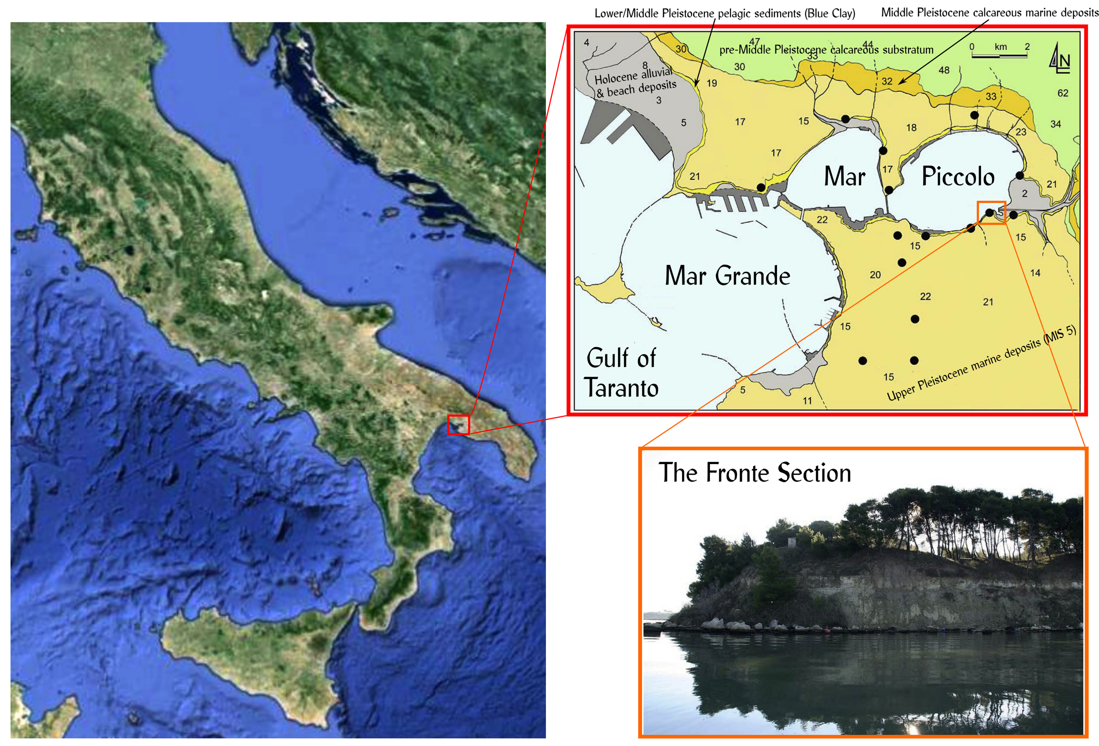
A high-resolution Upper Pleistocene palaeomagnetic record from the Fronte Section at Taranto, Italy

Pont Lurcock[1] <pont@talvi.net>, Fabio Florindo[1], Alessandra Negri[2], Stefano Marabini[3], Giuseppe Mastronuzzi[4], Caterina Morigi[5], Gian Vai[3]

[1]Istituto Nazionale di Geofisica e Vulcanologia, Rome [2]Università Politecnica delle Marche [3]Università di Bologna [4]Università degli Studi di Bari Aldo Moro [5]Università di Pisa

