

Miocene phosphate-rich sediments in Salento (southern Italy)



Karl B. Föllmi ^{a,*}, H el ene Hofmann ^{a,b}, Massimo Chiaradia ^c, Eric de Kaenel ^d, Gianluca Frijia ^e, Mariano Parente ^f

^a Institute of Earth Sciences, University of Lausanne, CH-1015 Lausanne, Switzerland

^b Department of Earth and Planetary Sciences, McGill University, Montreal, H3A 0E8, Canada

^c Department of Earth Sciences, University of Geneva, CH-1205 Geneva, Switzerland

^d DeKaenel Paleo-Research, CH-1185 Mont-sur-Rolle, Switzerland

^e Institute of Earth and Environmental Sciences, Potsdam University, D-14476 Potsdam, Germany

^f Department of Earth Sciences, Environment and Resources, University of Naples Federico II, I-80138 Naples, Italy

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ABSTRACT

The upper Middle to lower Upper Miocene (Serravallian to Tortonian) sedimentary succession in Salento (southern Italy) includes glauconite- and phosphate-rich deposits, which are associated with pelagic micrite. In Baia del Ciolo and Marittima (southern Salento), the succession is composed of shallow-water platform carbonates of Late Oligocene age (Chattian; Porto Badisco Formation), which are overlain by a 20- to 30-cm-thick level of glauconite-rich micrite with abundant reworked particles and fossils of the underlying Porto Badisco Formation. This interval is in turn covered by an up to 15 cm thick phosphatic crust ("Livello ad Aturia"), which itself is overlain either by a hemipelagic chalk-like carbonate of Middle to Late Miocene age ("Pietra Leccese"; Marittima) or directly by a micrite of Late Miocene age (Messinian; Novaglie Formation; Baia del Ciolo), which shallows upwards into a shallow-water platform carbonate. A large hiatus is present in this succession, which likely includes the Lower and lower Middle Miocene. In the region of Lecce, two discrete levels enriched in glauconite and phosphate—each associated with a major discontinuity—occur within the Pietra Leccese. The strontium-isotope ages derived on phosphate nodules and phosphatized and non-phosphatized fossils and calcareous nannofossil ages indicate a time interval of phosphogenesis between 13.5 and 7.5 Ma, with two clusters at 12 and 10.5 Ma. The glauconite and phosphate-rich sediments resulted from a current-dominated regime, which was characterized by low overall sedimentation rates, erosion and sediment reworking, and authigenesis. This regime was likely related to a generally westward-directed bottom current, which was forced to upwell once it arrived at the western border of the eastern Mediterranean basin. The timing of the principal phosphogenic phases can only partly be correlated to those of other occurrences in this part of the Mediterranean (Malta, Gozo, southern Sicily, Matese, Latium-Abruzzi platform). The partial diachrony in phosphogenesis may express the effect of lateral switching in and/or focusing of upwelling zones.

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1. Introduction

The widespread accumulation of authigenic phosphate in phosphorites and phosphate-rich sediments requires exceptional sedimentary and paleoceanographic conditions, which are usually encountered during periods of major paleoenvironmental and paleoclimatological change (Cook and McElhinny, 1979; Arthur and Jenkyns, 1981; Compton et al., 1990; Filippelli, 2008). The Miocene was an epoch of preferential phosphogenesis and accumulation of phosphate-rich deposits, and Miocene phosphorites are widespread (Cook and McElhinny, 1979; Burnett and Riggs, 1990; Garrison et al., 1990; Parrish, 1990; F ollmi et al., 2008). Their presence has been linked to changes in climate and concurrent changes in paleoceanographic conditions, notably during periods of general climate warming near the onset

of the Miocene, the Middle Miocene climate optimum and the latest Miocene phase of Indian monsoon intensification (Compton et al., 1990; Filippelli, 2008).

Miocene phosphorites are well known from the central Mediterranean region and especially the occurrences on Malta were extensively studied (Pedley and Bennett, 1985; Jacobs et al., 1996; John et al., 2003; F ollmi et al., 2008). Further phosphate-rich deposits are present in southern and central Italy, for example in southeastern Sicily, on the Salento Peninsula, the northwestern sector of the Latium-Abruzzi Apennines, and the Matese and Maiella Mountains (e.g., Giannelli et al., 1965; Carannante, 1982; Carannante et al., 1994; Mutti et al., 1997; F ollmi et al., 2008; Brandano et al., 2009). Whereas in Malta, on southeastern Sicily, and in the central Apennine Mountains, the phosphate-rich sediments are well dated both by nannofossil and foraminiferal biostratigraphy of the associated sediments as well as by strontium-isotope data directly obtained from the phosphates, the ages of the phosphogenic episodes on the Salento peninsula are less

* Corresponding author.

E-mail address: karl.foellmi@uni.ch (K.B. F ollmi).

well constrained. We therefore sampled three sections in this area, in order to better date the phosphatic levels and to reconstruct the mechanisms leading to phosphogenesis. Our data suggest that the Salento occurrences date from the Serravallian and Tortonian (late Middle and early Late Miocene), and were associated to an episode of profound deepening and the installation of pelagic conditions on the Salento platform. Through the likely upwelling of a westbound current system, a current-dominated depositional system was generated, which was favorable to phosphogenesis and glauconite precipitation.

