Microearthquake Survey at the Buranga Geothermal Prospect, Western Uganda

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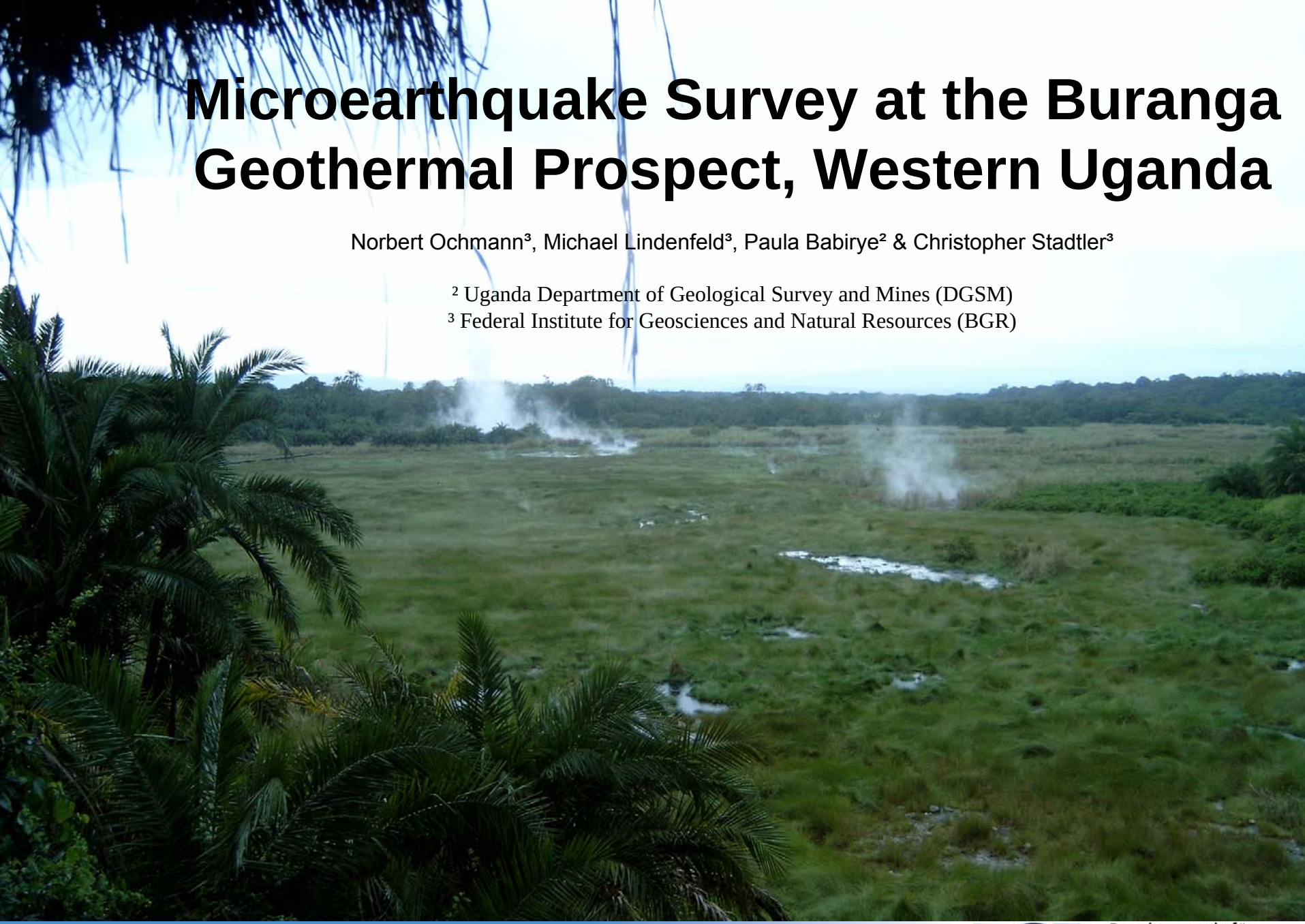
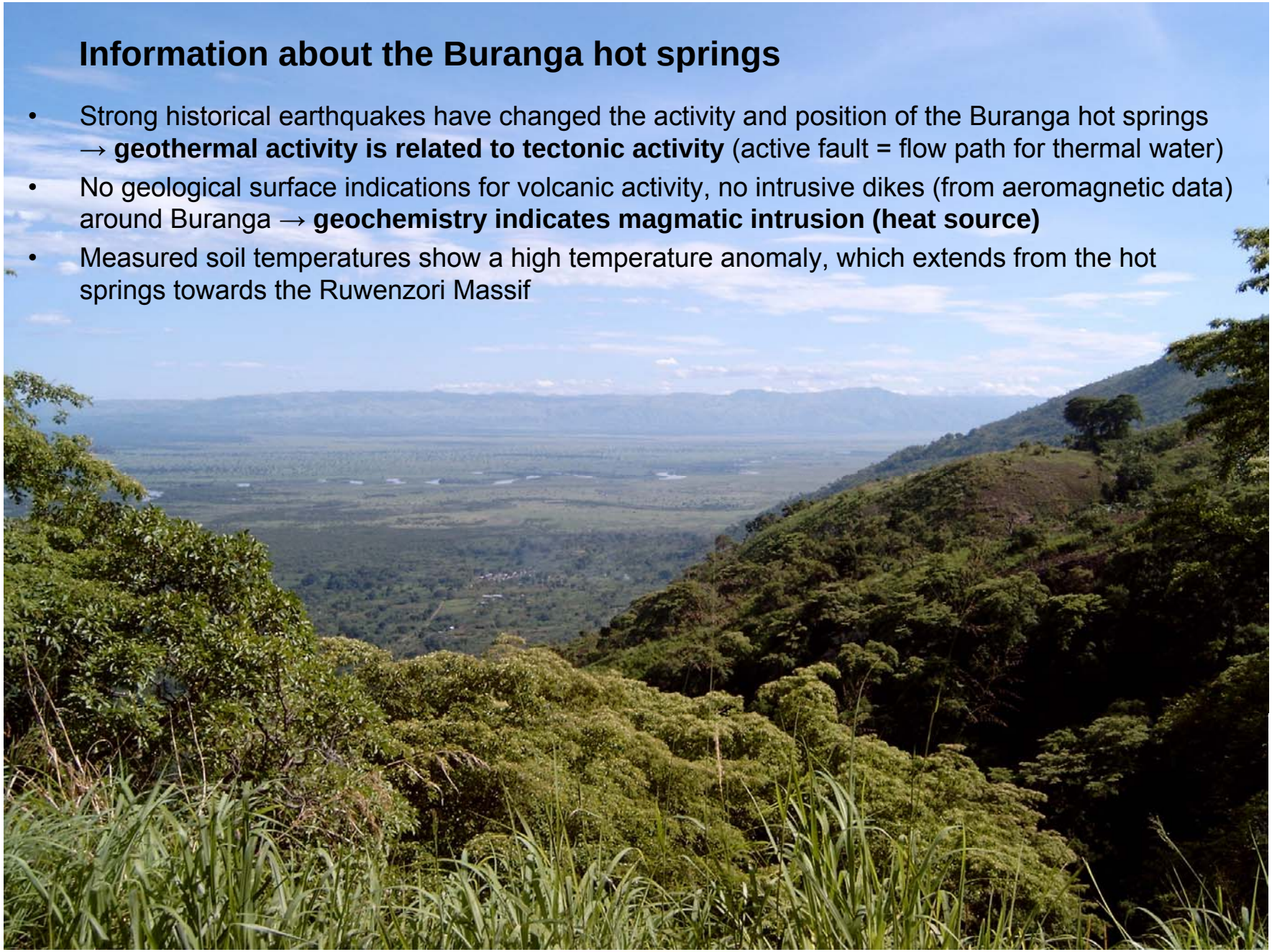


Information about the Buranga hot springs

- Strong historical earthquakes have changed the activity and position of the Buranga hot springs → **geothermal activity is related to tectonic activity** (active fault = flow path for thermal water)
- No geological surface indications for volcanic activity, no intrusive dikes (from aeromagnetic data) around Buranga → **geochemistry indicates magmatic intrusion (heat source)**
- Measured soil temperatures show a high temperature anomaly, which extends from the hot springs towards the Ruwenzori Massif



Objective for Geophysics:

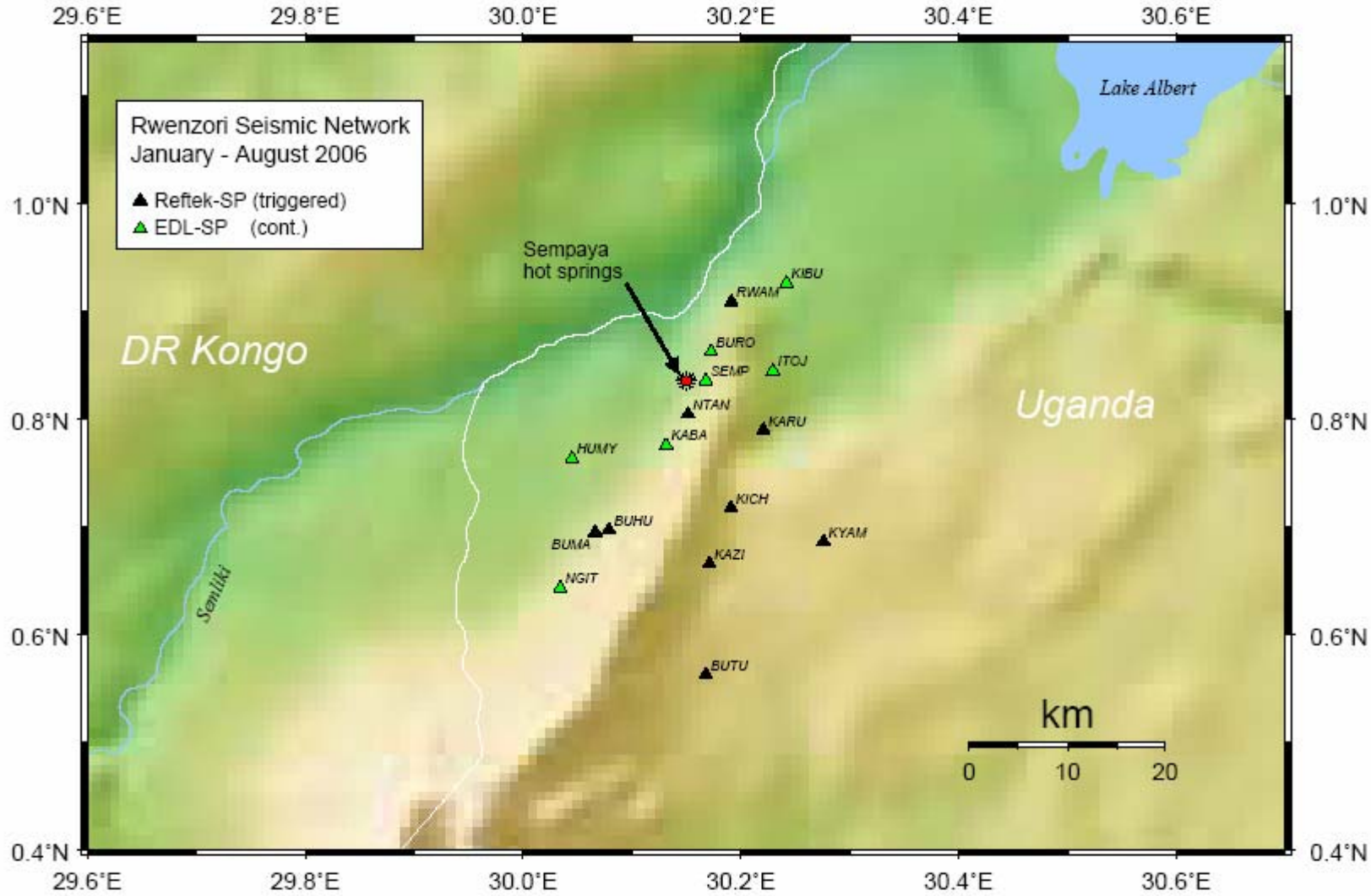
Delineation of underground magmatic intrusion is needed to recommend locations for geothermal exploration boreholes.

Attempt with active ground geophysics:
DC-Soundings, TEM and Gravity

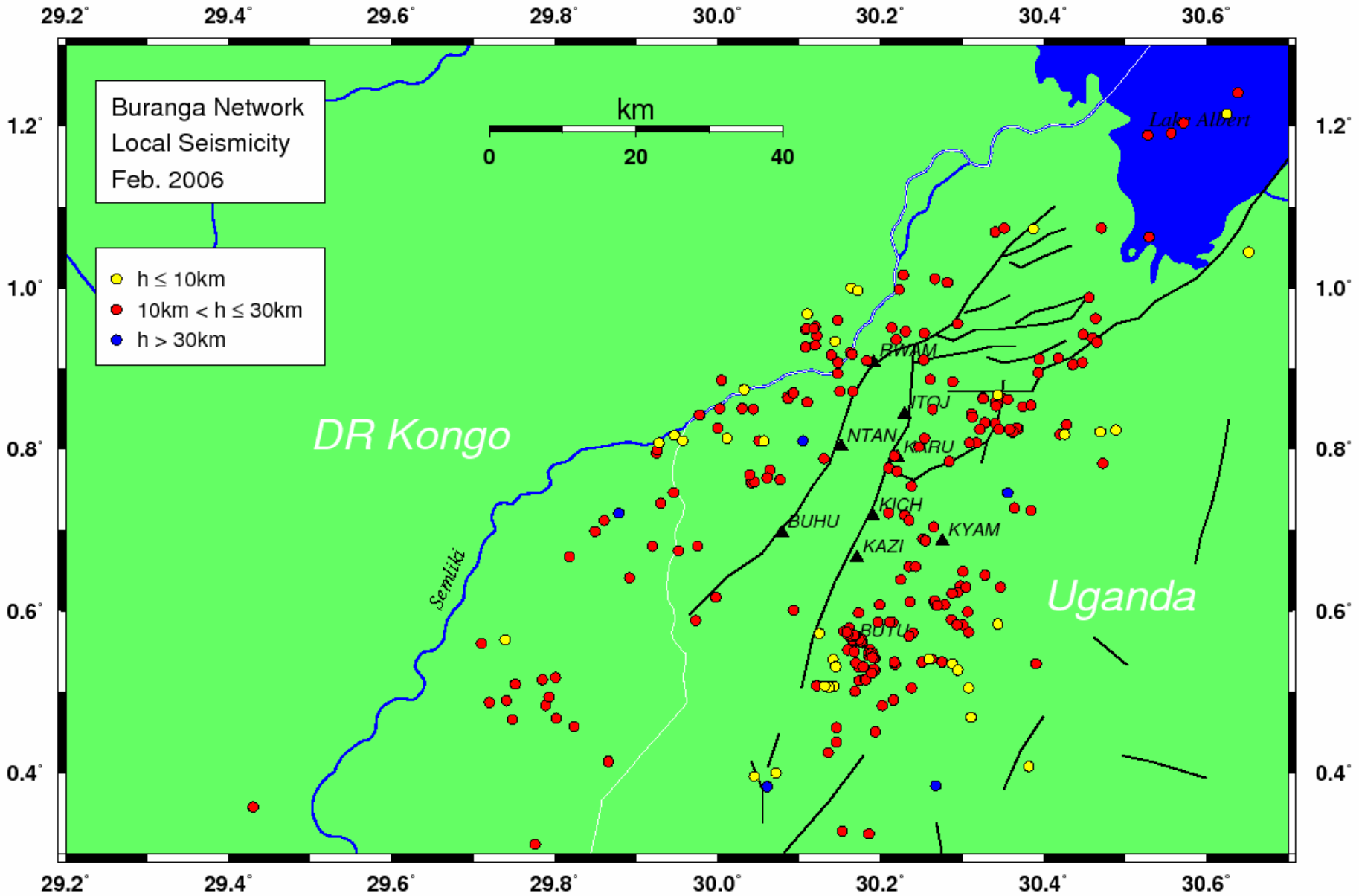
Results of this survey were insufficient to delineate a geothermal reservoir for 2 reasons:

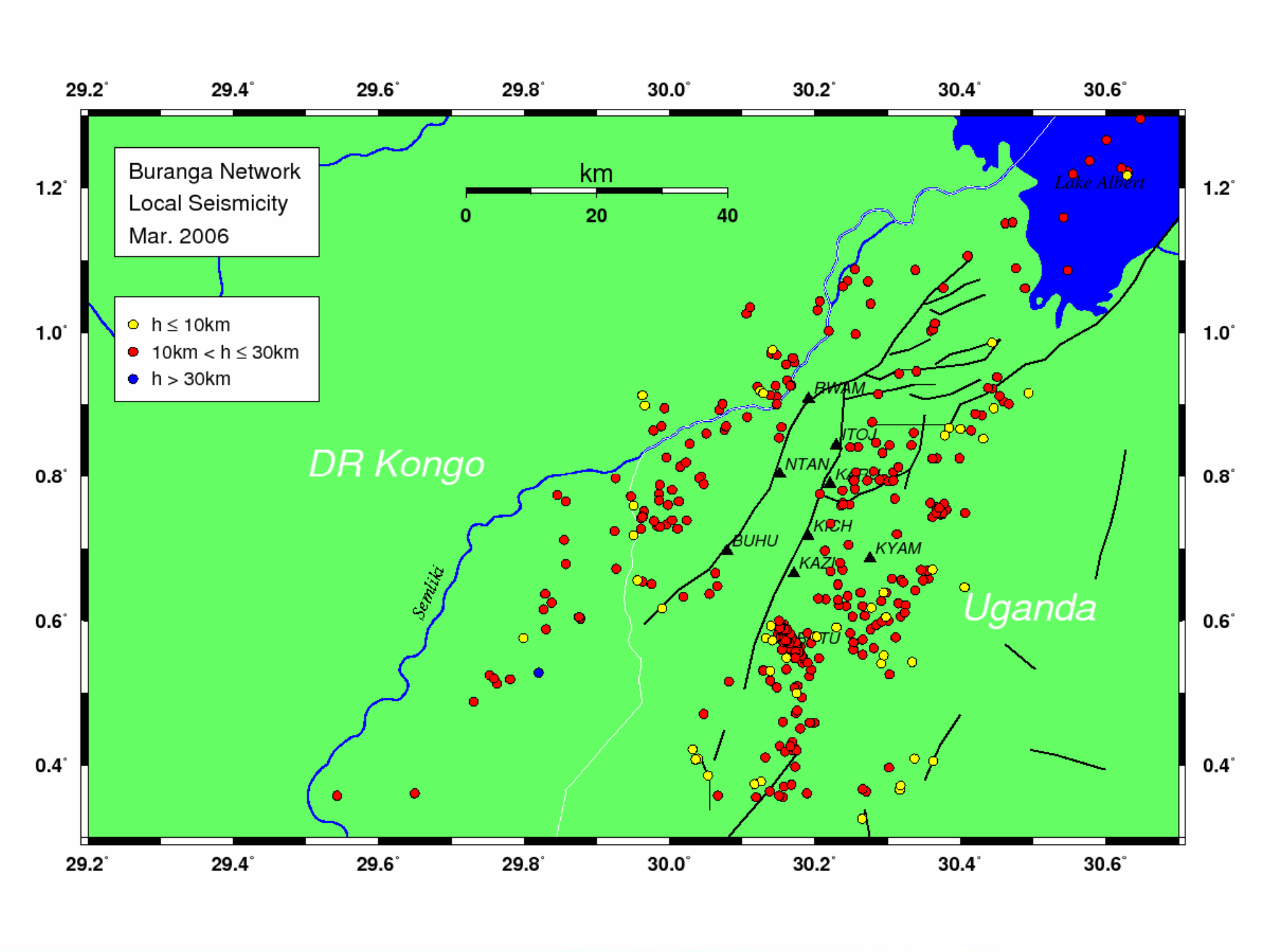
The bad/impossible accessibility of the terrain prevented to cover the survey area adequately with measurements/data.

