Nepheline syenite's potential as an alternative potash source for Malawi

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Fertilizer status in Africa

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- Fertilizer costs are largely determined by:
  - Importing costs,
  - Transport and distribution costs
  - Trader and agro-dealer margins
- African farmers pay 30-50% much more for fertilizer in Europe & N. America counterparts (Roberts & Vilakazi, 2014).
- Malawi faces severe fertiliser challenges for her agricultural sector growth and food crop production.
  - Farm input fertilizer subsidy program (FISP) introduced to cushion vulnerable farmers

Fertiliser imports for Malawi (2004-2011)

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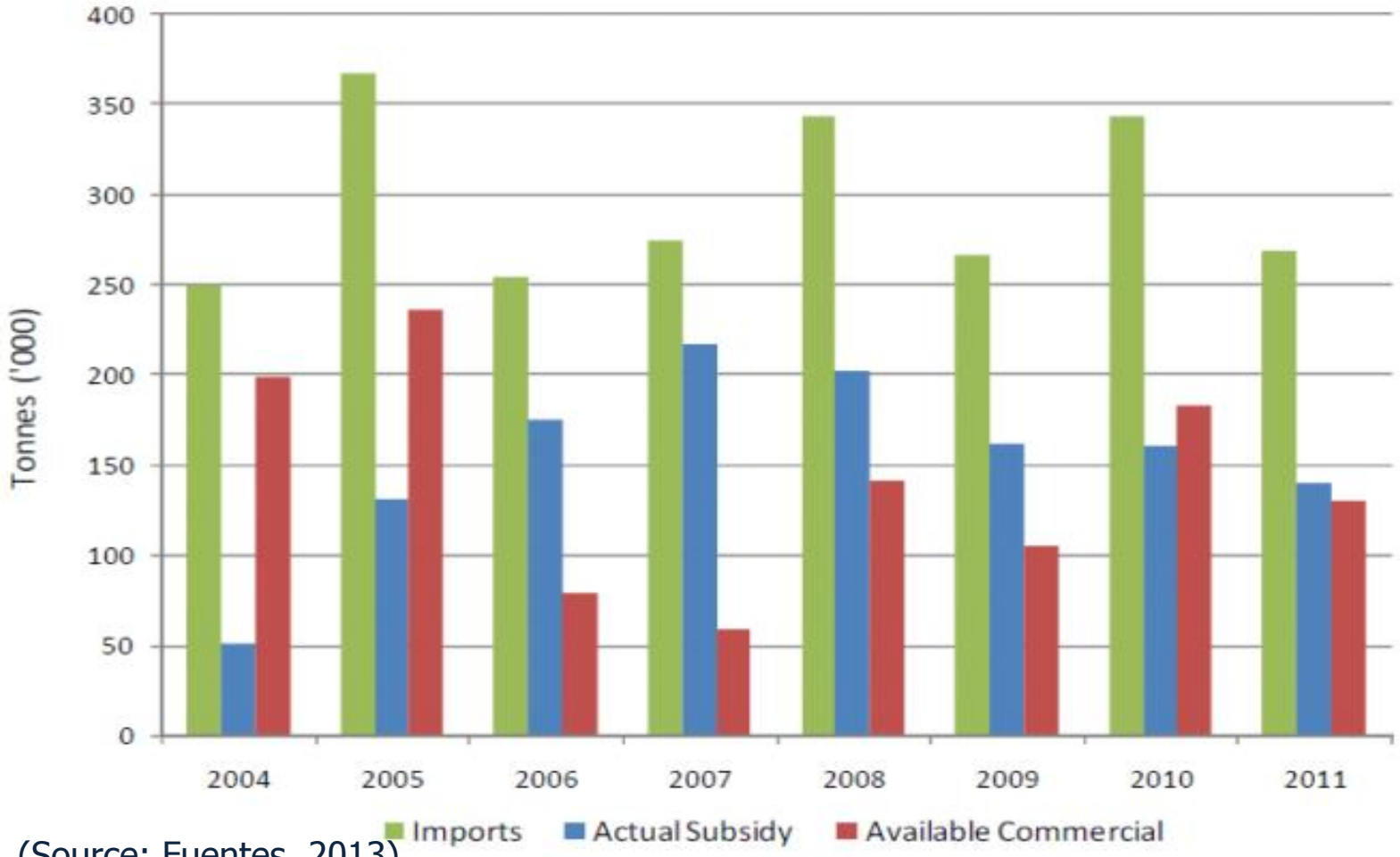
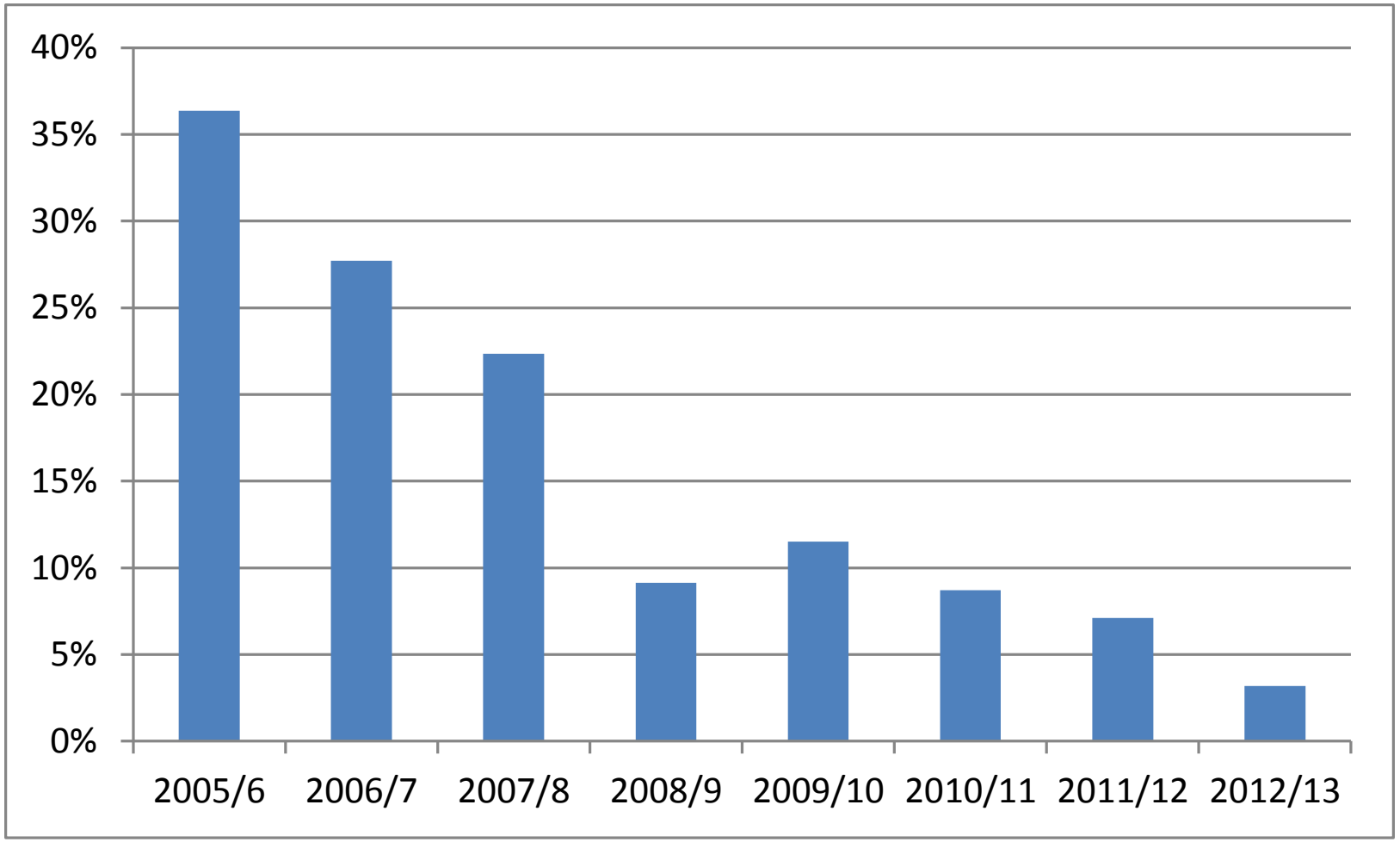


(Source: Fuentes, 2013)

