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# Petrofacies and petrologic characteristics of lower-middle Miocene sandstones of southern Calabria

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ABSTRACT. — The Stilo - Capo d'Orlando Formation is a Miocene sedimentary unit cropping out exclusively along the southern sector of the Calabria-Peloritani Arc (southernmost Calabria and Sicily). It is composed of conglomerate, sandstone and mudrock mostly deposited in a deep-marine environment.

Sandstones of the Stilo - Capo d'Orlando Fm are arkoses (i.e., quartz-feldspars-rich arenites). Average sandstone is composed of 45% quartz, 48% feldspars and 7% lithic fragments (recalculated to QFL percentages). Provenance was primarily from granitoid plutonic rocks and low-to-medium-grade metamorphic rocks. Most common aphanitic lithic fragments are phyllites; schists and a few volcanic lithics are also present. Locally, extrabasinal carbonate lithic fragments may represent a significant detrital component.

Point-count data document a direct correlation between detrital modes of Stilo - Capo d'Orlando Fm sandstones and present basement lithologies. Two different petrofacies are present. The northen petrofacies (Stilo and Allaro stratigraphic sections) has a predominantly plutoniclastic composition and was derived from the Serre massif, located directly to the west of the study area and mostly composed of Hercynian granitoid plutons. The southern petrofacies (Amendolea section) has metamorphiclastic composition and was derived from the Aspromonte massif, located directly to the north of the study area and mainly composed of middle-to-high-grade metamorphic rocks. These data indicate direct provenance of the Stilo - Capo d'Orlando Fm from the same rock types presently cropping out as the «geologic backbone» of the southern sector of the Calabria-Peloritani Arc. No exotic provenance has been documented.

*Key-words:* Calabria-Peloritani Arc. Stilo - Capo d'Orlando Formation, sandstone, petrofacies, point counting.

RIASSUNTO. — La Formazione di Stilo - Capo d'Orlando è un'unità sedimentaria di età miocenica affiorante lungo il settore meridionale dell'Arco calabro-peloritano (Calabria meridionale e Sicilia). Essa è composta da conglomerati, arenarie e peliti depositatisi prevalentemente in ambiente marino profondo.

Le arenarie della Formazione di Stilo - Capo d'Orlando sono classificabili come arkose (cioè areniti quarzo-feldspatiche). Esse sono composte mediamente da 45% quarzo, 48% feldspati e 7% frammenti litici (percentuali ricalcolate sulla somma QFL). La provenienza è principalmente da rocce plutoniche granitoidi e da metamorfiti di grado variabile da basso a medio. I frammenti litici afanitici più comuni sono di filladi; scisti e vulcaniti sono molto meno comuni. Localmente, i frammenti litici carbonatici extrabacinali possono essere una componente detritica quantitativamente significativa.

I risultati del conteggio dei punti documentano un legame diretto fra le mode detritiche delle arenarie della Formazione di Stilo - Capo d'Orlando e le litologie del basamento affiorante attualmente. Sono presenti due differenti petrofacies arenacee. La petrofacies settentrionale (corrispondente alle sezioni stratigrafiche Stilo e Allaro) ha composizione principalmente plutonoclastica ed è derivata dall'erosione delle Serre, situate immediatamente ad ovest dell'area studiata e prevalentemente composte da plutoniti erciniche di composizione granitoide. La petrofacies meridionale (sezione Amendolea) ha composizione metamorfoclastica ed è derivata dall'Aspromonte, situato immediatamente a nord dell'area studiata e prevalentemente composto da metamorfiti di grado medio-alto. Questi dati indicano una provenienza diretta e locale della Formazione di Stilo - Capo d'Orlando dagli stessi litotipi che formano attualmente la struttura portante del settore meridionale dell'Arco calabro-peloritano. Contributi clastici esotici non sono stati documentati.

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*Parole chiave*: Arco calabro-peloritano, Formazione di Stilo - Capo d'Orlando, arenaria, petrofacies, conteggio dei punti.

## Introduction

The Calabria-Peloritani Arc (CPA) is a foreing element in the Apennic-Maghrebian which subsequently completely overthrust the Apennines-Maghrebides orogen.

