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Volcanic events in the Eastern part of the Adriatic foreland (Northern Marchean Italy)

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ABSTRACT

Key words: Apennine chain; Marchean basin; volcanoclastic episodes.

In the Late Miocene sequence of the Pesaro-Gabicce cliff (external Marchean basin) two volcanoclastic events of regional relevance have been discovered.

The first important volcano-tectonic event occurred during the Tortonian/Messinian boundary (*Schlier/Euxinic-Pelites* Fms). It is characterized by volcano-derivated deposits, mainly constituted by the abundance of biotite, sanidine, andesine with smaller amounts of augite. The clayey minerals are mainly dominated by crystalline smectite accompanied by minor amounts of illite-smectite, illite, chlorite and vermiculite.

Piroclastic flow horizons intercalated within the turbiditic sequence of the *S. Donato* Fm (Upper Messinian) characterize the second volcanoclastic event of the sedimentary succession of the eastern Adriatic foreland basin. This event is connected with explosive acid volcanic activity (rhyolithic composition) probably located in the North Adriatic Foredeep.

Such volcanic events are probably correlated with similar lithologies outcropping in the Atlantic and Mediterranean areas (see Betic Cordillera).

The presence of global volcanic events offers new data on the geodynamic evolution of the sedimentary basins during Neogene.

INTRODUCTION

Volcanoclastic events are intercalated within neogenic sedimentary sequences. Their presence has been found in several zones of the Apennine and Mediterranean areas (Wezel,1977; Beccaluva, 1983; Lorenz, 1984; Perrone, 1987; Sartori, 1989; Guerrera & Veneri, 1989; Ardanese & Capuano,1990; Serri, 1990).

In this paper the volcanic sediments are described and discussed from the petrographic and geological point of view.

Along the Gabicce-Pesaro cliff two volcanoclastic episodes of regional relevance have been discovered (Fig. 1)(Capuano & D'Antonio,1992). They are interbedded within the latest Messinian sequence and close to the Tortonian/Messinian boundary (Figs. 2 and 3); these volcanoclastic episodes are considered to be important evidence of magmatic-tectonic events which have influenced the geodynamic evolution of basin during the Neogene. These events could probably be correlated with other different episodes of the Atlantic area (Eldholm,1990).

COMPOSITIONAL CHARACTER AND CONSIDERATIONS

The Tortonian/Messinian boundary (*Schlier/Euxinic-Pelites* Fms) is emphasized by a interval of volcanic-derived products rich in mm-sized biotite crystals with lateral continuity over 6 Km. It represents a guide level [named Livello Rossini (Gioacchino Rossini, composer, 1792-1868) by Coccioni *et al.*,1992] of variable thickness (Figs. 1 and 2).

XR diffrattometric data showing a primary composition formed by calcite, dolomite, quartz alpha (from detritic provenance minerals), biotite, sanidine, andesine, augite (from volcanic provenance minerals), kaolinite, smectite, illite,illite-smectite, chlorite, vermiculite (from alteration