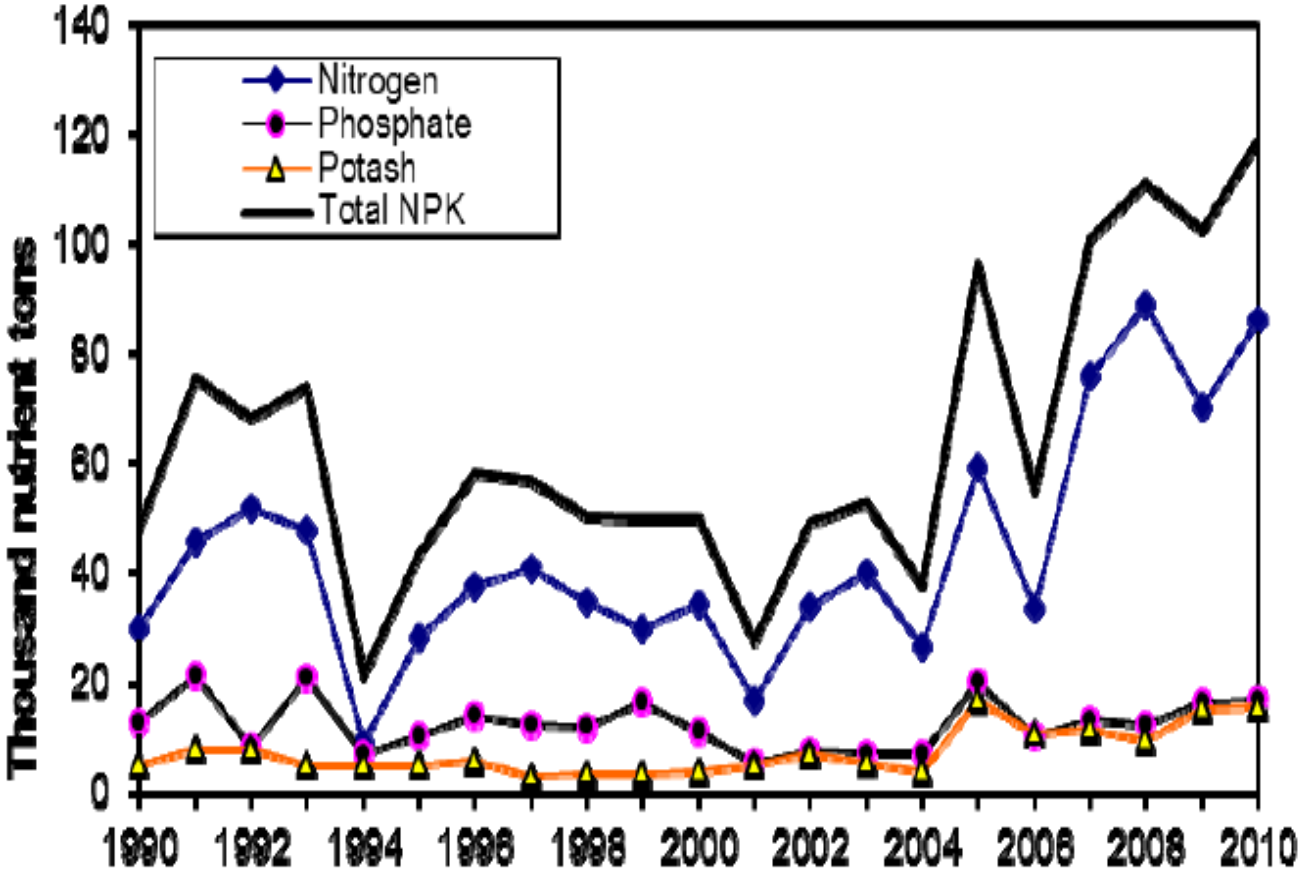
NPK is 23:21:0+4S or 23:10:5+6S+1.0Zn; agro-dealers choose which one to bid for.

Farmer contribution to FISP



(Njoloma et al. 2016)

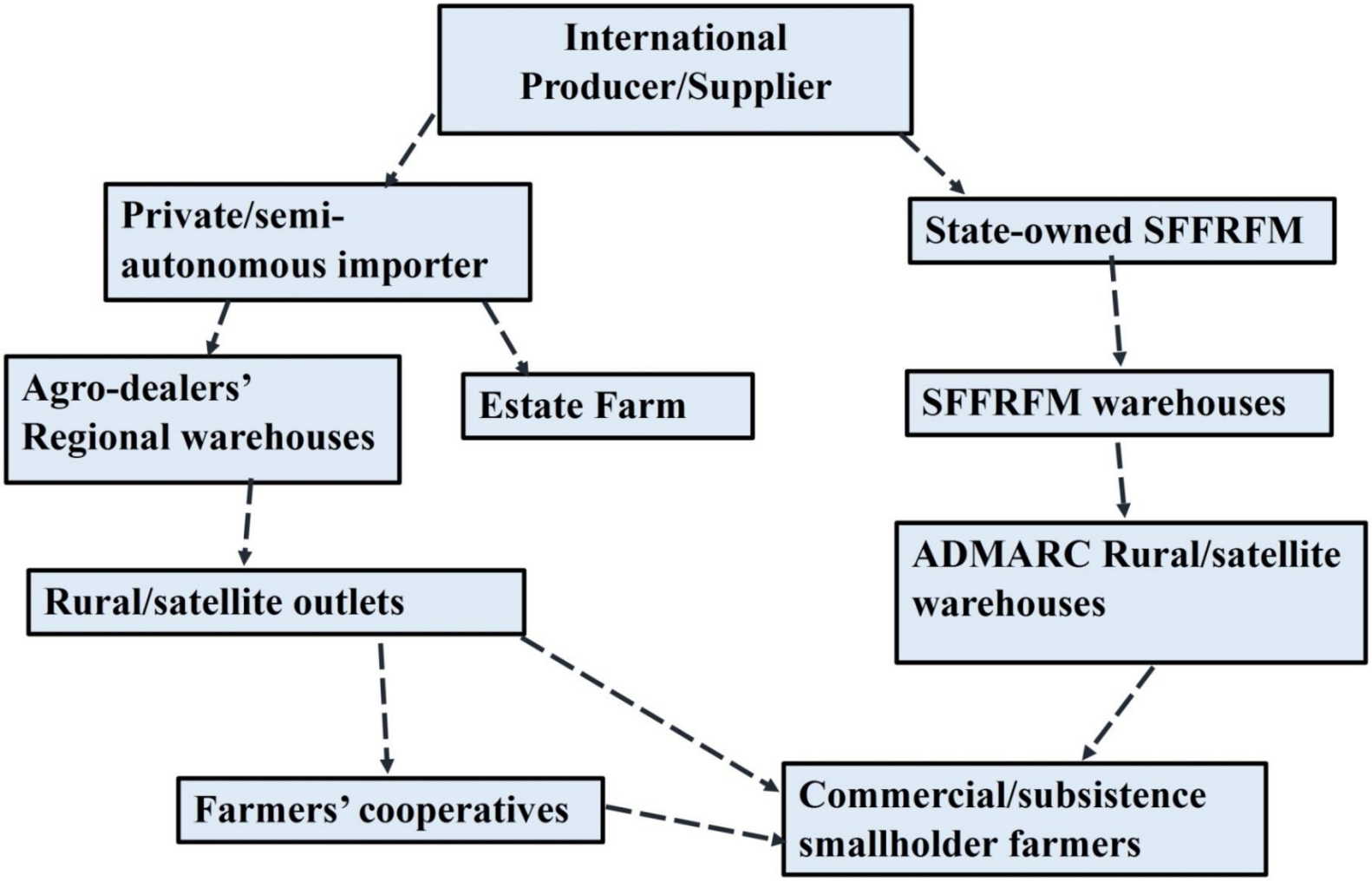
Malawi fertiliser composition



(Source: Fuentes, 2013)

