Verh. Geol. B.-A. | Jahrgang 1971 | Heft 2 | S. 326—343 | Wien, Juni 1971

Petrological and Geochemical Research on the Rocks of Predazzo and Monzoni (North Italy)

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Carried out during the years 1962—1969 in the Institute of Mineralogy and Petrography, University of Bologna.

Schlüsselwörter
Nord-Italien
Predazzo - Monzoni
Petrologie und Geochemie

Abstract

The results of the petrological and geochemical research, carried out during eight years in Mineralogical and Petrographic Institut of the University of Bologna, on the eruptive complex of Predazzo and Monzoni in North Italy, are briefly resumed.

Introduction

The eruptive massif of Predazzo and Monzoni has aroused and still arouses a particular interest, for both its problematic position in the geological structure of the Dolomites region, and its varied and complex petrographic composition. As it is known, its main distinctive feature is an extreme variety of rocks: in addition to monzonites, indicated by ROMBERG in 1902 as the normal standard rock of intrusion, there occur considerable masses of granites, syenites and more basic rocks having a quite variable composition.

The intrusive massif, covering an area of about 10 sq. km., is situated in the western Dolomites zone, that was affected in the Trias by an intense magmatic activity which gave rise to mighty volcanic formations, called by former Authors "porphyrites and melaphyres". The Triassic age of the latter formations is clearly proved by their lie relations with Ladinian-Carnian dolomitic calcareous formations. These relations indicate that the volcanic activity, which started and developed during the whole Ladinian in the Marmolada area (and adjacent Fassa, Gardena and Livinallongo areas), giving rise to the typical heteropias of facies, would have spread all over the southern area (the Fassa valley) by the end of the middle Trias (VARDABASSO, 1950).

The lie relations indicate that the intrusive mass settled after vulcanites; but we have no other references for a more precise chronological determination of the massif. The problem of age and of genetic and chronological relations between intrusive rocks and volcanic formations during the Trias has been arousing the

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interest of many investigators for a long time. Former Authors (HUBER, DOELTER, HOERNES, etc.) realized that a substantial analogy existed between the porphyritic-melaphyric group and the monzonitic intrusion, thus ascribing also the latter to a Triassic age. Others, such as SALOMON, GORDON, PHILIPP, PENK, VARDABASSO, etc., on the contrary, related the settlement of the intrusive mass to alpine tectonics and consequently they ascribed the Predazzo intrusion to a tertiary age.

Starting from a different interpretation of Predazzo area tectonics, in 1955/56 LEONARDI resumed the assumption that the intrusive mass belonged to a mesozoic age. In fact, according to this Author, the dislocations occurring in the rocky masses of Predazzo eruptive center may be related to volcano-tectonic phenomena rather than to alpine tectonics (LEONARDI, 1960). Therefore, as there is no causal relation between alpine tectonics and intrusion settlement, the latter does not turn out to be necessarily Triassic, but it can be chronologically related to the Triassic volcanism.

Let us omit now, for obvious reasons, to examine the single researches made on Predazzo and Monzoni, which amount to a few hundreds of publications representing the result of an extensive work developed in the last 150 years (VARDABASSO, 1922); nevertheless a good deal of the problems brought forward still expect an answer. For example, in addition to the problem of the age of these rocks, of their tectonics and succession, the real distribution of the various rocky facies, particularly of monzonites, was still to be determined, its relations with effussive rocks, the existence of different varieties, and their possible common origin from a primary magma. Furthermore, the phenomena of contact, the gradual changing over the various facies of acid rocks, the small masses of nephelinic rocks, and the numberless veins crossing eruptive and sedimentary rocks, which are quite different in nature (Tinguaitic, melaphyric, camptonitic, essexitic, etc.) constitute as many subjects being well-known through the long and accurate studies carried out by the previous Authors, but still expecting to be cleared up in their details, by taking into consideration the whole formation of Predazzo and Monzoni in a more complex unitary frame.

That is why P. GALLITELLI was induced, about ten years ago, to organize a series of systematic researches on this complex and interesting zone, with the purpose of gathering new useful data to facilitate the solution of at least a few of the above mentioned problems. Thus these researches have been included in the research programme of the National Committee for the geologic and petrographic study of Alps of the National Research Council, as subject of work of the IX. section with seat in Bologna, in the Institute of Mineralogy and Petrography of the University.

But it is thanks to my collaborators of the Institute of Mineralogy and Petrography, who for some years have been developing ticklish field works and laboratory researches with enthusiasm and competence, as well as to the precious co-operation offered by the Laboratory of Nuclear Geology of the University of Pisa, that it has been possible to take into consideration the usefulness of resuming investigations on the Predazzo-Monzoni area.

Therefore I wish to sincerely thank the Prof. EZIO TONGIORGI, principal and the Prof.s BORSI and FERRARA of the said Institute for their generous response to our requests, as well as all the researchers of the Institute of Mineralogy of Bologna, since what I am going to express, is just the outcome of their work [1]).

Of course we did not develop all the previously mentioned subjects: a few of them still are and will be the object of further researches, therefore we shall only report the unfailing data gathered up to now, as e. g. nephelinic rocks, different groups of basic dikes ecc.

The rocks of Predazzo

We started the research on Predazzo rocks by studying granitic rocks (PAGANELLI, TIBURTINI, 1964; EMILIANI, GANDOLFI, 1964; GANDOLFI, 1966 a, 1966 b; EMILIANI, VESPIGNANI-BALZANI, 1968; BONARELLI, EMILIANI, VESPIGNANI-BALZANI, 1966, 1967; DEL MONTE, PAGANELLI, TIBURTINI, 1966), that are considered by ancient Authors as normal granites and among the latest of the eruptive complex. Of 300 samples homogeneously collected in the granitic mass, 150 have been studied on thin section: 58 have been modally analysed and 11 have been chemically analysed. From the observations made we can infer that Predazzo granite has no constant features, as the fresh rock of granosyenitic type, moving from eastern to the western end of the outcrop, grows gradually rich in quartz, whereas biotite and plagioclase of intermediate temperature and with the nucleous with a maximum content of 40% on An, are respectively replaced by chlorite-muscovite and low-temperature albite.

