Distribution of trace elements in feldspars of granitic aplites and pegmatites from Alijó-Sanfins, northern Portugal

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Abstract

At Alijó-Sanfins there are many granitic aplite and pegmatite veins crosscutting different petrographic facies of the Hercynian granite batholith and also mica-schists. They are tin-bearing granitic rocks. Thirty-four samples of K-feldspar and 34 of albite from these veins and host granites were analysed to establish the distribution of elements and their fractionation trends in the sequence of feldspar crystallization. Rubidium and Cs increase, and Ba, Sr, Ba/K, Sr/K and K/Rb decrease in K-feldspar, whereas Na increases and Sr and Ca decrease in albite, from granites to aplites and pegmatites. In a few aplite-pegmatite veins Rb, Rb/Ba and Rb/Sr increase and Ba, Sr, K/Rb and Ba/Sr decrease in K-feldspar, and Rb increases and Sr decreases in albite from aplite to coexisting pegmatite. Equilibrium was not attained for trace elements between coexisting feldspars.

KEYWORDS: K-feldspar, albite, granitic pegmatite, aplite, trace elements.

Introduction

MICROPROBE techniques have been applied successfully to the determination of concentrations of trace elements of feldspars (e.g. Černý *et al.*, 1984), but bulk analyses will retain their value (Smith, 1975) for petrologic interpretations. Concentrations of elements of separated coexisting feldspars of granitic rocks from Alijó-Sanfins, northern Portugal, were determined in the present study by optical spectroscopy for this particular purpose.

The granites, granitic aplites and pegmatites from Alijó-Sanfins are tin-bearing granitic rocks, which are late differentiates of anatectic melts of S-type. Fractional crystallization is responsible for the tin enrichment, as shown in the straight-line correlations log Rb/Ba–log Sn and log Rb/Sr–log Sn (Neiva, 1984). In this mechanism, K-feldspar is important in controlling the distribution of Rb, Ba and Sr, while albite mainly controls the distribution of Sr. Therefore it was expected that the distribution of trace elements in K-feldspar and also in albite of these rocks would have been controlled by fractional crystallization. The data obtained confirm this mechanism.

Analytical methods

K-feldspar and albite were separated by magnetic separator and heavy liquids. A purity of about 99.8% for K-feldspar and 99.0–99.5% for albite was estimated by optical examination. The principal contaminants are zircon and muscovite for K-feldspar and quartz and zircon for albite.

The concentrations of Na and K in K-feldspar and albite were determined by flame photometry, whereas that of Ca was determined by titration with EDTA.

The trace elements were determined by emission spectroscopy in a large quartz-glass Hilger spectrograph with Pd as an internal standard. The readings were done optically on a Jarrell-Ash photodensitometer with a precision of $\pm 20\%$. The limits of sensitivity were Be 5, Ga 2, Li 1, Zr 5, Sr 3, Pb 5, Ba 5, Rb 5 and Cs 5 ppm.

Occurrence and types of feldspars

At Alijó-Sanfins, in the southern part of the Trás-os-Montes and north of Alto-Douro at about 23 km east from the town of Vila Real (Fig. 1*a*), 13 different

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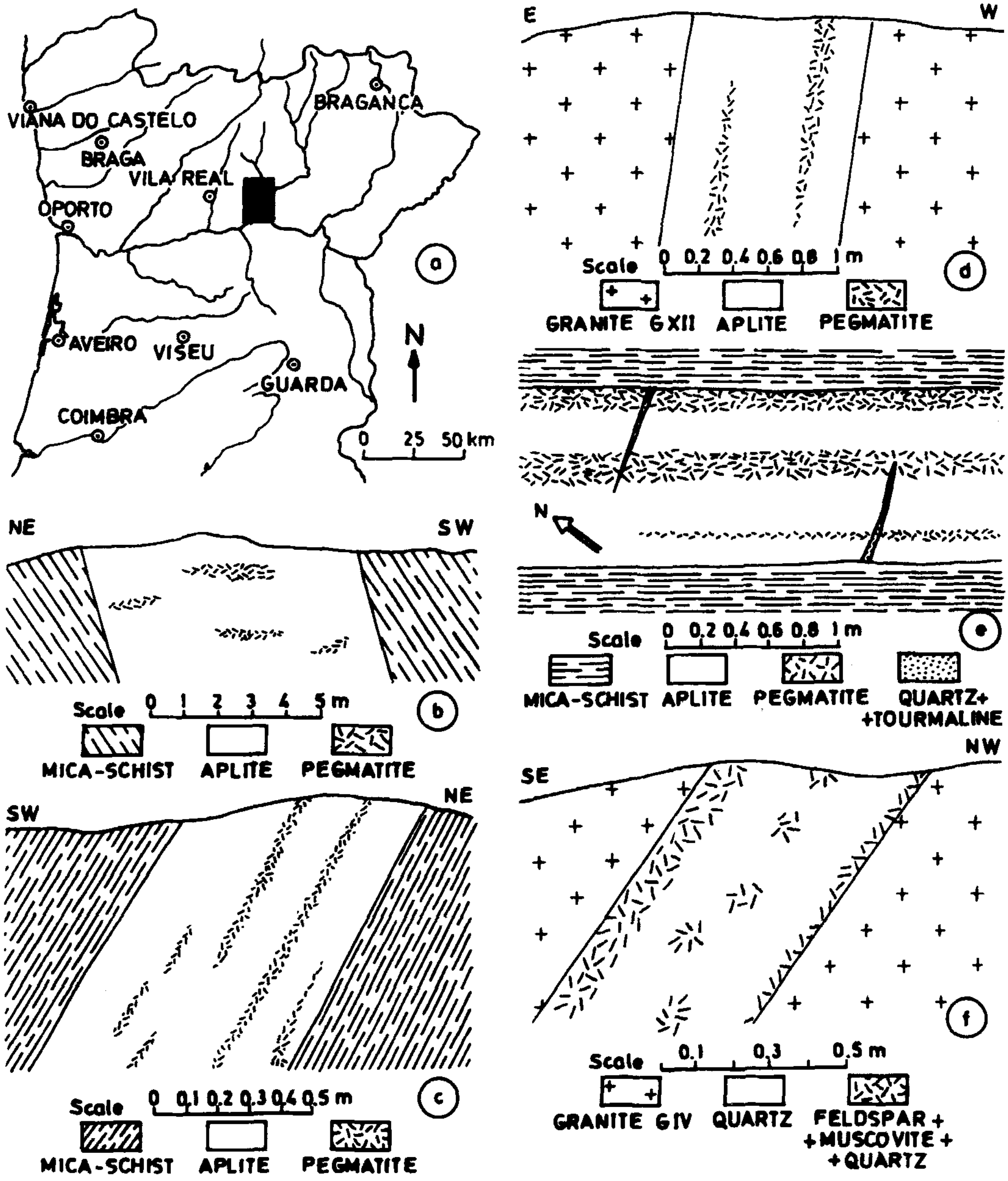

