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CONTRIBUTION TO THE KNOWLEDGE OF THE TECTONIC UNITS OF CALABRIA. RELATIONSHIPS BETWEEN COMPOSITION OF K-WHITE MICAS AND METAMORPHIC EVOLUTION

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ABSTRACT

In the Calabria-Peloritani arc, a fragment of the Alpine chain overthrusting the Maghrebide-Apennine chain is exposed.

All the units of the Alpine chain underwent pre-Alpine and/or Alpine metamorphism, while only two units of the Apennine chain have been affected by Alpine metamorphism, the others being unmetamorphosed.

In this work we shall discuss the composition of the K-white micas contained in all the phyllitic sequences of Central and Northern Calabria tectonic units, in order to get more informations about their metamorphic history.

Our researches corroborate the results of analogous investigation carried out in the Alps: the K-white mica b_o values of the Alpine phyllites cover a range clearly different from the range of the Hercynian ones, the micas having a phengitic composition in the former and a muscovitic composition in the latter.

The Apennine units derive from the southern continental margin of the Tethys. The examined Campotenese-Cetraro Unit underwent a Barrovian metamorphism.

The Alpine units derive from the Tethys ocean (ophiolites) and from its southern continental margin (Austroalpine nappes). In the ophiolites two groups of units are distinguishable; the first group, comparable with the Ligurian ophiolites, underwent very low-grade Alpine metamorphism. The second one, comparable with the Piemonte ophiolites, underwent two Alpine metamorphic events: the first of the blueschist facies, the second of the greenschist facies. In the sequences where the blueschist facies event is better preserved the white mica b_o values correspond to a Barrovian metamorphism like Otago; in the sequences where the greenschist facies event acted with higher intensity the white mica b_o values correspond to a Barrovian metamorphism like Dalradian.

In the units deriving from the continental margin of the Tethys the metamorphism is prevalently pre-Triassic, and the Alpine metamorphism acted with very low grade or was completely absent.

Besides the units certainly belonging to the Alpine and to the Apennine chains there are three units « incertae sedis »: the Longobucco, Mt. Gariglione and Stilo Units.

The K-white mica b_o values of the pre-Alpine Longobucco phyllites cover a range intermediate between HP Alpine values and LP Hercynian ones.

The Mt. Gariglione Unit does not contain phyllites, suitable for diffractometric investigation, but in any case no effects of the Alpine metamorphism have been recognized.

The K-white micas b_o values of the pre-Alpine Stilo phyllites correspond to a LP metamorphism like Bosost.

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RIASSUNTO

L'arco calabro-peloritano è costituito da un frammento di catena alpina sovrascorso sulla catena maghrebide-appenninica.

Le unità della catena alpina sono state interessate da un metamorfismo pre-alpino e/o dal metamorfismo alpino. Le unità della catena appenninica non sono metamorfiche, ad eccezione di due che hanno subito un metamorfismo alpino di basso grado.

Per approfondire la storia metamorfica delle unità tettoniche della Calabria centrale e settentrionale viene discussa la composizione delle miche bianche potassiche di tutte le sequenze filladiche.

Le nostre ricerche confermano i risultati di analoghi studi compiuti nelle Alpi: i valori b_0 delle miche bianche delle filladi alpine differiscono da quelli delle filladi erciniche: in queste ultime le miche hanno composizione muscovitica, nelle filladi alpine composizione fengitica.

Le unità appenniniche derivano dal margine continentale meridionale della Tetide. L'unità Campotenese-Cetraro (unica studiata) è stata interessata da un metamorfismo di tipo barroviano.

Le unità alpine derivano dalla Tetide (ofioliti) e dal suo margine continentale meridionale (falde austroalpine). Nelle ofioliti abbiamo distinti due gruppi di unità: il primo gruppo, comparabile con le ofioliti liguridi, ha subito un metamorfismo alpino di grado molto basso. Il secondo gruppo, comparabile con le ofioliti piemontesi, ha subito un metamorfismo alpino caratterizzato da due eventi: il primo in facies di scisti blu, il secondo in facies di scisti verdi. Nelle sequenze in cui l'evento in facies di scisti blu è meglio conservato, i valori b_0 delle miche bianche indicano un metamorfismo barroviano tipo Otago. Nelle sequenze in cui l'evento in facies di scisti verdi è più intenso i valori b_0 delle miche bianche indicano un metamorfismo barroviano tipo Dalradiano.

Nelle unità derivanti dal margine continentale della Tetide il metamorfismo è prevalentemente pre-triassico, il metamorfismo alpino è assente o di grado molto basso.

Accanto alle unità appartenenti certamente alla catena alpina ed alla catena appenninica vi sono tre unità « incertae sedis »: le unità di Longobucco, di M. Gariglione e di Stilo.

I valori b_0 delle miche bianche delle filladi pre-alpine di Longobucco cadono in un campo intermedio fra i valori fengitici e quelli muscovitici.

All'unità di M. Gariglione non appartengono metamorfiti adatte a questo tipo di ricerche. In essa non sono stati riconosciuti effetti di metamorfismo alpino.

I valori b_0 delle miche bianche delle filladi pre-alpine di Stilo corrispondono a quelli di un metamorfismo di bassa pressione tipo Bosost.

1. INTRODUCTION

A metamorphic belt, known in literature as the Calabria-Peloritani arc, is exposed in Southern Italy. A coherent picture of the tectonic evolution of this Alpine chain fragment is not yet available, the geologic information being incomplete and often contradictory; the metamorphic history, in particular, is still not well known.

Recently, researchers in the Alps (CIPRIANI *et alii*, 1971; SASSI, 1972) have shown that the composition of the potassic white micas may provide important information about the metamorphism of pelitic sequences. The b_0 values of the micas, in fact, have a barometric significance, and their investigation may represent a useful instrument of research.

Several tectonic units which make up the Calabria-Peloritani arc contain pelitic sequences, which are suitable for diffractometric investigation. Some papers, which corroborate SASSI's (1972) results have already been published (ATZORI & SASSI, 1973; DI PIERRO *et alii*, 1973; PICCARRETA & ZIRPOLI, 1974; COLONNA *et alii*, 1975).

In this work we shall discuss the composition of the K-white micas contained in all the phyllitic sequences of the Central and Northern Calabria

tectonic units, in order to get more information about their metamorphic history, considering the results according to the geological scheme of the region, at present available.

2. GEOLOGICAL SCHEME OF THE CALABRIA-PELORITANI ARC

The Maghrebide-Apennine mountain system forms in Southern Italy a wide arc convex towards the Ionian Sea, in which the main tectonic lineaments (axes of folds, great faults, overthrusts) change from the NW-SE direction in Campania and Lucania to the north-south direction in Calabria, and finally to the east-west direction in Sicily. The foreland of the Maghrebide-Apennine chain is represented by the Apulia platform in Campania-Lucania, by the Ionian area in Calabria, and by the Ragusa « platform » in Sicily. In Campania-Lucania and in almost the whole of Sicily the tecto-

