ISOTOPE HYDROLOGY IN THE EXPLORATION OF THE KATWE, BURANGA AND KIBIRO GEOTHERMAL SYSTEMS, UGANDA

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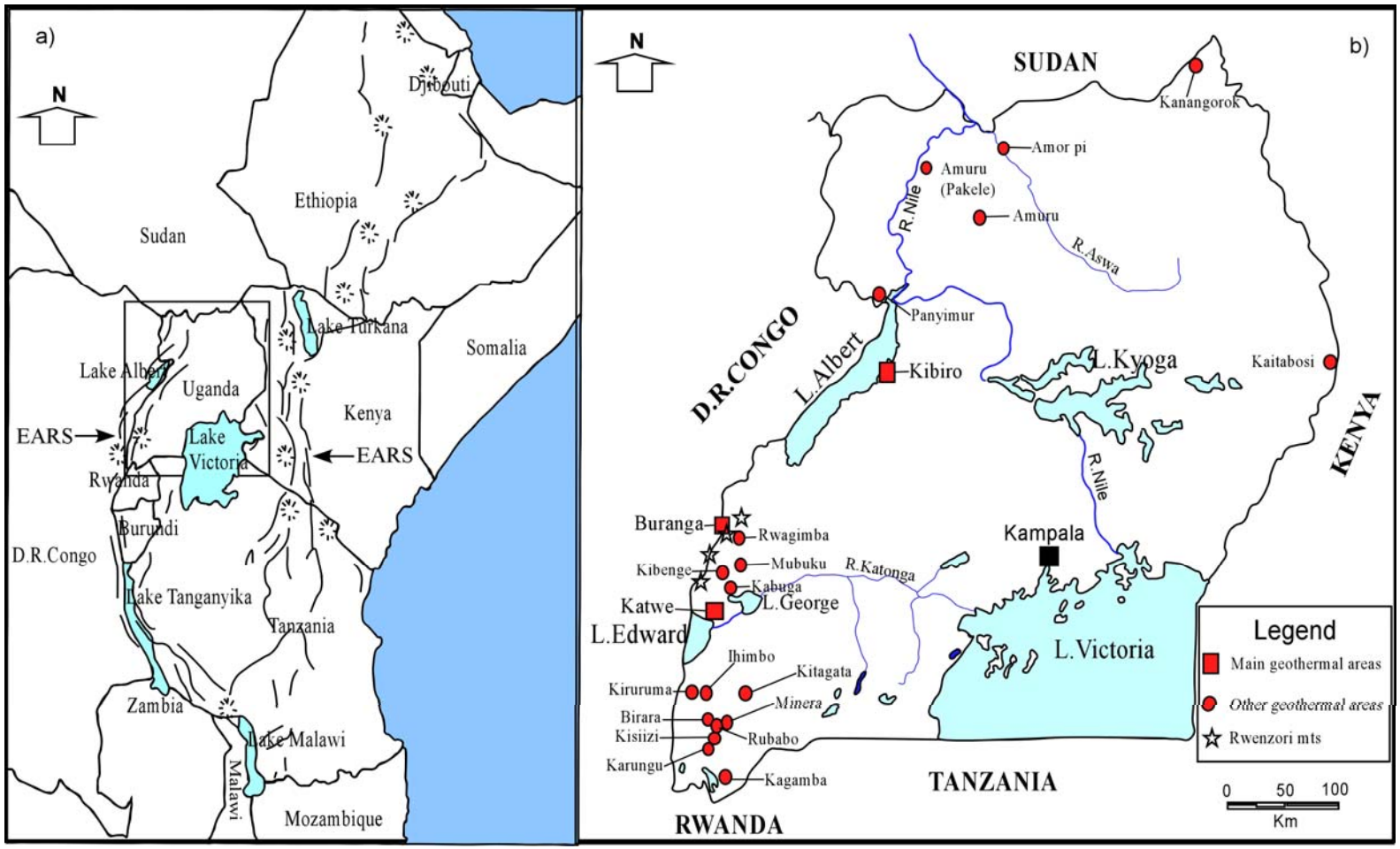
Outline

- 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

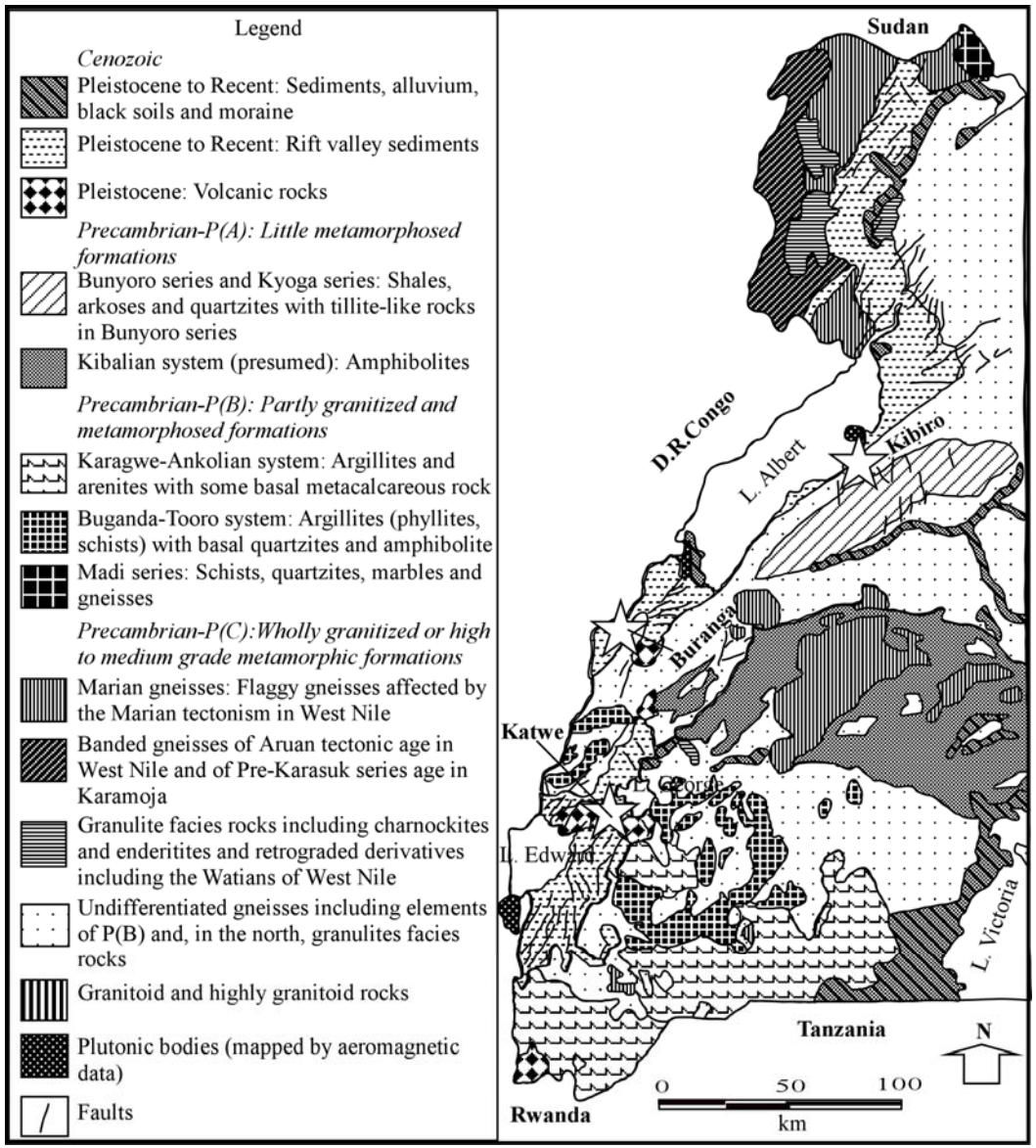

a)
N
Djibouti
Ethiopia
Sudan
Lake Turkana
Somalia
Lake Albert
Uganda
Kenya
EARS
Lake Victoria
EARS
Rwanda
Burundi
D.R.Congo
Lake Tanganyika
Tanzania
Zambia
Lake Malawi
Malawi
Mozambique
N
b)
SUDAN
Kanangorok
Amor pi
Amuru (Pakele)
Amuru
R.Nile
R.Aswa
Panyimur
D.R.CONGO
L.Albert
Kibiro
L.Kyoga
Kaitabosi
KENYA
R.Nile
Kampala
Buranga
Rwagimba
Kibenge
Mubuku
R.Katonga
Kabuga
Katwe
L.George
L.Edward
L.Victoria
Ihimbo
Kitagata
Kiruruma
Minera
Birara
Kisiizi
Rubabo
Karungu
Kagamba
TANZANIA
RWANDA
Legend
Main geothermal areas
Other geothermal areas
Rwenzori mts
0 50 100
Km

