration in water



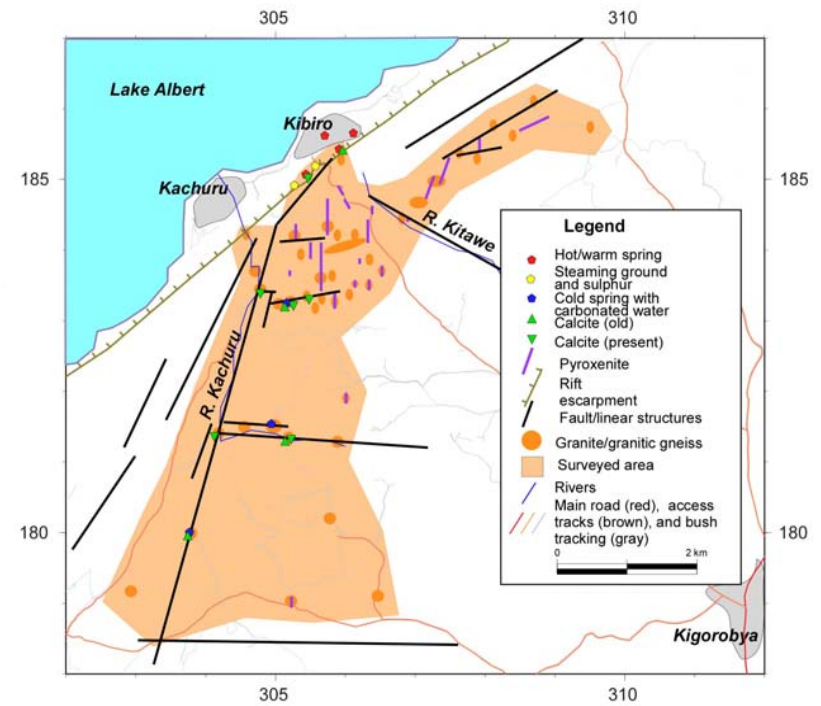
# *Kibiro: stable isotopes in water*



# Kibiro: deuterium concentration in