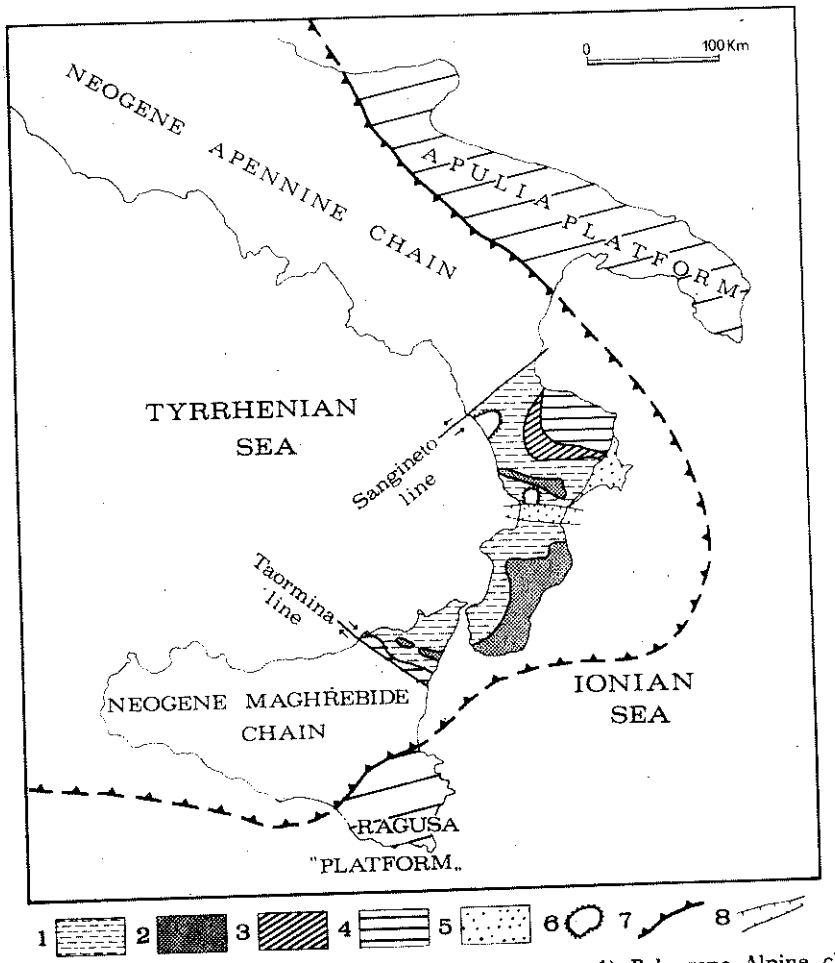

fig. 1 — Tectonic sketch of the Calabria-Peloritani arc. 1) Paleogene Alpine chain; 2) Stilo Unit; 3) Mt. Gariglione Unit; 4) Longobucco Unit (Longi Unit in Sicily, Peloritani Mts.); 5) Neoegne terrigenous sediments of the Crotone basin and of the Catanzaro Graben; 6) Main Apennine tectonic windows; 7) Front of the Neogene Maghrebide-Apennine chain; 8) Graben.

nic units consist mainly of Mesozoic and Tertiary sedimentary sequences, affected by orogenic transport during the Miocene and Pliocene; no metamorphism exists. In the most convex part of the arc, on the contrary, units consisting of igneous and metamorphic rocks are largely widespread. These elements « foreign » to the Apennines have been interpreted in different ways: portions of a parautochthonous massive (QUITZOW, 1935), « internal » Apennic units in a syncline of nappes (OGNIBEN, 1969; 1975), fragments of the Alps (DIETRICH & SCANDONE, 1972; HACCARD *et alii*, 1972; ALVAREZ *et alii*, 1974; SCANDONE *et alii*, 1974).

We interpret the Calabria-Peloritani arc (fig. 1) as a fragment of the Paleogene north-vergent (that is Europe-vergent) Alpine chain, overthrust upon the Neogene south-vergent (that is Africa-vergent) Marghrebide-Apennine chain (SCANDONE *et alii*, 1974). The Paleogene Alpine chain consists of elements deriving from the Central Tethys and from its southern continental margin, which have been piled up during the subduction of the ocean beneath the African continental margin, together with a part of the African continental crust (this phase corresponds in the Western Alps to the building up of the Pennine and Austroalpine nappes). The Neogene Maghrebide-Apennine chain consists of elements deriving from more external (1) African realms, piled up during the collision between Europe and Africa, when a lot of the African continental crust disappeared subducing beneath Europe. During this collision that part of the Alpine chain already formed at the end of the Paleogene along the northern border of the African continent, overthrusts *in toto* the highest nappes of the future Maghrebide-Appennine chain, which began to be built up in the Early Miocene.

In Table I the geometrical relationships among the tectonic units outcropping in Northern Calabria are given. Besides these units, there are three units « *incertae sedis* »: the Stilo, the Longobucco and the Mt. Gariglione Units, which have not yet been included in the structural scheme, their relationships with the Alpine and with the Maghrebide-Apennine chain not being completely clarified and interpreted until now.

3. THE BAROMETRIC SIGNIFICANCE OF THE K-WHITE MICAS

The content in phengite in solid solution in the potassic white micas may be determined using the b_0 spacing; the system of determination of the b_0 values has been described by DI PIERRO *et alii* (1973) and by SASSI & SCOLARI (1974).

In metapelites of the greenschist facies the content in phengites increases with increasing pressure (CIPRIANI *et alii*, 1968; 1971). Investigating potassic white micas from the Eastern Alps, SASSI (1972) reached an important conclusion: « The potassic white micas of the rocks whose metamorphism is Alpine are always phengites; the potassic white micas of the rocks whose metamorphism is pre-Permian are always muscovites ». Assuming this result is correct it is possible to distinguish phyllites with HP characters (Alpino-type metamorphism, ZWART, 1967) and phyllites with LP characters (Hercyno-type metamorphism, ZWART, 1967).

(1) The adjectives internal and external are indicative, of course, of the direction of the orogenic transport, from the ocean or from the continental margin towards the foreland.

TABLE 1

	CATENA COSTIERA (between Diamante and Fuscaldo)		*CATENA COSTIERA AND SILA PICCOLA* (between Fuscaldo and Nicastro)
ALPINE CHAIN	« UNITA' DIORITICO-KINZIGITICA » *Lithology*: biotite-garnet gneisses with sillimanite and cordierite, amphibolites, granulites, marbles, diorites s.l. *Thickness*: several hundred metres. *Metamorphism*: pre-Triassic, with Alpine effects localized in the lower part of the unit, indicative of moderately high pressure.		
	MALVITO UNIT *Sequence*: slightly metamorphic *Calpionella* limestones and cherts; metabasites. *Age of the sequence*: Jurassic-Lower Cretaceous. *Max. thickness*: 350 m. *Kind of metamorphism*: very low-grade of the greenschist facies. *Age of the metamorphism*: Oligocene (about 32 MY).	?	CASTAGNA UNIT *Lithology*: gneisses, augengneisses and granites s.l., micaschists. *Max. thickness*: around 700 m. *Metamorphism*: pre-Triassic, with Alpine effects localized in the lower part of the unit, indicative of HP and LT. BAGNI UNIT *Sequence*: radiolarites, metapelites and recrystallized limestones; metaconglomerates and quartzites unconformably overlying metapsammites and phyllites; occasionally metabasites. *Age of the sequence*: pre-Triassic basement and Triassic-?Lower Cretaceous sedimentary cover. *Max. thickness*: several hundred metres. *Kind of metamorphism*: low-grade of the greenschist facies (Hercynian metamorphism) and superimposed very low-grade of the greenschist facies, at the boundary with the diagenesis (Alpine metamorphism). *Age of the Alpine metamorphism*: not older than Early Cretaceous.
	DIAMANTE-TERRANOVA UNIT *Sequence*: calcareous schists, phyllites; metabasites, serpentinites. *Age of the sequence*: Jurassic-Lower Cretaceous. *Max. thickness*: 200-250 m. *Kind of metamorphism*: blueschist facies with superimposed greenschist facies. *Age of the metamorphism*: probably Late Cretaceous, and Paleogene.	?	GIMIGLIANO UNIT *Sequence*: phyllites and psammitic schists, cherts and recrystallized limestones; metabasites and serpentinites. *Age of the sequence*: Jurassic-Lower Cretaceous. *Max. thickness*: around 500 m. *Kind of metamorphism*: low-grade of the greenschist facies, with relict blueschist facies. *Age of the metamorphism*: probably Late Cretaceous and Paleogene.
	FRIDO UNIT *Sequence*: slates and subordinate limestones, quartzites. *Age of the sequence*: Upper Cretaceous-? *Thickness*: some hundred metres. *Kind of metamorphism*: very low-grade of the greenschist facies, at the boundary with the diagenesis. *Age of the metamorphism*: not older than Late Cretaceous.		
APENNINE CHAIN	VERBICARO UNIT *Sequence*: slightly metamorphic cherty limestones, dolomites and evaporites. Locally mafic lavas. *Age of the sequence*: Upper Triassic-Aquitanian. *Max. thickness*: 900-1000 m. *Kind of metamorphism*: very low-grade of the greenschist facies, with moderately high pressure. *Age of the metamorphism*: Aquitanian (18 MY).		CARBONATE UNIT OF THE TIMPONE DEL FORNO, TERME LUIGIANE, MONTE COCUZZO, GRIMALDI, BAGNI DI CARONTE WINDOWS *Sequence*: metamorphic cherty limestones and dolomites. *Age of the sequence*: ?Upper Triassic-?Aquitanian. *Thickness*: some hundred metres. *Kind of metamorphism*: unknown. *Age of the metamorphism*: ?Aquitanian.
	« Argiles à blocs »	?	
	CAMPOTENESE-CETRARO UNIT *Campotenese sequence*: metamorphic limestones and dolomites; phyllites with occasional mafic lavas. *Age of the sequence*: Middle Triassic-?Aquitanian. *Max. thickness*: 900-1000 m. *Cetraro sequence*: dolomites and evaporites; phyllites. *Age of the sequence*: Middle and Upper Triassic. *Max. thickness*: around 300 m. *Kind of metamorphism*: low-grade of the greenschist facies. *Age of the metamorphism*: probably Aquitanian.		