FIG. 1. (*a*) Location of the Alijó-Sanfins area on the map of Portugal. (*b–f*). Sketches of aplite-pegmatite veins and pegmatite from this area. (*b*) at 1725 m S53°W of the Lousa 2nd pyramid; (*c*) at km 50.550 on the road S. Mamede de Ribatua-Tua; (*d*) close to Quinta do Zimbro; (*e*) at the road between S.ta Eugénia and S.ta Bárbara 2nd pyramid; and (*f*) at the Chapel of Senhora da Cunha.

petrographic facies (GI–GXIII) were distinguished in the granite batholith. They have their origin in five different pulses of granitic magmas formed by the partial fusion of metasedimentary materials at a depth of ~ 15 km (Neiva, 1973). The older syntectonic granites (GI–GVII) and late-tectonic granite (GVIII) intruded during the upper Westphalian and lower Stephanian and are related to the Asturian phase of the Hercynian orogeny. The younger post-tectonic granites (GIX–GXIII) intruded during the lower Permian and are probably related to the Saalic phase. An extensive swarm of granitic aplite-pegmatite dykes is present at Alijó-Sanfins. Their emplacement was controlled partly by faults but mainly by joint sets.

In general, pegmatite bodies form unzoned lenses within the aplite or *en échelon* wisps inside the vein (Fig. 1*b*), but generally concordant with the elongation of the vein (Fig. 1*c,d,e*). In some cases the pegmatite is located close to the hanging wall, locally in elongated parallel lenses (Fig. 1*e*). There are also veins in which only a single rock type is represented (Fig. 1*f*). They cut granites, to which they are genetically affiliated, and the enclosing mica-schists (Neiva, 1975).

These granitic rocks are strongly peraluminous and contain mainly quartz, K-feldspar, albite and muscovite. Biotite generally ranges from 1 to 3%, but attains 5.20% by volume. Tourmaline, apatite, rutile, ilmenite, garnet and cassiterite are generally present, but the last two were only found in aplites and pegmatites. Beryl and fluorite were occasionally found in pegmatites.

The analysed K-feldspar and albite are from some of the co-existing aplite-pegmatite pairs and of the host granites. The rocks have been chosen to represent aplites and pegmatites cutting each of the granite facies, and a sample of the host granite has also been selected to separate the coexisting K-feldspar and albite. Feldspars from additional granitic aplites and pegmatites cutting the mica-schist, but related to the granite GX, were also analysed.

The obliquity $\Delta = 12.5\ (d_{131}-d_{1\bar{3}1})$ was determined from X-ray diffraction patterns of these separates of K-feldspar. The error generally does not exceed ± 0.003. The optical axial angle 2V was measured conoscopically with the Universal stage and with an error of $\pm 1°$ (Neiva, 1974*a*). K-feldspar of the parental granites is microperthitic microcline with $82° < 2V < 88°$ and $0.73 < \Delta < 0.95$. In aplites, it is also generally microperthitic microcline, with $80° < 2V < 88°$ and Δ between 0.61 and 0.90, but in two aplites it has 2V of only 72° and Δ of 0.38. In pegmatites, the K-feldspar is a finely microperthitic microcline with 2V in the range 80–87° and Δ in the range 0.66–0.95. In one sample of granitic pegmatite