The CPA may be divided into two sectors (BONARDI et al., 1979). Several arguments seem to point out different geologic histories for the two sectors of the CPA. In fact, most of the rock units present in the northern sector are strictly comparable to the eo-Alpine units of the Western Alps and northeastern

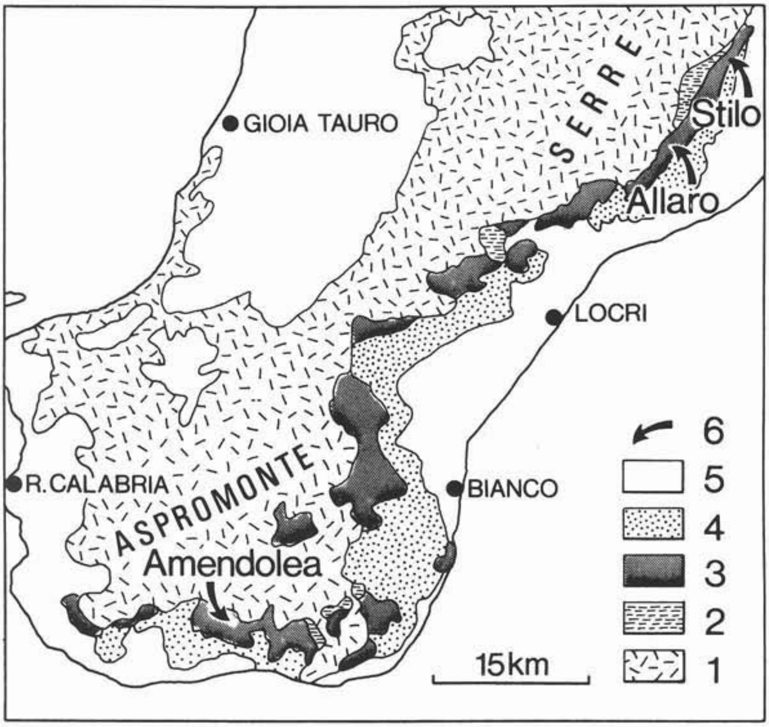


Fig. 1. — Simplified geologic map of southern Calabria (modified from BONARDI et al., 1981). Legend: 1) basement rocks of Aspromonte and Serre; 2) Mesozoic sedimentary cover; 3) Stilo - Capo d'Orlando Formation; 4) «argille varicolori»; 5) younger sedimentary deposits (middle Miocene to Holocene); 6) locations of studied sections.

scenario. The Apennines and Maghrebides are two distinct segments of the Neogene Africa-verging chain mostly composed of decollement nappes made up of Mesozoic and Tertiary sedimentary rocks. The CPA, on the contrary, mainly consists of pre-Triassic crystalline rocks partly affected by Alpine metamorphism. There exists general agreement among authors (ALVAREZ et al., 1974; AMODIO-MORELLI et al., 1976; SCANDONE , 1982) that at least part of the CPA is a fragment of the Cretaceous-Paleogene, Europe-verging Alpine chain, Corsica (AMODIO-MORELLI et al., 1976; SCANDONE, 1980), whereas the rock units of the southern sector have been hardly affected by Alpine metamorphism. Ophiolite-bearing nappes are present only in the northern sector. Furthermore, the southern sector (southern Calabria and Peloritani Mountains of Sicily) was a single continuous belt starting at least from latest Oligocene time (BONARDI et al., 1981). In fact, all crystalline units are stratigraphically overlain by the same lower-middle Miocene sedimentary unit: the Stilo

- Capo d'Orlando Formation, the subject of this paper, which is significantly absent in the northern sector of the CPA.

## The Stilo - Capo d'Orlando Formation

The Stilo - Capo d'Orlando Formation (SCO Fm) is a clastic unit composed of conglomerate, sandstone and mudrock deposited in a deep-marine environment. It crops out as a virtually continuous belt along the eastern and southern coasts of southern Calabria (Fig. 1). Is is also present in Sicily along a wide belt crossing the northeastern corner of the island with WNW-ESE trend. Maximum thickness of the SCO Fm is about 700 m. The age is late Aquitanian - Langhian, based on planktonic foraminifera and nannoplankton (Bonardi et al., 1981).

The lower boundary is a nonconformity separating the SCO Fm from the basement rocks of the southern sector of the CPA. In a few places, the SCO Fm overlies the Palizzi Formation (lower Oligocene), a very thin, shallow-marine sedimentary deposit (Bouillin et al., 1985). The basement is composed of low-to-high-grade metamorphic rocks intruded by granitoid plutons of Hercynian age, both locally covered by a thin and discontinuous veneer of Mesozoic carbonates. The SCO Fm is overlain by a chaotic terrain of Cretaceous-Paleogene age, which has been informally named «argille varicolori» by Amodio-Morelli et al. (1976). The «argille varicolori» are absent in the northern sector of the Calabria-Peloritani Arc.