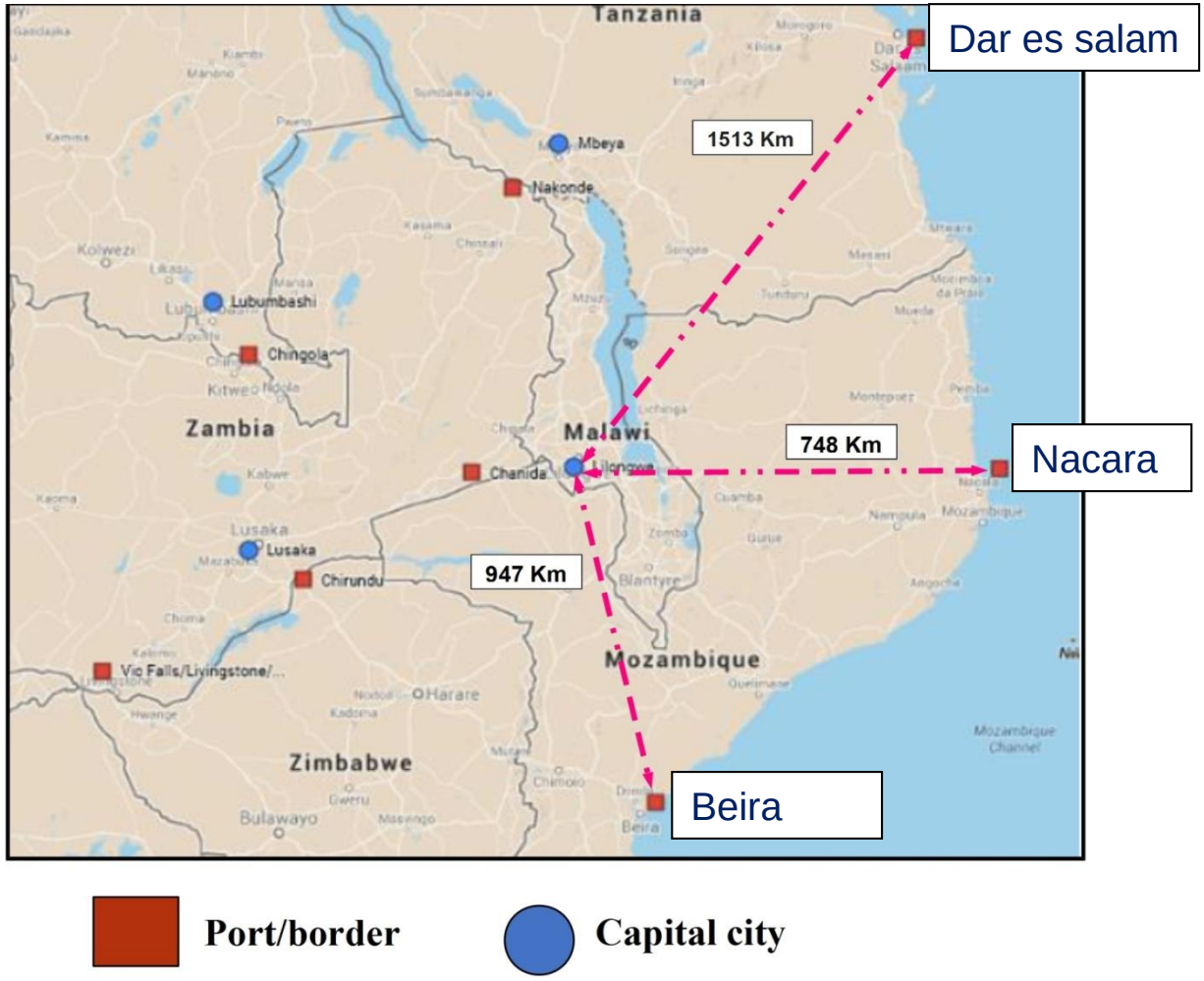
- > 60% of arable land is K-deficient (Chilimba & Liwimbi, 2008; Lakudzala, 2013).

Fertiliser supply chain



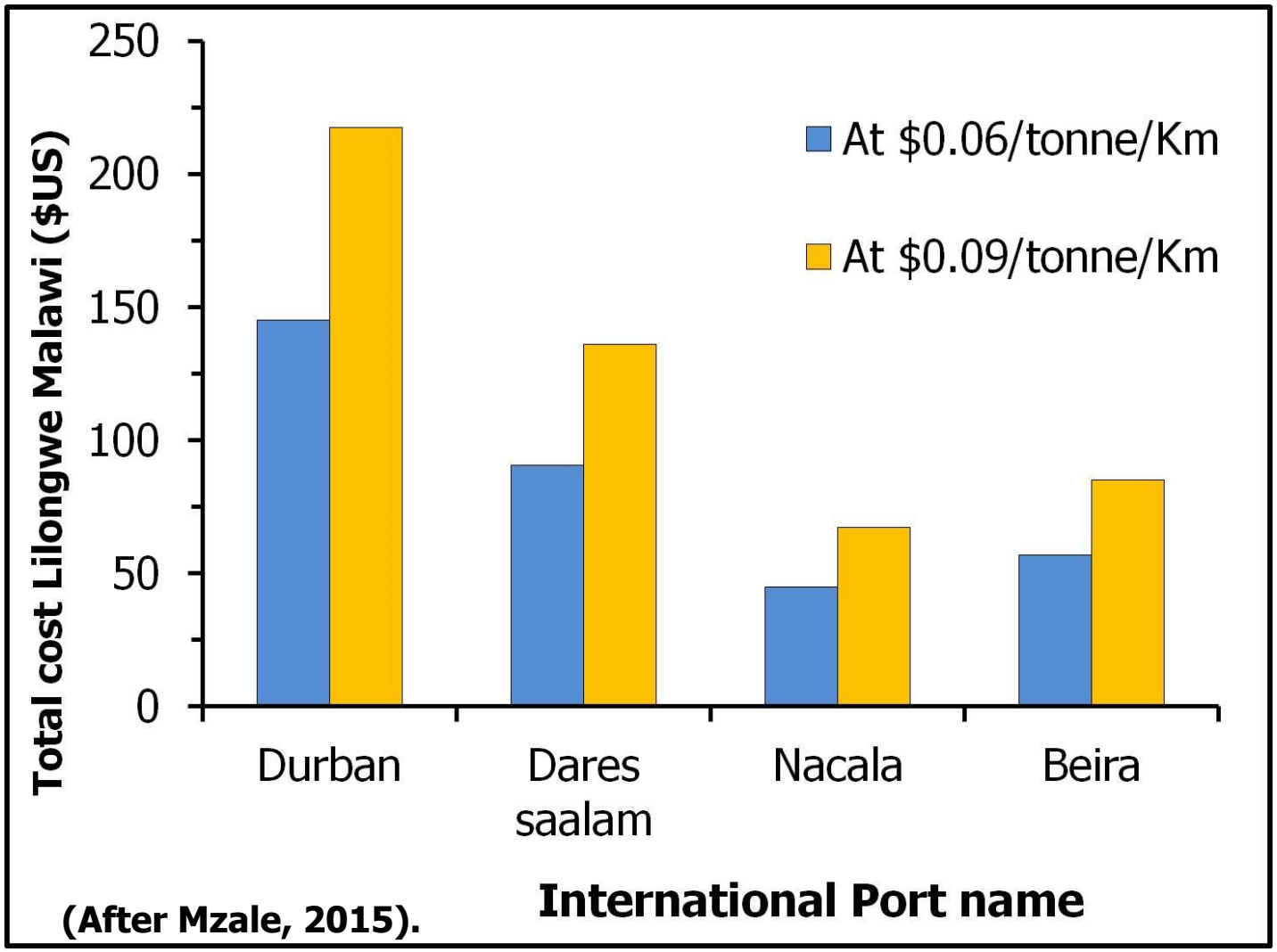
- Long route to smallholder farmer means high farm-gate prices

Fertilizer supply cost hiccups



- No production plants for fertilizer in Malawi.
  - Malawi import costs highest in SADC (Kaukonde, 2015).
- Beira and Nacara are two reliable ports
- Nacara port docks vessels up to 30,000T, plus is closer Lilongwe both by road and rail.

Import transport costs



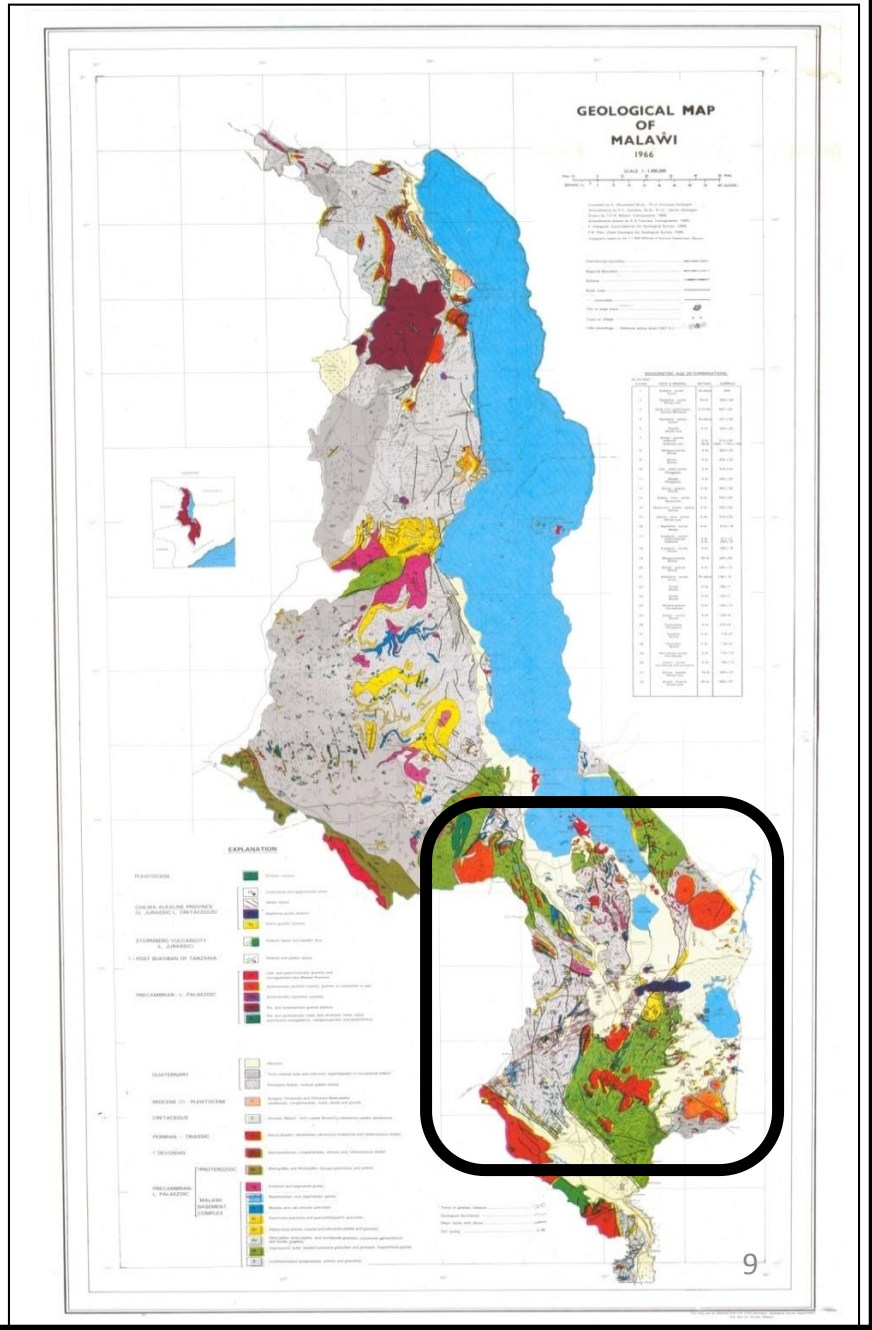
- Domestic distribution costs more @ $1.63/tonne/km