Low resistivities close to the surface were detected almost everywhere leading to insufficient distinction of results between geothermal active and non-active areas.

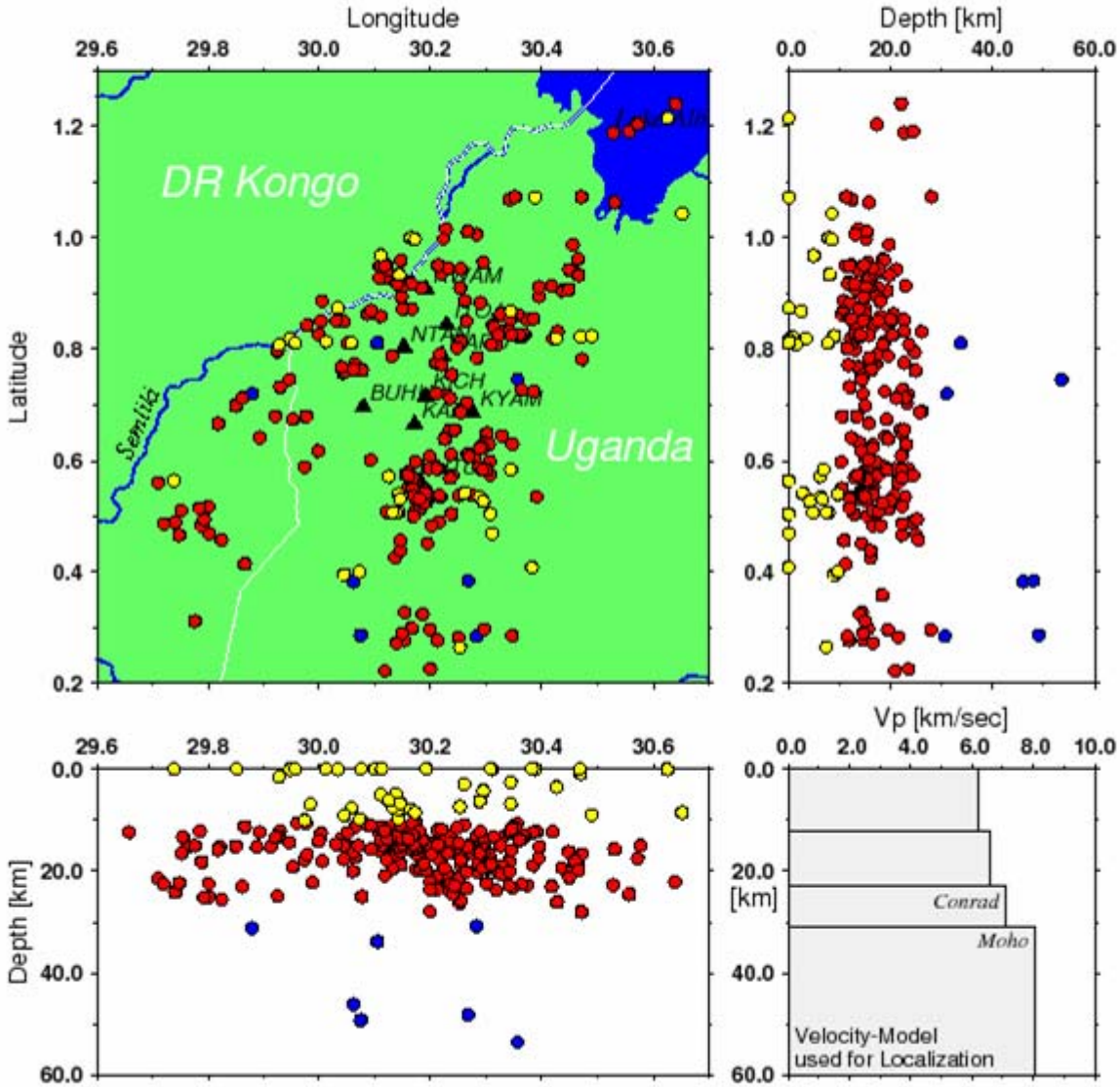

Rwenzori Seismic Network
January - August 2006
Reftek-SP (triggered)
EDL-SP (cont.)
Sempaya
hot springs
DR Kongo
Uganda
Lake Albert
Semliki
KIBU
RWAM
BURO
ITOJ
SEMP
NTAN
KARU
KABA
HUMY
KICH
BUHU
BUMA
KYAM
KAZI
NGIT
BUTU
km
0
10
20
29.6°E
29.8°E
30.0°E
30.2°E
30.4°E
30.6°E
1.0°N
0.8°N
0.6°N
0.4°N


REF TEK
6.

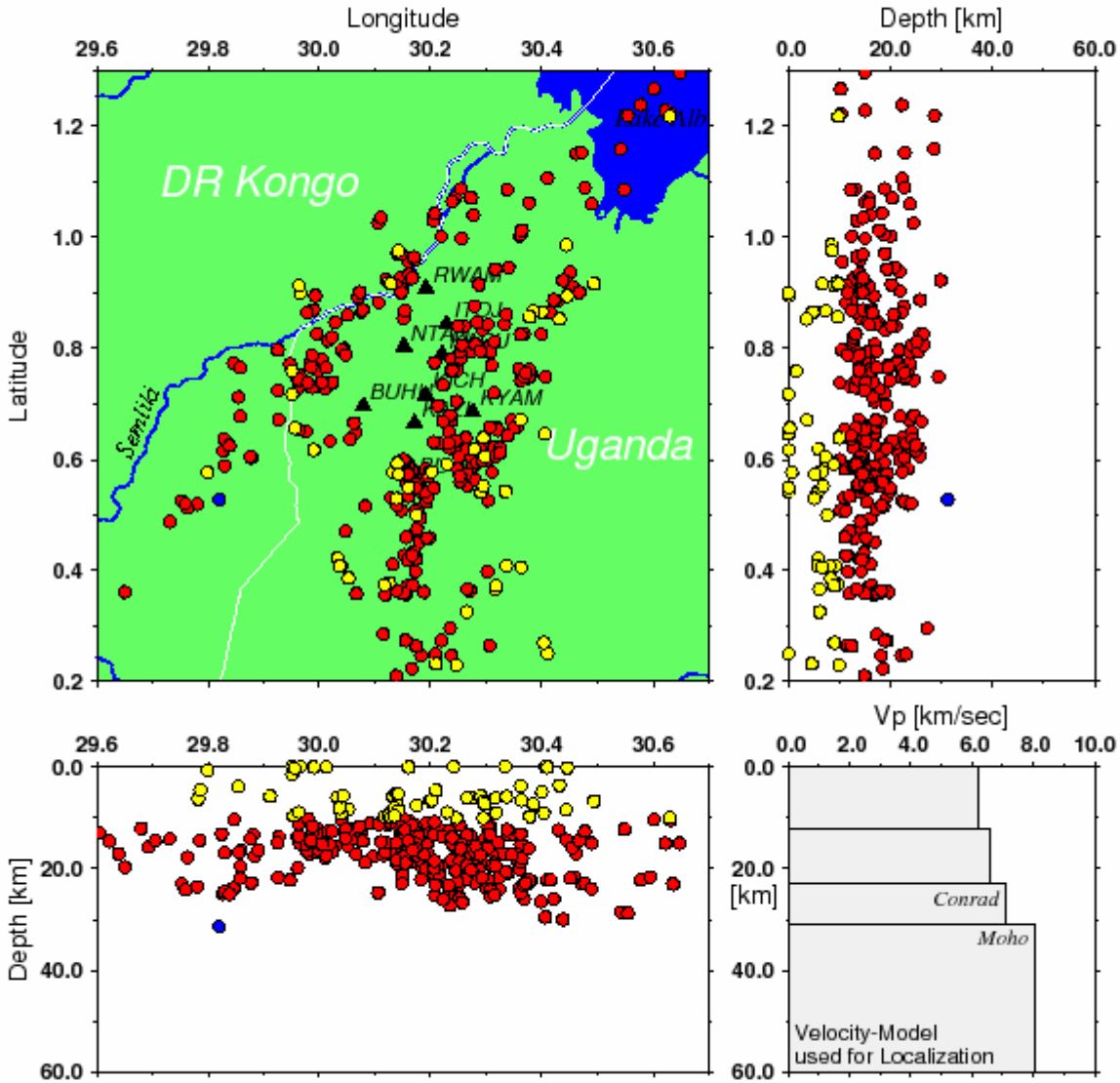

Buranga Network
Local Seismicity
Feb. 2006
h ≤ 10km
10km < h ≤ 30km
h > 30km
km
0
20
40
DR Kongo
Uganda
Lake Albert
Semliki
BWAM
ITOJ
NTAN
KARU
KICH
BUHU
KYAM
KAZI
BUTU
29.2°
29.4°
29.6°
29.8°
30.0°
30.2°
30.4°
30.6°
1.2°
1.0°
0.8°
0.6°
0.4°

