

E. MARSELLA ¹, G. PAPPONE ², B. D'ARGENIO ², G. CIPPITELLI ³ and A. W. BALLY ⁴

THE INTERNAL ORIGIN OF THE LAGONEGRO DOMAIN AND THE TECTONIC SETTING OF SOUTHERN APENNINES: A BRIEF OUTLINE

Abstract. During the past two decades most workers have accepted a paleogeographic model which places the Lagonegro Basin of the Southern Apennines in between the Campania-Lucania carbonate platform to the west and the Abruzzi-Campania platform to the east. Some also positioned further east a Molise basin that separated the Abruzzi-Campania platform from the Apulia platform. The authors re-examine the situation in the light of their field work of the last few years, recently published stratigraphic information, and the subsurface data released by oil companies. It is concluded that earlier interpretations which place the Lagonegro Basin farther west, i.e., in a relatively more internal position and to the west of the Campania-Lucania platform, are more likely to be correct.

The relative position of the Campania-Lucania Apennines pre-Miocene domains (see Fig. 1) has been deduced by studying the derived tectonic units, and an age of the base of the synorogenic silico-clastic succession, which is progressively more recent going from the inner areas of the chain to the outer ones, appears coherent (D'Argenio et al., 1973; Santo e Sgrosso, 1987; Pescatore, 1989; Sgrosso, 1981, 1992).

New data on tertiary silico-clastic deposits (Bonardi et al., 1985, 1992; Amore et al., 1992; Brancaccio e Cinque, 1992; Patacca and Scandone, 1989), which stratigraphically cover the tectonic units caused by the deformation of the Campania-Lucania Carbonate Platform domains and the Lagonegro Basin domain (Scandone, 1967, 1972, 1975; Wood, 1981; Miconnet, 1983; Marsella, 1988), lead us to reconsider the palinspastic relations between them.

On the basis of these data along with recently subsurface information released by oil company (Hill and Hayward, 1988; Mostardini e Merlini, 1988; Lentini et al., 1990; Casero et al., 1992), an internal origin is proposed for the Lagonegro Basin domain, instead of the accepted intermediate position between the Campania-Lucania Carbonate Platform domain and the more external Apulia Platform domains (Marsella et al., 1992).

In fact, the general "rejuvenation" of silico-clastic and carbonatic deposits, recently reported by many Authors (Bonardi et al., 1985, 1992; Amore et al., 1992; Brancaccio e Cinque 1992; Patacca and Scandone, 1989), at the tops of the respective units, is not apparent in the Lagonegro Units, which seem to have been deformed before the adjacent ones.

Moreover the Cilento Group Units of late Burdigalian-Langhian age (Ietto et al., 1965, 1983, 1985; Zuppetta et al., 1984; Bonardi et al., 1985, 1992; Amore et al., 1992) suture the tecto-

© Copyright 1994 by OGS, Osservatorio Geofisico Sperimentale. All rights reserved.

Manuscript received, December 22, 1992; accepted, September 10, 1993.

¹ Geomare Sud, Istituto di Geologia Marina del CNR, via Vespucci 9, 80142 Napoli, Italy.

² Dip. Scienze della Terra, Università Federico II, L.go San Marcellino 10, 80138 Napoli, Italy.

³ Via Jannozzi 38, S. Donato Milanese, Milano, Italy.

⁴ Department of Geology and Geophysics, Rice University, 6100 South Main Street, Houston, Tx 77005, U.S.A.

