



# Paleomagnetic results and dating from the Karoo traps



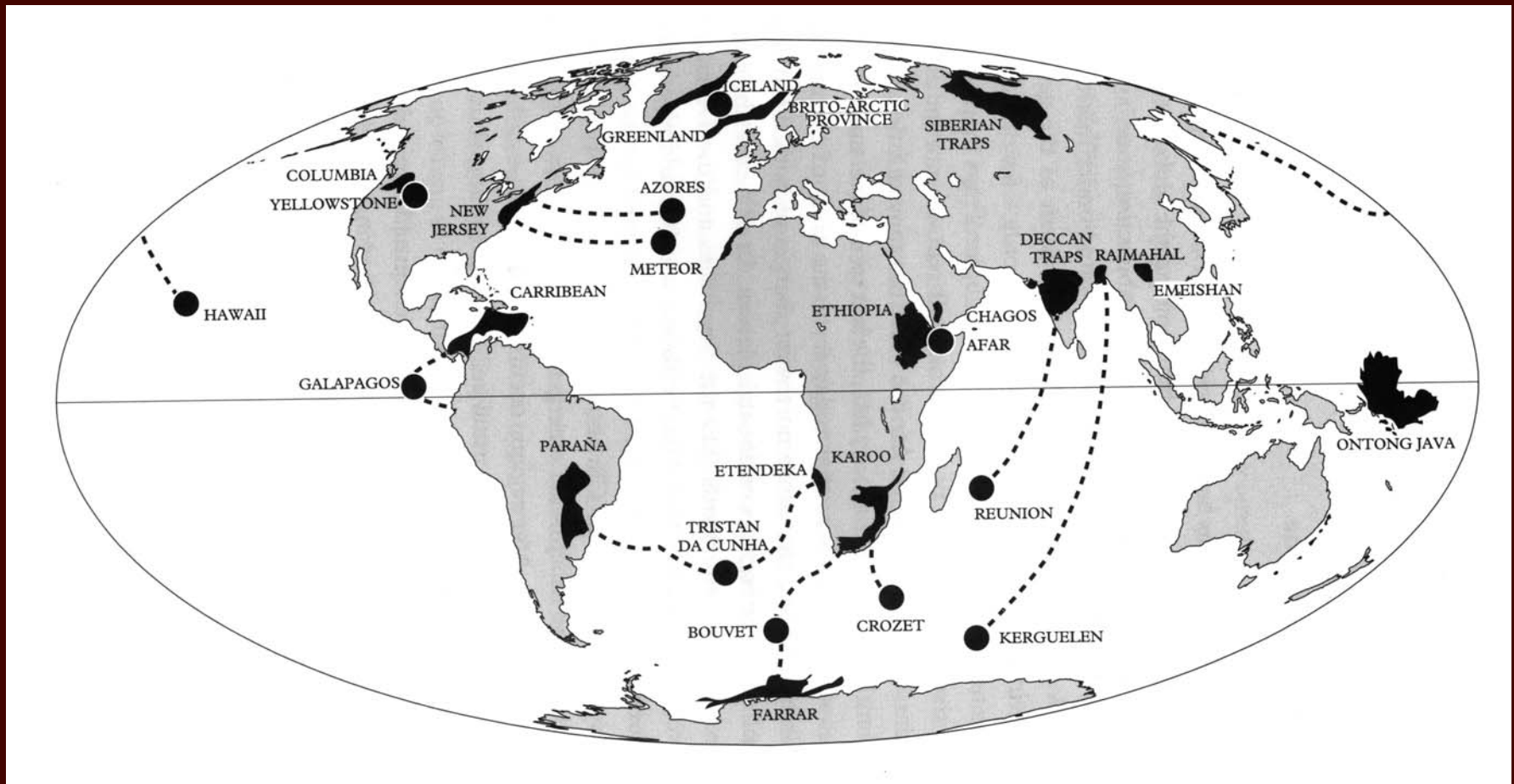
# Summary

1. Research objective
2. Study area
3. Preliminary dating results
4. Paleomagnetic results
5. Preliminary conclusions
6. Perspectives



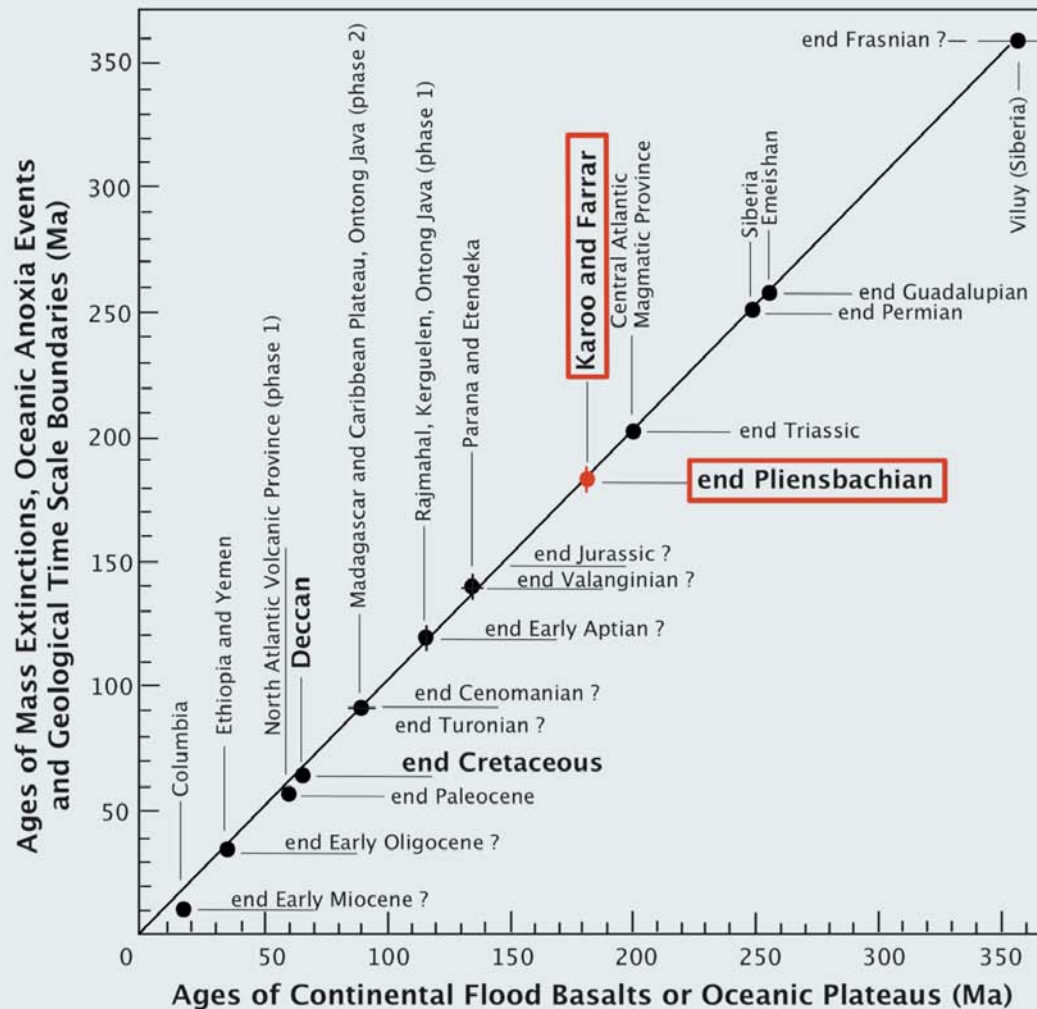
# 1. Research objective

## Location of the main Large Igneous Provinces (LIPs)



*Courtilot, 1995, 1999*

# 1. Research objective



A strong connexion between large igneous provinces (LIP) and mass extinctions (ME) or oceanic anoxia events (OAE)