Bonardi et al. (1981) established the name «Formazione di Stilo - Capo d'Orlando» and described several of its best outcrops in Calabria and in Sicily. That paper reorganized the confusing stratigraphic nomenclature previously used, and represented a starting point for subsequent research. Nevertheless, in spite of the excellent outcropping conditions of the SCO Fm, very little research has been done on this unit. Ferla and Alaimo (1976) studied the petrology of the conglomerate clasts in the Peloritani Mountains of northeastern Sicily. Carmisciano and Puglisi (1978, 1982) defined sandstone detrital modes and attempted a broad facies analysis in the same area. Sedimentary facies analyses and petrologic studies of the SCO Fm in Calabria are lacking. The purpose of this study is to assess sandstone compositional parameters of this significant unit in Calabria, in order to reconstruct provenance. This contribution is part of a larger project aimed at the sedimentologic-petrologic characterization of the SCO Fm (and to its eventual structural/geodynamic implications) over its entire outcropping area (Calabria and Sicily).

## Methods

Thirty-two sandstone samples were selected throughout the stratigraphic thickness of the SCO Fm along three stratigraphic sections whose locations are shown in Fig. 1. Studied sections represent the best outcrops of the SCO Fm in Calabria. Thin sections were cut perpendicular to bedding and stained for both calcium plagioclase and potassium feldspar.

Sandstone point counts were preceded by inspection of the basement rocks of the Calabria-Peloritani Arc. Over sixty basement samples of different lithologies were taken and examined in thin section, in order to be able to eventually recognize them as lithic fragments within the SCO Fm sandstones. In addition, about thirty SCO Fm conglomerate clast of various rocks types were thin-sectioned and examined for the same reason.

Sandstone point counts were performed following the procedures independently proposed by Gazzi (1966) and Dickinson (1970), and discussed by Gazzi et al. (1973) and Ingersoll et al. (1984). The peculiarity of the Gazzi-Dickinson point-counting method is that monomineralic crystals and other polymineralic grains of sand size (>.0625 mm) that occur within larger rock fragments are assigned to the category of the crystal or other grain, rather than to the category of the larger rock fragment. In this way, the effect of grain-size variations on sand/sandstone composition is minimized (Ingersoll et al., 1984). Unsorted samples of any sand size may be used for modal analysis, eliminating the need for sieving and

TABLE 1

*Explanation of petrographic parameters for Table 2 and Figures 2 and 3*

| | | | |
|---|---|---|---|
| Q = Qm + Qp | where | Q | = total quartzose grains |
| | | Qm | = monocrystalline quartz grains |
| | | Qp | = polycrystalline quartz grains |
| F = P + K | where | F | = total feldspar grains |
| | | P | = plagioclase feldspar grains |
| | | K | = potassium feldspar grains |
| Lt = L + Qp | where | Lt | = total aphanitic lithic grains |
| | | L | = total unstable aphanitic lithic grains |
| L = Lm + Lv + Ls | where | Lm | = metamorphic aphanitic lithic grains |
| | | Lv | = volcanic-hypabyssal aphanitic lithic grains |
| | | Ls | = sedimentary aphanitic lithic grains |
| L = Lvm + Lsm | where | Lvm | = volcanic-hypabyssal and metavolcanic aphanitic lithic grains |
| | | Lsm | = sedimentary and metasedimentary aphanitic lithic grains |
| Framework = Q + F + L + M + Mc | where | M | = monocrystalline phyllosilicate grains |
| | | Mc | = miscellaneous and unidentified framework grains |

multiple counts of different size fractions. Furthermore, use of the Gazzi-Dickinson method of point counting facilitates the application of actualistic petrologic models relating detrital composition to tectonic setting because it allows direct comparison between modern sands and poorly sorted ancient sandstones.

For each thin section, 500 points were counted, using the maximum grid spacing that resulted in coverage of the entire slide. All of the point-counted thin sections do not show evidence of quantitatively significant diagenetic replacement of framework grains, and virtually all grains were recognized with certainty. Therefore, 500 counts per section provided statistically significant values for all parameters (VAN DER PLAS and TOBI, 1965). Criteria used for distinguishing lithic types, matrix types and other components of samples are those of DICKINSON (1970) and GRAHAM et al. (1976). Point counts were perfomed with sample locations ad ages unknown to avoid bias.

