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COMPARISON BETWEEN CORSICAN ALBITITES AND OCEANIC PLAGIOGRANITES

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ABSTRACT

The nomenclature of low-K leucocratic rocks belonging to the upper part of the cumulate sequence in ophiolites is reconsidered. In Corsica, the geological setting, textural and petrographical features of the acid differentiates mainly found in the Rospigliani series lead to the following classification. Coarse-grained leucoferrodiorites with accumulate textures, sometimes deformed, have crystallized with ferrogabbros and ferrodiorites. The most abundant medium-grained albitites (meta-tonalites or albite-syenite), rich in accessory minerals, locally marked by flow and accumulate features, possess subhedral granular and/or cataclastic textures. These rocks and associated dolerites may belong to an upper border group of the magmatic chamber. The fine-grained albite-granite (meta-plagiogranites) with allotriomorphic granular textures occur mainly in dykes cutting the upper gabbros and the volcano-sedimentary formations of the Rospigliani series. Granophyric intergrowths recognized in the less evolved term are often obscured by brittle and plastic deformation related to magmatic injection (cataclastic to mylonitic textures).

The oceanic leucocratic rocks may be classified in the same way. A geochemical compilation of Corsican and oceanic samples has reinforced the similarities between the two suites. A compositional gap does not occur in the range 50-80% SiO_2. However, three main populations at about 55, 60 and 70% silica corresponding respectively to leucoferrodiorites, albitites (tonalites) and albite-granites (plagiogranites) have been emphasized.

The genesis of these rocks is related to the evolution of high-level magma chambers. Immiscibility may occur after the beginning of ferrogabbro crystallization, inducing various magmatic breccias and rapid ascent of more or less unmixed acid and basic magmas. As shown by REE patterns fractionation may occur in the silicic liquid after immiscibility. This process and late stage hydrothermalism as well as oceanic tectonism have favoured the dismantling of the upper border group, well exposed in the Rospigliani volcano-sedimentary series possibly formed in a transform-fault zone.

INTRODUCTION

Leucocratic rocks have long been known to occur in the upper part of ophiolitic cumulates but in variable proportion and composition: rare and plagioclase-rich in Corsica (type I ophiolites) and more abundant and quartz-rich (granophyres) in type II ophiolites (Rocci *et al.*, 1975) reaching 20% if keratophyres are also con-

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sidered (Brown *et al.*, 1979). As in type I ophiolites, acid residues are rare in the ocean, even in transform-fault zones, where lower cumulates and peridotites are well exposed. Therefore, a more extensive comparison between Corsican albitites and oceanic leucocratic rocks has been undertaken.

In Corsica, pre-Malm slices of the Liguro-piemontais oceanic crust are composed of lavas, mainly pillow-lavas, dolerites, gabbros and more or less serpentinized lherzolitic peridotites formed at mid-oceanic ridges, transform fault zones and seamounts. Low pressure fractionation of liquids corresponds to the crystallization of troctolites, olivine-gabbros, euphotides and ferrogabbros ending with acid differentiates (Ohnenstetter and Ohnenstetter, 1975; Beccaluva *et al.*, 1977).

The large gabbro and lava pile are more or less devoid of leucocratic acid rocks. Most of them are found in the Rospigliani series formed of a volcano-sedimentary sequence resting on a serpentinite or gabbro floor. Contemporaneous acid and basic magmas, which have intruded the sediments, may be related to a peculiar type of oceanic accretion occuring in a possible transform-fault zone (Ohnenstetter, 1979*a*). The setting of the leucocratic residue may give information on the development of oceanic magma chambers.

I. NOMENCLATURE OF LEUCOCRATIC RESIDUES

Nomenclature of acid residues must reflect mineral assemblages and not a geotectonic environment. For this reason the term oceanic plagiogranites (Coleman and Peterman, 1975; Coleman and Donato, 1979) used as a general term for the leucocratic rocks in the ophiolitic suite must be restricted only to dredged and cored samples from the oceans. Similarly, if a general term is needed to design the quartz-bearing leucocratic assemblage in the field, ophiolitic plagiogranite may be employed.

Most of the problems of these rocks come from their low K_2O contents, which result in the scarcity of K-feldspar and biotite. Nevertheless, the proposed classification of Streckeisen (1967, 1974) may be used, whatever the nature of the mafic minerals. Thus, in the presence of one feldspar (plagioclase) most of the rocks fall on the QP join and depending upon the quartz content would be called diorite, quartz-diorite ($5 < Q < 20$), tonalite ($20 < Q < 40$) and plagiogranite ($Q > 40$) using the subdivision of Ginsburg *et al.* (1962) in Streckeisen (1967). Trondhjemites belong to the diorite-tonalite family with a color index > 15 (Streckeisen, 1967). Using the CIPW normative proportion of feldspar (O'Connor, 1965) most of the acid residues fall in the trondhjemite and tonalite fields (Coleman and Peterman, 1976). If the An content is less than 5%, then the leucocratic rocks fall on the AQ join. Depending upon the amount of quartz, they are called albite-syenite, quartz albite-syenite and albite-granite.

The granophyres often described in type II ophiolites are mostly tonalite, trondhjemite and plagiogranite. The granophyric texture appears in interstitial position in quartz-diorite and invades progressively the groundmass in plagiogranite. In type I ophiolites, this texture is scarce partly due to the rarity of quartz-bearing rocks (BROUWER and EGELER, 1952). Moreover, as the composition of plagioclase has always been modified by several metamorphic events, the position of rocks around either the A or P apex is debatable. For this reason the term albitite has generally been used in the alpine chain (JAFFE, 1955; SALIMI, 1965; STEEN, 1972; BERTRAND and VUAGNAT, 1979) and corresponds to Q-poor rocks (see TRÖGER, 1935 and JOHANNSEN, 1937) in the syenite (LACROIX, 1922; PUSZTASZERI, 1969) or diorite families. With the presence of quartz, albite-granite was employed.

II. EMPLACEMENT OF ACID ROCKS RELATED TO THEIR TEXTURES IN CORSICA

Leucocratic rocks are mainly found in the upper cumulates and volcanics (OHNENSTETTER and OHNENSTETTER, 1975). As they represent the latest magmatic products (ROUTHIER, 1945; NETELBEEK, 1951; BROUWER and EGELER, 1952; SPIJER, 1955) their emplacement is closely related to the history of the upper part of the magma chamber.

In cumulates they occur in dykes or are closely associated with ferrogabbros. In the dykes cutting euphotides, intermediate gabbros and ferrogabbros, the composition of the leucocratic rocks varies from diorite, quartz-diorite, leucoferrodiorite to albitite. Generally, the dioritic rocks are coarse grained, with large more or less zoned plagioclase, relicts after green hornblende, some quartz and scarce and small zircon. Local recrystallization around plagioclase porphyrocrysts and at the dyke border are linked to magma emplacement (Pl. III C).

In the upper cumulates, leucocratic rocks, mainly leucodiorites are interbedded or intermingled with ferrogabbros and some noritic gabbros. Various ortho and mesocumulates may be defined depending upon the phase proportion and form contacts. Leucodiorites clearly separated from ferrogabbros present a hiatal porphyritic granular textures with coarse grained plagioclase, sometimes deformed and surrounded by smaller ones. Locally, they contain scattered aggregates of clinopyroxene, opaque minerals and apatite forming clusters characteristic of the iron-rich gabbros and diorites. The distribution of mafic minerals is more regular in leucoferrodiorites, which possess elongate euhedral juxtaposed plagioclases and in intersertal position, cumulus apatite and pyroxene enclosed in opaque minerals (Pl. II A).

Less mafic quartz-diorites possess zircon, more abundant when quartz is notably present. In all of these cumulates, magmatic lamination is often well developped. They are locally deformed and cut by basic dykes as in the Alps s.l. (GIANELLI and

PRINCIPI, 1974; OHNENSTETTER and OHNENSTETTER, 1975; 1976; STEEN *et al.*, 1977; MEVEL *et al.*, 1978; BERTRAND and VUAGNAT, 1979). Elsewhere magmatic melange composed of basalt, leucoferrodiorite, diorite and gabbro indicate that injection of liquids in hot cumulates was contemporaneous with deformation and in some places may induce it (OHNENSTETTER and OHNENSTETTER, 1975).

Large boulders of albitites with a finer grain size may be found in slices belonging to the Rospigliani series. In the highest cumulates these rocks may enclose pieces of ferrogabbro picked up when rising to the surface. Above, they are locally associated with ferrodolerites and leucoferrodolerites. They may also occur in dykes cutting serpentinites (PETERLONGO, 1968). They are fine grained, rich in accessory minerals such as zircon, apatite, opaque minerals and allanite and exhibit a wide range of textures. Zircons give a middle Jurassic age (OHNENSTETTER *et al.*, 1976; and submitted). Some samples clearly show orthocumulate features with granular textures marked by euhedral plagioclase developed during igneous lamination (Pl. IA; B). Crude internal layers of zircon and opaque minerals have been observed (Pl. IVC). These rocks remind one of the congelation cumulates of the Upper Border Group of Skaergaard (WAGER and BROWN, 1967). Other albitites with subhedral to anhedral granular textures possess randomly oriented plagioclase in a finer matrix (hiatale texture) of plagioclase, zircon and minor quartz (Pl. IC; D; II B). Relict forms after pyroxene or amphibole closely associated with opaque minerals and some apatite (comparable to clinopyroxene, titanomagnetite and apatite clusters in ferrogabbros) are organized in a decussate texture. In rare places, primary plagioclase has grown until in contact giving a pegmatitic equigranular texture. Moreover, in some outcrops monogenic acid breccias with a matrix mainly of plagioclase clasts may result from a late hydrothermal process (Pl. III B).

Leucocratic rocks varying from albitites to albite granites are also found cutting polygenic breccias and ophicalcites of the Rospigliani volcano-sedimentary series (OHNENSTETTER, 1979). They are fine grained with allotriomorphic granular (Pl. II C; III A) and sometimes intersertal textures (Pl. IV A; B). Myrmekites around plagioclase are present in the less evolved albite granites (Pl. IV D). With increase in silica, early crystallization of quartz with Na-plagioclase prevents the development of granophyric texture. Moreover, graphic intergrowths are often destroyed during brittle and ductile deformation related to magmatic injection. Cataclastic rocks possess xenomorphic plagioclase with undulose extinction scattered in a fine grained albite and quartz matrix (Pl. III C; D). At a more plastic stage, subgrains in foliated albite granites crystallized from the porphyroclasts (Pl. III A). Cataclastic textures are also common in Canyon Mountain acid rocks (THAYER and HIMMELBERG, 1968). Acid magmas have often been emplaced simultaneously with a more basic liquid (Pl. IV A; B). The following features are relevant of this phenomenon with some of them probably linked to an immiscible process (ROEDDER, 1979): round to oval trapped inclusions of acid and basic magma in each other, mechanical mixing of the magmas, nucleation and perpendicular growth from the margins of the globules, grain size increase far from the contact and common foliation in dykes. Discrepancies in the textures from acid and basic rocks are linked to the different rheological states of the magmas. Both liquids are also intermingled in extrusives (OHNENSTETTER, 1979).