Methodology

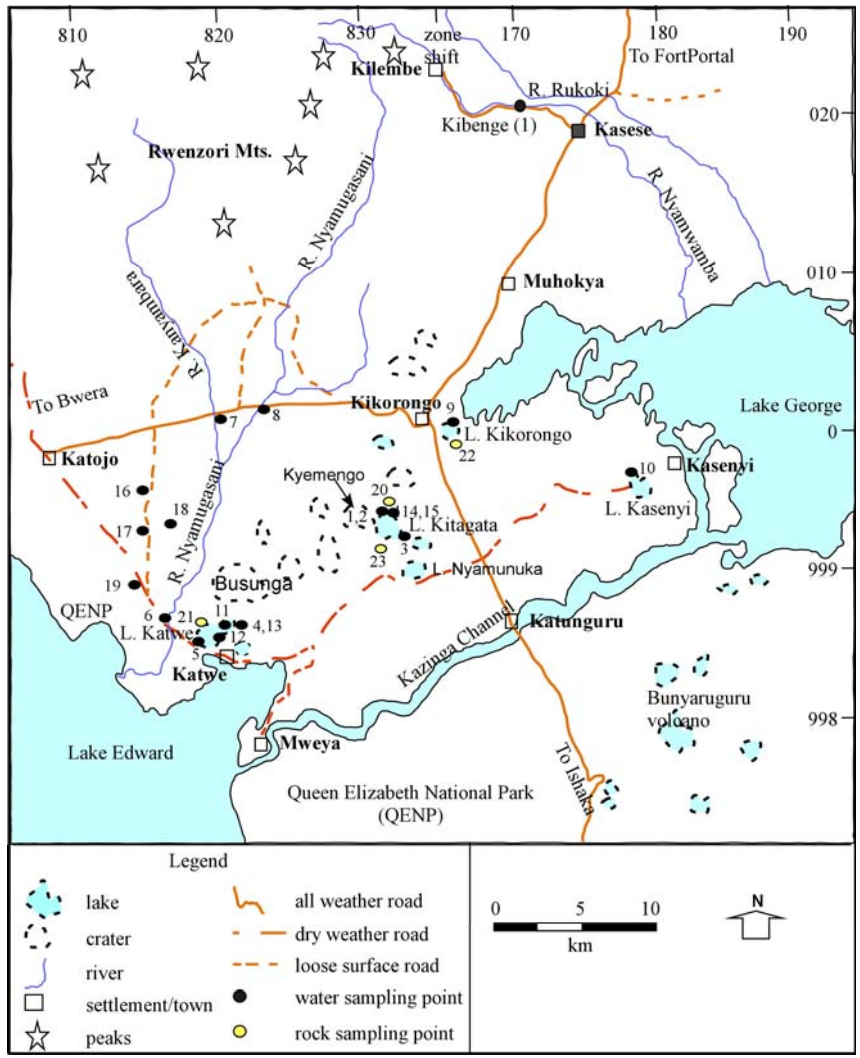
- 118 water samples from hot and cold springs, dug wells, rivers and lakes,
- 13 samples from surface outcrops of different types of rocks,
- Samples analyzed for chemical and isotopic compositions.
- Isotopes analyzed included hydrogen (δD and tritium), Oxygen ($\delta^{18}O$ in water and sulphate),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

Geology of the western Rift Valley

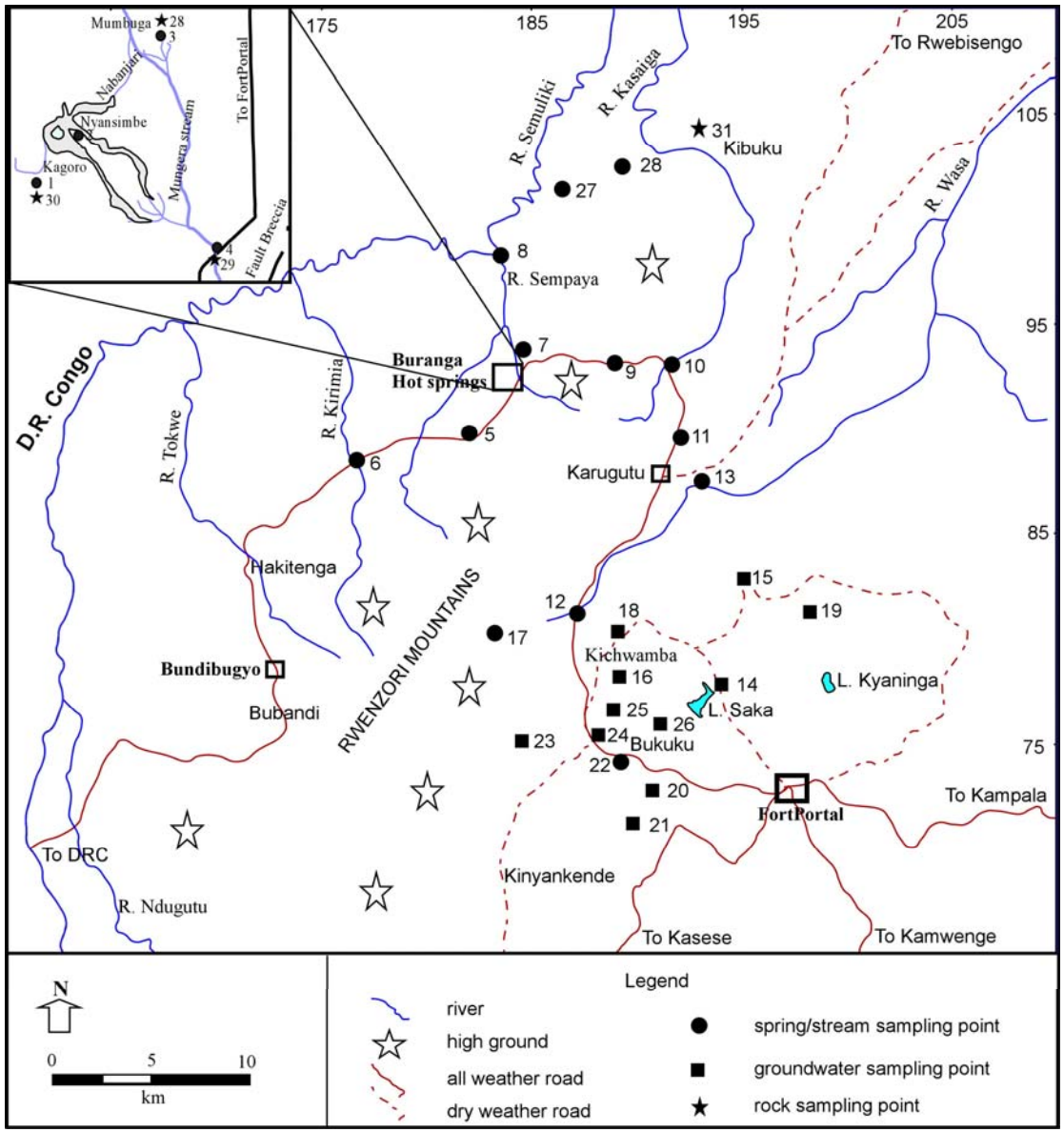
- Katwe: Volcanics
- Buranga: Sedimentary environment
- Kibiro: sedimentary west of the escarpment and crystalline environment east of the escarpment (granites/gneisses)