water

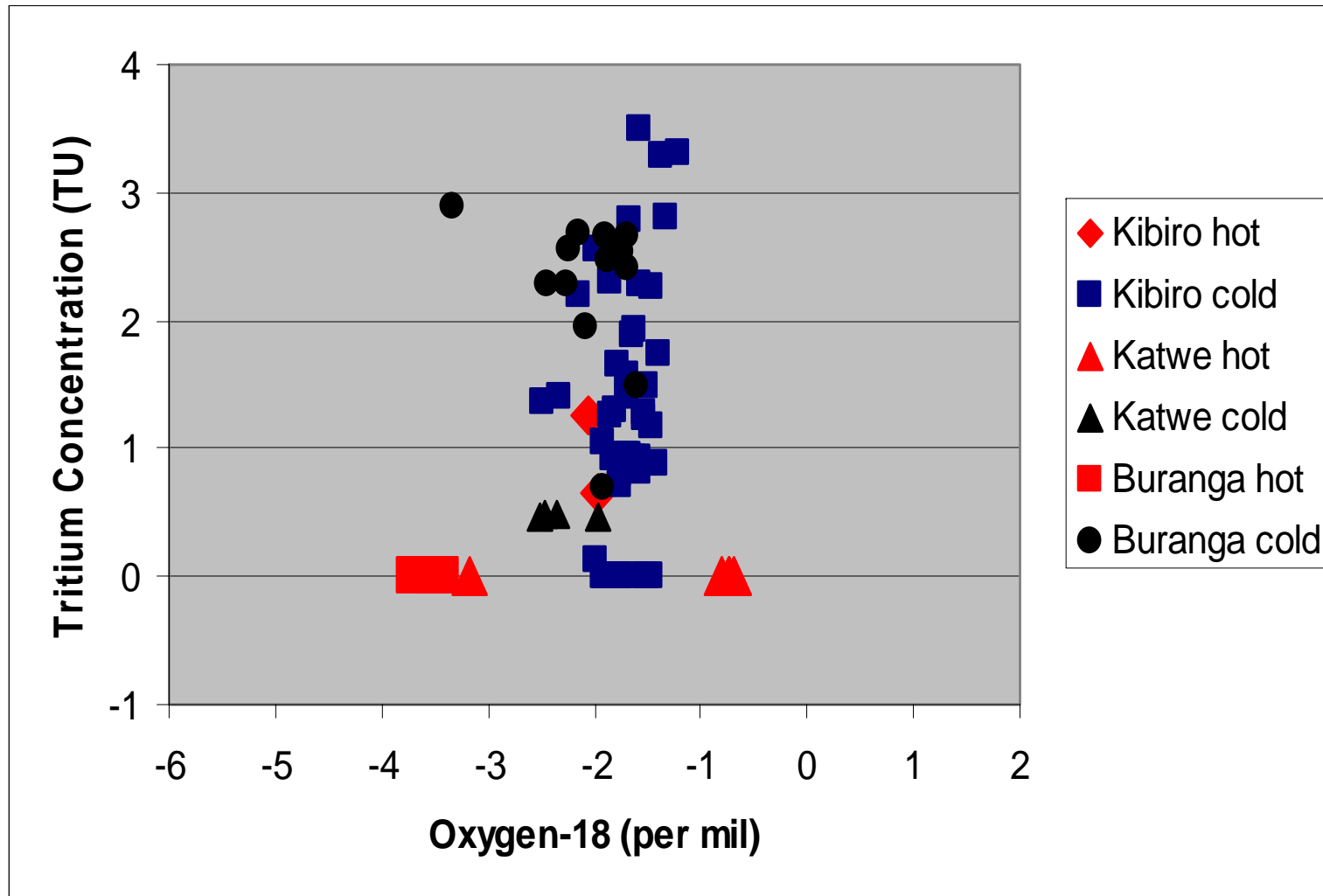


Deuterium in water



Geology of Kibiro

# *Tritium and mixing processes*