III. PETROGRAPHY AND MINERALOGY

1. CORSICA

As previously mentioned, leucocratic rocks may be placed in three main groups; diorites especially leucoferrodiorites, albitites (albite-syenite) and albite-granite. Leucoferrodiorites possess zoned (sometimes reversed) plagioclase of oligoclase composition, clinopyroxenes with herringbone twins, euhedral apatite enclosed in ilmenite and titanomagnetite. Quartz and zircon may be present as well as brown hornblende. In albitites similar phases may be recognized, except for fresh magmatic clinopyroxenes. The existence of Na-pyroxene rich albitite and Na-amphibole rich albitites (NETELBEEK, 1951) has lead to the supposition that magmatic pyroxene and amphibole have occurred (OHNENSTETTER *et al.*, 1976). The proportion of apatite and opaque minerals decreases for the lower acid cumulates, whereas zircon increase. Allanite is common, rimmed by pistacite. In one sample biotite flakes have been observed. The previous existence of magmatic aegyrine (ROUTHIER, 1945; 1946) may be suggested by relict form after elongated pyroxene. The last products, albite granites, are poor in mafic and accessory phases, especially zircon. In all three groups, especially albitites and albite granites blueschist facies assemblages, occurring between two, have overprinted the magmatic assemblages (OHNENSTETTER *et al.*, 1976; in preparation). The compositions of fresh magmatic clinopyroxene from leucoferrodiorites and ferrogabbros have been plotted (Fig. 1). They are more Mg and Ca rich than clinopyroxene from the ferrogabbro. Plagioclase is oligoclase in leucoferrodiorite and nearly pure albite in albitite and albite granite (see Fig. 2).

2. OCEANIC AREAS

A few occurrences of leucocratic rocks have been reported from the ocean in different settings: seamounts near Mid Atlantic Ridge at 45°N (AUMENTO, 1969); in fracture zones (MIYASHIRO *et al.*, 1970; ENGEL and FISHER, 1975; OHNENSTETTER, in prep.) in the Aves Rise (WALKER *et al.*, 1972), in the Kjushu-Palao ridge from marginal basin (ISHIZAKA and YANAGI, 1975). They are often associated with ferrogabbros, gabbros, olivine gabbros and serpentinized lherzolitic peridotites in the fracture zones. Oceanic samples may be ranged in the three main groups defined for Corsican rocks. The coarse grained leucoferrodiorite from the Vema fracture zone

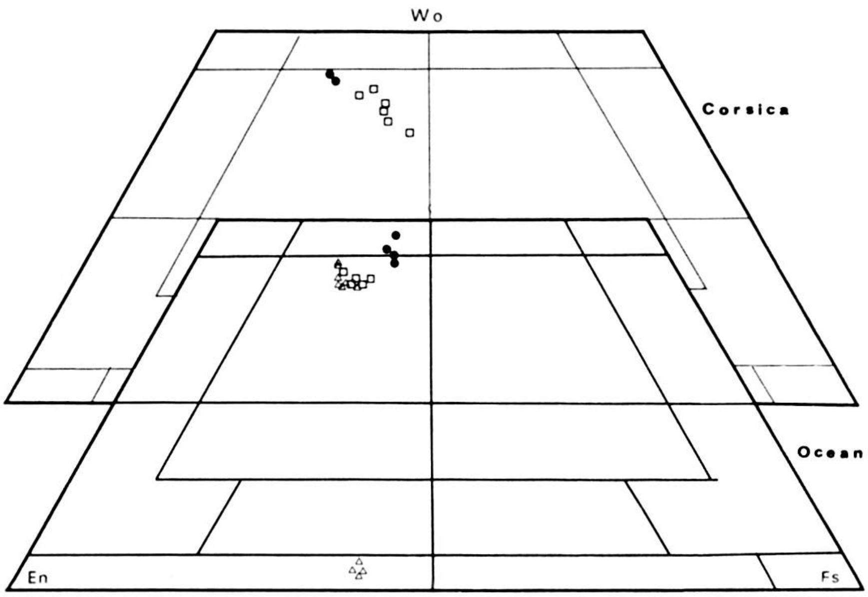

FIG. 1. — **Clinopyroxene compositions in the Hess quadrilateral.** Corsican samples: dot, leucoferrodiorite (75-4.6.8.); open square, ferrogabbro (20.9.5.). Oceanic samples from the Vema fracture zone: dot, tonalite (CH78-DR10-002A); open square, ferrodiorite (CH78-DR10-74); open triangle, ferrodiorite (CH78-DR1P-003).

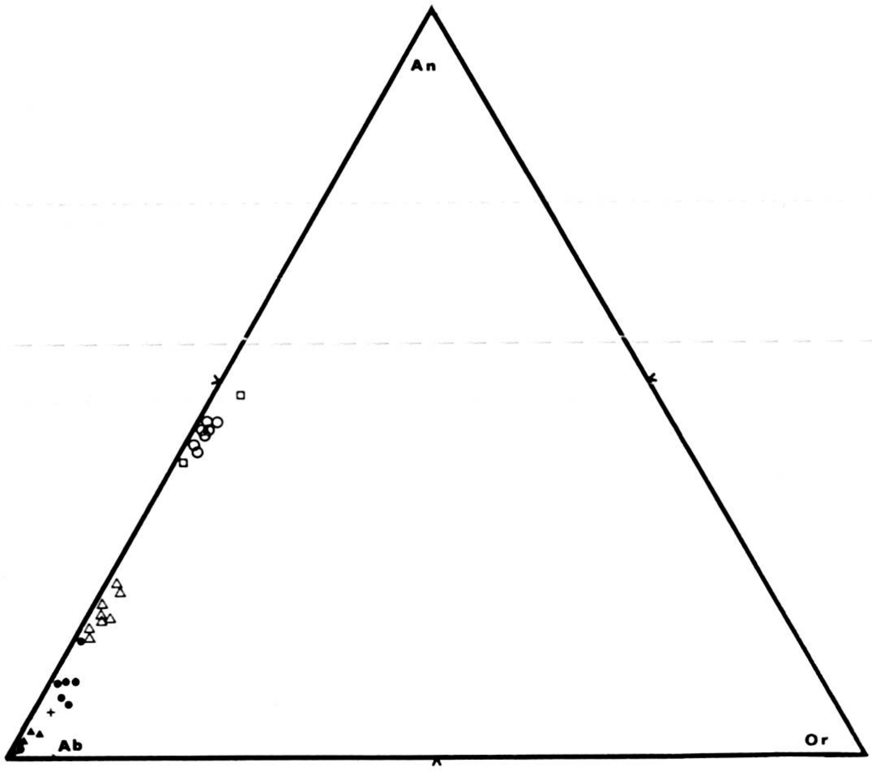

FIG. 2. — **Plagioclase composition of oceanic and corsican samples in the albite-orthose-anorthite triangle.** Corsican samples: dot (75-4.6.8.) and cross (75-7.6.9.), leucoferrodiorite; triangle, albitite (23.8.6-1A and 24.7.21.).Oceanic samples: open circle, ferrodiorite (CH78-DR10-003); open square, leucoferrodiorite (CH78-DR1P-74); open triangle, tonalite (CH78-DR10-002A).

is a cumulate with brown hornblende after clinopyroxene, relict forms after orthopyroxene, euhedral apatite, zircon and poikilitic titanomagnetite and ilmenite. Sample ANTP 2 (ENGEL and FISHER, 1975) belongs to the albitite-tonalite-trondhjemite group because of the medium grained texture and abundant accessory minerals like apatite and zircon. A fine grained rock of the same dredge may belong to the plagiogranite stem with minor accessory minerals like zircon (up to 25 μm) and micropegmatitic texture K-feldspars if they occur (quartz-monzonitic dykelet of ENGEL and FISHER, 1975) shown a heterogeneous repartition.

In a general way, andesine, albite, quartz, brown hornblende, apatite, magnetite, zircon, titanite are in varying proportions the most important phases which form the oceanic leucocratic differentiates. Clinopyroxene compositions of ferrodiorite and leucoferrodiorite from the Vema fracture zone are plotted in Fig. 1. As for Corsican samples, clinopyroxenes from the leucoferrodiorite are richer in wo content than the associated cumulates and may be due to the increase in alkalinity. Plagioclase compositions (Fig. 2) are similar to those of the Corsican leucoferrodiorite and much more sodic than those of the dredged ferrodiorites.

IV. CHEMISTRY

The compositions of Corsican and oceanic acid rocks are reported in Tables 1, 2 and 3. The low initial $^{87}Sr/^{86}Sr$ ratio in dredged samples is in agreement with derivation from a sub-oceanic mantle (ISHIZAKA and YANAGI, 1975). From textural evidence, the leucocratic rocks may be considered in some cases as solids with variable amounts of trapped liquid or as liquid with some primocrysts and clusters. No major gap is found in the 50-80% silica range. Leucoferrodiorites contain about 55% silica, the most important group, albitites around 60% and the plagiogranites reach 70-80%. These three main groups occur also in oceanic samples (Table 2). In both series the (FeO^T/MgO) ratio varies considerably. Aluminia decreases in the albite granites. SINTON and BYERLY (1980) have proposed a high-temperature vapor phase transport for removal of potassium during late-stage crystallization of silicic differentiates of abyssal oceanic magma. The concentrations of incompatible elements like Zr, Hf and RE may reach high values compared to type II ophiolites (COCHERIE, 1978). Zirconium and hafnium show strong maxima at 60% silica (albitites) whereas phosphorus is rather concentrated in ferrodiorites and leucoferrodiorites. Variable concentrations in LIL elements may be due to late stage hydrothermal processes or metamorphic alteration (COLEMAN and DONATO, 1979).

