Carrier of NRM in oceanic basalt studied by continuous thermal demagnetisation

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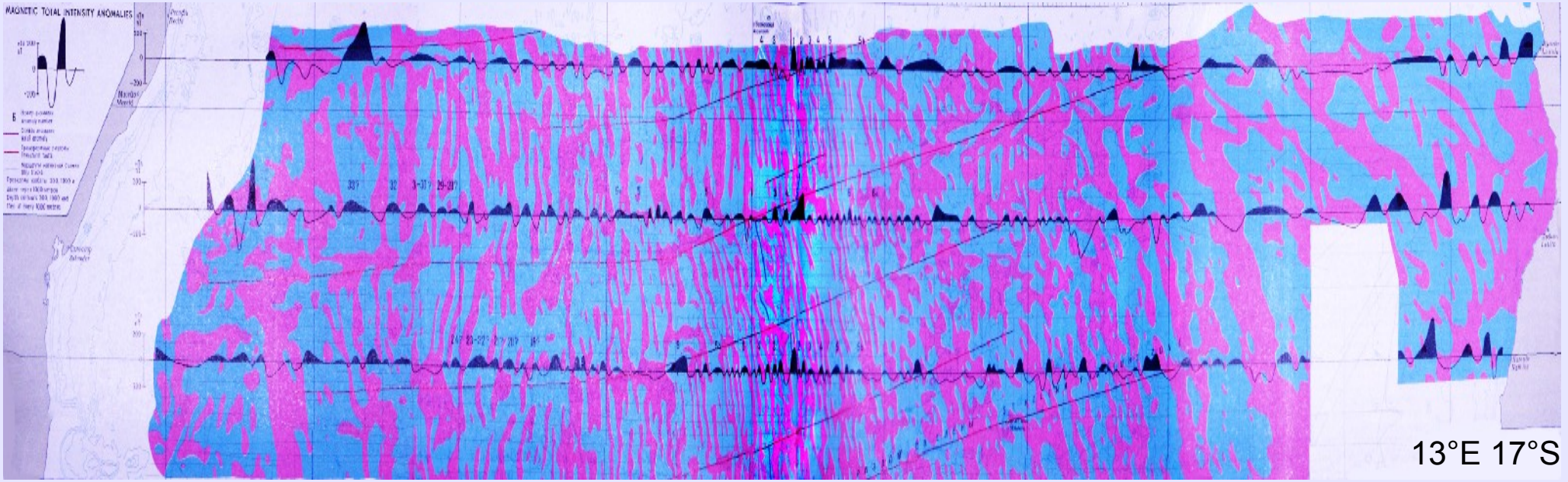
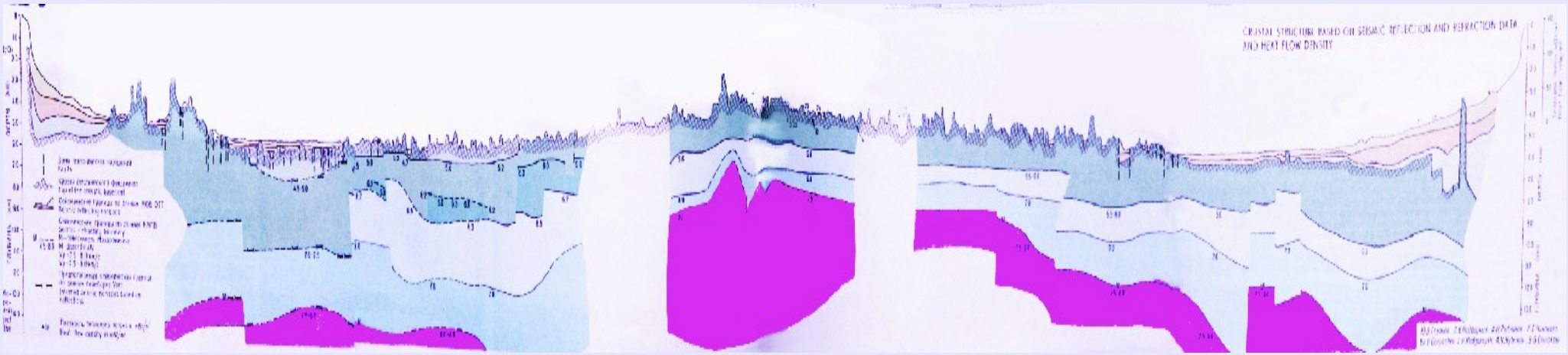
An example from the South Atlantic

35°W 7°S



13°E 17°S



Sketches taken from the International Geological-Geophysical Atlas of the Atlantic Ocean

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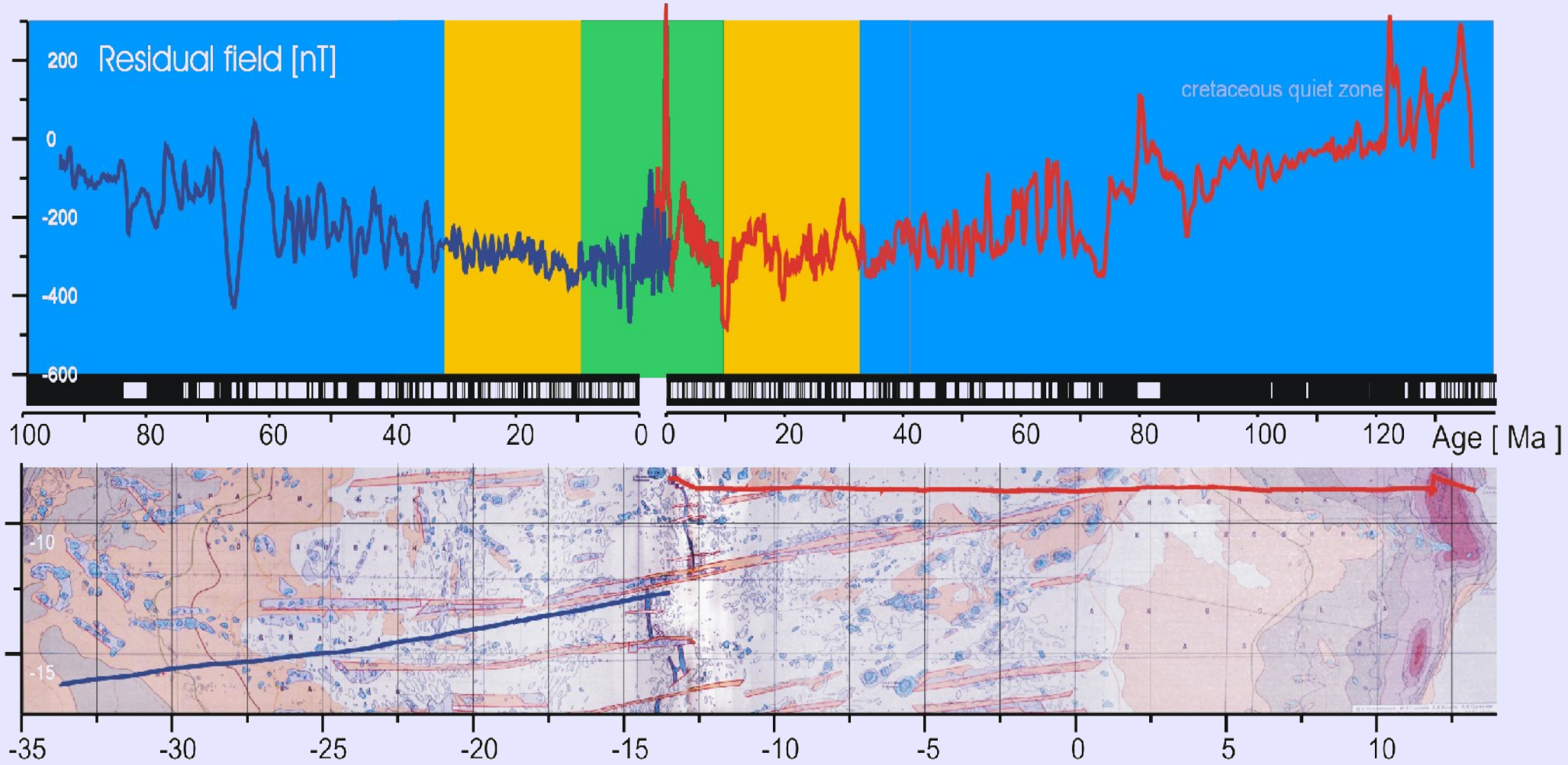
Oceanic basalt is a peculiar magnetisation carrier