Tectonic contact realized below high confining pressure conditions. — — — Tectonic contact realized below low confining pressure conditions.
Contact between the Alpine and the Apennine chains. ——— Tectonic contact with undecided confining pressure conditions. ····· Unconformity.

TABLE 2

	Units	Age of pelitic sediments	Age of metamorphism	n	$\bar{x}$	s
Apennine chain	Campotenese-Cetraro					
	— Campotenese area	Middle Triassic	Aquitanian	39	9.025	0.003
	— Cetraro area			51	9.024	0.003
Alpine chain	Ophiolitic units: Diamante-Terranova	Upper Jurassic-Lower Cretaceous	Late Cretaceous-Paleogene	52	9.033	0.005
	Ophiolitic units: Gimigliano					
	— Gimigliano area			109	9.022	0.003
	— Reventino area			98	9.021	0.005
	— Falerna area			36	9.030	0.004
	— Fuscaldo-Rose area			86	9.031	0.004
	Bagni	Pre-Triassic	Hercynian and Alpine (not older than Early Cretaceous)	168	9.013	0.006
	Pomo (*)	Pre-Triassic	Hercynian and (?) Alpine	76	8.997	0.006
	Castagna (**)	Pre-Triassic	Hercynian and Alpine	33	9.003	0.005
« Incertae sedis »	Stilo	Devonian	Carboniferous	76	8.994	0.004
	Longobucco	Pre-Triassic	Hercynian (and Caledonian?)	67	9.011	0.005

(*) From COLONNA *et alii*, 1975.
(**) From PICCARRETA & ZIRPOLI, 1975.

The validity of these conclusions has been confirmed by many works in the Alps, Calabria and Sicily (GEYSSANT & SASSI, 1972; SASSI & ZANFERRARI, 1972; ATZORI & SASSI, 1973; DI PIERRO *et alii*, 1973; PICCARRETA & ZIRPOLI, 1974; SASSI & SCOLARI, 1974; COLONNA *et alii*, 1975).

This analytic method has, of course, some limits. The composition of the potassic white micas is influenced by pressure, temperature and by the rock bulk composition; the variations of the b_0 values reflect real variations of pressure only in isochemical and isothermic conditions of metamorphism. Moreover the investigations are only possibile on greenschist facies rocks having a mineralogical composition that lies near the short diagonal of the quartz-albite-micas-carbonates diagram proposed by FRITSCH *et alii* (1967). Rocks containing carbonates, chlorites and K-feldspars (about 10%) must be discarded; also high quartz contents may modify the b_0 values.

In order to control the influence of the rock bulk composition on the white mica composition, we analized different lithotypes belonging to the same tectonic unit and having the same stratigraphic position. In the Gimigliano Unit, for instance, the b_0 values of micaceous lithotypes and those of lithotypes rich in quartz (about 25 %) and plagioclase (about 20%) are comparable (fig. 2).

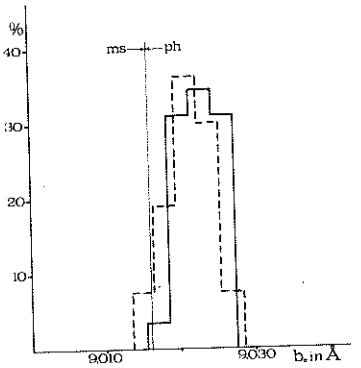

fig. 2 — Gimigliano Unit, Gimigliano sequence. b_0 value frequency histograms. Unbroken line: lithotypes rich in quartz and plagioclase; dashed line: phyllites.

Table 2 summarizes some information: age of examined pelitic sediments, age of metamorphism, number of investigated samples (n), arithmetic means ($\bar{x}$), standard deviation (s).

4. ANALYSIS OF THE TECTONIC UNITS

We shall distinguish the investigated tectonic units in three groups:

1. units belonging to the Apennine chain;
2. units belonging to the Alpine chain;
3. units « *incertae sedis* ».

In fig. 3 the localities of the samples collected for the b_0 value investigations are given.

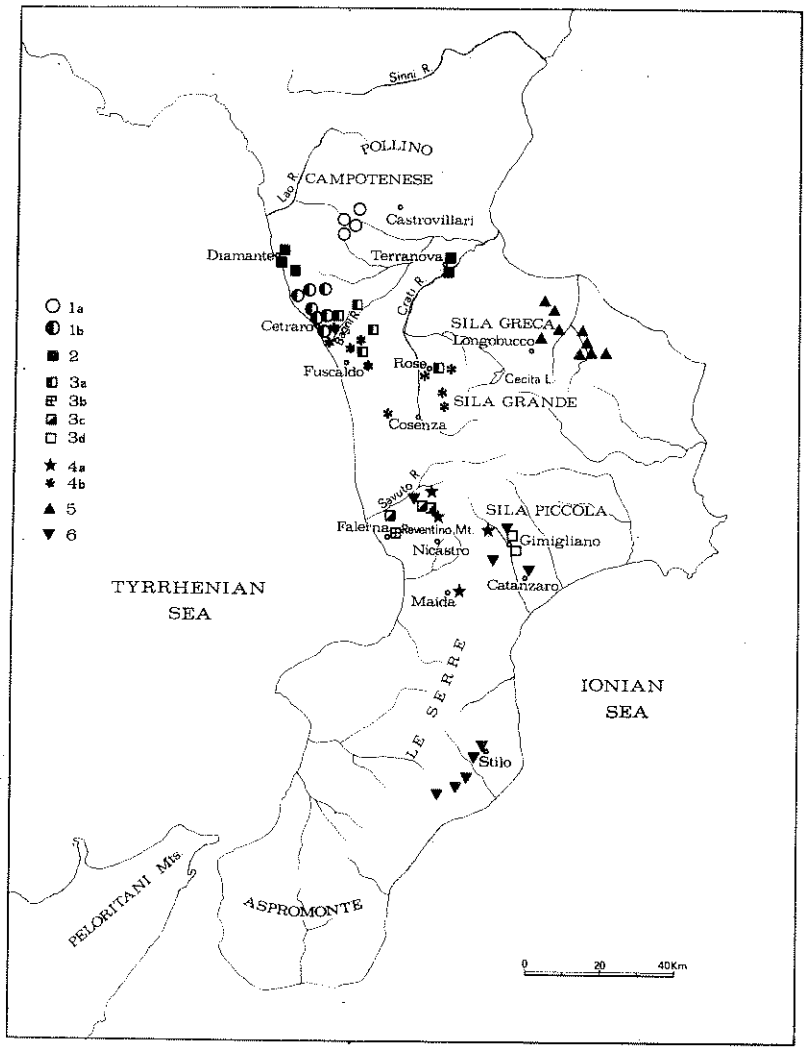

fig. 3 — Provenance of the collected samples. 1) Campotenese-Cetraro Unit: 1 a) Campotenese area; 1 b) Cetraro area. 2) Diamante-Terranova Unit. 3) Gimigliano Unit: 3 a) Fuscaldo-Rose area; 3 b) Falerna area; 3 c) Reventino Mt. area; 3 d) Gimigliano area. 4) Bagni Unit: 4 a) Pomo phyllites; 4 b) Bagni phyllites. 5) Longobucco Unit. 6) Stilo Unit.