# 1. Research objective

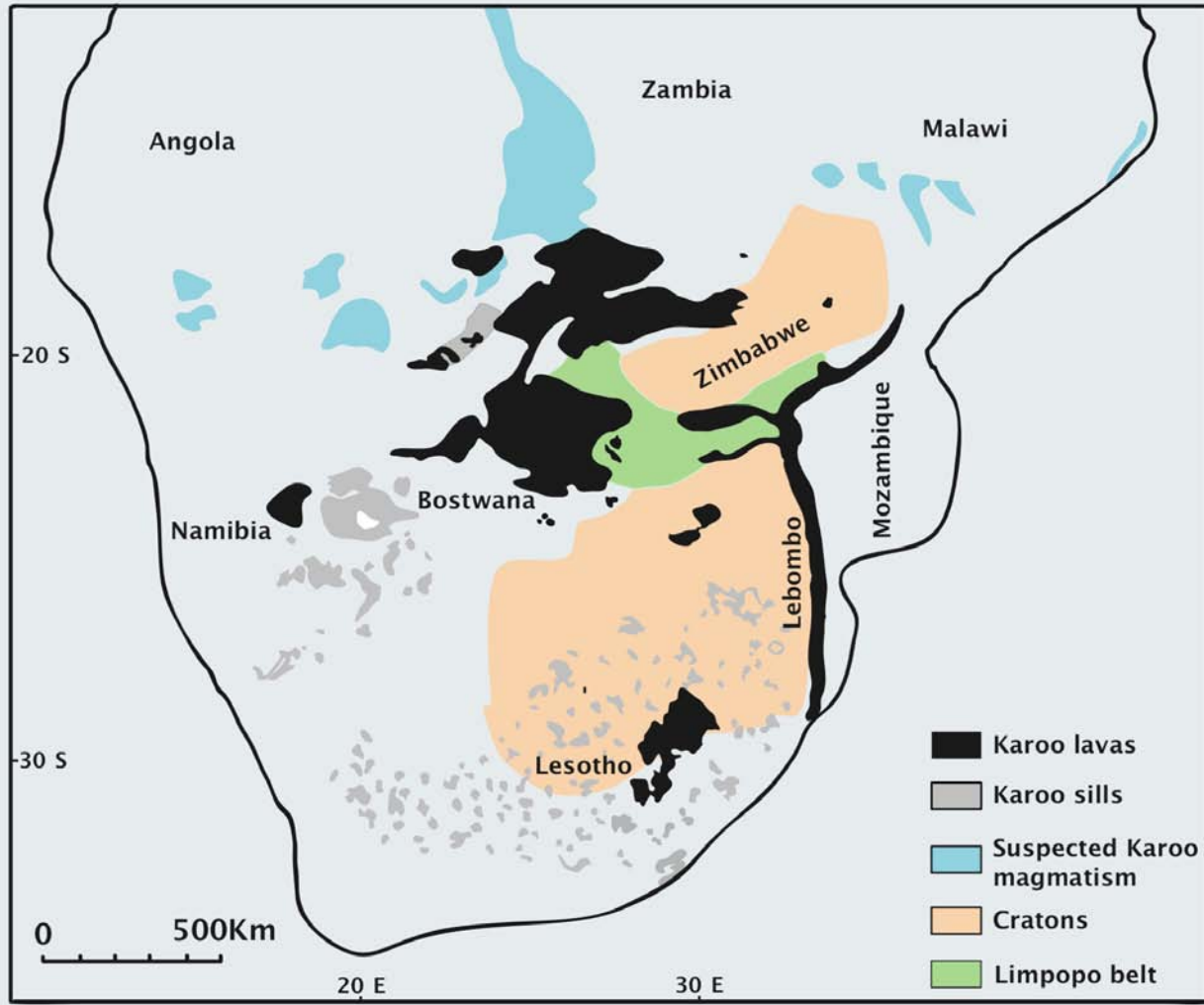
In order to model the climatic and environmental effects of LIPs, we must have access to:

- The details of timing
  - Volumes
- } of the eruptive sequence

## Methods:

- Paleomagnetism (secular variation)
- Geochronology ( $^{40}\text{K}$ - $^{40}\text{Ar}$  Cassinot-Gillot technique)
- Volcanology (flow types)
- Analysis of alteration levels between lava flows