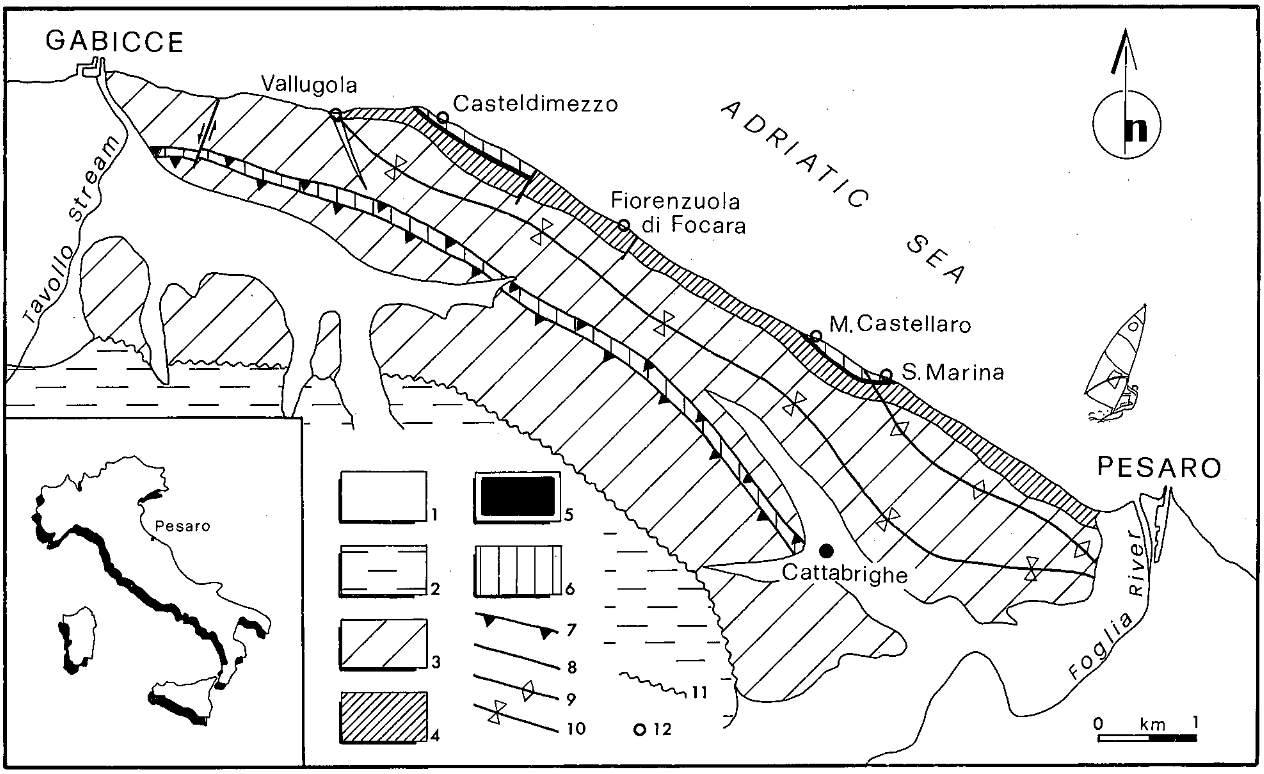

Fig. 1 — Geological sketch map of the Gabicce-Pesaro coastal ridge. 1 - terraced alluvial deposits (Pleistocene-Holocene); 2 - marls and sandstones (Lower Pliocene); 3 - Colombacci Fm. (Upper Messinian); 4 - S.Donato Fm. with pyroclastic deposits (Upper Messinian); 5 - Euxinic-Pelites Fm. (Lower Messinian) and Gessoso-solfifera Fm. (Middle Messinian ?); 6 - Schlier Fm. with volcanic products (Upper Tortonian); 7 - thrust; 8 - faults; 9 - anticline axis; 10 - syncline axis; 11 - marine pliocenic transgression; 12 - location of the sections studied.

minerals). A high level of smectite crystallinity index suggests a genesis connected to rapid transformation of volcanic products (Morandi, 1990). This mineralogical data testified that the volcanoclastic sedimentation occurred during an important tectonic phase. The depositional process in the basin of the volcanic-derivated sediments still appears problematic (Wright & Mutti, 1981).

Similar volcanogenic biotite-rich layers have been found beneath the well-known evaporite Vena del Gesso sequence, Northern Apennines, Romagna, Italy (Vai *et al.*, 1992)

Late Miocene volcanoclastic events connected with the magmatic-tectonic activity cycles are underlines both in the Eastern Betic Cordillera (Serrano, 1990) and in the North Atlantic basins (Eldholm, 1990).

Pyroclastic sediments are interbedded in the arenaceous-pelitic facies of *S. Donato* Fm (Figs. 4 and 5). The internal structure of pyroclastic deposits are normal grading and continue laminations.