4.1. Units belonging to the Apennine chain.

4.1.1. *Campotenese-Cetraro Unit.*

The Campotenese Unit is one of the units deriving from the tectonic fragmentation of the Campania-Lucania carbonate platform. The sequence consists of phyllites and quartzites with intercalated massive crystalline limestones and, occasionally, mafic lavas (Middle Triassic), followed by dolomites and limestones (Upper Triassic-Lower Miocene) (Bousquet & Dubois, 1967; Grandjacquet & Bousquet, 1969; Bousquet, 1971; Pierattini, 1975). According to Grandjacquet & Bousquet, the terrigenous metasediments and

the overlying recrystallized carbonates belong to two different tectonic units: the « Trias métamorphique » and the Campotenese-Pollino units. According to PIERATTINI, on the contrary, phyllites and carbonates form a single tectonic unit. We did not study this problem, as our investigations concerne only the Middle Triassic metapelites. The PIERATTINI's conclusions, in any case, seem enough convincing.

The Campotenese Unit tectonically overlies other units of the Campania-Lucania platform and is tectonically overlain by the Verbicaro Unit, which also represents part of the same carbonate platform.

South of the Sangineto line (2) metamorphites similar to that of the Campotenese sequence outcrop, mainly near Cetraro. They consist of phyllites, identical to the Campotenese phyllites, stratigraphically overlain by Upper Triassic evaporites. The bottom of the Cetraro Triassic rocks does not outcrop; on top lies the Verbicaro Unit, represented here only by small carbonate Klippen. The degree of metamorphism, defined by the mineral assemblage of the metabasites (albite, actinolite and horneblende, epidote, zoisite, calcite, chlorites; DIETRICH & SCANDONE, 1972) may be related to the low temperatures of the greenschist facies.

The identical geometric position and the identical lithologies of the Cetraro and Campotenese phyllites suggest that these two sequences belong to a single tectonic unit. This is also confirmed by the potassic white mica composition: the micas of the Cetraro and Campotenese phyllites are indistinguishable (fig. 4). The b_0 values indicate a phengitic composition. They lie

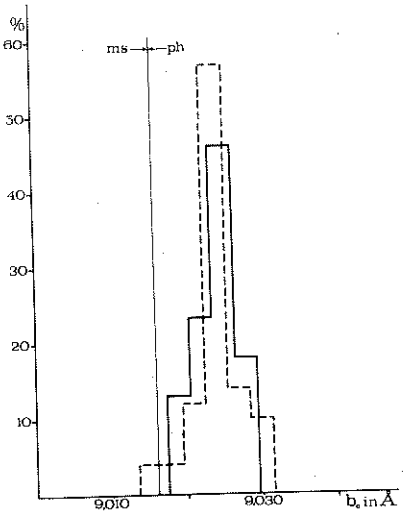

fig. 4 — Campotenese-Cetraro Unit. b_0 value frequency histograms. Unbroken line: Campotenese phyllites; dashed line: Cetraro phyllites.

in a very narrow range, with a predominant class around 9.025 Å. These histograms agree with the very simple metamorphic history of the Campotenese-Cetraro Unit, reconstructed by the metamorphic fabric and paragenesis. Although the samples were collected from a widespread area, the range of the b_0 values is extremely narrow. This fact indicates baric conditions uniform throughout the entire body.

(2) The Sangineto line is a transcurrent fault, active at least until Late Miocene. The Sangineto sinistral line and the Taormina dextral line have been assumed to be the main lines of motion of the Calabria-Peloritani belt (fig. 1) when the arc was emphasized (SCANDONE *et alii*, 1974).

The age of the metamorphism is uncertain. According to GRANDJACQUET (1967) it is Aquitanian, while according to BORSI & DUBOIS (1968) it is Eocene (48 ± 2 MY, white micas from Cetraro). At present we cannot judge, even though GRANDJACQUET's data fit other geological information better. In any case the metamorphism did not originate by the thrusting of the Paleogene Alpine chain, because Aquitanian unmetamorphosed terranes (« argiles à blocs », GRANDJACQUET, 1974) stratigraphically overlie Campotenese Unit and tectonically underlie the Verbicaro Unit.

4.1.2. *Verbicaro Unit.*

The sequence, slightly metamorphosed, consists of evaporites and dolomites (Upper Triassic), cherty limestones (Jurassic-Cretaceous), calcareous breccias and microbreccias, and marls (Paleogene-Aquitanian). Mafic lavas are known near the Cretaceous-Paleogene boundary (GRANDJACQUET & GRANDJACQUET, 1961; GRANDJACQUET, 1967; BOSQUET & GRANDJACQUET, 1969; DIETRICH & SCANDONE, 1972; PIERATTINI *et alii*, 1975).

The Verbicaro Unit tectonically overlies the Campotenese Unit and underlies the Frido Unit.

The degree of metamorphism is very low, and is defined by the metamorphic mineral assemblage of the mafic lavas (sericite, stilpnomelane, glaucophane, epidote, albite; titan-pyroxenes and olivine as residual minerals; PIERATTINI *et alii*, 1975). This assemblage suggests low temperature and moderatly high pressure. The Aquitanian age of the metamorphism is defined by stratigraphical evidence (GRANDJACQUET, 1974) and by radiometric data (18 MY, K/Ar total rock; PIERATTINI *et alii*, 1975).

We could not study white micas in this unit because there are no lithotypes suitable for this kind of analysis.

4.1.3. *Apennine carbonatic unit of the Timpone del Forno, Terme Luigiane, Coreca, Monte Cocuzzo, Grimaldi, Bagni di Caronte windows.*

The stratigraphic sequences are not well known. The lower part of the sequences is generally made up of dolomites (Upper Triassic?), the upper part of limestones, often with cherty nodules and bands (DUBOIS, 1970; DIETRICH & SCANDONE, 1972). Very little is known about the kind of metamorphism. Because of the tectonic position below the Frido Unit, this unit (or these units?) may be dubitatively correlated with the Verbicaro Unit or with the Campotenese-Cetraro Unit. In this hypothesis the age of metamorphism should be Aquitanian.

We did not study white micas from these sequences, since suitable lithotypes are absent.

4.2. UNITS OF THE ALPINE CHAIN.

4.2.1. *Frido Unit.*

In Northern Calabria the Frido Unit is the lowest nappe of the Alpine chain. Northwards, in Campania and Lucania, the Frido Unit underlies a thick flysch sequence, the Cilento flysch, but the nature of the contact is not

yet clarified. The sequence (VEZZANI, 1968) consists of slightly metamorphic psammitic (mainly quartzites) and pelitic schists, and of fine grained limestones. According to VEZZANI and to OGNIBEN (1969) the unit is lower Cretaceous and underlies stratigraphically the Cilento flysch; the age of metamorphism would be Eocene-Oligocene. The discovery of Upper Cretaceous microfossils (*Globotruncana*) in limestones of the Frido Unit (SCANDONE in PASSERINI *et alii*, 1973) in the Cilento area is in contradiction with the supposed Lower Cretaceous age. The stratigraphic continuity from the Frido to the Cilento flysch (VEZZANI, 1968; OGNIBEN, 1969) is not acceptable, as in the San Severino Lucano-Episcopia region other units of the Paleogene Alpine chain (ophiolitic units and « unità dioritico-kinzigitica ») are tectonically inserted within the Frido terranes or between the Frido and the Cilento flysch. The overlying Cilento flysch is untouched by any metamorphism. The age of the Frido metamorphism is unknown; of course it cannot be older than Late Cretaceous, the age of the *Globotruncana* affected by recrystallization.

Preliminary investigations on the b_0 values of the K-white micas were unsuccessful because of analytical difficulties related to the presence of clay minerals.