On an AMF diagram (Figs. 3 and 4) the acid rocks occupy the field between ferrogabbros and the A apex. In the GREIG's diagram (Figs. 5 and 6) oceanic and Corsican cumulates show a similar repartition linked to a common mechanism of formation. Ferrogabbros and acid rocks may be obtained through an immiscible

TABLE 1

Chemical compositions of corsican albitites. 1, leucoferrodiorite (in OHNENSTETTER and OHNENSTETTER, 1975 and BECCALUVA *et al.*, 1977); Inzecca massif; albite, oligoclase, Na-amphibole, zircon, apatite, ores. 2, pegmatoïde albitique (in BAUD, 1975); Balagne. 3, faciès grenu mésocrate (in COUTURIE, 1964); Pont de Piedicorte. 4, Pegmatoïde albitique (in BAUD, 1975); Balagne. 5, leucoferrodiorite, Punta di Puriolo; orthocumulate; oligoclase, albite, quartz, clinopyroxene, brown hornblende and ores. 6, metagabbro (in FRANCONI, 1967); Casaluna. 7, albitite-trondhjemite (in COCHERIE, 1978, sampled by OHNENSTETTER); Inzecca massif, orthocumulate with igneous lamination; albite, minor quartz, Na-pyroxene, Na-amphibole, zircon, ores. 8, albitite-trondhjemite (in OHNENSTETTER and OHNENSTETTER, 1975); Inzecca massif; metaplagioclasite without relict of primary texture; quartz, pumpellyite, chlorite. This sample is not reported in diagram. 9, albitite-trondhjemite (in OHNENSTETTER and OHNENSTETTER, 1975 and BECCALUVA *et al.*, 1977); Inzecca massif; same petrographic features as sample 7. 10, albitite, Punta di Puriolo; cataclastic and heterogeneous granular texture; albite, pistacite, quartz, chlorite, ores. 11, albitite; Punta Muzzone; granular texture; clinopyroxene, albite, green hornblendes. 12, albitite (in LACHARPAGNE, 1970); Pont de Teddia; dike in euphotide. 13, albitite, Inzecca massif; equant granular texture; zoned plagioclase with albite rims, glaucophane, stilpnomelane, chlorite, zircon. 14, albite-crossitite (in BROUWER and EGELER, 1952); Bocca Serna. 15, albite-granite-trondhjemite (in COCHERIE, 1978 sampled by OHNENSTETTER); Inzecca massif; orthocumulate with igneous lamination; albite, quartz, Na-pyroxene, Na-amphibole, chlorite, ores, titanite and zircon. 16, Pegmatoïde albitique (in BAUD, 1975); Balagne. 17, albite-granite-trondhjemite (in OHNENSTETTER and OHNENSTETTER, 1975); mylonitic texture; albite, quartz, chlorite, ores and rare zircon. 18, albite-granite-trondhjemite (in OHNENSTETTER and OHNENSTETTER, 1975); Inzecca massif granular texture; albite, interstitial quartz, actinote, pumpellyite, titanite, zircon. 19, albite-granite; Casaluna; dike in intermediate gabbros; granular texture with myrmekite; albite, quartz, chlorite, titanite, zoïsite, rare zircon. 20, albite-granite-trondhjemite (in COCHERIE, 1978 sampled by OHNENSTETTER); Inzecca massif; hiatal granular texture with myrmekite; albite, quartz, chlorite, ores and titanite. 21, residual differentiate (in BROUWER and EGELER, 1952); Noceta. 22, albite-granite-trondhjemite (in OHNENSTETTER and OHNENSTETTER, 1975); Inzecca massif; cataclastic and hiatal textures; anhedral albite in a fine grained albite and quartz matrix with a planar texture; stilpnomelane. 23, albite-granite, Puriolo; fine-grained euhedral and planar textures; albite, quartz, crossite, pistacite.

Sample No.	1 297131	2 105	3 25.62	4 133	5 P7985A2	6 188	7 2386 IAA	8 1.8.10/2	9 23.8.8 IAA	10 P79-83 I	11 M79 95B
SiO_2	54.00	55.30	57.05	57.92	58.09	58.70	59.90	60.08	60.48	60.87	60.98
TiO_2	1.44	.61	.50	.56	1.11	1.00	.88	.49	.79	.43	.49
Al_2O_3	14.15	15.44	16.75	18.84	15.98	16.20	17.23	16.74	16.99	17.67	17.82
Fe_2O_3	15.78	8.58	3.40	5.24	8.02	4.20	6.32	1.29	6.25	5.18	2.57
FeO			5.10			5.60					
MnO	n.d.	.15	.15	.11	.22	.20	.06	.04	.06	.06	.05
MgO	2.76	4.23	3.30	2.48	2.01	1.90	1.38	2.88	1.49	.77	4.19
CaO	2.22	6.72	4.85	3.68	2.97	3.50	1.78	13.95	1.84	4.92	1.50
Na_2O	8.02	6.56	7.00	8.48	8.22	6.70	10.80	.15	11.28	8.21	9.01
K_2O	.09	.27	0.00	.25	.47	.10	.10	.01	.05	.05	.17
H_2O^+	1.36	1.06	2.05	1.15	2.97	1.10	.71	4.15	.65	1.71	2.67
H_2O^-			0.00			.45					
P_2O_5	.40		.10			.40	< .10		.15		
CO_2	—		—			—					
Total	99.82	98.92	100.25	98.71	99.88	99.70	99.10	99.77	100.03	99.87	99.45
Sr	37	223	—	129	—	—	—	—	27	—	—
Ba	—	10	—	17	—	—	37	—	—	—	—
Cr	—	118	—	149	—	—	35.3	—	—	—	—
Zr	620	—	—	—	—	—	1638	—	2200	—	—
V	49	101	—	25	—	—	—	—	—	—	—
Ni	110	336	—	10	—	—	1	—	22	—	—
Cu	18	58	—	89	—	—	—	—	10	—	—
Co	25	19	—	10	—	—	24.7	—	10	—	—
Sc	—	—	—	—	—	—	11.9	—	—	—	—
Zn	208	—	—	—	—	—	—	—	65	—	—
Pb	—	—	—	—	—	—	—	—	—	—	—
Ga	—	—	—	—	—	—	—	—	—	—	—
B	—	—	—	—	—	—	—	—	—	—	—
Rb	< 6	—	—	—	—	—	.09	—	< 6	—	—
Nb	11	—	—	—	—	—	—	—	16	—	—
Y	170	—	—	—	—	—	—	—	—	—	—
Yb	—	—	—	—	—	—	—	—	—	—	—
Li	15	—	—	—	—	—	—	—	11	—	—

Sample No.	12 JCL 136	13 23.8.6/2	14 VII	15 2873	16 77	17 30.7.3.1	18 1.8.2.2	19 1.8.6	20 25.8.1	21 VI	22 28.7.9	23 79.84B
SiO_2	62.45	62.47	63.57	64.10	66.08	68.91	69.40	70.20	71.00	74.19	79.45	79.65
TiO_2	.70	.80	.70	.91	.26	.19	.25	.25	.27	.28	.15	.12
Al_2O_3	16.35	16.21	16.16	13.67	18.96	16.52	16.12	15.95	13.87	13.99	12.08	11.48
Fe_2O_3	6.15	5.78	3.71	8.17	1.18	3.01	.70	1.79	3.89	.81	1.35	.52
FeO	1.30		2.66							.92		
MnO	.10	.04	.08	.12	.03	—	.02	.08	.03	.03	n.d.	.01
MgO	2.00	1.55	1.58	1.46	.72	2.17	.78	.45	2.98	.94	< .01	.08
CaO	1.20	1.11	1.10	1.40	1.47	.03	3.10	1.67	.10	.68	.10	.32
Na_2O	7.35	10.23	9.55	8.65	10.17	7.84	7.49	6.93	5.80	7.32	6.59	6.59
K_2O	.30	.18	.15	< .10	.17	< .01	< .01	.77	< .10	.08	< .01	.05
H_2O^+	1.70	1.41	.84	1.90	.48	1.28	1.41	1.39	.48	.64	.54	.59
H_2O^-	.45		.10							.07		
P_2O_5	.35		.17	.13					< .10	.03		
CO_2	—		—	—						.02		
Total	100.40	99.78	100.37	100.50	99.52	99.95	99.27	99.48	98.30	100.00	100.26	99.41
Sr	—	—	—	84	1.41	—	—	—	—	—	9	—
Ba	—	—	—	20	18	—	—	—	13	—	—	—
Cr	—	—	—	28.4	177	—	—	—	25.3	—	—	—
Zr	—	—	—	1028	—	—	—	—	436	—	305	—
V	—	—	—	—	10	—	—	—	—	—	—	—
Ni	—	—	—	35.3	10	—	—	—	77.7	—	—	—
Cu	—	—	—	—	222	—	—	—	—	—	22	—
Co	—	—	—	41.4	10	—	—	—	28.5	—	8	—
Sc	—	—	—	9.1	—	—	—	—	2.2	—	—	—
Zn	—	—	—	—	—	—	—	—	—	—	17	—
Pb	—	—	—	—	—	—	—	—	—	—	—	—
Ga	—	—	—	—	—	—	—	—	—	—	—	—
B	—	—	—	—	—	—	—	—	—	—	—	—
Rb	—	—	—	.6	—	—	—	—	1.8	—	< 6	—
Nb	—	—	—	—	—	—	—	—	—	—	25	—
Y	—	—	—	—	—	—	—	—	—	—	180	—
Yb	—	—	—	—	—	—	—	—	—	—	—	—
Li	—	—	—	—	—	—	—	—	—	—	—	—

TABLE 2

Chemical compositions of acid oceanic rocks. 1, leucoferrodiorite, Vema fracture zone; clinopyroxene, brown hornblende, actinote, oligoclase, titanomagnetite, magnetite, apatite and zircon. 2, granophyric diabase, Argo fracture zone, Western Indian ocean, (in ENGEL and FISHER, 1975); albitized andesine, K-feldspar, hornblende remplacing augite, apatite and opaque minerals. 3, diorite, Mid-Atlantic Ridge (in AUMENTO, 1969); Plagioclase (An_{40}-An_{20}), K-feldspar, albite, green hornblende after pyroxene and olivine, biotite, magnetite, spinel, apatite, sphene, allanite. 4, diorite, Mid-Atlantic Ridge at 45°N (in AUMENTO, 1969), same mineralogy as sample 3.5, Quartz monzonitic dikelet in sample 2, Argo fracture zone, Western Indian ocean (in ENGEL and FISHER, 1975), quartz, K-feldspar, hornblende, biotite, apatite, zircon and ores. 6, aplite, Argo fracture zone, Western Indian ocean (in ENGEL and FISHER, 1975); quartz, oligoclase, albite, aegyrine, apatite, sphene, zircon, chlorite. 7, aplite, Mid-Atlantic Ridge near 23°N31 at the ridge and fracture zone junction (in MIYASHIRO *et al.*, 1970); albite (5-8% An).

