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Tectonic and climatic control on geomorphological and sedimentary evolution of the Mercure basin, southern Apennines, Italy

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ABSTRACT

The morpho-tectonic and sedimentary evolution of the Mercure intramontane basin (Calabria–Lucania boundary, southern Apennines) has been assessed through facies analysis, morphostratigraphy and geomorphological correlation with adjacent areas.

The Mercure basin, one of the most active seismogenic zones of the southern Apennines, is a favorable area for reconstructing the main stages of landscape evolution of the axial zone because of its capability to record changes in base level during the Quaternary. In addition, the presence of both erosional and depositional Palaeosurfaces is a useful marker for reconstructing tectonic and morphogenetic events, and hence to detect the role played by tectonics and climate in its genesis, evolution and extinction.

The present study identifies the key role of tectonics and denudation, combined with high-frequency floods, as mechanisms controlling alluvial sedimentation in the study area. During endorheic conditions, denudational processes driven by pulses of extensional deformation of the basin margin caused strong alluvial inputs that resulted in the development of alluvial fans. Alluvial facies are mainly characterized by turbulent, subaerial, hyperconcentrated flood flows deposited during the glacial, semi-arid conditions of MIS 14. The retrogradational stacking pattern of the alluvial system indicates decreasing rates of tectonic activity along with declining river gradients.

The Mercure coalescing alluvial fans were inundated by lake transgression during MIS 13 in response to (i) abrupt tectonic subsidence at the basin margins and (ii) large decrease of coarse sediment supply due to the interplay among climate, tectonics and catchment size changes. In this regard, it is suggested that tectonic control on the drainage network along with climate and long-term slope evolution may have caused marked pulses in sediment supply, thus influencing the arrangement of facies associations in the sedimentary succession. In addition, the study points out that the main tectonic landforms developed during each period of the landscape evolution well correspond with some active fault segments.

1. Introduction

The axial zone of the southern Apennines orogenic belt hosts a series of Quaternary intramontane basins (Fig. 1), which developed during the late stage of continental collision (Patacca and Scandone, 2001). Their evolution has been controlled by a NW–SE striking normal and normal-oblique fault systems that have developed since the Early Pleistocene in response to the eastward migration of extensional tectonics (Hippolyte et al., 1995; Catalano et al., 2004), whereas according to some authors (Patacca and Scandone, 2001; Benvenuti et al., 2006) some intramontane basins in the region developed in response to the E-verging thrusting related uplift.

The Mercure basin (GE.MI.NA., 1963; Vezzani, 1967; Schiattarella et al., 1994) is located between the Vallo di Diano, the Valle del Noce and the Val D'Agri basins to the north (La Rocca and Santangelo, 1991; Amicucci et al., 2008; Zembo et al., 2009; Gioia et al., 2011), the S. Arcangelo basin to the east (Hippolyte et al., 1994; Pieri et al., 1994; Patacca and Scandone, 2001; Benvenuti et al., 2006), and the Morano and Castrovillari basins to the south (Schiattarella, 1998) (Fig. 1). The axial zone of southern Apennines is therefore characterized by an alternation of morphostructural ridges and Quaternary tectonic depressions bounded by high-angle fault scarps. In particular, the Morano–Castrovillari and Mercure basins developed in the subsiding hangingwall of the Pollino fault, the main active and segmented normal fault system of the southern Apennines. The Pollino ridge (Fig. 1)