Alternative potash sources

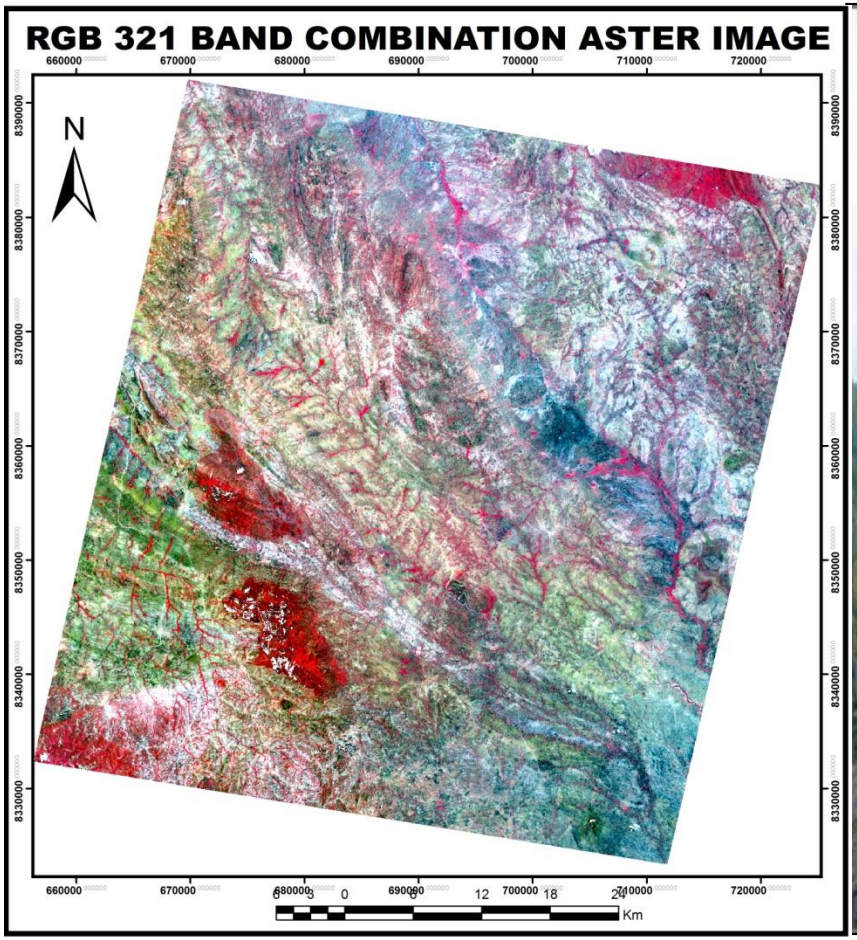
- Need for alternative potash necessitated by:
  - High transport and purchase costs of conventional fertilizers.
  - FISP is not sustainable.

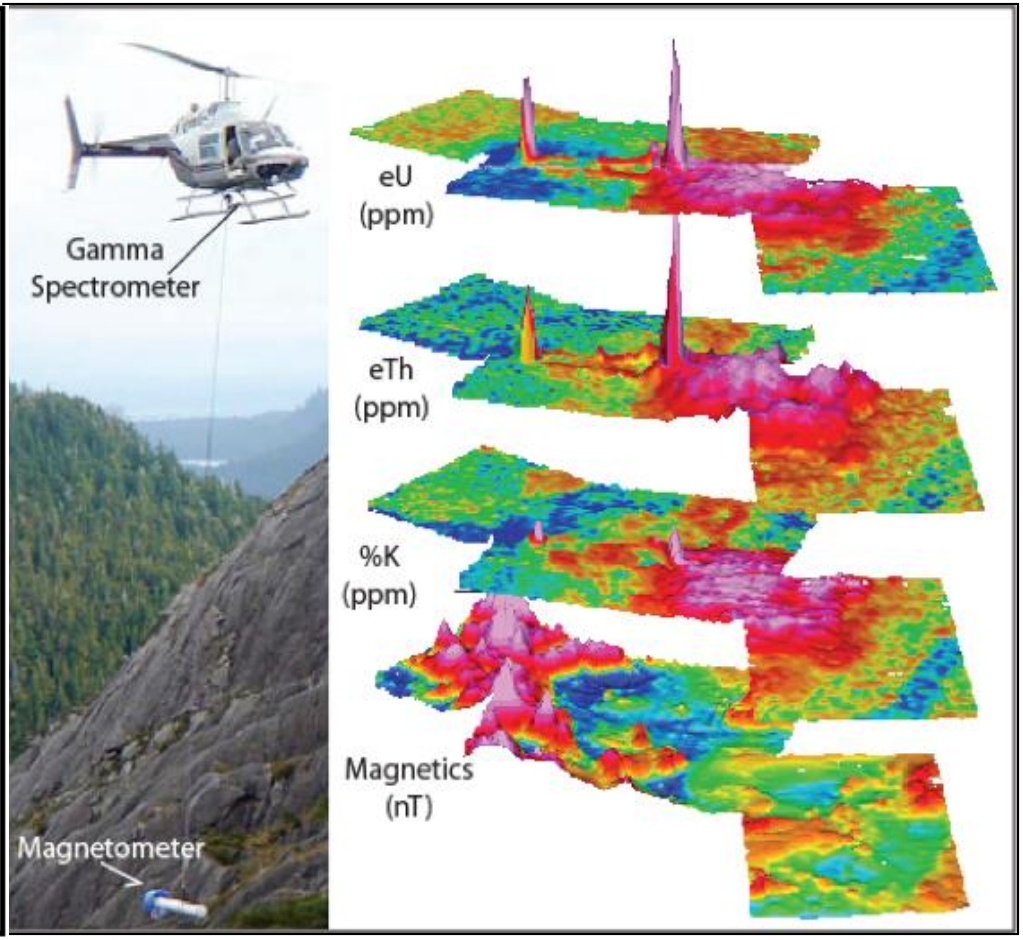
- Potential of nepheline syenites as K sources noted by Goldschmidt in 1922 (Ciceri et al. 2015).
- Malawi has numerous intrusions which could be useful.

❖ **Therefore, applied gamma-ray spectrometry and remote sensing techniques to delineate nepheline syenites in rift tectonics.**



Methodology





(Source: http://crustal.usgs.gov/projects/)

Progress...