Chemical analyses point out the alkaline character of granosyenite, which in the facies with higher quartz content belong to Niggli types "aplitisch-granitisch" "yosemitaplitisch" "yosemitgranitisch" "engandinitisch", whereas the facies scanty in quartz belong to "rapakivitisch" and "granosyenitisch" types. Spectrographic determinations on 81 samples of the different facies have pointed out low strontium contents and very low barium contents in comparison with the average contents of these elements in granites all over the world. Moreover, in albitized facies a further strontium impoverishment occured, so that it is possible to infer that a part of the granite underwent deep actions which have altered its primary composition (EMILIANI, VESPIGNANI-BALZANI, 1964).

A series of determinations by the Potassium-Argon and Rb/Sr methods (BORSI, FERRARA, 1967), both on the rocks and on the individual minerals (feldspar and biotite), have given concordant results leading to establish the age of the granitic intrusion in 230 million years. Values of 215 million years are obtained for deuterized albitic granite. This leads to admit that the granitic intrusion, occured 230 million years ago, underwent an alteration process after its settling-down, a process which may be valued with some probability as lasting 15 million years.

[1]) Collaborate to these research: dr. BONARELLI-MARZOCCHI L., dr. BONDI M., prof. EMILIANI F., Sig. FABBRI B., dr. GANDOLFI G., dr. LUCCHINI F., dr. MEZZETTI R., dr. MORANDI N., dr. PAGANELLI L., prof. PIRANI R., dr. ROSSI P. L. M., prof. SIMBOLI G., dr. TIBURTINI R., dr. VESPIGNANI-BALZANI C.

As regards the rocks indicated as syenitic in the geologic maps, observations on a few hundres of samples (DEL MONTE, PAGANELLI, 1966; PAGANELLI, 1967 a, 1967 b) have pointed out that syenites "sensu stricto" are limited to two small outcrops, as most of the so-called "syenites" can be referred to leucomonzonites, latites and monzonites, like on the southern slope of Mount Mulat.

Now, if we consider the rocks that are undoubtedly the most distinctive of the whole zone, i. e. monzonites, our observations (LUCCHINI, SIMBOLI, 1970 b) make it possible to state that in the Predazzo zone these dont reach 50% of the outcrops marked on geologic maps as the remaining consists in more acid rocks, i. e. leucomonzonites, or monzo-syenites changing into granosyenites and syenites, and partly in more femic ones, gradually shading into monzodiorites, monzogabbros, gabbros and pyroxenites. This is a very important fact, which for some of these rocks, makes it unlikely that it is a question of distinct and subsequent intrusions as ROMBERG supposed in the past.

The recognized facies are:

1. PRAGATTAI's leucomonzonite, with a Si-monzonitic-leucomonzonitic chemism (PAGANELLI, 1967) corresponding partly to the syenites of the VARDABASSO's map.

2. Medium-grained monzonite, corresponding to LEITMEIER's augitic-uralithic types and which we might call "normal type", with a si-monzonitic to monzonitic chemism (LUCCHINI, SIMBOLI, 1970 b).

3. Monzodiorites and rocks types till diorites, gabbros and pyroxenites (LUCCHINI, SIMBOLI, 1970).

In all these facies the crystallization succession is uniform and corresponding to the classic scheme of intrusive magmas: there is a considerable prolongation of the crystallization of accessory minerals which sometimes not scanty. The composition and the thermic state of the plagioclases, often zoned, is variable in the different rock types.

The chemical character of the most widespread types corresponds to NIGGLI's si-monzonitic leucomonzonitic, monzonitic and monzodioritic, with a rather high value of the parameter k (generally included between 0,40—0,48), which points out a clear mediterranean trend and their belonging to the alkaline-potassic series. The more basic gabbrodioritic types have an alkali-calcic character, showing an evident mediterranean trend.

Relationship of monzonitic rocks with Triassic lavas

If on one hand the close relationship of monzonites with syenitic rocks is to be ascribed to the ascertained presence of transitory facies, on the other the relations with Triassic lavas were uncertain and ill-defined, if TSCHERMACK too in 1869 noticed some analogy of chemical composition between the two rocks.

A new study undertaken by G. SIMBOLI (1966) on the lavas of Avisio right-hand side in Val Gardonè and Val Scalotta, which were partly in immediate contact with monzonites, and carried out on a larger number of samples, allowed to ascertain that a part of these lavas in its bottom paste contains considerable

quantities of potassic feldspar, that microscopic research has missed up to now, whereas the chemical composition corresponds to that of Predazzo monzonitic rocks owing to its alkaline-potassic character.

The numerous chemical analyses which have been carried out, through NIGGLI's representation, of RITTMANN's σ index and of PEACOCK's index, made it possible to determine the serial character of the complex, which, starting from a medium (alkali-calcic) pacific type passes through a weak pacific type to a weak mediterranean type and finally to a medium mediterranean type. Therefore it is possible that these rocks represent successive fractions of the series of differentiation of an alkali magma.

These new data on the close chemical bonds between intrusive and effusive rocks, lead to think that both phenomena may be contemporary.

The intrusive rocks of Monzoni

Now, if we examine the intrusive rocks outcropping north of Predazzo in the Monzoni Area, and that have aroused the interest of numerous students' generations, we can easily realize that some problems, such the intrusion age, its probable genesis, have been extensively dealt with, whereas the definition of the petrographic types and their distribution on the field, which is so important to draw general conclusions on the whole rocky complex, have not been sufficiently developed.

