# Low altitude magnetic field at the Moon: Artemis observations

1. **Crustal anomaly: direct measurements**
2. **Crustal anomaly: interaction with the solar wind**

Magnetometer workshop, Jizerce, March 2014

# Magnetic field near the Moon

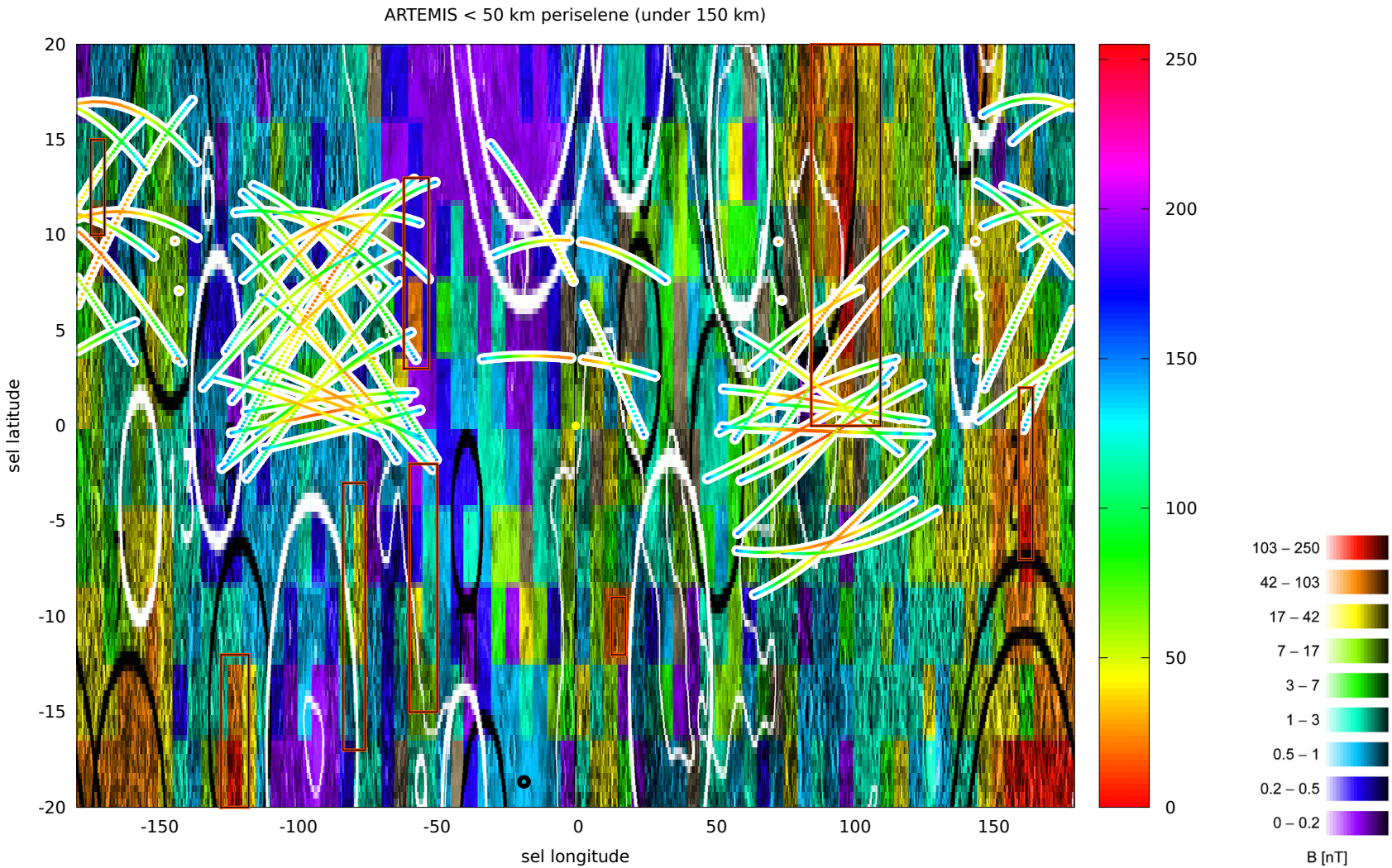
- Core signature
  - two probes $\Rightarrow$ interior properties ($\sigma$)
- Crustal magnetic anomalies: direct measurement
  - Moon night side or Earth magnetotail
  - same area, different altitudes $\Rightarrow$ dipol strength and depth
- Crustal magnetic anomalies: interaction with the solar wind
  - reflected ions, upstream waves
  - bowshock?
  - mini-magnetospheres?