## 2. Study area



Distribution of  
the Karoo traps

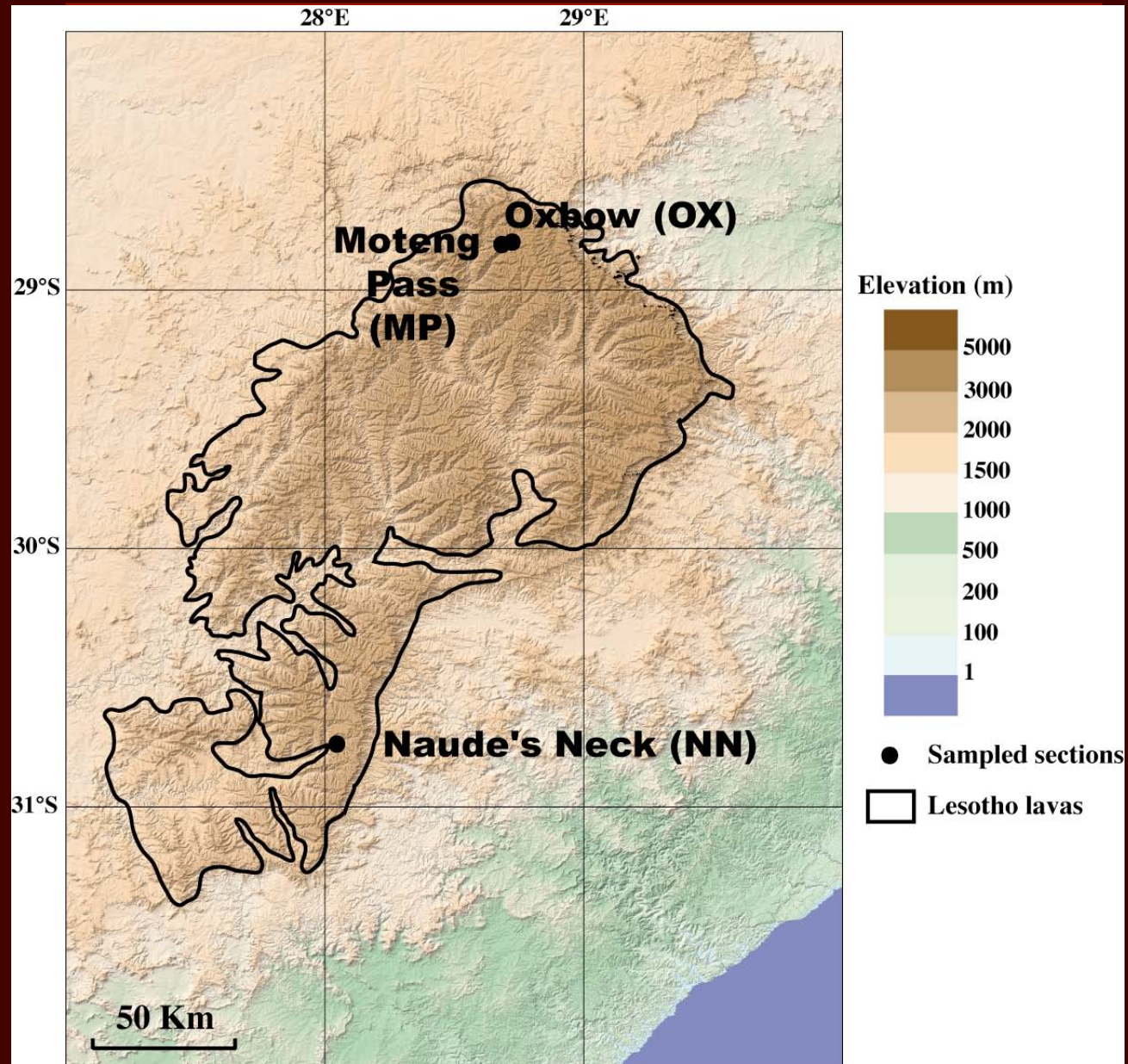
*Modified after Jourdan et al., 2005.*

## 2. Study area

Three field trips in  
2006, 2008 and  
2009

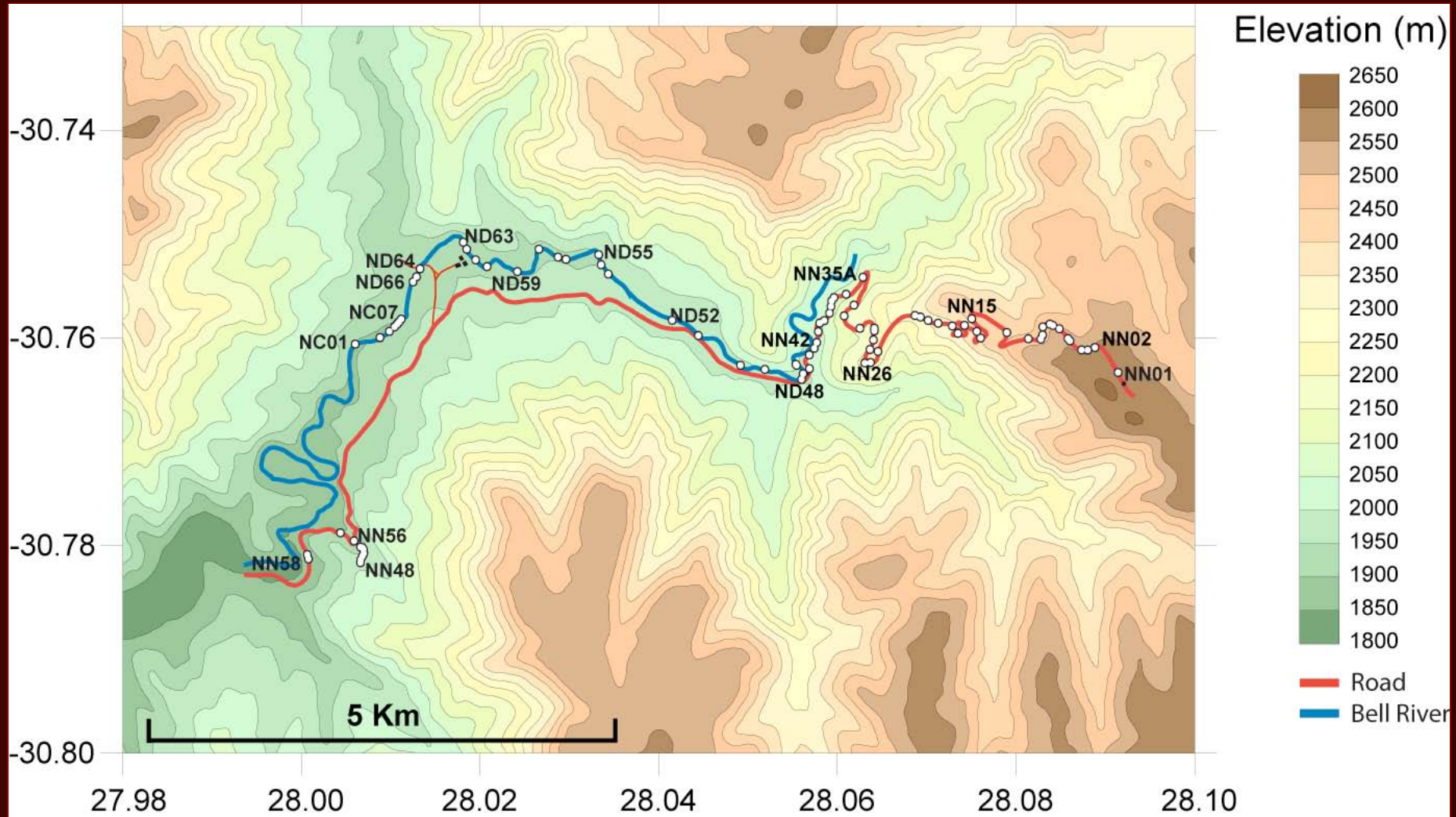


Three full sections  
sampled in the  
south and in the  
north of the  
volcanic sequence



## 2. Study area

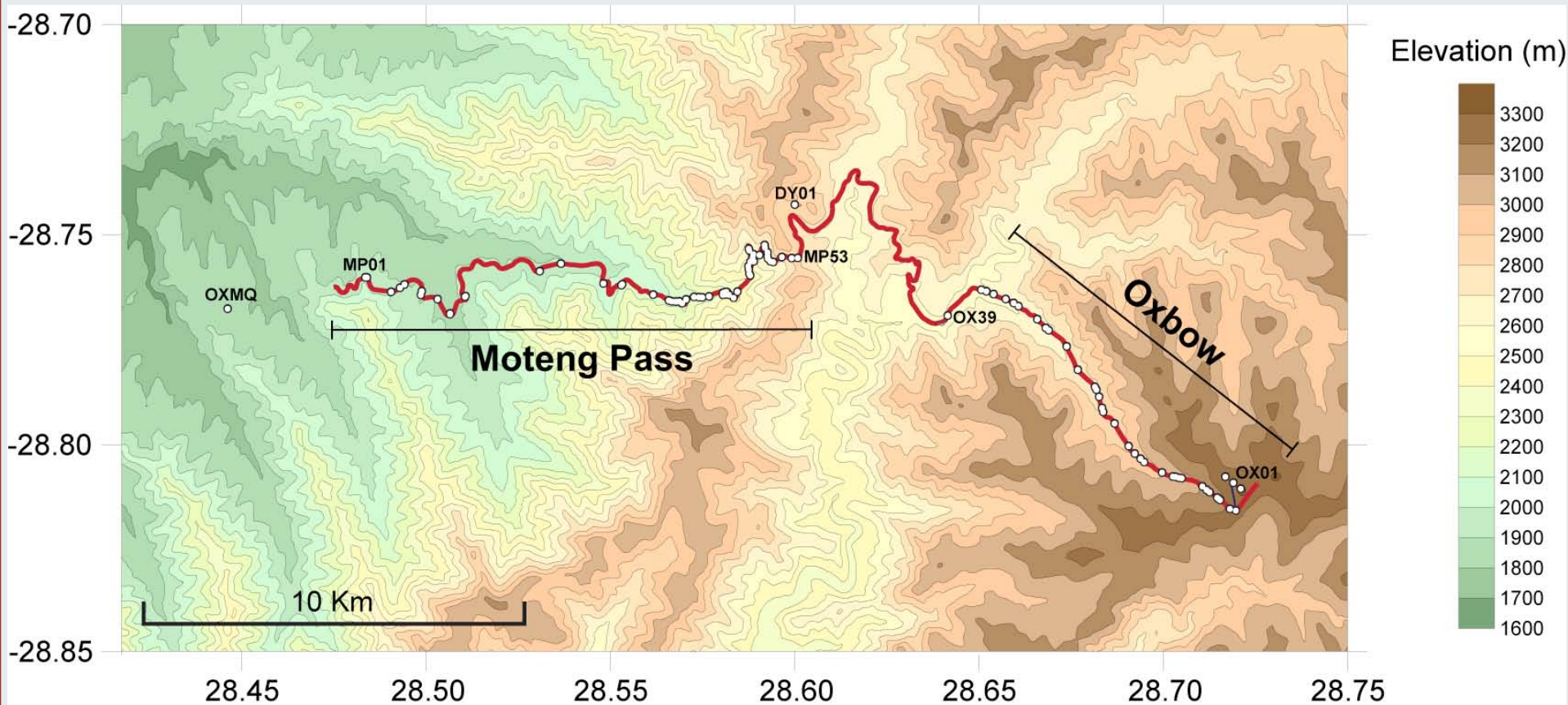
The Naude's Neck section (86 sites, 800 cores)





