

What origin(s) for millennial-timescale variations of rock magnetic parameters observed in NW Bulgarian loess through MIS 6 ?



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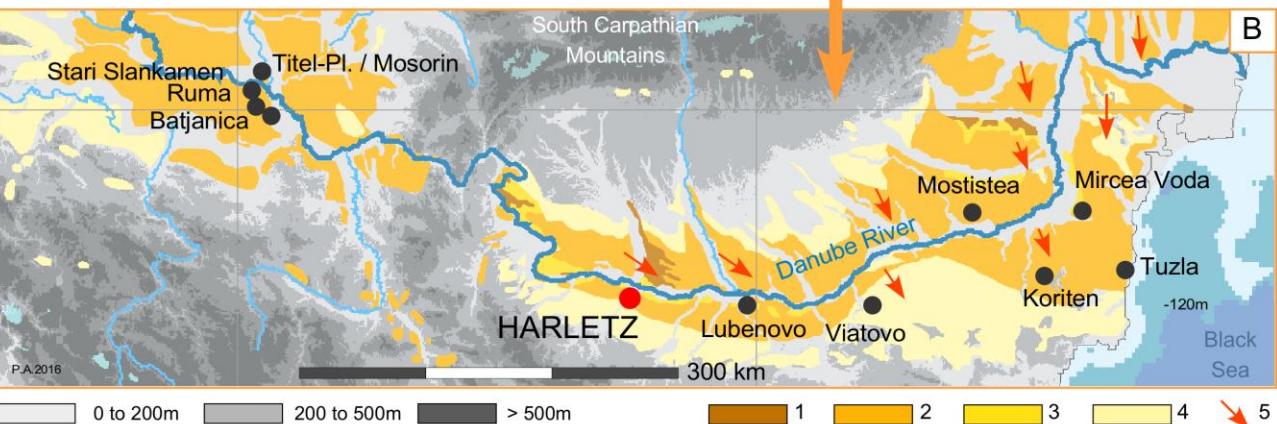
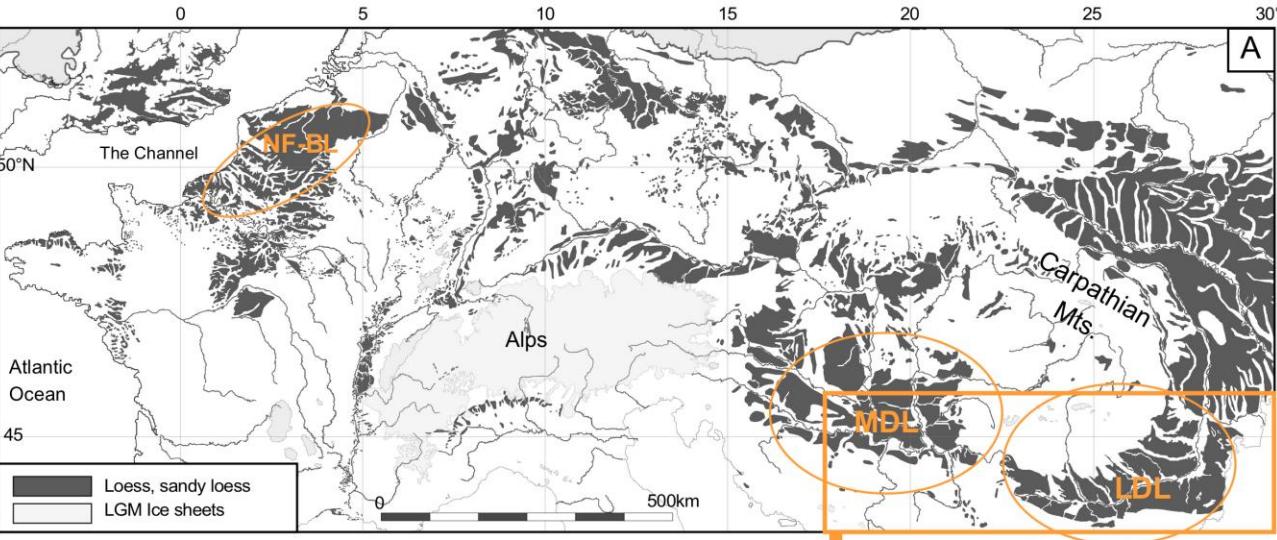
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Harletz (HZ12) Loess & Paleosol Sequence

Geographical Location

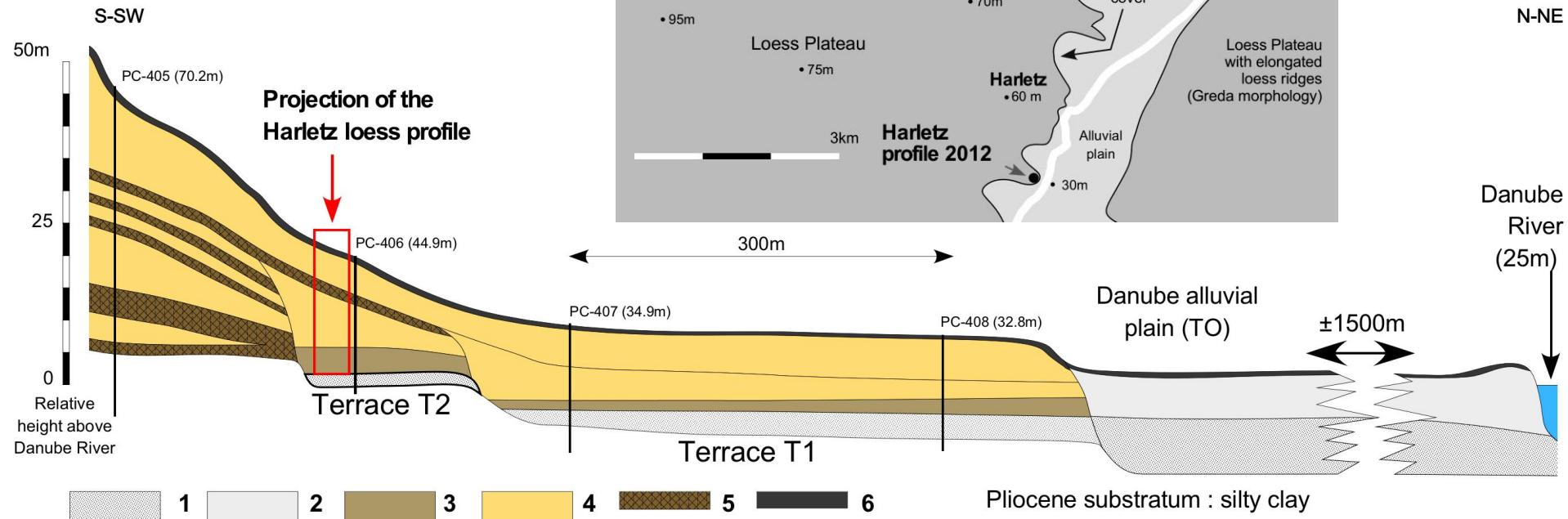
- European loess belt
- Lower Danube loess
- Northwestern Bulgaria



Antoine et al. (2019)

Harletz (HZ12) Loess & Paleosol Sequence

Geological Setting



Harletz (HZ12)