Introduction

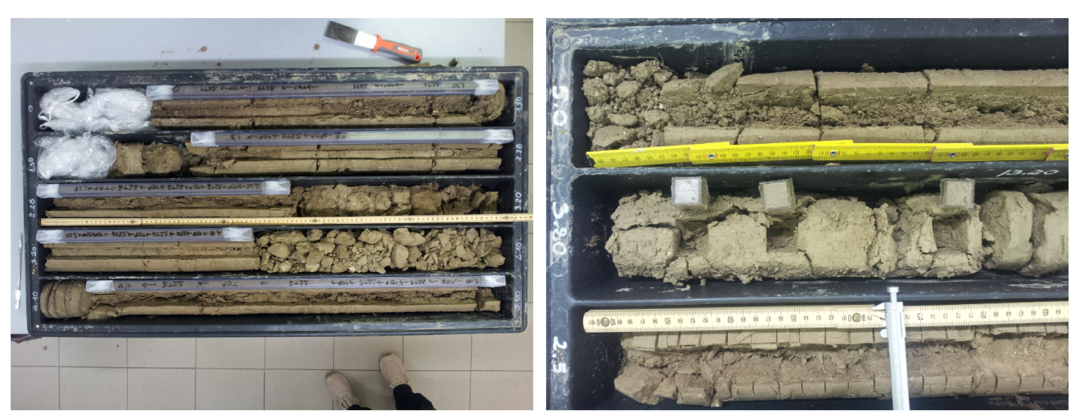
As part of an ongoing project to establish a global boundary stratotype section and point (GSSP) for the Upper Pleistocene (Negri et al., 2015), we have investigated the geomagnetic palaeosecular variation and relative palaeointensity of two parallel marine sedimentary cores drilled at the Fronte section at Taranto, Italy.



Location of the Fronte section in the Gulf of Taranto. Area map and reconstruction of marine terraces after Negri et al. (2015). Numbers give elevation above sea level; black dots indicate outcrops with 'Senegalese' fauna.

Methods

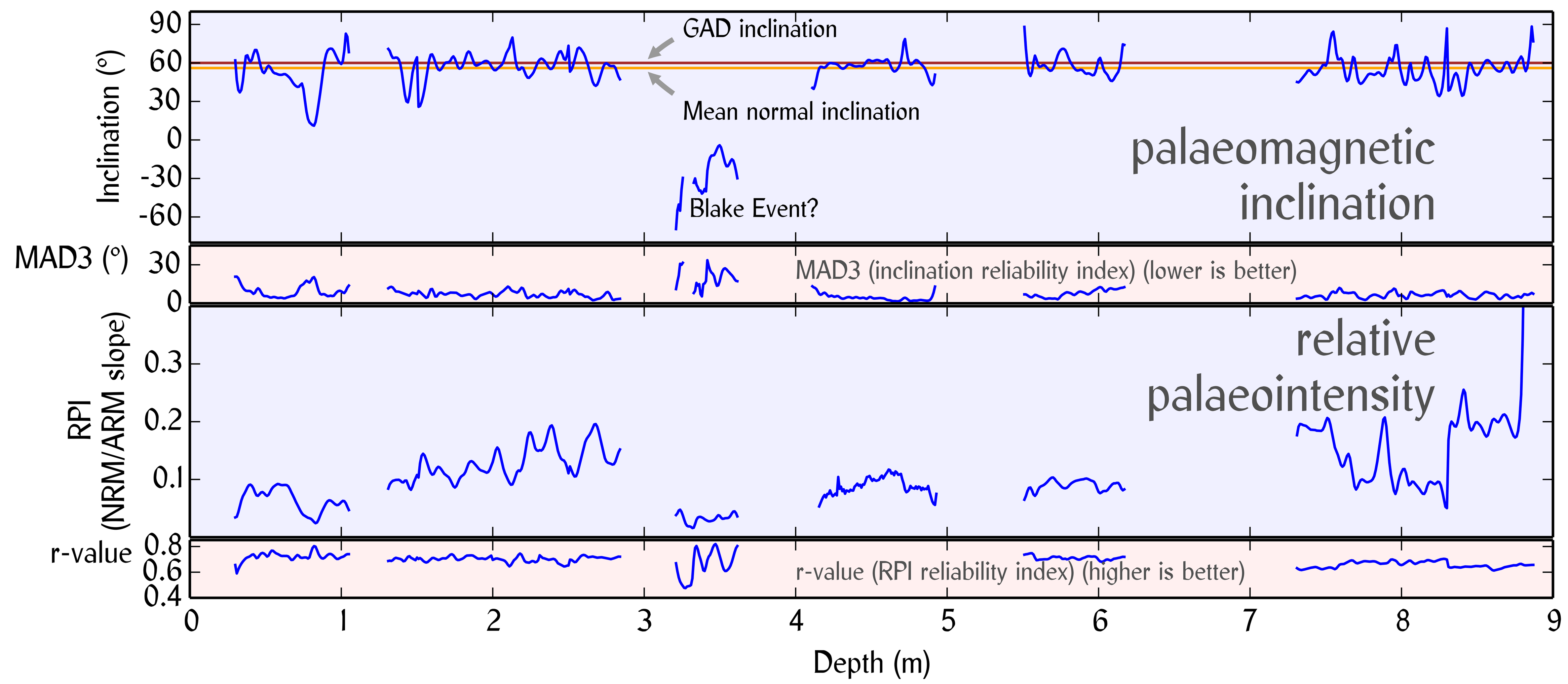
U-channel samples were taken wherever core recovery and lithology permitted, producing a palaeomagnetic record at 1 cm resolution covering around 5 m of the total 9 m coring depth; discrete samples were taken from several of the intervals unsuitable for u-channelling.