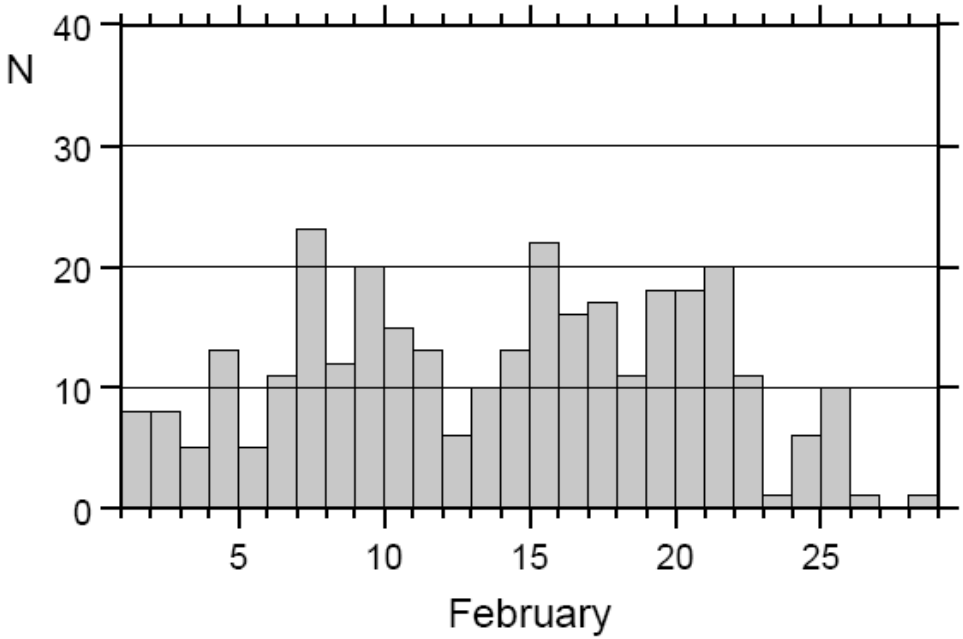

Buranga Network
Local Seismicity
Mar. 2006
h ≤ 10km
10km < h ≤ 30km
h > 30km
km
0
20
40
DR Kongo
Uganda
Lake Albert
Semliki
BWAM
ITOJ
NTAN
KYAM
KAZI
BUHU
29.2°
29.4°
29.6°
29.8°
30.0°
30.2°
30.4°
30.6°
1.2°
1.0°
0.8°
0.6°
0.4°

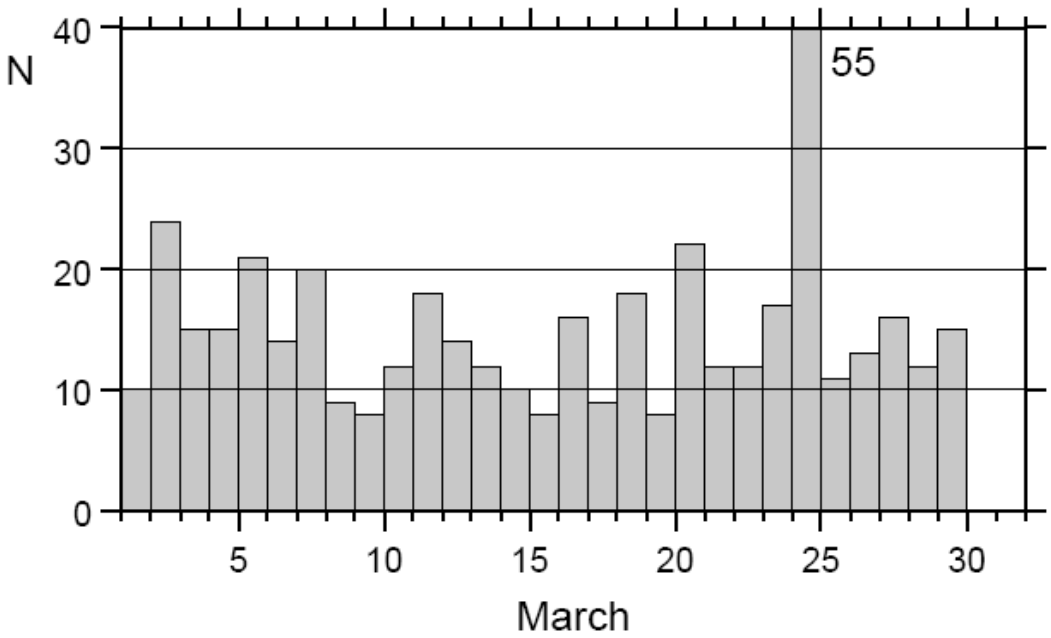
February 2006



March 2006


Longitude
29.6
29.8
30.0
30.2
30.4
30.6
Latitude
1.2
1.0
0.8
0.6
0.4
0.2
DR Kongo
Uganda
Semliki
RWAM
ITDJ
NTAM
KCH
KYAM
BUHI
Depth [km]
0.0
20.0
40.0
60.0
Vp [km/sec]
2.0
4.0
6.0
8.0
10.0
[km]
Conrad
Moho
Velocity-Model
used for Localization