## Petrologic results

Point-counted grains were originally classified according to twenty-nine categories. Point-count data were then recalculated to produce the grain parameters indicated in Table 1. The resulting modes appear in Table 2. Four types of triangular plots were constructed from these data (Figs. 2 and 3). Means and standard deviations listed in Table 2 and plotted on Figs. 2 and 3 are not

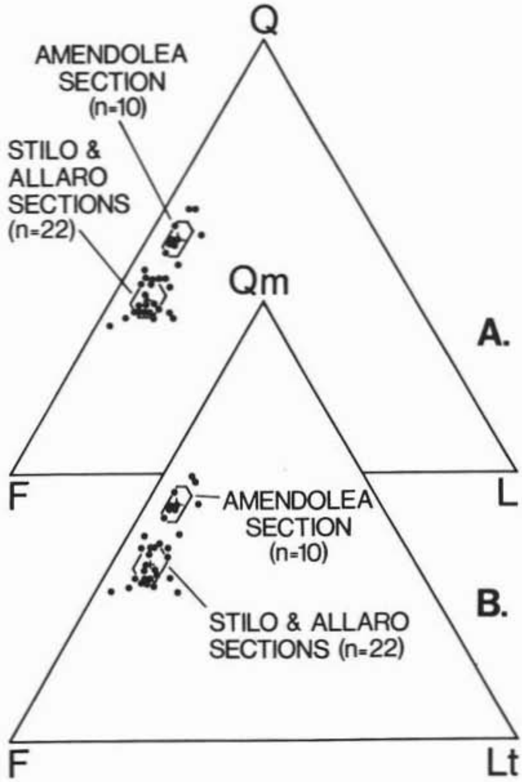


Fig. 2. — QFL and QmFLt ternary diagrams showing compositions of Stilo Capo d'Orlando sandstones in southern Calabria. See Table 1 for explanation of symbols. For both diagrams, crosses and polygons represent means and standard deviations of the sample population, n indicates number of samples. See text for a discussion of data distribution.

statistically rigorous values because the data sets are constant-sum and constrained. Nevertheless, means and standard deviation fields are useful in illustrating visually the overall petrologic characteristics of sandstone sample populations (INGERSOLL and SUCZEK, 1979).

The QFL plot (Fig. 2a) illustrates the quartzo-feldspathic nature of the sample population. In fact, SCO Fm sandstones could be broadly classified as arkoses (i.e. quartz-feldspar-rich arenites). The average SCO Fm sandstone is composed of 45% quartz, 48% feldspars and 7% lithic fragments, recalculated to QFL percentages (Table 2). On the QFL diagram, the studied sandstone samples show similar composition, as also

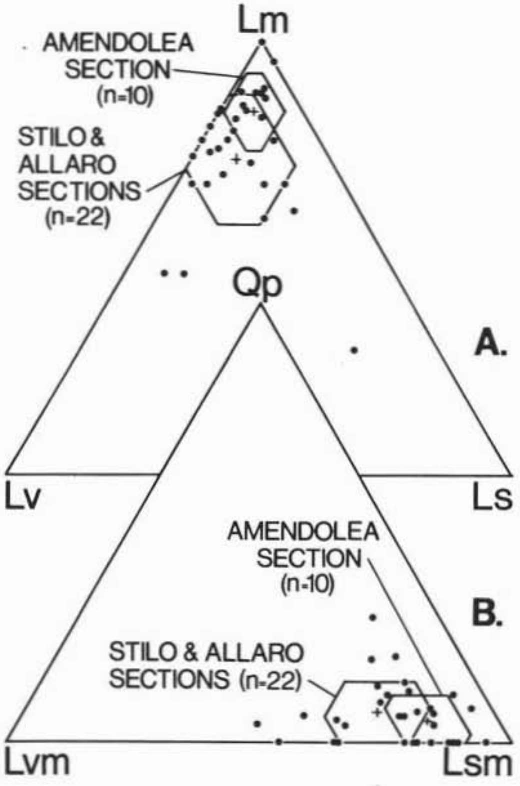


Fig. 3. — LmLvLs and QpLvmLsm ternary diagrams showing compositions of Stilo - Capo d'Orlando sandstones in southern Calabria. See Table 1 for explanation of symbols. For both diagrams, crosses and polygons represent means and standard deviations of the sample population, n indicates number of samples. See text for discussion.

indicated by very low values of the standard deviation. Nevertheless, it is possible to define two populations with significantly different compositional parameters. Samples from the Stilo and Allaro stratigraphic sections have virtually identical composition, whereas those from the Amendolea section have higher quartz and lower feldspars contents. In all diagrams (Figs. 2 and 3), all samples are indicated by the same symbol to stress the overall compositional similarity, whereas regional differences are emphasized by means and fields of standard deviation.