- Small amplitudes around 20 Ma



data provided by National Geophysical Data Center (NGDC)

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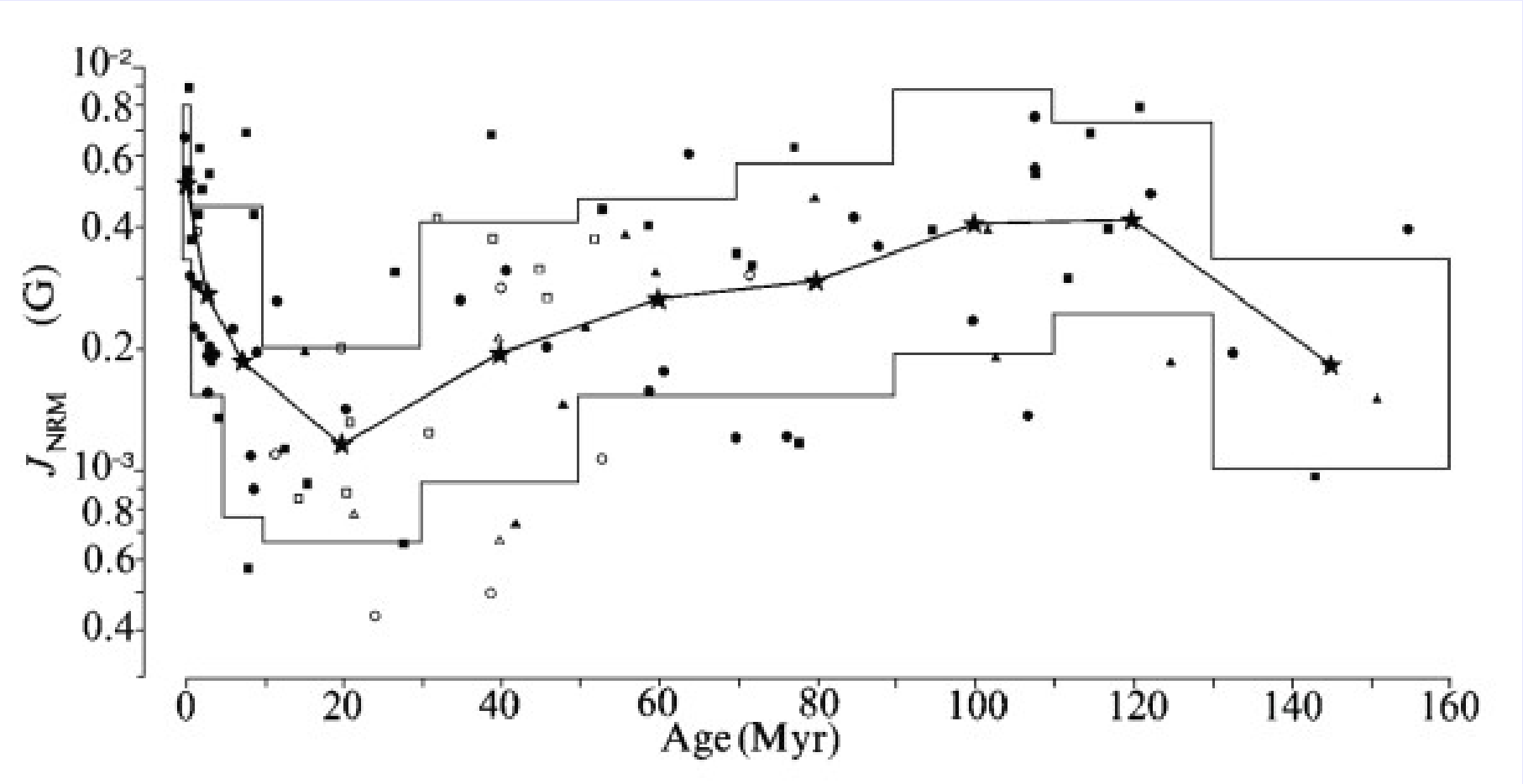
NRM intensities of ocean basalts



Bleil and Petersen, 1983

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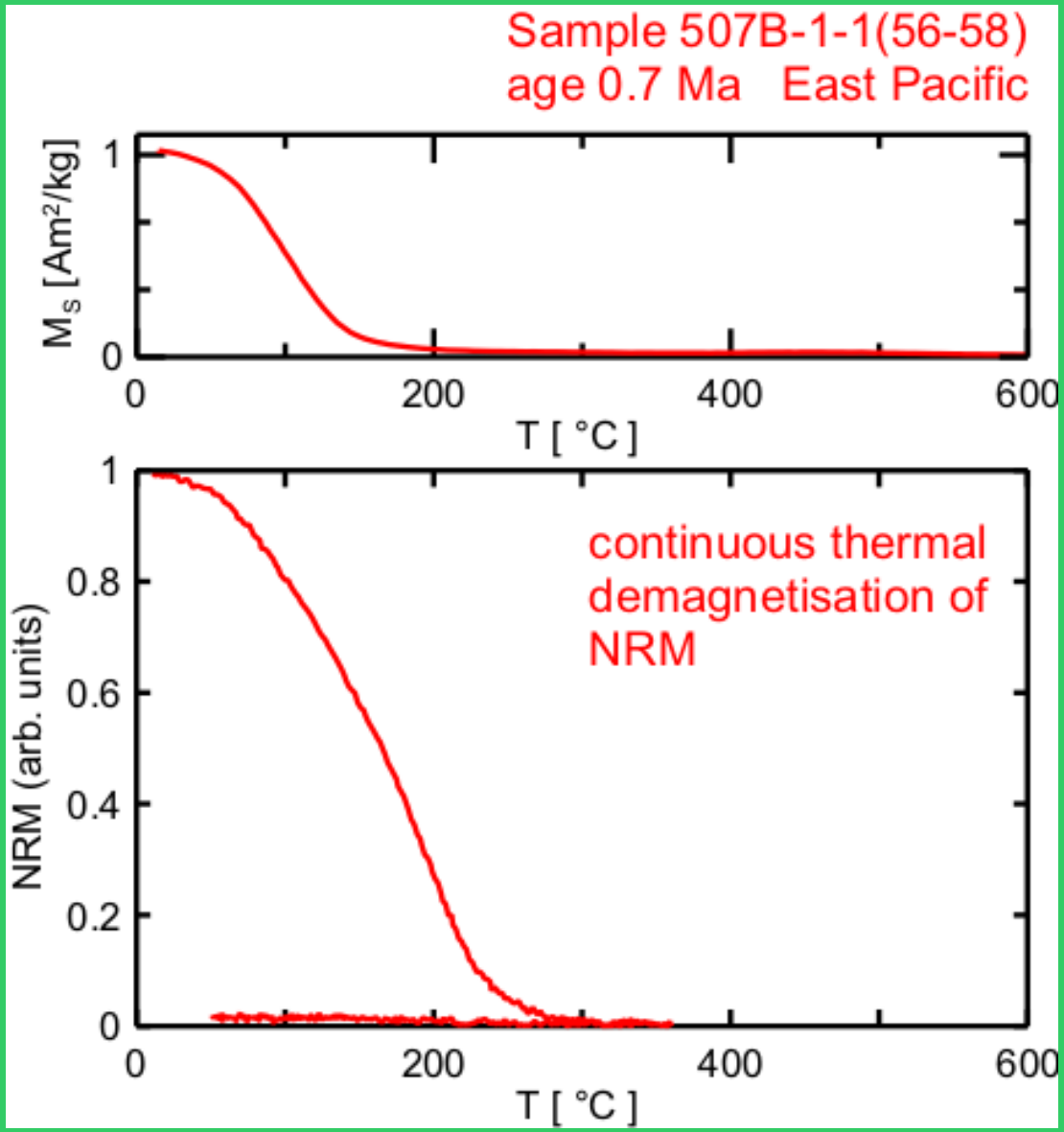
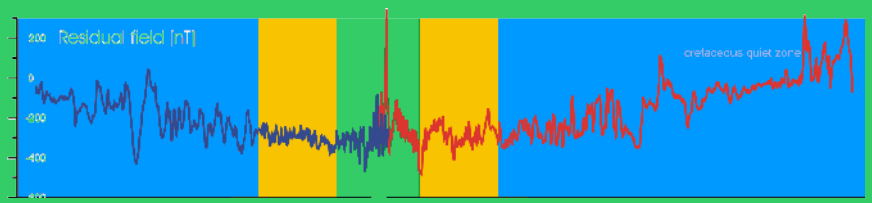
At the mid-ocean ridge...