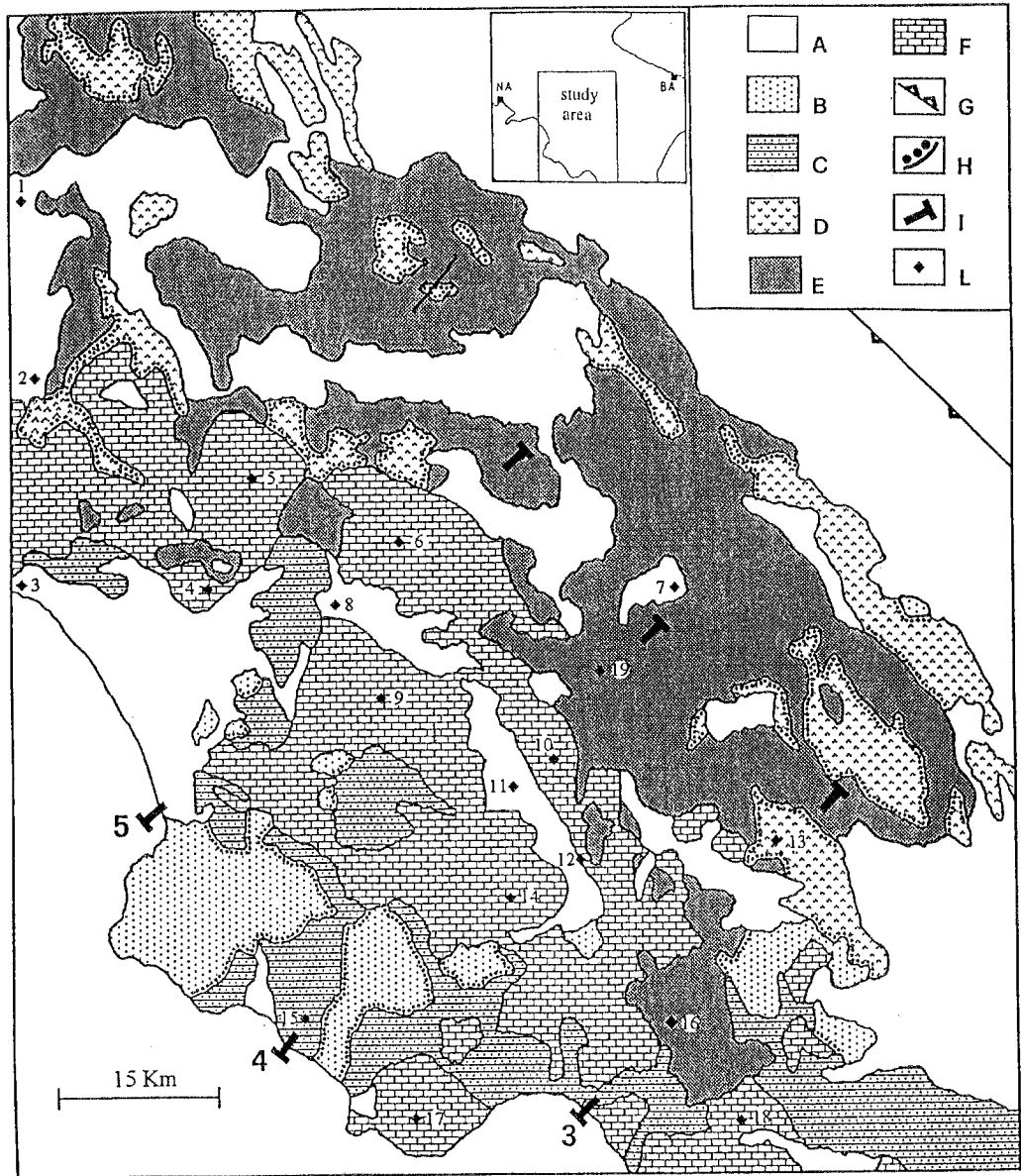


Fig. 1 - Schematic tectonic map of the Campania-Lucania Apennines with index of localities quoted in the text. *Legend:* A) alluvial, clastic and evaporitic deposits, Quaternary-Pliocene; B) silico-clastic deposits of Cilento Unit, Miocene; C) silico-clastic and carbonatic deposits of Liguridi Units, partly affected by low-grade metamorphism, Paleogene-Jurassic; D) silico-clastic and carbonatic deposits of Irpinian Units, Neogene; E) siliceous, marly and carbonatic deposits of Lagonegro Units, Miocene-Triassic; F) carbonatic deposits and resediments of tectonic units deriving from the deformation of Campania-Lucania Carbonate Platform Auct., Miocene-Triassic; G) eastern margin of the Apenninic chain; H) stratigraphic boundaries (dots indicate younger deposits); I) cross-sections of Fig. 2; L) Localities and deep boreholes quoted in the text: 1) Benevento; 2) Avellino; 3) Salerno; 4) Campagna tectonic window; 5) Monte Cervialto; 6) Monte Marzano; 7) Potenza; 8) Contursi 1 well; 9) Monti Alburni; 10) Monti della Maddalena; 11) Vallo di Diano; 12) Padula tectonic window; 13) Costa Molina well; 14) Monte Cervati; 15) Perdifumo well; 16) Lagonegro 1 well; 17) Monte Bulgheria; 18) Serra Rotonda-Monte la Spina; 19) Pignola 1 well.

nic contact between the Liguridi Units and Lagonegro Units. In turn, the Gorgoglione Flysch deposits (Irpinian Basin domain) (Pescatore, 1978; Pescatore e Tramutoli, 1980; Pescatore et al., 1992; Perrone e Sgrosso, 1982; Patacca and Scandone, 1989) of Tortonian age lay irregularly on the Cilento Group Units (Albidona formation) and on those stratigraphically higher portions of the Lagonegro Units which were at that time already deformed.