Sample No.	1 CH78 DR10.0029	2 ANTP 125.4b	3 AG 159.35	4 AG 159.39	5 ANTP 125.4c	6 ANTP 125.16	7 E
SiO_2	55.73	57.27	61.97	72.47	75.07	76.37	78.39
TiO_2	1.42	1.76	.94	.33	.15	.42	.09
Al_2O_3	16.41	14.57	16.00	14.17	13.18	12.78	12.68
Fe_2O_3	} 8.56	1.50	3.22	1.85	.76	.39	.38
FeO		9.57	3.57	1.19	1.15	.46	.41
MnO	.20	.16	.09	.08	.03	.02	.01
MgO	2.91	2.31	2.43	1.39	.23	.87	.54
CaO	5.80	5.94	3.24	1.48	1.10	.84	.55
Na_2O	6.69	5.17	5.55	5.55	4.55	7.70	6.66
K_2O	.36	.72	.75	.24	3.27	.07	.06
H_2O^+	} 1.90	.44	} 1.28	} .90	.20	.25	.38
H_2O^-		.04			.08	.03	.03
P_2O_5		.32	.22	.06	.12	.02	.01
CO_2		—	<.10	<.10	—	—	—
Total	99.98	99.77	99.26	99.71	99.89	100.22	100.19
Sr	—	150	140	89	18	86	—
Ba	—	160	260	200	120	180	—
Cr	—	6	<20	<20	8	7	—
Zr	—	97	760	200	250	550	—
V	—	63	38	22	5	9	—
Ni	—	9	46	22	<10	29	—
Cu	—	16	24	30	5	5	—
Co	—	17	<20	<20	<10	<5	—
Sc	—	29	<10	<10	<10	10	—
Zn	—	—	52	27	—	—	—
Pb	—	<20	2.2	1.8	<20	47	—
Ga	—	21	32	40	20	21	—
B	—	—	2.2	1.7	—	—	—
Rb	—	—	<30	<30	—	—	—
Nb	—	<20	—	—	29	25	—
Y	—	150	—	—	150	180	—
Yb	—	12	—	—	13	17	—

TABLE 3

REE, Rb, Sr, Th, U, Ta and Hf contents of corsican albitites and oceanic plagiogranites. Corsican samples: 23.8.6.1A; 28.7.3; 25.8.1; (in COCHERIE, 1978). For the mineralogy, see Table 1. Oceanic samples: ANTP 1254b, 1254c (in HEDGE *et al.*, 1979); for the mineralogy, see Table 2. GDP 8.12.1, 8.12.4, 11.7: plagiogranites from the Kyushu-Palau ridge and the Arami Plateau (in ISHIZAKA and YANAGI, 1975).

Sample No.	23.8.6 1A	28.7.3	25.8.1	ANTP 125.4b	ANTP 125.4c	GDP 8.12.21	GDP 8.12.4	GDP 11.17.1
La	11.8	16.2	28.5	—	—			
Ce	43.8	60	92.3	63.9	53.2			
Nd	45.4	50.5	64	49.7	30.3			
Sm	13	15.5	17.1	14.5	7			
Eu	4.76	4.37	1.19	4.17	.616			
Gd	12.5	16	12.9	17.	8.22			
Tb	2.3	3	—	—	—			
Dy	14.4	20.7	10.9	19.2	10.8			
Er	8.29	12	6.74	15.7	7.68			
Tm	1.17	2.05	—	—	—			
Yb	8.46	11.6	7.67	16	8.22			
Lu	1.5	1.65	1.16	—	—			
Σ REE	178	227.	261	200.17	126.036			
Rb	.9	.6	1.8	30.5	89.5	3.16	13.2	4.9
Sr	25	84	—	133	27.7	1.91	217.8	957
$^{87}Sr/^{86}Sr$	—	—	—	.70338	.70418	.70336	.70338	.7032
Th	.28	.84	1.96					
U	.23	.21	.53					
Ta	.80	1.22	1.40					
Hf	35.3	28.4	19.1					

process (OHNENSTETTER *et al.*, 1979). The evolution of the leucocratic rocks testifies to a late fractionation event controlled mainly by plagioclase (Fig. 7).

The high REE (Σ REE $\approx$ 200 ppm) concentrations (Table 3) as well as the high Zr content, unexplainable solely by a single fractional crystallization model (COCHERIE, 1978) may be due also to an immiscible process. Moreover, similar REE patterns may be observed for Corsican and oceanic leucocratic differentiates according to their petrographic classification (Fig. 8). Flat REE patterns with slight negative Eu anomalies are exhibited by oceanic ANTP 125 4b granophyric diabase (HEDGE *et al.*, 1979) and Corsican 2873 albitite which shows more evident rapid cooling features. Compared to the previous samples, the Corsican 23861A orthocumulate possesses a slight positive Eu anomaly and a HREE depletion. The albite granite 2581 and the quartz-monzonitic dykelet ANTP 125 4c show REE patterns with strong Eu negative anomalies coupled to low HREE. Plagioclase, apatite and zircon

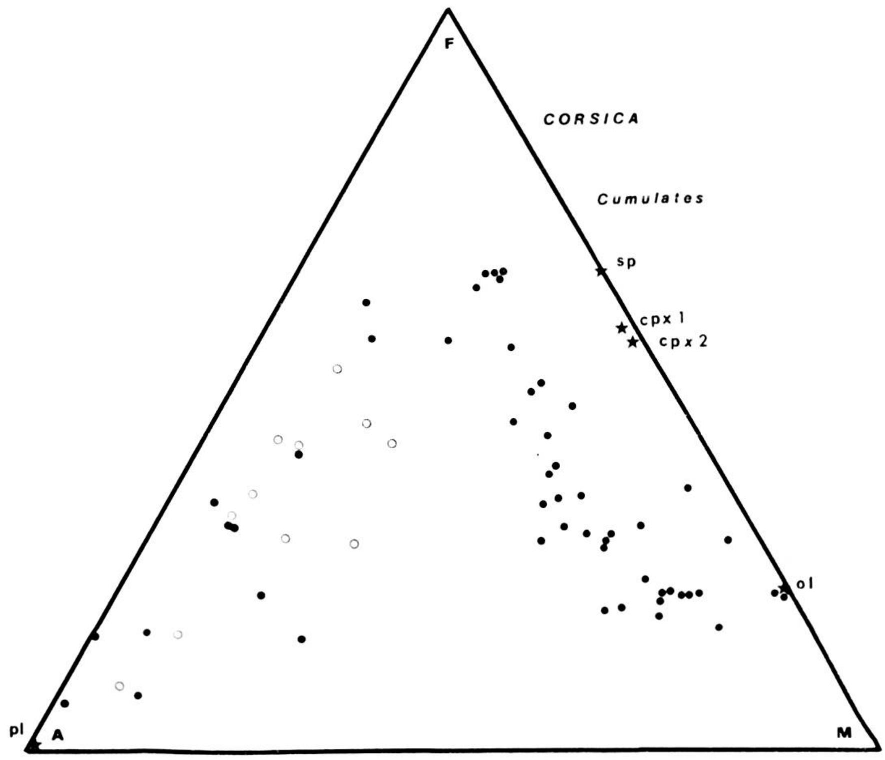

FIG. 3. — **AMF triangle for corsican samples.**
Dot, data after OHNENSTETTER, D. and M. Open circle, data from the litterature (see Table I).
Olivine, clinopyroxene, spinel and albite from the Corsican cumulates are also reported.

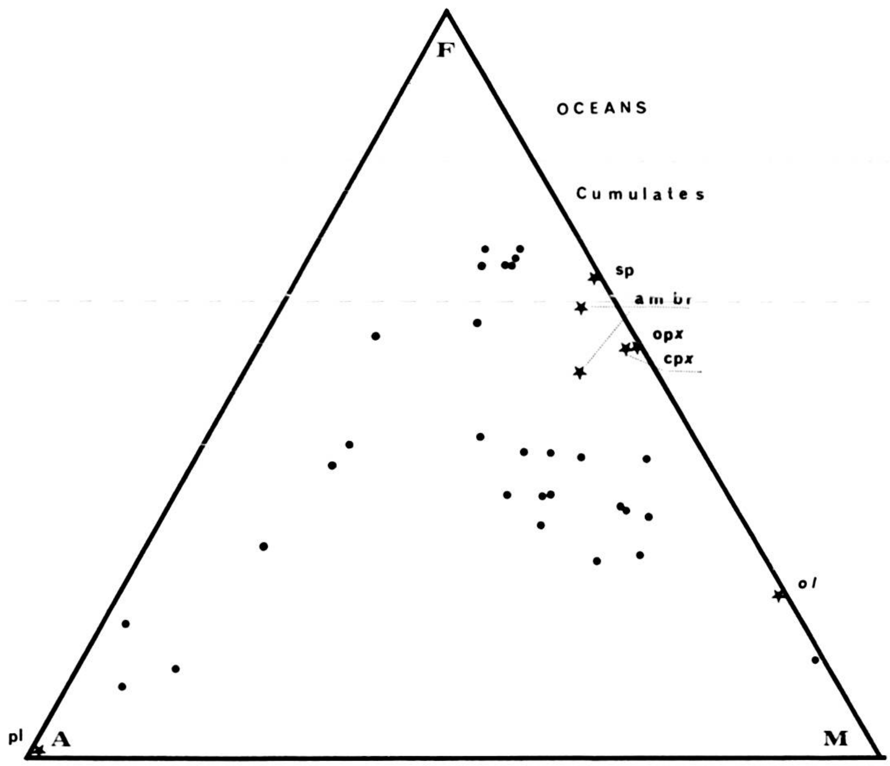

FIG. 4. — **AMF triangle for oceanic samples.** Data from AUMENTO (1969), BONATTI *et* al. (1971); CANN (1971); PRINZ *et al.* (1976); BONATTI *et al.* (1975); ENGEL and FISHER (1969; 1975); MIYASHIRO *et al.* (1970); THOMPSON (1973); OHNENSTETTER, M., unpublished data. Compositions of the plotted minerals are from HODGES and PAPYKE (1976); PRINZ *et al.* (1976); OHNENSTETTER, M., unpublished data.

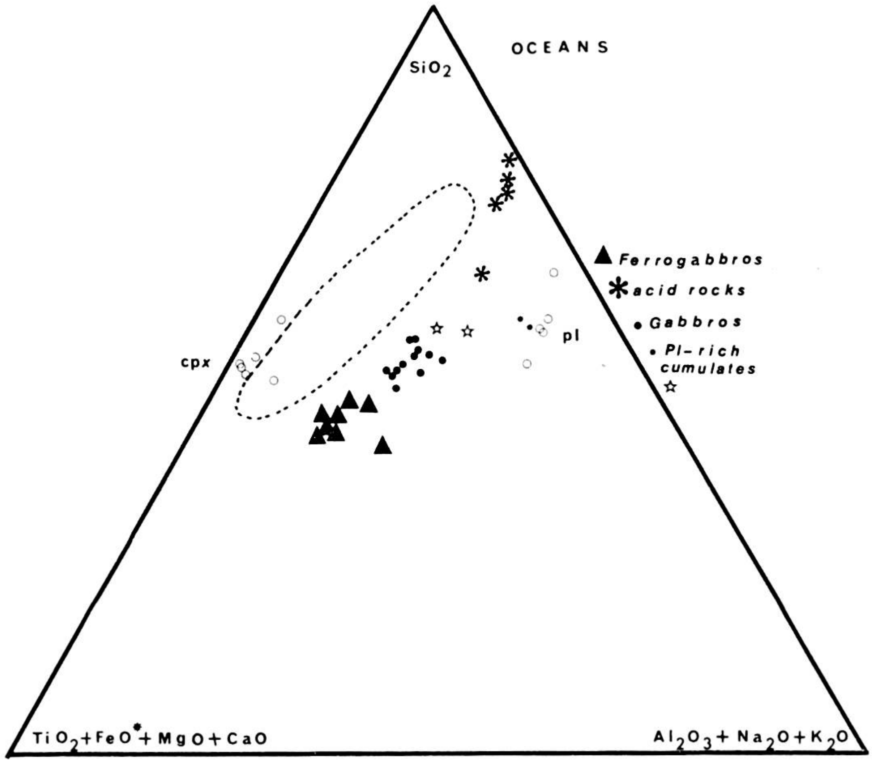

FIG. 5. — **Pseudoternary Greig diagram for Corsican samples.**
The immiscibility envelope is from ROEDDER (1978);
data source is the same as for Fig. 3.