## 2. Study area

The Oxbow and Moteng Pass sections (97 sites, 870 cores)



## 2. Study area

Typical example of the 3-fold division of lava flows in the Karoo traps



**Core and basal  
flow**

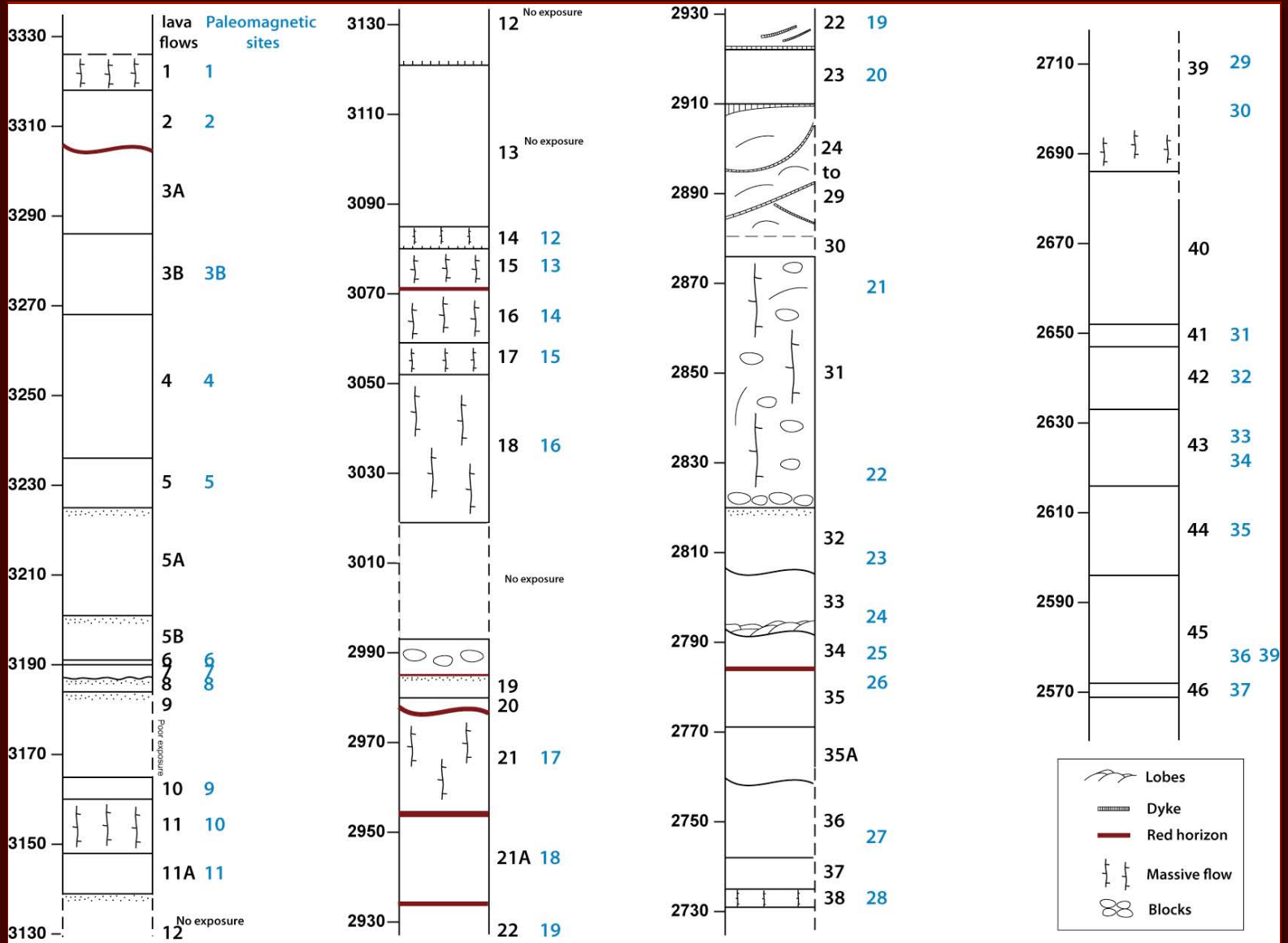
**Pipe vesicles  
(Bottom of a flow)**

**Flow contact**

**Vesicles  
(top of a flow)**

# 2. Study area

## Log of the Oxbow section

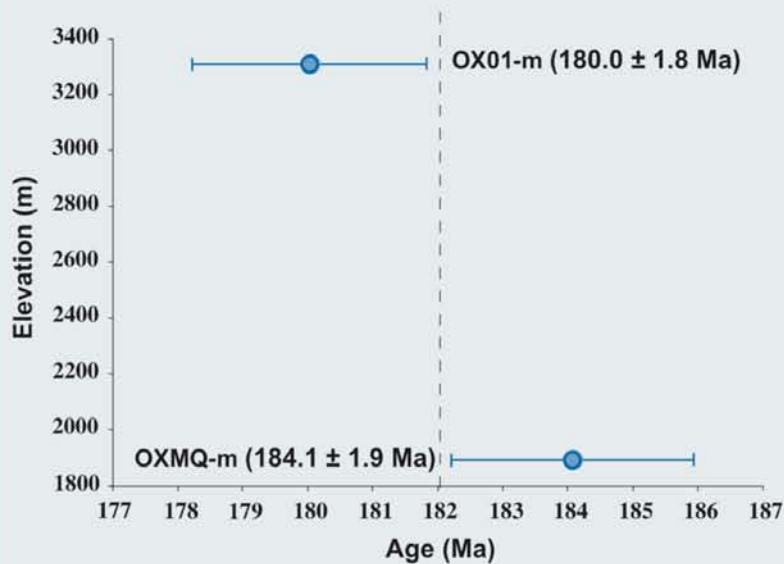


### 3. Preliminary dating results

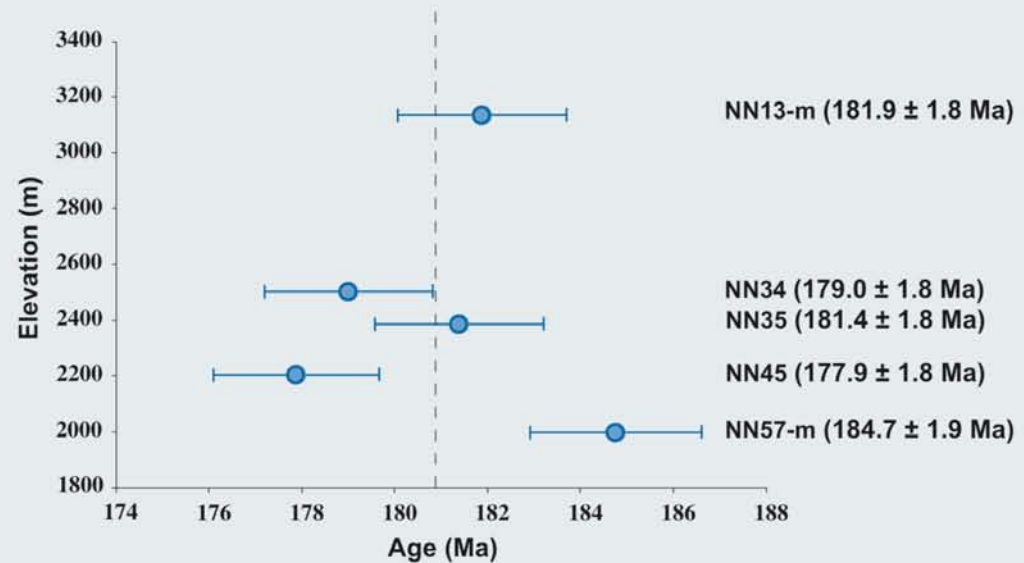