# Factors affecting the low altitude magnetic field

- Altitude of the periselene
- Periselene position over the Moon crust (magnetic features)
- Ambient plasma and field parameters
  - Location of the Moon in respect with the Earth
    - Solar wind
    - Inside the Earth's magnetosheath or tail
  - Periselene position (Sun - Moon)
    - Day side
    - Night side
    - Limb

# Artemis periselenes below 50 km

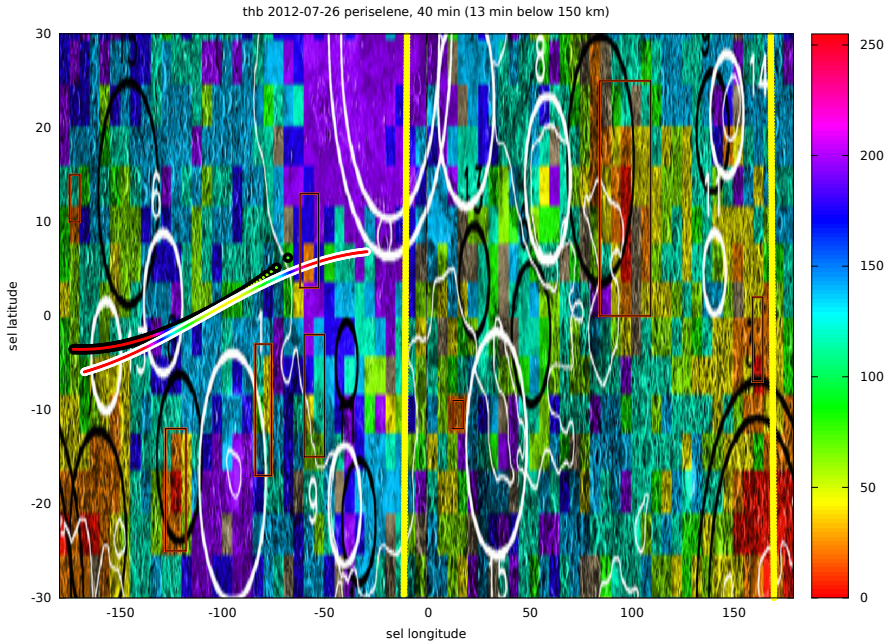
## 49 events between August 2011 and March 2014

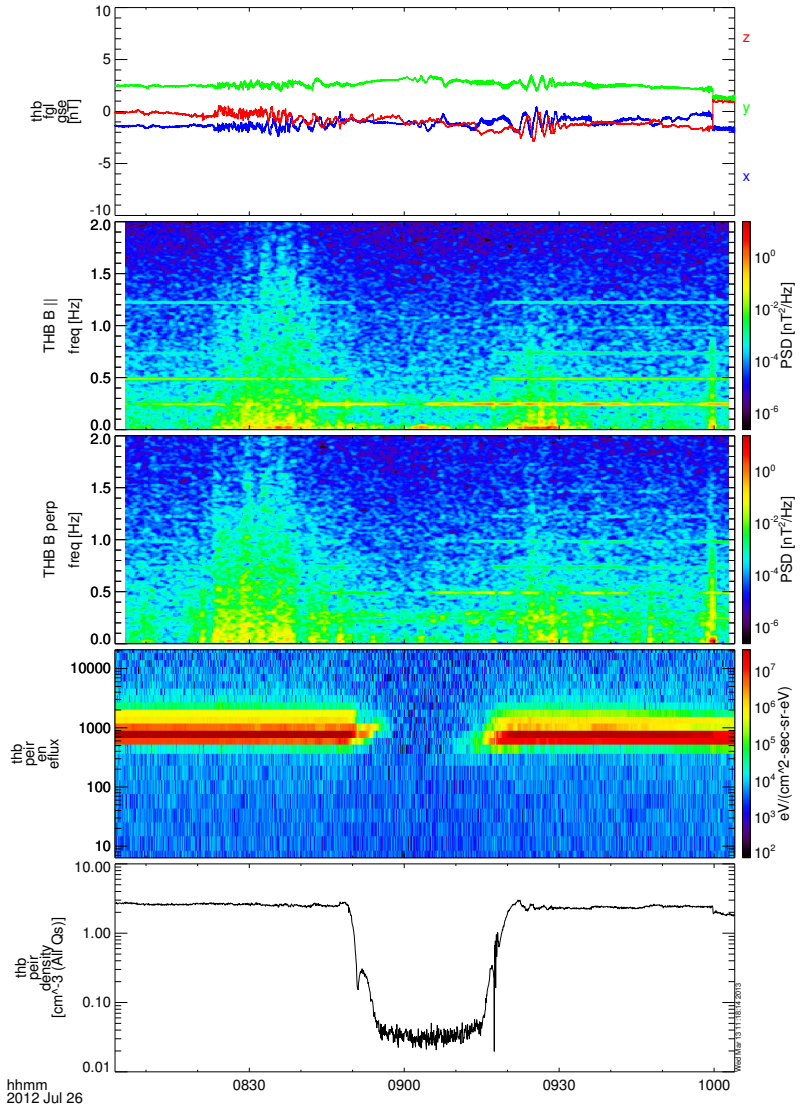





Crustal field map from *Mitchell et al, Icarus 2008* (0-200 nT)