The QmFLt triangular diagram (Fig. 2b) depicts a similar distribution. This is due to the scarcity of polycrystalline quartz grains within the sample population. Nevertheless, this diagram is also used because it is a standard representation of sandstone detrital modes (e.g. DICKINSON and SUCZEK, 1979; DICKINSON et al., 1983) and, therefore, allows comparison with published data.

Phaneritic granitoid and gneissic rock fragments are very common within the SCO Fm sandstones; they are the primary source of Qm and F. Aphanitic lithic populations are dominated by metasedimentary rock types: slates, phyllites and, subordinately, quartz-mica schists. Carbonate lithics and volcanic lithics with felsitic and microlitic textures are generally minor detrital components. Aphanitic rock fragments are relatively scarce in sandstones of the Stilo - Capo d'Orlando Formation (average QFL%L = 7). This situation reduces the statistical significance of any plot based on these components, and creates some scatter of data. Several diagrams based on lithic populations have been designed. The LmLvLs and QpLvmLsm triangular plots were introduced by INGERSOLL and SUCZEK (1979) as useful indicators of provenance. On these plots (Fig. 3a, b), detrital modes of the studied samples show predominance of metamorphic (particularly metasedimentary) lithic fragments. On both plots, in spite of a considerable overlap, samples from the Amendolea section are richest in metamorphic lithic components.

**Discussion**

Petrologic characteristics of the SCO Fm sandstones suggest that provenance of the sample population was primarily from crystalline basement terranes, mostly of granitoid composition, as well as from extensive low-to-high-grade metasedimentary terranes.

Although detrital modes of sandstone samples from the same section are very consistent throughout its stratigraphic thickness, a few variables display significant vertical trends. For example, in the Allaro section, the total percentage of carbonate extrabasinal detritus decreases abruptly within the first 200 meters of section (Fig. 4). This decrease was produced by rapid erosion of the thin Mesozoic sedimentary cover overlying

