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Paleomagnetism in the Pannonian; Problems, Pitfalls and Progression

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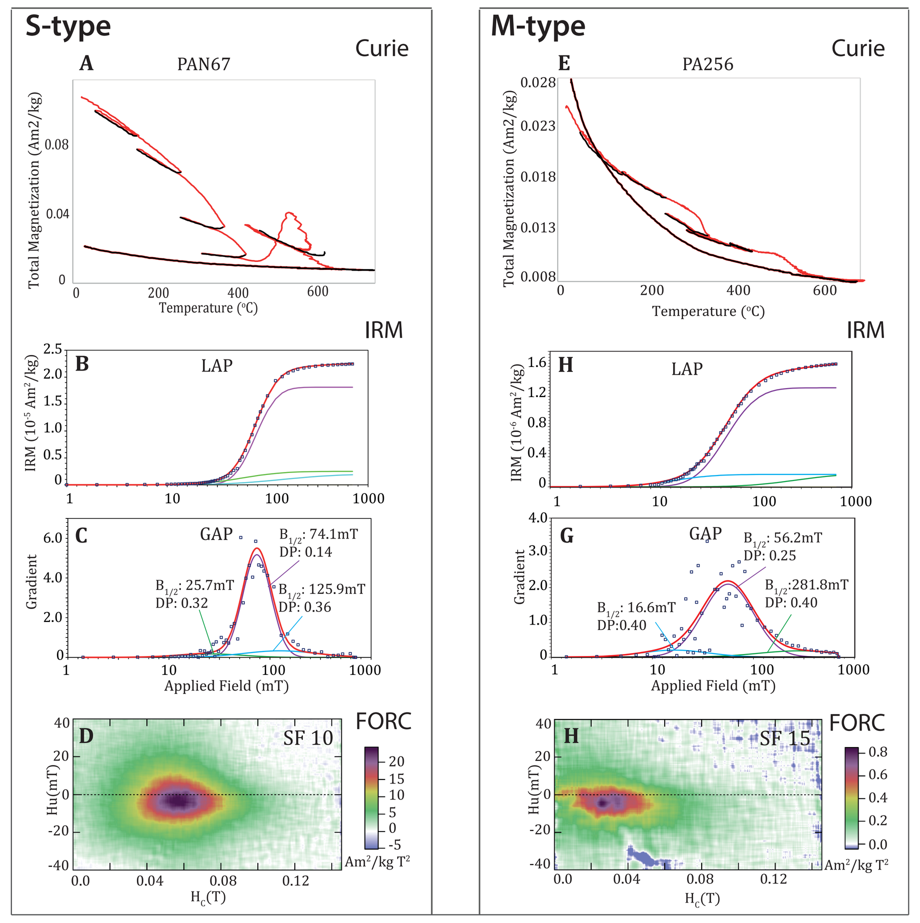
Dating of Upper Miocene sediments in the Pannonian Basin has proven difficult due to endemic biota, scarcity of reliable radioisotopic data, and generally inconsistent paleomagnetic results associated with diagenetic forms of the iron sulfide greigite[a]. Here, we present a greigite-bearing well core from Hungary in which opposite magnetic polarities within the same horizons can be distinguished. We demonstrate that magnetostratigraphic dating of such material is feasible by using a careful thermal demagnetization method with extra small steps (10 °C). Classic alternating field demagnetization results in an unreliable polarity pattern and should be avoided.

Terminology

M-type: multiple-polarity sample
S-type: (apparent) single polarity sample
LT/MT/HT: low/medium/high temperature range
TH/AF: thermal/alternating field demagnetization

Rock magnetic results



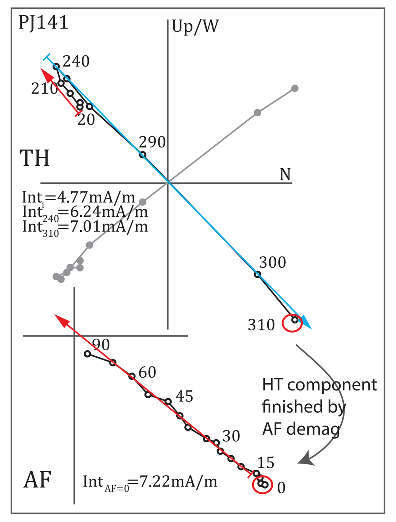
Left: A clear greigite sample. A) Irreversible decrease in magnetization ~250-400 °C depicts greigite break-down. Pyrite to magnetite peak between 400 and 580 °C; B/C) IRM values in the greigite range; D) Slightly negative peak at 50-60 mT, closed large concentric contours, indicative of SD greigite.