If we consider that the deformation age of the Campania-Lucania Carbonate Platform Units, outcropping west of the Lagonegro Units, ranges from Tortonian (Alburno Cervati Unit) to Late Tortonian (Monti della Maddalena - Monte Marzano Unit) (Santo e Sgrosso, 1987; Santo, 1988; Brancaccio e Cinque, 1992; Patacca and Scandone, 1989; Patacca et al., 1992), it does not seem possible to deduce that the Liguridi Units (of accepted internal origin) overlapped Lagonegro Units (of supposed external origin) since the Late Burdigalian-Langhian, skipping the Alburno Cervati and Monti della Maddalena - Monte Marzano Units (of supposed intermediate origin), taking in account that the latter will be deformed later on, in the Late Tortonian.

Along with information of a stratigraphic nature, we must keep in mind all data which suggest that, structurally, Lagonegro Units are above the Monti della Maddalena - Monte Marzano Unit (Marsella et al., 1992). We believe moreover that the latter unit should be extended so as to include the carbonatic structure of Serra Rotonda - Monte La Spina to the south, and the Monte Cervialto, to the north.

Carbonatic terrains which are found above the Lagonegro Units (Scandone et al., 1967; Turco, 1976; Marsella, 1988; Marsella et al., 1992; Bonardi et al., 1992; Carbone et al., 1992) are referred, in this paper, to the Alburno-Cervati Unit. The latter unit, therefore, is geometrically the highest in the chain, and overthrusts the Lagonegro Units after they had overlapped the platform domains, which today are represented by the Monti della Maddalena-Monte Marzano Unit.

Such overlapping goes back to the age of initial deposition of the Castelvetero Flysch which sutures the tectonic contact between Lagonegro Units and the Monti della Maddalena - Monte Marzano Unit in the Late Tortonian (?) - Early Messinian.

The present day front of this thrust (Alburno Cervati Unit above Lagonegro Units) corresponds to a belt of terrains, where the structures related to extensional tectonics are more common than in other areas of the Southern Apennines. We believe these two aspects are genetically related to one another (D'Argenio et al., 1987; Ferranti e Pappone, 1992; Marsella, 1988; Marsella et al., 1992).

With this structural outline in mind (see Fig. 2), the most convincing solution to a simple kinematic reconstruction is to accept a point of origin for the Lagonegro Units, west of those deriving from the Campania-Lucania Carbonate Platform (Selli, 1962; Scandone, 1967; D'Argenio, 1970; Marsella et al., 1992).

The convergence of stratigraphical and tectonic data which suggested such an interpretation allows us to postulate the following succession of events.

The Ligurid domain starts to be deformed during the late Burdigalian (oldest age in the Cilento Group Unit) and overthrusts the Lagonegro Domain in the Langhian.

Between the Langhian and the Tortonian, the Lagonegro-Liguride complex overthrusts inner portions of the Campania-Lucania Carbonate Platform and forms a sedimentation area for piggy-back type basins (Gorgoglione Flysch deposits).

In the Late Tortonian-Early Messinian (age of Castelvetero Flysch) the Lagonegro-Liguride thrust sheets already overlap the Monti della Maddalena-Monte Marzano Unit.

Between the Messinian and the Pliocene, the Liguridi-Lagonegro Units reach the outer front of the Bradano foredeep. In the same interval, some thrusting occurs and strongly develops in more internal areas as compared to the front of the chain. An episode of such thrusting is what brought the Alburno Cervati onto the Lagonegro Units.