2. Stratigraphy of the Salento Peninsula (southern Italy)

The phosphate- and glauconite-rich deposits of Miocene age studied here are preserved on the Salento Peninsula (Puglia, southern Italy; Fig. 1). The sediments of the Salento region are part of the eastern border of the Apulia platform, which is composed of Mesozoic to Cenozoic

platform carbonates (Bernoulli, 2001; Bosellini, 2002, 2004; and references therein). The outcrops studied include Baia del Ciolo, which is located along the eastern coastline close to Cagliano del Capo; an outcrop approximately 800 m north of Baia del Ciolo, in a road cut along the road to Gagliano del Capo, just before it bends into the main coastal road; an outcrop along the road between Marittima and Castro near the eastern coastline; and an outcrop in a quarry along the northern side of the road between Cursi and Melpignano (Fig. 1). Along the eastern coastline of Salento, Upper Oligocene and Upper Miocene platform-carbonate successions unconformably overly shallow-water carbonates of Cretaceous age, with the local intercalation of alveolinid- and nummulitid-rich limestones of Middle Eocene age and coral limestones of Late Eocene age (Bosellini and Parente, 1994; Parente, 1994; Bosellini et al., 1999). The Oligocene deposits comprise two units, both of Chattian age. The lower one is known as the Castro Limestone and is characterized by an abundant and high-diversity coral fauna associated with

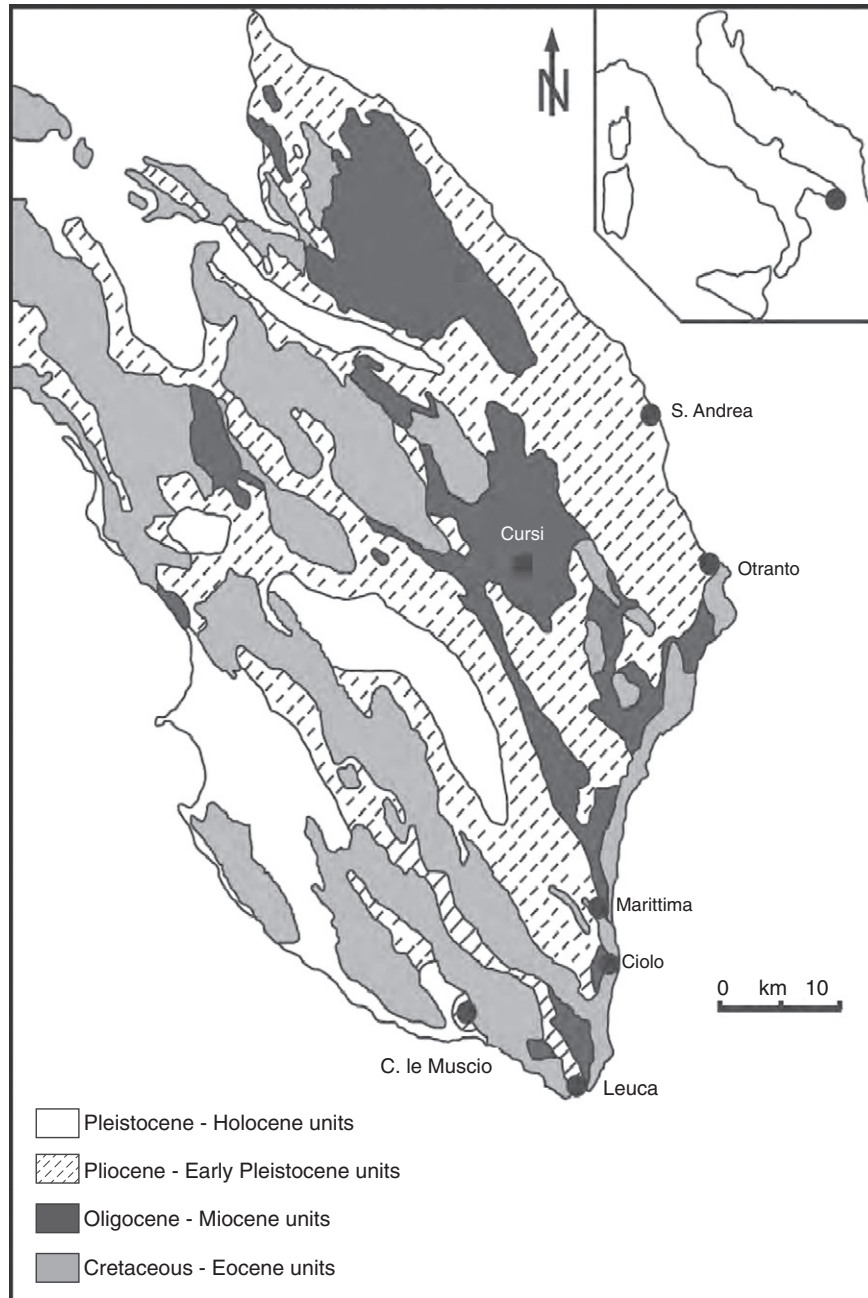


Fig. 1. Simplified geological map of southern Salento showing the investigated localities. Modified after (www.isprambiente.gov.it).

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