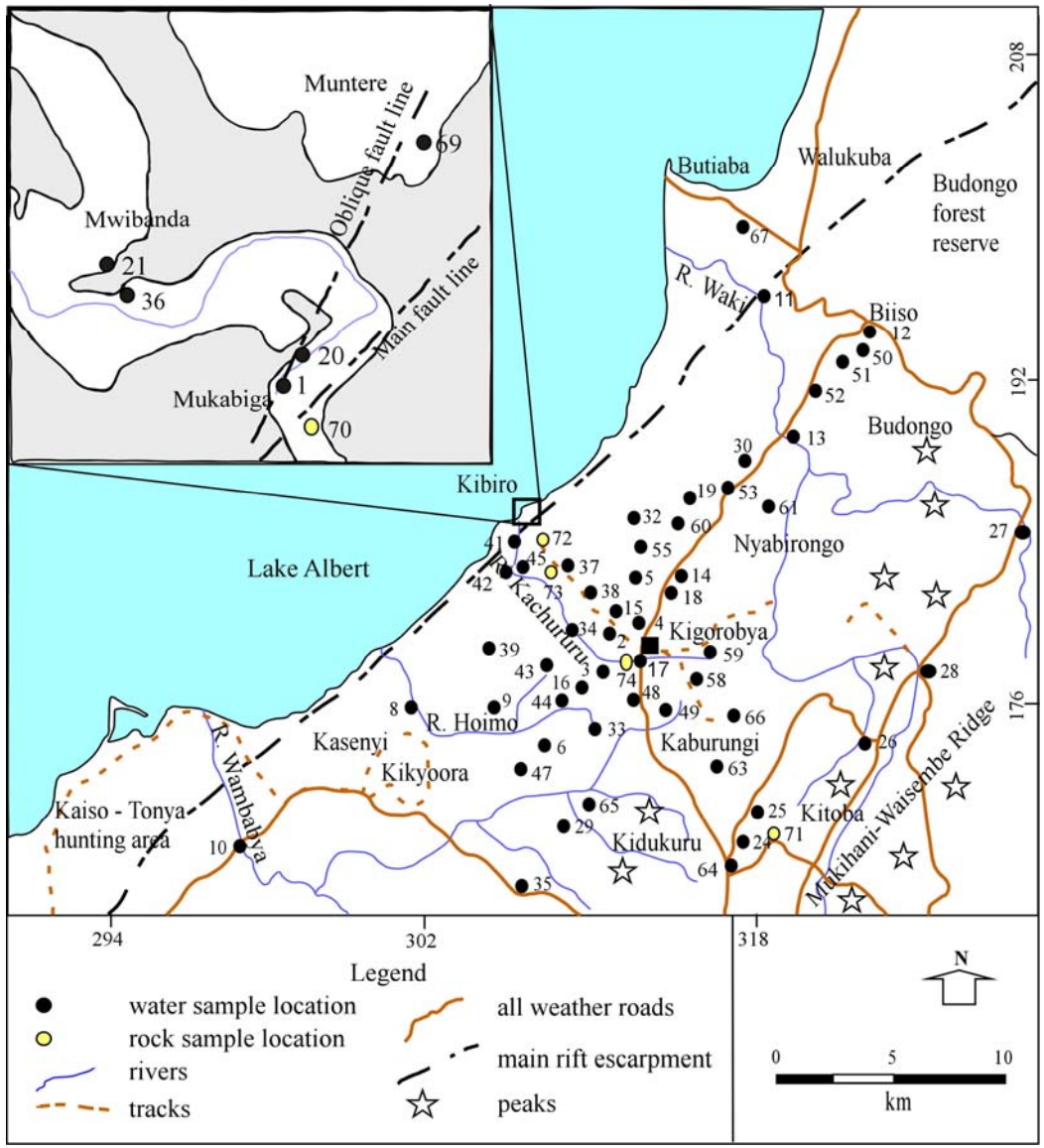
Katwe: sampling points



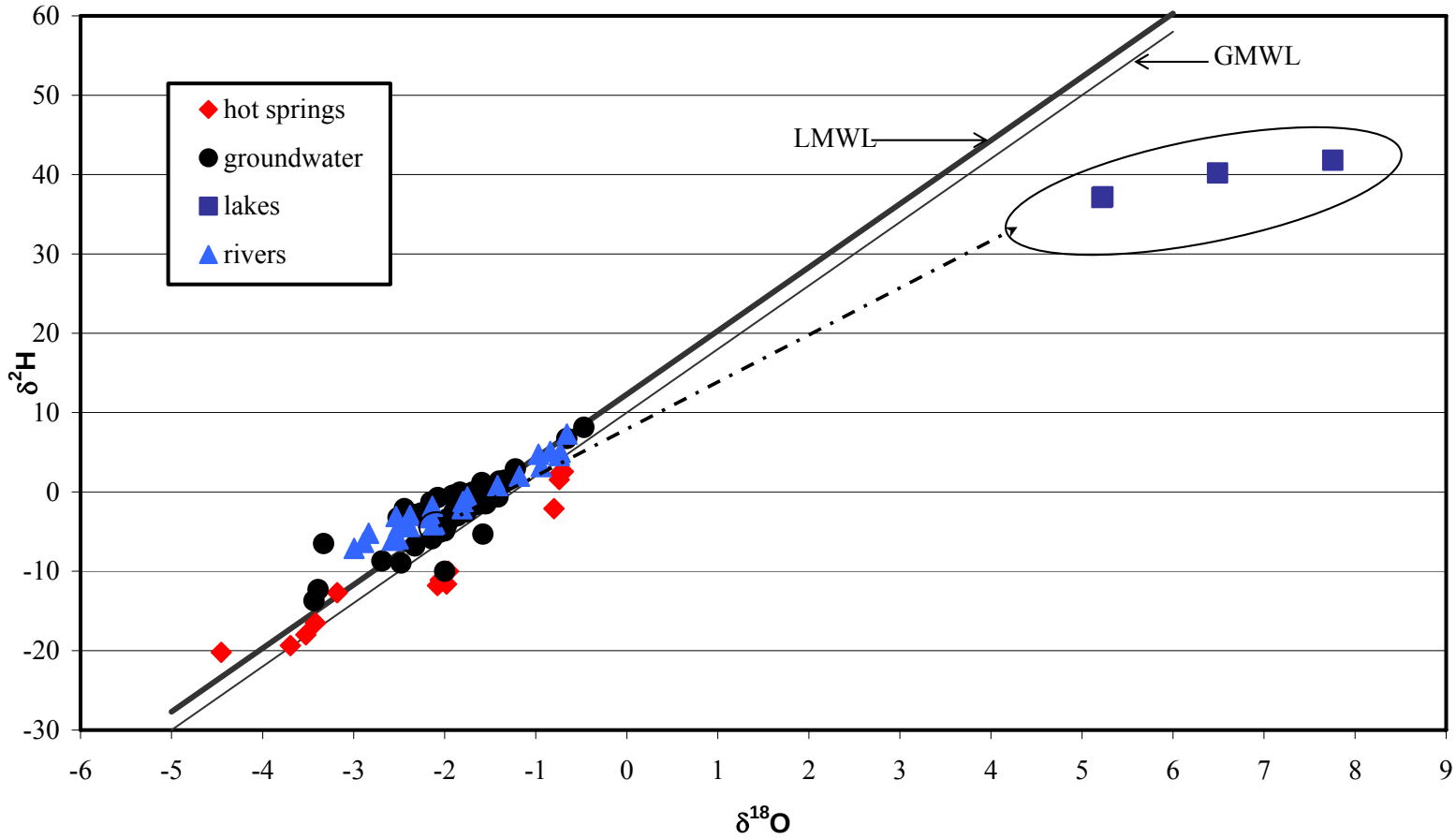
Buranga: sampling points