Variable sediment quality meant that some intervals had to be cube sampled, or omitted entirely from sampling.

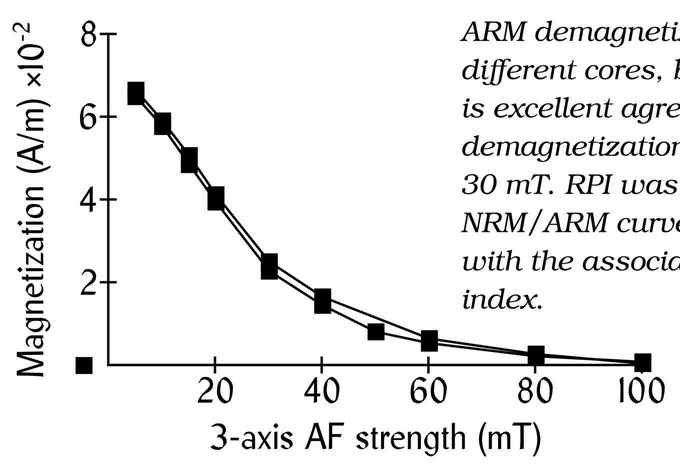
We demagnetized the samples in ten increasing steps of alternating-field treatment (max. 100 mT), then subjected them to ARM treatment (100 mT AF with 50 µT DC bias) and re-applied the AF demagnetization steps. Data was analysed using PuffinPlot (Lurcock and Wilson, 2012).

Results: palaeosecular inclination and relative palaeointensity



Stepwise alternating-field treatment resulted in good demagnetization behaviour, with most samples showing a clear, major origin-directed magnetization component. The average inclination of around 56° is close to the geocentric axial dipole inclination of 60° for the sampling site, with the discrepancy attributable to typical inclination shallowing effects.

Stepwise AF cleaning of ARM for RPI estimation produced, in general, highly linear behaviour up to at least 30 mT, with a shallowing slope thereafter. Deviations from linearity were greatest in the 3.2–3.6 m interval.