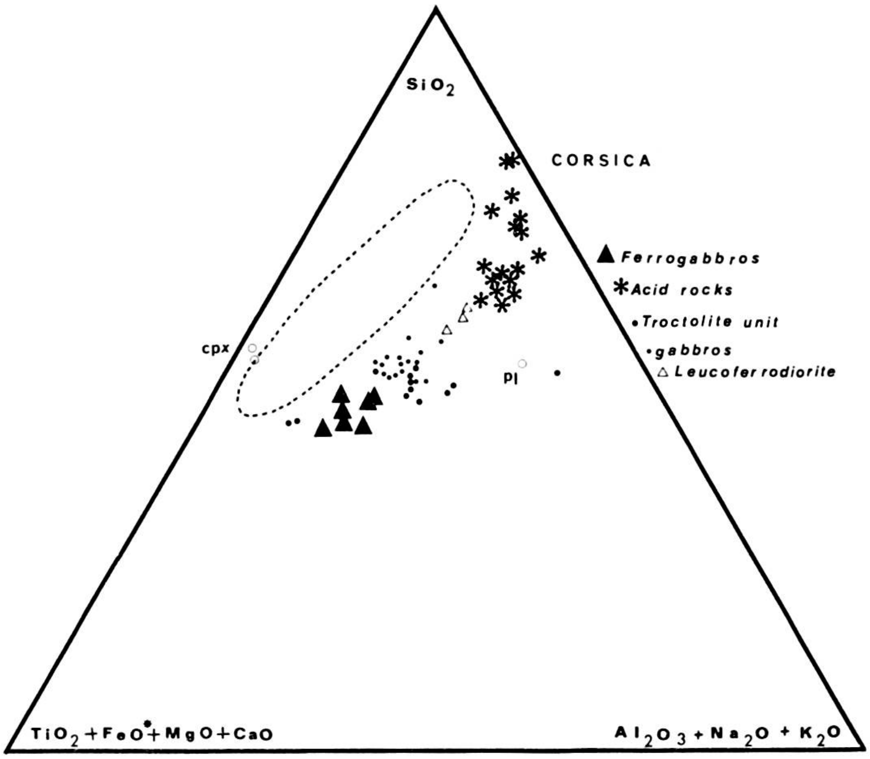

FIG. 6. — **Pseudoternary Greig diagram for oceanic samples.**
The data source is similar as for Fig. 4.

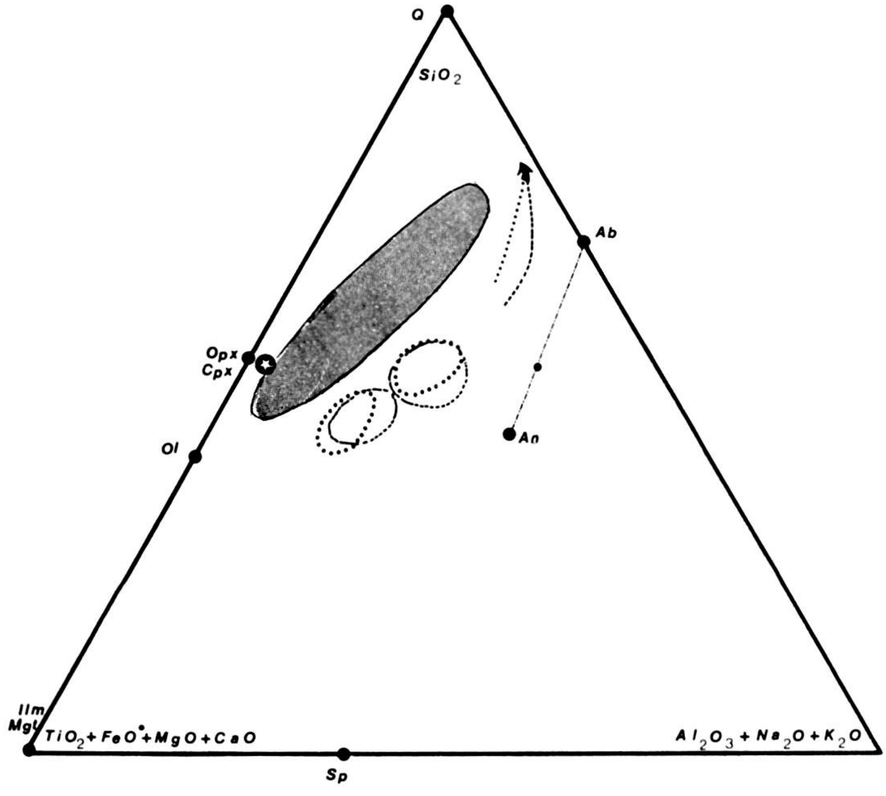

FIG. 7. — **Envelope and evolutionary trend of plutonic rocks from Corsica and the oceans in the Greig diagram:** dot, oceanic samples; dashed, corsican samples.

(NAGASAWA, 1970; WATSON, 1979; 1980) decrease and quartz increase in the final products may be responsible for this pattern. Feldspar and apatite removal has been envisaged to explain the negative europium anomaly in oceanic samples (HEDGE *et al.*, 1979). Consequently, the diversity pointed out for REE distribution is due to various proportions of solid and liquid in rocks at different stages of fractionation after the immiscible process. Hydrothermal fluids at late stage of crystallization may also explain a LREE enrichment (EXLEY, 1980).

V. CONCLUSION

A compilation of dredged acid differentiates has emphasized their scarcity in oceanic environment. Similarly in the Alps they are not frequently described and their occurrence in Corsica is sporadic and mainly limited to the Rospigliani series. Therefore, the genesis of these rocks must testify to a special tectonic environment in the ocean (COLEMAN and PETERMAN, 1975) and the plagiogranite layer must thus

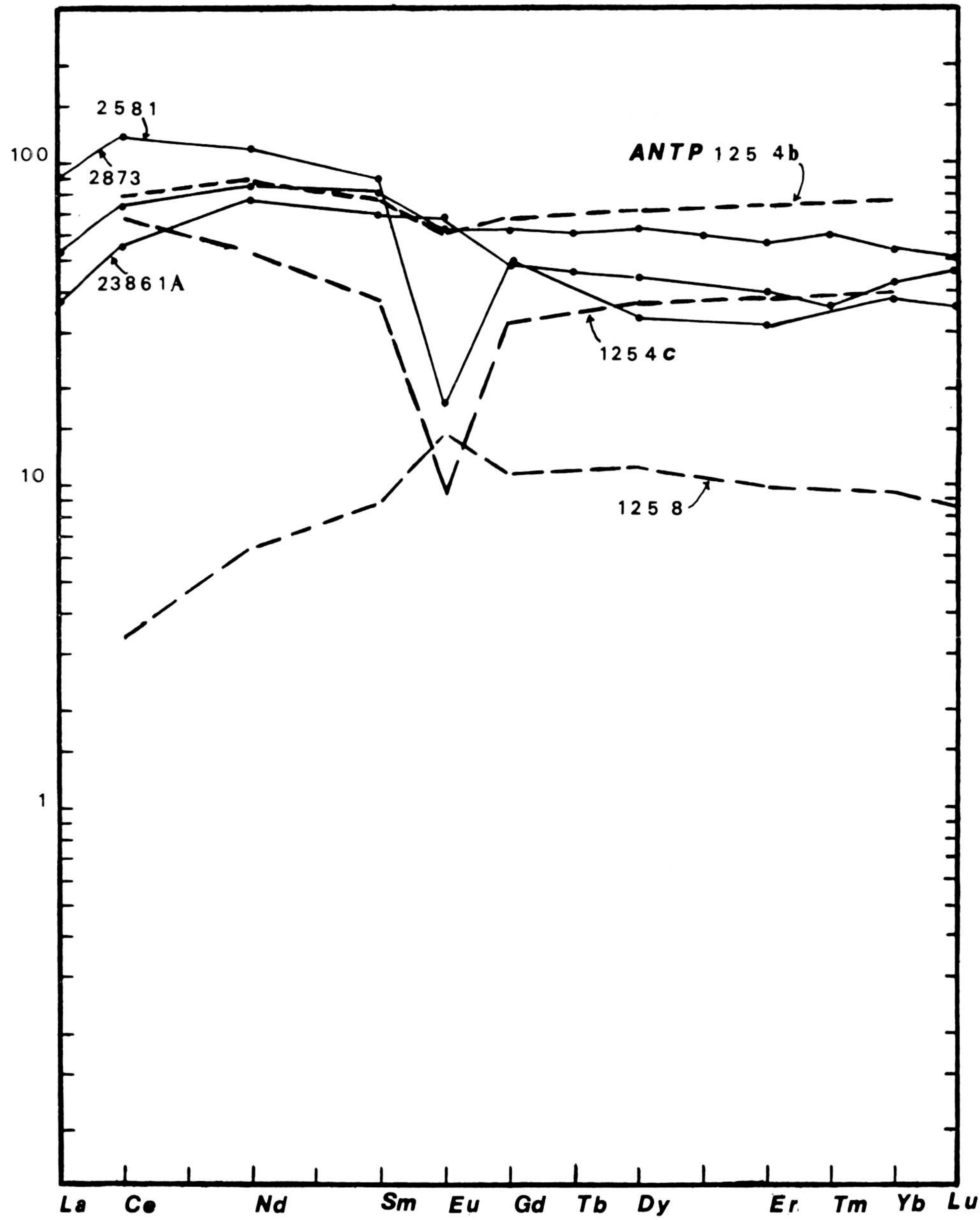

FIG. 8. — **Rare-earth normalized patterns.** Data after COCHERIE (1978) for Corsican samples: 23.8.6.1A and 28.7.3., albitite; 25.8.1, albite-granite. Data after HEDGE *et al.* (1979) for oceanic samples: 12.5.8., Ti-Fe gabbro; ANTP 1254c, granophyric diabase; ANTP 1254b, quartz-monzonite dikelet.

be laterally discontinuous (CHRISTENSEN, 1977). Textural, petrographic and geochemical (major and trace element) comparisons between Corsican and oceanic acid differentiates have stressed the close resemblance between these two suites. Similar magmatic processes are expected to be responsible for their genesis.