- High marine magnetic anomalies
- High saturation magnetisation
- Curie temperature approx. 150 °C
- Carrier of the NRM is weakly maghemized titanomagnetite





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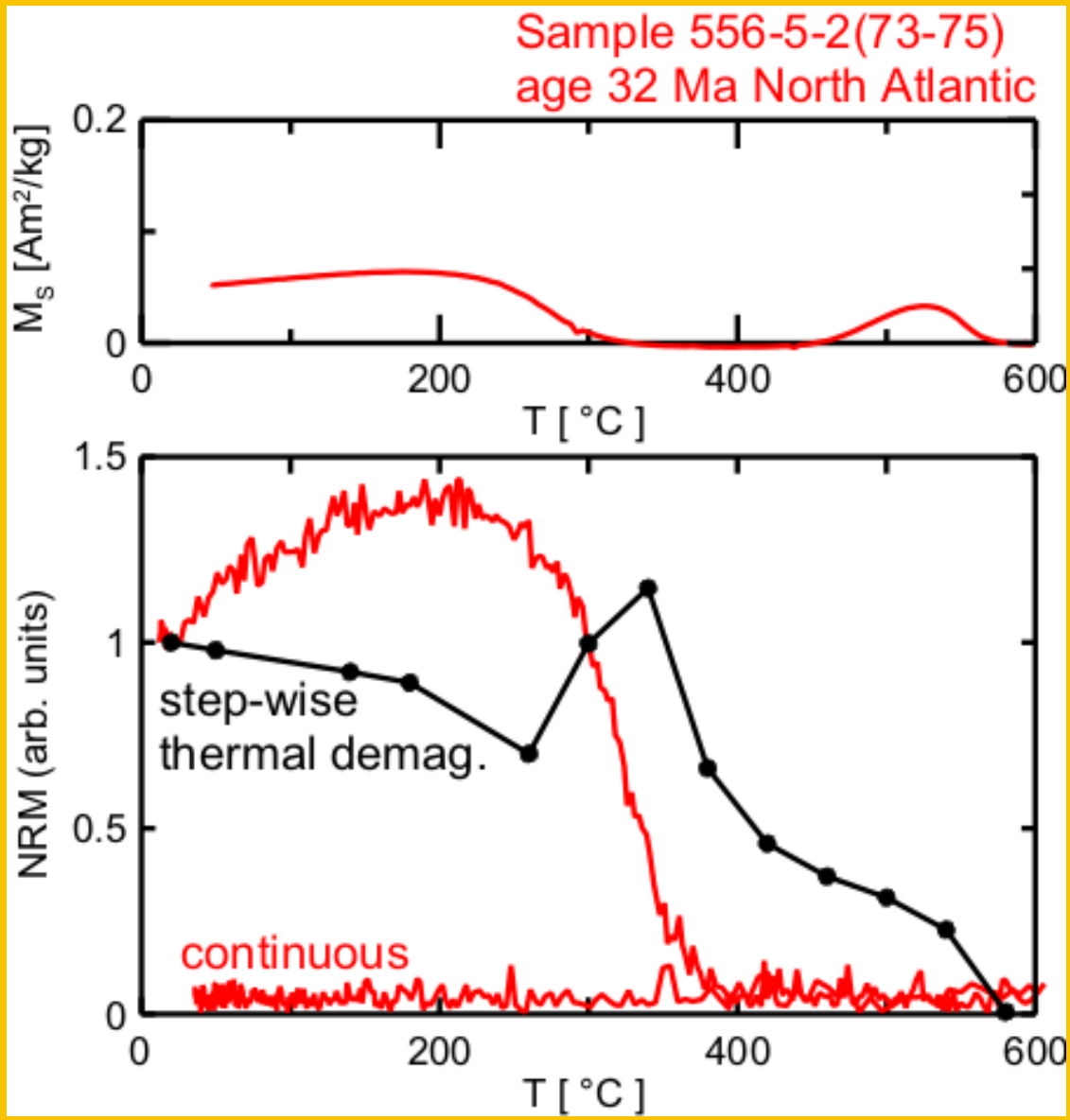
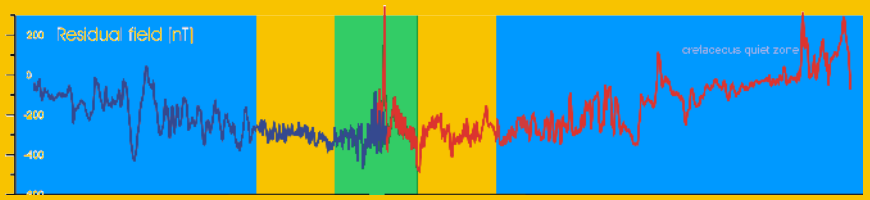
In 10 to 35 Ma old oceanic crust

- Low marine magnetic anomalies
- Low saturation magnetisation
- Curie temperature approx. 300 °C
- Carrier of the NRM is titanomaghemite