4.2.2. *Ophiolitic units.*

At least two kinds of ophiolites outcrop in Northern Calabria, affected by different metamorphism (DIETRICH & SCANDONE, 1972). The first kind, comparable with the Ligurian ophiolites, consists of slightly metamorphic diabases, stratigraphically covered by cherts and limestones; the second one, comparable with the Piemonte ophiolites, consists of blue—or greenschist facies metabasalts, with their sedimentary cover. The « Ligurian » ophiolites outcrop along a narrow strip on both sides of the Sangineto line, and constitute the Malvito Unit. They tectonically overlie the « Piemonte » ophiolites everywhere. Within the latter the geometrical relationships between blue—and greenschists are not yet clear. The blueschist facies metamorphites outcrop prevalently north of the Sangineto line, the greenschist facies ones prevalently south of this line. The regional distribution of the metamorphism does not suggest gradual transitions. The sedimentary covers of the blueschists and of the greenschists are also quite different. We think that the blueschists and the greenschists belong to two different tectonic units, that we denominate Diamante-Terranova Unit and Gimigliano Unit. In the first one a quite uniform blueschist facies is recognizable; in the second a greenschist facies is widely exhibited, but evidence of a previous event in blueschist facies is still preserved.

Diamante-Terranova Unit.

The sequence consists of metabasites followed by calcareous schists and metapelites (Jurassic-Lower Cretaceous) (DIETRICH & SCANDONE, 1972).

The unit tectonically overlies the Frido Unit and underlies the Malvito Unit. The metamorphism is defined by the assemblage: glaucophane, pumpellyite, lawsonite, albite, aragonite, muscovite (DUBOIS, 1967 a, b; HOFFMANN, 1970; DE ROEVER, 1972; DE ROEVER *et alii*, 1974). The presence of actinolite around the Na-amphiboles indicates an incipient second metamorphic event in greenschist facies. The age of metamorphism is not yet defined.

The histogram of the potassic white mica b_0 values (fig. 5) shows phengitic composition with a sharp maximum around 9.033. About 15% of the samples reaches high phengitic composition (max 9.050), and these values agree with the values typical of the blueschist facies (9.045-9.050 according to SASSI & SCOLARI, 1974). The greatest part of the b_0 values which lie below 9.045 are the result of a change in composition related to the second event. The white micas, of course, reacted to this event more easily than the amphiboles.

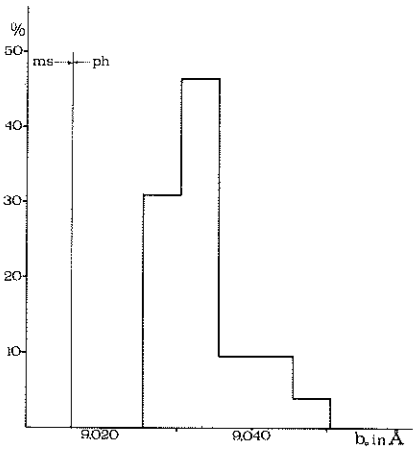

fig. 5 — Diamante-Terranova Unit: b_0 value frequency histogram.

Gimigliano Unit.

The Gimigliano Unit tectonically overlies the Frido Unit and underlies the Malvito Unit in the northern part of the Catena Costiera, and the Bagni Unit in all the other localities.

The sequence is made up of metabasites followed by psephitic, psammitic and pelitic schists, cherts and crystalline limestones (Jurassic-Lower Cretaceous). The metamorphism of the unit consists of a first HP/LT event characterized by Na-amphiboles, and of a second one in greenschist facies. This metamorphic history is similar to the history of the Diamante-Terranova Unit, but the second event is here responsible for the partial obliteration of the blueschist mineral assemblage, the temperature having acted more intensely than in the Diamante-Terranova Unit. Both events did not act everywhere with the same intensity, so that it is possible to divide Northern Calabria into different metamorphic zones, the metamorphism varying from west to east and from north to south (DUBOIS, 1970; DE ROEVER, 1972; PICCARRETA, 1972; DE ROEVER et alii, 1974; PICCARRETA & ZIRPOLI, 1974; 1975). In this distribution of the metamorphic zones the Falerna and Gimigliano rocks lie on extreme opposite positions, the former characterized by a slight obliteration of the HP/LT event, the latter by an almost complete recrystallization in greenschist facies.

Here we furnish four examples, indicative of the distribution of the metamorphic zones eastwards from Falerna to Gimigliano, and southwards from Fuscaldo-Rose to Falerna-Gimigliano. In the Falerna area (fig. 6 A) the potassic white micas have higher phengitic composition, in agreement with

the lower intensity of the second metamorphic event. In the Monte Reventino and Gimigliano areas (fig. 6 A) the potassic white micas have similar compositions, only the M. Reventino values cover a wider range than the Gimigliano ones. This difference may be explained partly because of the metamorphic gradient (in the Gimigliano area the effects of the second event were slightly more intense than in the M. Reventino area, PICCARRETA, 1972).

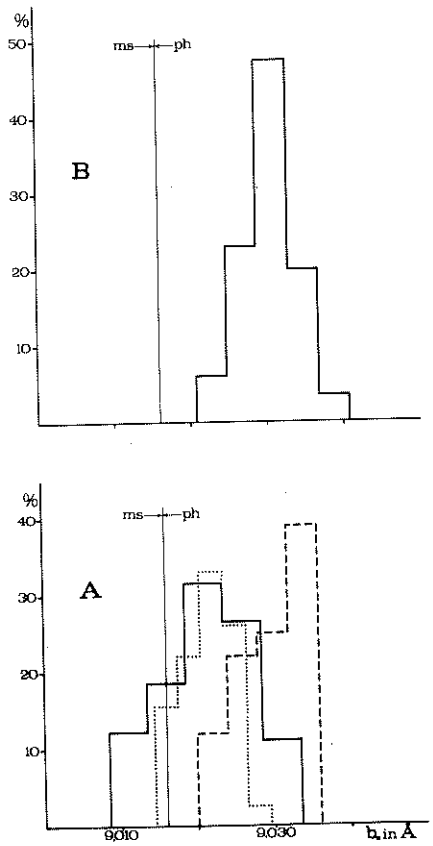

fig. 6 — Gimigliano Unit. b_o value frequency histograms. 6 A) Dashed line: Falerna sequence; unbroken line: Reventino Mt. sequence; dotted line: Gimigliano sequence. 6 B) Fuscaldo-Rose sequence.

In the Fuscaldo-Rose area the intensity of the second metamorphic event was slightly higher than in the Falerna area, and clearly lower than in the M. Reventino and Gimigliano areas (DUBOIS, 1970; DE ROEVER, 1972; PICCARRETA & ZIRPOLI, 1974; 1975). The composition of the potassic white micas (fig. 6 A and 6 B) is comparable with that of Falerna.

Malvito Unit.

The sequence consists of metabasites (massive porphyric diabases, pillow lavas and pillow breccias, hyaloclastites) stratigraphically covered by slightly metamorphosed cherts, graded calcareous microbreccias and fine grained *Calpionella* limestones, with intercalated thin phyllitic layers (Jurassic-Lower Cretaceous) (AFCHAIN, 1961; BOUSQUET, 1961; DIETRICH & SCANDONE, 1972).

The unit tectonically overlies the Diamante-Terranova or the Gimigliano Units, and tectonically underlies the « unità dioritico-kinzigitica ».

The metamorphism belongs to the low-grade of the greenschist facies, with occurrence of lawsonite.

Preliminary radiometric data indicate an Oligocene (about 32 MY) age of the metamorphism (3).

We could not study the b_0 values of the white micas in the phyllitic beds, because of their high carbonate contents.

4.2.3. *Bagni Unit.*

The unit consists of a pre-Triassic basement unconformably overlain by a thin Mesozoic sedimentary cover (SCANDONE, 1971; DIETRICH & SCANDONE, 1972; BONARDI *et alii*, 1973). The basement is made up of phyllites and metapsammites (mainly quartzites and metagraywackes), with subordinate metaconglomerates. Locally basic rocks are present (chlorite, albite, epidote, actinolite, horneblende, calcite). The sedimentary cover, known only in the Guardia Piemontese-Bagni River-Acquappesa region, consists of slightly metamorphic conglomerates and quartzites like « Verrucano », dolomites (Triassic), limestones and cherts (Jurassic-Lower Cretaceous?).

The sedimentary cover of the Bagni Unit shows a very low grade Alpine metamorphism; the degree of metamorphism in the basement is also low (greenschist facies without traces of high pressure minerals), but in any case higher than in the sedimentary cover. The difference in metamorphic degree shows that the basement has been affected by the Hercynian as well as by the Alpine metamorphism. The exact age of the Alpine metamorphism is unknown, but it should not be older than Middle Cretaceous.