Loess & Paleosol Sequence

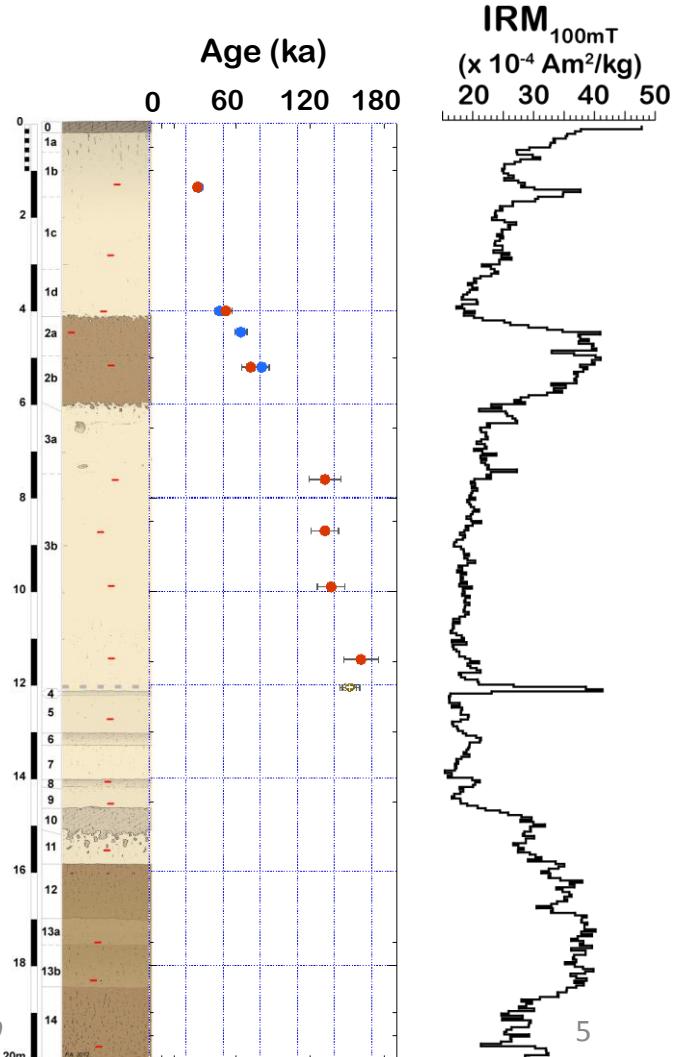
Sampling and Analyses

- Field measurements on cleaned face:
 - Magnetic susceptibility*
 - Color spectroscopy*
- Continuous column bulk sampling of 5 cm intervals, homogenised & redistributed
 - Analyses : *granulometry*
 - magnetic mineralogy*
 - carbon isotopes*
- Oriented sampling @ 5 cm depth intervals, 2 to 4 specimens per interval
 - Analyses : *magnetic anisotropy*
 - paleomagnetism*
- Other specialized sampling for:
 - Optically stimulated luminescence (OSL)
 - Mollusc species identification



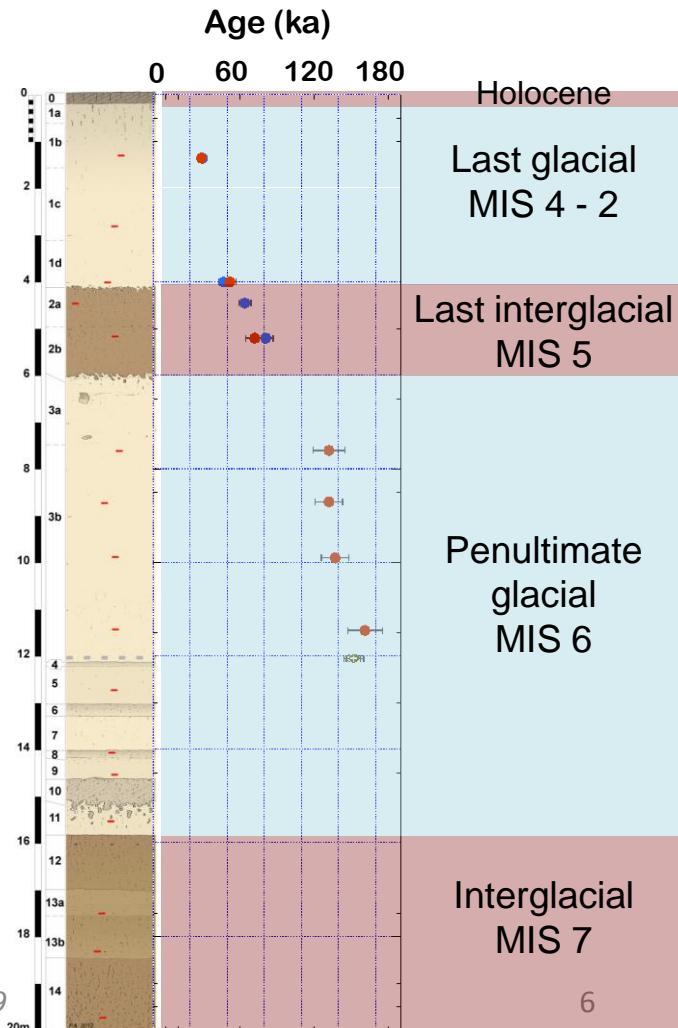
Harletz (HZ12) – Stratigraphy & Chronology

- 20 m thick loess and paleosol sequence (Antoine et al., 2019, *Quat. Sci. Rev.*)
 - Basal Ogosta Soil complex developed on alluvial plain sediment.
 - 10 m of loess with at its base 4 incipient soils
 - Harletz Soil complex (Cambisol – steppe soil)
 - 4 m of loess heavily bioturbated
 - Truncated topsoil
- OSL age determinations on fine grained quartz and coarse grained feldspar (Lomax et al., 2019, *Boreas*)
- Tephra in the 12.10-12.00 m depth interval
 - Not observed in the field
 - Prominent in rock magnetic data
 - Likely Vico B ignimbrite (Geochemical and stratigraphic arguments)
 - Leicher et al. (2016) Lake Ohrid 162 +/- 8
 - Manella et al. (2019) Fucino paleolake 158.4 +/- 2.5 ka