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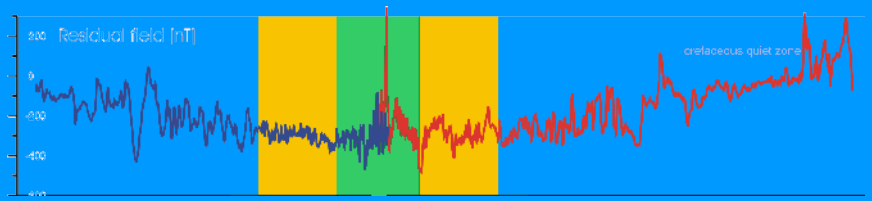
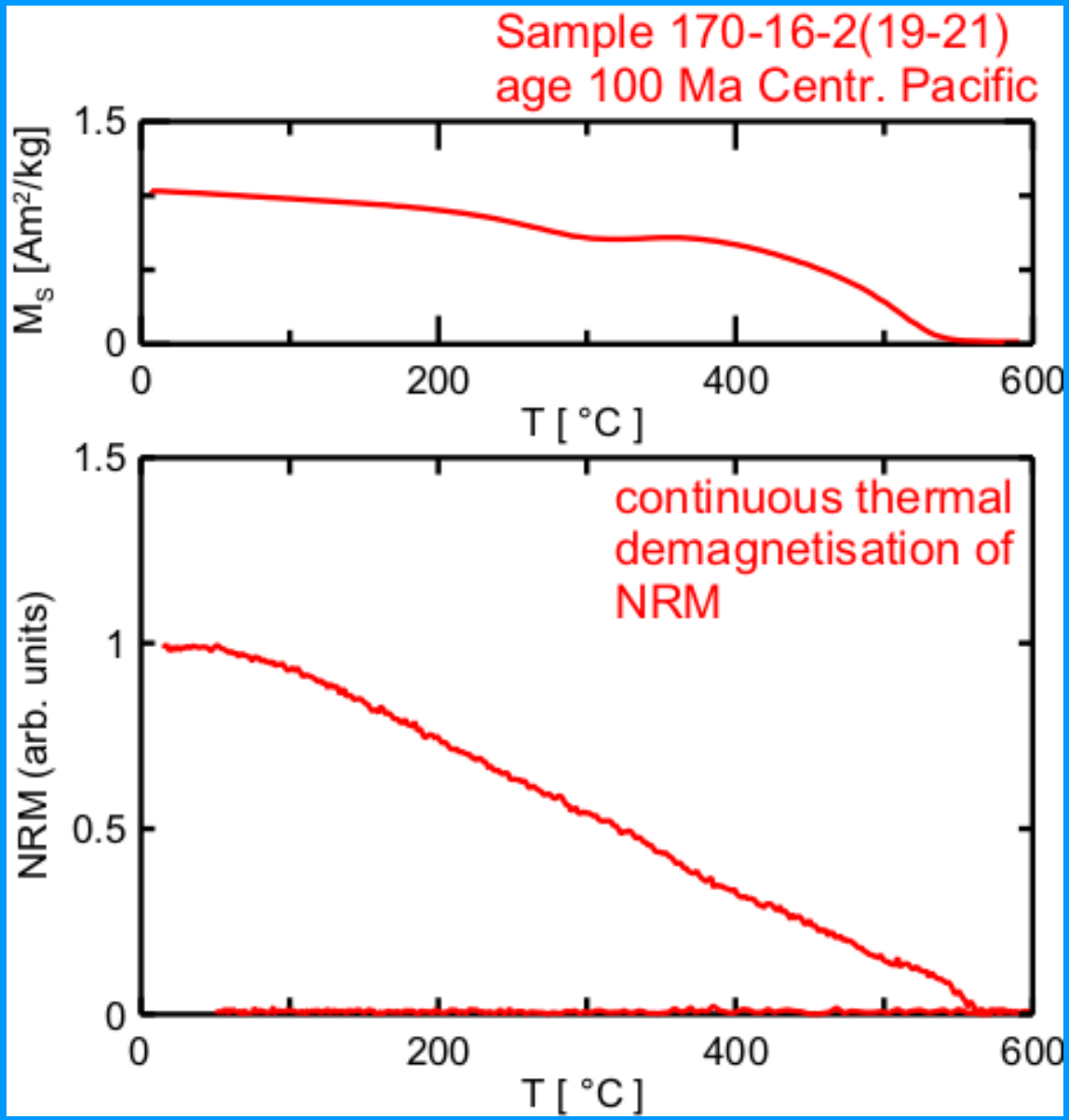
In oceanic crust older than 35 Ma

- High marine magnetic anomalies
- High saturation magnetisation
- 2 (?) Curie temperatures
- Carrier of the NRM is magnetite





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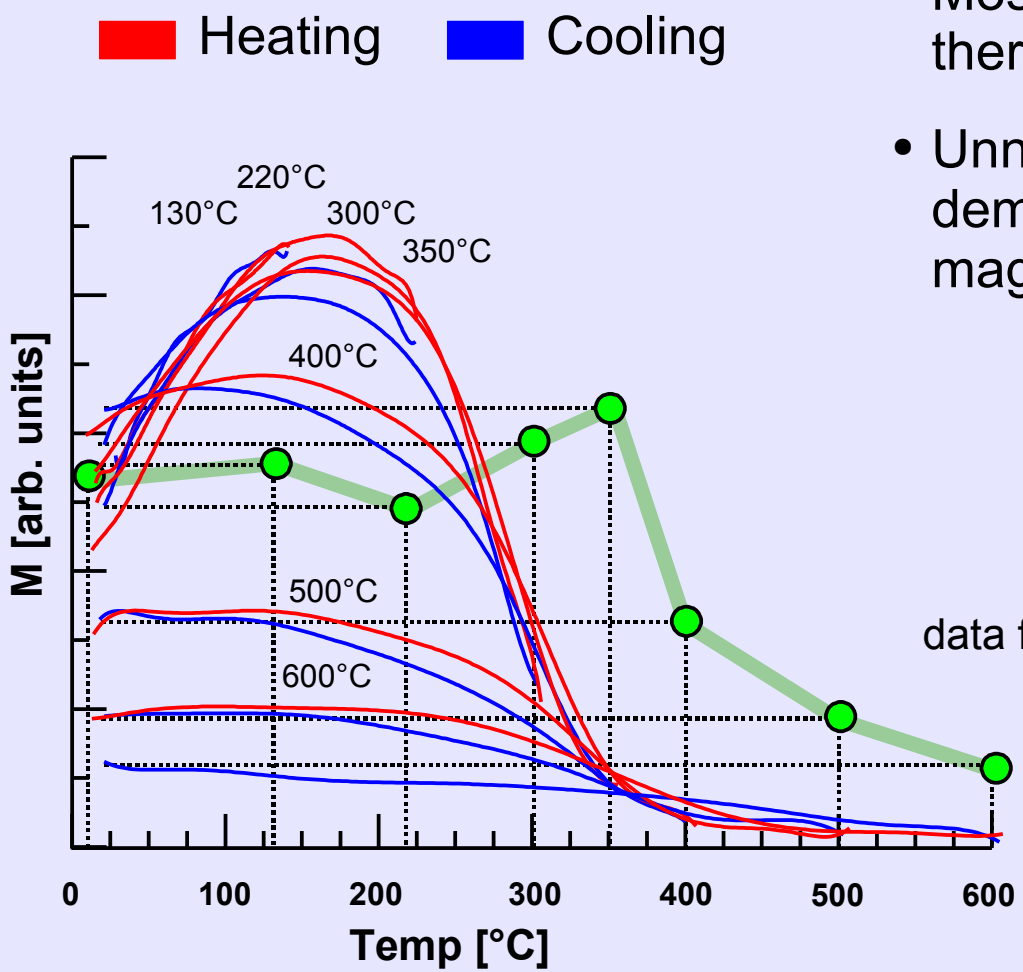
Classic stepwise vs. continous thermal demagnetisation