The research made on the whole Monzoni area (DEL MONTE, PAGANELLI, SIMBOLI, 1967) and on many hundreds of samples, have allowed to recognize 6 facies spanning a long interval of composition:

7%	ultrafemites (pyroxenites) with about 90% of mafic components, chiefly pyroxenes and with basic plagioclases.
3%	mafitic gabbros with about 75% of mafic components, chiefly pyroxenes, and with plagioclases: sometimes also small amounts of orthoclase are present.
10%	gabbros with plagioclases, pyroxenes and olivine.
20%	monzogabbros with plagioclases, pyroxenes, olivine and orthoclase.
20%	diorites and leucogabbros with plagioclases and pyroxenes.
40%	monzodiorites with plagioclases, pyroxenes, orthoclase and often quartz.
100%	

All the facies contain moderate quantities of biotite, and present macro- and microscopic differences that have made possible their recognition on the soil.

The color index and the presence or absence of olivine have been particularly significant for the classification.

The detailed study of plagioclases (DEL MONTE, PAGANELLI, 1967) proved to be quite interesting since they show a variable composition and structure in the various rocky facies, tending to pass from the disordered to the mainly ordered state as anorthite contents diminish from the most basic rocks, i. e. pyroxenites, to the least basic ones down to monzonites.

Some new data, which are useful to interpret the genetic and evolutive process of at least a part of Monzoni rocks have been obtained from the study of enallogenous inclusions contained therein (DEL MONTE, 1966). Thus we could ascertain that crystalline xenoliths with potassic feldspar, spinel and corundum are particularly abundant in the monzonitic facies, whereas they are rare in monzo-gabbros. Owing to their mineralogical composition, texture and alteration of thin footwalls of potassic feldspar with other ones rich in ercinite, pleonaste and corundum, and to their chemical composition corresponding to that of phyllitic rocks, these inclusions seem to be derived from pelitic rocks: the relict structures, with one or two series of Surfaces S, suggest the hypothesis that it is a question of phyllites of the crystalline bed. Their presence only in the monzodioritic facies, characterized by hypersthene crystals with plagioclase nuclei rich in anorthite (70—80% An) leads DEL MONTE to consider the hypothesis of a partial synthessis of phyllitic shreds which would have led the primary gabbrodioritic composition of at least a small portion of the Monzoni rocky complex towards monzo-gabbroid and monzo-dioritic terms.

The chemical character of gabbroid and dioritic rocks is of the alkali-calcic type with a slight tendency towards the sodic series (DEL MONTE, PAGANELLI, SIMBOLI, 1967), that of monzodioritic and monzogabbroid rocks is of the alcali-calcic type with a potassic tendency or even, more rarely, towards the sodic series.

From a more general viewpoint, and according to NIGGLI's and BURRI's schemes, the prevailing character of the rocks on the ground of *al* and *fm* values turns out to be isophalic, although some samples have a more mafic character. On the ground of the alk/al ratio, they have a character from medium alkaline to relatively poor in alkalis; as for *c* values, they turn out to be from *c* normal to *c* rich.

From the considerations so far developed, it appears to be clear that the serial position of these rocks is intermediate, as they do not have a final character allowing to include them in a simple evolution scheme. The intermediate character of Predazzo and Monzoni rocks led STARK, as it is known, to define a "Predazzo Province", and NIGGLI to a "mixed Province"; however, these denominations, though they expressed an actual state, did not bring a decisive contribution to the better comprehension of the genesis of these rocks.

Now, if we consider the positions of the representative points of the Monzoni rocks analysed in our Institute (DEL MONTE, PAGANELLI, SIMBOLI, 1967), we must observe that they fall astride the dashed separation line or even in the field of Predazzo rocks. This proves that the distinction between Predazzo and Monzoni, suggested by BURRI, ROMBERG, is not so clearly defined as it first seemed, for the new data collected (300 samples, 150 modal analysis, 16 chemical analysis LUCCHINI, SIMBOLI, 1970 b) particularly point out the bonds existing between the two tendencies and put forth the hypotesis of the existence of a complete evolution series between Predazzo and Monzoni rocks, most of which are basic, showing a pacific-atlantic character, whereas the more acid ones have a pacific-mediterranean character.

The same Author, in a recent work (BURRI, 1961) resuming the opinion already expressed by other, considers Predazzo and Monzoni as belonging to the young Alpine province and precisely to the syenitic tendency of the latter, and he includes the whole eruptive complex in the synorogenetic or late orogenetic plutonism, with a character from pacific to mediterranean, which can be subdivided into two series, a tonalitic-granodioritic one (pacific) and a syenitic one (mediterranean).

Relationship of Predazzo and Monzoni rocks

The recent results on the determination of the absolute age of Predazzo rocks extended to the various rocky facies appearing in the Monzoni (BORSI, FERRARA, 1967; BORSI, FERRARA, PAGANELLI, SIMBOLI, 1968) have proved that all the Predazzo and Monzoni intrusive rocks are contemporary and all of them have an age which can be valued around 230 million years. If we add to these the results of SIMBOLI's research (1966), which have proved, as mentioned above, the perfect correspondence of mineralogical and chemical composition of volcanic rocks (the so-called porphyrites) with the intrusive rocks of monzonitic type, we can no longer accept the premises of the above mentioned hypotheses and we can no longer support the idea, put forth by several Authors, who deemed that Predazzo and Monzoni rocks originated in two different cycles: volcanic rocks during the Trias, whereas intrusive rocks, chiefly granites, should have been at least of the Alpine age. And, even if the determinations of the absolute age do not exclude that some of the different rocks of Predazzo and Monzoni complex are of early genesis and other ones of late genesis — as it is proved by the lie relations which can be observed on the field — it should be always a question of little differences which for the moment cannot be valued by the means utilized nowadays for the determination of the absolute age. Consequently these results oblige us to consider Predazzo and Monzoni eruptive complex on the whole, ascribing it entirely to the Triassic age (medium Trias). Therefore it must have originated in non-orogenic conditions, and therefore it is post-orogenic with respect to ercinic movements, or at most coinciding with the very early symptoms of the Alpine movement.