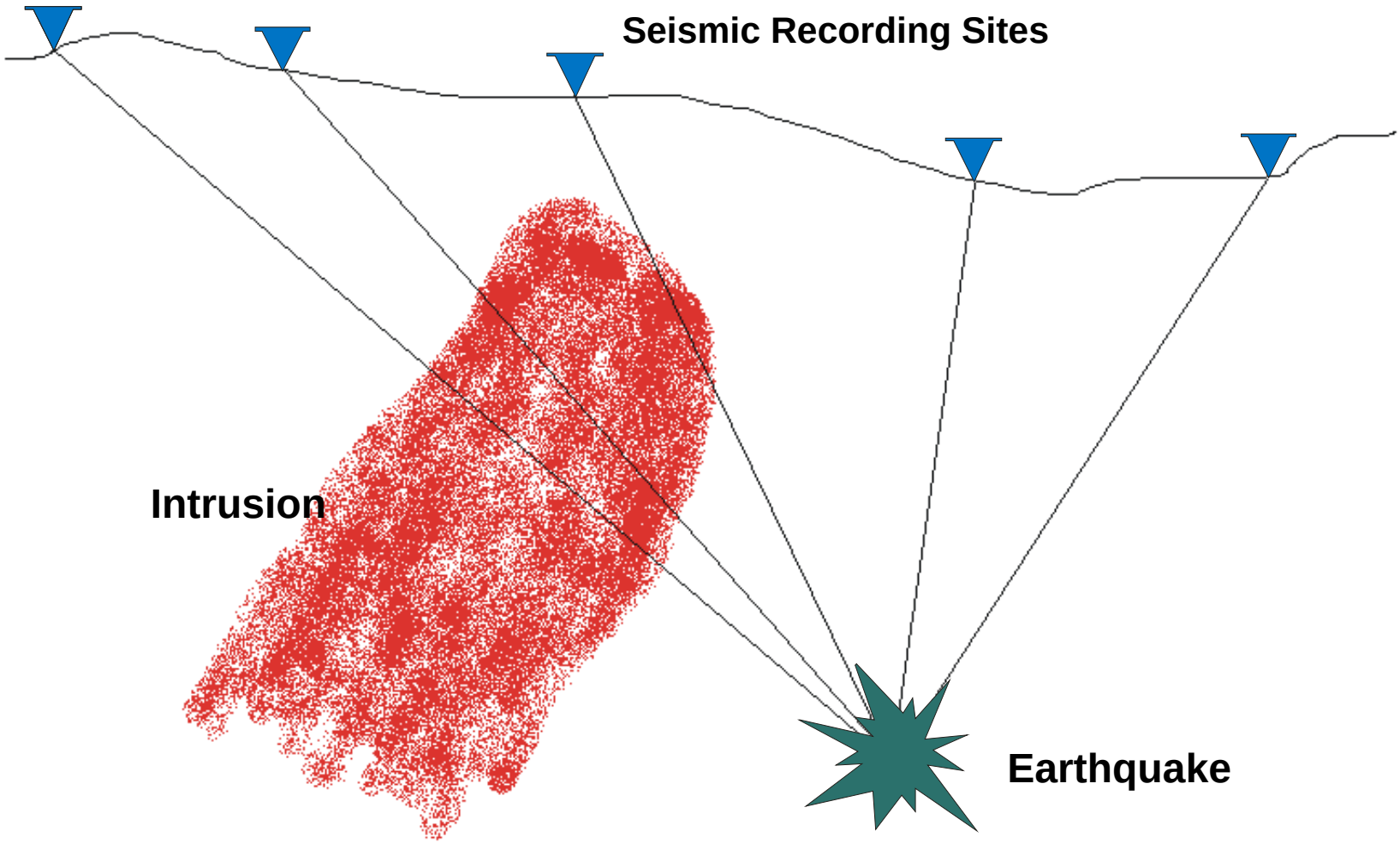


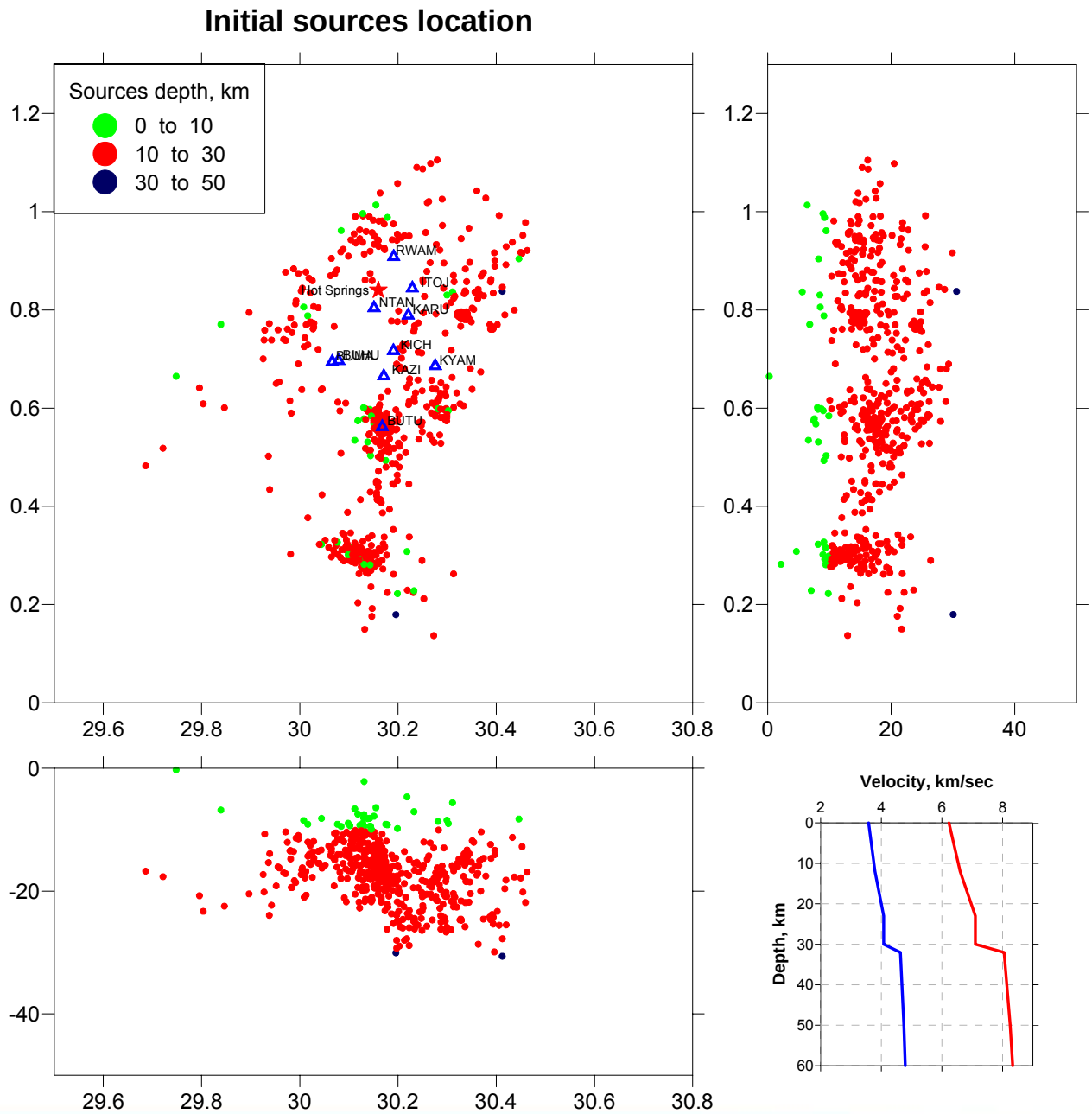


located earthquakes in February and March 2006:

- total: 760 events
- average: 13 per day

How can Seismology help to delineate an assumed magmatic Intrusion?





A Data Subset of

602 events

was used for inversion

6616 rays

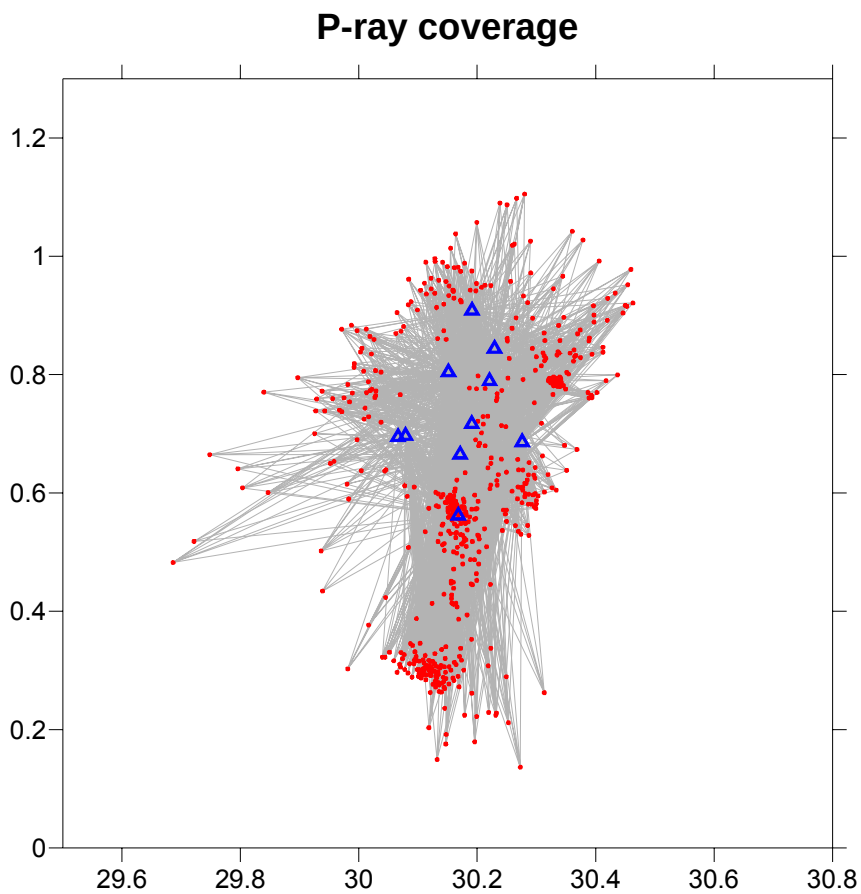
3336 P-rays

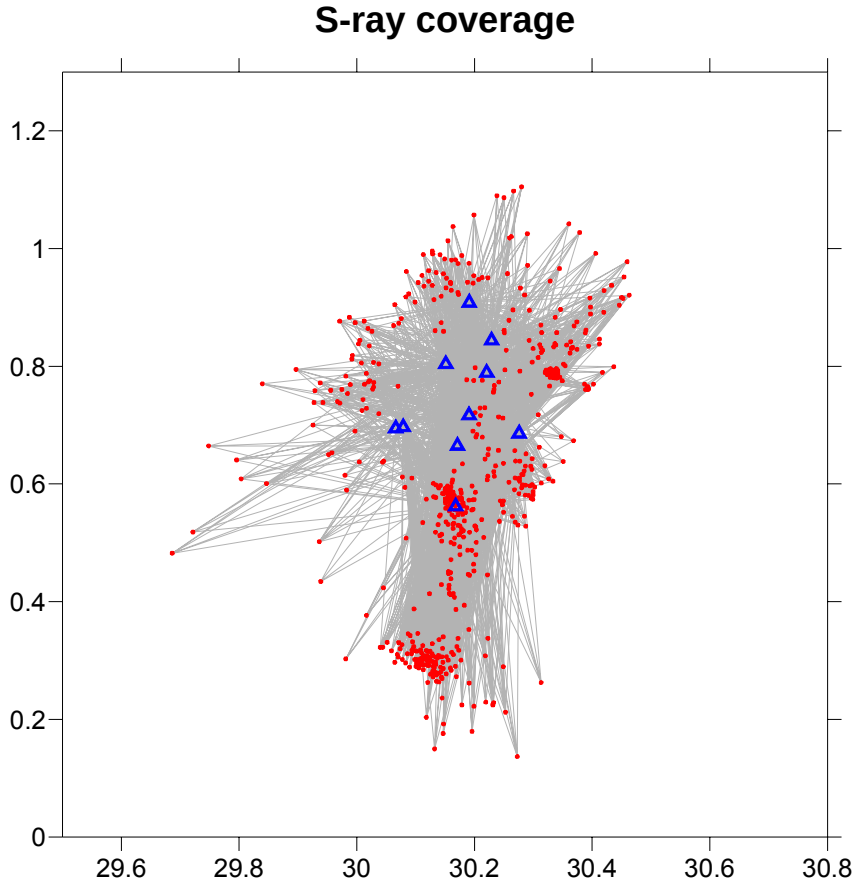
3280 S-rays

10 stations from February to May 2006 having errors in location <= 5 km and RMS of residual <= 0.1 sec.