- Most paleomagnetic data by stepwise thermal demagnetization
- Unnoticed effects in stepwise demagnetization due to alteration of magnetic minerals

data from ODP sample 9-0079-017R-01w 102-106

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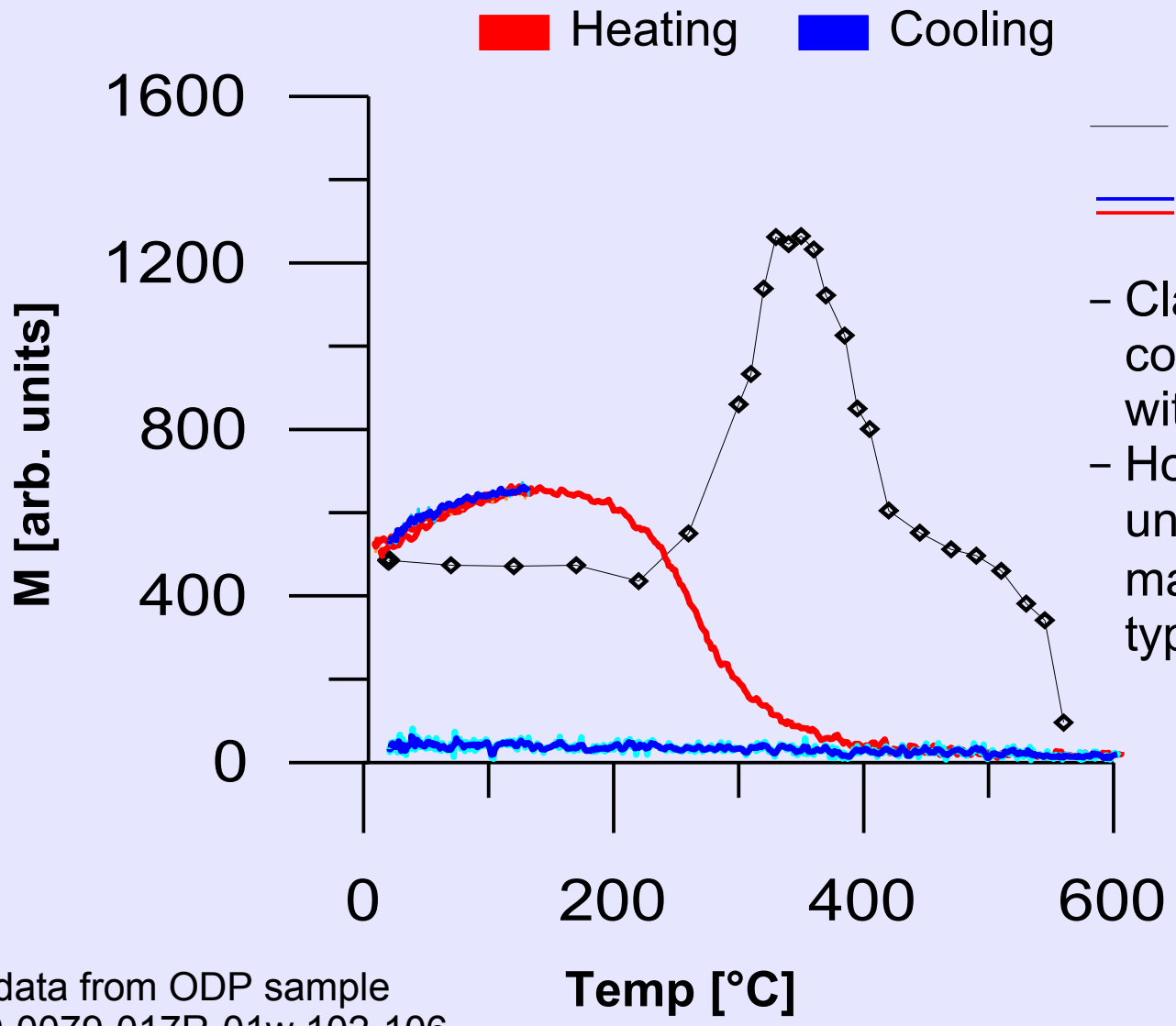
Classic stepwise vs. continous thermal demagnetisation



Stepwise data

Data from Hotspin 1

- Classic interpretation: 3 components including one with magnetite
- Hotspin shows mineral unblocking at 350°C ⇒ titano-maghemite and P- resp. N-type (Neel) behavior

data from ODP sample
9-0079-017R-01w 102-106

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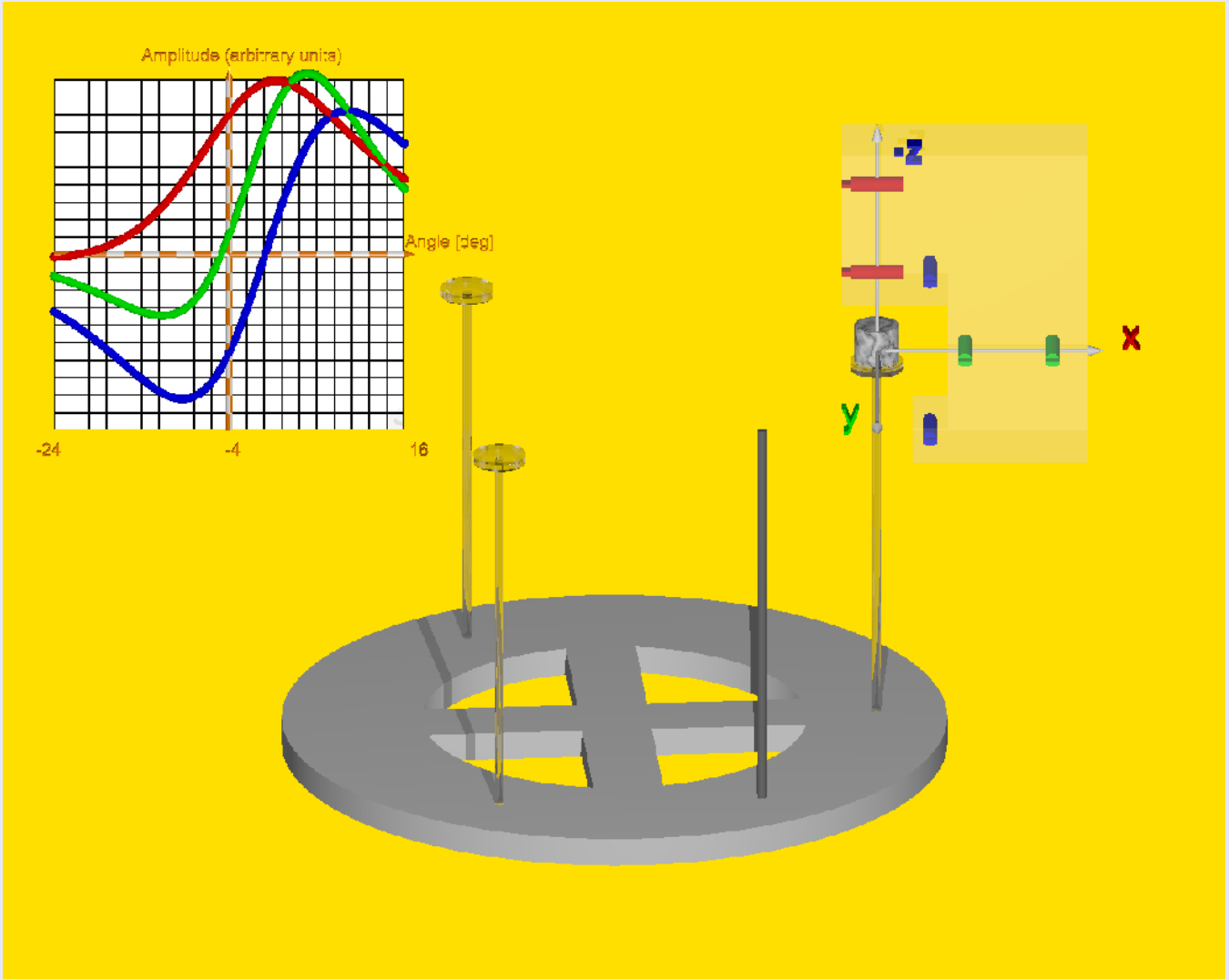
The Idea of the Hotspin 2 Instrument