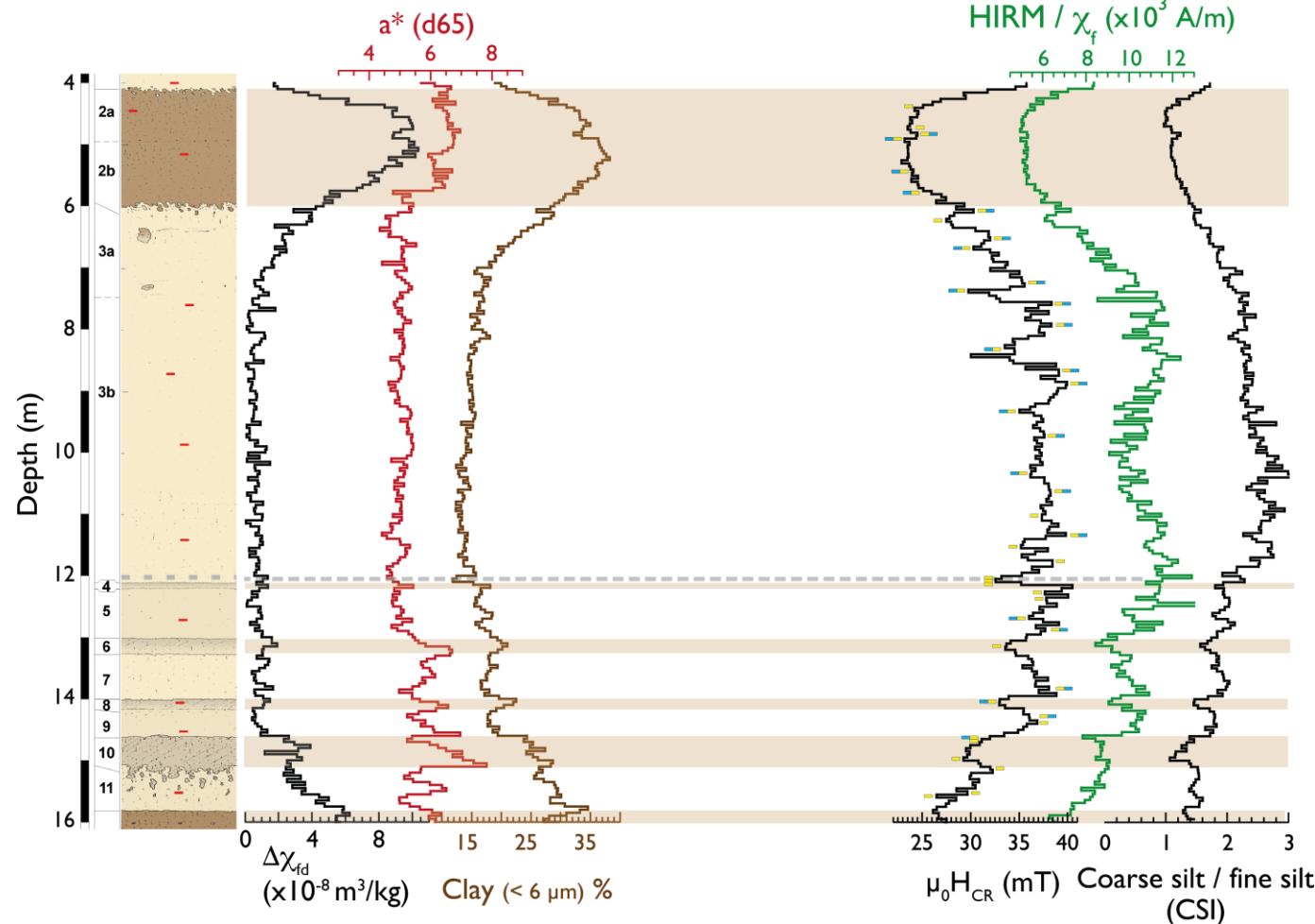


Harletz (HZ12) – Stratigraphy & Chronology

- Loess & Paleosol archive spans from MIS 7 to the present.
 - Last 2 glacial / interglacial cycles
- Remarkably dilated 10m record of the penultimate glacial period (MIS 6).
 - Unique in the European loess belt, so far.
- Sedimentation rates through MIS 6 average ~16 cm/kyr.
 - Possible to record millennial timescale variations in climate and environmental change.



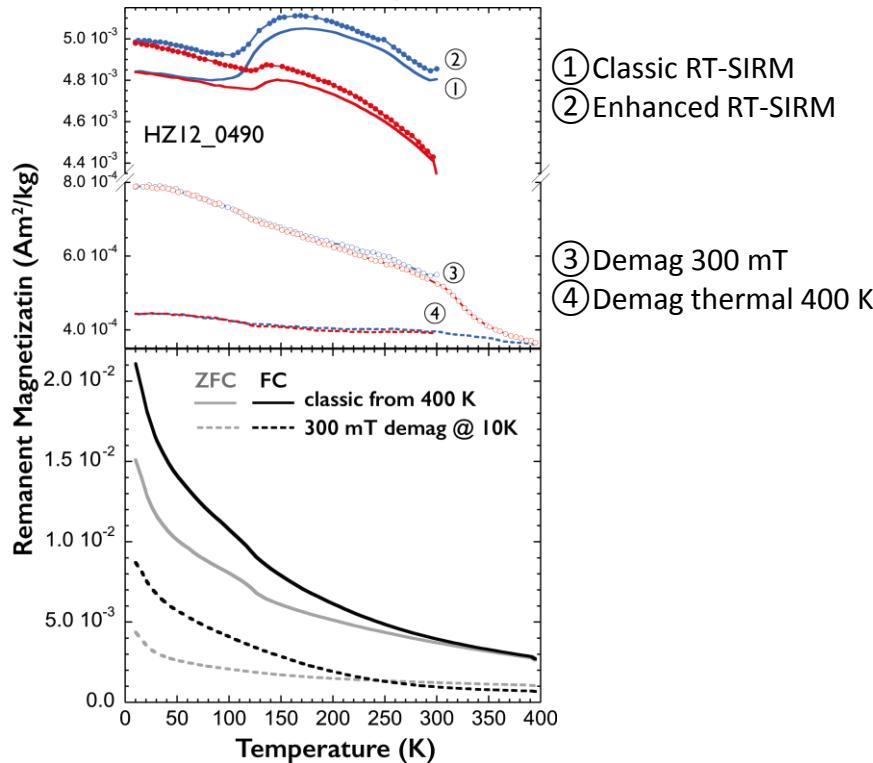
Harletz (HZ12) – Close-up and multidisciplinary view of the Penultimate Glacial Loess