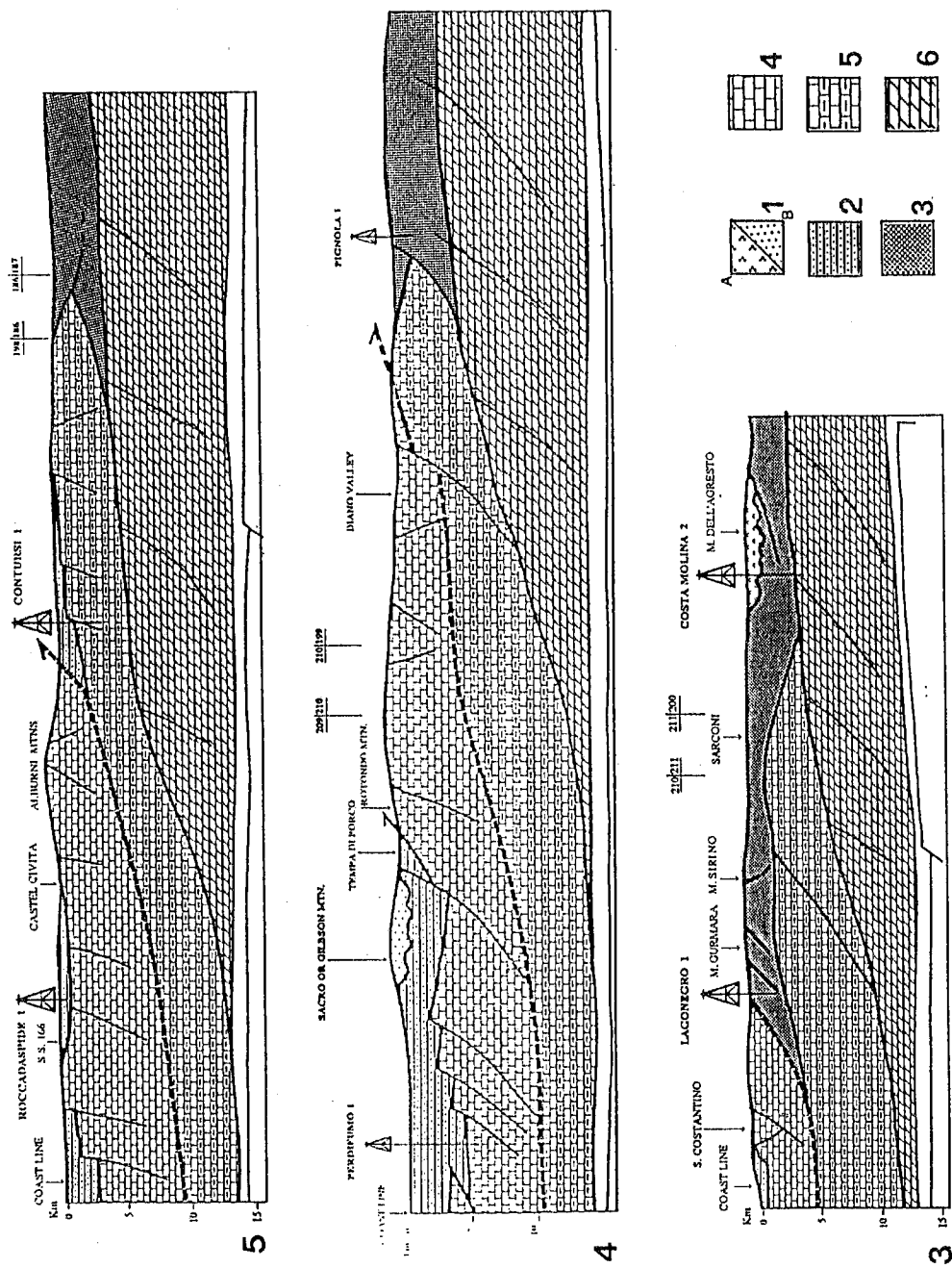


Fig. 2 - Schematic cross-sections of the discussed area, reinterpreted from Mostardini and Merlini (1988) on the basis of data discussed in the text and analyzed in Marsella et al. (1992); 1) Terrigenous unit, Neogene: a) Cilento unit, b) Irpine units; 2) Liguridi Units; 3) Lagonegro Units; 4) Alburno-Cervati Unit; 5) Monte la Spina-Monti della Maddalena-Monte Marzano Unit; 6) Apulia foreland. For location see Fig. 1.