The main pyroclastic component is represented by very clear and well-preserved glass shards (44%). It is characterized by typical morphology: curved, tabular, and Y-shaped, or elongated pumice fibrous and spheroidal vesicles (Fig. 6). Average 37% interstitial component is formed by 2/3 of fine vitric shards and 1/3 of very fine-grained calcite. The phenocrysts are rarely represented but display an excellent degree of freshness and preservation; zoned plagioclase is most representative (Fig. 7). The quartz (2%) is represented by monocrystalline grains; chalcedony spherulites are rarely present. The lithic rock fragments are mainly constituted by volcanic clast and chert (Table 1). Texture and composition are derived from explosive volcanic activity contemporaneous to sedimentation. This fact could be considered to be evidence of geodynamic activity. These pyroclastic sediments are related to ones documented in the external marchean basin (Guerrera *et al.*, 1986); composition, grain-size distribution and thickness allow me to hypothesize the uniqueness of this volcanic event throughout the Marchean basin. The existence of considerable grain-size variation from average 800 μm (northern marchean basin) to average 100 μm (southern marchean basin) proves that the bacinal area of Gabicce-Pesaro was nearer to explosive centres (Fig. 8). These products were distributed in periods of intense volcanic activity. Periods of greater volcanic activity shoud be related to important magmatic-tectonic events in the Mediterranean and Atlantic areas.