Harletz (HZ12) – Experimental decomposition of the magnetic mineral assemblage

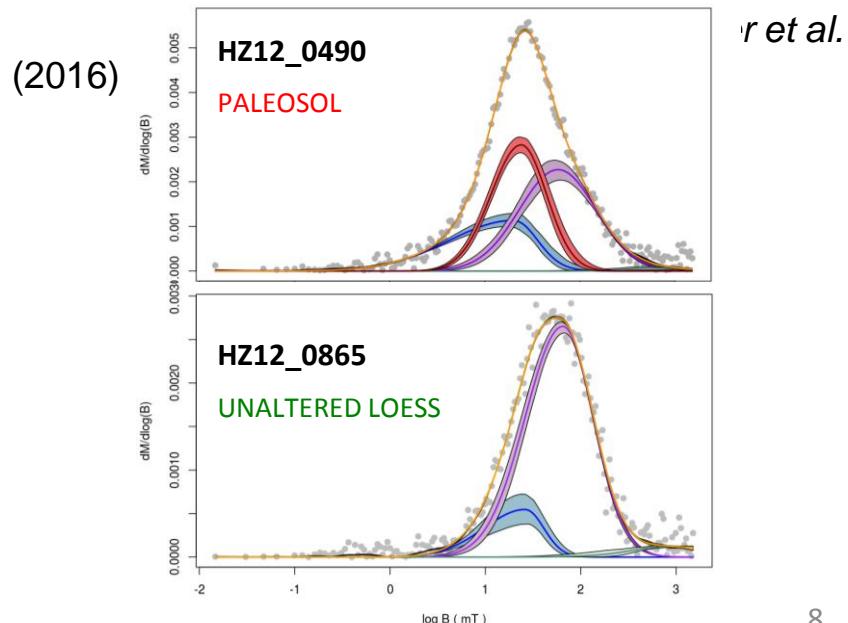
Low-temperature remanence experiments

- Following protocol in *Lagroix & Guyodo (2017)*
- 28 samples analyzed



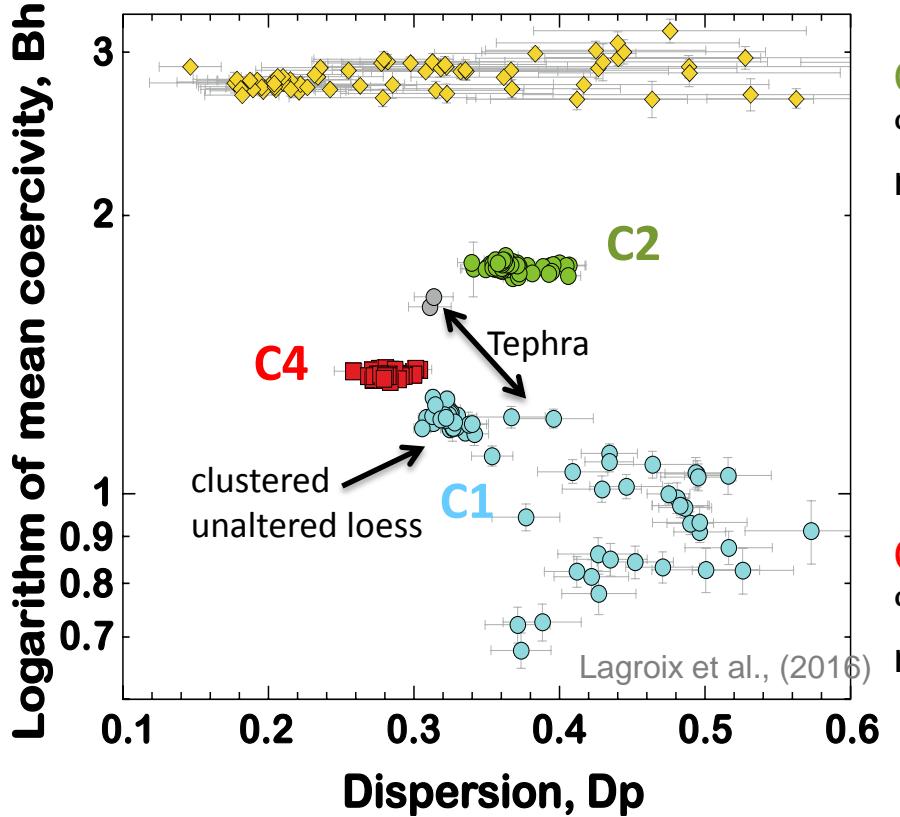
IRM acquisition curves

- Acquisition up to 1.5 T in 200 steps
- 67 samples analyzed
- coercivity spectra decomposed using Max_UnMix