# Example: event 23, July 26 2012

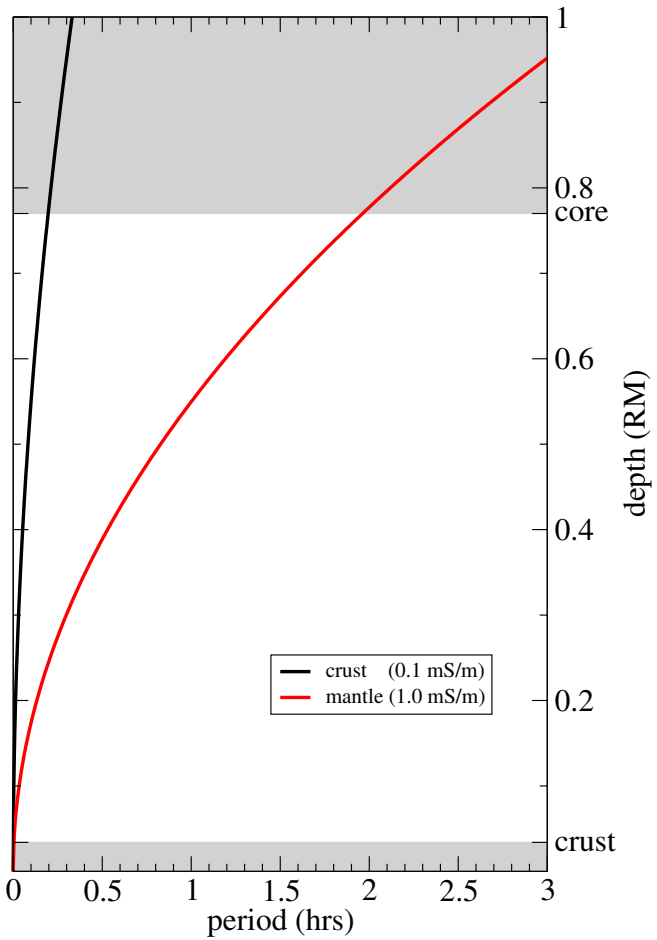



- Periselene at 39 km
- Night side
- Solar wind

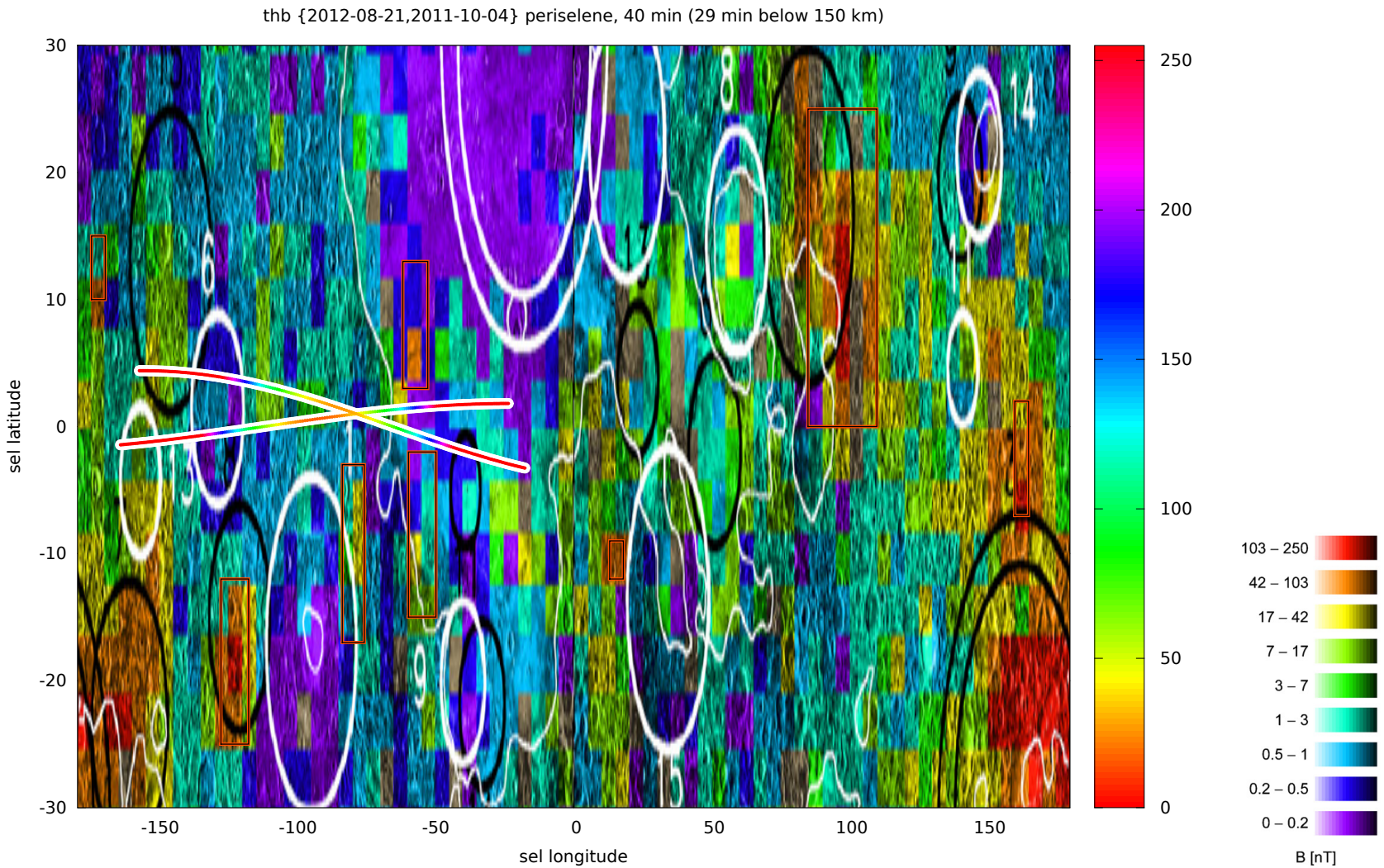
# Core signature

- transient response
- transfer functions in the night side
- For core detection: 3 hours period
- Artemis time below 150 km: 14 min