The systematic research development on the complex of volcanic rocks, carried out on a large chemical basis, (700 samples, 260 thin sections, 34 chemical analysis, 34 partial chemical analysis, determination trace elements, LUCCHINI, SIMBOLI, 1970; ROSSI, 1970, SIMBOLI, 1966), in particular in the section between the St. Pellegrino Valley and Predazzo, has made it possible to clarify the nature of these rocks, their relations with the Predazzo-Monzoni intrusive complex, as well as to define the position of volcanic rocks in the systematic classification.

Volcanic rocks were divided by previous researches essentially into "porphyrites" and "melaphyres" on the ground of the presence of olivine in the latter. This subdivision, that most often is not possible on the field and never put in practice on maps, not even in the excellent VARDABASSO's geologic map, cannot often be carried into effect even by the microscopic study, as the more

or less alkaline character of the rocks depend essentially on the nature of the ground mass vitreous, crypto or microcrystalline not easily solvable. The scanty chemical analyses which were available until some time ago, were coming from few samplings carried out without rigorous criteria on extensive zones. The data obtained, often apparently contrasting, have for long decennia stirred up, instead of making clear, the polemics among the numerous researchers, as regards the alkaline or not character of the effusive complex.

Now, by utilizing the new chemical data, coming from systematic samplings, on well-defined areas, in the diagrams suggested by KUNO (1960—1968) and by utilizing RITTMANN's serial index σ, (SIMBOLI, 1966; ROSSI, 1970; LUCCHINI, SIMBOLI, 1970 a) we obtain a moderately alkaline character for the whole effusive complex.

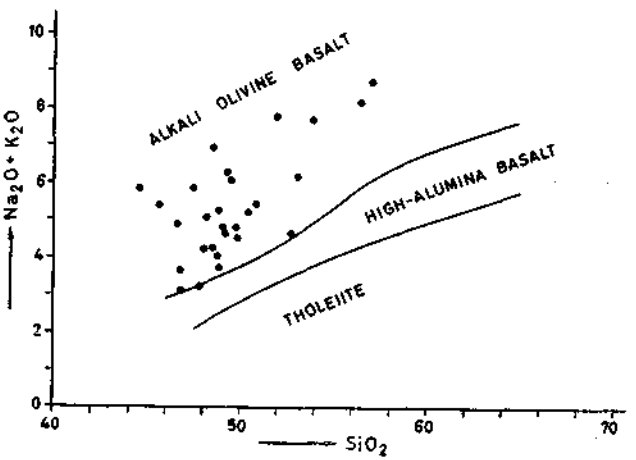

Fig. 1. Alkali-silica diagram (KUNO, 1968) for the volcanic rocks of the Predazzo-Monzoni area (LUCCHINI F., SIMBOLI G., 1970 a).

By analysing in detail the nature of the rocks in the different sections, we find for those of St. Pellegrino Valley, representing the least differentiated terms of volcanic rocks, a serial character which is mainly atlantic, medium-weak, and subordinately pacific, whereas in the section between Moena and Predazzo volcanic rocks, slightly differentiated, have a more indefinite serial character, which may be subcalcic-alkaline or mediterranean. In the above mentioned section of Val Gardonè, where the most differentiated terms of the series are present, the serial character is more evidently mediterranean, in spite of the presence of terms with a tendency to the pacific series. The alkaline character of volcanic rocks can be pointed out also by considering the contents of the elements in traces, Ba-Rb-Sr, or by utilizing also the diagram suggested by different Authors.

After all, for the effusive complex there is a repetition of the evolution scheme already noticed for the intrusive one, namely a variation from pacific-atlantic terms for the least differentiated volcanic rocks, to pacific-mediterranean and