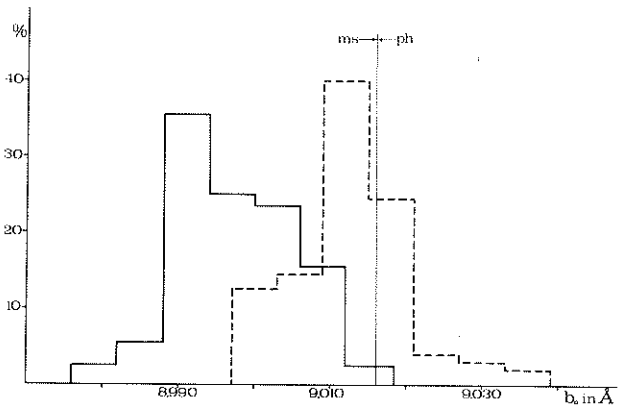

fig. 7 — Bagni Unit. b_0 value frequency histograms. Unbroken line: Pomo phyllites; dashed line: Bagni phyllites.

The histogram of the potassic white mica b_0 values in the Bagni phyllites (fig. 7) covers a really wide range, since they vary from muscovitic to phengitic composition. The muscovites are quantitatively prevalent. This fact can be explained by considering the polymetamorphism of the phyllites: the Hercynian metamorphism may be responsible for the original prevalent

(3) Personal communication of L. CIVETTA and M. CORTINI, Naples. K/Ar age determined from total rock and plagioclase.

muscovitic composition (LP), the Alpine one for the partial phengitization (HP). The wide dispersion of the b_0 values witnesses an incomplete phengitization process, in agreement with the very low grade Alpine metamorphism. We could not relate the degree of phengitization to a peculiar composition of the rock or to a particular tectonic position.

Of course we tried to analize the composition of the potassic white micas from the Mesozoic sedimentary cover, in order to distinguish the effects of the Alpine and Hercynian metamorphisms, but the results were unsuccessfull, lithotypes suitable for this investigation being absent.

In the Sila Piccola region COLONNA & PICCARRETA (1975) recognized a Fiume Pomo phyllite Unit affected only by Hercynian metamorphism. We identify this unit with the Bagni Unit, because it consists of the same lithologies and occupies the same tectonic position. The histogram of the potassic white mica composition of the Bagni phyllites and that one of the Fiume Pomo phyllites (COLONNA *et alii*, 1975, fig. 2 d) look very different. In order to correlate comparable elements, we replotted the histogram relative to the Pomo phyllites, using the original data of COLONNA *et alii* (4), but following the criteria adopted for the construction of the other histograms contained in this paper (the groups of classes have been defined by the s value, and the class distribution is symmetric to the $\bar{b}_0$). The new obtained histogram is shown in fig. 7, and appears once again very different from the Bagni phyllites one. All the sample b_0 values lie in a muscovite range, while the Bagni sample b_0 values vary from a typical muscovitic composition to a typical phengitic composition. We are convinced that the Pomo and the Bagni phyllites belong to the same Alpine tectonic unit, and that the Bagni phyllites at least underwent both Hercynian and Alpine metamorphism, as witnessed by the metamorphosed Mesozoic sedimentary cover. In the Gimigliano Unit we have seen that the Alpine metamorphism was not homogeneously developed in the whole of Northern Calabria, but—at least relatively to the greenschist event—a variation in southward and eastward direction has been recognized. Because of this fact several sequences have been selected in order to guarantee homogeneous collections of samples. The results also, therefore, have been assembled in homogeneous classes. For the Bagni Unit too we can expect regional variations in the Alpine metamorphism (5). Present knowledge does not allow to recognize the distribuition of the metamorphic zones and therefore to group the available data in homogeneous classes. The histogram of the Bagni phyllites may be considered indicative for the variability of the metamorphism in the northern part of the Catena Costiera and in Sila, while the histogram of the Pomo phyllites may be indicative for the variability in the southern part of the region. This picture suggests that the Alpine metamorphism acted with higher baric conditions in the northern area, and also allows to hypothetize a Hercynian baric gradient having the same direction as the Alpine one.

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(4) We are grateful to the Authors who provided us with their original b_0 values. From these data $n=76$, $\bar{x}=8.997$, $s=0.006$.

(5) A possible distribution of the metamorphic zones in the Bagni Unit should not coincide with the distribution recognized in the Gimigliano Unit: the Bagni Unit, in fact, occuppied its tectonic position upon the Gimigliano Unit when both units had been affected by their own metamorphism.

4.2.4. *Castagna Unit.*

Above the Bagni Unit and below the « unità dioritico-kinzigitica » in Sila and in the Catena Costiera exists an assemblage of gneisses, augengneisses and granites s.l., often in migmatitic association, and micaschists, known in literature as the « Castagna nappe » (DUBOIS, 1966). This assemblage has not yet been sufficently studied, so that we do not know whether this « Castagna nappe » represents a single Alpine tectonic element or includes more Alpine units. PICCARRETA & ZIRPOLI (1974) investigated the potassic white micas from micaschists occupying the lower part of the Castagna Unit. In fig. 8 we report the histogram of the micaschist b_0 values, plotting the original data (kindly provided by the Authors) following the same criteria adopted for the construction of the other histograms contained in this paper. All

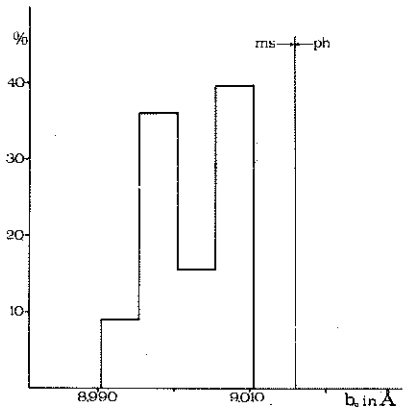

fig. 8 — Castagna Unit. b_0 value frequency histogram (from the original data of PICCARRETA & ZIRPOLI).

the b_0 values lie in the muscovitic range, but about 40% has a more phengitic composition. According to PICCARRETA & ZIRPOLI the HP Alpine metamorphism was responsible for a partial phengitization of the Hercynian muscovites. This interpretation is supported by further investigation carried out by COLONNA & PICCARRETA (1975), who recognized Alpine metamorphic effects recorded by lawsonite and Na-amphiboles blastesis in the Castagna Unit micascists.

4.2.5. « *Unità dioritico-kinzigitica* ».

The « unità dioritico-kinzigitica » is the highest recognized unit of the Alpine chain in Calabria. It shows a wide variability of lithotypes: biotite-garnet gneisses with sillimanite and cordierite, fine grained biotite gneisses, amphibolites, amphibolic gneisses, granulites, Ca-silicate marbles and diorites s.l. Aplitic and pegmatitic veins are frequent.

The metamorphic history of the unit is very complex: the most evident metamorphic aspect, pre-Alpine in age, is of LP/HT. The main post-Hercynian events consisted of a strong uplift of lower continental crust (6) (LOREN-

(6) This event is recorded by the ages determined by K/Ar and Rb/Sr investigations, ranging from 103 to 252 MY (BORSI & DUBOIS, 1968; CIVETTA *et alii*, 1973).

ZONI & ZANETTIN LORENZONI, 1975), followed by the involvement of this crust in the building up of the Alpine chain. QUITZOW (1935) recognized lawsonite, related to the orogenic transport of the unit.

We did not study potassic white mica b_0 values in the « unità dioritico-kinzigitica » because there are no rocks suitable for such investigations.

4.3. « INCERTAE SEDIS » UNITS.

We shall describe here three units whose relationships with the Alpine and the Maghrebide-Apennine chains have not yet been clarified: the Longobucco, the Mt. Gariglione and the Stilo Units.

The first two outcrop widely in Sila Grande and Sila Greca, while the Stilo Unit outcrops in Serre and Aspromonte, Sila Piccola and Catena Costiera.

The Stilo Unit overthrusts the Alpine chain. The age of this orogenic transport is post-Aquitanian and pre-Tortonian, the youngest transported terranes being Burdigalian and the oldest post-orogenic ones being Tortonian (perhaps Serravallian).