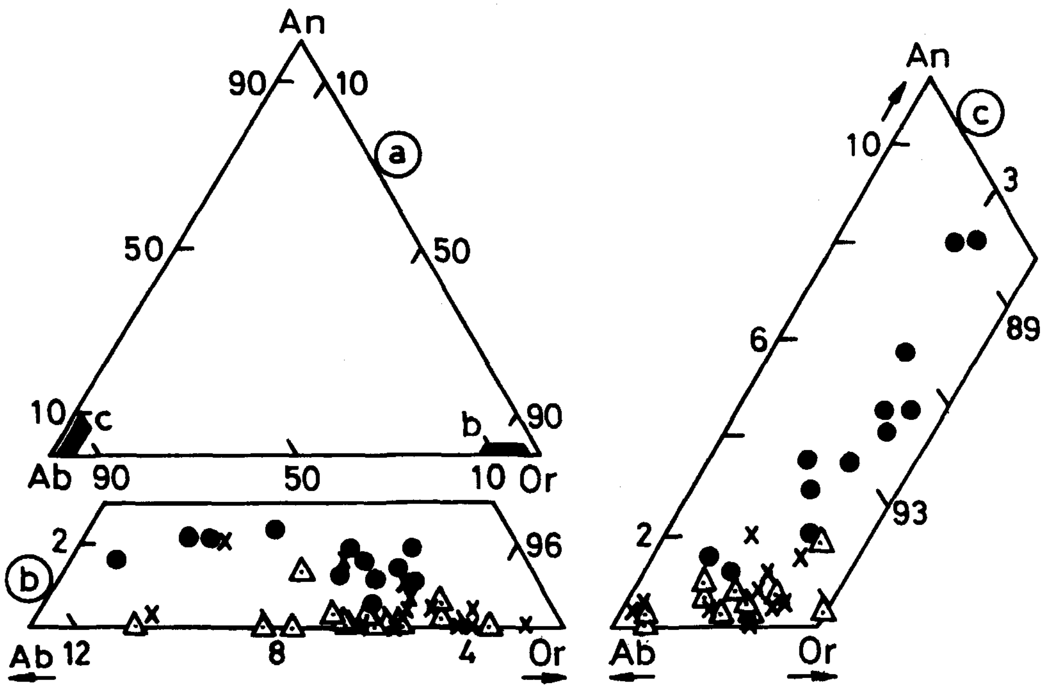

FIG. 2. An–Ab–Or diagram (*a*) showing location of diagrams (*b*) and (*c*); variations in bulk composition in K-feldspar (*b*) and albite (*c*) of granites and granitic aplites and pegmatites from Alijó-Sanfins, northern Portugal. Symbols: ● – granite; × – aplite; △– pegmatite.

TABLE 1. Some major elements in wt.% and trace elements in ppm of K-feldspars of granitic rocks from Alijó-Sanfins northern Portugal

	Granites				Aplites				Pegmatites			
	Mean	s	Minimum	Maximum	Mean	s	Minimum	Maximum	Mean	s	Minimum	Maximum
K_2O	15.58	0.35	14.87	15.95	15.97	0.23	15.63	16.34	15.87	0.26	15.48	16.36
Na_2O	0.74	0.21	0.54	1.23	0.56	0.10	0.34	0.68	0.69	0.17	0.42	0.99
CaO	0.32	0.11	0.12	D.47	0.08	0.10	0	0.32	0.04	0.08	0	0.27
Be	*	0	*	*	4	14	*	46	5	14	*	46
Ga	24	4	11	25	20	5	11	25	19	4	11	25
Li	6	6	*	18	15	11	3	34	15	14	*	42
Zr	9	9	*	23	*	*	*	*	*	0	*	*
Sr	118	43	35	205	43	35	4	105	35	28	3	75
Pb	88	69	25	220	36	15	15	70	27	18	10	70
Ba	686	279	78	1130	103	108	10	270	47	45	5	125
Rb	1414	286	1040	1900	1986	276	1500	2400	2275	361	1700	2900
Cs	28	18	10	60	130	67	37	275	176	125	55	450
$Cs10^3/K$	0.21	0.14	0.08	0.46	0.97	0.50	0.27	2.02	1.3	0.96	0.42	3
Rb/Ba	4	7	0.93	24	88	97	6	225	165	188	16	580
Rb/Sr	15	13	5	54	134	179	16	563	178	252	26	933
K/Rb	95	18	69	121	70	11	55	89	59	9	46	77
$Sr10^3/K$	0.92	0.35	0.27	1.66	0.32	0.26	0.03	0.79	0.26	0.20	0.02	0.58
$Pb10^3/K$	0.69	0.56	0.19	1.8	0.27	0.11	0.11	0.53	0.20	0.14	0.07	0.53
$Ba10^3/K$	5	2.3	0.60	9	0.78	0.81	0.07	2.0	0.36	0.34	0.04	0.92
Ba/Sr	6	1.49	2.2	8	2.3	1.38	0.33	4	1.52	1.04	0.17	3
Rb/Cs	71	39	30	136	20	11	7	45	20	13	6	45
n	12				11				11			

* – below the limit of sensitivity; n – number of analyses.
Analyst: A. Neiva.