- Off-axis spinner magnetometer
- Fluxgate sensors
- Expected magnetic signals similar to those measured over magnetic anomalies in the subsurface



video

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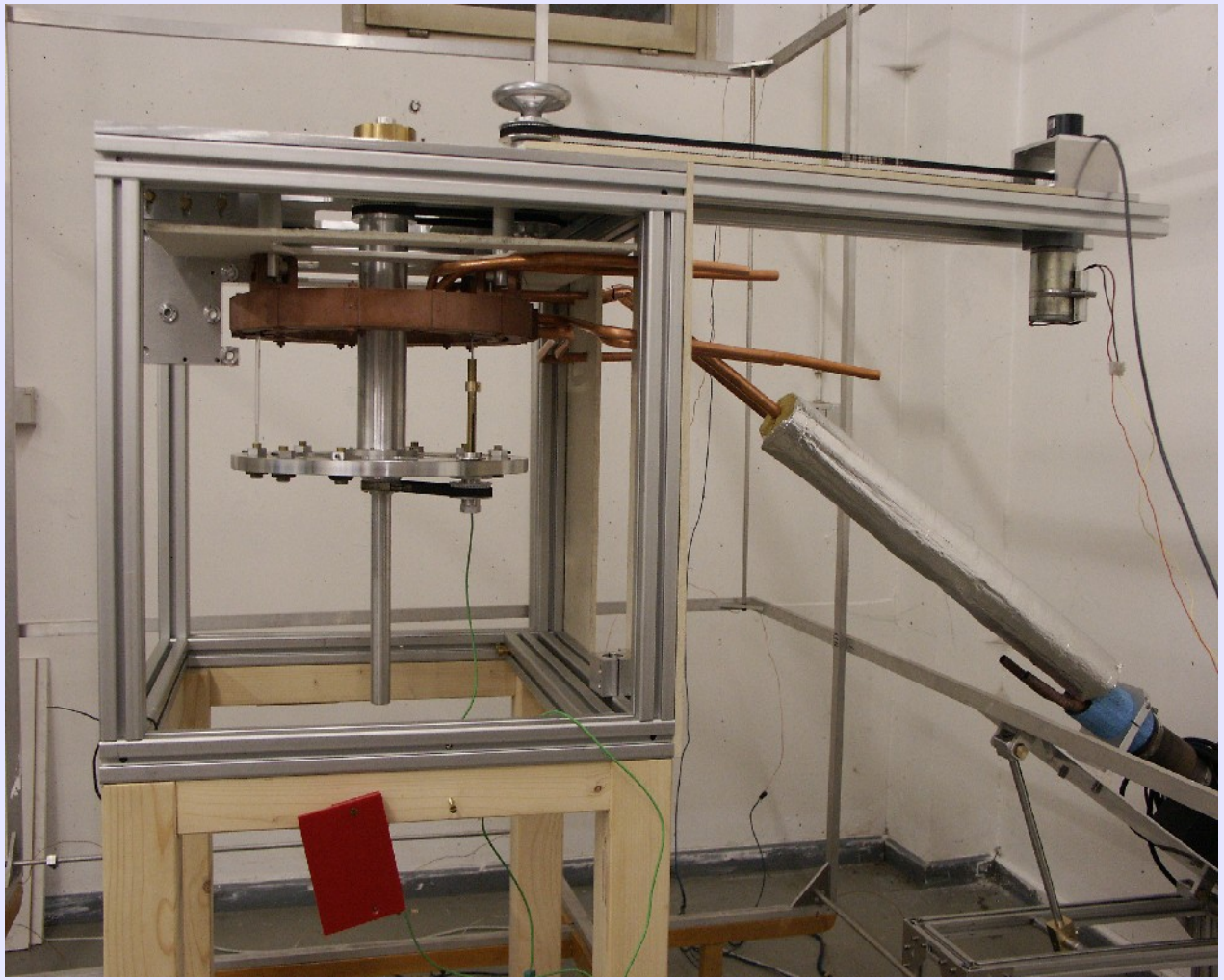
The Hotspin 2 instrument under construction …

- Specimens and temperature sensor moving on circular (R=15cm) path in a circular oven
- Heating by hot air (details later)
- All electrical powered or magnetical stuff away from samples and sensors
- External field compensated by three Helmholtz coils



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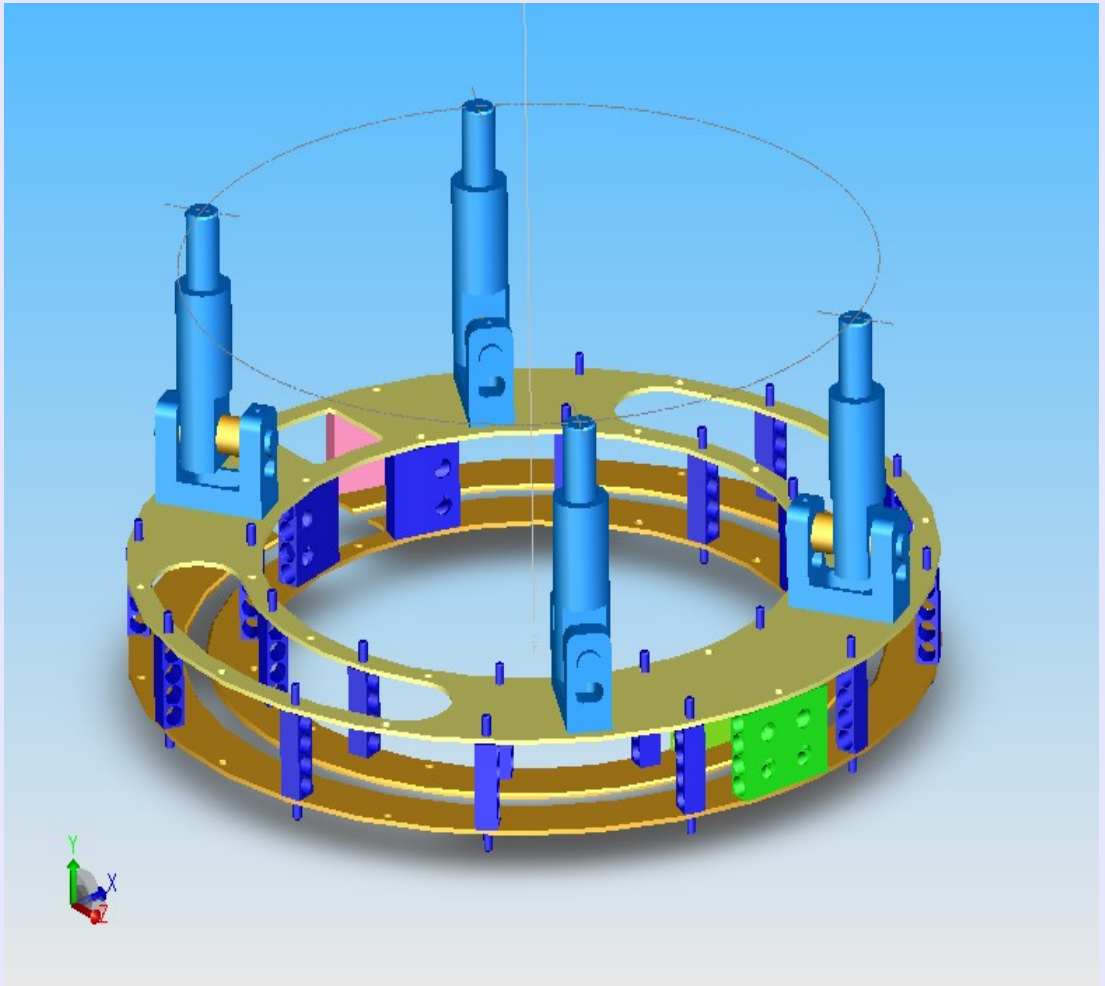
Circular Oven

