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The Middle–Upper Pleistocene Fronte Section (Taranto, Italy): An exceptionally preserved marine record of the Last Interglacial

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ABSTRACT

The Fronte Section, a well-exposed stratigraphic succession from southern Italy (Taranto area), provides an uninterrupted marine sedimentary record of MIS 5e. At this location, a highly expanded (8.5 m thick) stratigraphic succession, unconformably overlying Middle Pleistocene marine clay deposits, provides evidence for sea-level fluctuations during the Last Interglacial. An integrated study of Fronte Section, including facies analysis, detailed macrofaunal and meiofaunal characterization, and sequence stratigraphy, is presented. The occurrence of *Persististrombus latus* (=*Strombus bubonius*) and other warm-water indicators ("*Senegalaise*" – "Senegalian" – guests of Gignoux, 1913), together with the presence of the dinocyst *Polysphaeridium zoharyi* and ten U-series dates on *Cladocora caespitosa* samples, permit an unequivocal MIS 5e age assignment to the upper part of the study succession. Above a stratigraphic unconformity marked by the boring coastal-lagoonal bivalve *Pholas dactylus*, the MIS 5e succession displays a first transgressive *suite* of brackish to shallow-marine deposits. These latter include highly fossiliferous muds rich in *C. caespitosa*, overlain by a fossil-rich calcarenite, 2 m-thick, yielding warm-water "Senegalian" mollusks. Above this prominent stratigraphic marker (regionally called *panchina*), which is interpreted to represent a short-lived phase of sea-level stillstand or gentle fall during MIS 5e, renewed transgression took place, leading to the accumulation of middle-outer shelf muds, about 5 m thick. The maximum flooding zone is clearly identified on the basis of the turnaround from a deepening-up to a shallowing-up trend. The upper part of Fronte Section records a second fossil-rich, sublittoral calcarenite containing warm-water mollusks, which is interpreted to reflect the subsequent phase of sea-level highstand, likely correlative with the MIS 5e plateau.

1. Introduction

The Last Interglacial (Marine Isotope Stage 5e), being characterized by remarkable ice-sheet retreat, entails significantly warmer conditions and higher eustatic sea level than at present (Kukla et al., 2002; van Kolfschoten et al., 2003; Carlson et al., 2008; Clark and Huybers, 2009; Kopp et al., 2009; Sánchez-Goñi et al., 2012). Hence, the MIS 5e interval (135–116 ky BP in Shackleton et al., 2003) is generally regarded as a good analog of near-future Earth developments in response to the projected global warming (Overpeck et al., 2006; IPCC, 2007; Rohling et al., 2008; Siddall and Valdes, 2011). Dramatic oceanographic and climatic changes related to the Last Interglacial occurred over few millennia, and are recorded in several continental, marine and ice-core successions of the Northern Hemisphere (Sánchez-Goñi et al., 1999; Shackleton et al., 2002, 2003; Tzedakis et al., 2003; Martrat et al., 2004; NGRIP, 2004; Brauer et al., 2007; Couchoud et al., 2009; Milner et al., 2013). However, different time-scale resolution, latitudinal variability and complex proxy-environment relationships make precise

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land-sea correlation very difficult (e.g., Shackleton et al., 2002, 2003; Sánchez-Goñi, 2007).

Several, almost continuous deep-sea records exist for MIS 5e in the Mediterranean area (Cita et al., 2005). These include ODP site 976 in the Alboran Sea (Comas et al., 1996), Core KET 80–22 in the Tyrrhenian Sea (Tucholka et al., 1987), Core KC01B in the Ionian Sea (Castradori, 1993; Lourens, 2004), piston core RC 9–181 in the Levantine Basin (Ryan, 1972; Vergnaud-Grazzini et al., 1977; Cita and Ryan, 1978; Hilgen, 1991), and Core PRAD 1–2 in the Adriatic Sea (Piva et al., 2008a,b). Along the Mediterranean coasts a variety of sea-level indicators, including tidal notches, marine terraces and raised beaches suggest an average sea level for the Last Interglacial 7 ± 3 m higher than modern sea level (Lambeck et al., 2004; Ferranti et al., 2006; Antonioli, 2012). At these locations, age assignments of Last Interglacial deposits rely on: (i) the occurrence of raised marine terraced deposits with *Persististrombus latus* (= *Strombus bubonius*) and/or other warm-water taxa (e.g., *Patella ferruginea*, *Conus ermineus*, *Gemophos viverratus*, *Cardita calyculata senegalensis*, and *Hyotissa hyotis*), (ii) U/Th ages on corals, and (iii) amino acid racemization analyses on mollusk shells. In onshore areas, however, sedimentary successions of MIS 5e age are very thin and crop out discontinuously (see Ferranti et al., 2006, for a review). For this reason, previous work has focused mostly on morphological and morphostratigraphic, rather than sedimentological features of MIS 5e deposits (Zazo et al., 2003; Bardají et al., 2009; Orrù et al., 2011; Mauz et al., 2012, 2013; Zazo et al., 2013), with few exceptions (Dabrio et al., 2011). Thick MIS 5e successions have been reported from beneath several modern coastal and alluvial plains of Europe (Amorosi et al., 1999; Cleveringa et al., 2000; Törnqvist et al., 2000; Gibbard, 2003; Törnqvist et al., 2003; Amorosi et al., 2004; Carboni et al., 2010; De Santis et al., 2010). At these locations, the Last Interglacial is represented by a characteristic transgressive-regressive cycle, the thickness of which attains ~25 m in the highly subsiding Po Basin (Amorosi et al., 1999, 2004; Scarponi and Kowalewski, 2004). Finally, wide documentation of the Eemian exists from several, well-known lacustrine successions of the Mediterranean area (e.g., Wijmstra and Smit, 1976; Follieri et al., 1988; Tzedakis, 1994; Brauer et al., 2007). Recently, the Eemian has also been reported from thermogene travertines of central Italy, where palynologic investigations combined with U/TH dating have shown the possibility of extracting a paleoclimate record from a unique terrestrial archive (Bertini et al., 2014).

