magma, the less differentiated products being the NS dykes.

The excess of Na, K, Rb and H_2O in most of the mafic dykes is probably due to hydrothermal processes.

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HANSON A.* - *New data on the bertossaite-palermoite series from the granitic pegmatites of the Gatumba field, Rwanda*

The Li-rich pegmatites of the Gatumba field are known for the complexity of their aluminium phosphates associations. During the study of a large number of specimens from the Buranga pegmetite, the wide range of chemical composition for bertossaite samples has prompted us to carry on a detailled investigation.

Bertossaite, $Li_2CaAl_4(PO_4)_4(OH)_4$, is characterized by high Ca = Sr, OH = F and restricted Li = Na substitutions. The unit cell parameters were refined for ten samples and plotted against the Ca/(Ca + Sr) ratios showing a relatively confident relationships. The poor correlations of the optical properties and densities versus fluorine or calcium contents may betray inhomogeneous materials but could also originate from the number of possibile substitutions, and the abundance of fluid inclusions in the minerals. A selected number of analysed samples were also investigated by infrared spectroscopy. As in the case of the amblygonite-montebrasite series (FRANSOLET and TARTE, 1977), the intensites of the high frequency bands (—3598 cm^{-1}) assigned ot free (OH) groups vary as a function of increasing fluorine contents.

These new mineralogical properties compared with those of the literature confirm that there is an isomorphous series between palermoite $Li_2SrAl_4(PO_4)_4(OH)_4$ and bertossaite. It must be stressed that the calcium-rich members of the series are typical of the Buranga pegmatite whereas palermoite is found in the pegmatite, New Hampshire. This could be explained by a very low strontium content in the Buranga pegmatite as we can deduce it from the lack of Sr-rich minerals also from the occurrence of the Sr-poorest amblygonite in this lithium-bearing pegmatite (RILEY, 1970).

In a few sample amblygonite-montebrasite occurs with of bertossaite and corroded remnants of this mineral are found in bertossaite (VON KNORRING, 1969). Therefore this rare species has also a petrological significance and it suggest the following bulk reaction:

$$4(LiAlPO_4(OH)) + 1Ca \rightarrow Li_2CaAl_4(PO_4)_4(OH)_4 + 2Li$$

This assumption is in good agreement with parts of the evolution of the ironmanganese phosphate associations of the Tsabismund pegmatite: increasinf of the Ca actives and decreasing of the Li contents of the morther phases (FRANSOLET et al., 1986).

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HUBBARD F.H.* - *Basic intrusions and associated charnockite-rapakivi granite crustal depletion, S.W. Sweden*

The emplacement and fractionation of the Proterozoic charnockite-rapakavi granite plutonic complex of Varberg, S.W. Sweden, is bracketed in time by the intrusion of basic magmas. All the mafic rocks have metamorphic mineral assemblages. Those which precede the granites are garnet-amphibolites while those which postdate the granites are garnet-pyribolites in the charnockites and granulite facies country rocks, and garnet-amphibolites, in the granite and amphibolite facies country rock zones.

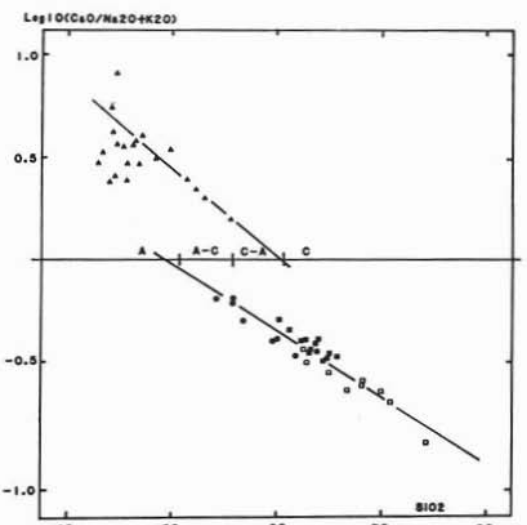

Fig. 1. — Alkali-lime diagram for the basic and acid intrusives. Filled triangles - younger basic, open triangles - older basic, filled circles and squares - charnockite, open squares - rapakivoid granite.