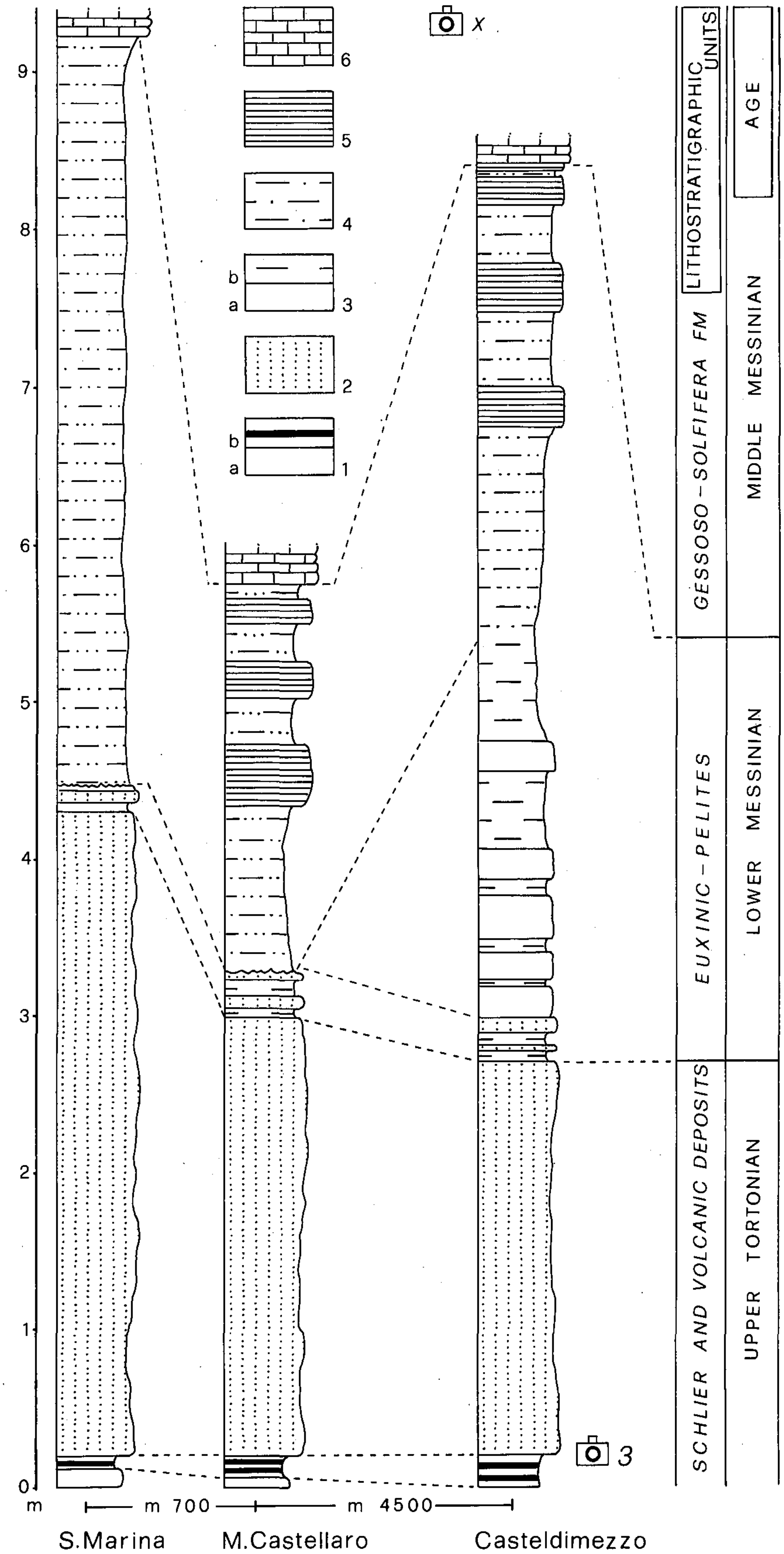

Fig. 2 — Lithostratigraphic correlation of the Tortonian/Messinian boundary. 1 - silty marls (a) and anossic pelites (b); 2 - volcanic deposits; 3 - bioturbated (a) and bituminous (b) marls; 4 - tripolaceous marls; 5 - finely laminated diatomites; 6 - stromatolithic carbonates.

Fig. 3 — Casteldimezzo area. Lithostratigraphic transition from the Schlier Fm. (1) to the volcanic deposits (2 and 3).

SIGNIFICANCE AND PROVENANCE OF THE VOLCANIC DEPOSITS

Late Miocene volcanoclastic episodes represented an important "key" for the palaeogeographical reconstruction and geodynamic evolution of Mediterranean and, maybe, Atlantic areas.

The areal and vertical extension of volcanic sediments implied interaction processes between volcanic activity and depositional environment in an orogenic system or active continental margins.

The volcanoclastic sediments at Tortonian/Messinian boundary are little-known and their origin is an enigma. In the marchean basin the volcanic products that marked the Tortonian/Messinian boundary show a mineralogical assemblage typical of shoshonitic magmatism probably connected to phases of related subduction. The origin from calc- alkaline and/or alkaline-potassium magmas connected to migration Apenninic orogen during Neogene seems a plausible hypothesis. Recently, the orogenic volcanism with shoshonitic or alkaline-potassium composition is identified in Stromboli and Volcano Island (Savelli, 1984; Beccaluva *et al.*, 1985).

Recent radiometric dates from Livello Rossini, entirely included within the *Globorotalia suterae* Subzone (Iaccarino, 1985), give the value 6.83 My (Coccioni *et al.*, 1992).

The pyroclastic levels interbedded in the latest Messinian sequence show a large lateral extension but little vertically; they consist of materials of mainly rhyolithic composition (Guerrera *et al.*,1986).

The volcanic source was geographically located probably near to North Marchean Adriatic Foredeep where tectonic and endogenous mechanism were acting during the Messinian times. The Adriatic plate was probably subducted under the Apenninic Zone during the Neogene.

In view of the widespread occurrences of the pyroclastics and their relationship to the Mediterranean area and Atlantic volcanic margin, I prefer to assign the pyroclastic events to individual eruptive centers located along the basin itself.

CONCLUSION

In the late Miocene sequence of the outer marchean basin two volcanic levels of regional rilevance have been discovered.

The first (guide levels Rossini) underlines the Tortonian/Messinian boundary; it is constituted by biotite, sanidine, andesine, augite and smectite. This mineralogical association suggests their origin is from orogenic volcanism (shoshonitic or alkaline-potassium magmas).

The existence of pyroclastic flows (Upper Messinian, in age) prove the presence, at the same time as the sedimentation, of intense explosive volcanic activity. Grain-size distribution and thickness show that the coastal ridge of Gabicce-Pesaro was nearer to active calc-alkaline magmatic system.