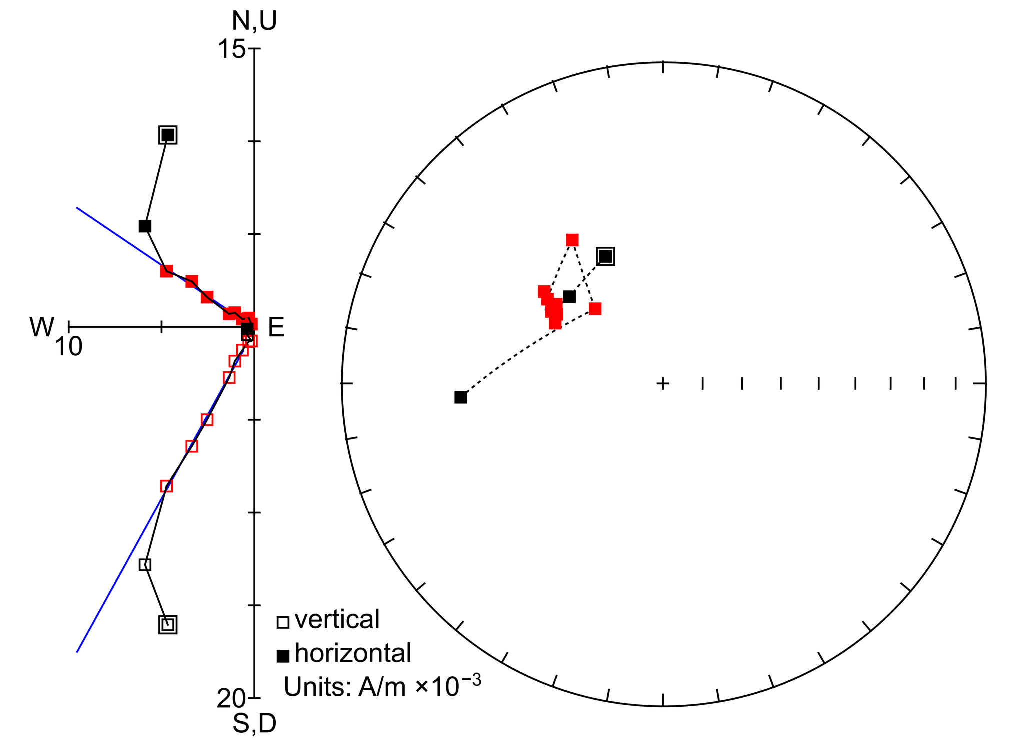


ARM demagnetization curves for samples from two different cores, both at a depth of 176.0 cm. There is excellent agreement between the two cores, and demagnetization behaviour is highly linear up to 30 mT. RPI was estimated as the slope of the NRM/ARM curve determined by linear regression, with the associated r-value used as a data quality index.

Our record contains several brief inclination excursions. The most significant of these is a reversal that reaches an inclination of around −70°. We have tentatively identified this excursion as a record of the Blake event. Unfortunately, interpretation of this feature is complicated by the gaps in the record immediately above and below it, where the sediments were unsuitable for palaeomagnetic sampling. However, the character of the reversed interval itself, with a progressive, non-monotonic steepening of negative inclination, matches other records of the Blake Event (e.g. Channell et al., 2012).

Relative palaeointensity is also markedly different across this interval: throughout the hypothesized Blake Event at around 3.2–3.6 m, RPI values are the lowest of those measured in these cores. As in the inclination data, the behaviour observed in our cores is consistent with other published records of the Blake Event (e.g. Osete et al., 2012).

Results: palaeomagnetic behaviour



Zijderveld and equal-area plots showing typical results of stepwise alternating-field demagnetization (core depth 463.2 cm).

Most samples showed good demagnetization behaviour, with a major origin-directed component, sometimes with a weak overprint which disappeared around the 10 mT demagnetization step. Demagnetization behaviour in the putative Blake Event interval was more complex. Cores were azimuthally unoriented, so the measured declinations cannot be converted to estimates of palaeofield declination.

Where sampling permitted analysis of both cores at the same depth, there was good agreement between the palaeomagnetic directions and palaeointensities, increasing our confidence in our results.

Conclusions and further work

Results obtained so far indicate that the sedimentary record from the Fronte cores provides a reliable record of geomagnetic palaeoinclination and, in most parts, of palaeointensity. From biostratigraphic age constraints, the reversed interval seems likely to correspond to the Blake event; ongoing biostratigraphic work should provide further confirmation of its age.

Analysis of NRM and ARM results from the discrete samples will provide better coverage of the gaps in the existing u-channel data, and rock magnetic studies (hysteresis loops, IRM acquisition, first-order reversal curves, temperature dependence of magnetic susceptibility) will aid interpretation of the more complicated palaeomagnetic behaviours.

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