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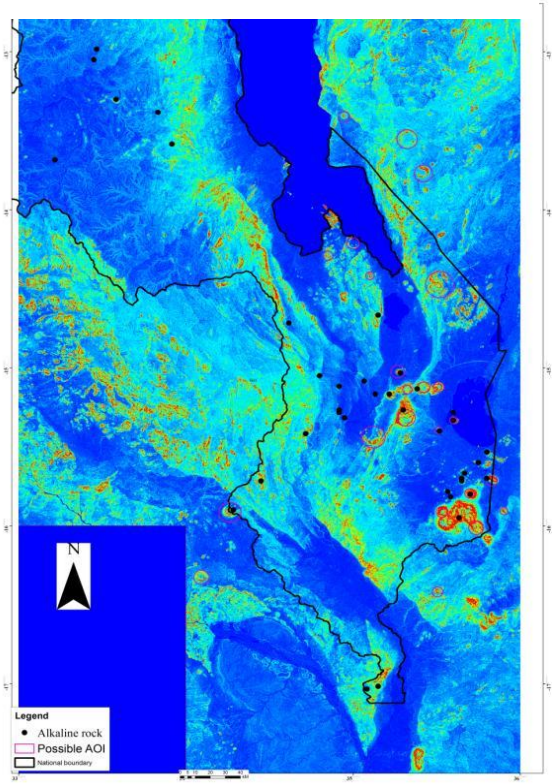
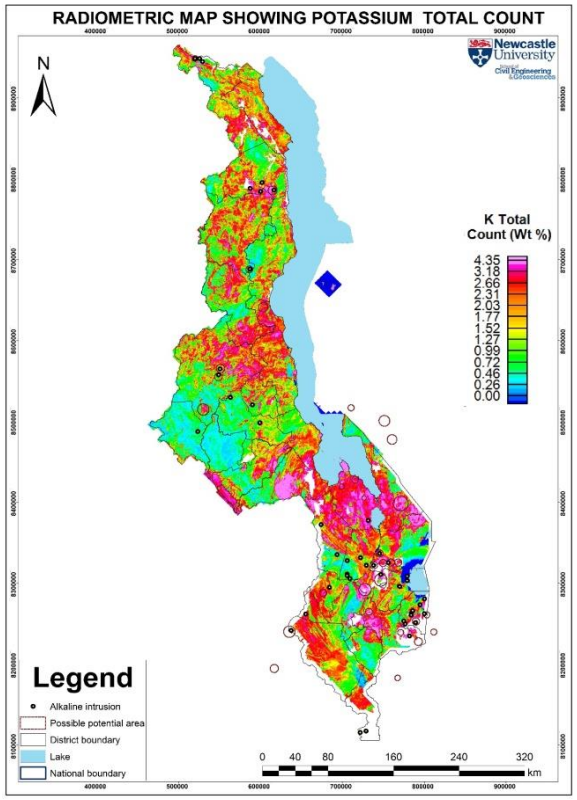
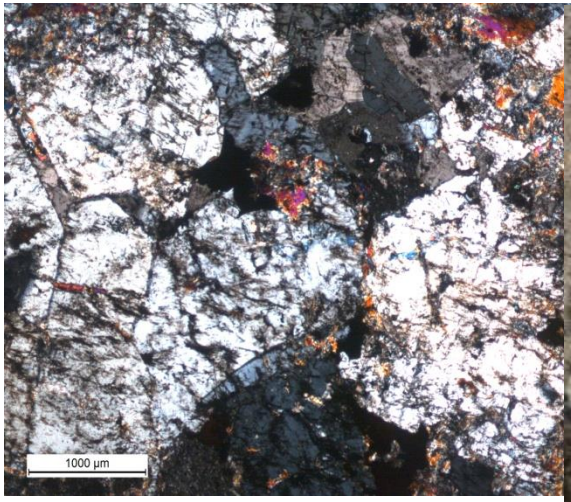
DTM from SRTM







Progress...

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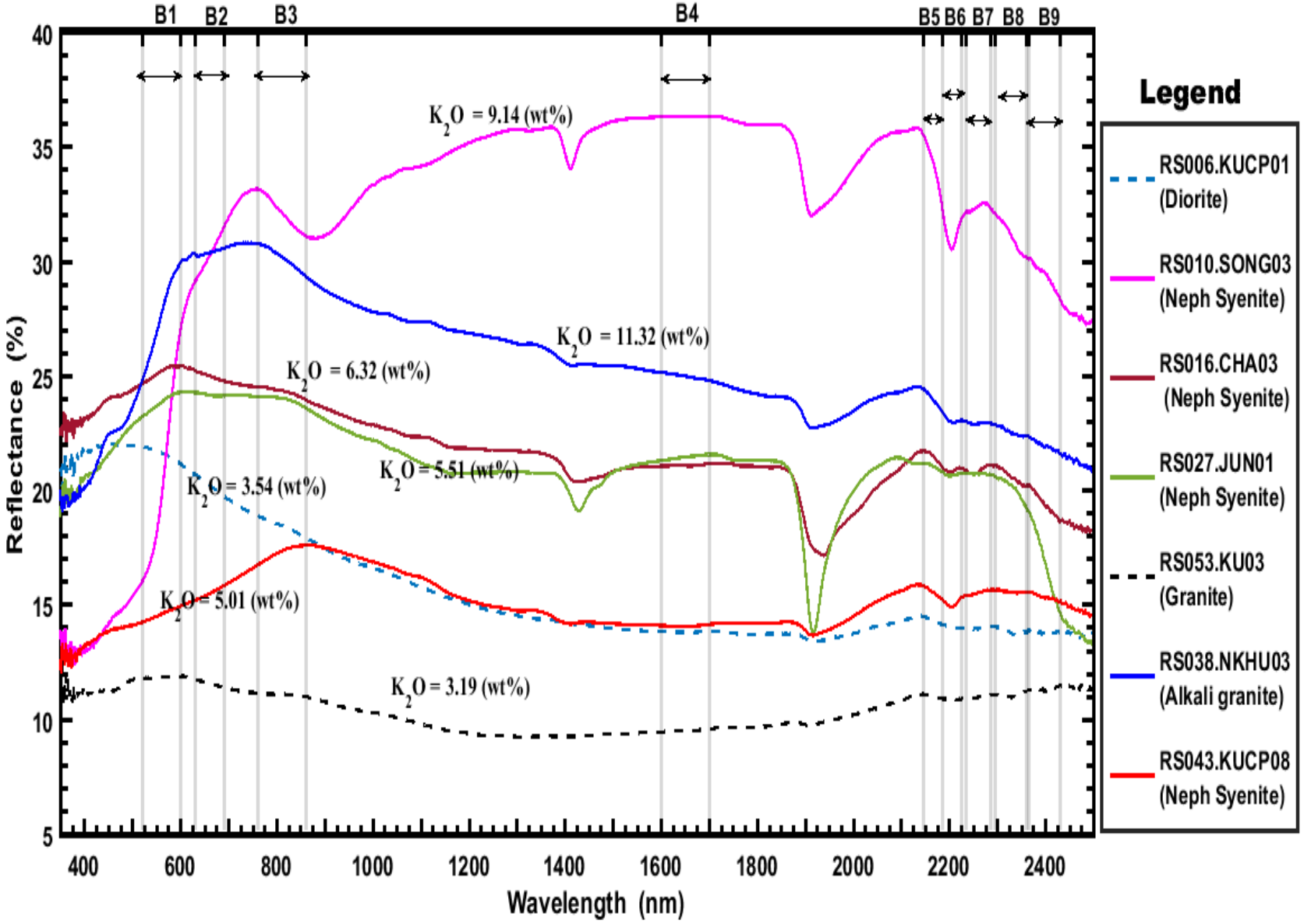