An immiscible phenomenon may occur after the crystallization of some ferrogabbros for a residual liquid fraction <35 (BECCALUVA *et al.*, 1977) leading to an iron-rich liquid and a silicic one (OHNENSTETTER *et al.*, 1979) in agreement with experimental work on oceanic tholeiites (DIXON and RUTHERFORD, 1979). The high density iron-rich liquid, giving clinopyroxene, apatite and ore clusters in close association with leucoferrodiorites may form troughs in the underlying cumulates. The low density and viscous silicic magma showing a "peralkaline tendency", rapidly escaping towards the surface participates in the building up of the roof of magma chamber. Albitites (tonalites-trondhjemites) have well recorded this process with congelation cumulates (solid and trapped liquids) and anhedral granular textures obtained during more rapid cooling (COX *et al.*, 1979). They constitute a border group with less evolved dolerites and ferrodolerites which may locally disappear during the latest successive acid injections. Albite granites (plagiogranites) result from the fractionation of this demixed liquid and are injected mostly in dykes showing locally plastic deformation related to their emplacement. Late stage hydrothermal fluids induce cataclasis and brecciation of the acid differentiates. Sulfur deposits may be related to this event. The more or less demixed acid and basic liquids reaching the surface form the agglomerates of the Rospigliani series and may correspond to the evolved liquids of the oceans (e.g. Galapagos and transform fault zones). The rapid dismantling of the upper cumulates and the border group is favoured by rapid uprise of unmixed magmas and by late stage hydrothermal processes. Soon after their formation, these rocks may be incorporated in slight reworked sediments associated with ophicalcites. Erosional features are also induced by serpentinite protrusions linked to oceanic tectonism (LEMOINE, this volume). Therefore, the development of the magma chamber leading to a complete cumulate sequence may have occurred in a dynamic environment compatible with a transform fault zone.

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REFERENCES

AUMENTO, F. (1969). Diorites from the Mid-Atlantic Ridge at 45° N. *Science*, 168, 1112-1113.

BECCALUVA, L., D. OHNENSTETTER, M. OHNENSTETTER and G. VENTURELLI (1977). The trace element geochemistry of Corsican ophiolites. *Contr. Mineral. Petrol.*, 64, 11-31.

BERTRAND, J. and M. VUAGNAT (1979). Un nouveau mode de gisement d'albitite dans le massif ophiolitique du Montgenèvre (Hautes-Alpes, France). *C. R. des Séances, SPHN Genève*, 14, 62-72.

BONATTI, E., J. HONNOREZ and G. FERRARA (1971). Peridotite-gabbro-basalt complex from the equatorial Mid-Atlantic Ridge. *Phil. Trans. Roy. Soc. Lond. A.*, 268, 385-402.

BONATTI, E., J. HONNOREZ, P. KIRST and F. RADICATI (1975). Metagabbros from the Mid-Atlantic Ridge at 06° N: contact-hydrothermal-dynamic metamorphism beneath the axial valley. *Jour. Geol.*, 83, 61-78.

BROUWER, H. A. and C. G. EGELER (1952). The glaucophane facies metamorphism in the Schistes Lustrés nappe of Corsica. *Kon. Ned. Ak. Wet., Verh. Afd. Nat. D.L.* XLVIII, 1-71.

BROWN, E. H., J. Y. BRADSHAW and G. E. MUSTOE (1979). Plagiogranite and keratophyre in ophiolite on Fidalgo Island, Washington. *Geol. Soc. Am. Bull.*, 90, 493-507.

CANN, J. R. (1971). Petrology of basement rocks from Palmer Ridge, NE Atlantic. *Phil. Trans. Roy. Soc. Lond. A.*, 268, 605-617.

CHRISTENSEN, N. I. (1977). The geophysical significance of oceanic plagiogranite. *Earth Planet. Sci. Letters*, 36, 297-300.

COCHERIE, A. (1978). *Géochimie des terres rares dans les granitoïdes*. Thèse 3e cycle, Université de Rennes, 116 p.

COLEMAN, R. G. and M. M. DONATO (1979). *Oceanic plagiogranite revisited. In: Trondhjemites, dacites and related rocks.* BAKER F. ed. Elsevier, 149-168.

COLEMAN, R. G. and Z. E. PETERMAN. Oceanic plagiogranite. *Jour. Geophys. Res.*, 80, 1099-1108.

COUTURIE, J. P. (1964). *Etude géologique de la série des Schistes Lustrés de la vallée du Tavignano (Corse)*. Thèse 3e cycle Université de Clermont-Ferrand, 69 p.

COX, K. G., J. D. BELL and R. J. PANKHURST (1979). *The interpretation of igneous rocks*. George Allen and Unwin ed. 450 p.

DIXON, S. and M. J. RUTHERFORD (1979). Plagiogranites as late-stage immiscible liquids in ophiolite and mid-ocean ridge suites: an experimental study. *Earth Planet. Sci. Letters*, 45, 45-60.

DOSTAL, J. and G. K. MUECKE (1978). Trace element geochemistry of the peridotite-gabbro-basalt suite from DSDP Leg 37. *Earth Planet. Sci. Letters*, 40, 415-422.

ENGEL, C. G. and R. L. FISHER (1969). Lherzolite, anorthosite, gabbro, and basalt dredged from the Mid-Indian Ocean Ridge. *Science*, 166, 1136-1141.

—— (1975). Granitic to ultramafic rock complexes of the Indian Ocean Ridge system, western Indian Ocean. *Geol. Soc. Am. Bull.*, 86, 1553-1578.

EXLEY, R. A. (1980). Microprobe studies of REE-rich accessory minerals: implications for Skye granite. Petrogenesis and REE mobility in hydrothermal systems. *Earth Planet. Sci. Lett.*, 48, 97-110.

FRANCONI, A. (1967). *Etude géologique des ophiolites et Schistes Lustrés de la Casaluna entre Ponte-Leccia et Sermano (Corse)*. Thèse 3e cycle Université de Grenoble, 173 p.

GIANELLI, G. and G. PRINCIPI (1974). Breccias of the ophiolitic suite in the Monte Bocco area (Ligurian Apennine). *Boll. Soc. Geol. It.*, 93, 277-308.

HEDGE, C. E., K. FUTA, C. G. ENGEL and R. L. FISHER (1979). Rare earth abundances and Rb-Sr systematics of basalts, gabbro, anorthosite and minor granitic rocks from the Indian Ocean ridge system, Western Indian Ocean. *Contrib. Mineral. Petrol.*, 68, 373-376.

HODGES, F. N. and J. J. PAPIKE (1976). DSDP site 334: Magmatic cumulates from oceanic layer 3. *Jour. Geophys. Res.*, 81, 4135-4151.

ISHIZAKA, K. and T. YANAGI (1975). Occurence of oceanic plagiogranites in the older tectonic zone, southwest Japan. *Earth. Planet. Sci. Letters*, 27, 371-377.

JAFFE, F. C. (1955). *Les ophiolites et les roches connexes de la région du col des Gets (Chablais, Haute-Savoie)*. Thèse Université de Genève, 150 p.

JOHANNSEN, A. (1937). *A descriptive petrography of the Igneous rocks*. The University of Chicago Press, 4 vol.

LACROIX, A. (1922). *Minéralogie de Madagascar*. A. Challamel ed., vol. 2, p. 395.

LACHARPAGNE, J. C. (1970). *La série ophiolitique, les Schistes Lustrés, et le métamorphisme à glaucophane dans la vallée d'Alésani (Corse)*. Thèse 3e cycle, Université de Clermont-Ferrand, 117 p.

MEVEL, C., R. CABY and J. R. KIENAST (1978). Amphibolite facies conditions in the oceanic crust: example of amphibolitized flaser-gabbro and amphibolites from the Chenaillet ophiolite massif (Hautes-Alpes, France). *Earth Planet. Sci. Letters*, 39, 98-108.

MIYASHIRO, A., F. SHIDO and M. EWING (1970). Crystallization and differentiation in abyssal tholeiites and gabbros from Mid-Oceanic ridges. *Earth Planet. Sci. Letters*, 7, 361-365.

NAGASAWA, H. (1970). Rare earth concentrations in zircons and apatites and their host dacites and granites. *Earth Planet. Sci. Lett.*, 9, 359-364.

NETELBEEK, T. A. F. (1951). *Géologie et pétrologie de la région entre Vezzani et Lugo di Naza (Corse)*. Thèse, Amsterdam, 125 p.

O'CONNOR, J. T. (1965). A classification of quartz rich igneous rocks based on feldspar ratios. *U.S. Geol. Surv. Prof. Paper*, 552 B, B 79-B 84.

OHNENSTETTER, D. and M. OHNENSTETTER (1975). *Le puzzle ophiolitique Corse. Un bel exemple de paléo-dorsale océanique*. Thèse 3e cycle, Université de Nancy, 418 p.

—— (1976). Modèle de fonctionnement d'une ride médio-océanique à partir de l'étude pétrologique des ophiolites corses. *Bull. Soc. Géol. Fr.*, 18, 889-894.

OHNENSTETTER, D., M. OHNENSTETTER, A. PAUPY et G. ROCCI (1979). La diversité des ophiolites: importance de la nature du fractionnement et conséquences métallogéniques. In: Facteurs contrôlant les minéralisations sulfurées de nickel. Besson, M. ed., *Mémoire du BRGM*, 97, 47-61.

OHNENSTETTER, D., M. OHNENSTETTER and G. ROCCI (1975). Tholeiitic cumulates in a high pressure metamorphic belt. *Pétrologie*, 1, 291-317.

—— (1976). Etude des métamorphismes successifs des cumulats ophiolitiques de Corse. *Bull. Soc. Géol. Fr.*, 18, 115-134.

OHNENSTETTER, M. (1979). La série ophiolitifère de Rospigliani (Corse) est-elle un témoin des phénomènes tectoniques, sédimentaires et magmatiques liés au fonctionnement des zones transformantes? *C. R. Acad. Sc. Paris*, 289, D, 1199-1202.

—— (1979). Le magmatisme de la série de Rospigliani (Corse). *C. R. som. Soc. Géol. Fr.*, 5-6, 217-218.

OHNENSTETTER, M., D. OHNENSTETTER et Ph. VIDAL (1977). *L'âge des ophiolites de l'Inzecca (Corse)*. Implications. 5e R.A.S.T. Rennes, 357 (abstract).

OHNENSTETTER, M., D. OHNENSTETTER, Ph. VIDAL, D. HERMITTE, J. MACE and J. CORNICHET (submitted). Crystallization and age of zircon from Corsican ophiolitic albitites: Consequences for the oceanic expansion in Jurassic time. *Earth Planet. Sci. Lett.*

PETERLONGO, J. M. (1968). Les ophiolites et le métamorphisme à glaucophane dans le massif de l'Inzecca et la région de Vezzani (Corse). *Bull. BRGM, section IV*, 1, 17-94.