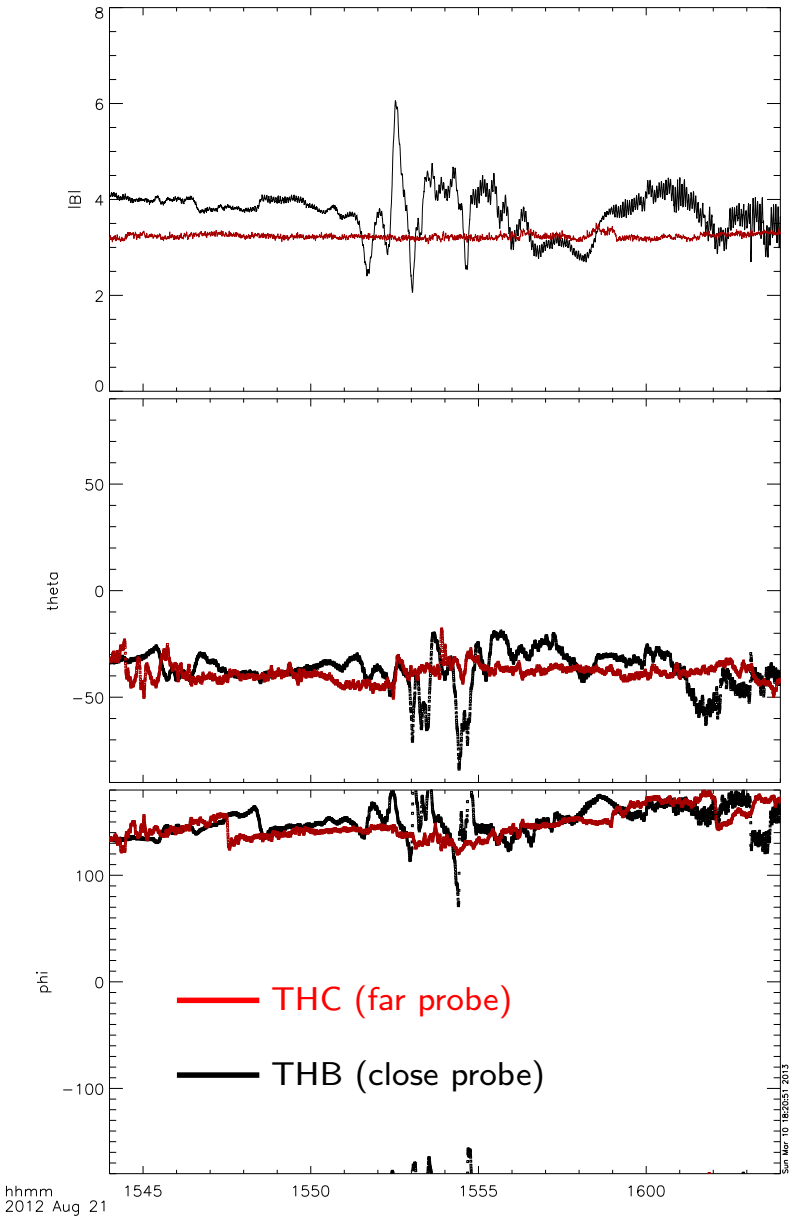
# Crustal anomaly: Direct measurement

Two passes over same area at 14 and 23 km, SW, Night side

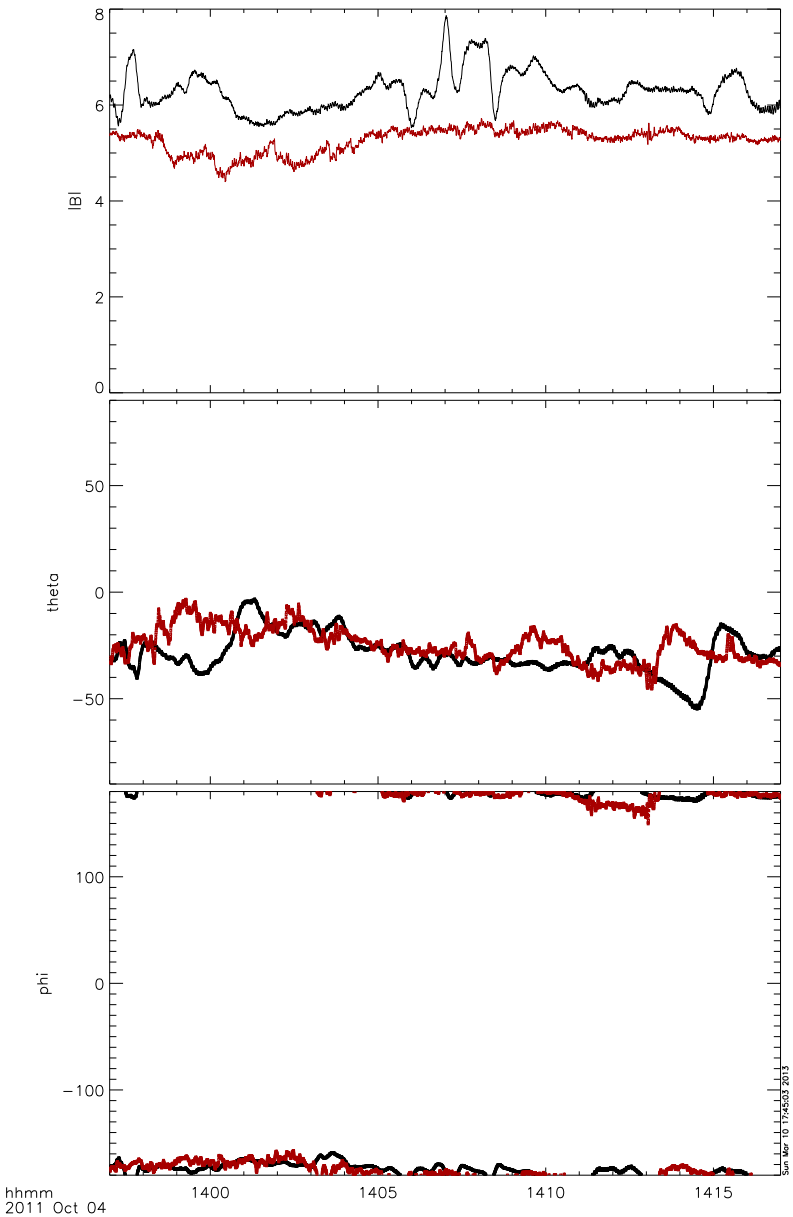