The Mt. Gariglione Unit tectonically overlies the Longobucco Unit and also the « unità dioritico-kinzigitica ».

The relationships between the Longobucco Unit and the units of the Alpine chain are unknown at present. In Sicily (Peloritani Mts) the Longi Unit, equivalent to the Longobucco one, tectonically underlies the Alpine chain units (OGNIBEN, 1960).

4.3.1. *Longobucco Unit.*

The unit consists of a pre-Triassic basement, unconformably overlain by a not metamorphic sedimentary cover (MAGRI *et alii*, 1963; STURANI, 1968).

The basement is made up of phyllites with metagraywackes, acid metavolcanites and slightly recrystallized limestones. These terranes were intruded and thermically metamorphosed by granites s.l. in Hercynian time (BORSI & DUBOIS, 1968) (7). The most common lithotype consists of granites with megacrystals of K-feldspar. Injection migmatites and dikes of porphyrs are widely developed.

The sedimentary cover consists of conglomerates and sandstones like « Verrucano » (Lower Jurassic), basinal limestones, marls and clays (Lower Jurassic-Cretaceous); conglomerates, marls and siltstones (Paleogene) (AFCHAIN, 1962; MAGRI *et alii*, 1963; STURANI, 1968).

The Longbocucco pre-Triassic basement is not yet well known. We have examined only the phyllites, which are suitable for diffractometric analyses.

In the histogram (fig. 9) the potassic white mica b_0 values are shifted towards phengitic terms, so that they move away from the range of values considered typical of the Hercynotype metamorphism, in which, for instance, the Stilo phyllites perfectly lie. At present, the highest Hercynotype metamorphism b_0 values are not higher than 9.005 Å (SASSI, 1972; SASSI & SCOLARI, 1974). The Longobucco histogram may be interpreted in different ways. The

(7) In the paper of BORSI & DUBOIS the 1 b, 1 c and 1 d samples belong to the Longobucco Unit, while the 1 a sample belong to the Mt. Gariglione Unit.

first possibility is that the Hercynian metamorphism acted upon this unit with exceptionally high pressure; the second one is that the Longobucco phyllites are affected only by Caledonian metamorphism; the third possibility is that the phyllites are polymetamorphic, and a low-pressure Hercynian metamorphism was superimposed upon a higher-pressure Caledonian metamorphism, without complete obliteration of the original characters. We have at present no data for a definitive choice.

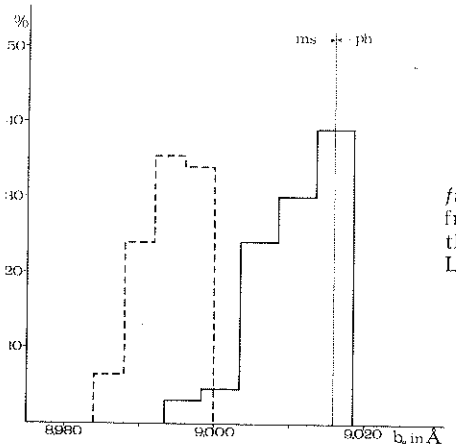

fig. 9 — Stilo and Longobucco Units. b_o value frequency histograms. Dashed line: phyllites of the Stilo Unit; unbroken line: phyllites of the Longobucco Unit.

4.3.2. *Mt. Gariglione Unit.*

The Mt. Gariglione Unit outcrops in Sila Grande, and is still poorly studied. It consists of granites s.l. intruded into gneisses. The igneous rocks are represented by several lithotypes: granites s.s., tonalites, diorites, gabbros. Porphyrs, porphyrites and microgranites are also widespread. The granites often contain gneissic xenolithes. The intruded rocks consist of biotite gneisses with or without garnets. Thermal metamorphism generally exists close to the magmatic contacts, producing andalusite and sillimanite fels. Injection migmatites are very frequent. Both granites and gneisses are irregularly crossed by aplites.

The age of the granite intrusion is Hercynian (BORSI & DUBOIS, see note below (7)). No traces of regional metamorphism younger than the thermal recrystallization is present

We did not study the potassic white mica composition, suitable lithotypes being absent in the Mt. Gariglione Unit.

4.3.3. *Stilo Unit.*

The unit consists of a pre-Triassic basement, unconformably overlain by a not metamorphic sedimentary sequence (8). The basement is made up of two Hercynian complexes, both intruded by the same stock of Carboniferous granites (COLONNA *et alii*, 1973). The first complex (Mammola paragneisses) is affected by a low-grade amphibolite-almandine facies; the second one (Stilo-Pazzano phyllites) is characterized by a very low degree of meta-

(8) According to LORENZONI & ZANETTIN-LORENZONI (1975) the original paleogeographic belt of this unit was close to the « unità dioritico-kinzigitica » belt.

morphism, which is at the boundary of the diagenesis (COLONNA *et alii*, 1973). The Mammola paragneisses and the Stilo-Pazzano phyllites are unconformably stratigraphically overlain by conglomerates, sandstones and siltstones like « Verrucano », dolomites (Triassic), shallow water limestones (Jurassic- Aquitanian), conglomerates, sandstones and clays (Lower Miocene) (BONARDI *et alii*, 1971).

The regional metamorphism of the Stilo-Pazzano phyllites is certainly Carboniferous, the granites being Carboniferous and the youngest beds affected by metamorphism being Upper Devonian (AFCHAIN, 1969; DE CAPOA BONARDI, 1970; GOERLER & IBBEKEN, 1970); in the whole basement there is no trace of regional metamorphism subsequent to the intrusion of the Hercynian granites, and the Mesozoic sedimentary cover is absolutely untouched.

In Central Calabria the Stilo Unit overthrusts almost all units of the Alpine chain (LORENZONI & ZANETTIN LORENZONI, 1975); in Southern Calabria the Stilo Unit forms the greatest part of the eastern side of the Serre mountains, tectonically overlying the « unità dioritico-kinzigitica » (BORSI *et alii*, in preparation).

In fig. 9 the potassic white mica b_0 values are plotted. All micas have an evident muscovitic composition, corresponding to a LP metamorphism, peculiar of the Hercynian metamorphism, and lie in a very narrow range (DI PIERRO *et alii*, 1973) (9).

5. CONCLUSIVE REMARKS

In fig. 10 we summarize the available data on the composition of the potassic white micas contained in the Central and Northern Calabria phyllites.

In our analysis we do not consider, in a first approach, the curves relative to units which underwent both Hercynian and Alpine metamorphism (Castagna, Pomo and Bagni) and the curves relative to units which possibly have been touched by both Caledonian and Hercynian metamorphism (Longobucco).

The simplest curves are those relative to the Stilo (Hercynian) and to the Campotenese (Alpine) units. Both underwent a single low-grade metamorphic event of the greenschist facies, with constant characters over the whole area in which they outcrop, and with similar thermal conditions acting upon both units. Now, if we consider the other Alpine units (Gimigliano, Diamante-Terranova), we see that they are represented by curves lying in a narrow range close to the Campotenese-Cetraro curve on the right side of the diagram, while the curve of the Hercynian Stilo phyllites lies on the opposite side of the diagram. The results of the investigation in Calabria, therefore, support the general model proposed by SASSI (1972), which postulates an easy discrimination of the Hercynotype and of the Alpinotype metamorphisms (ZWART 1969) by the b_0 values of the potassic white micas.

(9) In the diagram of fig. 9 more data than in the paper of DI PIERRO *et alii* (1973) have been plotted. Moreover the available data concerning the Stilo phyllites relative to Central Calabria have been joined with those relative to Southern Calabria, these phyllites belonging to the same tectonic unit.

Within the Alpine units the ophiolitic ones present a more complicated metamorphic history than the Campotenese-Cetraro Unit, as they underwent two metamorphic events, the first of the blueschist facies, the second of the greenschist facies.

