Looking into Ngauruhoe;
can we use muons to get a density profile

Tony Hurst
Volcanology Department
GNS Science, New Zealand

New Zealand Volcanoes

Mt Eden, Auckland

Mount Ruapehu

Taranaki / Mount Egmont

Ngauruhoe

frequent eruptions until 1975

Ngauruhoe History

- In historical period (since 1840) there have been frequent minor ash eruptions, generally steaming between eruptions.
- Lava eruptions in 1949 and 1954-55.
- Vulcanian eruptions in 1974-1975, then decline to complete quiescence
- Very low level of seismicity for last 20 years

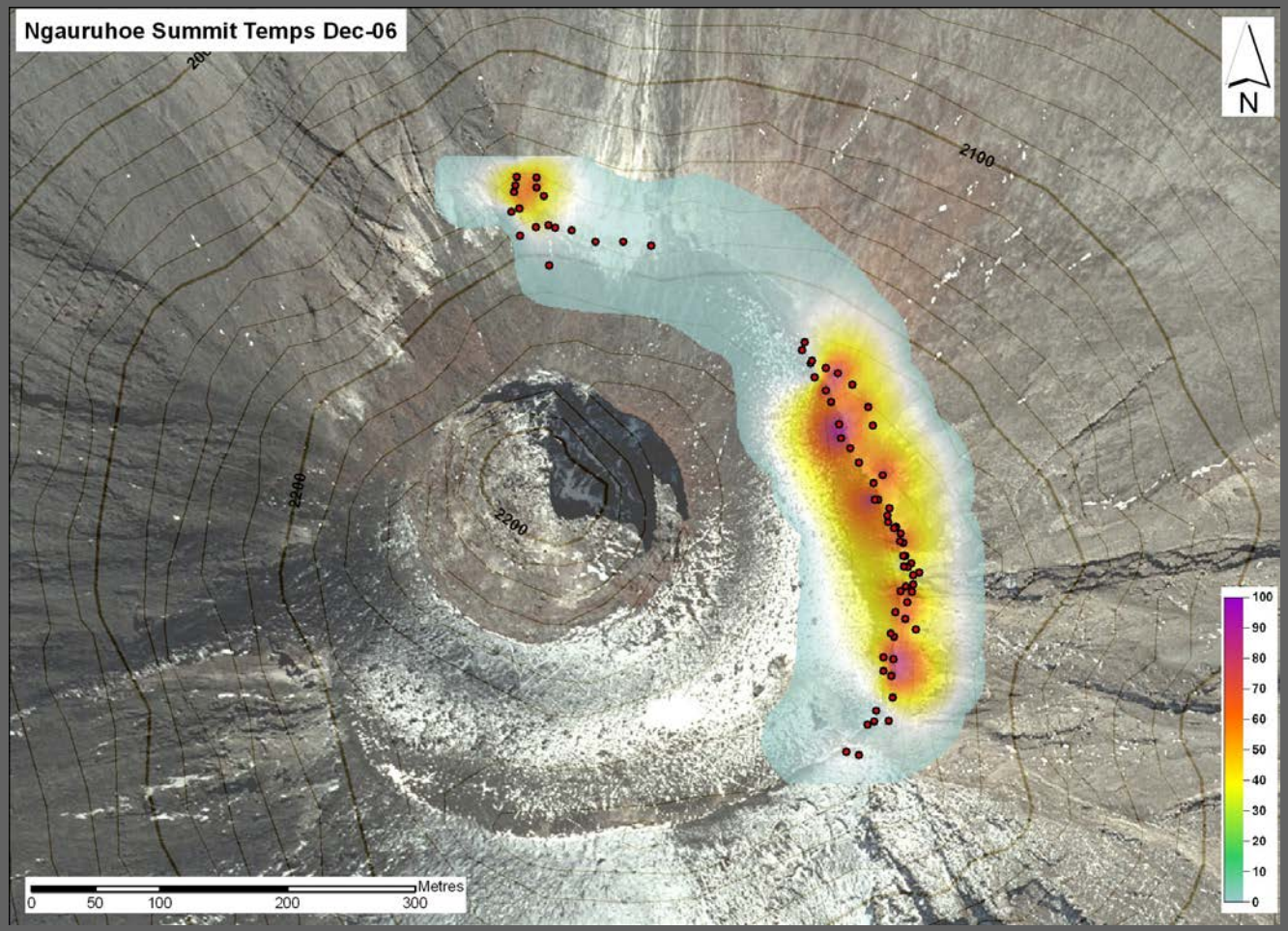
Ngauruhoe Eruption Timeline

Ngauruhoe erupting in 1974

Looking into Ngauruhoe vent, January 1974
Estimated depth of 200 metres

Ngauruhoe volcano in 1998

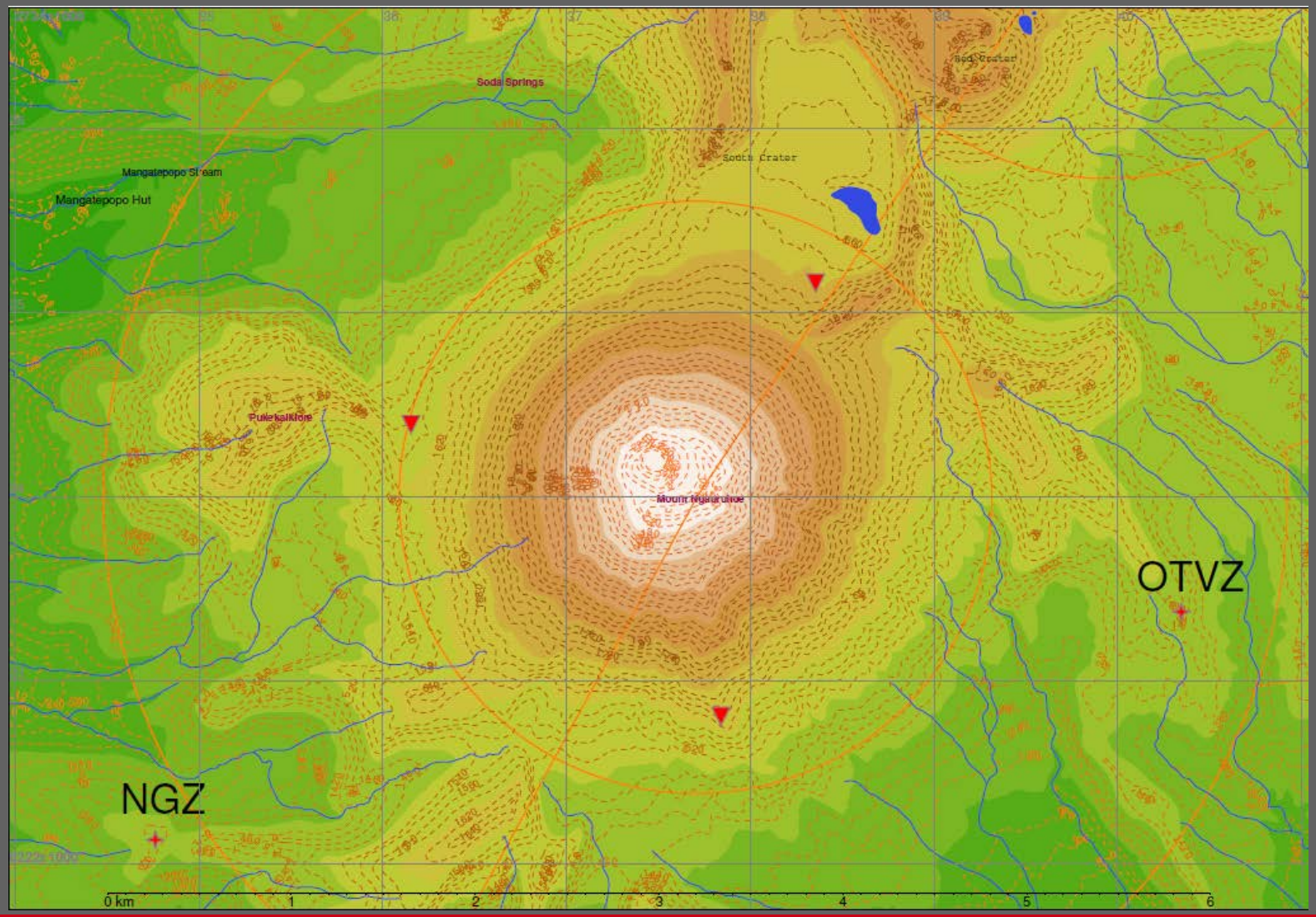
Ngauruhoe aerial view with 1 m temperatures