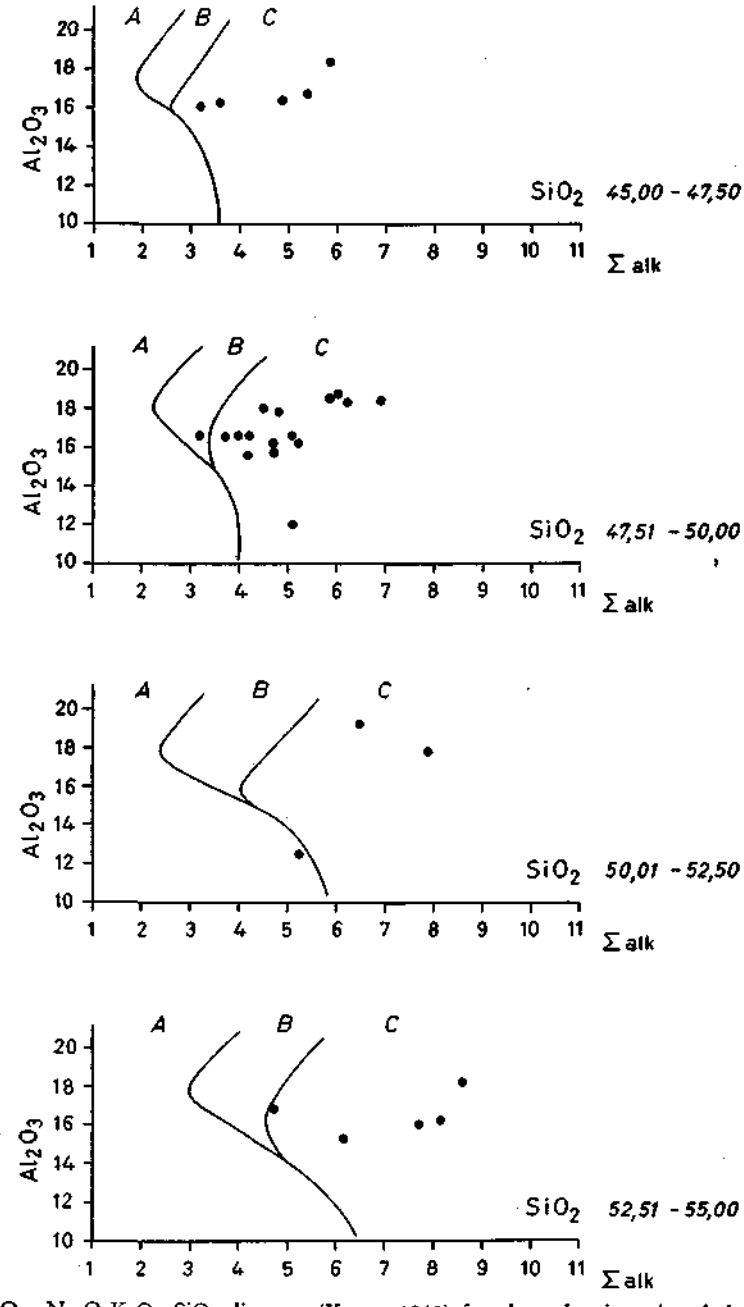

Fig. 2. Al_2O_3 - Na_2O-K_2O - SiO_2 diagram (KUNO, 1960) for the volcanic rocks of the Predazzo-Monzoni area (LUCCHINI F., SIMBOLI G., 1970 a).

A = Tholeiites
B = High-alumina basalts
C = Alkali-olivine basalts

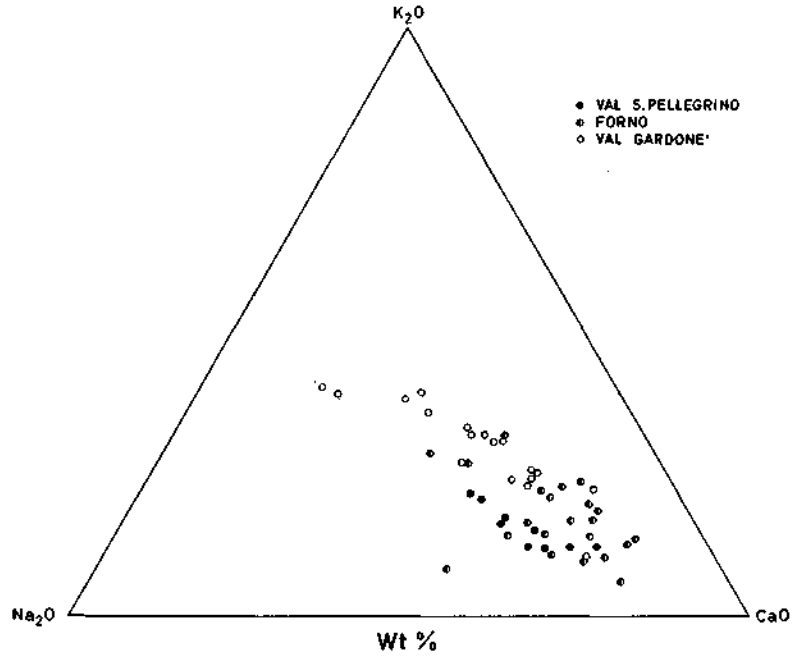

Fig. 3. CaO-K₂O-Na₂O variation diagram for the volcanic rocks of the Predazzo-Monzoni area (LUCCHINI F., SIMBOLI G., 1970 a).

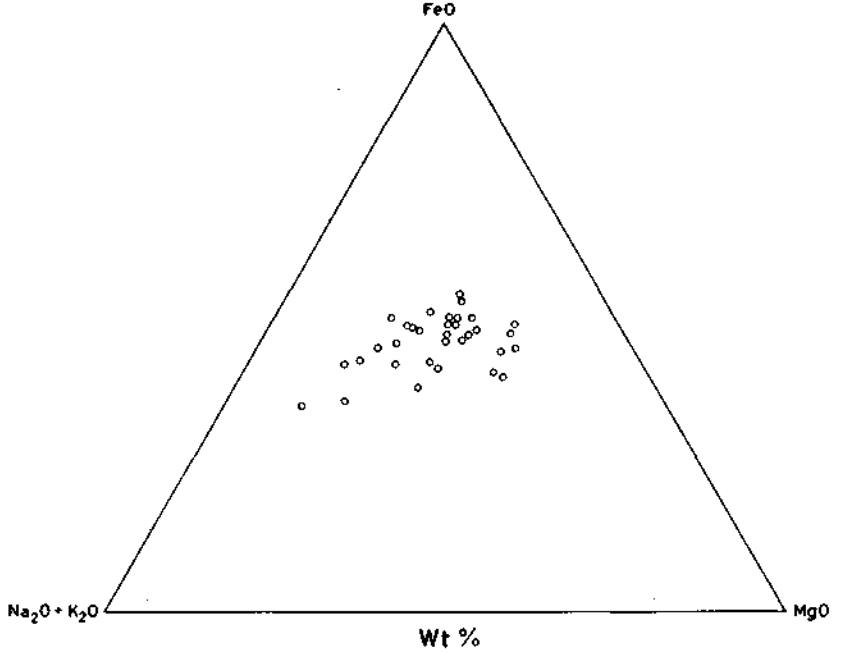

Fig. 4. MgO-FeO_{tot}-Na_2O+K_2O variation diagram for the volcanic rocks of the Predazzo-Monzoni area (LUCCHINI F., SIMBOLI G., 1970 a).

mediterranean for the most differentiated terms of the complex. This evolution scheme can be well pointed out in the k-mg diagram of volcanic rocks, or by comparing STRECKEISEN's (1967) diagrams for Predazzo and Monzoni intrusive rocks with that of effusive rocks constructed on the ground of modal-normative data.