REFERENCES

- Amore F.O., Bonardi G., Ciampo G., De Capoa P., Perrone V. e Sgrosso I.; 1992: *Relazioni tra "Flysch interni" e domini appenninici: reinterpretazione delle formazioni di Pollica, S. Mauro e Albidona e il problema dell'evoluzione inframiocenica delle zone esterne appenniniche*. Mem. Soc. Geol. It., **41**, 285-297.
- Bonardi G., Ciampo G. e Perrone V.; 1985: *La formazione di Albidona nell'Appennino Calabro Lucano: ulteriori dati biostratigrafici e relazione con le unità esterne appenniniche*. Boll. Soc. Geol. It., **104**, 539-549.
- Bonardi G., D'Argenio B. e Perrone V. (eds); 1992: *Carta geologica dell'Appennino meridionale*. 74° Congresso della Società Geologica Italiana, Sorrento 13-17 settembre 1988.
- Bonardi G., Amore F.O., Ciampo G., De Capoa P., Miconnet P. e Perrone V.; 1992: *Il complesso liguride Auct.: stato delle conoscenze e problemi aperti sulla sua evoluzione pre-appenninica ed i suoi rapporti con l'arco calabro*. Mem. Soc. Geol. It., **41**, 17-35.
- Brancaccio L. e Cinque A.; 1992: *Escursione nell'Appennino campano-lucano*. In: *Convegno-Escursione su Evoluzione Geomorfologica e tettonica quaternaria dell'Appennino centro meridionale*, Napoli, 52 pp..
- Carbone S., Catalano S., Lentini F. e Monaco C.; 1992: *Le unità stratigrafico-strutturali della alta Val d'Agri (Appennino Lucano) nel quadro dell'evoluzione del sistema catena avanfossa*. Mem. Soc. Geol. It., **41**, 331-341.
- Casero P., Roure F., Endignoux L., Moretti I., Muller C., Sage L. and Vially R.; 1992: *Neogene geodynamic evolution of the southern Apennines*. Mem. Soc. Geol. It., **41**, 109-120.
- D'Argenio B., Pescatore T., Scandone P.; 1973: *Schema geologico dell'Appennino meridionale (Campania e Lucania)*. In: *Atti del Convegno: Moderne vedute sulla geologia dell'Appennino*. Acc. Naz. Lincei, Quad., **183**, 49-72.
- D'Argenio B., Ietto A. and Oldow J.; 1987: *Low angle normal faults in the Picentini Mountains (Southern Italy)*. Rend. Soc. Geol. Ital., **9**, 113-125.
- Ferranti L. e Pappone G.; 1992: *Nuovi dati sui rapporti tettonici tra i Terreni Lagonegresi e quelli della Piattaforma Carbonatica Campano Lucana nei dintorni di Campagna (Salerno - Appennino meridionale)*. Rend. Acc. Scien. Fis. e Mat., Napoli, **4**, 103-119.
- Hill K.C. and Hayward A.B.; 1988: *Structural constraints on the Tertiary plate tectonic evolution of Italy*. Marine and Petroleum Geology, **5**, 2-15.
- Ietto A., Pescatore T. e Cocco E.; 1965: *Il Flysch mesozoico terziario del Cilento occidentale*. Boll. Soc. Natur. in Napoli, **74**, 396-402.
- Ietto A., Gianni A. and Pappone G.; 1983: *Cilento flysch nappes, Southern Apennines*. Tectonic and paleogeographic interpretation. Terra Cognita, **3**, 248-249.
- Ietto A., Calcaterra D., Del Re M.C., Gianni A. e Pappone G.; 1985: *Il Flysch del Cilento nella Catena Appenninica*. Sci. Geol. Bull., **37**, 107-118.
- Lentini F., Carbone S., Catalano S. e Monaco C.; 1990: *Tettonica a thrust neogenica nella Catena Appenninico-Maghrebide: esempi dalla Lucania e dalla Sicilia*. Studi Geol. Camerti, *spec. vol.*, 19-26.
- Marsella E., Pappone G., D'Argenio B., Cippitelli G. e Bally A.W.; 1992: *L'origine interna dei terreni lagonegresi e l'assetto tettonico dell'Appennino meridionale*. Rend. Acc. Sci. Fis. Nat., Napoli, **59**, 73-101.
- Marsella E.; 1988: *I terreni lagonegresi tra S. Fele e l'alta Val d'Agri. Evoluzione tettonico sedimentaria (Trias superiore-Giurassico)*. Tesi di Dottorato in Geologia del Sedimentario, Università Napoli, 159 pp.
- Miconnet P.; 1983: *La region de Lagonegro (Italie Meridionale): evolution géologique d'un bassin dans sons cadre alpin*. These 3e cycle, Univ. Science et Techniques de Lille, n. 1033.
- Mostardini F. e Merlini S.; 1988: *Appennino centro-meridionale: sezioni geologiche e proposta di modello strutturale*. Mem. Soc. Geol. It., **35**, 177-202.
- Patacca E. and Scandone P.; 1989: *Post-Tortonian mountain building in the Apennines. The role of the passive sinking of a relic lithospheric slab*. In: Boriani A., Bonafede M., Piccardo G.B. and Vai G.B. (eds), *The lithosphere in Italy, Advances in Earth Science Research*. It. Nat. Comm. Int. Lith. Progr., Mid-term Conf. (Rome, 5-6 May 1987), Atti Conv. Lincei, **80**, pp. 157-176.
- Patacca E., Scandone P., Bellatalla M., Perilli N. and Santini U.; 1992: *The numidian-sand event in the southern Apennines*. Mem. Soc. Geol. It., **43**, 296-337.
- Perrone V. e Sgrosso I.; 1982: *Il bacino pre-irpino: un nuovo dominio paleogeografico miocenico dell'Appennino meridionale*. Rend. Soc. Geol. It., **4**, 365-368.
- Pescatore T.; 1978: *Evoluzione tettonica del bacino Irpini (Italia Meridionale) durante il Miocene*. Boll. Soc. Geol. It., **97**, 783-805.
- Pescatore T. e Tramutoli M.; 1980: *I rapporti tra i depositi del bacino di Lagonegro e del bacino Irpino nella media valle del Basento*. Rend. Acc. Sci. Fis. e Mat. Napoli, **47**, 19-41.
- Pescatore T.; 1989: *La sedimentazione miocenica nell'Appennino campano-lucano*. Rend. Acc. Sci. Fis. e Mat., ser. IV, **55**, 85-106.
- Pescatore T.S., Renda P. e Tramutoli M.; 1992: *Rapporti tra le Unità Lagonegresi e le Unità Sicilidi nella media Valle del Basento*. Mem. Soc. Geol. It., **41**, 353-361.
- Santo A.; 1988: *Ricerche sul terziario dei M. Alburni (Campania)*. In: *Atti 74° cong. Soc. Geol. Ital.*, A-481 A-485, Sorrento.
- Santo A. e Sgrosso I.; 1987: *Alcune precisazioni sulle "trasgressioni" mioceniche nell'Appennino meridionale*. Mem. Soc. Geol. It., **38**, 225-240.