- Hot air runs through copper pipes on the in- and outside of the ring
- Samples are primarily heated through radiation
- Air circulation is optimized for a good temperature dispersion
- No magnetic effects on samples
- At the moment temperatures up to 400°C can be achieved



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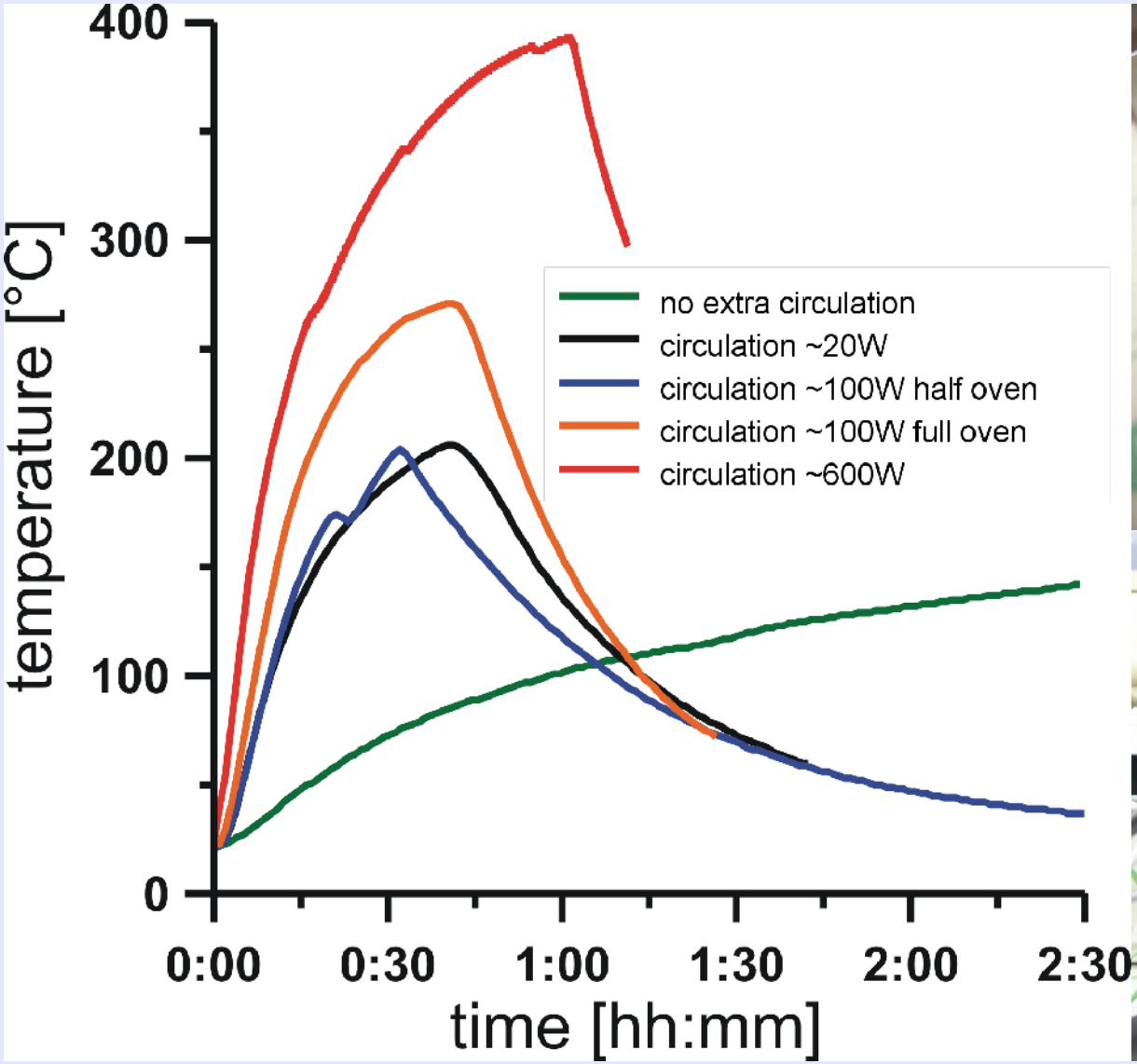
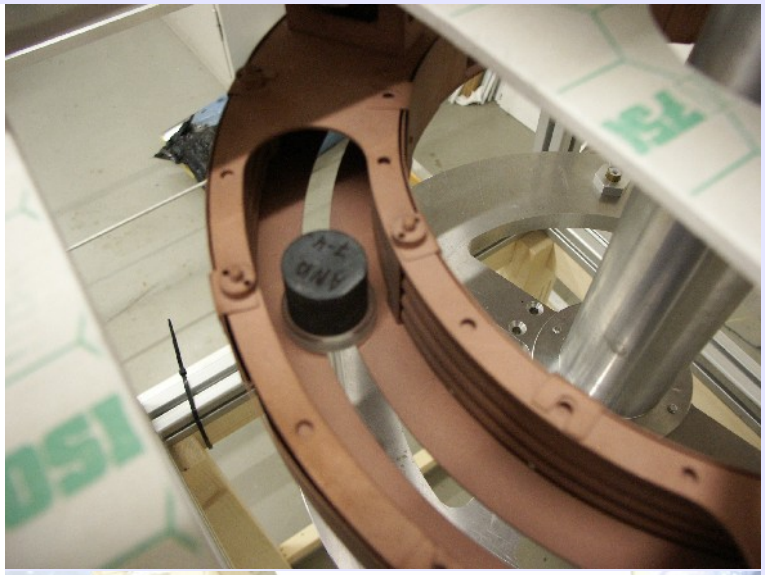
Heating





