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Late Quaternary climatic evolution of the Arno coastal plain (Western Tuscany, Italy) from subsurface data

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Abstract

A multidisciplinary study of a 105-m-long core was carried out on the Tyrrhenian coast of Tuscany, Western Italy. Detailed description of sedimentary facies, foraminifer and ostracod assemblages, pollen, and ^{14}C ages is presented in this paper.

Identification in core of two transgressive surfaces (TSs) as the most prominent stratigraphic markers allows subdivision of the Late Quaternary stratigraphic succession into two transgressive–regressive (T–R) sequences, attributed to the last 150 kyr BP. Sequence boundaries have no unequivocal physical expression in the core.

Detailed pollen analysis documents a direct relationship between vertical facies evolution and climate fluctuations. Coastal to shallow-marine sediments in the lower part of T–R sequences were deposited during the last two interglacial periods (OIS 1 and 5e), under rising sea-level conditions and during the following sea-level highstands. By contrast, alluvial sedimentation (upper part of T–R sequences) took place during periods of sea-level fall and subsequent sea-level lowstands, and was invariably linked to the onset of glacial periods (OIS 4–2 and 6, respectively).

This paper presents the first detailed facies documentation of a Late Quaternary incised-valley fill sequence from Italy. About 51 m of Holocene sediments are recorded beneath the present Arno River valley. Early transgression is documented in the lower part of the incised-valley fill by wave-dominated estuarine facies overlying lowstand fluvial deposits. Late transgression records the rapid landward migration of a beach-barrier system, followed by the establishment of an open-marine environment. Highstand sedimentation is represented by a shallowing-upward succession, which reflects progradation of the modern delta/strandplain.

Keywords: Late Quaternary stratigraphy; Sea-level change; Incised-valley system; Pollen; Micropalaeontology; Arno River

1. Introduction

Stratigraphic investigation of Late Quaternary deposits has become increasingly popular in the last decade, because of the unique opportunity to use tectonically undisturbed and easily datable sediments as a basis for the definition of realistic and accurate depositional models (Blum and Törnqvist, 2000; Cattaneo and Steel, 2003). These models may be successfully used for the prediction of possible scenarios of environmental

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change under rising sea-level conditions, and for the development of new conceptual models in the field of sequence stratigraphy (e.g. Saito, 1994; Blum and Törnqvist, 2000; Plint and Nummedal, 2000; Amorosi and Colalongo, 2005). Such models can also be applied to the interpretation of older successions and may serve to elucidate late Quaternary tectonic activity.

Facies analysis and sequence stratigraphy of Late Quaternary deposits traditionally deals with detailed reconstructions of Holocene successions buried in the uppermost few tens of metres beneath the modern alluvial and coastal plains (Lowrie and Hamiter, 1995; Somoza et al., 1998; Amorosi et al., 1999a; Hori et al., 2002; Amorosi et al., 2003; Overeem et al., 2003; Tanabe et al., 2003; Hori et al., 2004; Amorosi et al., 2005; Storms et al., 2005). Although a cyclic stacking pattern of facies in response to Milankovich-scale cycles has been observed within pre-Holocene deposits (Massari et al., 2004), there have been few attempts to depict the detailed facies architecture of the last two glacial–interglacial cycles (from OIS 6 onwards). This is mostly due to problems in the recovery of pre-Holocene data within buried successions. Long-cored pollen series from continental successions in Europe have documented the climatic evolution of the last 150 ky (Wijmstra, 1969; Wijmstra and Smit, 1976; Woillard, 1978; Follieri et al., 1988; De Beaulieu and Reille, 1992; Tzedakis, 1993; Reille et al., 1998; Tzedakis, 1999), and have been shown to correlate with oxygen-isotope stratigraphy (see Tzedakis et al., 1997; Caspers and Freund, 2001; Guiter et al., 2003; Preusser, 2004). These studies, however, generally lack detailed facies analysis. Few studies have investigated in detail the response of coastal and deltaic depositional systems to the last two Quaternary glacio-eustatic cycles on the basis of multiple datasets (Amorosi et al., 1999b; Törnqvist et al., 2000, 2003; Lim and Park, 2003; Amorosi et al., 2004; Konradi et al., 2005; Hanebuth et al., 2006).