We are working on some samples for dating with the  $^{40}\text{K}$ - $^{40}\text{Ar}$  Cassinoli-Gillot technique in Orsay. Seven results have been obtained so far:



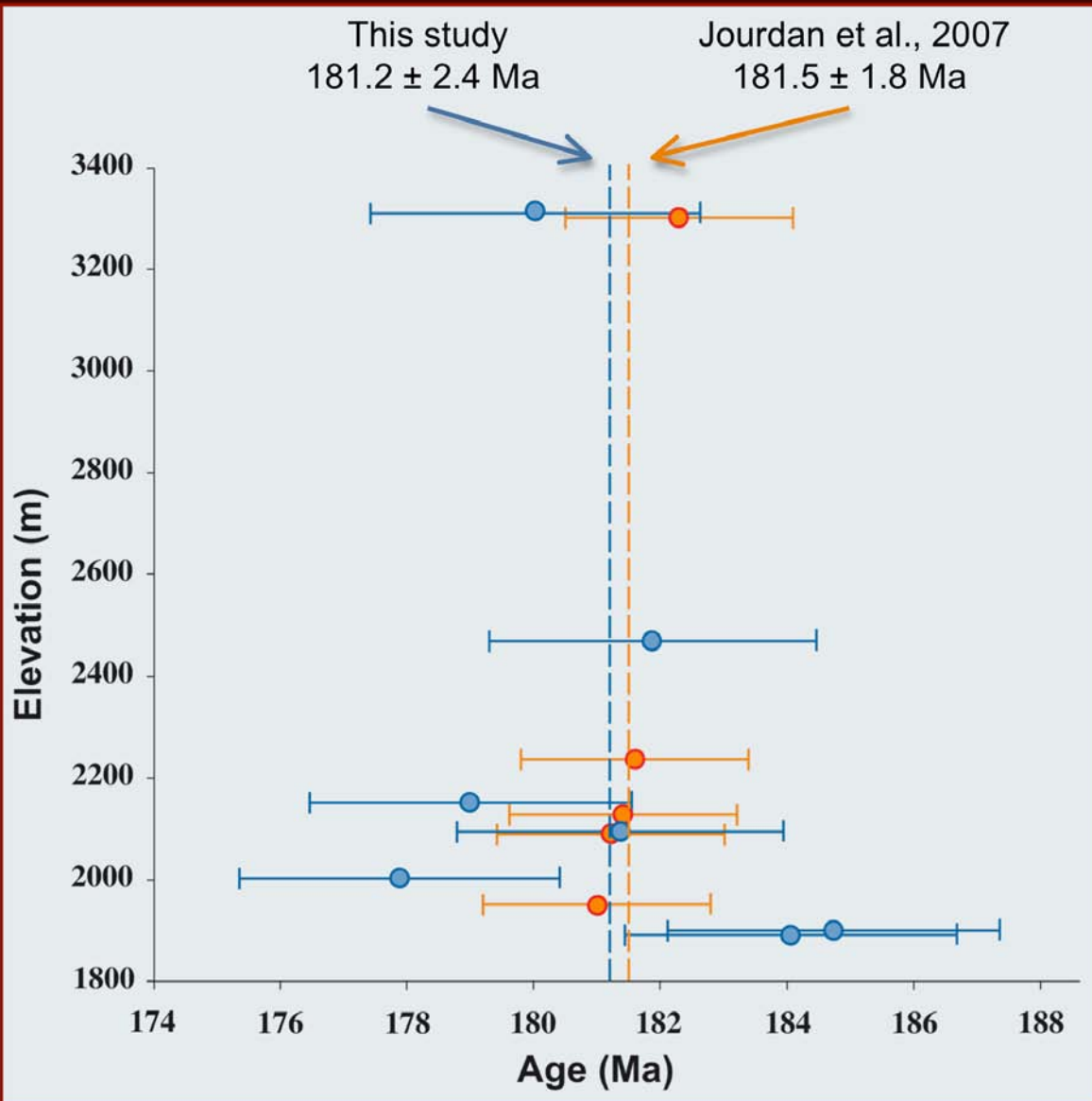
The Oxbow and Moteng Pass sections



The Naude's Neck section



### 3. Preliminary dating results



The five plagioclase  $^{40}\text{Ar}/^{39}\text{Ar}$  ages obtained for the Lesotho sequence by Jourdan and al., (2007) and our ages are statistically indistinguishable

### 3. Preliminary dating results

No difference in age between top and bottom of the Lesotho lava pile.