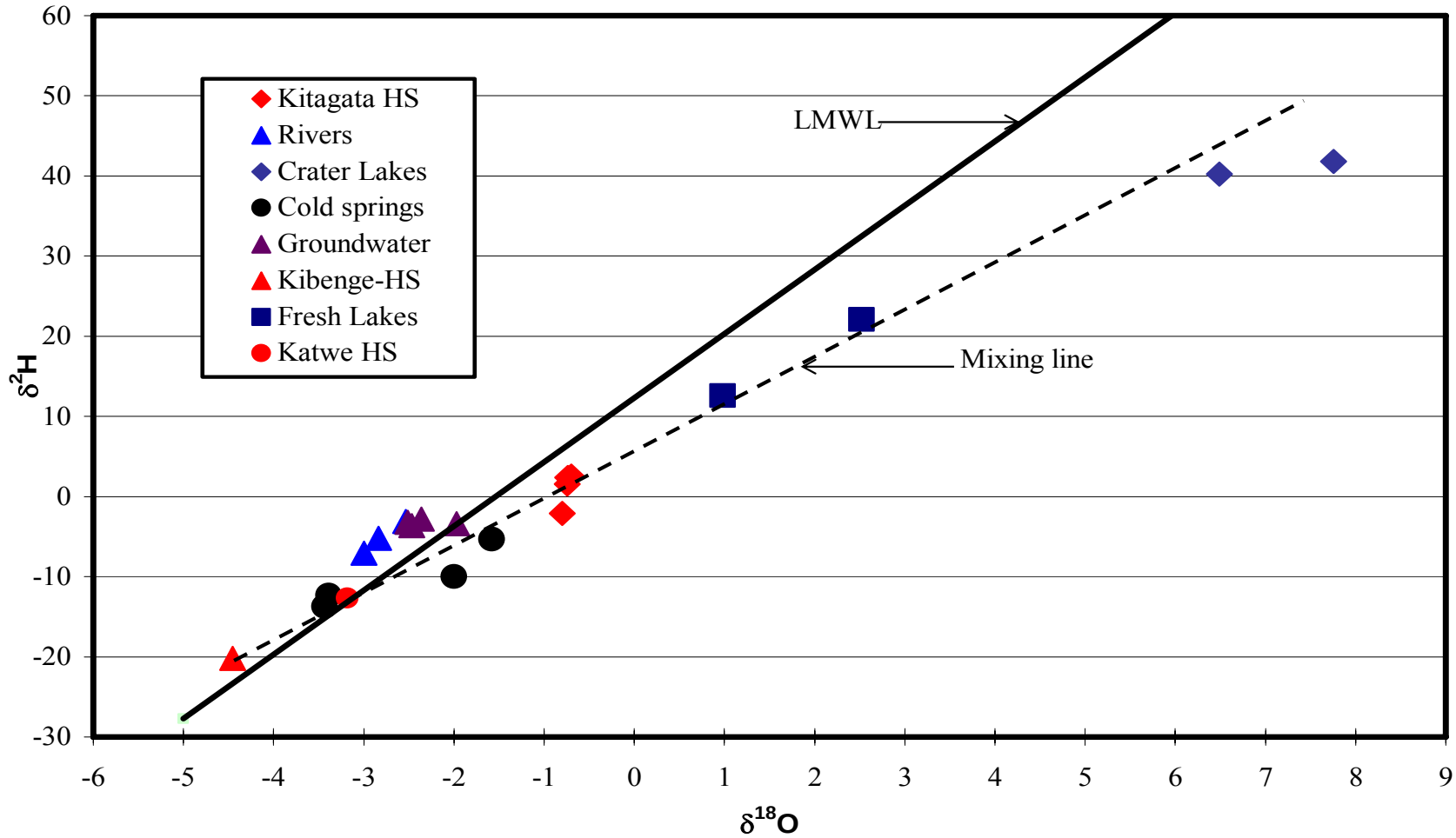
Kibiro: sampling points



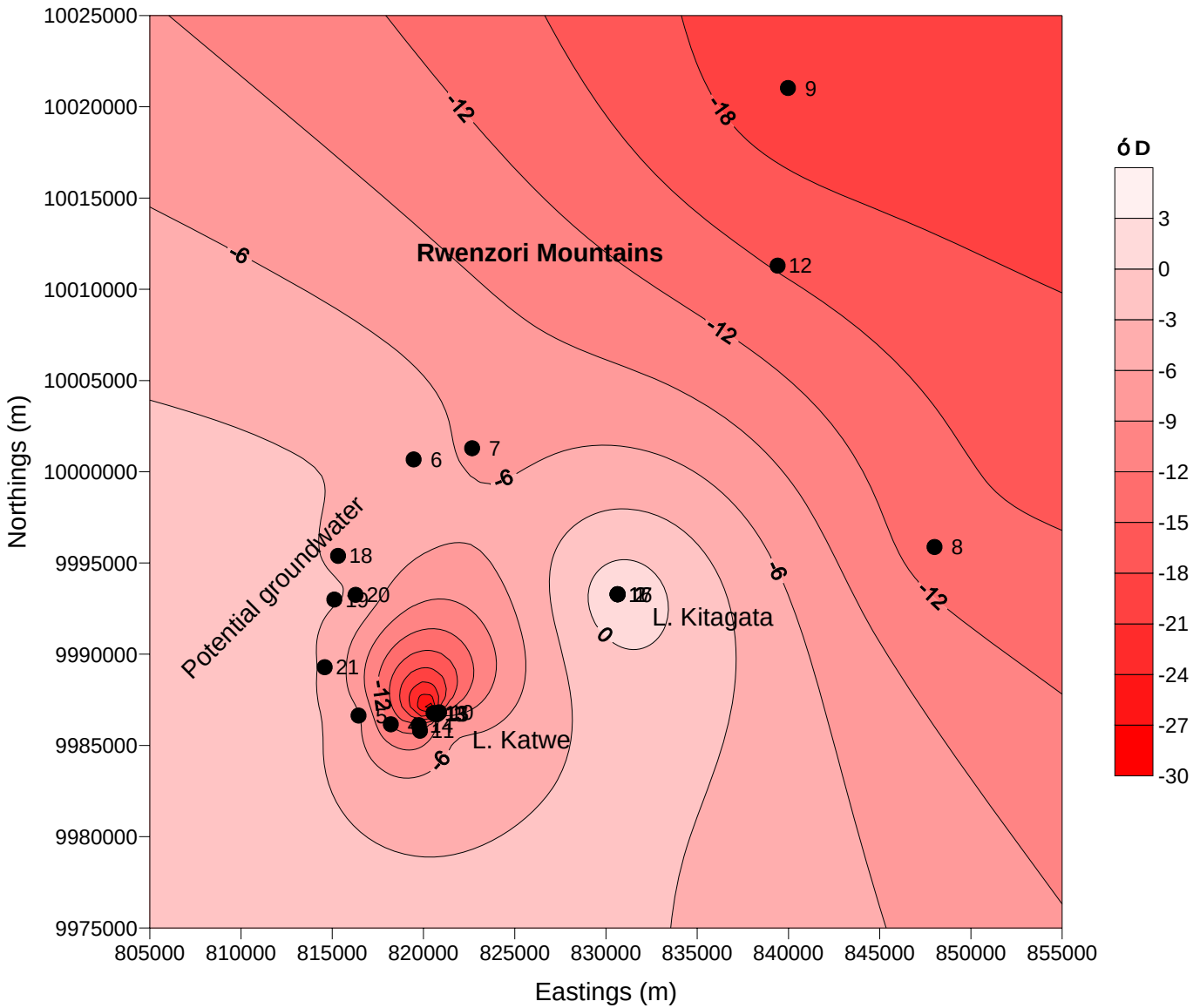
Stable isotopes in water



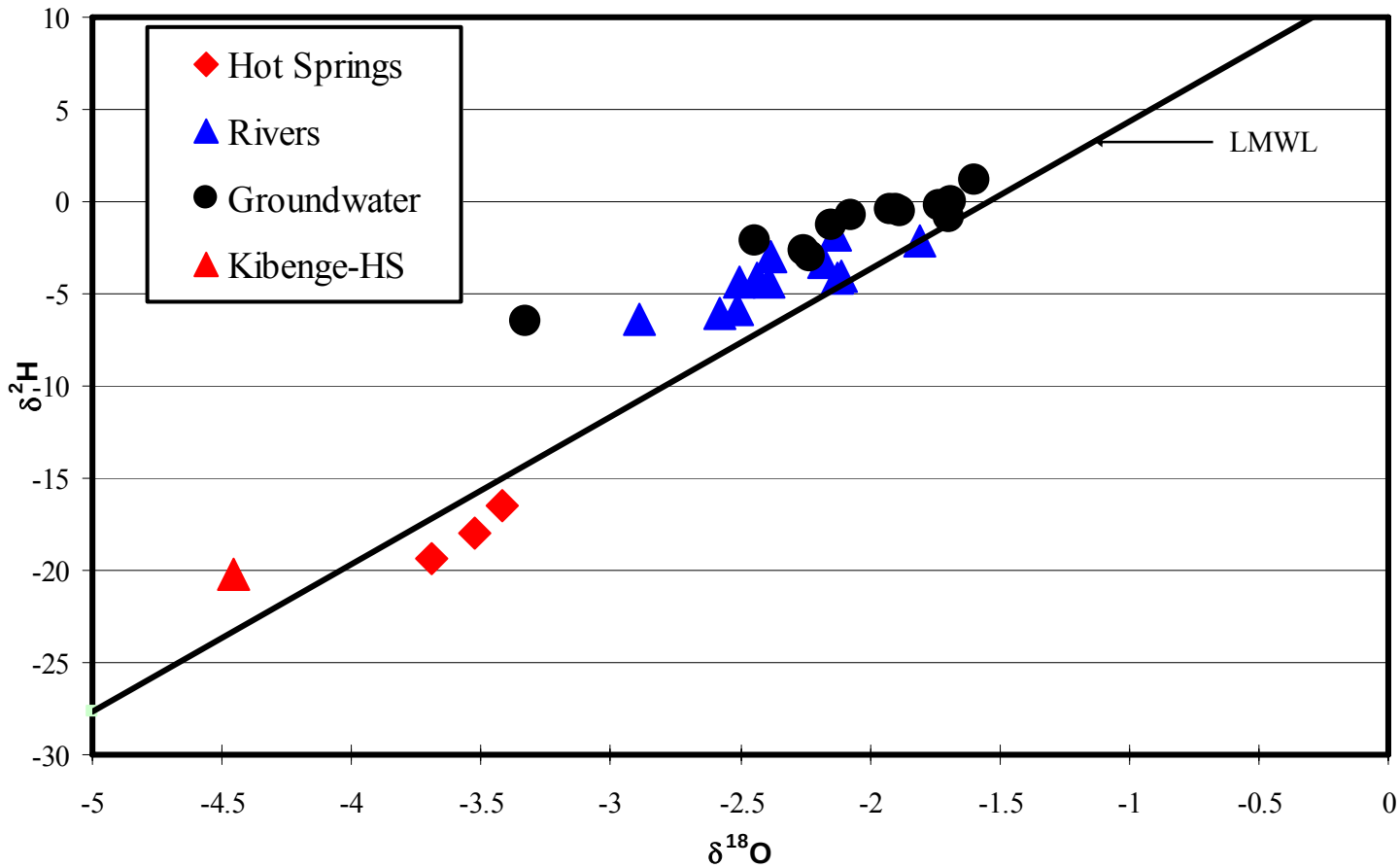