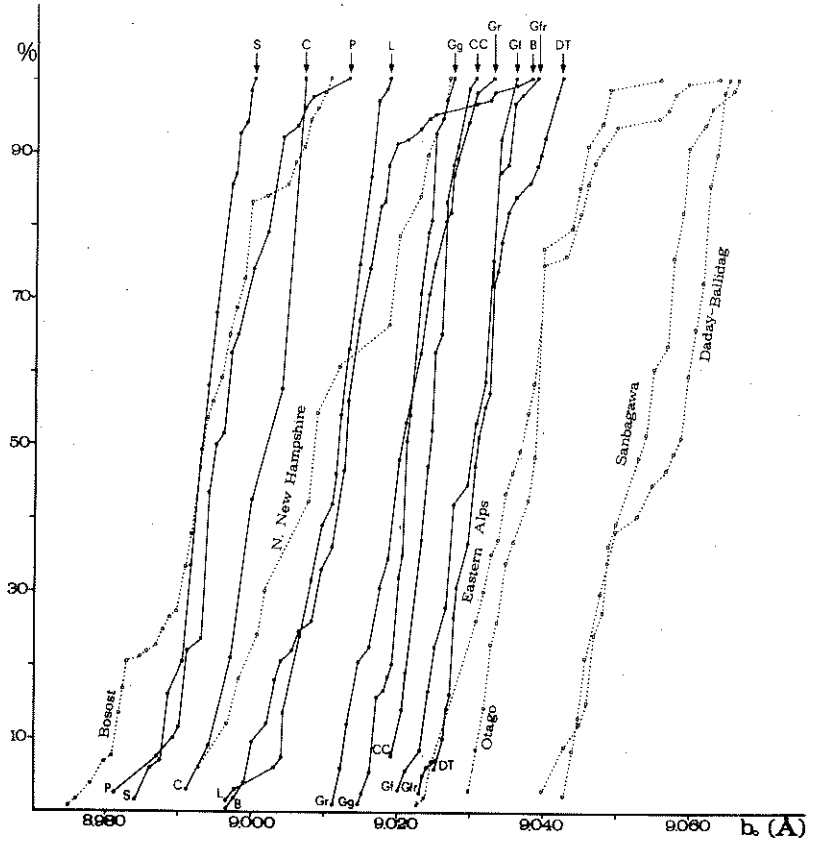

fig. 10 — Cumulative frequency curves. S) Stilo Unit. C) Castagna Unit. P) Pomo phyllites (Bagni Unit). L) Longobucca Unit. G) Gimigliano Unit: Gg) Gimigliano sequence; Gr) Reventino Mt. sequence; Gf) Falerna sequence; Gfr) Fuscaldo-Rose sequence. CC) Campotenese-Cetraro Unit, Campotenese sequence. B) Bagni Unit. DT) Diamante-Terranova Unit.

The blueschist facies metamorphic event is well preserved in the Diamante-Terranova Unit, while the greenschist facies event deeply obliterated the HP mineral assemblage in the Gimigliano Unit. Gradients of this second event directed southwards and eastwards are recognizable.

The metamorphic history is recorded in the frequency cumulative curves.

— The curve relative to the Diamante-Terranova Unit is representative of the most phengitic terms. The complexity of the curve, rather high if compared with the very simple Stilo and Campotenese curves, may be indicative of a metamorphic evolution not uniform within the whole body.

— The four curves relative to the Gimigliano Unit cover quite a wide range. The curves relative to the Monte Reventino and to the Gimigliano phyllites lie in a range of low b_0 values (8.996-9.039), the greenschist event having deeply obliterated the blueschist one. The curves relative to the

Fuscaldo-Rose and Falerna phyllites, on the contrary, lie near the Diamante-Terranova curve, the greenschist event having acted here with lower intensity.

— The Bagni Unit is represented by two curves, relative to the Bagni and to the Pomo phyllites. The first curve is complex, and covers a very wide range of the b_0 values, in agreement with the polymetamorphism of the unit, which underwent both Hercynian and Alpine metamorphism. Nevertheless only a short segment of the curve, corresponding to about 10% of the population, has a more gentle slope, suggesting significant phengitization effects only on this part of the population. The curve relative to the Pomo phyllites (according to the data of COLONNA *et alii*, 1975) covers a clearly different range of the b_0 values, but has a general trend very similar to the Bagni phyllite trend. This similarity suggests the possibility that the two curves (except for the short upper segments) record different baric conditions acting in the northern (Bagni) and in the southern (Pomo) areas already in Hercynian times. It is probable that if we had discriminated among different sequences in different areas (as we did within the Gimigliano Unit) we could have got more information about the metamorphic evolution and about possibile baric gradients in Hercynian and Alpine times.

— The curve representative of the Longobucco Unit lies in an intermediate range of the b_0 values, between typical Hercynian and typical Alpine values, but more close to the latter. The general trend is very simple, and only few terms showing a more muscovitic composition (less than 10% of the whole population) lie on a segment having a more gentle slope. The trend of the curve does not give any indication as to whether the Longobucco phyllites underwent Hercynian or Caledonian metamorphism, or both. In the first case, of course, baric conditions higher than in the metamorphism of the Stilo phyllites would have acted.

— The curve representative of the Castagna Unit is very simple, and does not point out the two metamorphic events recognized by COLONNA & PICCARRETA (1975).

Comparing our frequency cumulative curves with those analyzed by SASSI & SCOLARI (1974), it can be seen that the curve representative of the Stilo phyllites more or less corresponds to the Bosost curve, while all the curves representative of the units which underwent only the Alpine metamorphism lie left of the curve representative of the Austridic Permo-Mesozoic cover of the Eastern Alps (Barrovian metamorphism). Also the curve relative to the Pomo phyllites is similar to the Bosost curve, while the curve relative to the Bagni phyllites is shifted towards the curves typical of Alpine metamorphism. We would like to underline that the Pomo phyllites represent the most southern part of the Bagni Unit in the investigated area, and here the Alpine metamorphism effects were very weak or completely absent (COLONNA *et alii*, 1975; COLONNA & PICCARRETA, 1975), and the Hercynian metamorphism probably acted under baric conditions lower than in the northern area.

SASSI & SCOLARI (1974) propose an empirical scale of the b_0 values in order to distinguish different kinds of metamorphism in low-grade metapelites. Comparing the $\overline{b_0}$ values of the Calabria phyllites (see Table 2) with the $\overline{b_0}$ values of this scale (Table 3) we can deduce:

TABLE 3

EMPIRICAL SCALE OF THE b_o VALUES IN LOW-GRADE METAMORPHISM OF PELITIC SCHISTS (after SASSI & SCOLARI, 1974)

FACIES SERIES	1	2	3	4	5	6
Mean b_o values	≅8.990	≅8.995	≅9.010	9.020-9.025	≅9.035	≅9.055

1) Low-pressure metamorphism (and+cord) without chlorite-zone (for ex.: Bosost).
2) Low-pressure metamorphism (and+cord) with chlorite-zone (for ex.: Hercynian metamorphism in Eastern Alps).
3) Low-intermediate pressure metamorphism (and) with the chl → bio → alm sequence in the greenschist facies (for ex.: New Hampshire).
4) Typical barrovian metamorphism (Dalradian metamorphism in Scotland).
5) Barrovian-type metamorphism, with simultaneous first appearance of biotite and almandine (for ex.: Otago).
6) Glaucophanitic greenschist facies (for ex.: Sanbagawa).

— the K-white mica $\overline{b_0}$ value in the Stilo phyllites corresponds to the facies series 2, indicative of a LP metamorphism;

— the K-white mica $\overline{b_0}$ value in the Campotenese-Cetraro Unit and in the Gimigliano Unit p.p. (Reventino Mt. and Gimigliano sequences) corresponds to the facies series 4 (Barrovian metamorphism like Dalradian);

— the K-white mica $\overline{b_0}$ value in the Diamante-Terranova Unit and in the Gimigliano Unit p.p. (Fuscaldo-Rose and Falerna sequences) is close to the facies series 5 (Barrovian metamorphism like Otago). The b_0 value of phyllites in which blueschist characters are recognizable (i.e. Diamante-Terranova phyllites) is, in any case, far from those values considered typical of the glaucophanic greenschist facies like Sanbagawa;

— the K-white mica $\overline{b_0}$ value in the Longobucco phyllites should indicate, if they are monometamorphic, a low-intermediate pressure metamorphism like New Hampshire.

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