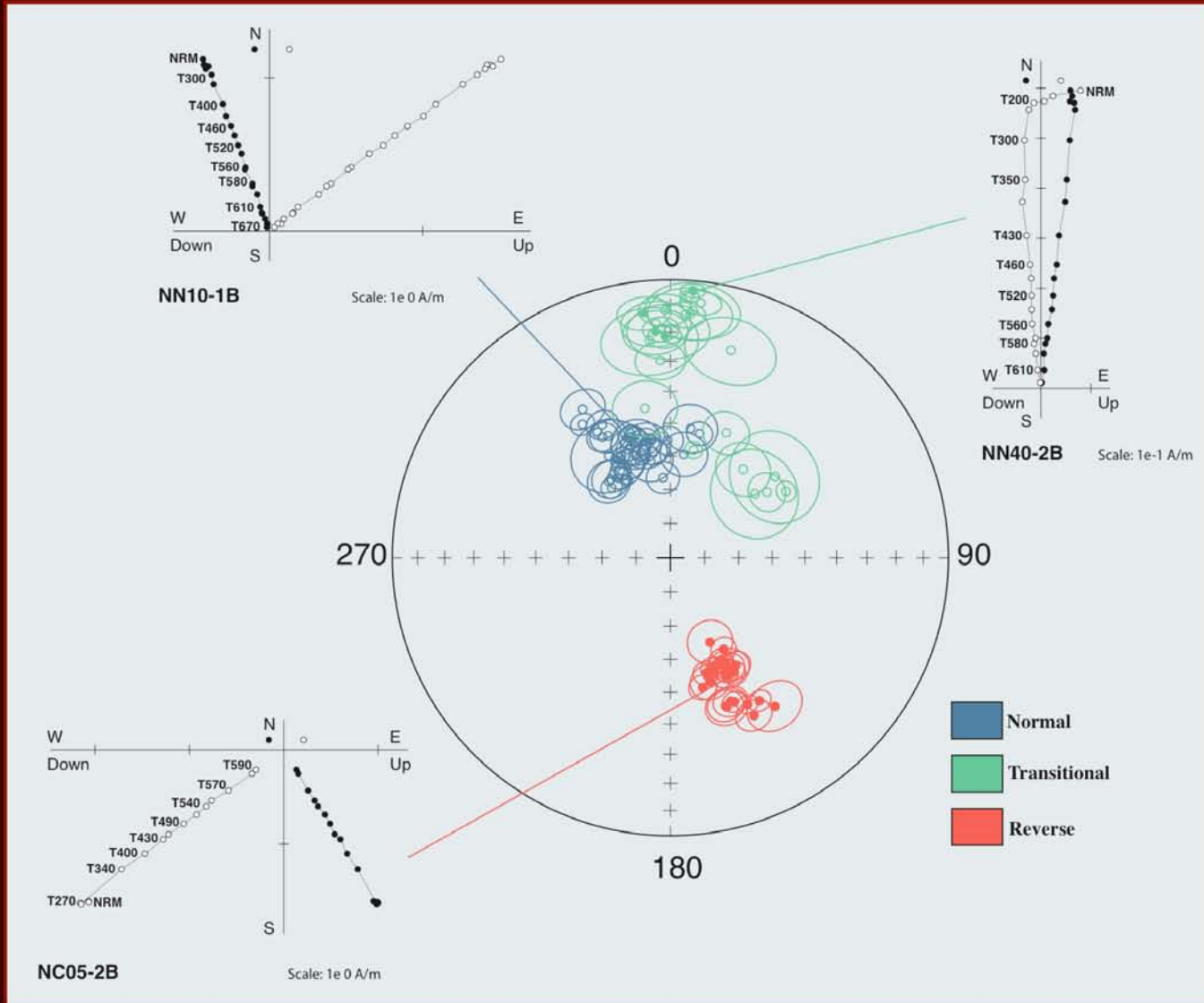
Ages obtained using the K-Ar and Ar-Ar are statistically indistinguishable validating the K-Ar technique for this type of samples.

#### **Perspectives:**

- Some samples have been prepared for dating by  $^{40}\text{Ar}/^{39}\text{Ar}$  technique.
- We hope to find zircons in segregation veins to obtain U/Pb ages.

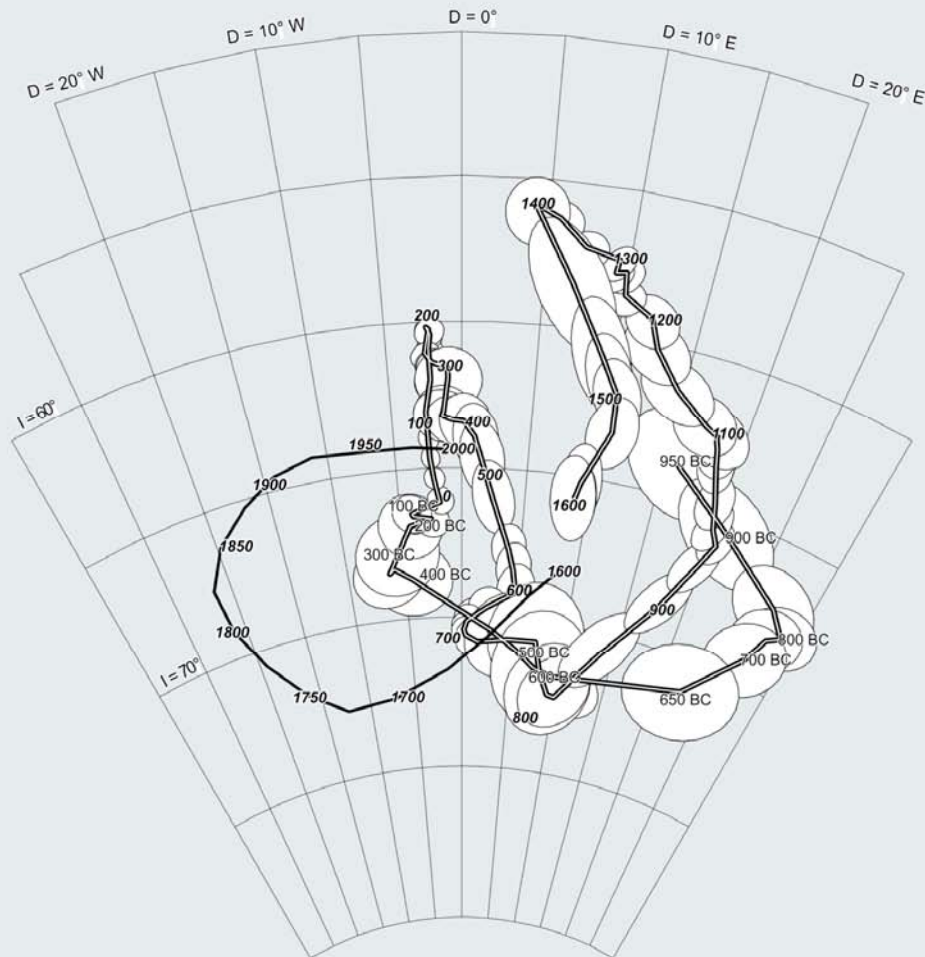
# 4. Paleomagnetic results

Mean magnetic directions for 86 sites of the Naude's Neck section



## 4. Paleomagnetic results

Secular variation used as a relative chronometer



Recent geomagnetic  
secular variation:

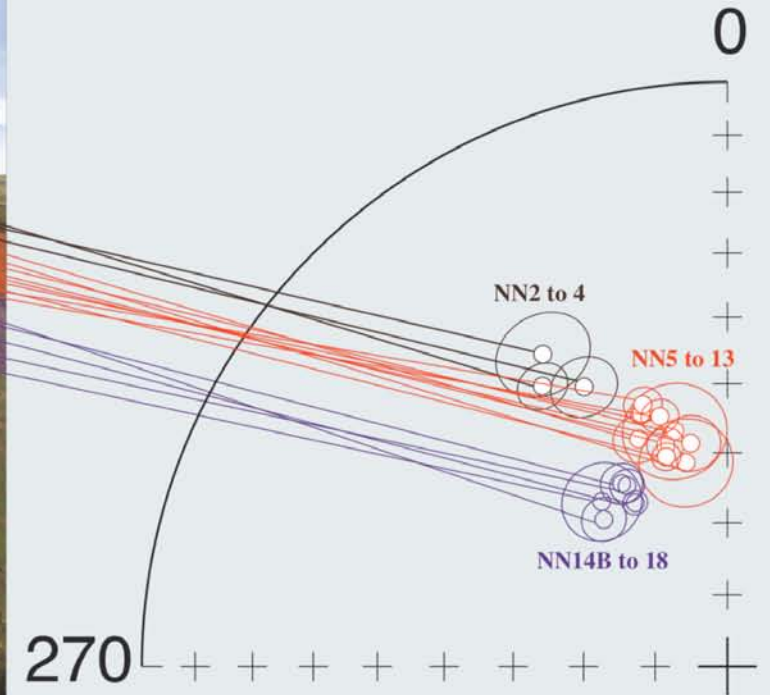


A few degrees per  
century



## 4. Paleomagnetic results

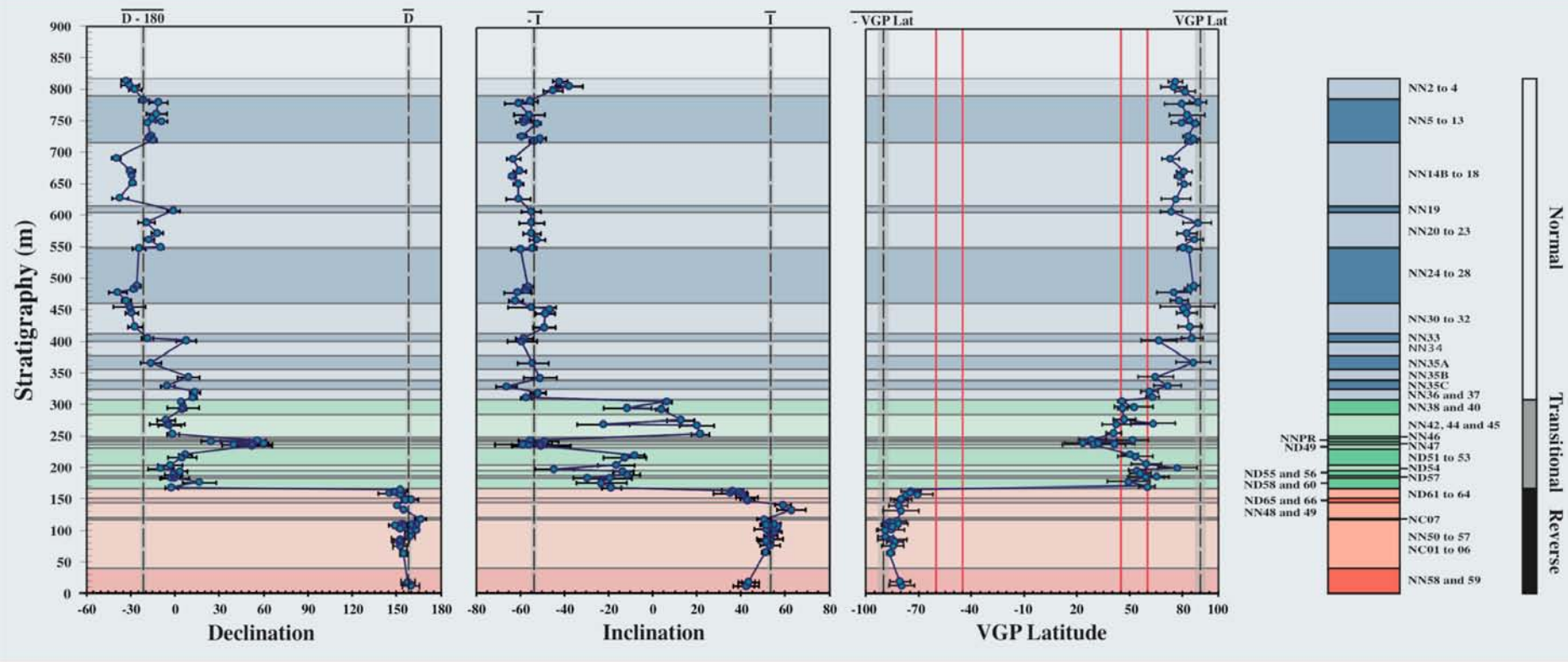
Secular variation used as a relative chronometer



→ Packages of lavas displaying statistically undistinguishable magnetic directions, erupted and cooled over less than  $\approx 100$  yrs

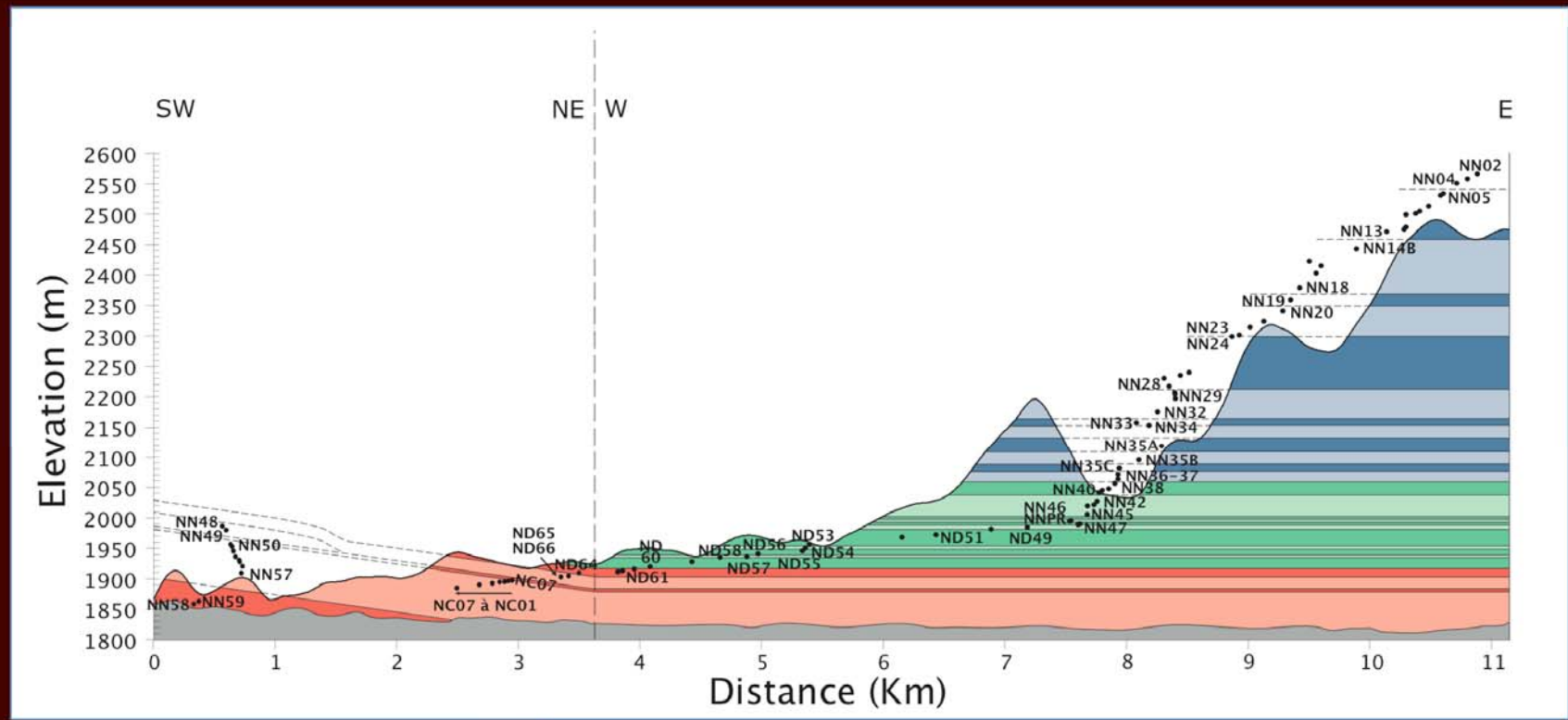
# 4. Paleomagnetic results

## Magnetostratigraphy of the Naude's Neck section



- 17 volcanic pulses and 13 interbedded individual lava flows
- Volcanic activity may have been as short as 3000 yrs