Katwe: stable isotopes in water



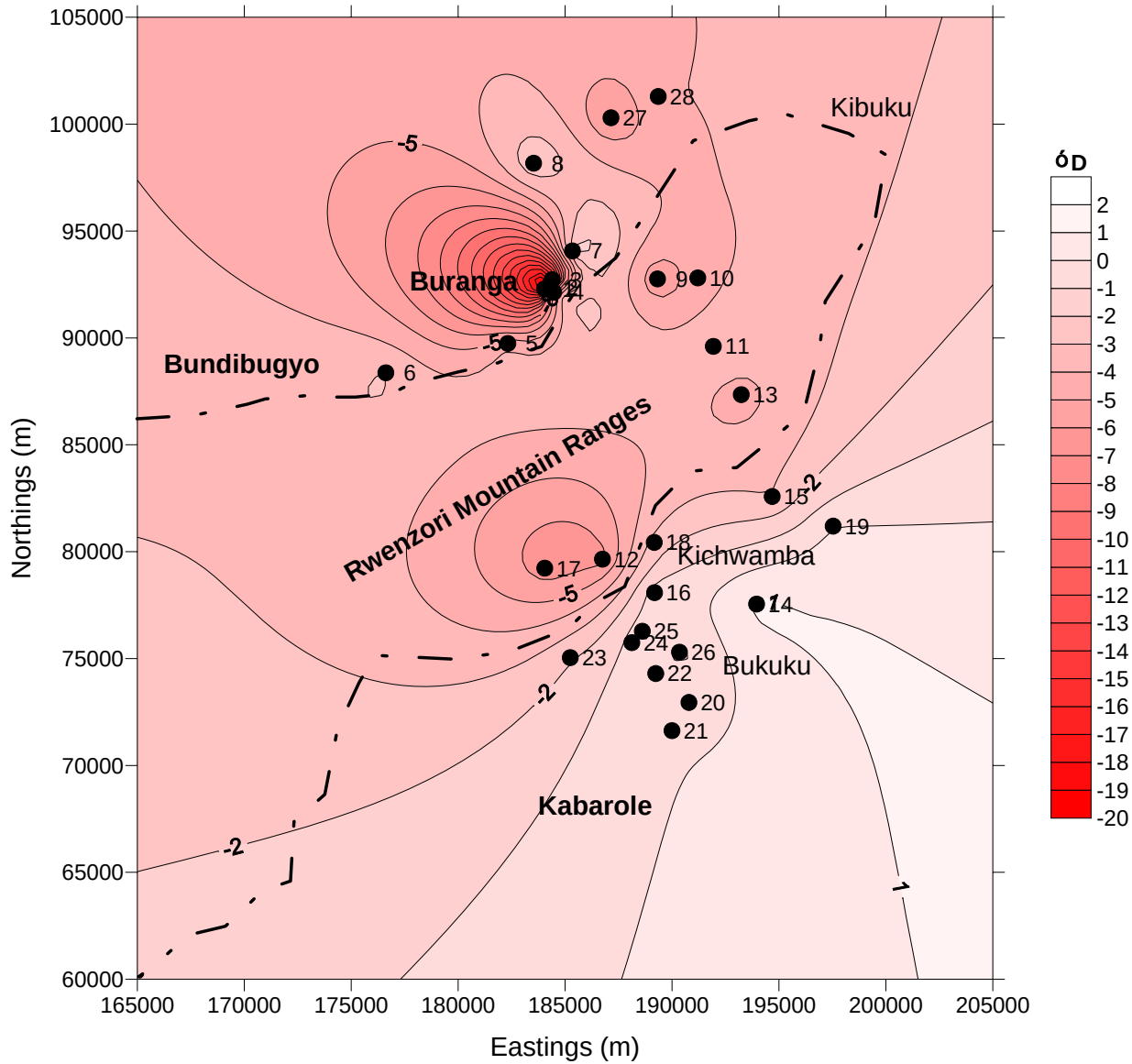
Katwe: deuterium concentration in water