Geophysical and DTM results

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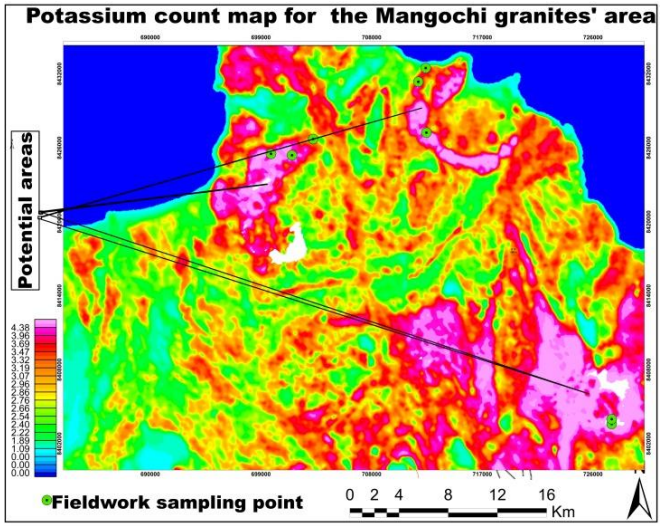
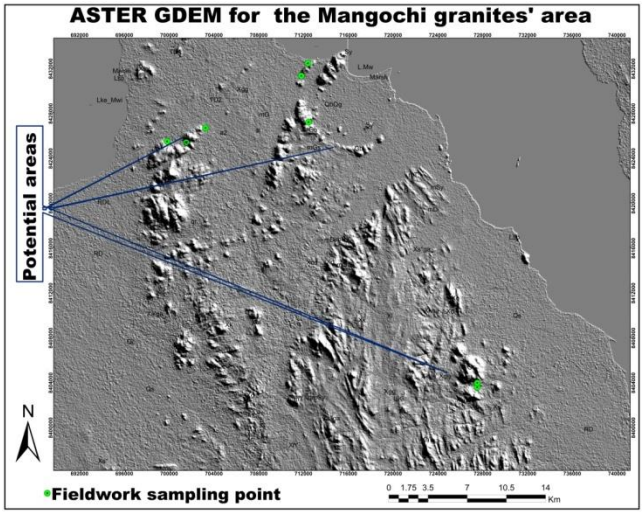
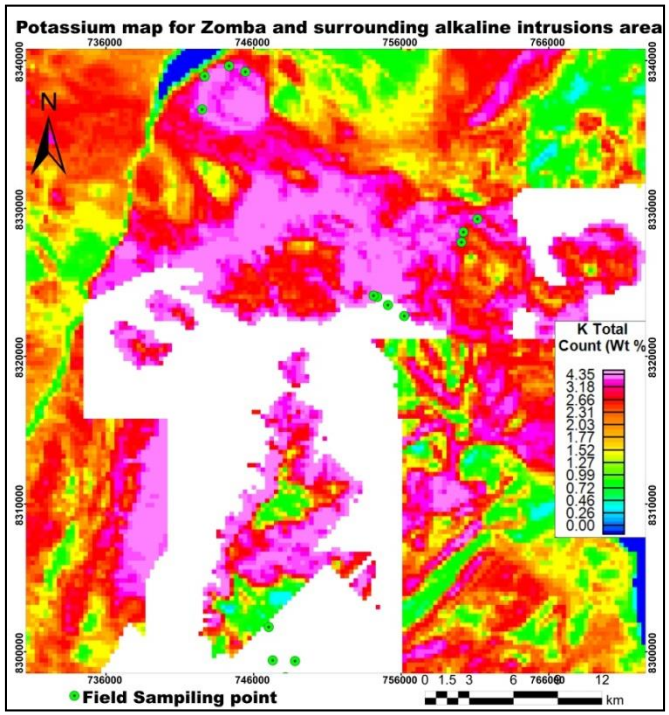
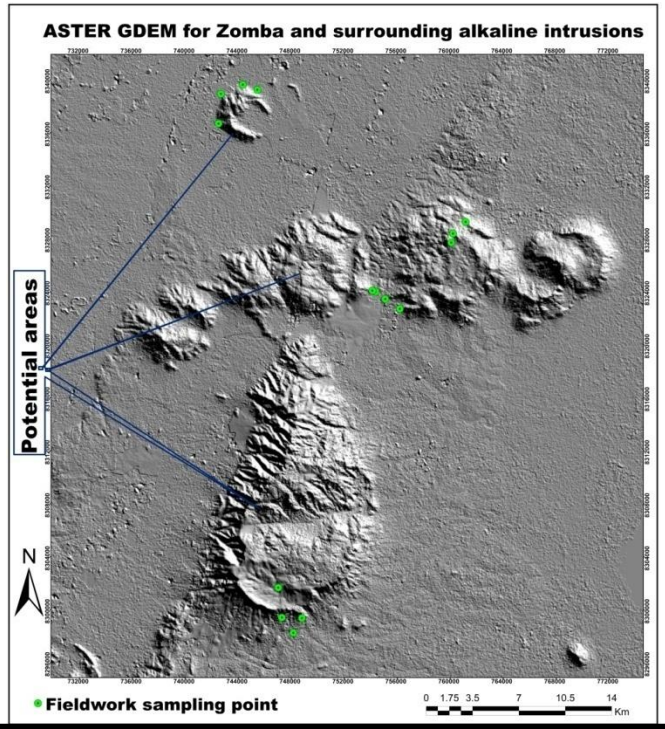
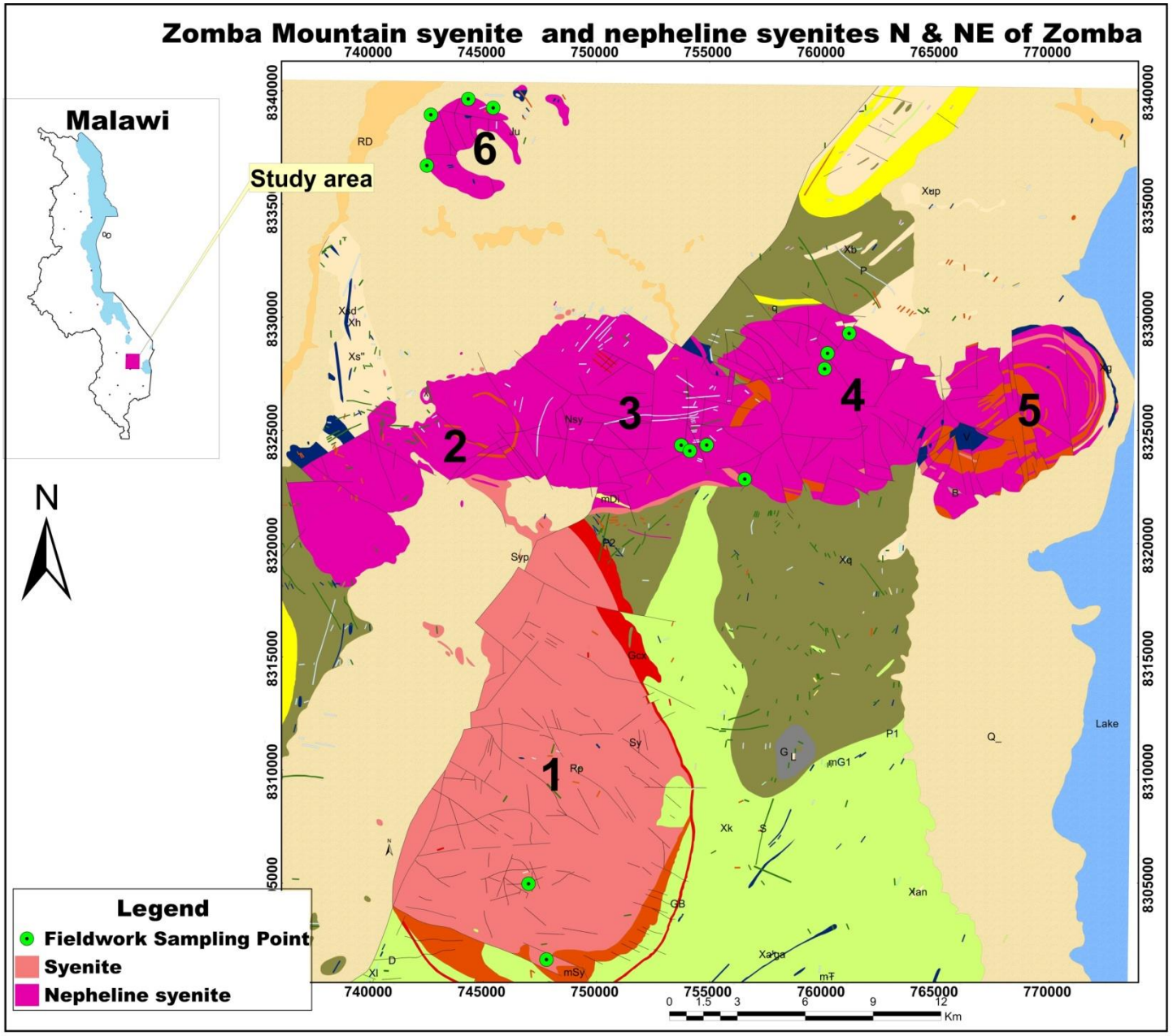