Harletz (HZ12) -

IRM acquisition curves



C2 – Parent Loess component

% Observed concentration

mean $B_h = 57$ mT

C1 –

clusters

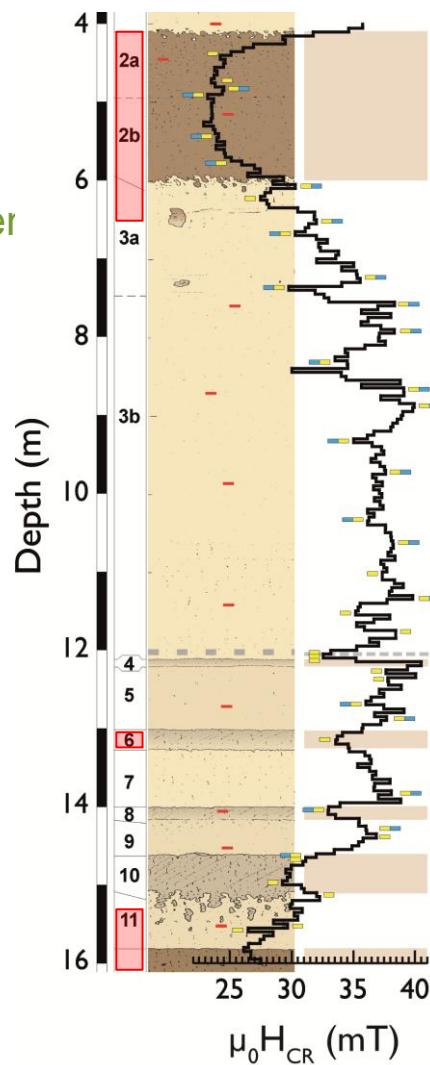
disperses

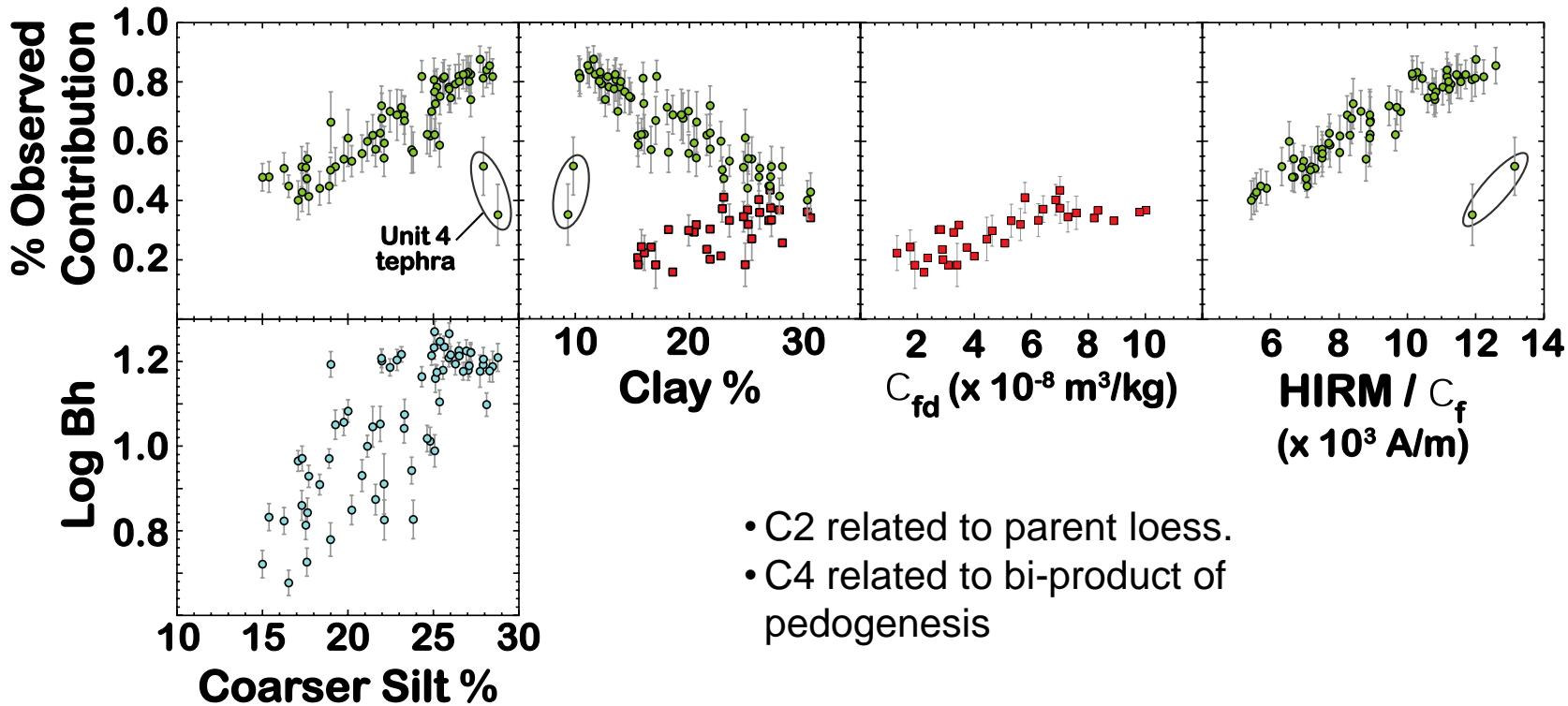
mean $B_h = 16$ mT

C4 – Pedogenic component

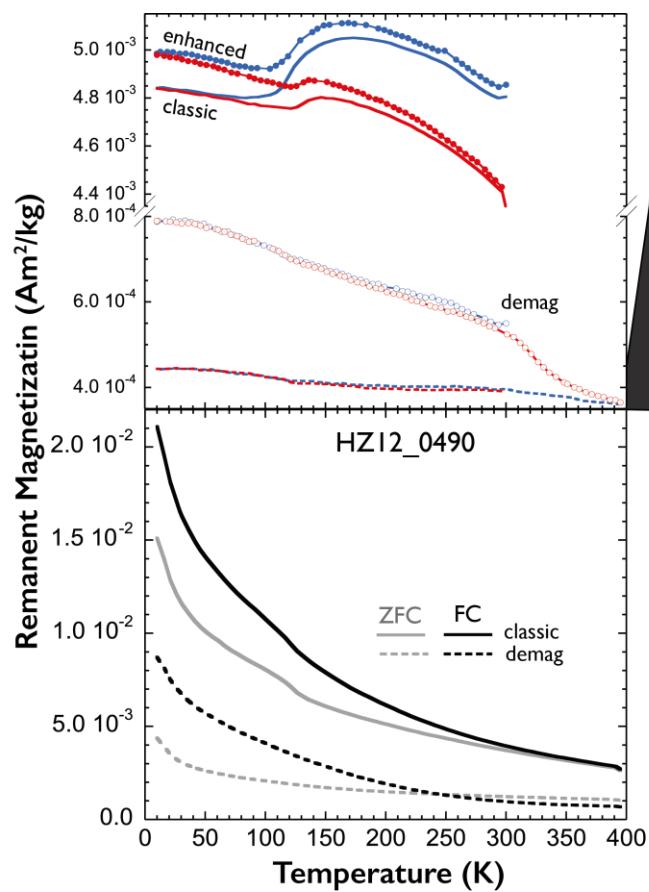
% Observed concentration

mean $B_h = 22$ mT

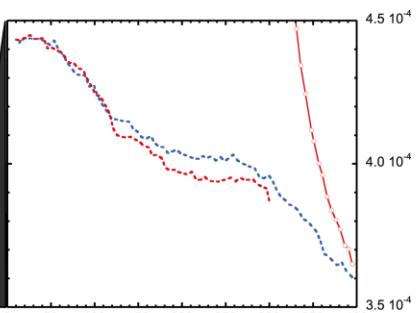




Harletz (HZ12) – Low-temperature remanence experiments

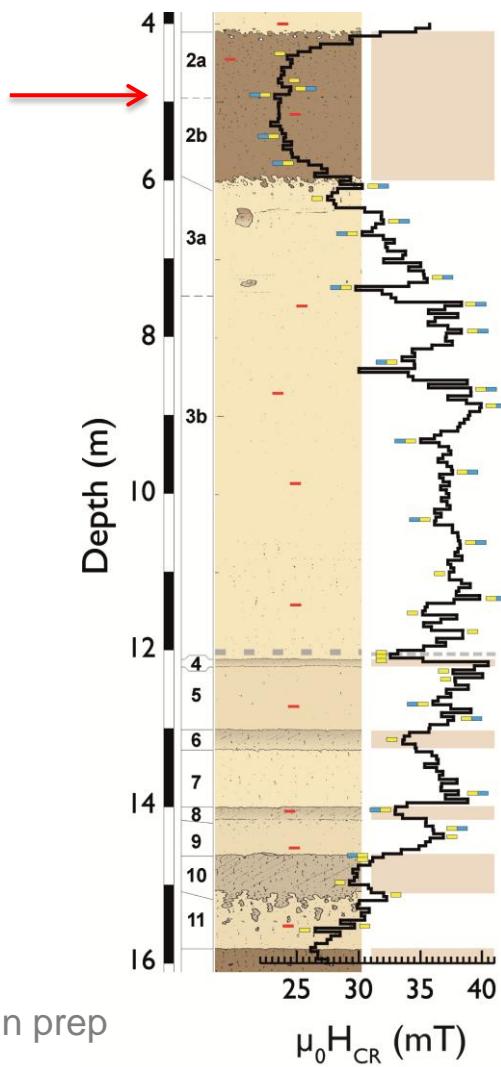


MIS 5 Interglacial soil

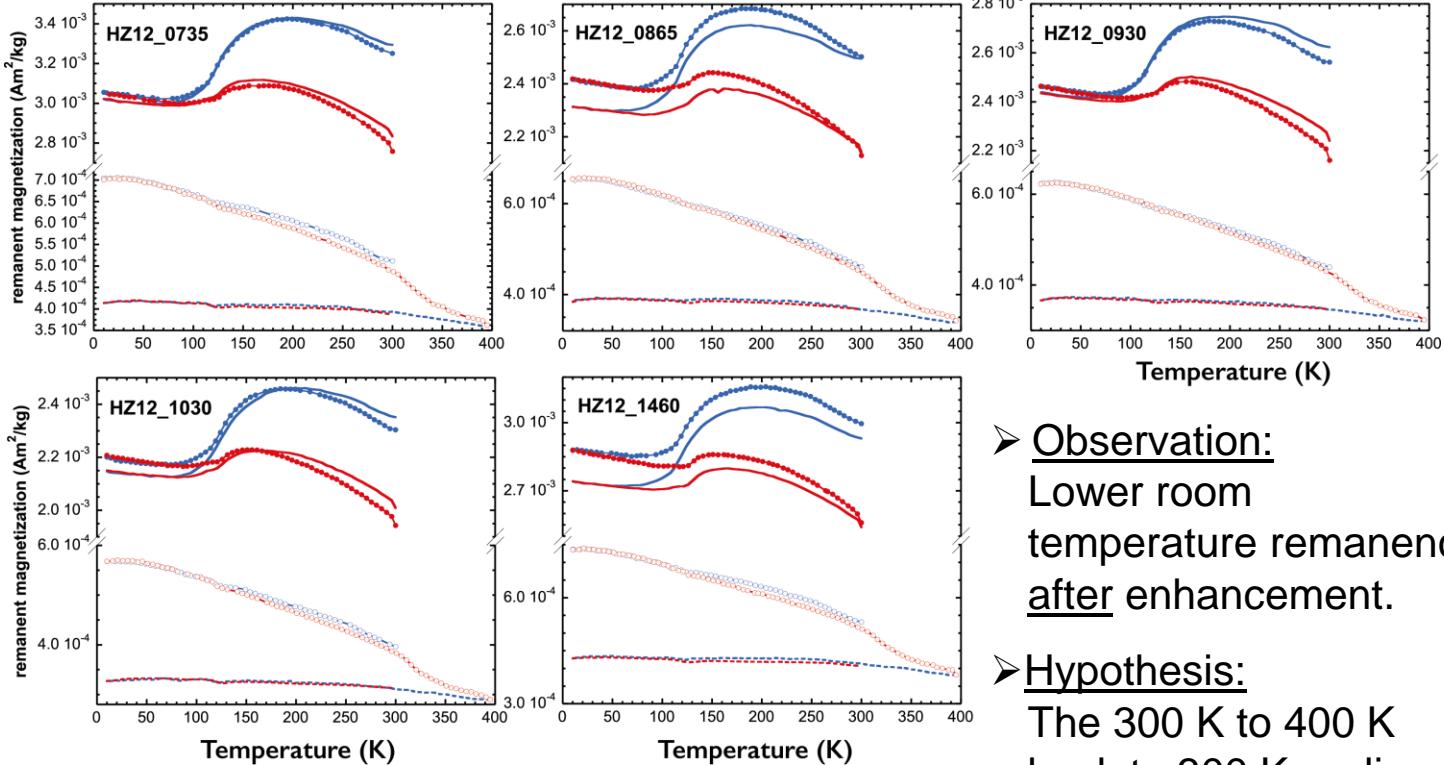


➤ Qualitative observations for:

- Magnetite
- Goethite
- Hematite
- Maghemite

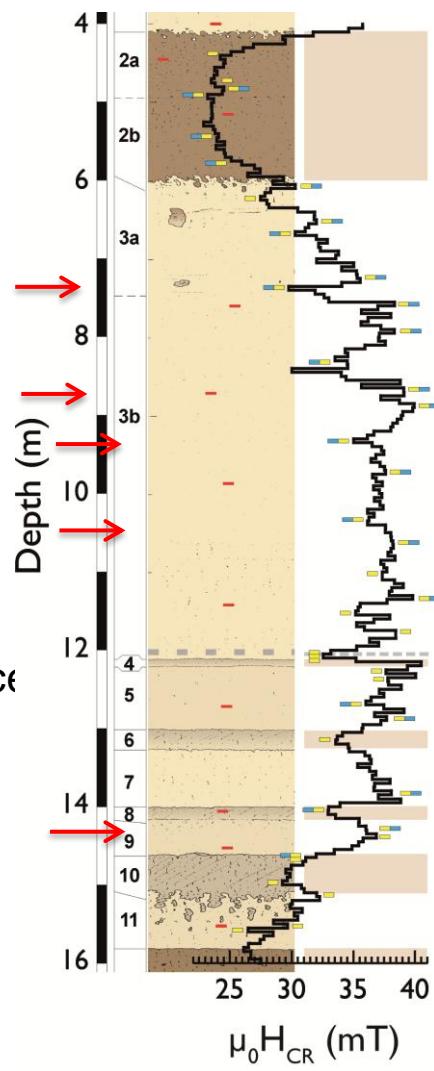


Lagroix et al., in prep



➤ Observation:
Lower room
temperature remanence
after enhancement.

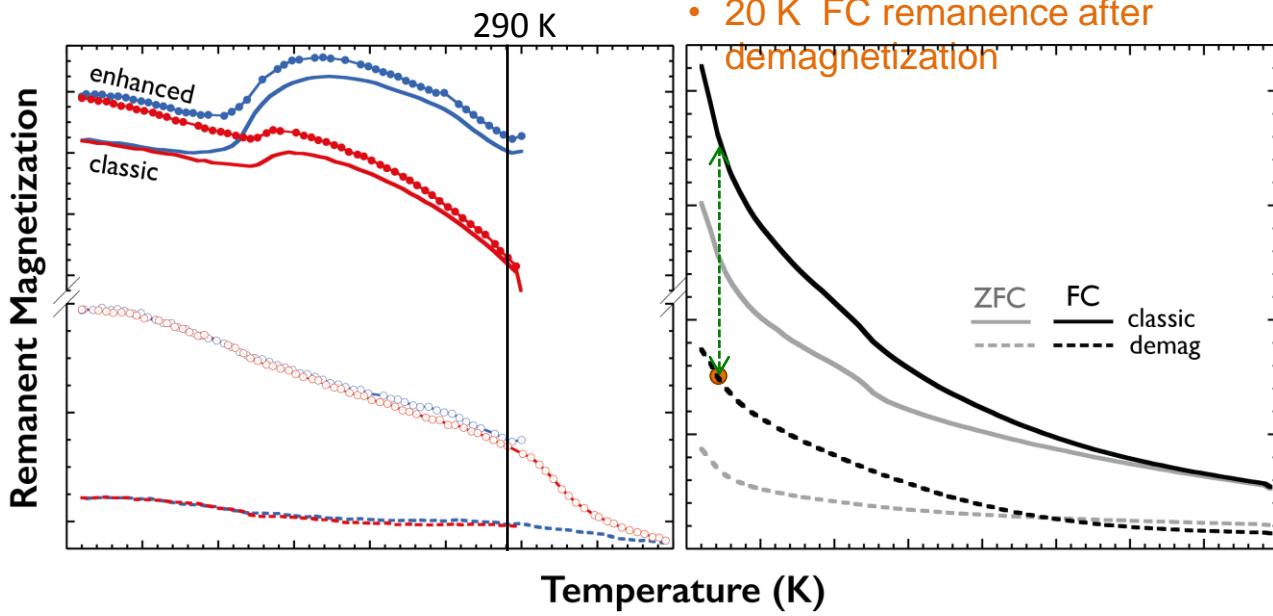
➤ Hypothesis:
The 300 K to 400 K
back to 300 K cycling
anneals ferrimagnetic
particles lowering
remanence.



➤ Quantitative data extracted

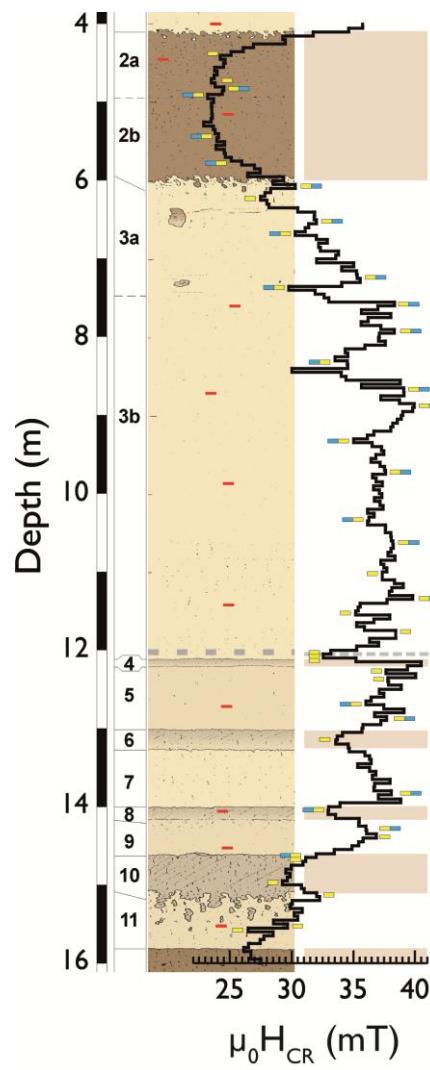
RT-SIRM series

- At 290K, difference before and after enhancement



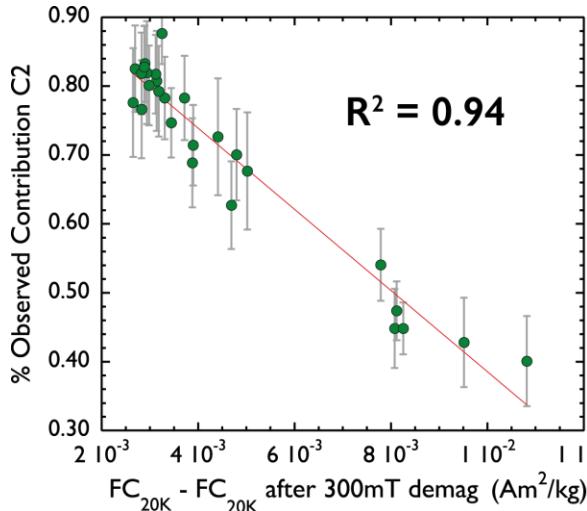
ZFC / FC series

- At 20 K, difference in FC remanence before and after demagnetization
- 20 K FC remanence after demagnetization