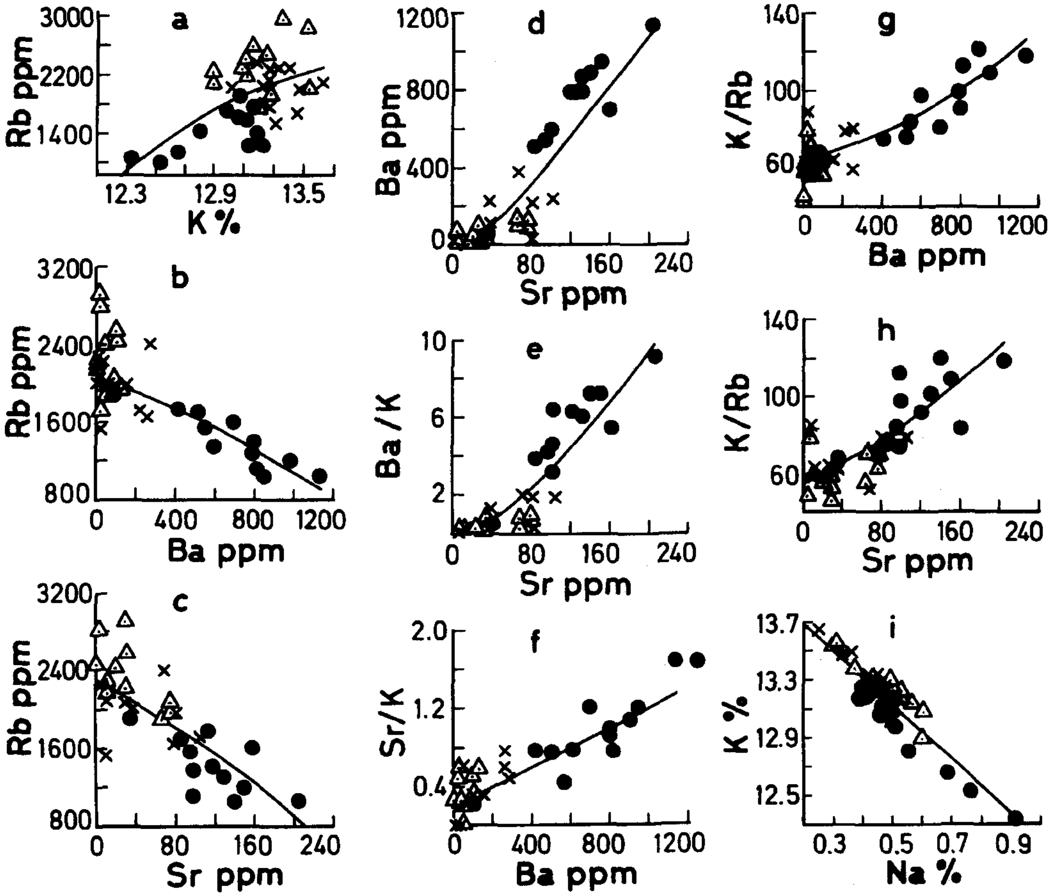

FIG. 3. Distribution of trace elements and K and Na in K-feldspar of granites, and granitic aplites and pegmatites from Alijó-Sanfins, northern Portugal. Correlations between: (*a*) Rb and K; (*b*) Rb and Ba; (*c*) Rb and Sr; (*d*) Ba and Sr; (*e*) Ba/K and Sr; (*f*) Sr/K and Ba; (*g*) K/Rb and Ba; (*h*) K/Rb and Sr; and (*i*) K and Na. Symbols as in Fig. 2.

vein it has $2V = 78°$ and $\Delta = 0.59$. Thus there is a broad range of values with $0.38<\Delta<0.95$ and $72°<2V<88°$ for the K-feldspars of 12 granites, 26 aplites and 25 pegmatites from an area of 320 km^2. The samples were collected along E-W parallels 16 km long and N–S meridians, 20 km long. A correlation was noted between obliquity and 2V, but no correlation was found between either obliquity or 2V and the bulk composition and trace element contents given in Table 1.

The bulk Or, Ab, composition of K-feldspar of these granitic aplites and pegmatites is generally constant. The K-feldspar of a few granites has Or lower and Ab higher than the K-feldspar of the other granites and of the aplites and pegmatites, because they are relatively more microperthitic (Fig. 2*a,b*).

The composition of the albite is An_1–An_8 in granites and An_0–An_2 in granitic aplites and pegmatites (Fig. 2*c*; Neiva, 1973, 1974*b*, 1977).

Trace elements in K-feldspar

The major and trace element contents end ratios for K-feldspar are shown in Table 1.

The K-feldspar of granitic aplites and pegmatites has a composition generally distinct from that of K-feldspar of granites (Fig. 3). Generally Rb increases and Ba, Sr, K/Rb, Ba/K and Sr/K decrease from K-feldspar in granites to that of aplites and pegmatites. There does not seem to be any evidence of metasomatic mobility of the alkalis in this suite of granitic rocks, as shown in the diagram Na–K of their microperthitic K-feldspar (Fig. 3*i*).

The K-feldspar from granitic aplites and pegmatites has similar or higher K, Be, Li, Rb and Cs contents and similar or lower Na, Ca, Sr, Pb and Ba contents relative to the K-feldspar of granites. It also has similar or higher Cs/K, Rb/Ba and Rb/Sr and similar or lower K/Rb, Sr/K, Pb/K, Ba/K, Ba/Sr and Rb/Cs.

The K-feldspar of granitic pegmatites has similar or higher Li, Rb, Cs, Cs/K and Rb/Sr, and similar or lower Ca, Sr, Ba, K/Rb, Sr/K, Ba/K and Ba/Sr than the K-feldspar of granitic aplites.