TABLE 2

*Racalculated modal point-count data (see Table 1 for explanation of symbols)*

| Sample Number | Meters Above Base | QFL% Q | QFL% F | QFL% L | QmFLt% Qm | QmFLt% F | QmFLt% Lt | FRMW% M | Q/F | LmLvLs% Lm | LmLvLs% Lv | LmLvLs% Ls | QpLvmLsm% Qp | QpLvmLsm% Lvm | QpLvmLsm% Lsm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amendolea section | | | | | | | | | | | | | | | |
| 86-83 | 507 | 61 | 34 | 5 | 60 | 34 | 6 | 9.1 | 1.79 | 95 | 0 | 5 | 8 | 4 | 88 |
| 86-82 | 443 | 53 | 42 | 5 | 53 | 42 | 5 | 9.4 | 1.25 | 82 | 14 | 4 | 4 | 13 | 83 |
| 86-81 | 390 | 53 | 42 | 5 | 53 | 42 | 5 | 15.8 | 1.25 | 89 | 5 | 6 | 0 | 11 | 89 |
| 86-80 | 338 | 51 | 44 | 5 | 51 | 44 | 5 | 12.4 | 1.17 | 100 | 0 | 0 | 0 | 5 | 95 |
| 86-79 | 263 | 55 | 35 | 10 | 54 | 36 | 10 | 5.5 | 1.54 | 77 | 1 | 5 | 4 | 31 | 65 |
| 86-78 | 212 | 54 | 40 | 6 | 54 | 40 | 6 | 5.8 | 1.36 | 67 | 12 | 21 | 0 | 12 | 88 |
| 86-77 | 165 | 57 | 39 | 4 | 57 | 39 | 4 | 4.7 | 1.47 | 79 | 16 | 5 | 0 | 16 | 84 |
| 86-76 | 91 | 61 | 34 | 5 | 59 | 34 | 7 | 7.2 | 1.76 | 77 | 9 | 14 | 19 | 18 | 63 |
| 86-75 | 45 | 45 | 48 | 7 | 45 | 48 | 7 | 5.9 | 0.94 | 77 | 11 | 1 | 0 | 12 | 88 |
| 86-74 | 4 | 54 | 41 | 5 | 53 | 41 | 6 | 4.6 | 1.31 | 83 | 17 | 0 | 14 | 14 | 72 |
| X | - | 54 | 40 | 6 | 54 | 40 | 6 | 8.0 | 1.38 | 83 | 10 | 7 | 5 | 14 | 81 |
| SD | - | 4 | 4 | 2 | 4 | 4 | 2 | 3.4 | 0.25 | 9 | 6 | 6 | 6 | 7 | 10 |
| Allaro section | | | | | | | | | | | | | | | |
| 86-41 | 410 | 44 | 52 | 4 | 44 | 52 | 4 | 5.9 | 0.84 | 80 | 20 | 0 | 6 | 19 | 75 |
| 86-40 | 393 | 39 | 54 | 7 | 39 | 54 | 7 | 7.9 | 0.73 | 85 | 11 | 4 | 0 | 19 | 81 |
| 86-39 | 368 | 37 | 54 | 9 | 37 | 54 | 9 | 6.1 | 0.69 | 59 | 20 | 21 | 0 | 35 | 65 |
| 86-38 | 341 | 47 | 50 | 3 | 47 | 50 | 3 | 0.6 | 0.95 | 67 | 27 | 6 | 6 | 38 | 56 |
| 86-37 | 302 | 34 | 63 | 3 | 34 | 63 | 3 | 3.0 | 0.54 | 87 | 6 | 7 | 6 | 19 | 75 |
| 86-36 | 257 | 41 | 53 | 6 | 40 | 53 | 7 | 2.5 | 0.76 | 77 | 23 | 0 | 13 | 20 | 67 |
| 86-35 | 215 | 36 | 59 | 5 | 35 | 59 | 6 | 5.4 | 0.61 | 83 | 17 | 0 | 11 | 19 | 70 |
| 86-34 | 153 | 39 | 55 | 6 | 37 | 55 | 8 | 5.8 | 0.70 | 67 | 16 | 17 | 20 | 13 | 76 |
| 86-33 | 121 | 44 | 50 | 6 | 44 | 50 | 6 | 2.3 | 0.90 | 46 | 46 | 8 | 4 | 48 | 48 |
| 86-31 | 42 | 37 | 50 | 13 | 37 | 50 | 13 | 3.2 | 0.74 | 29 | 17 | 5 | 0 | 19 | 81 |
| X | - | 40 | 54 | 6 | 39 | 54 | 7 | 4.3 | 0.75 | 68 | 20 | 12 | 6 | 25 | 69 |
| SD | - | 4 | 4 | 3 | 4 | 4 | 3 | 2.1 | 0.12 | 18 | 10 | 16 | 6 | 11 | 10 |
| Stilo section | | | | | | | | | | | | | | | |
| 86-28 | 562 | 37 | 57 | 6 | 37 | 57 | 6 | 4.2 | 0.64 | 75 | 21 | 4 | 0 | 21 | 79 |
| 86-27 | 536 | 44 | 50 | 6 | 44 | 50 | 6 | 2.3 | 0.86 | 46 | 42 | 12 | 0 | 46 | 54 |
| 86-24 | 464 | 45 | 51 | 4 | 43 | 51 | 6 | 1.2 | 0.88 | 88 | 6 | 6 | 29 | 13 | 58 |
| 86-22 | 431 | 48 | 43 | 9 | 47 | 43 | 10 | 0.5 | 1.10 | 67 | 30 | 3 | 5 | 32 | 63 |
| 86-21 | 407 | 43 | 47 | 10 | 42 | 48 | 10 | 3.3 | 0.90 | 88 | 10 | 2 | 7 | 12 | 81 |
| 86-20 | 322 | 38 | 52 | 10 | 38 | 52 | 10 | 2.2 | 0.73 | 84 | 11 | 5 | 7 | 15 | 78 |
| 86-19 | 308 | 45 | 47 | 8 | 44 | 47 | 9 | 6.8 | 0.96 | 61 | 13 | 26 | 12 | 14 | 74 |
| 86-18 | 241 | 39 | 52 | 9 | 39 | 52 | 9 | 1.1 | 0.74 | 73 | 27 | 0 | 0 | 35 | 65 |
| 86-17 | 206 | 36 | 50 | 14 | 34 | 50 | 16 | 3.4 | 0.70 | 82 | 9 | 9 | 7 | 13 | 80 |
| 86-16 | 153 | 37 | 56 | 7 | 36 | 56 | 8 | 4.4 | 0.66 | 74 | 23 | 3 | 9 | 21 | 70 |
| 86-15 | 72 | 37 | 55 | 8 | 36 | 55 | 9 | 2.0 | 0.67 | 69 | 23 | 8 | 8 | 21 | 71 |
| 86-14 | 33 | 36 | 54 | 10 | 35 | 54 | 11 | 5.6 | 0.66 | 88 | 7 | 5 | 11 | 6 | 83 |
| X | - | 41 | 51 | 8 | 40 | 51 | 9 | 3.1 | 0.79 | 75 | 18 | 7 | 8 | 21 | 71 |
| SD | - | 4 | 4 | 2 | 4 | 4 | 3 | 1.8 | 0.14 | 12 | 11 | 7 | 7 | 11 | 9 |
| Stilo and Allaro section combined | | | | | | | | | | | | | | | |
| X | - | 40 | 53 | 7 | 40 | 52 | 8 | 3.6 | 0.77 | 72 | 19 | 9 | 7 | 23 | 70 |
| SD | - | 4 | 4 | 3 | 4 | 4 | 3 | 2.1 | 0.13 | 15 | 11 | 12 | 7 | 11 | 10 |
| Total | | | | | | | | | | | | | | | |
| X | - | 45 | 48 | 7 | 44 | 49 | 7 | 5.0 | 0.96 | 75 | 16 | 9 | 6 | 20 | 74 |
| SD | - | 8 | 7 | 3 | 8 | 7 | 3 | 3.3 | 0.33 | 15 | 10 | 10 | 7 | 11 | 11 |