602 events

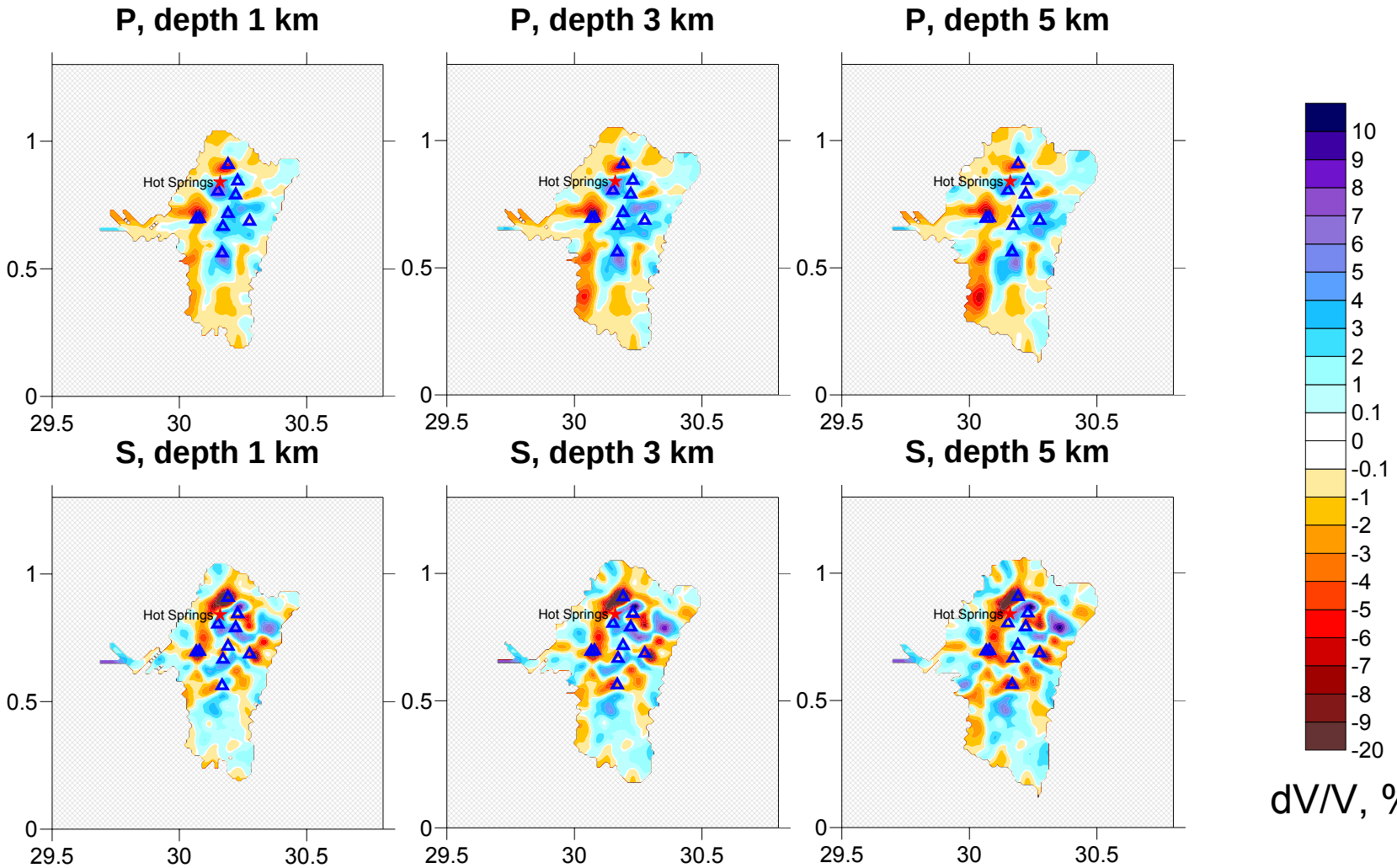
Rays coverage





602 events

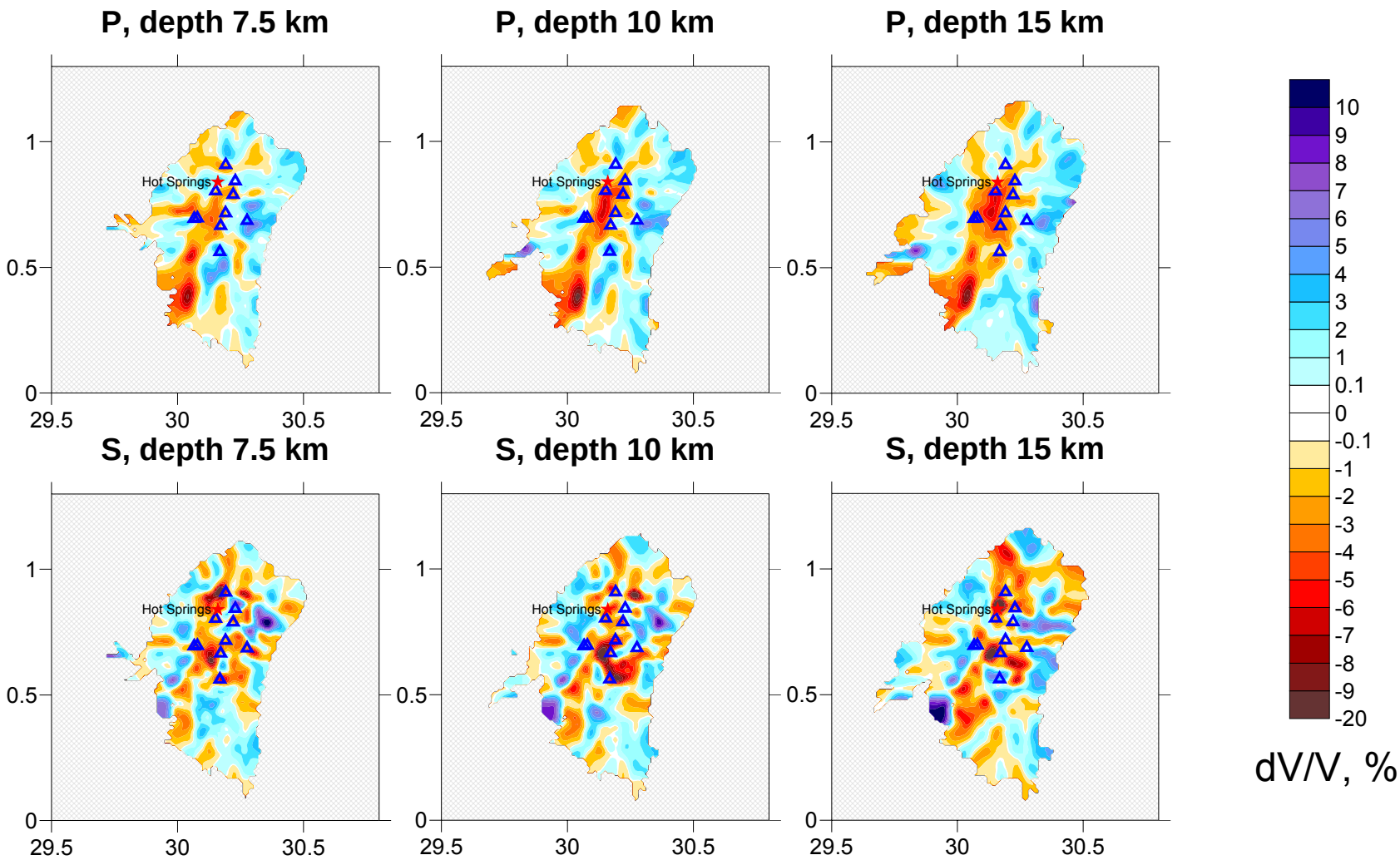
Results



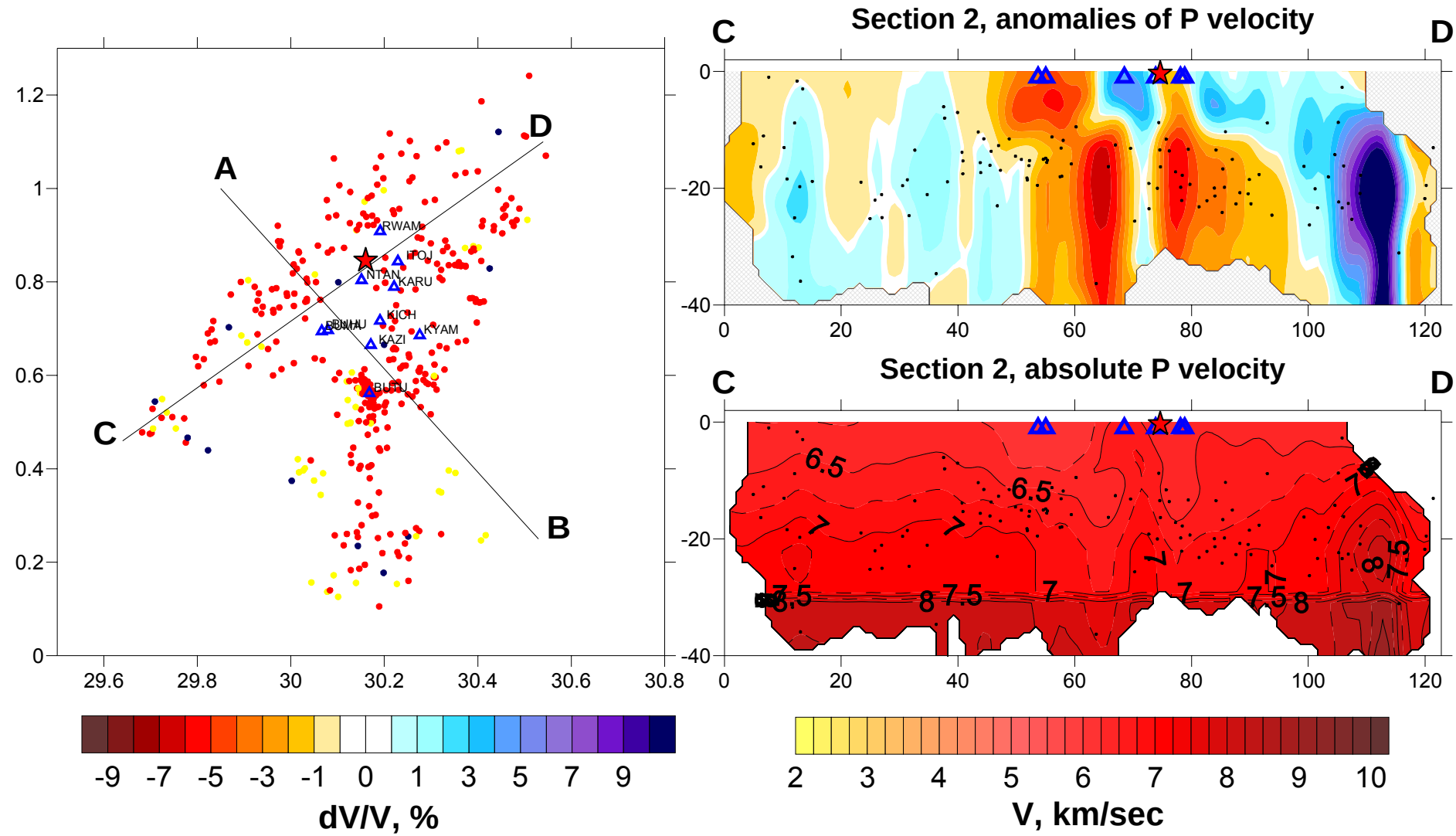
Anomalies of P and S velocities in different depth levels.

602 events

Results