The comparison is quite convincing and it is in this connection that we propose to give up the old terminology — porphyrites, melaphyres, in favour of a newer one consisting of: basalts, latit-basalts, latitandesites, latites — which thus better corresponds to the terminology used for intrusive rocks — gabbros, monzo-diorites, monzonites.

In comparison with normal alkali-basalts, volcanic rocks of the Predazzo-Monzoni area show considerable contents in potassium even in the least differentiated terms (LUCCHINI, SIMBOLI, 1970 b); on the contrary, the TiO_2 contents seem to be modest for alkaline basalts and perhaps more characteristic for basalts of tholeitic type.

However, also alkali-basalts like those of the Gough island studied by LE MAITRE (1962) are present in nature, showing much higher potassium contents in comparison with the basalts of other islands of the mediumatlantic ridge-line.

Camptonites

A particular study effected on a series of lamprophyric seams of camptonitic type (LUCCHINI, MEZZETTI, SIMBOLI, 1969) has allowed to notice variable alkali contents and generally above the values corresponding to the average of 78 camptonites reported by METAIS and CHAYES, but is seems, what is more significant, that it is often potassium that prevails on sodium. This ascertainment leads to strengthen LEITMEIER's and VARDABASSO's hypothesis of the close bond existing between camptonites and "monzonitic" magma.

The amphibole characterizing these camptonites has proved (BONDI, PIRANI, SIMBOLI, 1968), on the ground of chemical and optical analyses, to possess intermediate features between the amphiboles of kaersutitic type and those of syntagmatitic type, and not of barkevikitic type as it was previously thought. The composition of amphiboles is extremely variable as regards MgO content and Fe/Fe + Mg ratios in close parallelism with the composition of the rock containing them.

Remarks on probable origin of Predazzo and Monzoni rocks

Several researchers deem that the trachy-basaltic and trachy-andesitic character assumed by some basaltic magmas, during their evolution, depends on phenomena of syntexis or hybridization of basaltic magmas themselves.

BORSI's, FERRARA's research (1967) and BORSI's, FERRARA's, PAGANELLI's, SIMBOLI's ones (1968), which have made it possible to date Predazzo-Monzoni eruptive complex by the K/Ar and Rb/Sr methods (50 determinations), have supplied also indications on the value of the Sr^{87}/Sr^{86} isotopic ratios for the

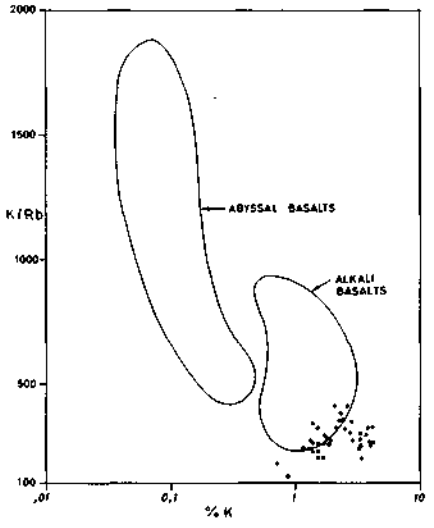

Fig. 5. K/Rb ratios and K contents (GAST, 1968) for the volcanic rocks of the Predazzo-Monzoni area (LUCCHINI F., SIMBOLI G., 1970 a).

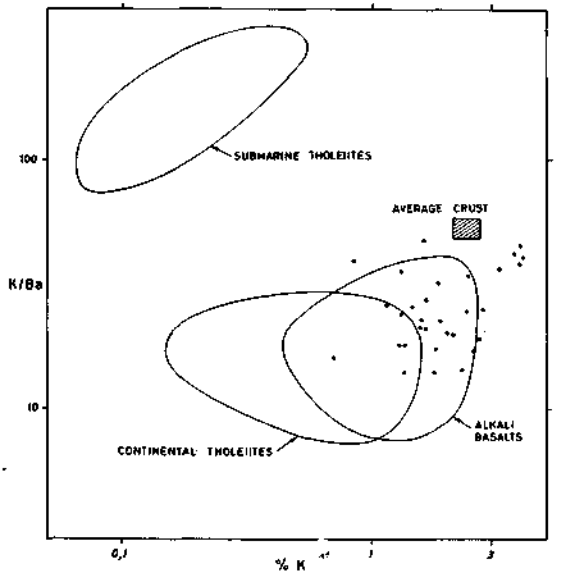

Fig. 6. K/Ba ratios and K contents (CONDIE et al., 1969) for the volcanic rocks of the Predazzo-Monzoni area (LUCCHINI F., SIMBOLI G., 1970 a).

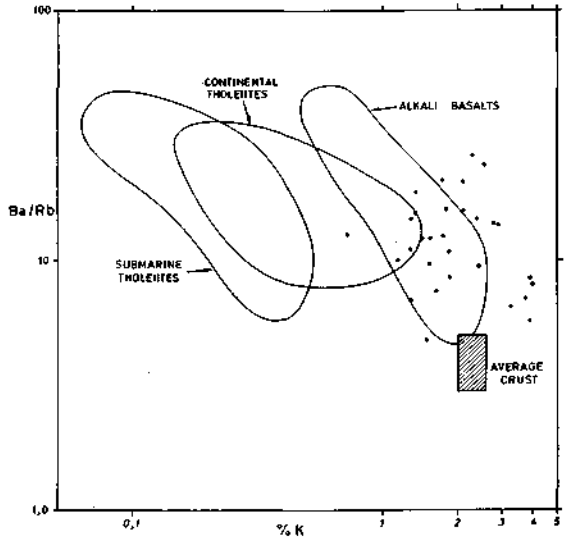

Fig. 7. Ba/Rb ratio and K contents (CONDIE et al., 1969) for the volcanic rocks of the Predazzo-Monzoni area (LUCCHINI F., SIMBOLI G., 1970 a).