*Note: Values shown are based on 500 total grain points per sample. X and SD indicate mean and one standard deviation from the mean. Point-counting raw data and exact location of samples are available from the author upon request*

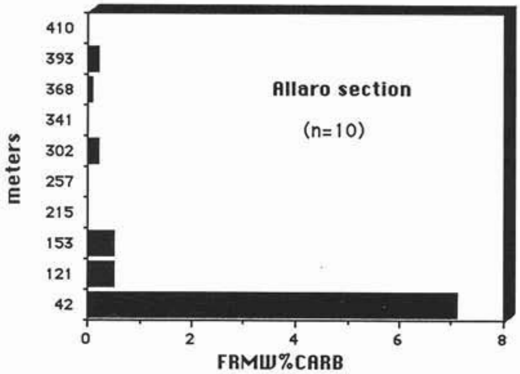


Fig. 4. — Histogram showing an example of vertical compositional variation within sandstones of the Stilo - Capo d'Orlando Formation. n indicates number of samples. Note how the total amount of carbonate grains relative to the total framework grains (FRMW%CARB) decreases abruptly within the first 200 meters of the Allaro section. This trend reflects relatively quick erosion of a thin Mesozoic carbonate cover overlying the basement in the sediment source area (unroofing sequence).

the basement rocks and, therefore, documents unroofing of the source terranes.

Compositions of sandstone samples from the Stilo and Allaro sections-combined and from the Amendolea section differ significantly. For example, samples from the Amendolea section have higher proportions of quartz (average QFL%Q = 54 versus 41 for the Stilo and Allaro sections combined) and, accordingly, lower proportions of feldspars (average QLF%F = 40 versus 52) (see Table 2). Another petrologic parameter discriminating the two groups of sample is the relative amount of monocrystalline phyllosilicates (FRMW%M). This parameter has a mean of 3.1 and 4.3, respectively, for the Stilo and Allaro sections, and 8.0 for the Amendolea section.

The relatively higher quartz content of the Amendolea section is probably the result of a different provenance. In fact, the south-central Serre massif (most likely, the sediment source area for the northern Stilo - Capo d'Orlando Formation, as also supported by paleocurrent data yet to be published) is mostly composed of Hercynian granitoid intrusions (mostly granodiorites, with subordinate tonalites and granites) characterized by a quartz/feldspars ratio (Q/F) ranging from 0.49 to 0.58 (see ROTTURA et al., 1986, p. 24, for list of data sources). On the other hand, the Aspromonte massif is mainly composed of middle - grade metamorphic rocks (mostly gneisses and subordinate micaschists) (BONARDI et al., 1979; CRISCI et al., 1982). Modal analyses of the Aspromonte basement rocks are rare. They are instead available for the basement rocks of the easternmost Peloritani Mountains, which are considered to be equivalent of those of Aspromonte (D'AMICO et al., 1973; AMODIO-MORELLI et al., 1976). They have a quartz/feldspars ratio ranging from 0.68 and 1.55, most commonly greater than 1.0 (D'AMICO et al., 1972; ATZORI et al., 1976; ATZORI and LO GIUDICE, 1982). Therefore, these is close correspondence between petrologic parameters of the SCO Fm and those of the basement terranes from which it was evidently derived, and the Q/F ratio represents a significant «petrologic tracer» for the delineation of the Miocene sediment dispersal routes in southern Calabria.