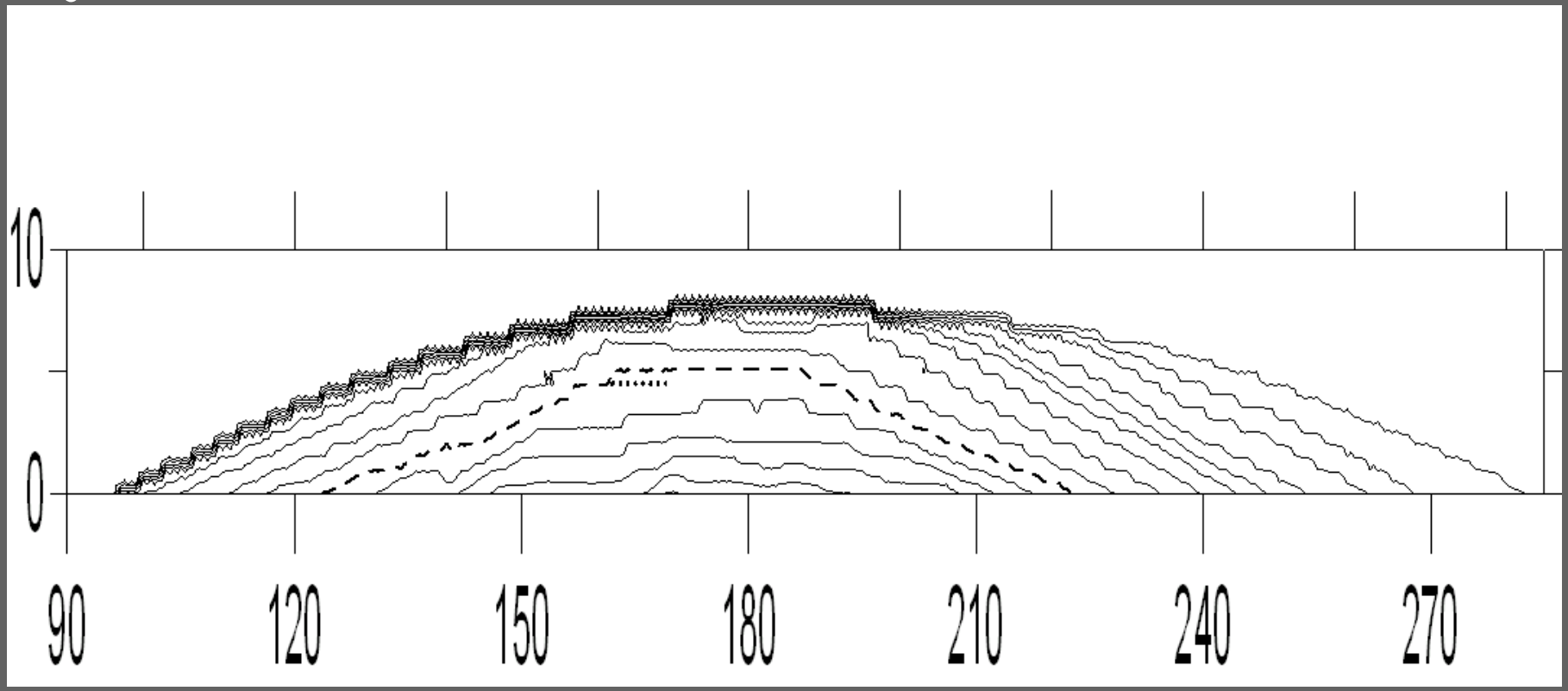
Ngauruhoe Structure

- Seismic Tomography – very little seismicity
- Muon tomography
  - fine-scale study
  - only above detector
  - detector must be high because of attenuation
  - potential target is upper part of vent
  - density range 0.9/1.5 (fill) to 2.8 (lava)
  - gives indication of precursors to new activity