# Crustal anomaly: Direct measurement

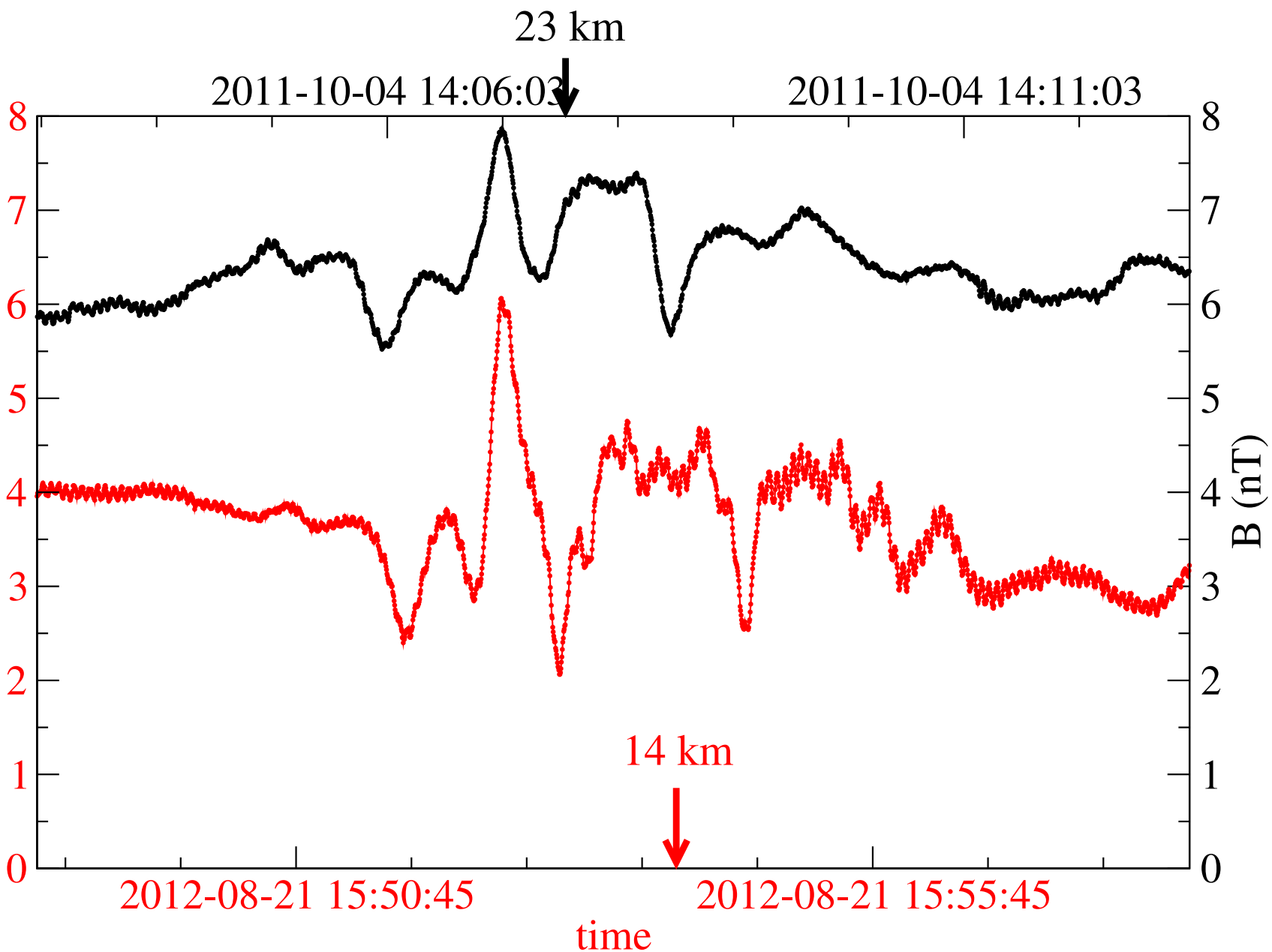
2012-08-21, 14 km




2011-10-04, 23 km



# Crustal anomaly: Direct measurement

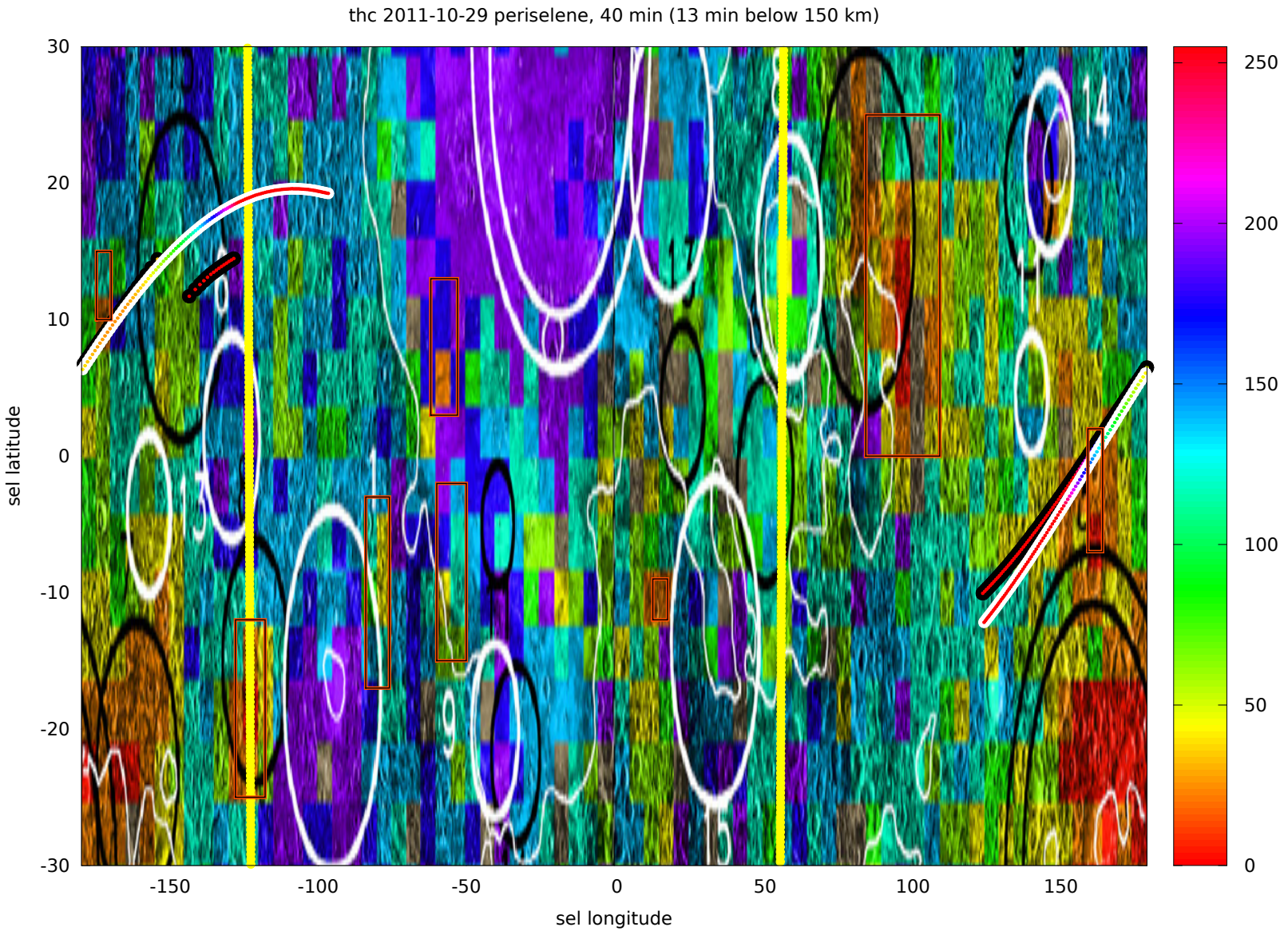