In this paper, we address the potential of a well exposed, easily accessible, 8.5 m-thick marine succession from southern Italy (Fronte Section), as an exceptionally expanded stratigraphic succession of MIS 5e cropping out in a coastal location. Fronte Section crops out along a 1.1 km-long coastal cliff, about 7 km east of Taranto (Fig. 1), on the Southern coast of the innermost inlet of Mar Piccolo. At Fronte Section, marine deposits containing warm-water "Senegalian" fauna (Gignoux, 1913) have been documented, providing several U/Th uncorrected ages consistent with a MIS 5 attribution (for a detailed synthesis, see Mastronuzzi and Sansò, 2003). We outline the value of multiproxy reconstruction based on a variety of biological (mollusks, benthic meiofauna, planktic foraminifers, calcareous nannofossils, palynomorphs) and sedimentological indicators.

2. Geological setting

The Taranto area lies within the Apulia carbonate platform (Mostardini and Merlini, 1986; Patacca and Scandone, 1989), which represents part of the Adriatic foreland of the Apenninic chain

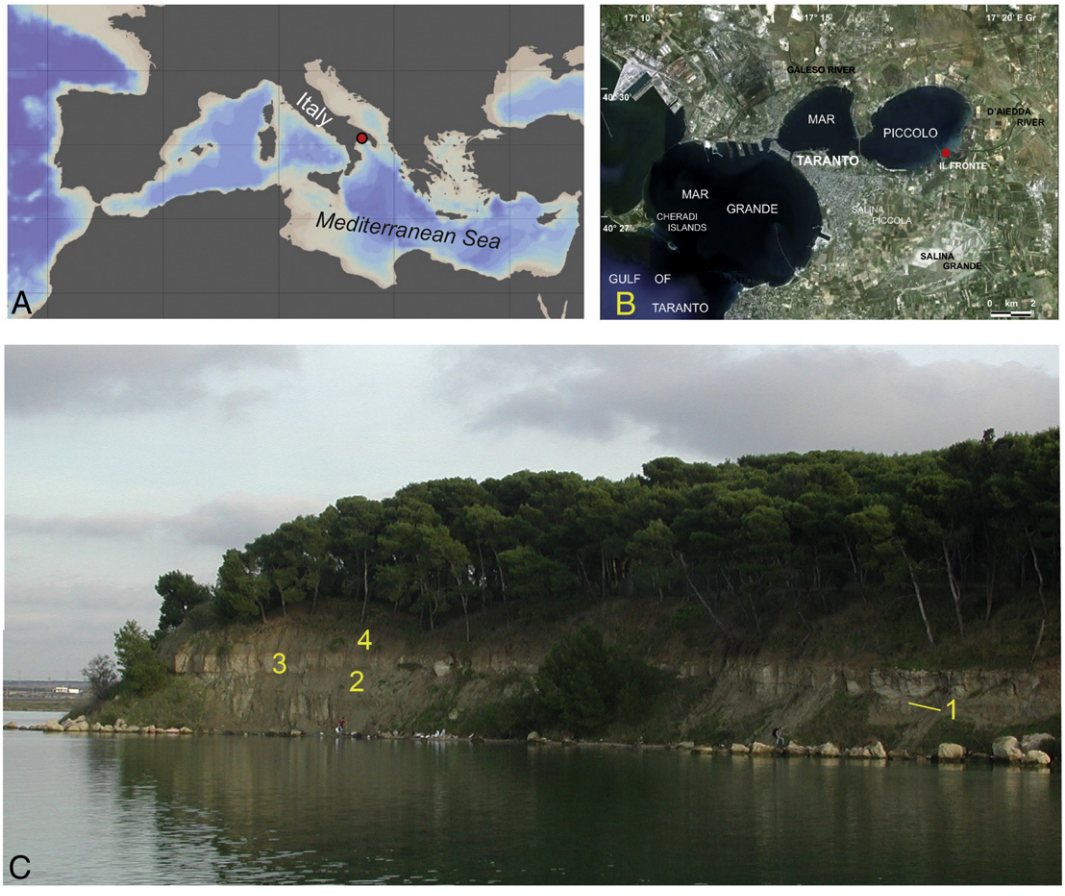

Fig. 1. Geographic location (red dot in A, B) and outcrop view (C) of Fronte Section. Numbers refer to the stratigraphic units of Fig. 3.