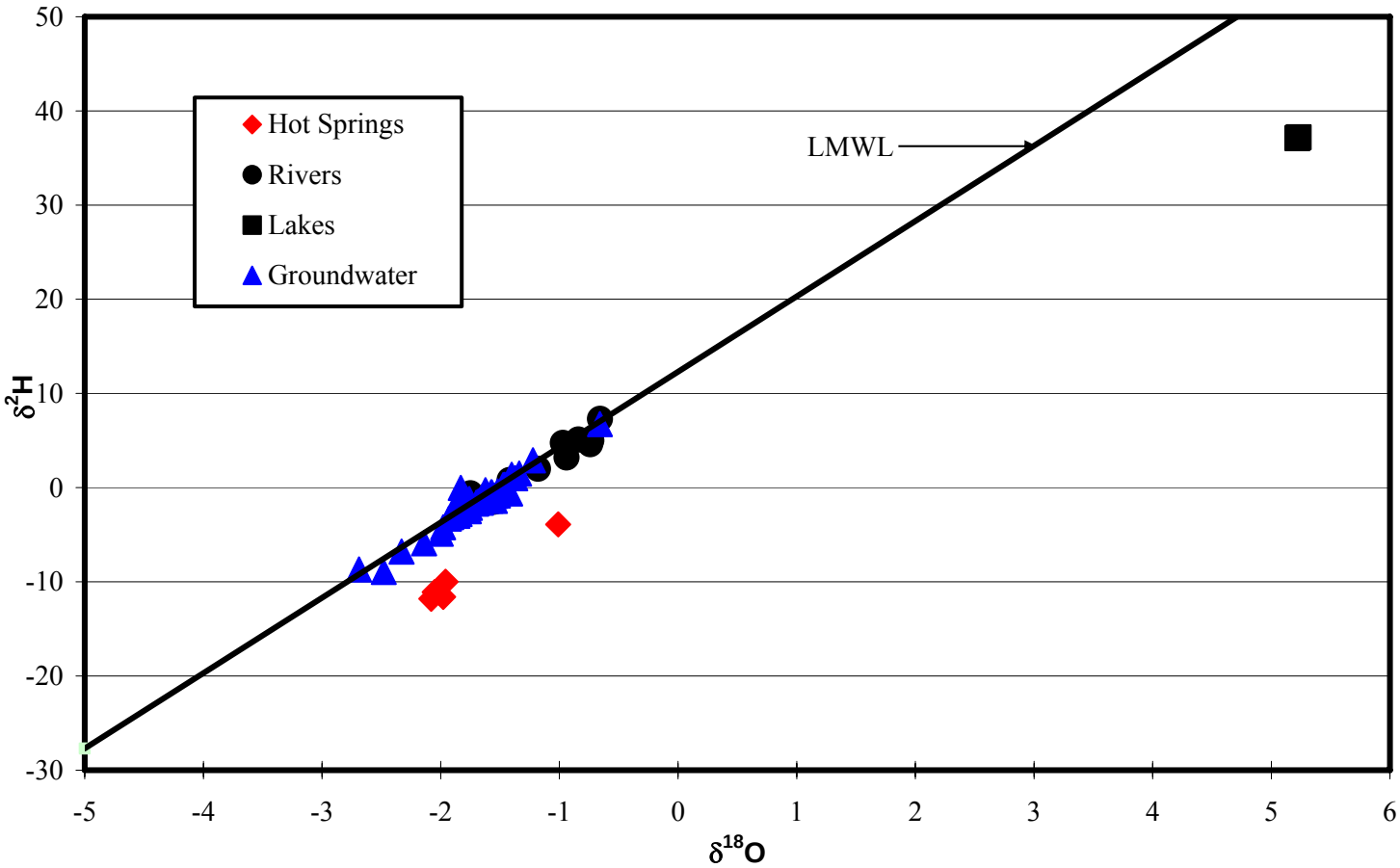
Buranga: stable isotopes in water



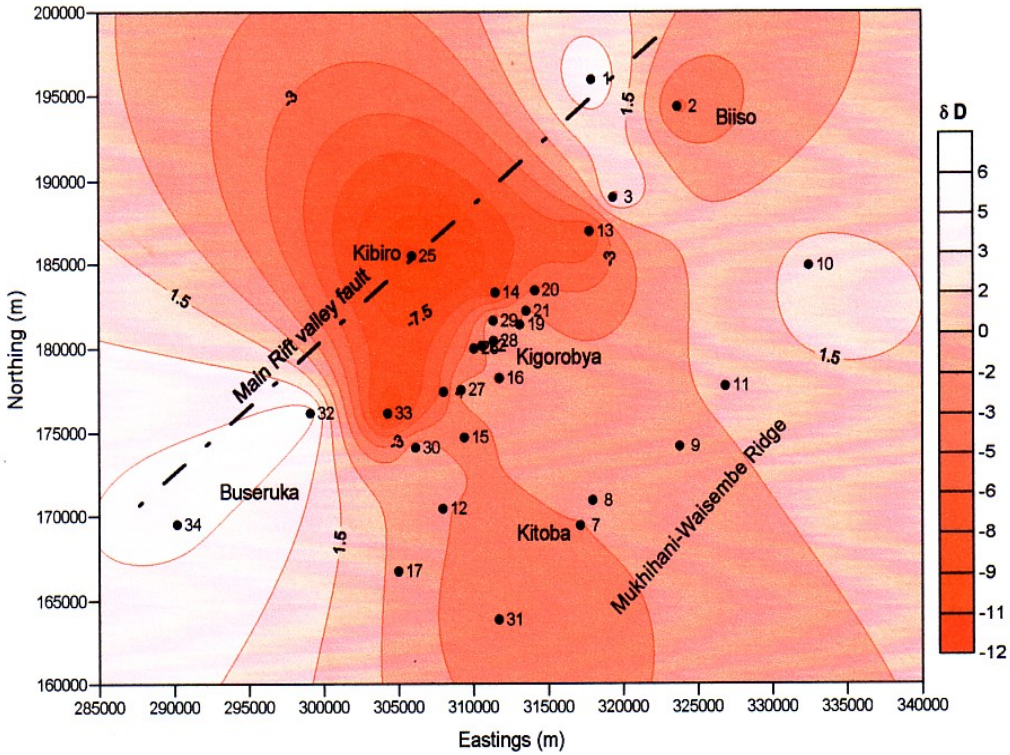
Buranga: deuterium concentration in water