Geochemical parameters suggest that the granitoids are not assimilation-fractional crystallisation (AFC) derivatives from the parent magmas of either of the basic suites (Fig. 1) but rather represent mobilised country rock granite gneisses with accumulation-fractionation of the melt fraction during flow (Fig. 2). *In situ*

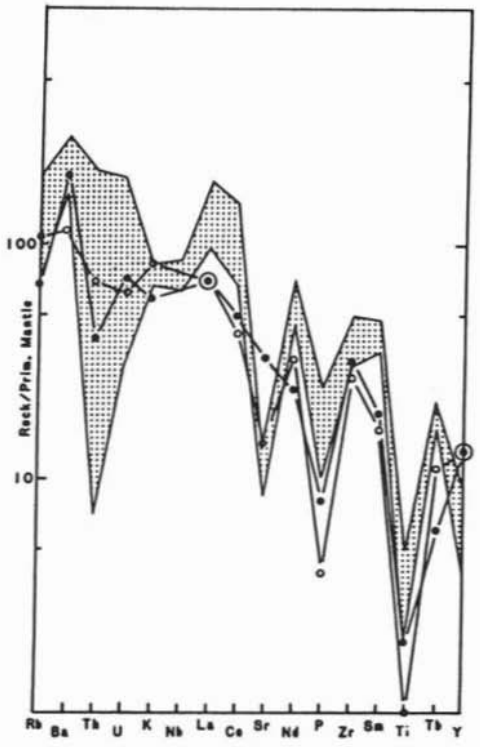

Fig. 2. — Primitive mantle normalised trace element pattern for the granite gneisses (open circles) and charnockitised granite gneisses (circles) superimposed on the field of variation of the granite complex.

charnockitisation preceded mobilisation and fractionation.

The basic magmas, which may represent leakage from crustal under/interplating, transported heat to, and controlled volatile composition and distribution in, the crust. In the consequent localised granulite facies metamorphism, it is suggested that limited anatexis of the charnockitised granitic paragneisses led to the development of mobile systems which rose and fractionated internally to leave, largely crystalline, charnockite residues with separation of more buoyant, melt-dominated, alkali granites fractions. The compositions of the granitic rocks are controlled by the crustal rocks affected. There is no apparent significant compositional contribution from the basic magmas. This constrasts with the current models for Phanerozoic, plate tectonic-related, granite magmatism which are based on compositional modification of basic magmas fron the mantle providing the granite compositional spectrum. The style of granite plutonism revealed at Varberg is viewed as a process of crustal depletion during granulite facies metamorphism near the outer limit of CO_2-flushing influence. Tha basic magmatism created the environment for this activity but was not prime source for the granite magmas.

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JAYANANDA M.*, MAHABALESWAR B.* - *The petrogenesis of Southern Closepet granite: implications for charnockite development and crustal anatexis in Southern Karnataka, India*

The Archaean Closepet granite (2500 Ma) is a polyphase body intruding the Peninsular gneissic complex and associated supracrustal rocks. The granite outcrop runs nearly 500 kms, with a width of 20-25 km and cut across the regional metamorphic structure passing from granulite facies in the south and greenschist facies in the north. The southern part of the granite is heterogenous and shows complex internal structure. It is intimately associated with migmatites and charnockite. Field observation suggest that anatexis of Peninsular gneisses led to the formation of granite melt and there is space-time relationship between migmatite formation, charnockite development and emplacement of granite magma.

Based on mode of occurrence, cross-cutting relationships and texture four major granite phases are recognised. The composition varies from granodiorite to granite and there is a general evolutionary trend from early granodiorite to late granite. Texturaly the granite is medium to coarse grained and from hypidiomorphic granular to porphyritic. The mineral phases present are biotite, plagioclase, quartz, K-fedlspar, amphibole and rarely clinopyroxene. The accessories are zircon, apatite, allanite and sphene. Where the order of crystallization is deduced biotite generally forms an early phase, followed by plagioclase and quartz or quartz followed by plagioclase. K-feldspar is generally a late phase, and there was still sufficient space for it to crystallize as subhedral phenocryst. Amphibole is unstable breaking down to biotite symplectites. Textural evidence suggests that it is partly crystallised from the melt. Clinopyroxene is interstial to late phase. The accessories such as zircon may be derived and apatite, allanite and sphene are early phases in the melt.

Geochemical variations of granite suite are consistent with fractional crystallization or partial melting, but in both the cases feldspar + biotite must be involved as fractionating or residual phases during melting to account trace element chemistry. Trace element modelling suggests the partial melting and to a certain extent fractional crystallization were operative during evolution of the granite. REE abundaces observed indicate no evidence of progressive fractionation of REE from granodiorite to granite. The REE pattern and abundances suggest that the granite is derived from heterogenous source at crustal depth.

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JOUVIN F.*, ROLET J.* - *The Odet-Lestonan leucogranitic pluton emplacement (Armorican Massif, France): a complete study*

The Odet-Lestonan mass is a leucogranitic body which

belongs to the belt bording the South Armorican Shear Zone (S.A.S.Z.). The purpose of this work is to understand the relations between the magma's ascent and the regional deformation, the timing of metamorphic and tectonic events and the global P-T conditions during the emplacement of the pluton.