Right: Noisy sample. E) As in A) but less pronounced, possibly mixture of primary greigite and magnetite; G/H) Noisy IRM, values on boundary magnetite/ greigite. H) Shifted peak to lower coercivities at 20-40 mT. Closed converging contours and large vertical spread. Indicative of a greigite/magnetite mixture or greigite sample with a substantial SP grain population.

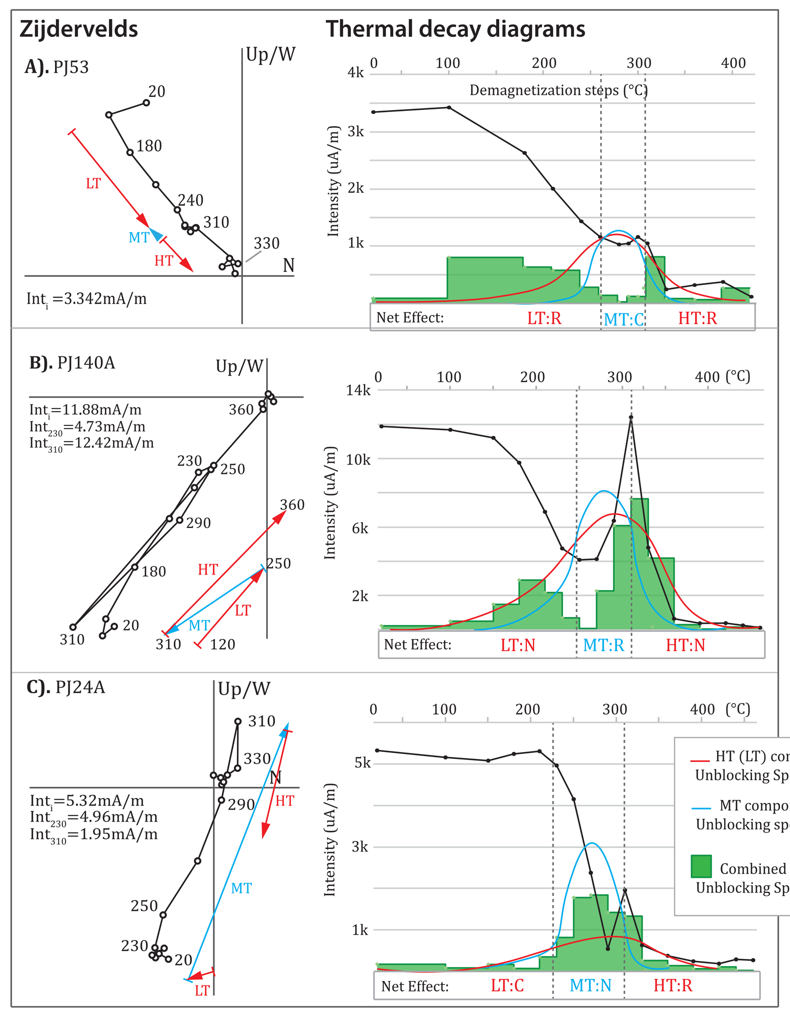
Careful methodology

General: 10-20 °C steps are key to resolve the different components.

Right: The HT component can be completely removed by consecutive TH-AF cleaning, avoiding the growth of magnetite from pyrite > ~400 °C.



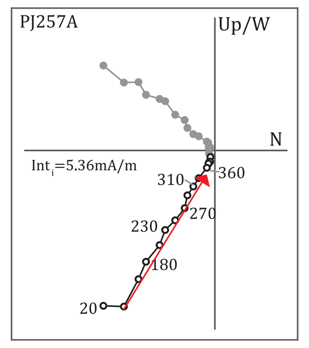
M-type: conflicting polarities



Zijderveld diagrams of M-type samples with varying MT:HT intensity ratios (left) with their corresponding sketched unblocking spectra (right). The individual unblocking spectra for the MT (blue) and LT/HT (red) components contribute to the total unblocking spectrum (green), and explain the variation in NRM behavior in the Zijdervelds.