- Scandone P.; 1967: *Studi di geologia lucana: la serie calcareo-silico-marnosa e i suoi rapporti con l'Appennino calcareo*. Boll. Soc. Natur. in Napoli, **76**, 1-175.
- Scandone P.; 1972: *Studi di geologia lucana: nota illustrativa della carta dei terreni della serie calcareo-silico-marnosa*. Boll. Soc. Natur. in Napoli, **81**, 225-300.
- Scandone P.; 1975: *The preorogenic history of the Lagonegro basin (southern Apennines)*. In: Squyres C. (ed), *Geology of Italy*, Earth Science Soc. Libyan, Tripoli, pp. 305-315.
- Selli R.; 1962: *Il Paleogene nel quadro della geologia dell'Italia centro-meridionale*. Mem. Soc. Geol. It., **3**, 737-789.
- Sgrosso I.; 1981: *Il significato delle calciruditi di Piaggine nell'ambito degli eventi del Miocene inferiore nell'Appennino campano-lucano*. Boll. Soc. Geol. It., **100**, 129-137.
- Sgrosso I.; 1992: *Nuovi dati biostratigrafici sul Miocene del M. Alpi (Lucania) e conseguenti ipotesi paleogeografiche*. Mem. Soc. Geol. It., **41**, 343-351.
- Wood A.W.; 1981: *Extensional tectonics and birth of the Lagonegro basin*. N. Jb. Geol. Palaont. Abb., **161**, 93-131.
- Zuppetta A., Russo M., Turco E. e Gallo L.; 1984: *Età e significato della Formazione di Albidona in Appennino meridionale*. Boll. Soc. Geol. It., **103**, 159-170.