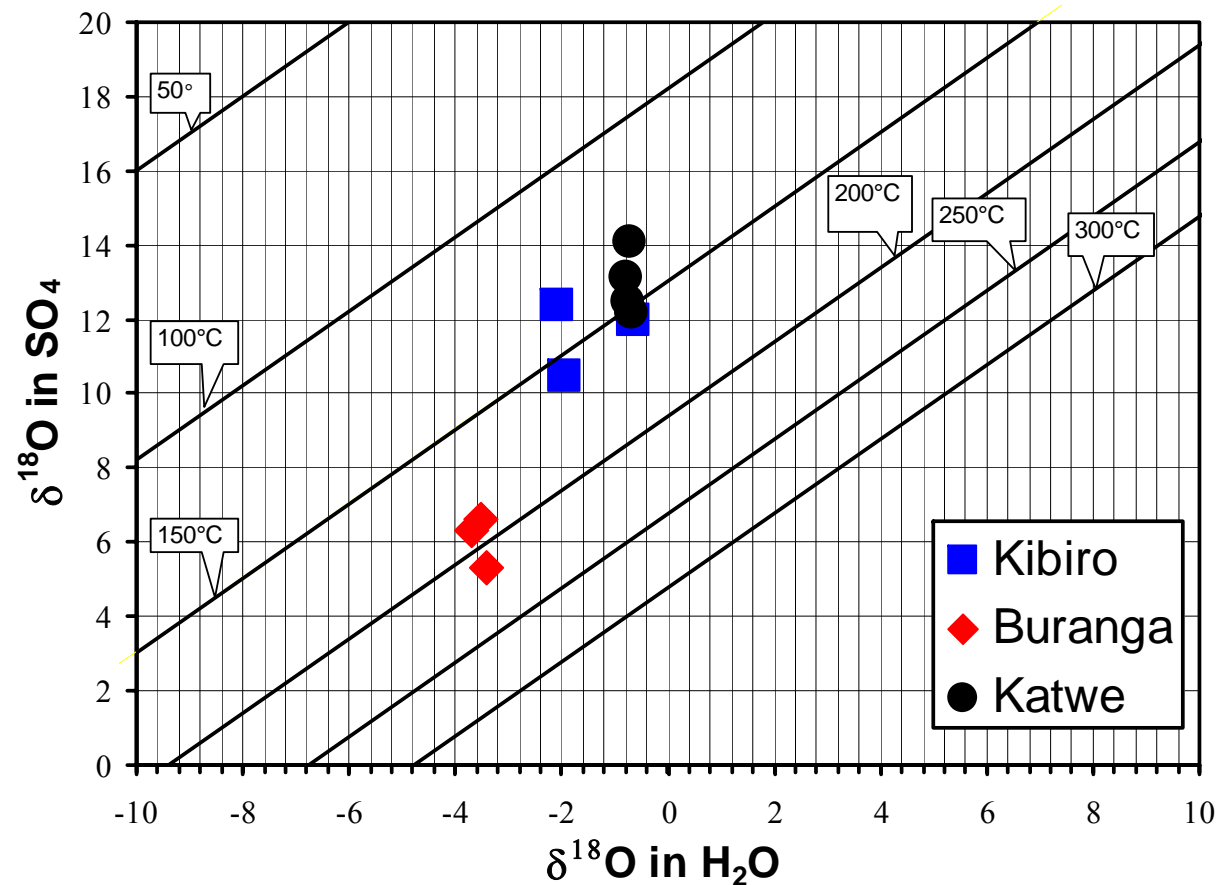


# Isotope and chemical geothermometry

## Solute

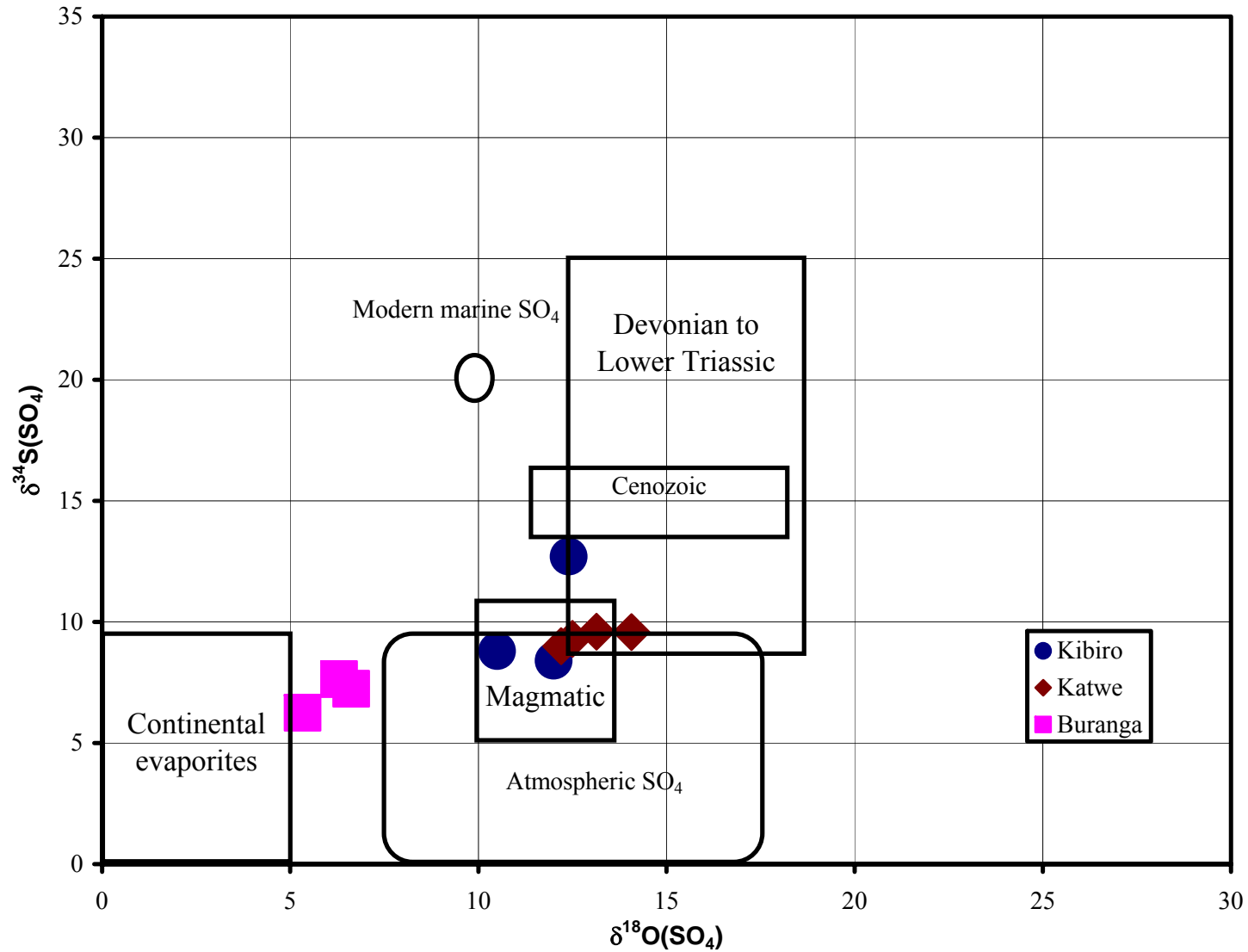
geothermometry:

- Katwe: 140-200°C
- Buranga: 120-150 °C
- Kibiro: (a) 150°C and (b) 200-220 °C

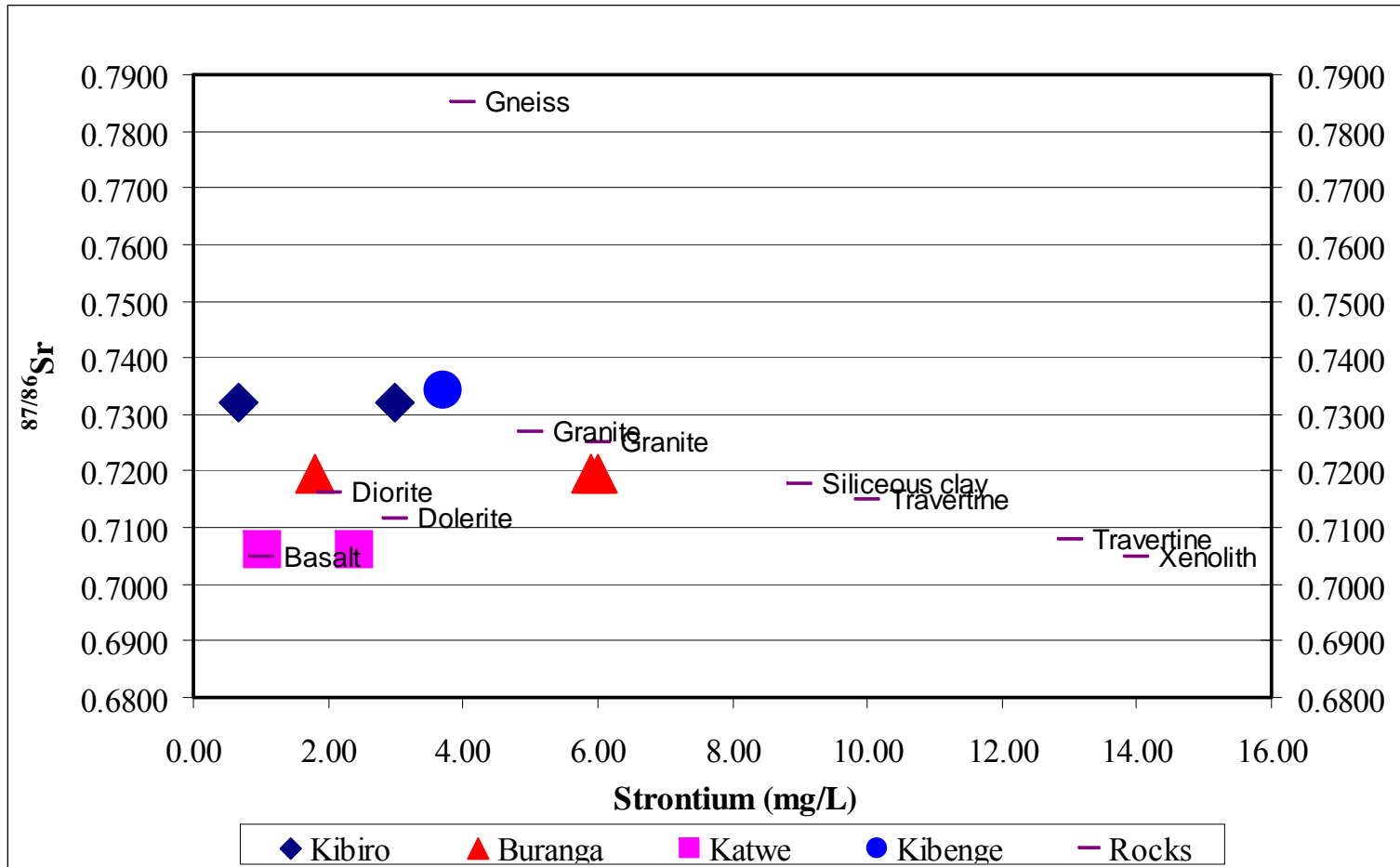


sulphate-water ( $\text{S}^{18}\text{O}_4\text{-H}_2^{18}\text{O}$ ) isotope geothermometer

# Sources of solutes



# Water-rock interactions



## *Conclusions*

- Recharge to the geothermal areas is from high ground: Rwenzori mountains for Katwe and Buranga; Mukihani-Waisembe Ridge for Kibiro.
- Movement of the fluids from recharge areas to the reservoirs and hot springs is fault controlled.
- Subsurface temperatures predicted by isotope geothermometry are highest for Buranga (200°C), and 140 – 160°C for Katwe and Kibiro.
- Reservoir rock types are most likely basalt in Katwe, and granites/gneisses in Buranga and Kibiro.
- The major source of solutes is rock dissolution with magmatic input.