Ngauruhoe topography

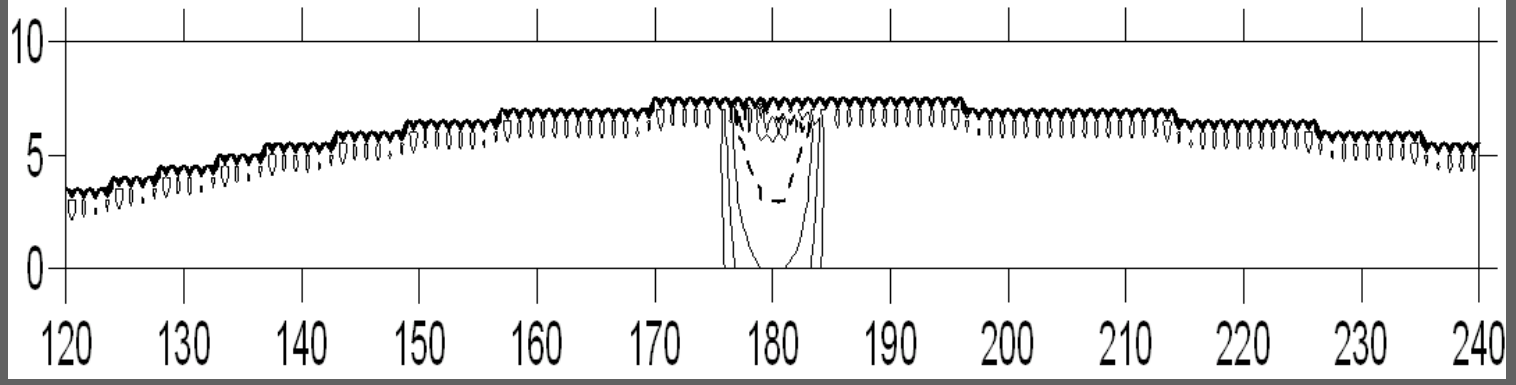


Rock thickness from point on Ngauruhoe north slope, at elevation of 1890 metres

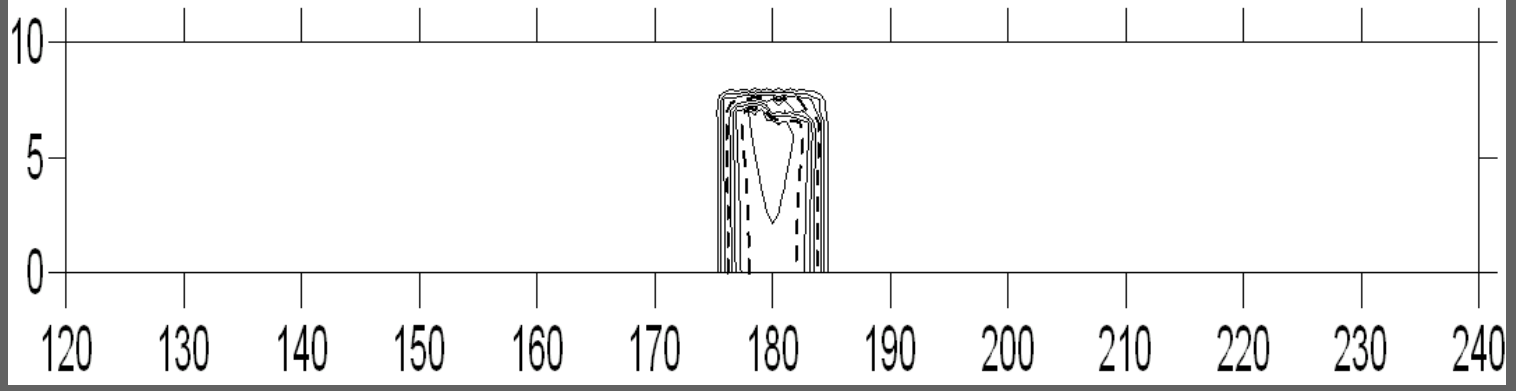


Dotted line is 1000 metre thickness

Ratio Plot, dotted at 0.96



Difference Plot, dotted at 20 & 40 metres



Conduit 90 metres diameter, with half normal density

Location Options

- Altitude – about 1900 m to look at top 300 m of vent
- End of lava cliffs offer good mounting sites
- Lava walls on north side too popular for climbers, also need Iwi permission
- No suitable features on north-east slopes
- East side very steep, avalanche/rockfall risk
- Recent north-west lavas very unstable, older lavas on arc from west through south to east may be best option.
- Nearest off-mountain site Pukekaikiore at 2 km distance, would have lower flux per angle and less resolution

End of lava from below and from side

North side too popular – Tongariro Crossing

Southern slopes of Ngauruhoe