The K-feldspar of these small, homogeneous, unzoned, granitic pegmatites yields the highest values of Li, Rb, Cs, Cs/K, Rb/Ba, Rb/Sr and the lowest values of Sr, Pb, Ba, K/Rb, Sr/K, Pb/K, Ba/K and Ba/Sr compared with those of K-feldspar of these aplites and host granites. However the K-feldspar of small unzoned bodies of granitic pegmatites from other parts of the world have similar Ba, Rb and Cs contents to those in the host granites, but, in large pegmatites, trace element contents vary from one body to another and from one part to another of the same pegmatite. In a complex, zoned rare-metal pegmatite Ba tends to decrease, whereas Rb and Cs tend to increase as differentiation proceeds (Smith and Brown, 1988).

The K-feldspar of these pegmatites has similar or higher Rb (1700–2900 ppm), similar or lower Cs (59–450 ppm), Li (not detected – 42 ppm), Sr (3–75 ppm), Ba (5–125 ppm) than the K-feldspar of the three zoned pegmatites from Black Hills, South Dakota (Shearer *et al.*, 1985), which contains 740–2550 ppm Rb, 15–540 ppm Cs, 39–96 ppm Li, 20–230 ppm Sr and < 20–1080 ppm Ba.

The K-feldspar of highly evolved pegmatites in the Harney Peak (Shearer *et al.*, 1992) has Ba < 60 ppm, K/Rb < 50 and Rb/Cs < 10, whereas in Harney Peak there are also pegmatites with K-feldspar relatively high in Ba (> 140 ppm) which gives K/Rb > 150 and Rb/Cs > 20. The K-feldspar of granitic pegmatites from Alijó-Sanfins has 5–125 ppm Ba, K/Rb 46–77 and Rb/Cs 0.17–3, which indicate that these pegmatites are evolved to highly evolved.

Potassium/rubidium ratios of K-feldspar have been shown to be a sensitive indicator of pegmatite fractionation (Trueman and Černý, 1982). These authors present a diagram of K/Rb *vs* Cs of K-feldspar in the pegmatites of the Winnipeg River district which has a K/Rb range of 12–470. Consequently the K/Rb ratios of 46–77 of the K-feldspar of granitic pegmatites from Alijó-Sanfins also indicate that they are evolved. The K/Rb ratio of the K-feldspar decreases from barren pegmatites to the spodumen-phosphate-bearing and spodumene-bearing pegmatites (Shearer *et al.*, 1985). At Alijó-Sanfins the pegmatites do not contain spodumene or phosphates.

In the feldspar samples examined, the highest value of Cs is 450 ppm, which is significantly lower than the highest Rb level (of 2900 ppm); both are found in K-feldspar from granitic pegmatites. This observation agrees with findings of Taylor and Heier (1960) for the K-feldspar of Norwegian granitic rocks, and with data from other terrains.

Lithium tends to be uniform or to increase in K-feldspar from granites to that of granitic aplites and pegmatites from Alijó-Sanfins, with the highest value in the K-feldspar from one of the most fractionated pegmatites whose K-feldspar has the highest Rb/Sr, the lowest Sr/K and Ba/K and one of the lowest K/Rb ratios. Lithium in K-feldspar can be attributed to a coupled substitution with Rb, as suggested by Černý *et al.* (1985), and is a consequence of an increase in Li in late solutions. This is supported by the fact that muscovite of these aplites and pegmatites also contains more Li than muscovite from the granites (Neiva, 1975). However these pegmatites do not contain lepidolite, spodumene, petalite and triphylite–lithiophylite. The highest Li content in the analysed K-feldspar is 42 ppm, which is significantly lower than the high values (> 80–100 ppm) associated with the presence of Li-aluminosilicates such as spodumene and/or petalite (Smeds, 1992).

A few granitic aplite-pegmatite veins from Alijó-Sanfins contain some beryl. The highest Be content (46 ppm) was found in two K-feldspar samples of these veins. The highest Be content found in the respective rocks is 85 ppm in a pegmatite, which is lower than the bulk value of 180 ppm stated as necessary by Solodov (1971, quoted by Trueman and Černý, 1982) for the crystallization of beryl. The K-feldspar of these few pegmatites plot in the field of Be-bearing pegmatites in the diagram K/Rb *vs* Cs in pegmatitic K-feldspar given by Trueman and Černý (1982).

Gallium is widespread but does not display any significant variation. It attains 25 ppm in the K-feldspar of granites and granitic aplites and pegmatites from Alijó-Sanfins, whereas Zr was only detected in some K-feldspar of granites and most likely is bound in zircon.