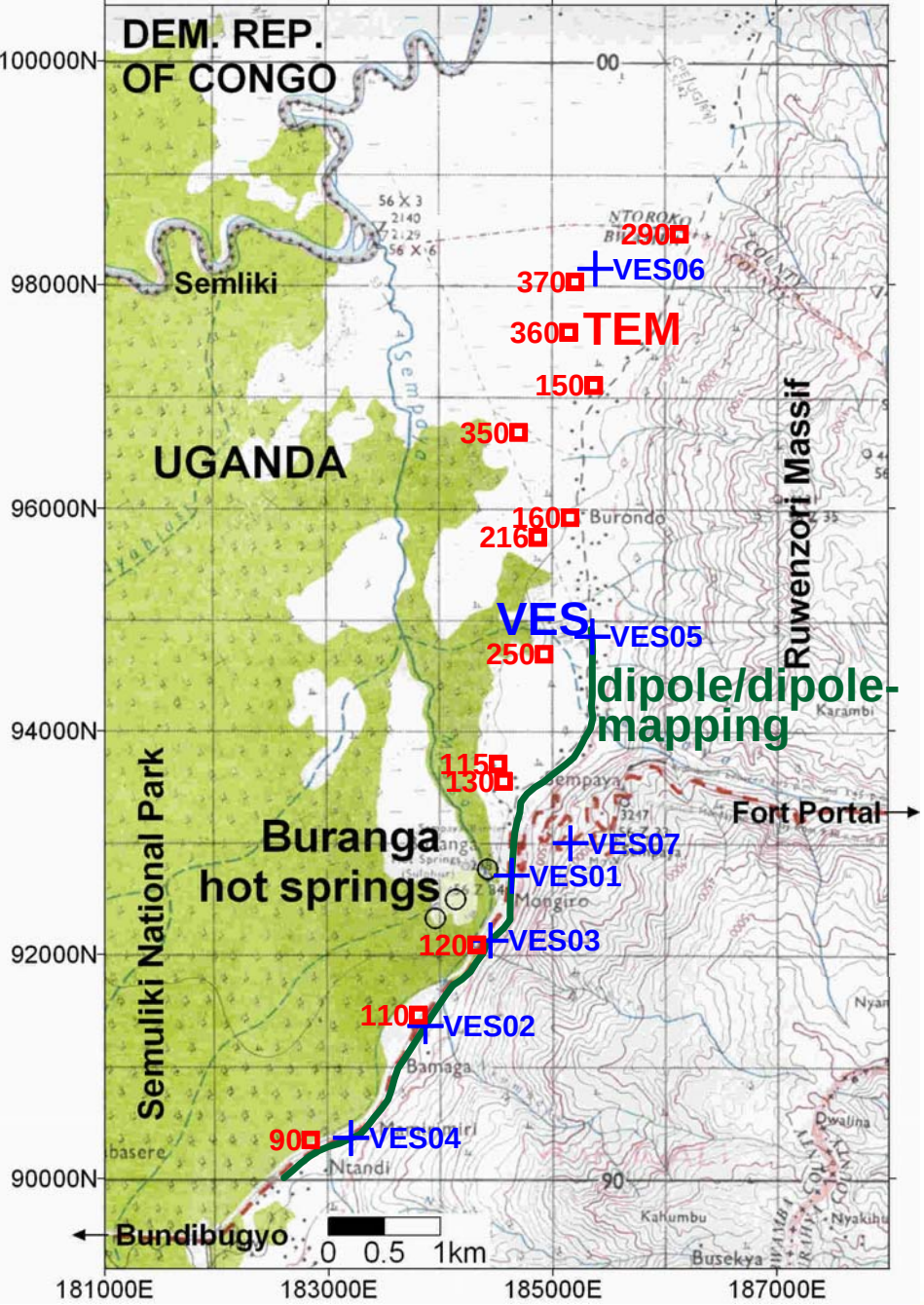
Anomalies of P and S velocities in different depth levels.



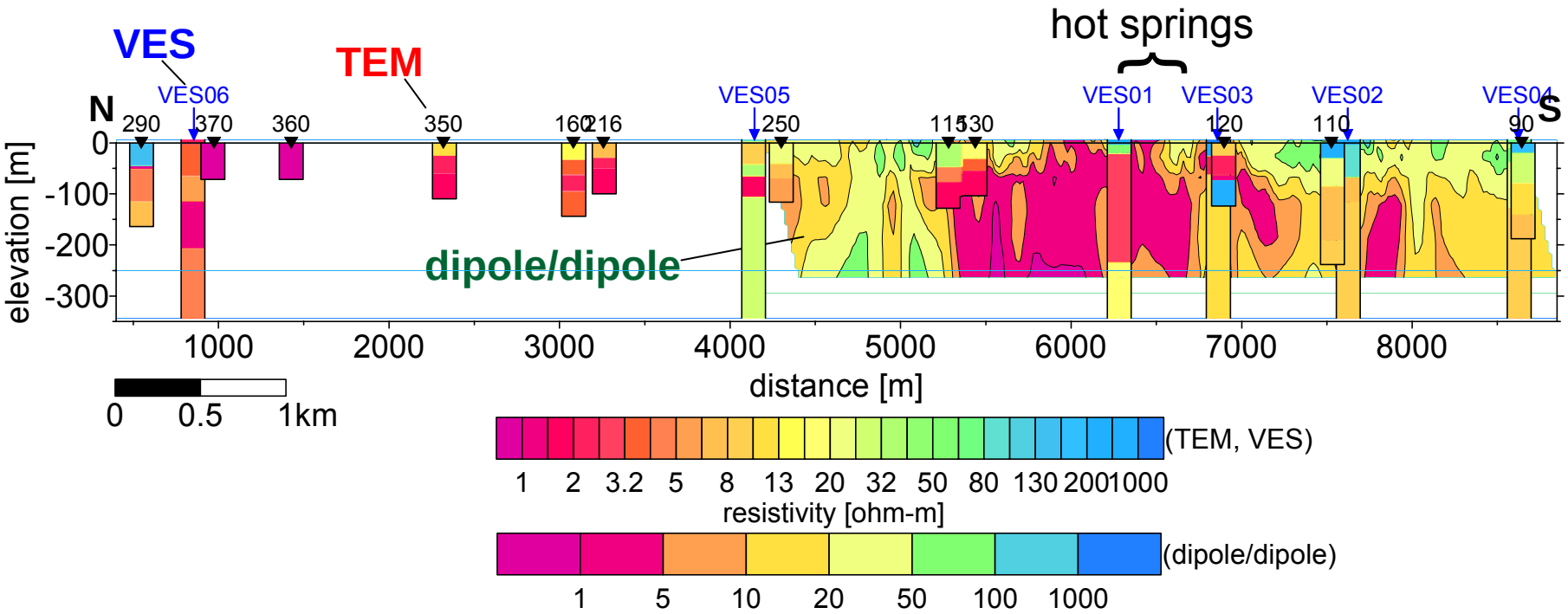
Results of the inversion in vertical section CD, P-velocity model. Events are shown if the distance from the section is not larger then 10 km.