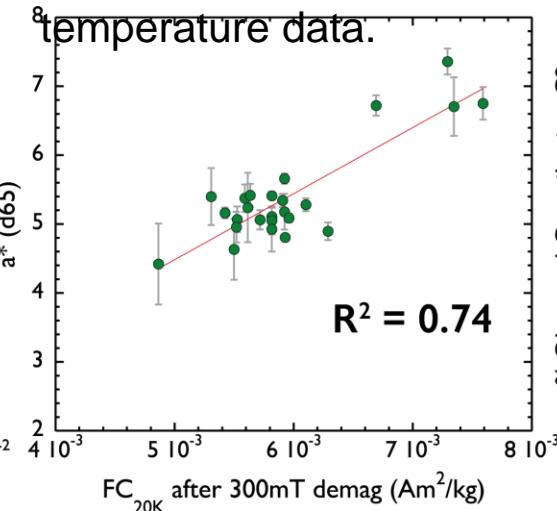


Improving proxies and interpretations

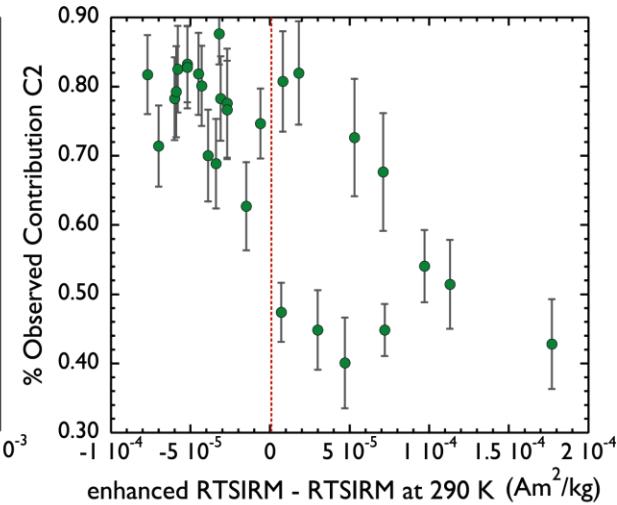
Betters all ferrimagnetic relative concentration estimates derived from room temperature data.



No satisfactory remanence based proxy of pedogenic component derived from room temperature data.

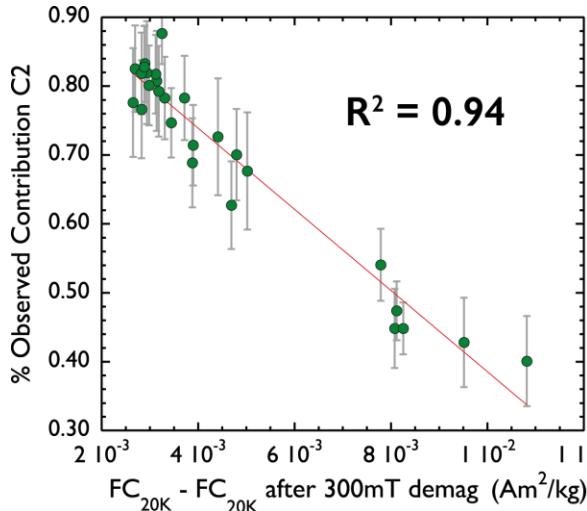


Lower remanence after enhancement treatment originates from the parent loess.

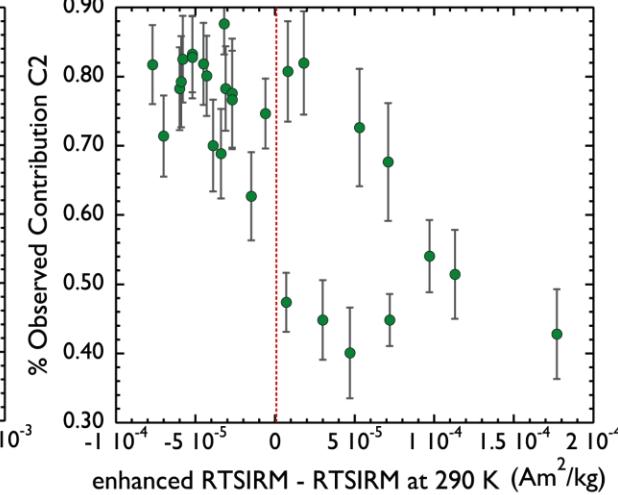
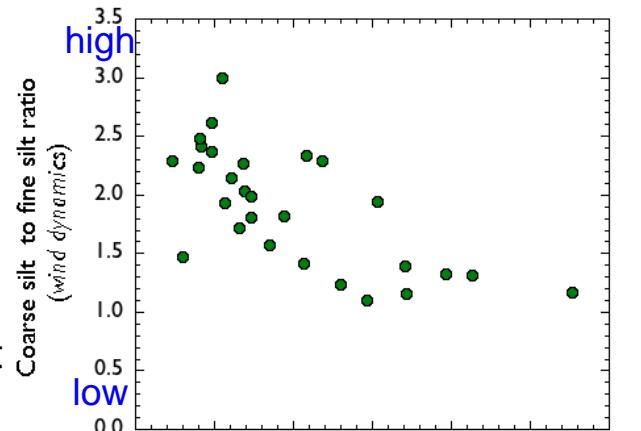
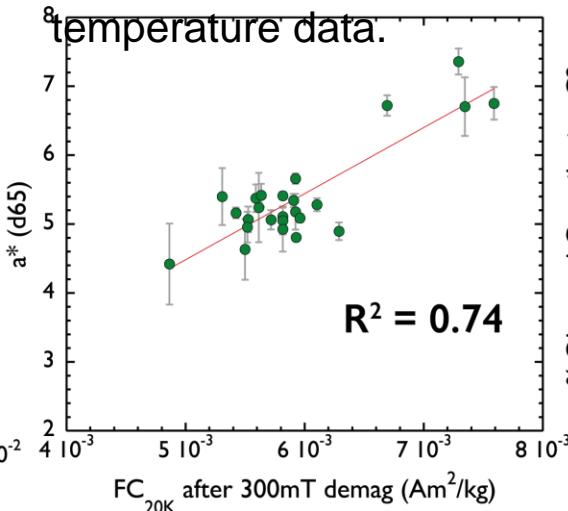