In the K-feldspar of granitic aplites and pegmatites coexisting in the same vein, there is not a general clear cut difference in trace element contents. This is mainly due to the fact that Sr and Ba are uniform in K-feldspar of these veins, presenting very low contents of these elements. Rubidium is the most abundant trace element and shows an increase from the K-feldspar of aplite to that of coexisting pegmatite. In a few pairs Rb, Rb/Ba and Rb/Sr increase and Ba, Sr, K/Rb and Ba/Sr tend to decrease from K-feldspar of aplite to that of coexisting

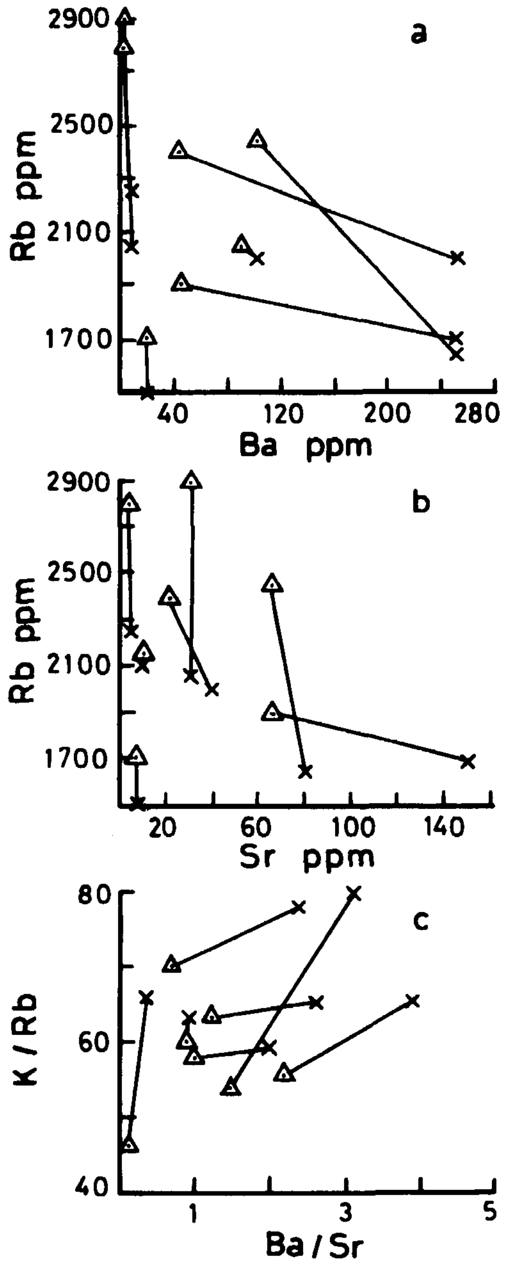

FIG. 4. Distribution of: (*a*) Rb and Ba; (*b*) Rb and Sr; and (*c*) K/Rb and Ba/Sr of K-feldspar of granitic aplites and coexisting pegmatites from Alijó-Sanfins, northern Portugal. Symbol as in Fig. 2. Lines connect K-feldspar of paired aplite and pegmatite.

pegmatite (Fig. 4). The distance between samples making up the pair, the proximity to the host rock and the location within a given vein do not seem to have any significant influence.

Many factors control the chemical composition of feldspars (Smith, 1974). The effects of fractional crystallization of a minimum granitic melt composition on Rb, Sr and Ba in K-feldspar are shown by Shearer *et al.* (1985). The degree of fractionation of the granitic melt is of utmost importance for K-feldspar of Alijó-Sanfins. As fractional crystallization progresses, Rb, Cs and Li concentrations of K-feldspar increase, whereas Sr and Ba concentrations decrease, because the K-feldspar/melt distribution coefficients for Rb, Cs and Li are smaller than 1, while those for Sr and Ba are greater than 1. The ranges of mineral/melt partition coefficients collected by Jolliff *et al.* (1992) from several references and those of Arth (1976) for Sr were used.

Trace element contents of a pegmatite may also result from the exsolution of a fluid phase, in addition to crystal fractionation. The K-feldspar derived from a fluid phase would be enriched in Sr and Ba, and present a lower Rb/Sr ratio (Shearer *et al.*, 1985). Therefore at Alijó-Sanfins the K-feldspar of granitic pegmatites is not derived from a fluid phase because it has generally less Sr and Ba and higher Rb/Sr than the K-feldspar of granites and aplites.

The K/Rb ratio of K-feldspar is expected to decrease, whereas the Rb/Sr and Rb/Ba ratios of this mineral are expected to increase with increasing crystal fractionation of a minimum granitic melt (Shearer *et al.*, 1985). The best ratios for indicating the degree of fractionation of K-feldspar of granites, aplites and pegmatites from Alijó-Sanfins are Rb/Ba and Rb/Sr. The K/Rb and Cs/K ratios are also good indicators and Ba/K, Sr/K and Ba/Sr ratios are useful.

The K-feldspar of granites, aplites and pegmatites from Alijó-Sanfins has a high K_2O content ranging between 15.48 and 16.36 wt.%. It is evolved to highly evolved, being more evolved in aplites and pegmatites. Consequently, it is nearly pure, and can be used in ceramic and glass industries.

Trace elements in albite

Concentrations of selected major and trace elements in albite are given in Table 2. The albite of granitic aplites and pegmatites has similar or higher Na, Be and similar or lower Ca, Sr and Ba contents than the albite of granites. It also has higher Na/Ca and lower Ca/Sr and Sr/Na ratios.