# Crustal anomaly: Direct measurement

- two passes over the same region on the night side
- at altitudes of 14 and 23 km
- the Moon is in the solar wind, similar conditions
- assume $r^3$ decay of the magnetic field
- $\Rightarrow$ anomaly depth: 15 km
- $\Rightarrow$ anomaly strength at the surface: 60 nT

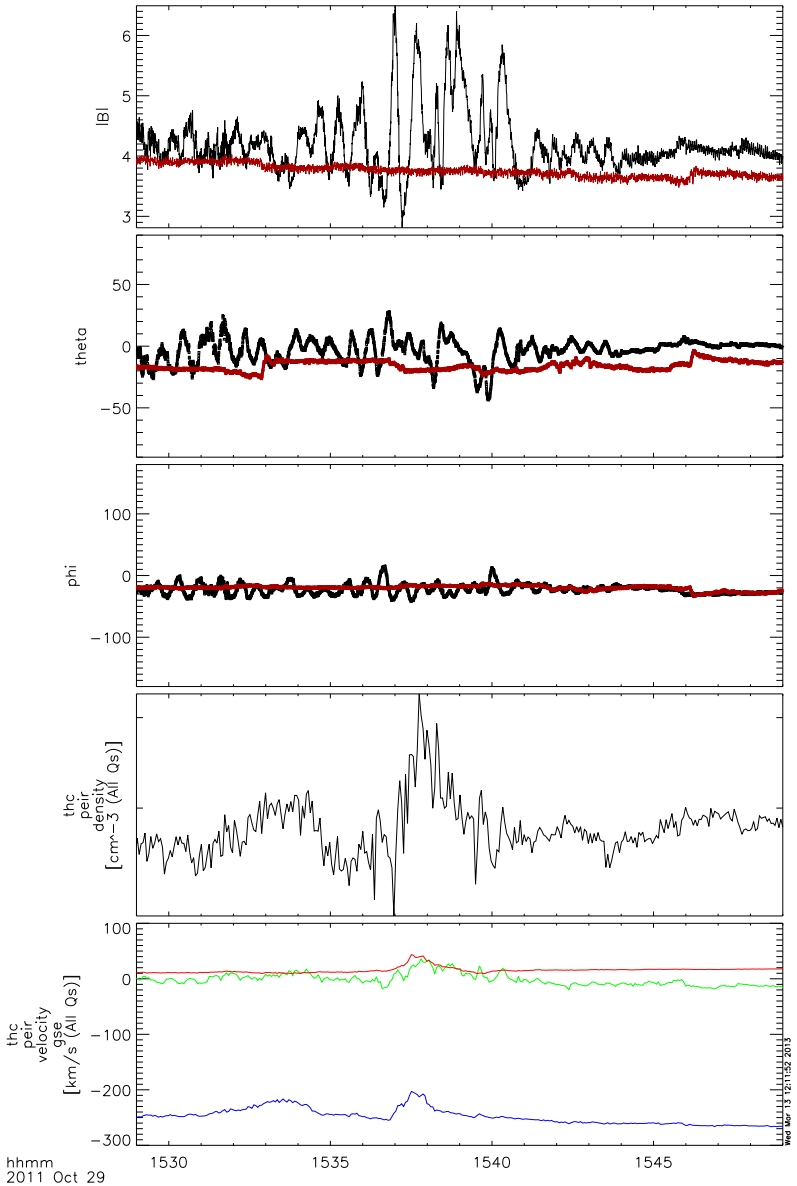
# Crustal anomaly: interaction with the solar wind