PRINZ, M., K. KEIL, J. A. GREEN, A. M. REID, E. BONATTI and J. HONNOREZ (1976). Ultramafic and mafic dredge samples from the equatorial Mid-Atlantic Ridge and fracture zones. *Jour. Geophys. Res.*, 81, 4087-4103.

PUSZTASZERI, L. (1969). Etude pétrographique du massif du Chenaillet (Hautes-Alpes, France). *Bull. Suisse Min. Petr.*, 49, 425-466.

ROEDDER, E. (1979). *Silicate liquid immiscibility in magmas. In: The evolution of the Igneous rocks*. YODER H. S. ed., Princeton University Press, 15-57.

ROCCI, G., D. OHNENSTETTER and M. OHNENSTETTER (1975). Duality of Tethyan ophiolites, *Pétrologie*, 1, 172-174.

ROUTHIER, P. (1945). Sur les roches à riebeckite et aegyrine du cortège ophiolitique. *C. R. Somm. Soc. Géol. Fr.*, 15, 61-63.

—— (1946). Un type particulier de gîte cuprifère associé à des roches vertes: le gîte de Saint-Véran (Hautes-Alpes). *Bull. Soc. Fr. Miner.*, 69, 99-150.

SALIMI, F. (1965). Etude pétrographique des roches ophiolitiques des Préalpes romandes. *Bull. Suisse Miner. Pétr.*, 45, 189-279.

SINTON, J. M. and G. R. BYERLY (1980). Silicic differentiates of abyssal oceanic magmas: evidence for late-magmatic vapor transport of potassium. *Earth Planet. Sci. Lett.*, 47, 423-430.

SPIJER, S. B. (1955). *Géologie de la région de Venaco (Corse).* Thèse, Amsterdam 124 p.

STEEN, D. M. (1972). *Etude géologique et pétrographique du complexe ophiolitique de la Haute-Ubaye (Basses-Alpes, France).* Thèse, Université de Genève, 235 p.

STEEN, D., M. VUAGNAT and J. J. WAGNER (1977). *Early deformation in Montgenèvregab bro.* Coll. Inter. CNRS Orogenic BUMA, Grenoble (abstract).

STRECKEISEN, A. L. (1967). Classification and nomenclature of Igneous rocks. *N. Jb. Miner. Abh.*, 107, 144-214.

—— (1974). Classification and nomenclature of plutonic rocks. *Geol. Rundsch.*, 63, 773-785.

THAYER, T. P. and G. R. HIMMELBERG (1968). *Rock succession in the Alpine-type mafic complex at Canyon Mountain, Oregon.* XXIII International Congress, 175-186.

THOMPSON, G. (1973). Trace-element distributions in fractionated oceanic rocks, 2. Gabbros and related rocks. *Chemical Geol.*, 12, 99-111.

TRÖGER, W. E. (1935). *Spezielle Petrographie der Eruptivgesteine.* E. Schweizerbart'sche Verlagsbuchhandlung. (Nägele u. Obermiller) Stuttgart, 360 p.

WAGER, L. R. and G. M. BROWN (1967). *Layered Igneous rocks.* Oliver and Boyd ed., 588 p.

WALKER, B. M., T. A. VOGEL and R. EHRLICH (1972). Petrogenesis of oceanic granites from the Aves ridge in the Caribbean basin. *Earth Planet. Sci. Letters*, 15, 133-139.

WATSON, E. B. (1979). Zircon saturation in felsic liquids: experimental results and applications to trace element geochemistry. *Contrib. Mineral. Petrol.*, 70, 407-419.

—— (1980). Some experimentally determined zircon/liquid partition coefficients for the rare earth elements. *Geochim. Cosmochim. Acta*, 44, 895-897.

PLATE I

IA. Albitite. Congelation cumulate: broad plagioclase primocrysts in a subhedral albite-rich matrix with Na-pyroxene (Na-pyr), zircon (zr); opaque minerals and rare apatite and quartz. Inzecca massif.

IB. Albitite. Congelation cumulate showing igneous lamination: euhedral plagioclase laths and sodic amphiboles (crossite rimmed by glaucophane) are separated by interstitial xenomorphous albite and quartz. Accessory phases: opaque minerals, zircon and apatite. Inzecca massif.

IC. Albitite. Mesocumulate: subhedral plagioclases are surrounded by a rim of albite. Aggregates of zircon or mafic minerals, mainly glaucophane (gl) are scattered in the rock; stilpnomelane occupies interstitial areas. Inzecca massif.

ID. Albitite. Subhedral granular texture with large poikilitic albite. Some mechanical twins and suture boundaries are related to slight deformation. Other minerals: magnetite, chlorite, clinozoïsite, sphene and zircon. Casaluna massif.

PLATE II

IIA. Leucoferrodiorite. Orthocumulate. Coarse andesine, clinopyroxene, apatite are cumulus minerals whereas titano-magnetite, ilmenite, sodic plagioclase and some quartz and zircon are intercumulus. Casaluna massif.

IIB. Albitite. Subhedral to anhedral granular texture in a coarser grained albitite with small interstitial area now filled with chlorite and stilpnomelane. Inzecca massif.

IIC. Albite-granite. Xenomorphic inequigranular texture. Sutured boundaries along strained minerals, porphyroclasts of sodic plagioclase and quartz, and local development of mortar texture are evidence of deformation. Opaque minerals, chlorite, oxychlorite and rare zircon. Inzecca massif.

IID. Leucoferrodiorite. Equigranular tabular texture in which large porphyroclasts of plagioclase and clinopyroxene are sometimes present. Opaque minerals, apatite, sodic amphiboles and clinopyroxenes, lawsonite, sphene and chlorite are associated with the strained sub-grains of plagioclase. Inzecca massif.

PLATE III

IIIA. Albite-granite. Mortar texture developped from a xenomorphic inequigranular sample. Abundant albite and quartz associated with glaucophane, opaque minerals, sphene and rare zircon. Inzecca massif.

IIIB. Albitite. Protoclastic texture in a congelation cumulate. Hornblende, sodic amphibole, opaque minerals, apatite and zircon. Chlorite has mainly crystallized in the matrix. Inzecca massif.

IIIC. Albitite. Mylonitic texture formed at the border of a dike. Abundant xenocrysts of gabbro and pyroxene. Epidote, amphiboles, chlorites, opaque minerals and rare zircon. Mte Piano Maggiore, Casaluna massif.

IIID. Albitite-granite. Mylonitic texture locally developped from an anhedral inequigranular one with sub-grains showing curved boundaries. Epidote, sodic amphiboles, chlorites and opaque minerals. Casaluna massif.

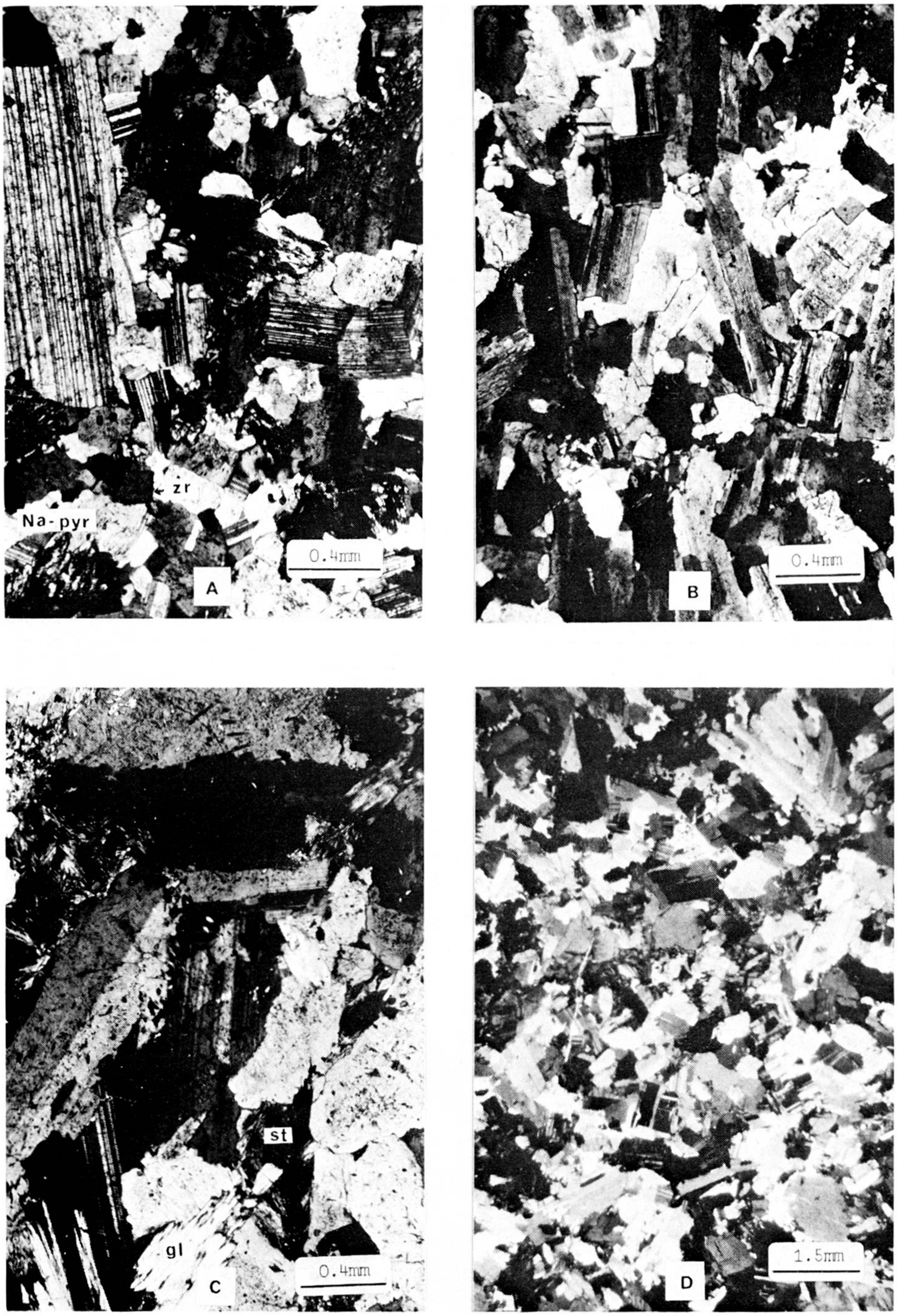
PLATE IV

IVA. Contemporaneous basic and acid liquids. Radiating plagioclase developped from a trapped more basic bubble. San Cervone, Casaluna massif.

IVB. Contemporaneous basic and acid liquids perhaps related to immiscibility (same sample as for plate IVA). Contorted boundaries between basic and acid magmas. The holocrystalline matrix (albite-granite) shows an intersertal texture and some phenocrysts of plagioclase. Acid bubbles may be seen in the basic liquids.