The negative correlations Na–Ca, Sr–Na and the positive correlation between Sr and Ca (Fig. 5*a,b,c*) show fractionation trends of albite crystallization and, consequently, the albite of granitic aplites and pegmatites is generally separated from that of

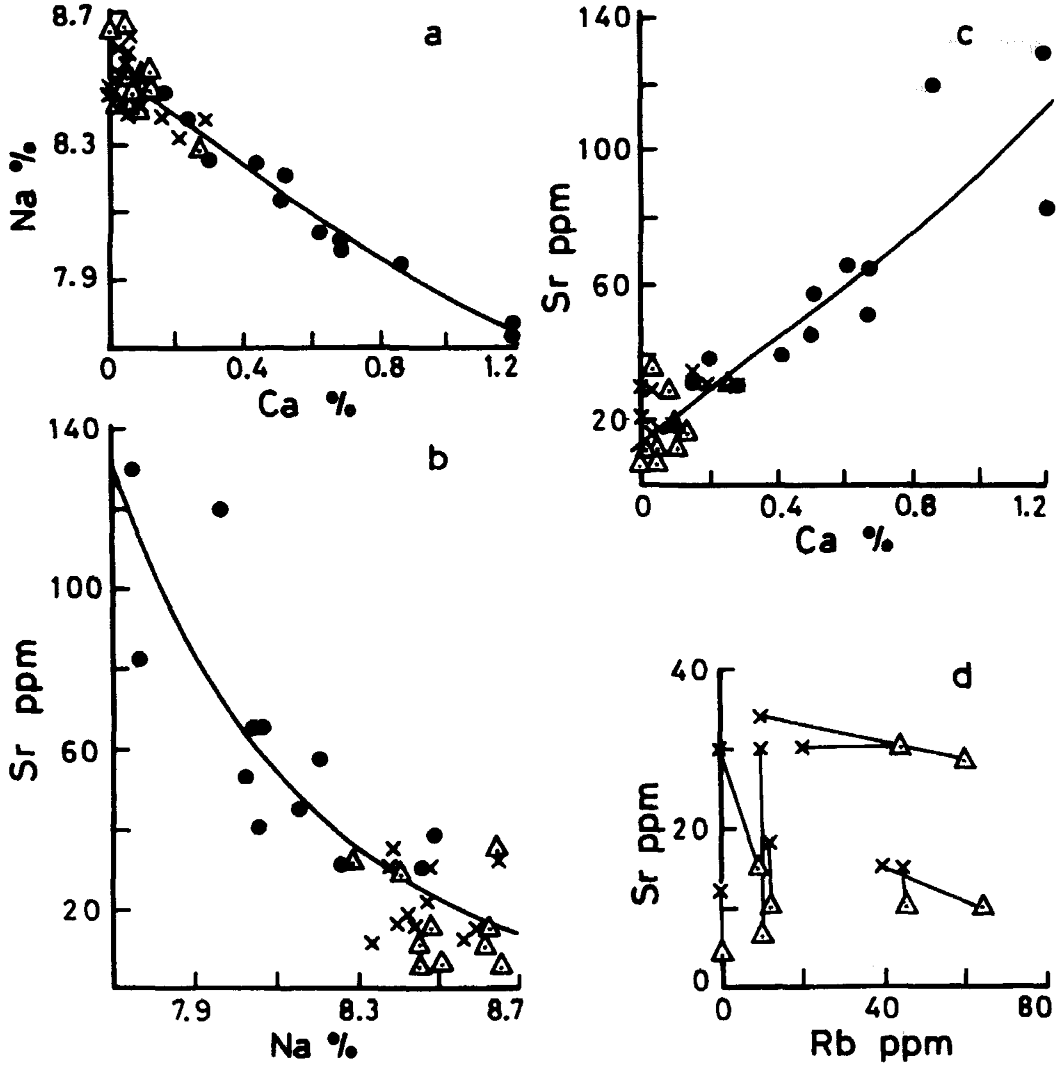

FIG. 5. Distribution of some elements in albite of granites and granitic aplites and pegmatites from Alijó-Sanfins. Correlations between: (*a*) Na and Ca; (*b*) Sr and Na; (*c*) Sr and Ca; and (*d*) distribution of Sr and Rb between albite of aplites and of coexisting pegmatites (connected by tie-lines). Symbols as in Fig. 2.

granites. The Na–Ca correlation applies to all examples of albite in granitic rocks in the world. The Sr–Ca correlation in plagioclase was also found by other authors (e.g. Corlett and Ribbe, 1967; and Christie *et al.*, 1970), and the correlation between Sr and Na in plagioclase was found in ion-probe analyses of this mineral from the Stillwater Complex (Smith and Frown, 1988).

The albite of pegmatite tends to have similar or higher Be, Li, Rb and similar or lower Sr than the albite of aplites.

The analysed albite of granitic pegmatites has lower CaO (0–0.37 wt.%), K_2O (0.22–0.60 wt.%), Li (1–22 ppm), Sr (4–34 ppm) and Ba (5–10 ppm) contents and higher Na_2O (10.47–11.64 wt.%) and Rb (5–6 ppm) contents than the primary albite of wall and intermediate zones from the Věžná pegmatite which contains 2.40–3.09 wt.% CaO, 0.75–1.23 wt.% K_2O, 58 and 67 ppm Li, 400 ppm Sr, 330 and 290 ppm Ba, 8.50–9.55 wt.% Na_2O and 2 and 5 ppm Rb, according to data cf Černý *et al.* (1984). However it has a similar or lower Ca content,

TABLE 2. Some major elements in wt.% and trace elements in ppm of albites of granitic rocks from Alijó-Sanfins, northern Portugal