Ground verification



Airborne vs ground gamma-ray spectrometry

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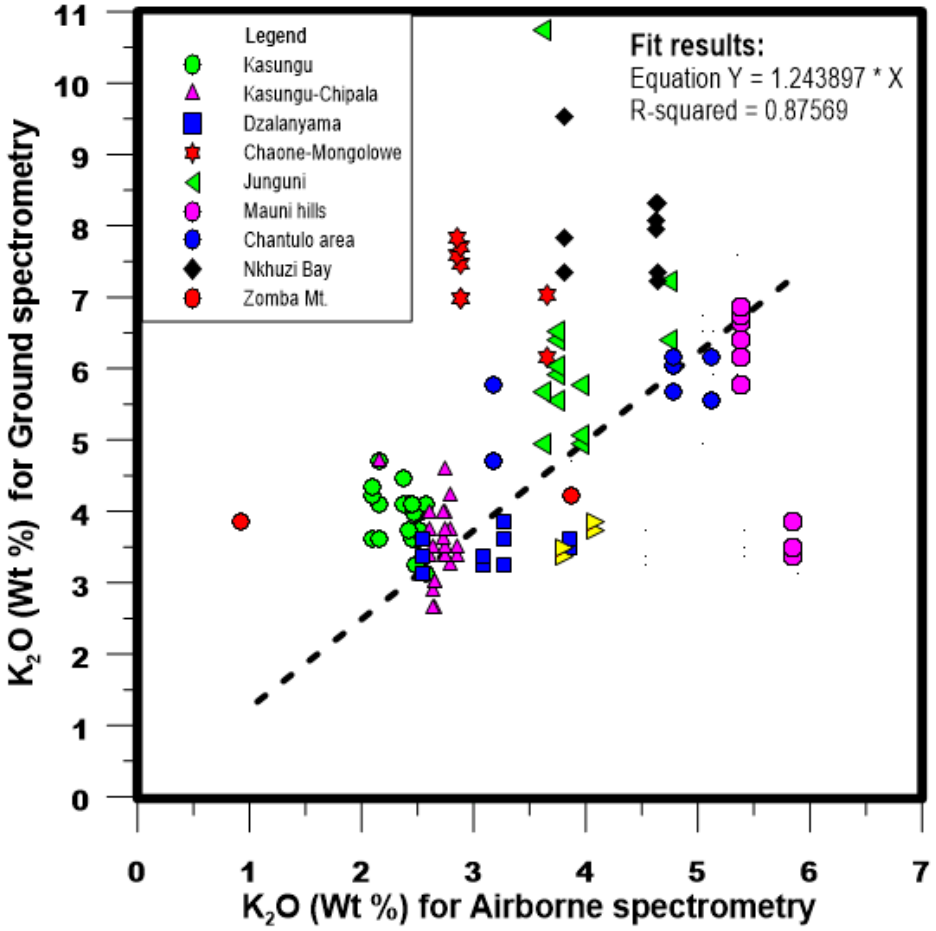
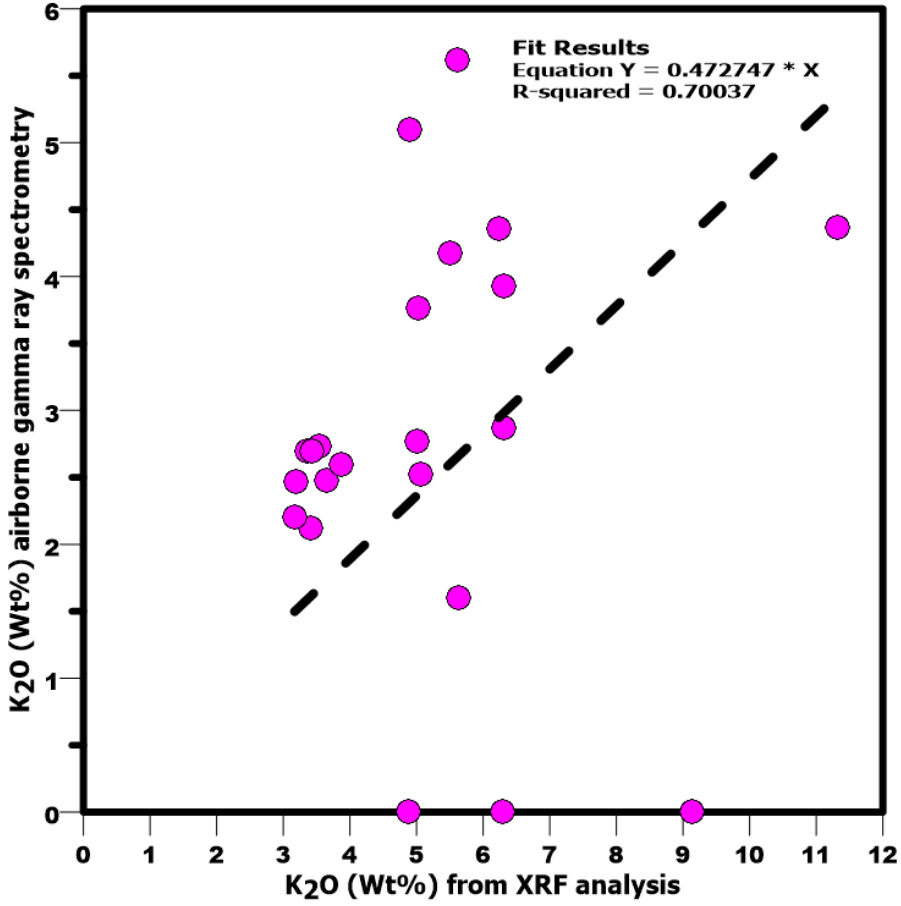
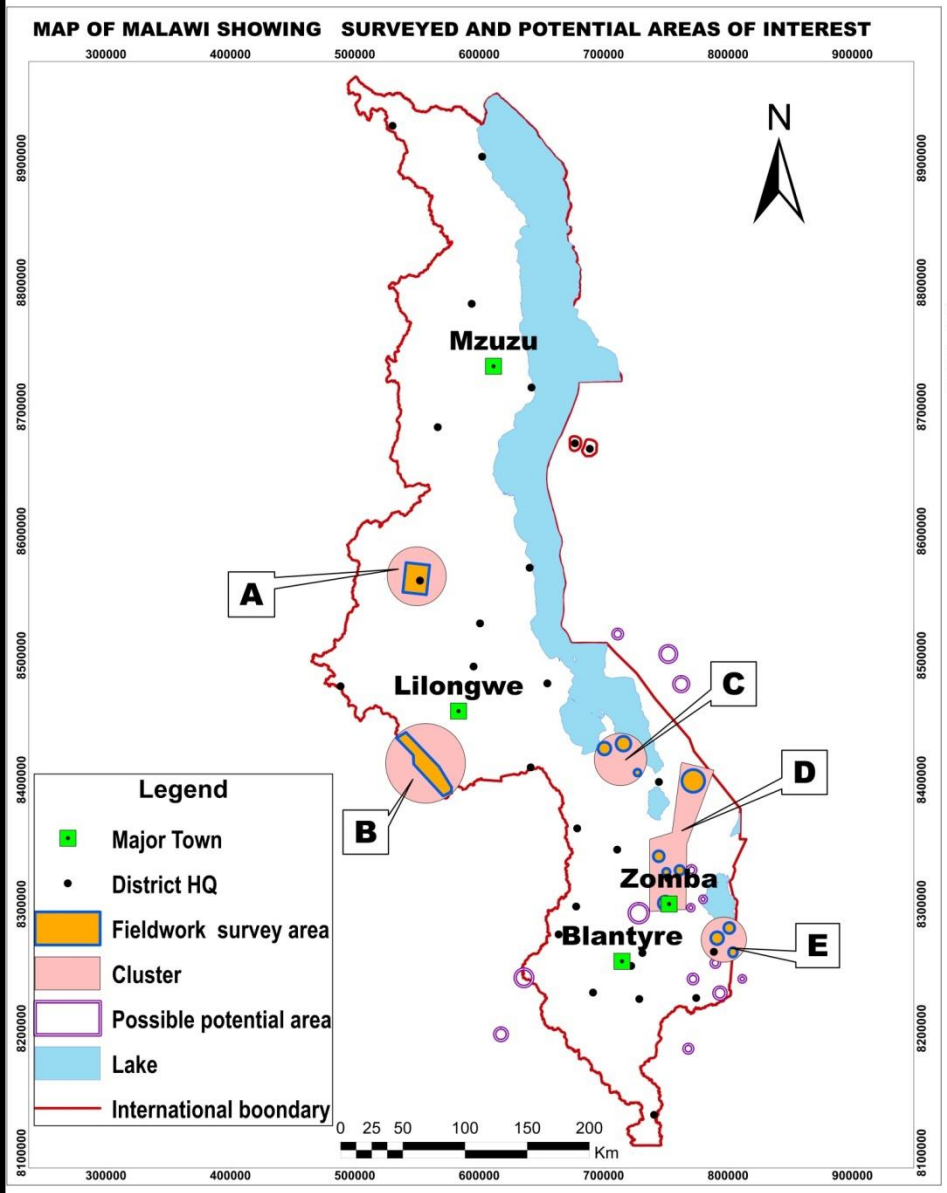
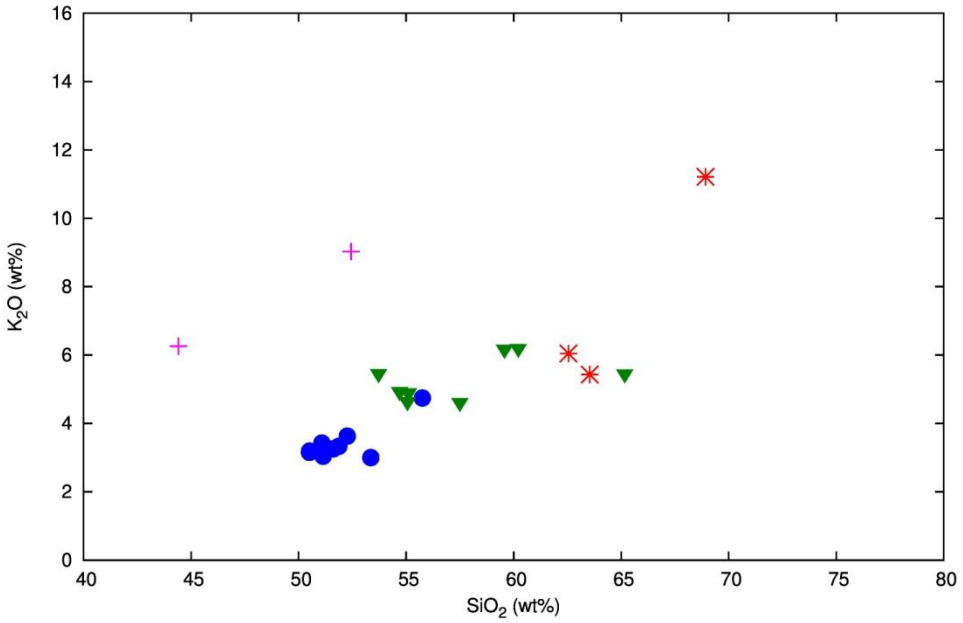