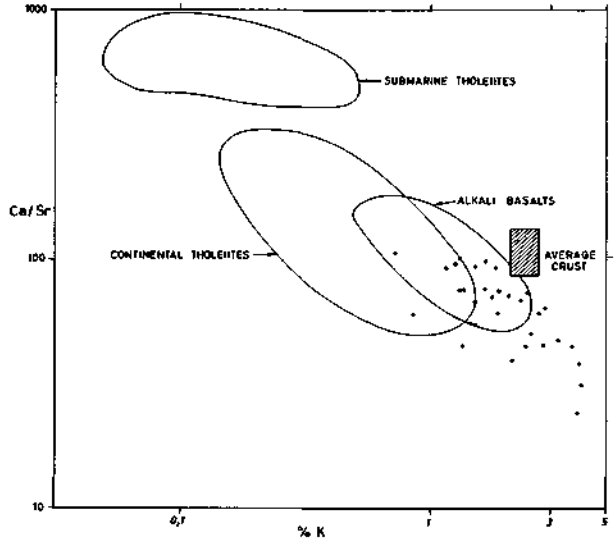

Fig. 8. Ca/Sr ratios and K contents (CONDIE et al., 1969) for the volcanic rocks of the Predazzo-Monzoni area (LUCCHINI F., SIMBOLI G., 1970 a).

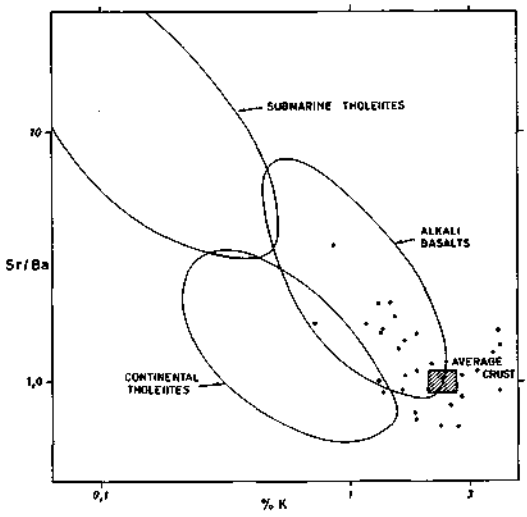

Fig. 9. Sr/Ba ratio and K contents (CONDIE et al., 1969) for the volcanic rocks of the Predazzo-Monzoni area (LUCCHINI F., SIMBOLI G., 1970 a).

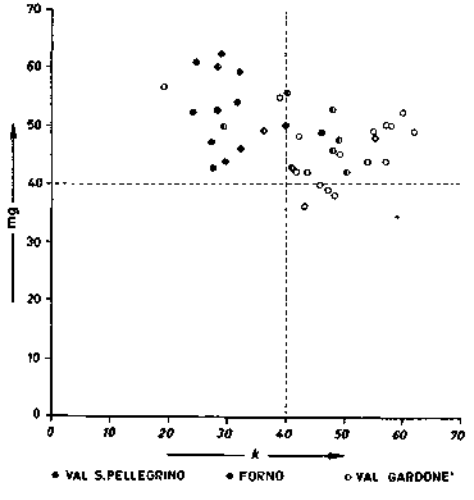

Fig. 10. k/mg diagram for the volcanic rocks of the Predazzo-Monzoni area (LUCCHINI F., SIMBOLI G., 1970 a).

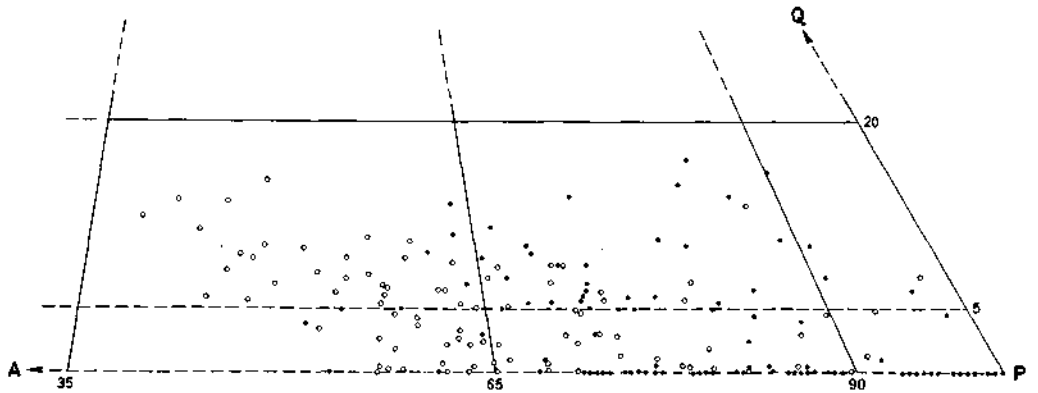

Fig. 11. Q-A-P diagram (STRECKEISEN, 1967) for the intrusive rocks of the Predazzo (o) Monzoni (•) area (Granites and syenites are not plotted) (LUCCHINI F., SIMBOLI G., 1970 b).