	Granites				Aplites				Pegmatites			
	Mean	s	Minimum	Maximum	Mean	s	Minimum	Maximum	Mean	s	Minimum	Maximum
CaO	0.83	0.46	0.23	1.65	0.13	0.13	0	0.40	0.11	0.10	0	0.37
Na_2O	10.65	0.60	9.23	11.43	11.20	0.19	10.86	11.52	11.24	0.36	10.47	11.64
K_2O	0.52	0.10	0.30	0.67	0.48	0.14	0.19	0.64	0.46	0.14	0.22	0.60
Be	5	8	*	18	5	8	*	22	84	126	*	400
Ga	26	2	25	30	21	6	11	25	24	3	15	25
Li	8	6	1	20	6	5	*	15	5	6	*	22
Zr	31	22	5	64	3	7	*	23	*	*	*	*
Sr	63	33	30	130	23	8	12	34	16	10	4	34
Pb	*	0	*	*	*	0	*	*	*	*	*	*
Ba	42	60	*	200	4	4	*	10	3	4	*	10
Rb	22	16	*	64	16	15	*	45	27	25	*	65
Ca/Sr	96	27	53	145	39	29	0	97	54	35	0	110
$Sr10^3/Na$	0.78	0.43	0.35	1.68	0.27	0.10	0.14	0.41	0.19	0.12	0.05	0.39
n	12				11				11			

* – below the limit of sensitivity; n – number of analyses.
Analyst: A. Neiva.

a lower Ba content and similar or higher Li than the primary albite in cavities of this Czechoslovakian pegmatite, which yields 0.06–1.12 wt.% CaO, 34 ppm Ba and 3 ppm Li.

In pegmatite and coexisting aplite from the same vein, the albite of the former generally has similar or higher Rb and similar or lower Sr than the albite of the latter, but Sr shows a better distinction (Fig. 5*d*).

The albite/melt partition coefficient for Rb is smaller than 1, while that for Sr is greater than 1 (Arth, 1976). Consequently, as fractionation progresses, the Rb content in albite increases, whereas that of Sr decreases. The data tend to follow the general rule of increase in Rb and decrease in Sr of primary albite of pegmatite from an early to late generation (e.g. Černý *et al.*, 1984).

The Na/Ca, Ca/Sr and Sr/Na are the ratios of the analysed albite which are the best indicators of albite fractionation. The Sr of albite is correlated with bulk Sr of granitic rocks (Fig. 6), because albite is the main concentrator of Sr in these rocks. Albite of these granitic rocks has Na_2O ranging between 9.23 and 11.64 wt.%. In the albite from granitic aplites and pegmatites,the Na_2O range is better (10.47–11.64 wt.%) for the glass industry, particularly in respect of the most evolved albite.

Distribution of trace elements between K-feldspar and albite

Albite has similar or higher Be, Ga, similar or lower Sr, and lower Pb, Ba and Rb than the coexisting K-feldspar, which agrees with findings of other authors reviewed by Smith (1974) and Smith and Brown (1988). The distribution of Sr between both feldspars is well correlated.

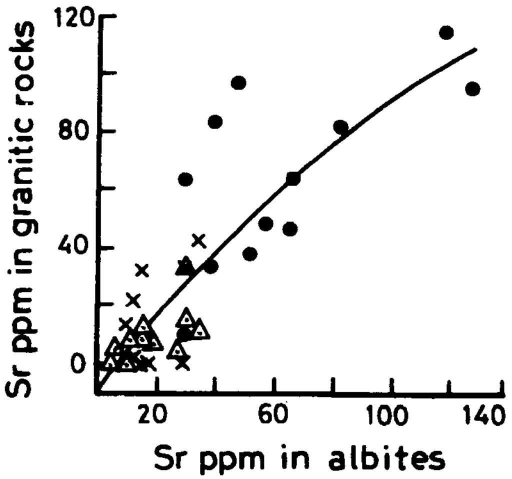

FIG. 6. Correlation between Sr in albite and Sr in its parent granitic rock from Alijó-Sanfins. Symbols as in Fig. 2.

The distribution coefficients (*D*) between coexisting feldspars, in which *D* is the concentration for K-feldspar over that for albite, present large ranges indicating disequilibrium. They are: for Rb 24–190 in granites, 47–513 in aplites and 30–725 in pegmatites; for Sr 1.2–3.3 in granites, 1.3–5.3 with also two other values of 0.23 in aplites, and 0.30–7.5 in pegmatites; for Ba 3.5–127 in granites, 2.5–68 in aplites and 1.5–20.8 in pegmatites. In these calculations, Rb and Ba below the limit of sensitivity were taken as 4 ppm.

If these *D* values are compared with those (9.6 for Rb, 0.78 for Ba and 0.80 for Sr) in the region of Henry's law obtained by Iiyama (1968) who synthesized K-feldspar ($Or_{75}Ab_{25}$) and plagioclase ($An_{30}Ab_{70}$) at 600°C and 1 kbar, it can be concluded that equilibrium was not attained for Rb, Ba and Sr. However only two *D* values (0.67 and 0.88) for Sr in pegmatites are closer to equilibrium. The *D* values depend on the composition of the feldspar pair (Iiyama, 1968). Therefore the data selected here from his work correspond to the pair whose composition is closer to the feldspar pairs from Alijó-Sanfins. The triclinicity and 2V of K-feldspar of this suite show that in terms of degree of Al,Si order, the K-feldspar has not attained equilibrium. Structural disequilibrium seems to be reflected in compositional disequilibrium.

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