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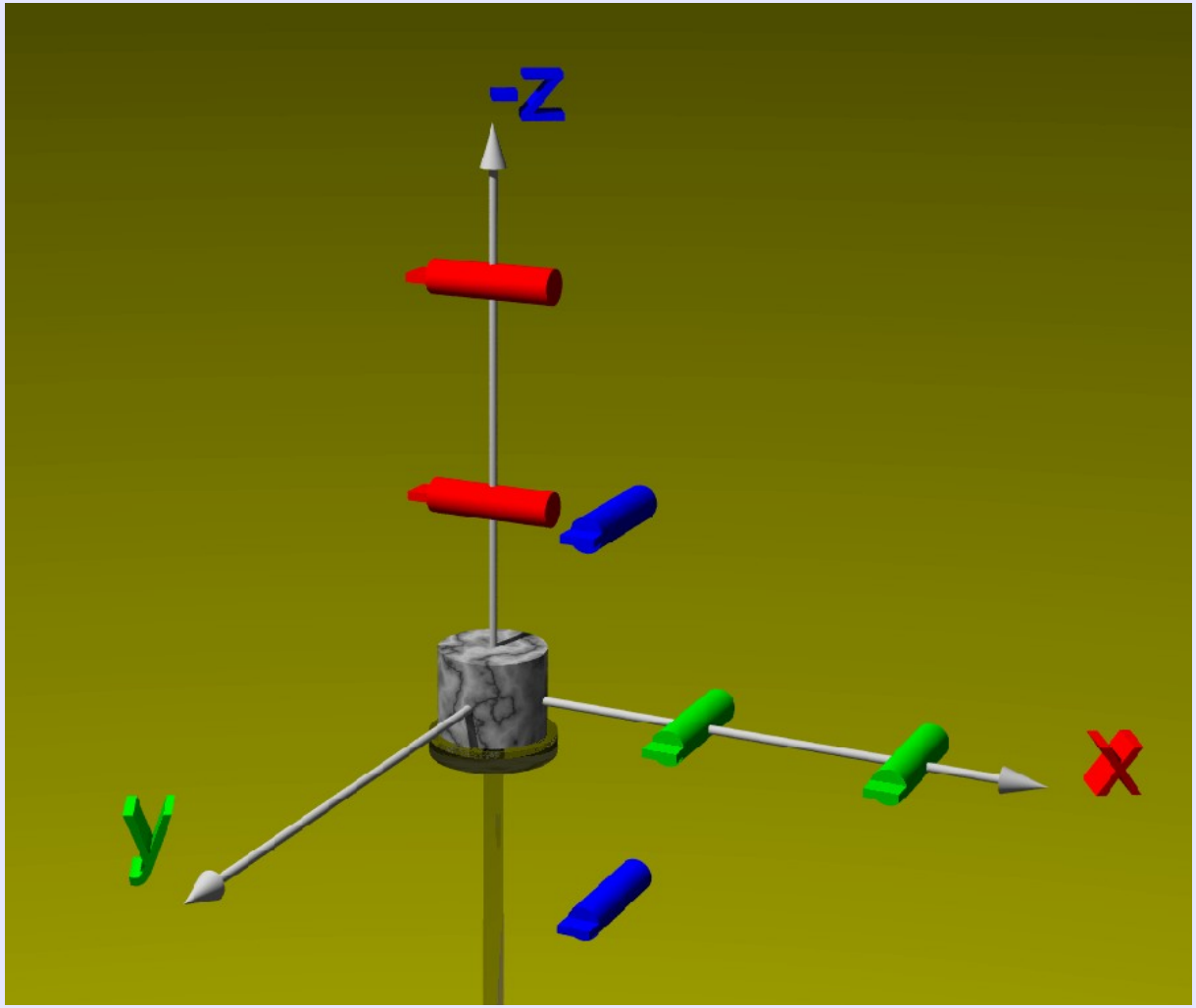
Sensor Arrangement

- Optimized for:
  - Maximum sensitivity
  - Minimum interference
  - Good seperation of magnetisation components



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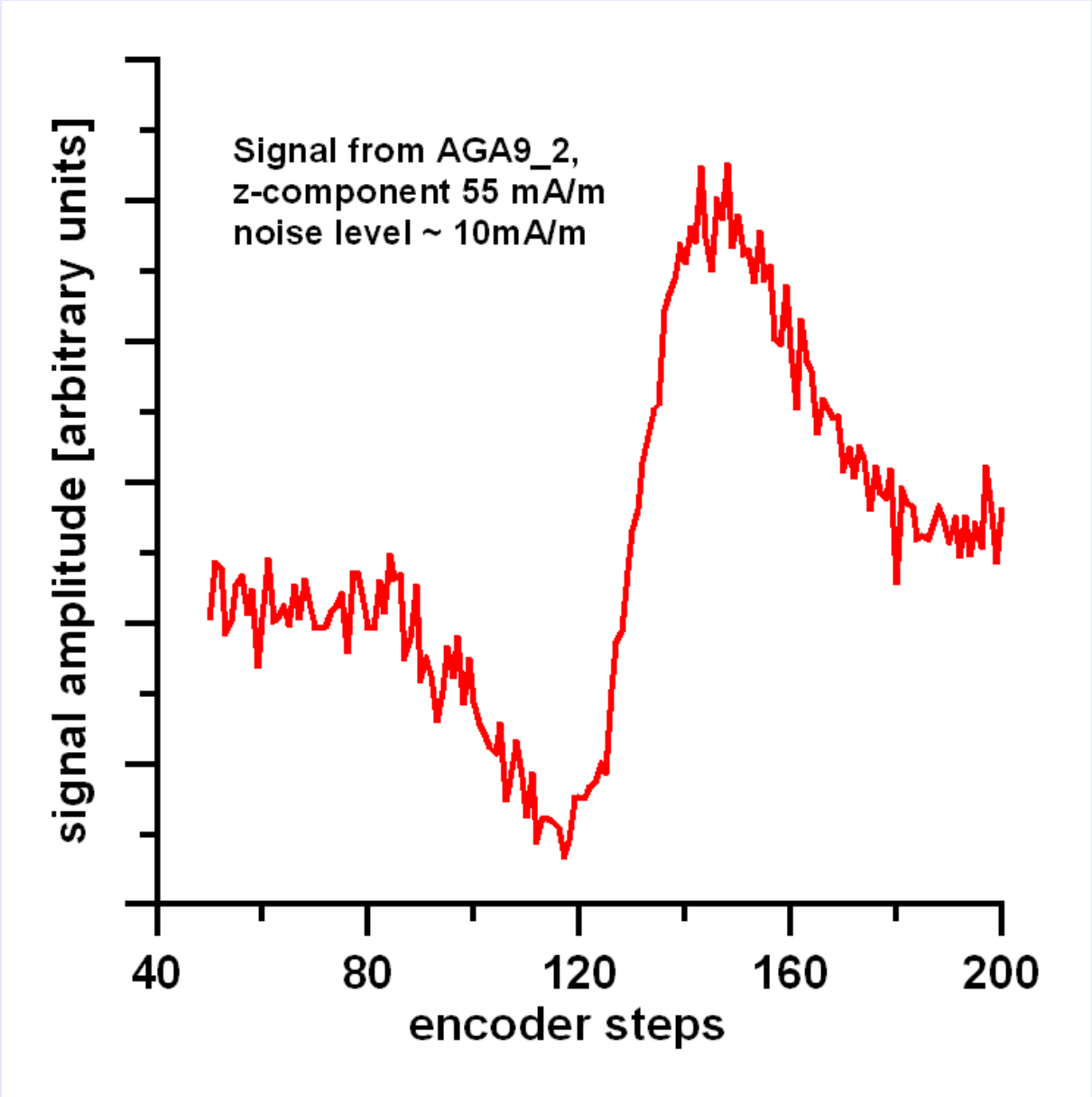
Sensitivity



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Thank you!

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