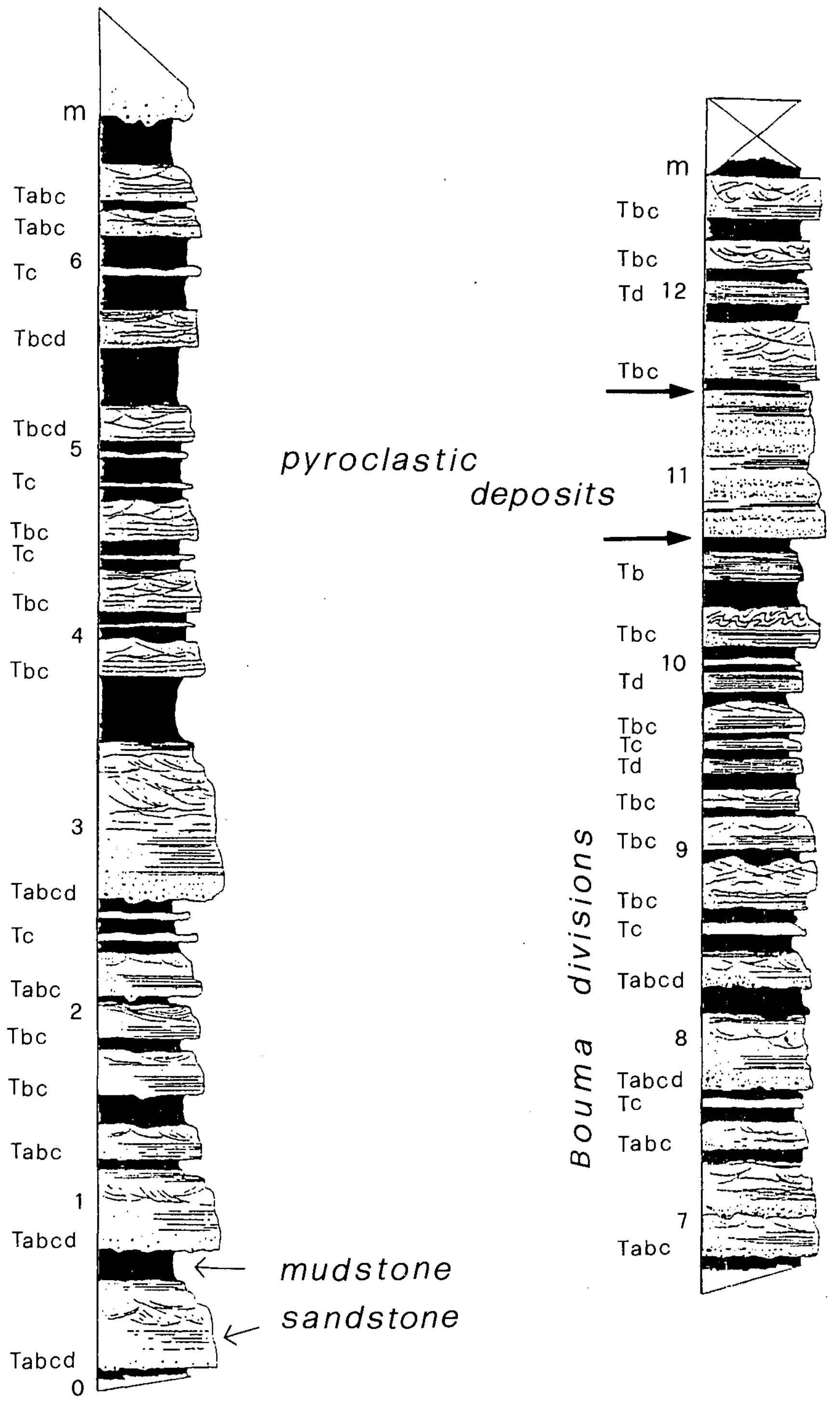

Fig. 4 — Pyroclastic deposits in the turbidite sequence (i.e. S. Donato Fm.).

Fig. 5 — S. Marina area. Arenaceous-pelitic facies of the S. Donato Fm.
The arrow indicate the intrastratified pyroclastic horizon.

Fig. 6 — Some examples of pumice fibrous and spheroidal vesicles (photomicrograph take with parallel nicols).