The geological surroundings of this granite are trondhjemite, metadolerite dykes, quartz veins and mesozonal brioverian metasediments (micaschists). These last are characterized by an E-W schistosity S_1, subparallel to the pluton's limits and to the axial plane of large scale symmetric folds. This metamorphic cleavage bears a subhorizontal mineral lineation L_1, parallel to the foliation's direction and to the folds' axis. The pluton itself shows a cartographic E-W stretched dissymetric ellipse owing to the interference between the magma's ascent and the regional strain. Indeed, the internal structure of the granite (the magmatic foliation), showing a clear warping toward the North, is underlined by several shear zones (N100°E-N110°E) parallel to the S.A.S.Z. So, the parallelism between S_1 and the internal structure of the granite, the geometrical continuity between these structures getting through the pluton's limits as well as the elongated shape of the pluton prove that the emplacement is related to a *synkinematic* and *synmetamorphic ascent* during a tectono-metamorphic stage marked by ductile *trascurrent shears*.

Several thin sections realized near and far the granite, have shown two main metamorphic minerals: phorphyroblasts of *staurolite* coexisting with *andalusite*. These minerals can be ante-, syn- or post-S_1. At last, the absence of contact metamorphism allows us to say that the mesozonal low-pressure regional metamorphism was characterized by a T° about *510°C-580°C* for *1.5-3.3 Kbars* in pressure.

The geocronology (K/Ar method) has provided about 280-285 My for the biotites of miscaschists, about 290 My for the granite's and 295 My for the trandhjemite's. We obtained comparable results (295-296 My) for small muscovites of quartz veins while ages about 315-305 My were found for large scale muscovites of the granitic mass as one pegmatitic facies. The younger ages *(280-295 My) underline the end of a final metamorphic episode* connected with *the end of granitizations* in South Brittany. We have noticed that the reopening of micas was associated with this event. Moreover, we believe that *the ascent of the pluton took place at about 315-305 My* or slightly before.

The determination of the regional stress axis has been realized by informatic methods at the U.S.T.L., Montpellier, France. This research relied on the program created by ETCHECOPAR A. (1984) has end up to determine one *N150°E-N160°E compression* related to *WNW-ESE strike-slip faults*.

This belt along the S.A.S.Z. shows a complex evolution underlined by other granites as Pontivy, Rostrenen or Lizio which have different ages, mineralogy or structural behaviour. So, systematic detailed studies on each granites body could help us to understand the chronology and mechanism of the hypercollision process during these Carboniferous times.

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KEER A.*, EGLINGTON B.M.**, MILNE G.C.* - *Geological, geochemical and isotopic studies on proterozoic granites from Natal, South Africa*

The Natal Structural and Metamorphic Province (NSMP) is exposed in Natal as an almost continuous elongate erosional inlier which trends subparallel to the coast for almost 250 km. It is essentially composed of supracrustal high-grade gneisses and granitoids which, on various grounds, are thought to be the eastern continuation of the Namaqua Metamorphic Province. These two provinces have, together, been referred to as the Namaqua-Natal Mobile Belt (MATTHEWS, 1972; TRUSWELL, 1977).

Previously published age determinations (NICOLAYSEN and BURGER, 1965; BURGER and COERTZE, 1975-6) on mineral separates from rocks in the NSMP are in the range 1016-950 Ma and have been interpreted as dating cooling after the prominent « 1000 Ma Namaqua-Natal » metamorphic events (SACS, 1980).

The NSMP can be subdivided into two major east-west trending terranes on the basic of lithological, structural and metamorphic features (cf. MATTHEWS, 1981). These are:

a) a northern zone 15-30 km wide which defines the southern boundary of the Archean Kaapvaal craton and is thought to represent the metamorphosed and deformed upper of an obducted ophiolite sequence (MATTHEWS, 1972). It is characterised by extensive thrust sheets of predominantly amphibolitic gneisses;
b) a southern zone at least 200 km wide, which is composed of alternating linear belts of supracrustal gneisses, magmatites and granitoid intrusions with granitic material becoming more extensive in the south. These rocks comprise the Mapumulo Group (SACS, 1980). Rocks of the granulite facies and charnockites form a major proportion of the most southerly sector of the terrane.

Over the past two decades, an extensive research programme has been undertaken on selected areas within the NSMP with particular emphasis on the abducted northern zone (see MATTHEWS, 1981; for references). The present contribution describes the chemical characteristics of some of the major granitoid rocks from three selected areas within the previously little-known Mapumulo Group (Fig. 1). Until recently only limited geological investigations had been undertaken on the rocks of the southern zone, with geochemical and isotopic data almost completely lacking.

The Valley of a Thousand Hill's area

KERR (1985) has described a large composite pluton of megacrystic granites which he termed the Mgeni Megacrystic Granite. Seven distinct lithological varietes were recognised and divided into three different suites. Suite I contains pyroxene- and hornblende- bearing granites and four members have been identified. It is the least silicic (59-70% SiO_2) and richest in Ti, Al, total Fe, Mn, Mg, Ca, Sr, Ba, Zr, Zn and Nb. The rocks also show many characteristics of A-type granites, having