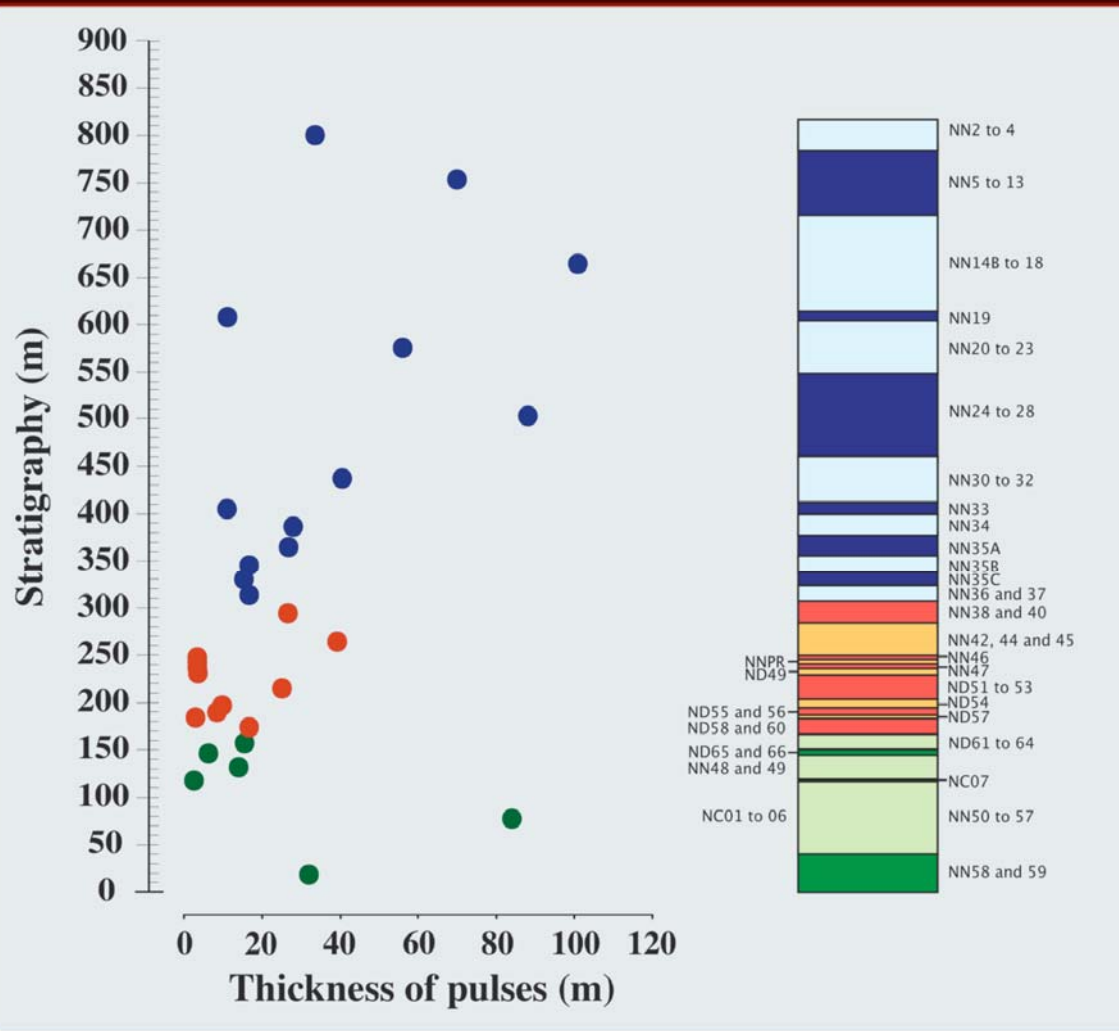
# 4. Paleomagnetic results



The first lavas flows were emplaced on a slightly tilted paleosurface (Clarens formation)

# 4. Paleomagnetic results

An overestimate of the time of volcanic activity?

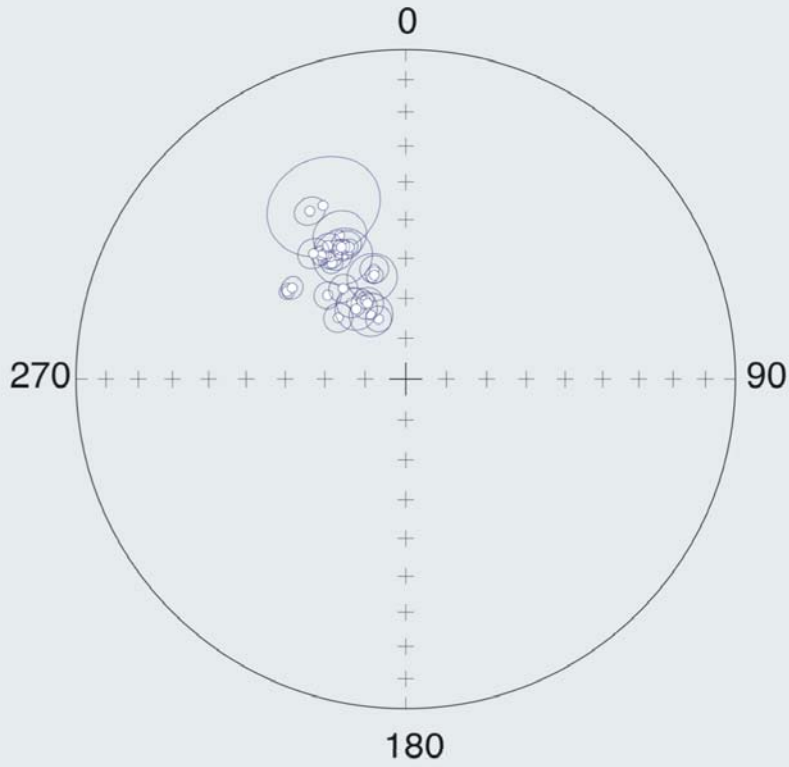


Pulse thickness seems to increase when one moves away from the reversal



Possibly indicating an increase in secular variation amplitude during the reversal (dipole field smaller)

# 4. Paleomagnetic results



First results for the top of the Oxbow section

As previously for the top of the Lesotho lava pile, we find a normal polarity.



## 5. Preliminary conclusion

- The 800 m thick (~ 80 flows) Naude's Neck section shows only one magnetic reversal in the lower part of the sequence.
- The eruptive sequence can be divided into 17 volcanic pulses and 13 individual lava flows with actual volcanic activity having lasted less than 3000 years.
- In this area, lava flows likely have a small but not negligible dip (2-3%), which must be taken into account for proper magnetostratigraphic correlation and interpretation.
- Preliminary dating results are in good agreement with previous studies.

## 6. Perspectives

- We will date other samples in the Naude's Neck, Oxbow and Moteng Pass sections using  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  and U/Pb methods.
- We will complement this work with magnetostratigraphy of the Oxbow and Moteng Pass sections.
- We intend to focus in particular on:
  - 1) details of the « historical » Van Zijl reversal.
  - 2) estimate of total duration, existence of pulses and quiet intervals.