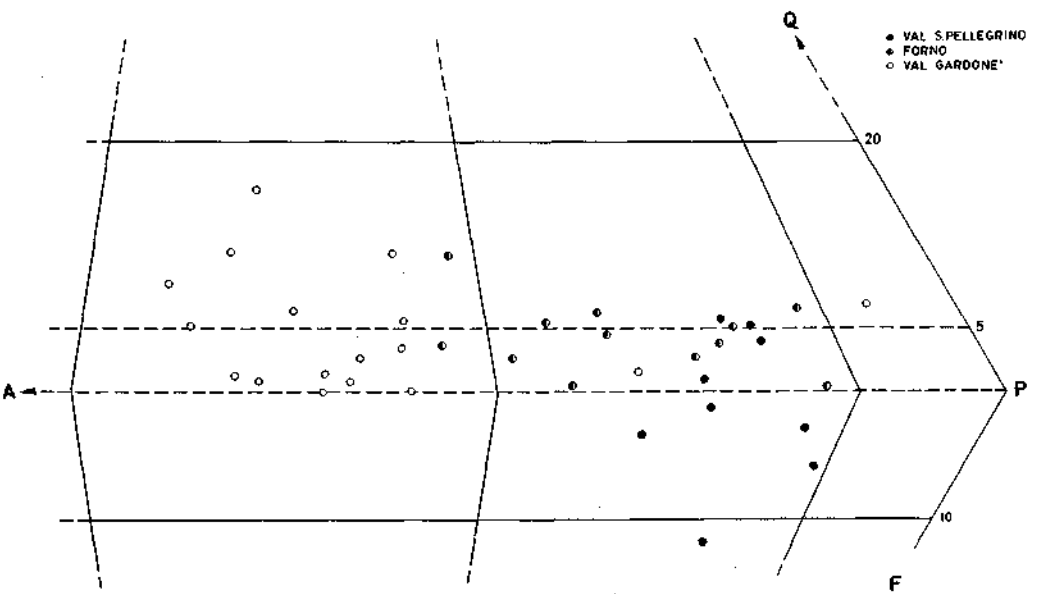

Fig. 12. Q-A-P-F diagram (STRECKEISEN, 1967) for the volcanic rocks of the Predazzo- Monzoni area, according to their actual or calculated mineral composition (LUCCHINI F., SIMBOLI G., 1970 a).

whole series of rocks examined. This average value (obtained from 25 determinations), corresponding to 0,705, is slightly higher than that of the simatic rocks — 0,702—0,704 — and corresponding to the average low values of continental basalts. On the contrary, the crustal materials and the highly contaminated magmas by syntexis generally have higher values for these ratios.

As for the series of volcanic rocks of the Gough atlantic island, already mentioned, we have a value of the ratio corresponding to 0,7045.

From what is reported above it seems to be possible to infer that the eventual contamination by syntexis of the magma of the Predazzo-Monzoni area should have been quantitatively limited and also occurred in the large magmatic reservoir, because all the rocks later formed, intrusive, effusive, dike rocks reflect the same features.

As a consequence of the dating effected on the rocks under examination, the relation between "monzonitic" intrusions and Alpine orogenesis is no longer well-grounded. However, one might try to define the chemism of magmas in relation to the tectonic situation, by utilizing the log τ log σ diagram recently proposed by GOTTINI and RITTMANN (1969). Three sections can be distinguished in this diagram:

A = typical of simatic magmas of the high and low cratons;

B = for the crustal anatectic magmas of orogenic zones;

C = for the magmas having a mediterranean character, which are mainly present in the hinterland of the orogens, and for the differentiated extremes of simatic magmas, and also for peculiar type of crustal magmas.

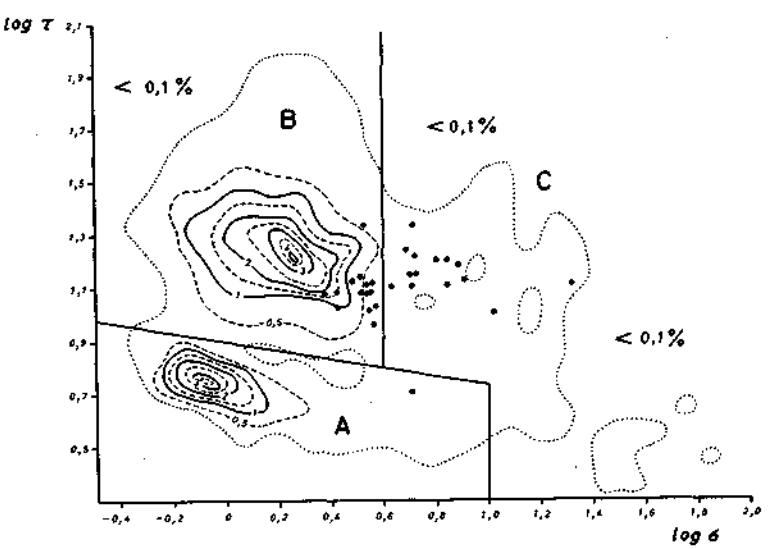

Fig. 13. Log σ/log τ GOTTINI's diagram (1969) for the volcanic rocks of the Predazzo-Monzoni area (LUCCHINI F., SIMBOLI G., 1970 a).

The points relating to the volcanic rocks studied by us, are distributed in a peculiar way on a low-frequency area, placed in the section C and partly in the section B, as it grows thick at the border of the said sections.

This, because of the relations admitted between chemism of magmas and tectonics, would seem to denounce, as for the area under examination, not precisely orogenic nor cratogenic conditions, but perphaps those of partially stabilized zones: thus this diagram too would confirm the character of NIGGLI's mixed Province or STARK's and TRÖGER's Predazzo Province, in relation to a peculiar tectonic situation in course of stabilization or evolution.

This might be a possible interpretation of the particular character of the magma characterizing the Predazzo-Monzoni petrographic Province, unless one wants to see different evolution or differentiation schemes.

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