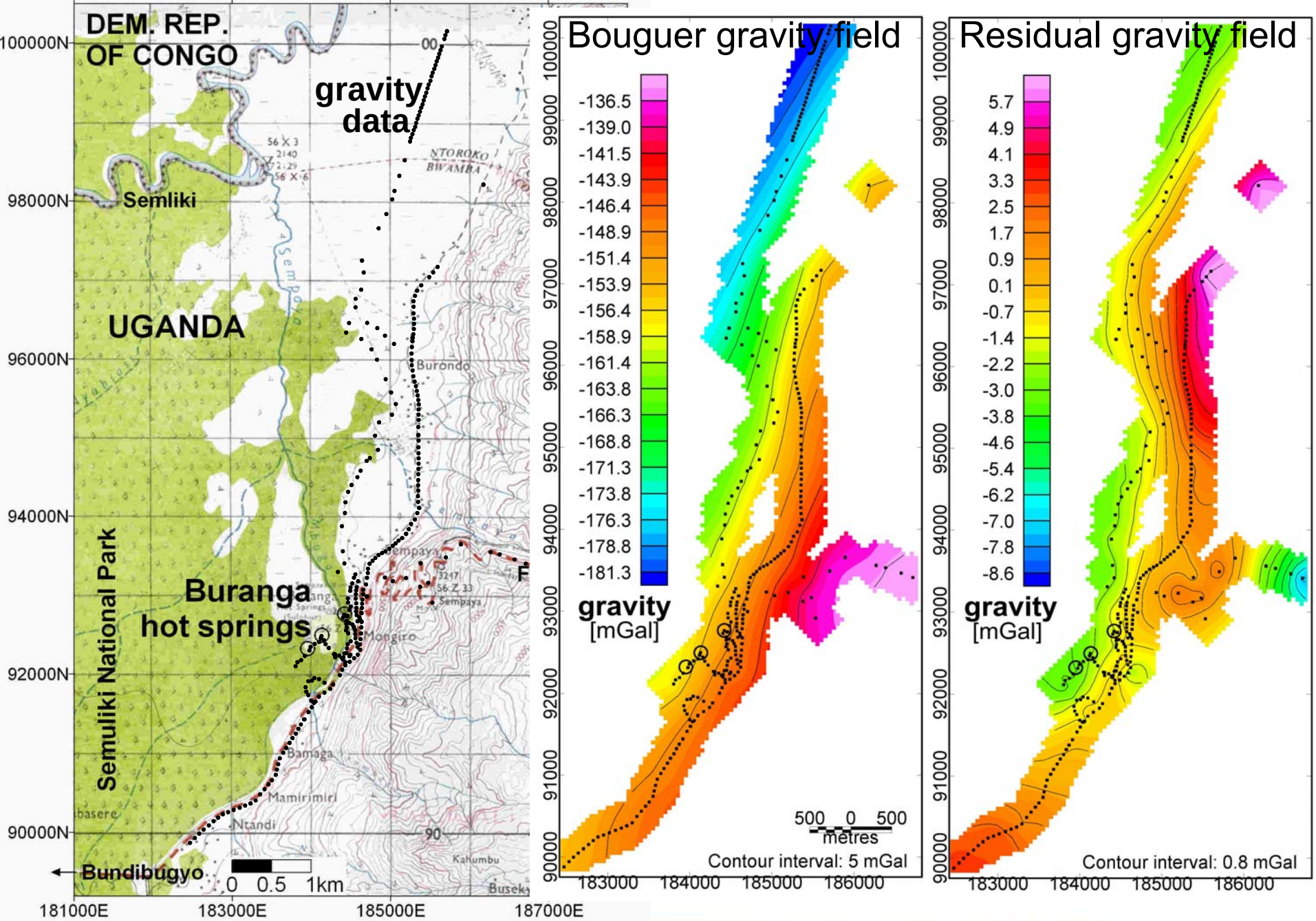
Olkaria geothermal field in Hells Gate National Park, Kenya

Resistivity methods

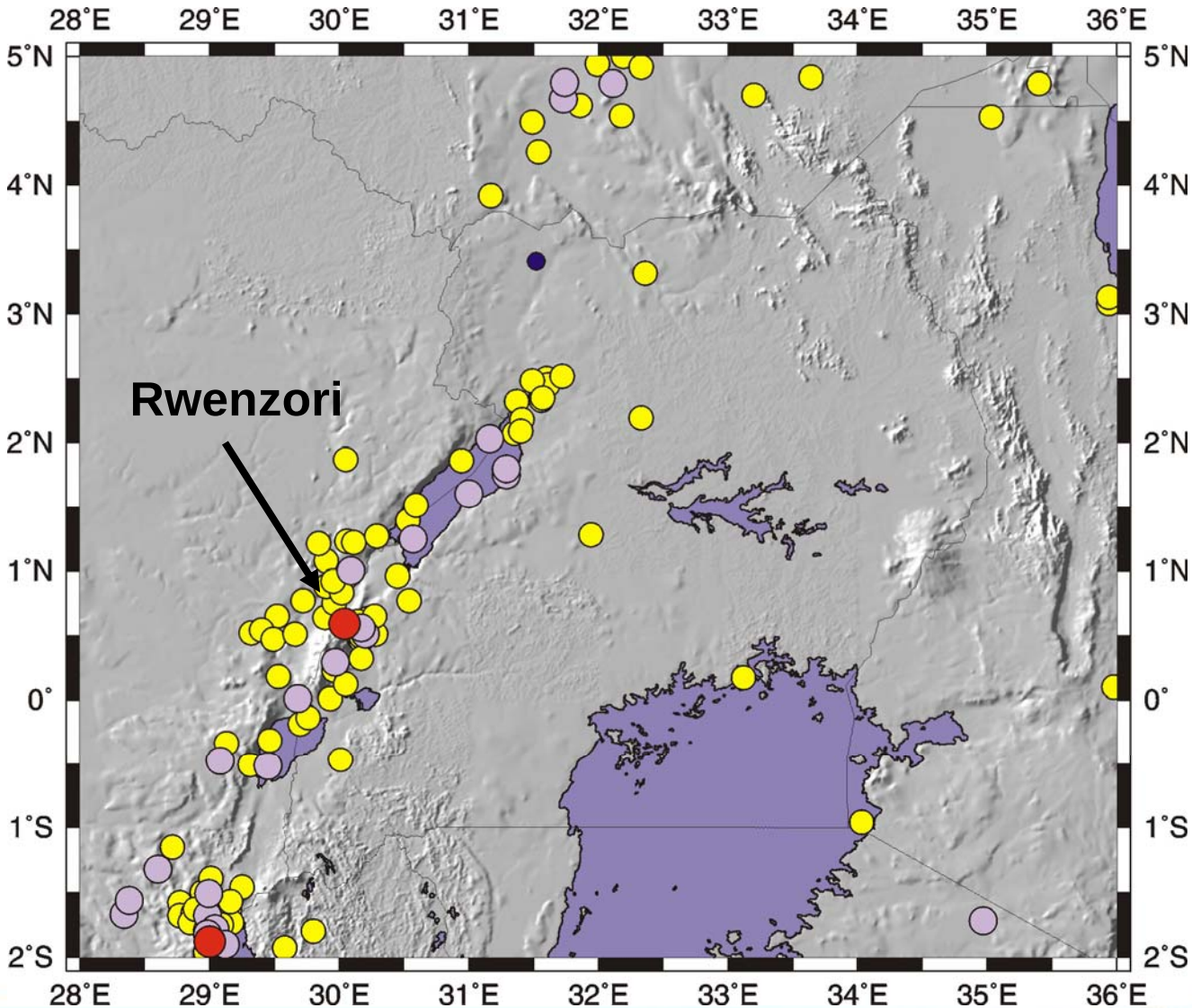


Results of resistivity methods (TEM, Schlumberger-soundings (VES) and dipole/dipole-mapping)




DEM. REP. OF CONGO
gravity data
UGANDA
Semliki
Buranga hot springs
Semuliki National Park
Bundibugyo
Burondo
Sempaya
Mongiro
Bamaga
Mamirimiri
Ntandi
Kahumbu
Buseku
0 0.5 1km
100000N
98000N
96000N
94000N
92000N
90000N
181000E
183000E
185000E
187000E
Bouguer gravity field
-136.5
-139.0
-141.5
-143.9
-146.4
-148.9
-151.4
-153.9
-156.4
-158.9
-161.4
-163.8
-166.3
-168.8
-171.3
-173.8
-176.3
-178.8
-181.3
gravity [mGal]
500 0 500 metres
Contour interval: 5 mGal
Residual gravity field
5.7
4.9
4.1
3.3
2.5
1.7
0.9
0.1
-0.7
-1.4
-2.2
-3.0
-3.8
-4.6
-5.4
-6.2
-7.0
-7.8
-8.6
gravity [mGal]
Contour interval: 0.8 mGal
100000
99000
98000
97000
96000
95000
94000
93000
92000
91000
90000
183000
184000
185000
186000

Rwenzori - Seismicity



Magnitude

- 4-5
- 5-6
- >6