The higher percentage of phyllosilicate grains (FRMW%M) of the Amendolea section samples is another clue to a local but significant metamorphic detrital input. A large southern metamorphiclastic input is indicated also by the LmLvLs and QpLvmLsm plots (Figs. 3a, b) depicting a shift for the Amendolea section subpopulation towards metamorphic lithics and sedimentary-metasedimentary lithics, respectively.

On these grounds, in spite of the overall similarity in composition, sandstones of the SCO Fm in Calabria can be divided into two different petrofacies (MANSFIELD, 1971) (i.e., rock bodies characterized by distinctive petrologic parameters). A northern petrofacies, including the samples from the Stilo and Allaro sections, and a southern one, including the samples from the Amendolea section. Several petrologic parameters allow discrimination of the two petrofacies. The northern petrofacies is characterized by a lower percentage of quartz (average QFL%Q = 41, versus 54 of the southern one), a relatively larger amount of feldspars (average

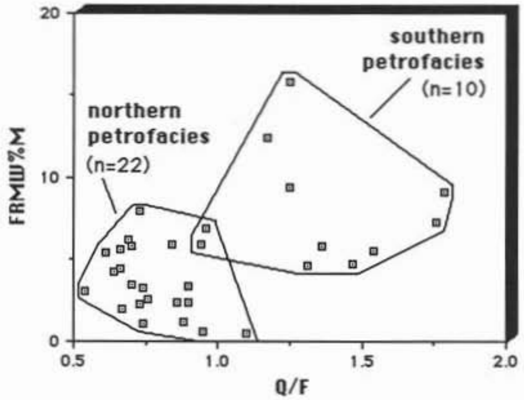


Fig. 5. — FRMW%M-Q/F diagram of Stilo - Capo d'Orlando sandstones in Calabria. FRMW%M indicates the percentage of monocrystalline phyllosilicate grains, Q/F indicates the ration between total quartz grains and total feldspar grains, n indicates number of samples. Note how the northern (Stilo and Allaro sections) and southern (Amendolea section) petrofacies are unequivocally discriminated using these petrologic parameters. See text for discussion.

QFL%F = 52 versus 40), a smaller amount of monocrystalline phyllosilicate grains (average FRMW%M = 3.6 versus 8.0), and a smaller amount of metamorphic lithic grains (Figs. 3a, b).

The two parameters which best discriminate the two petrofacies are the ratio between total quartzose grains and total feldspar grains (Q/F) and the percentage of monocrystalline .phyllosilicate grains (FRMW%M) (Fig. 5). Combined use of these two parameters produces a significant discrimination of the sample population.

## Conclusions

Sandstones of the Stilo - Capo d'Orlando Formation have quartzo-feldspathic composition and, broadly speaking, have a mixed plutonic-metamorphic provenance. In spite of the rather homogeneous detrital modes, there are several petrologic parameters which allow discrimination of two different petrofacies. Detrital modes of the two petrofacies can be matched with present basement lithologies in the adjacent source areas. The northern petrofacies reflects provenance from granitoid plutonic rocks forming the bulk of the Serre, whereas the southern petrofacies was derived from the mostly metamorphic terranes of the Aspromonte.

Exotic detrital inputs have not been documented. Some peculiar rock types, which are present in the northern sector of the Calabria-Peloritani Arc (e.g., serpentinites and associated rocks of the Gimigliano and Diamante-Terranova units; AMODIO-MORELLI et al., 1976), have not been documented during this study as detrital components of the Stilo - Capo d'Orlando Fm sandstones. These northern detrital components might be absent: i) because the northern sector was too far away to act as a sediment source area; ii) because they were not yet exposed; or iii) because the sediment paleodispersal system carried the detritus eroded from those peculiar units to a different sedimentary basin.

There is a close similarity between the compositional parameters of the SCO Fm sandstones of southern Calabria and those of the corresponding basement rocks in the same region. This fact indicates that both documented petrofacies had a local provenance and that, during early Miocene time, sediment source areas (the Serre and Aspromonte regions) were already composed of the same rock units cropping out today.

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