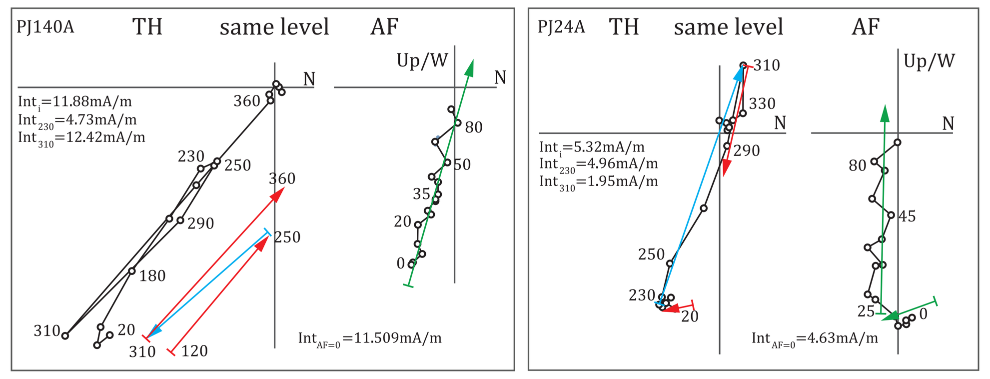
S-type

Some samples show one clear direction

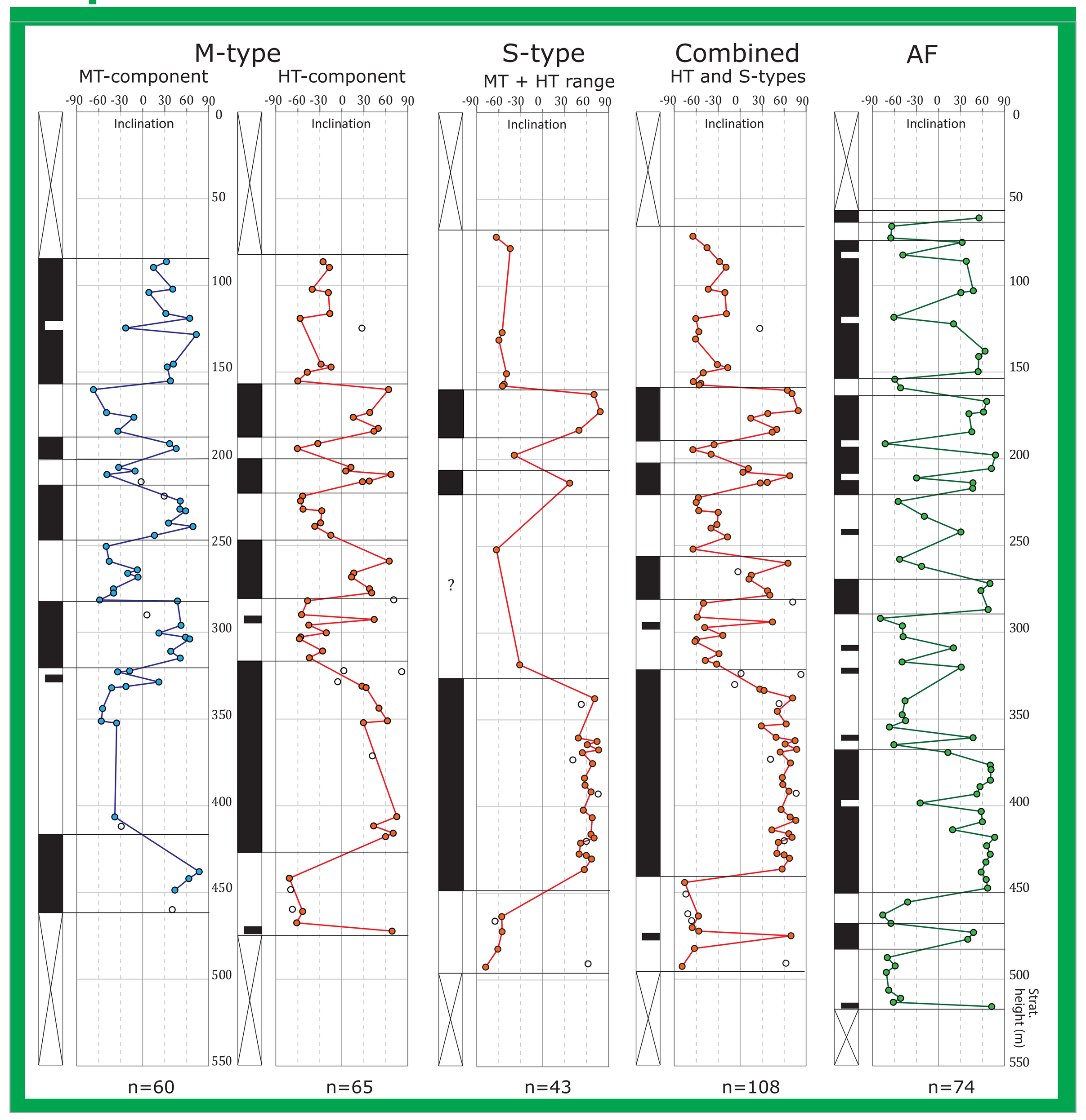


AF fails

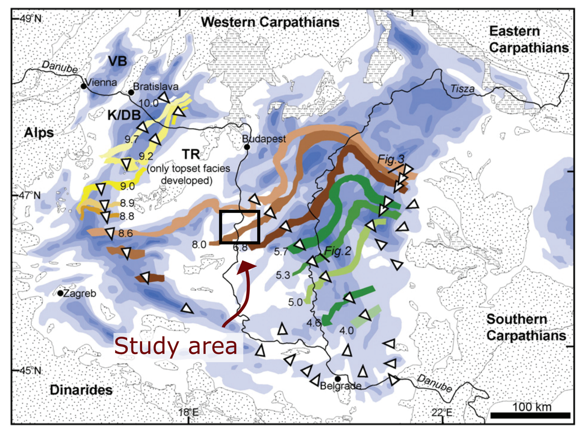
AF demagnetization reflects only one component (MT or HT)