The aim of this paper is to present the first detailed example of an integrated sedimentological and micro-palaeontological study of late Quaternary deposits in the Tyrrhenian area, based on analysis of a 105 m-long core that was drilled in 2003 in western Tuscany (Italy), only 200 m from the present shoreline (Fig. 1). Specific

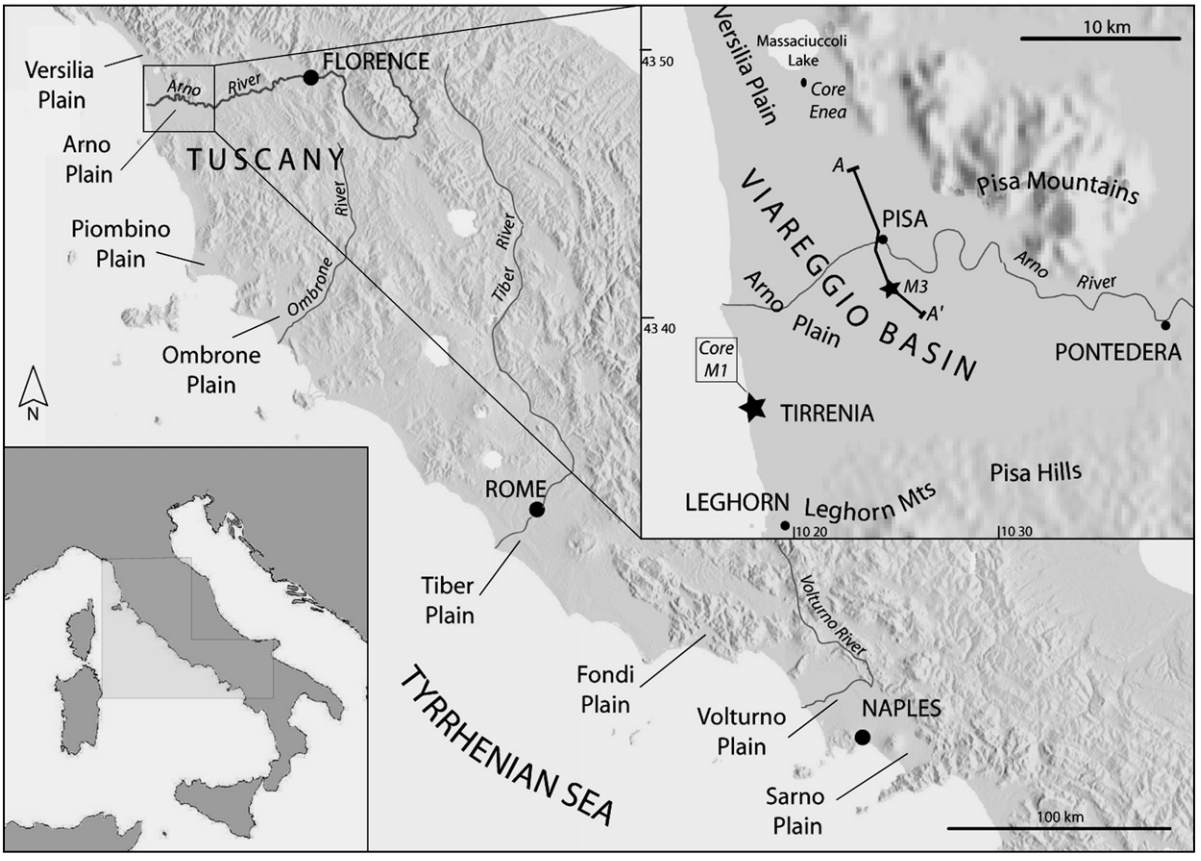

Fig. 1. Map of the study area with location of the major coastal plains along the Tyrrhenian coast of Italy. AA′: section trace of Fig. 5.