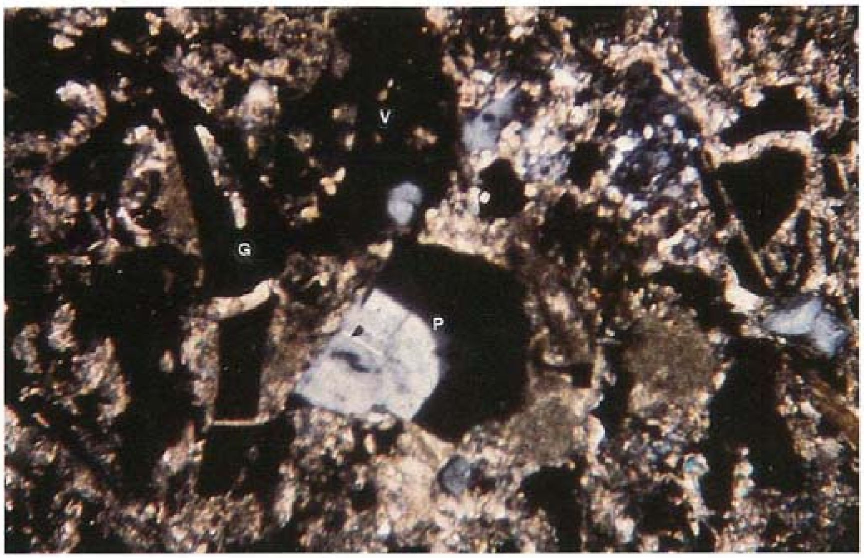

Fig. 7 — Some examples of volcanic glass fragments (G) and zoned plagioclase grain (P) constituting pyroclastic flows of the turbidite sequence of S. Donato Fm. V - volcanite lithic frg. (0.35 mm long).

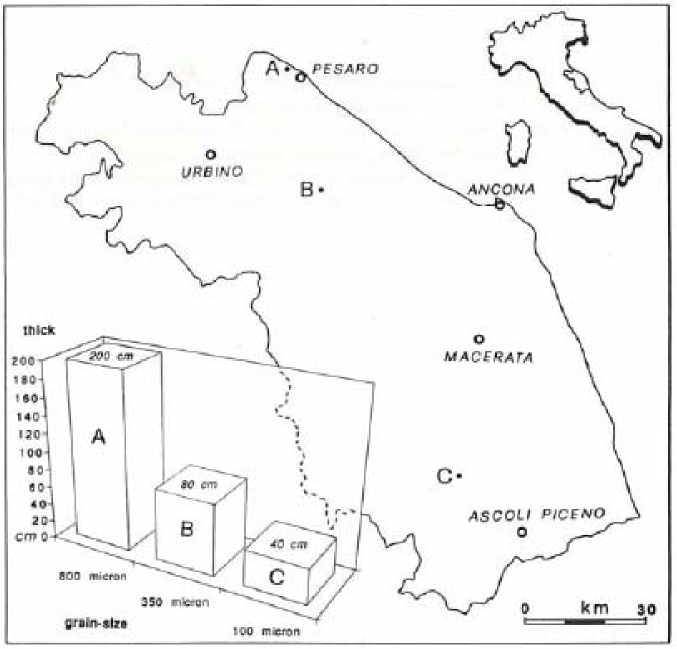

Fig. 8 — Geographical setting of the Marche Region; the histogram showing thickness and grain-size distribution of the pyroclastic event, Upper Messinian in age, present in the S. Donato Fm. A - proximal area (nearer to explosive centres); B - proximal-intermediate area; C- distal area.

		X
Vrf	Volcanic rock fragments	1.87
Srf	Sedimentary rock fgm (chert)	0.20
Mf	Biotite	1.60
Qm	Quartz monocrystalline grains	1.72
Qp	Quartz polycrystalline grains	0.32
Vg	Volcanic glass shards	19.62
Pf	Fibrous pumice	15.73
Pc	Cellular pumice (spheroidal vesicles)	3.40
F	K-feldspar	1.06
	Plagioclase	2.29
Bi	Bioclasts	0.20
Ox	Iron oxides and opaque minerals	2.26
Cmc	Cement (calcite spar)	6.40
Crv	Calcite replacement of volcanic glass	5.80
Mtv	Vitrous matrix	24.99
Mtc	Carbonate matrix	12.54
	Total	100.00

Table 1 — Main mineralogical composition of intercalated pyroclastite in the S. Donato Fm; x = arithmetic mean samples.

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