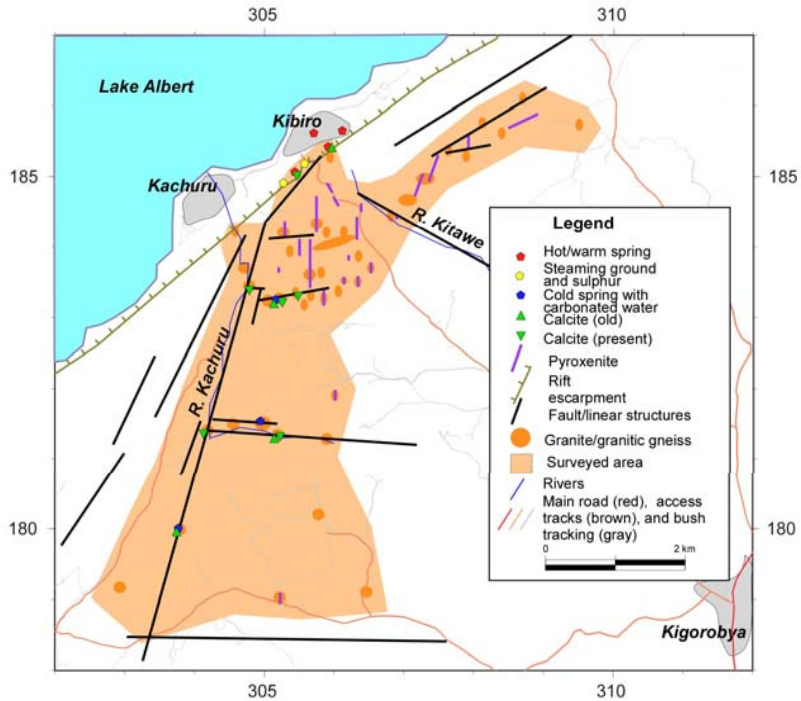
Kibiro: stable isotopes in water



Kibiro: deuterium concentration in water

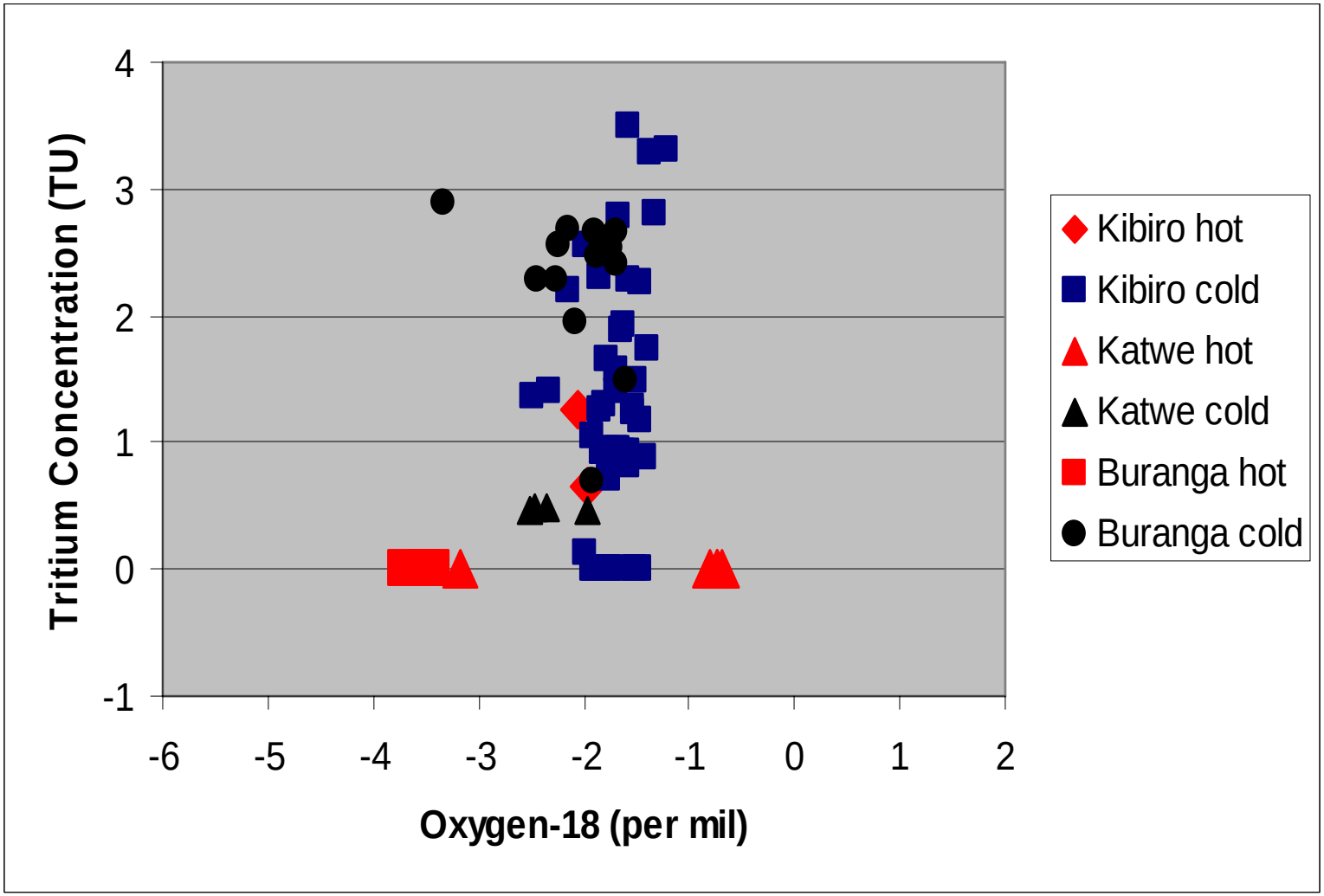


Deuterium in water



Geology of Kibiro

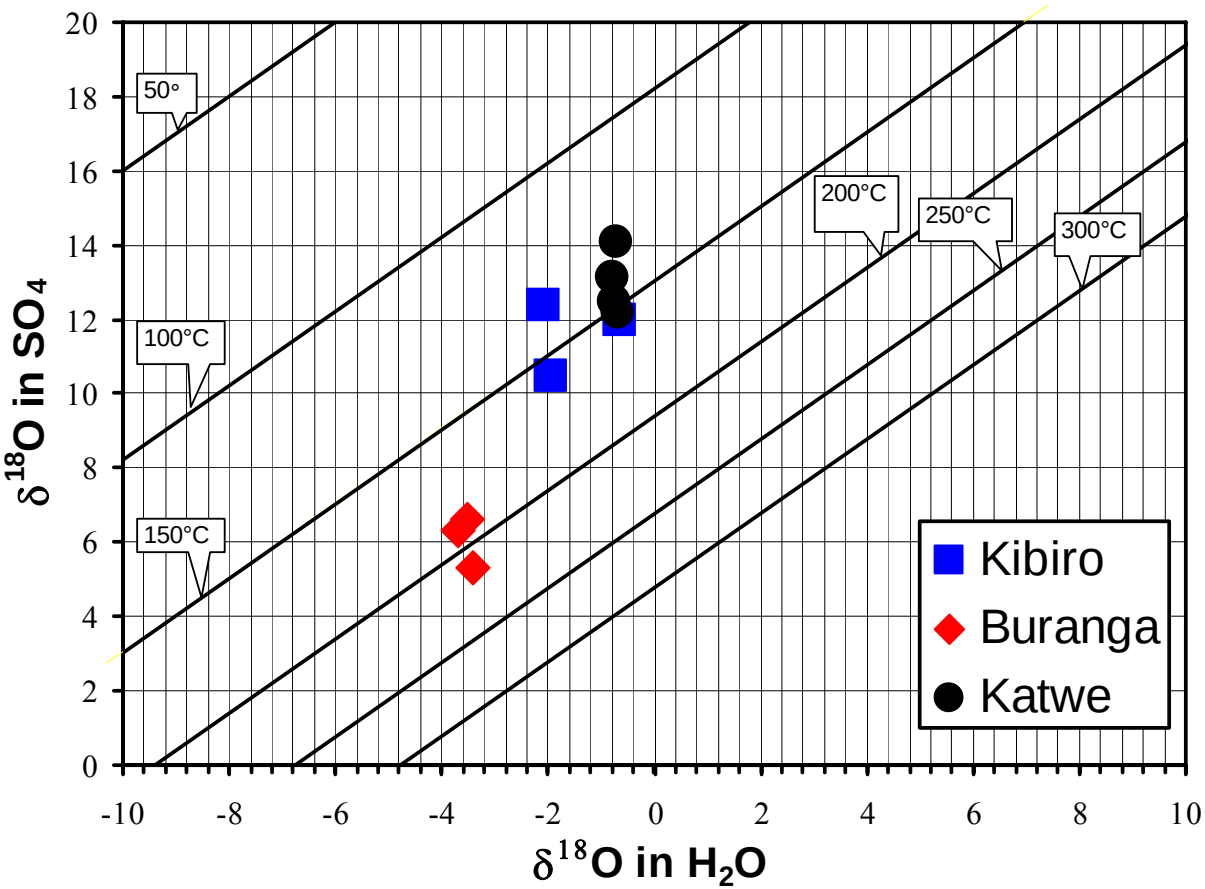
Tritium and mixing processes



Isotope and chemical geothermometry

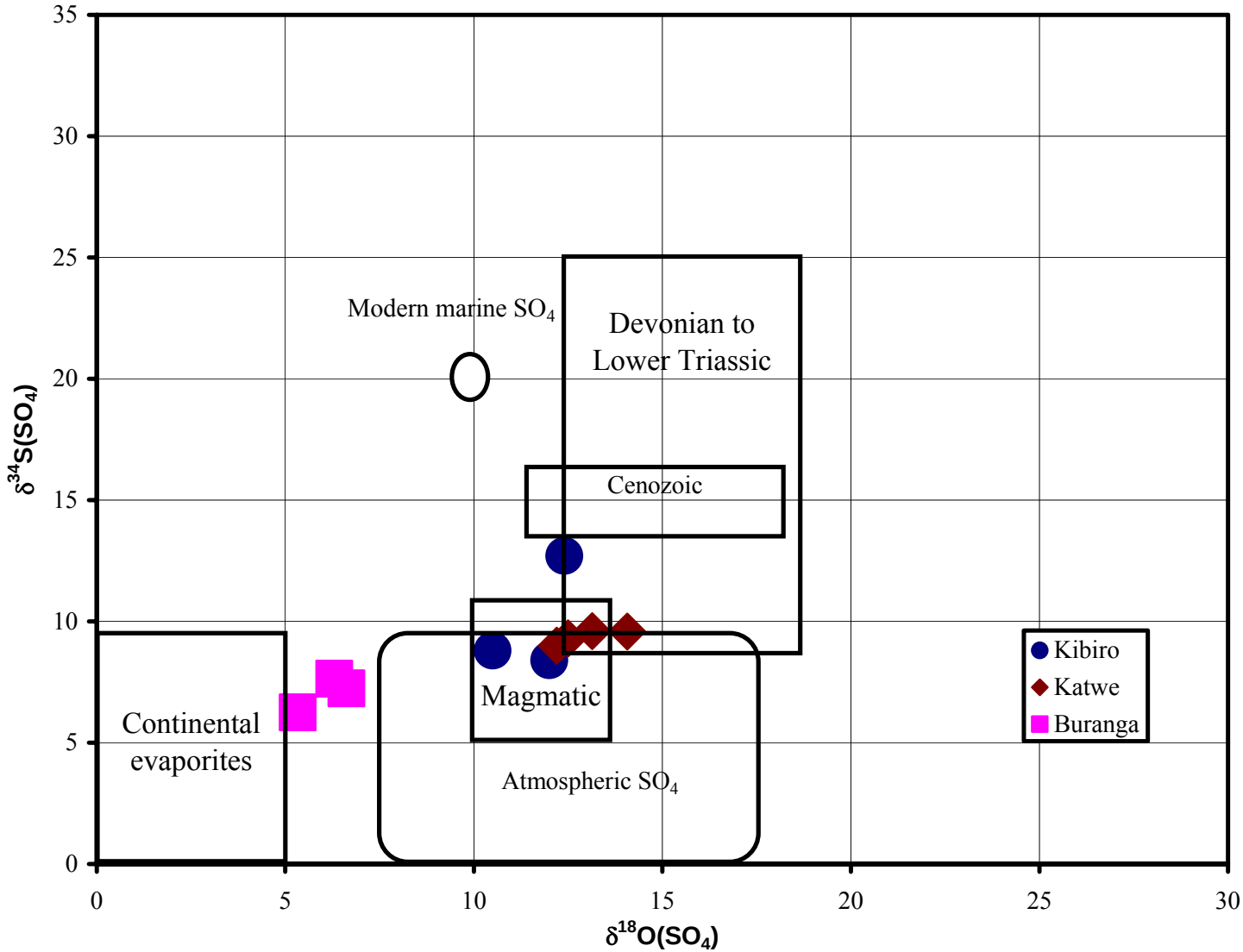
Solute geothermometry:

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

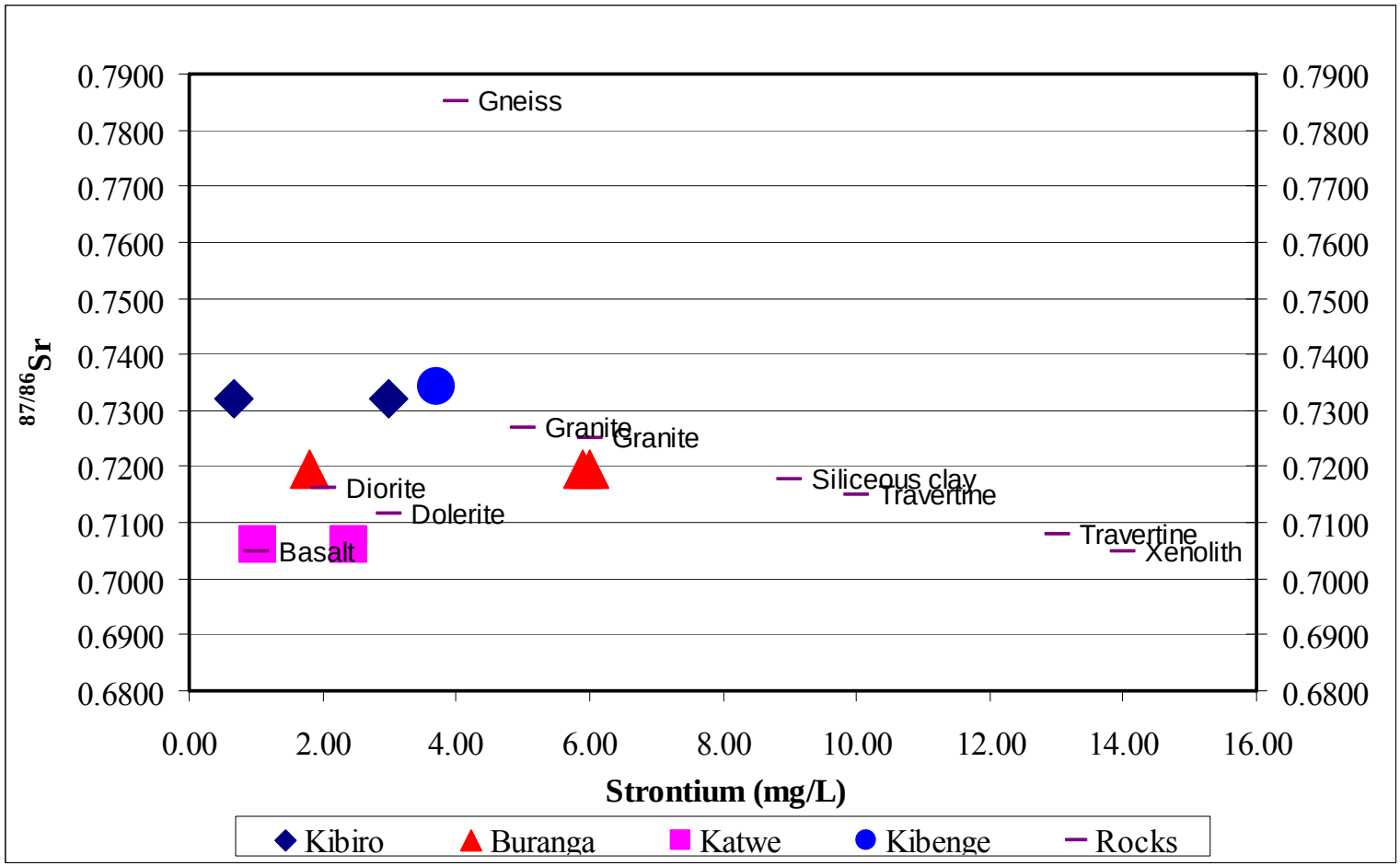


sulphate-water ($S^{18}O_4$-$H_2{}^{18}O$) isotope geothermometer

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 and ultramafic xenolith in Katwe, and granites/gneisses in Buranga and Kibiro.
- The major source of solutes is rock dissolution with magmatic input.


Thank You