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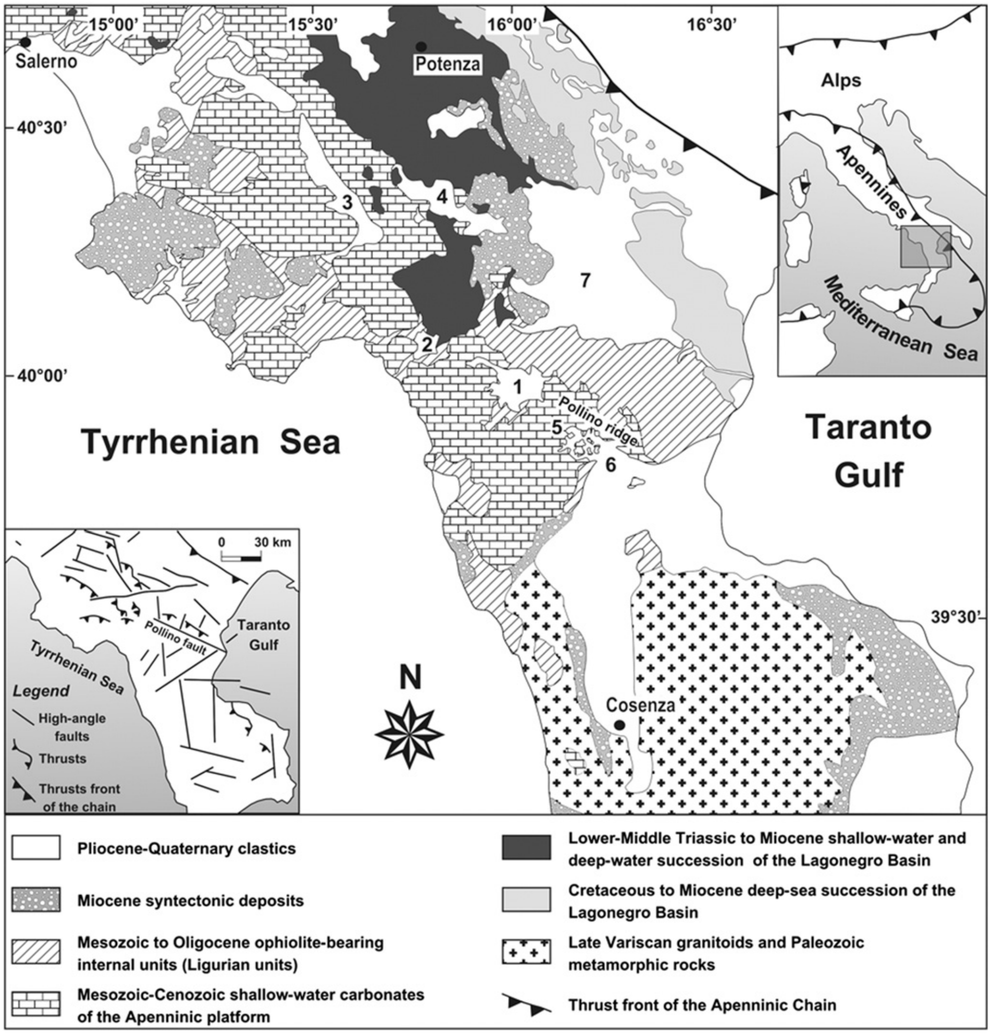

Fig. 1. Geological sketch map of southern Italy and its location in the central Mediterranean framework (top inset). The tectonic sketch map reporting the main tectonic features is shown in the inset on the bottom left. (1) Mercure basin. (2) Noce basin. (3) Vallo di Diano basin. (4) Val d'Agri basin. (5) Morano basin. (6) Castrovillari basin. (7) Sant'Arcangelo basin (modified after Martino et al., 2009).

is one of the widest N120°-trending morpho-structures of the southern Apennines at the Calabria–Lucania boundary, which separates the sedimentary units of the southern Apennines and the metamorphic units of the Calabrian Arc (Monaco, 1993; Monaco et al., 1998). In addition, its proximity to uplifted Quaternary marine deposits allows better chronological constraint of the different steps of landscape evolution.

The Mercure basin is bounded northeastward by SSW-dipping fault systems, among which the Castelluccio fault is morphologically the most evident (Fig. 2A). Although its boundary faults have been commonly related to regional strike-slip tectonics (Monaco, 1993; Schiattarella et al., 1994; Marra, 1998; Monaco et al., 1998), the structural evolution of the depression has long been debated. According to some authors, NW-trending strike slip tectonics was active during the entire Pleistocene, leading to block rotations and step-over phenomena responsible for the opening of the Mercure basin (Turco et al., 1990). The inversion of the step on the two main left-lateral, NW-trending strike-slip faults led Marra (1998) to advocate a transtensional tectonic phase, followed by a transpressive phase during the Late Pleistocene. Schiattarella et al. (1994) and Schiattarella (1998) stated that the Early Pleistocene strike-slip faults were reactivated with a normal and oblique, right-lateral-kinematics due to a Middle Pleistocene extensional strain field characterized by a NE–SW extension axis rotating clockwise through time; this resulted in some endorheic basins located westward of the Pollino N120°-trending fault zone. Despite the quoted assumptions, Papanikolaou and Roberts (2007) stated that the Pollino area experienced extensional tectonics since Late Pliocene times. Some segments of the fault systems are still active (Michetti et al., 1997; Papanikolaou and Roberts, 2007; Brozzetti et al., 2009), making the Pollino area a key point for characterizing the seismic hazard of the Calabria–Lucania boundary.

The aforementioned studies focused their efforts on clarifying the structural and seismotectonic framework of the Mercure area, unfortunately to the detriment of the accuracy on the stratigraphical and geomorphological settings. In fact, although the relationships between tectonics and sedimentation have been hypothesized (Schiattarella et al., 1994), facies analysis was not performed.

Therefore, this paper aims to provide new data to assess the role played by tectonics, climate and landscape evolution in the geomorphological and stratigraphical history of the Mercure basin and to more accurately constrain the timing of its origin and extinction. The Mercure basin is one of the most favorable areas in the southern Apennines for this work, as it provides good exposures that allow recognition of the evolution of the stratigraphic successions, the sedimentary processes and the deformational events. A common opinion is that sedimentary cyclicity and/or each major change in depositional processes and sedimentation is generally related to interplay of base-level changes, climate, and tectonics, which control the supply of sediment and the