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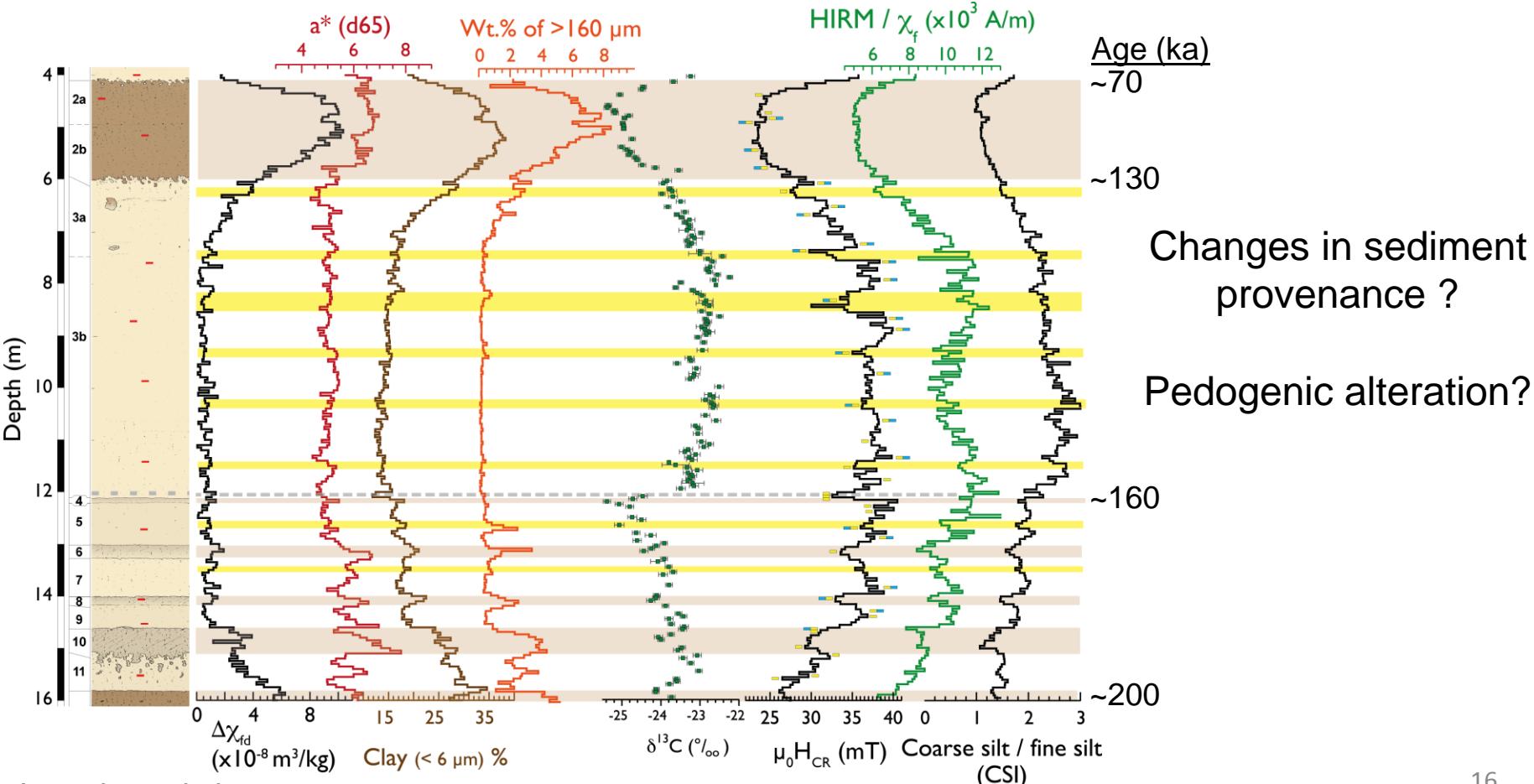
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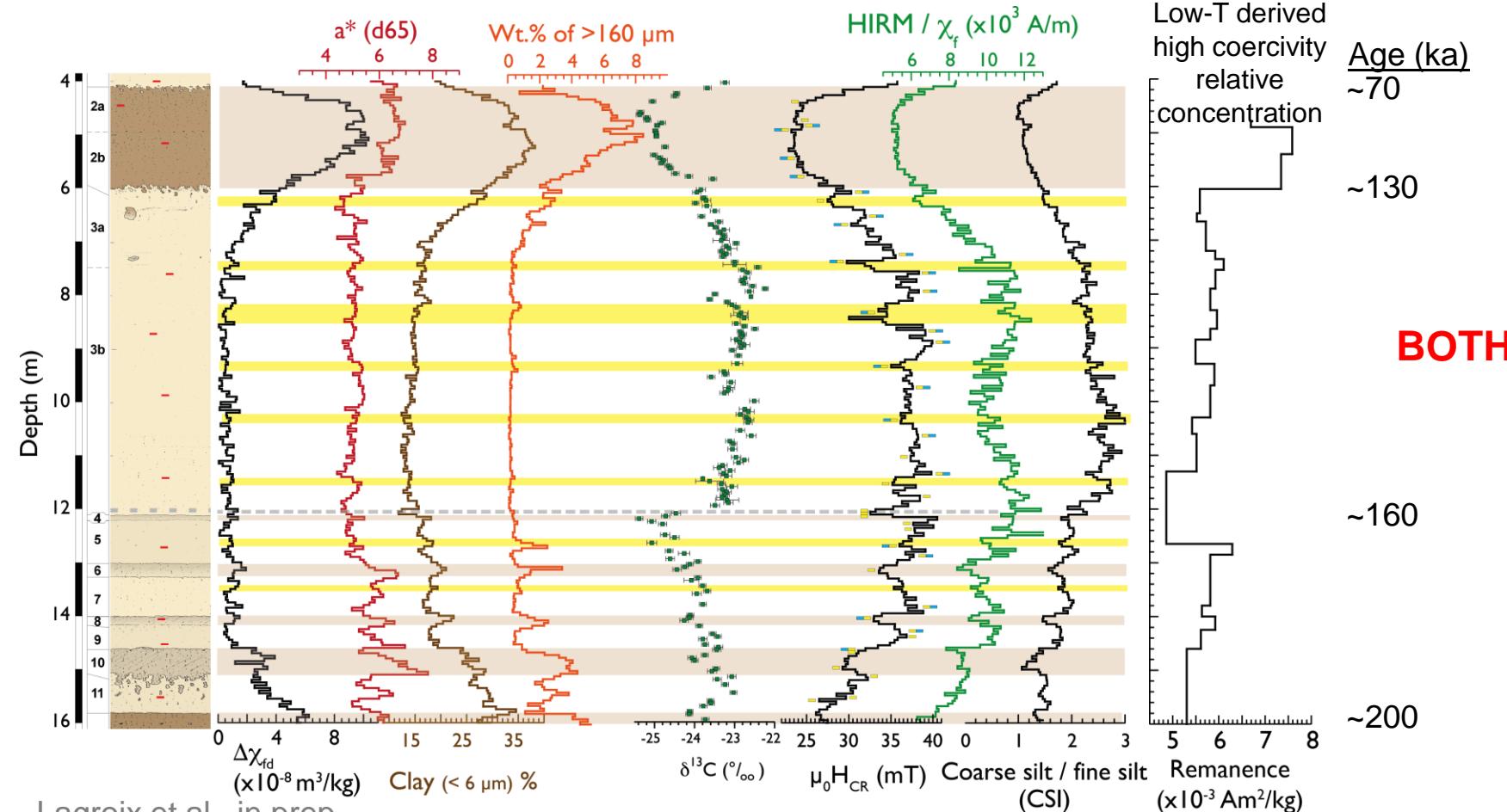
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Nussloch Loess Sequences

Rhine Valley, Germany

High resolution record of MIS 2 and 3

- Quarry setting enabled multiple sequences to be studied through multidisciplinary analyses.

Antoine et al. (2001, 2009) Rousseau et al. (2002)

Moine et al. (2008, 2017) Hatté & Guiot (2005)

Taylor et al. (2014) Taylor & Lagroix (2015)

- With time excellent age control was obtained demonstrating sedimentation rates of up to ~11 cm/kyr
Interstadials are archived through the occurrence of tundra gleys.