All patterns



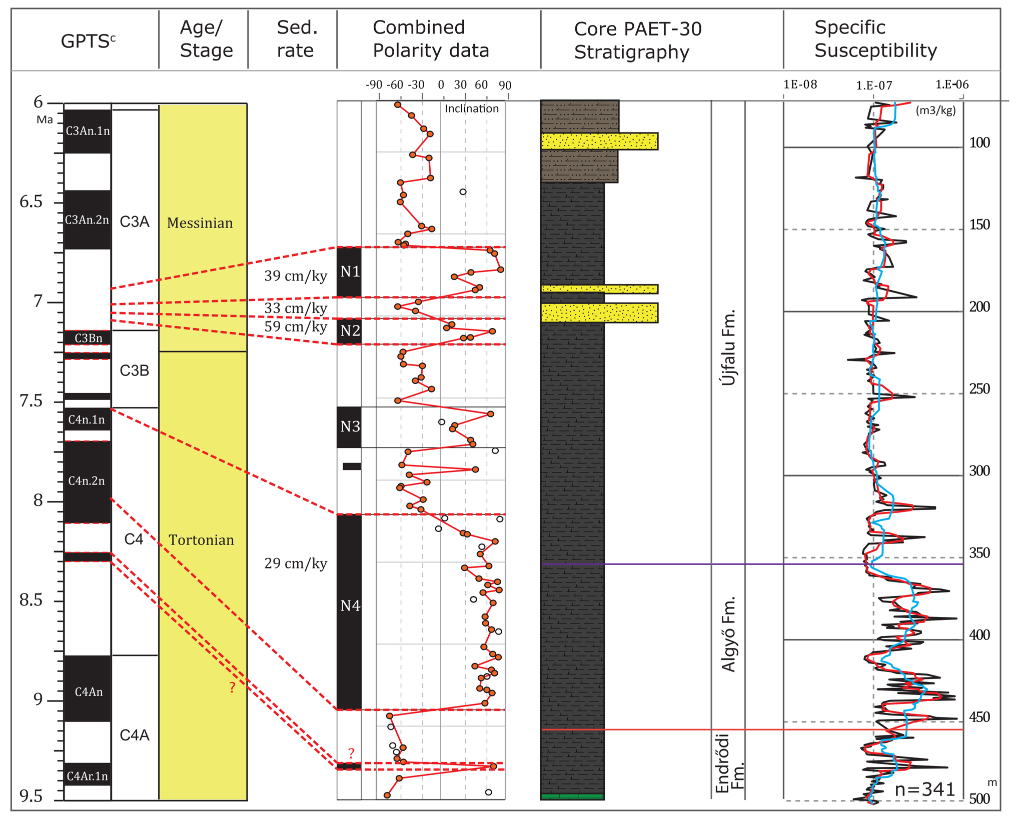
The HT-polarities of the M-type samples are consistent with the directions of the S-type samples. We assume that they reflect an early-diagenetic signal and that their combined polarity pattern can be used for magnetostratigraphic dating of the studied succession.



Lake Pannon

study area in Hungary[b]

Correlation to the GPTS



We correlate the normal base (N4) to Chron C4n.2n, and the top (N1) to C3Bn, so that the core yields ~1.5 Myr. Correlations of N4 to C4An, or N1 to C3An.1n are precluded by biostratigraphy (*Congeria rhomboidea* sublittoral mollusc biozone in N4, and *Prosodacnomya vutskitsi* littoral mollusc biozone in N1) and seismic correlation.

Prospectives

We have mapped **pitfalls** for paleomagnetism in greigite-bearing sediments and exemplified a practical method to tackle dating **problems** in the Pannonian Basin, and beyond. We strongly wish for an improved geochemical characterization of different greigite forms in order to make more **progression** with paleomagnetic methods in greigite-prone basins.

References: [a]Babinszki, E., et al. (2007); PPP 252, 626–636 / [b]Magyar., I., et al. (2013); GPC 103, 168–173 / [c]Hilgen, F. J., et al. (2012); The Neogene Period.

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