## Dayside, THC periselene at 23 km over 170 W, 10 N anomaly



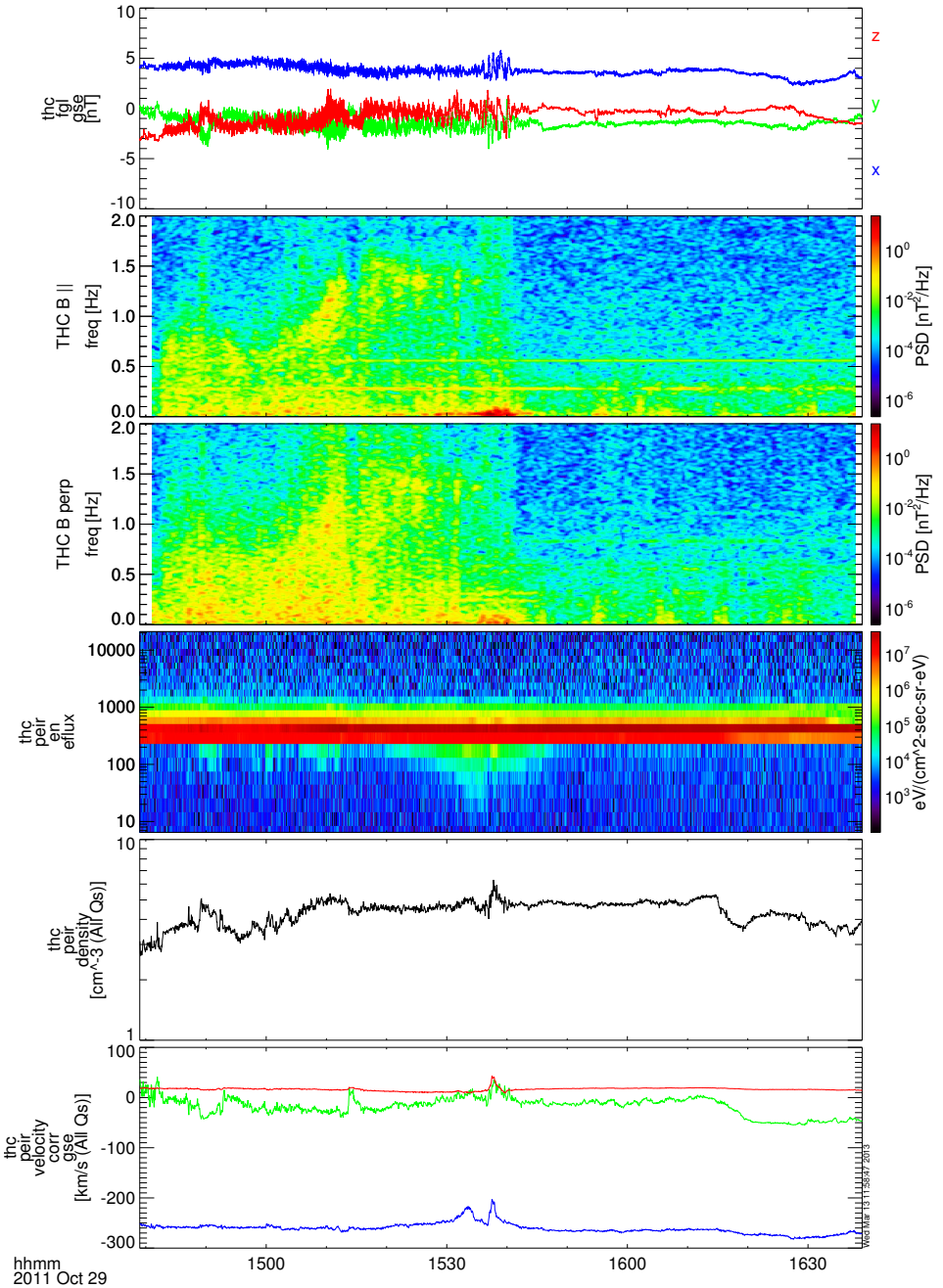
# Crustal anomaly: interaction with the solar wind

- solar wind is quiet (THB)
- before periselene: (THC)
  - variations in module
  - variations in direction
- close to periselene: (THC)
  - $|B|$ amplitude increase
  - density increase
  - plasma flow deflection
- after periselene: (THC)
  - smaller variations



# Crustal anomaly: interaction with the solar wind

- upstream waves
- reflected ions
- mini-magnetosphere?



# Summary

- Measurements on the night side can give a detailed view of crustal anomalies
- Detection of previously unknown 60 nT crustal magnetic feature
- Strong crustal anomalies interact in a complex way with the solar wind and could form mini-magnetospheres.