- No apparent association between potassium and vegetation cover

Rocks' geochemical variations

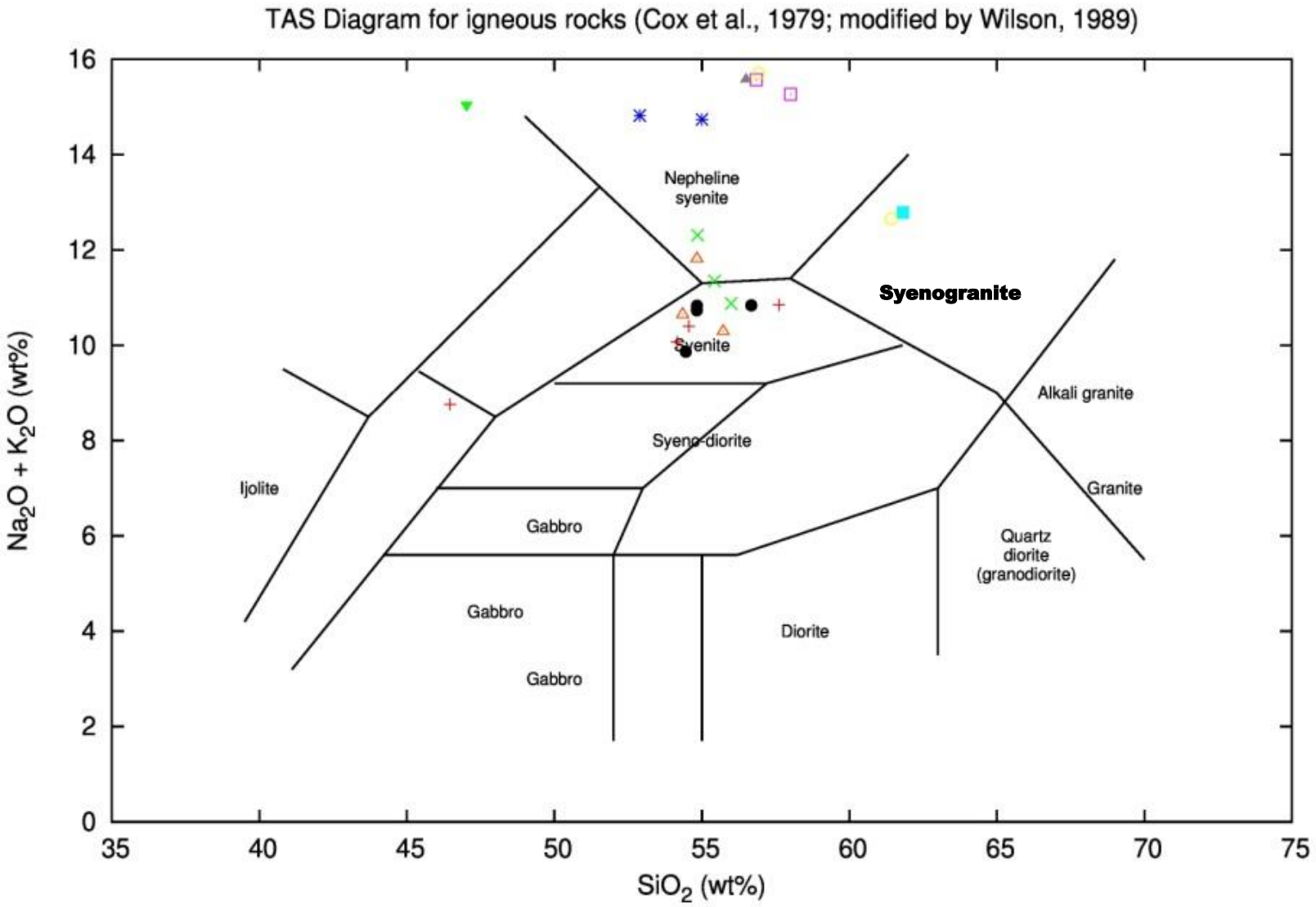




Key

- A: Central nepheline syenites
- C: South-east alkali granites
- D: South-east nepheline syenite and syenites
- E: Nepheline syenites in Carbonatite complex

Malawi and North Cape Nsy



ungu (W)

ungu Chipala (W)

nba (W)

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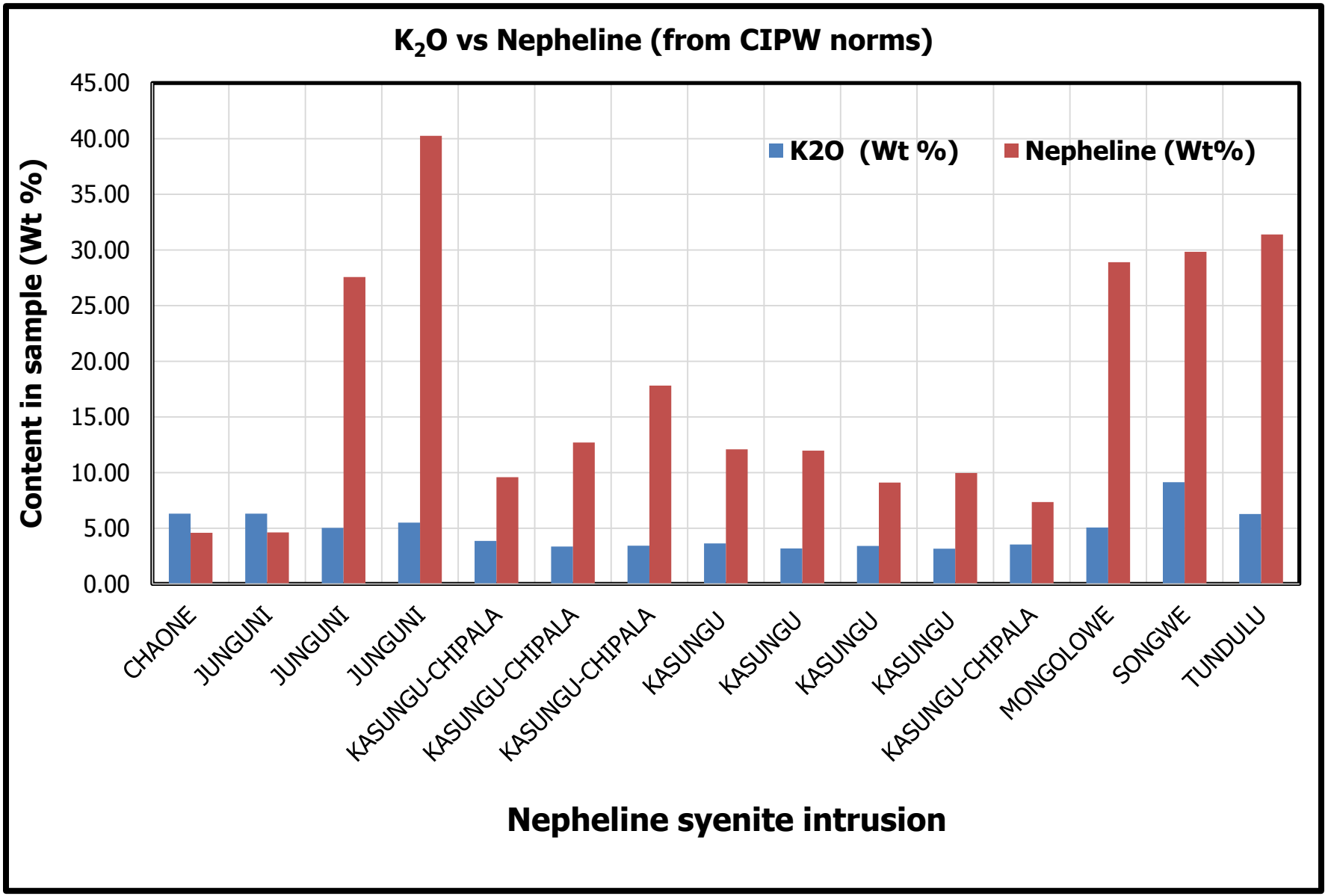
(North Cape data from Mohammed et al, 2015; W after Woolley,2001)


K2O vs Nepheline (from CIPW norms)
Content in sample (Wt %)
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
K2O (Wt %)
Nepheline (Wt%)
CHAONE
JUNGUNI
JUNGUNI
JUNGUNI
KASUNGU-CHIPALA
KASUNGU-CHIPALA
KASUNGU-CHIPALA
KASUNGU
KASUNGU
KASUNGU
KASUNGU
KASUNGU-CHIPALA
MONGOLOWE
SONGWE
TUNDULU
Nepheline syenite intrusion

Conclusion

- Gamma ray data and DTMs show potential in mapping alkaline intrusions.
  - Airborne corresponds to ground gamma measurements.
- Field spectrometry shows close relationship between orthoclase and nepheline spectra
- Nepheline syenite K_2O content range from 3.1-9.14 (Wt %).
- Highest K_2O content in S. Eastern alkali granite
  - ✓However, not automatic preference but nepheline content for this project.
- Work continuing to locate nepheline syenites using satellite remote sensing.

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Questions?

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