IVC. Albitite. Local concentration of zircon and opaque minerals. Inzecca massif.

IVD. Albite-granite. Myrmekite around plagioclase laths. Casaluna massif.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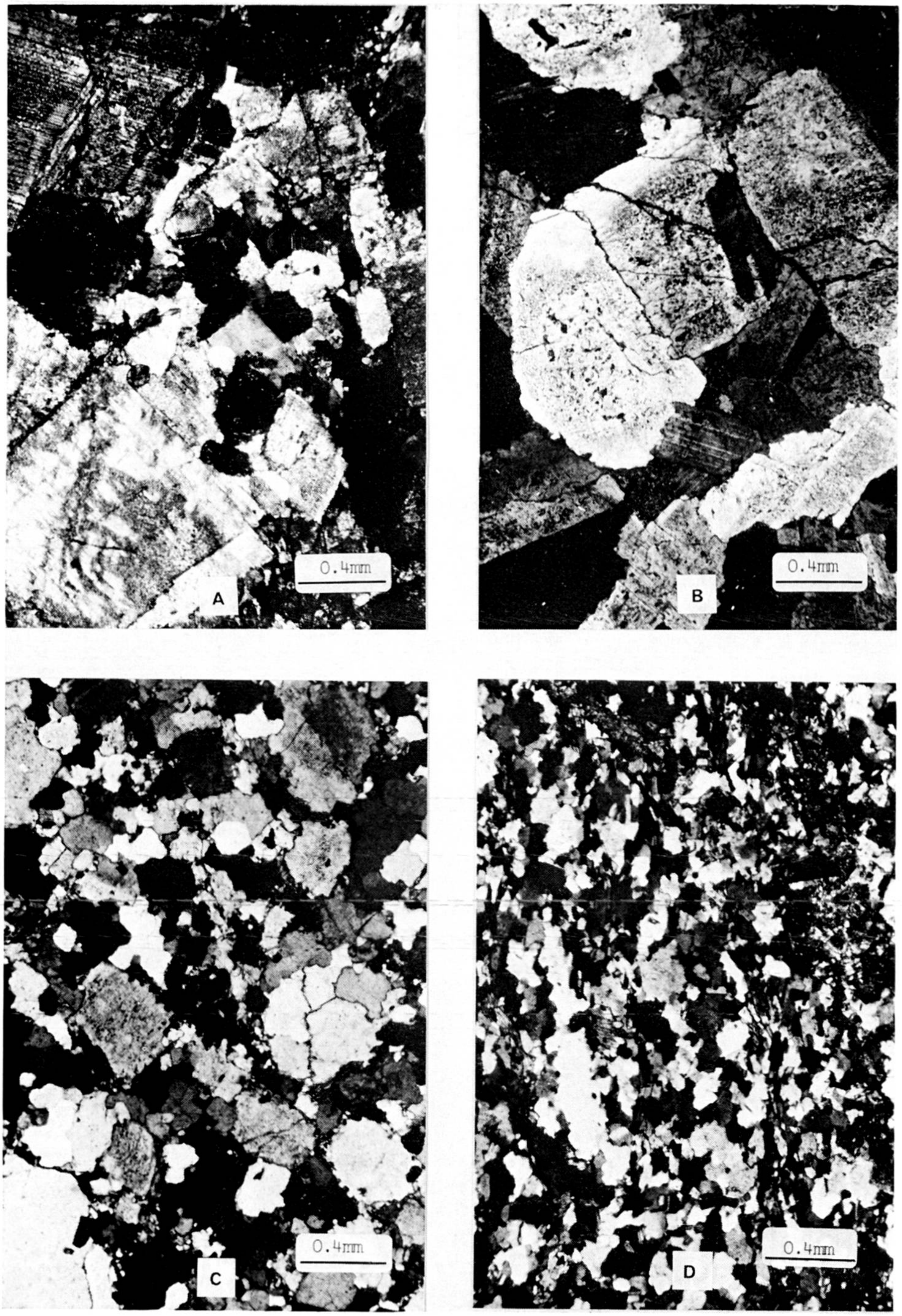
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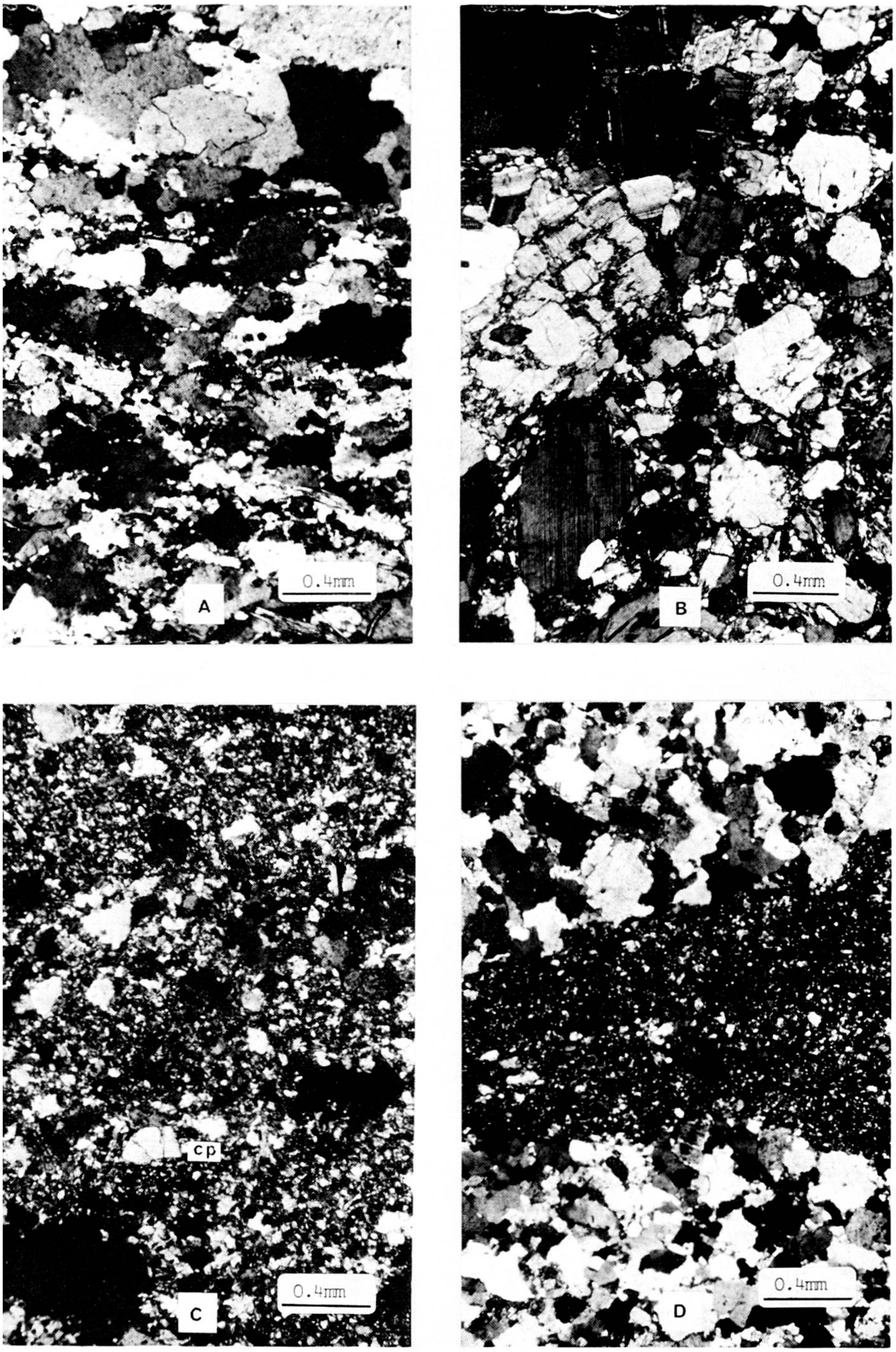
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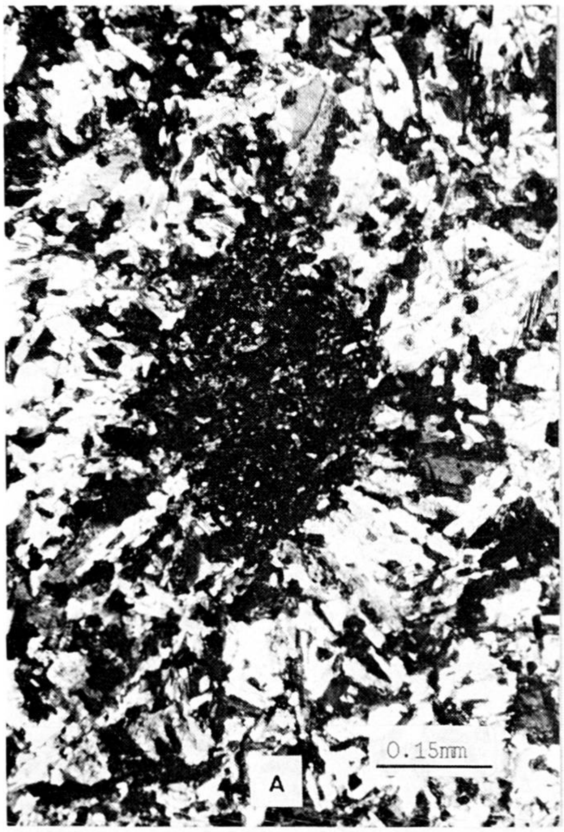
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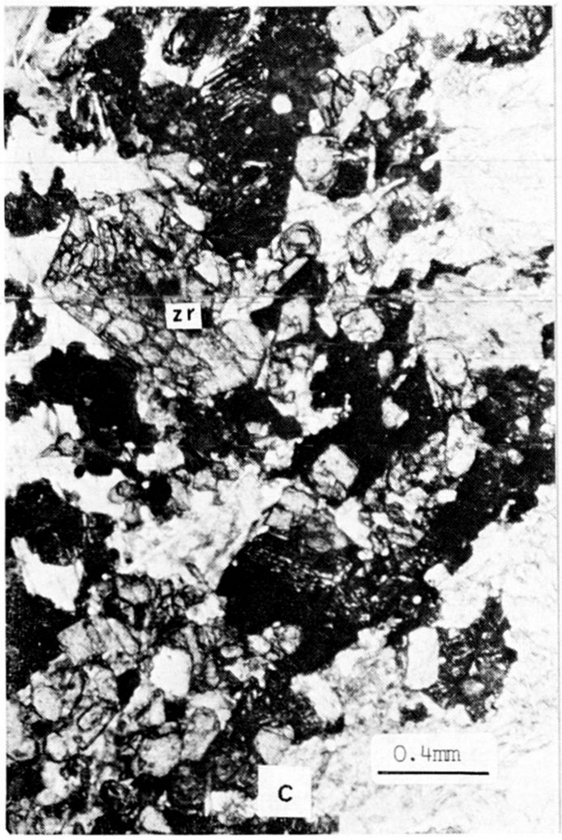
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