J. Univ. Kuwait (Sci.) **3**, 1976

Textural properties of feldspars in Ras Barud granitic rocks, Safaga District, Eastern Desert, Egypt

MOHAMED E. HILMY, ADEL M. REFAAT, MAHMOUD L. KABESH*, AND ZEINAB M. ABDALLAH

Department of Geology, Faculty of Science, Ain Shams University, Abbasia, Cairo, Teachers' Institute of Education, El-Odylia, Kuwait, Earth Sciences Laboratory, National Research Centre, Dokki, Cairo and Teachers' Institute of Education, El-Shamia, Kuwait.

ABSTRACT

The purpose of this paper is to study the textural variations of Ras Barud granitic rocks. It is evident that the microcline perthite of the buff granites is characterised by the presence of poikilitic albite which is formed through the action of Na-bearing solutions penetrating the fissures of the unmixed perthite. The occurrence of exsolution and replacement processes at high and low temperatures respectively is responsible for the formation of the examined microcline perthite in the buff granites. The microcline perthite of some examined adamellites contains albite, quartz, and muscovite in its cracks indicating deposition from external solutions. The shape and nature of the graphic intergrowths between orthoclase and quartz in the red and pink granites are controlled by kinetic factors during the simultaneous crystallization of magma under vapour-rich and rapid cooling conditions. The intergrowth relation between perthite, microcline perthite and quartz in the greyish-white and buff granites suggests that sodic and silicic solutions have attacked the K-feldspar and given rise to perthite and microcline perthite which are cut by quartz rods forming graphic texture. The granophyres of the white granite are mostly formed by a very rapid simultaneous growth between quartz and feldspars.

INTRODUCTION

The examined area forms one of the numerous granitic bodies of the basement complex in the Eastern Desert of Egypt (Fig. 1). Ras Barud granitic rocks consist mainly of red, pink, buff, greyish-white and white granites, in addition to adamellite, granodiorite and quartz diorite. Ras Barud batholith covers about 90 km^2 and has an elliptical pattern with markedly irregular boundaries, sharp and disharmonious contacts. Ras Barud batholith exhibits various topographic forms, ranging from relatively low outcrops with gentle slopes to high outcrops with steep slopes. The batholith is dissected mainly by Wadi Barud which is directed from east to west separating Ras Barud granitic rocks into two parts. The northern one consists mainly of the red, pink, buff, greyish-white and white granites, while the granodioritic rocks and scattered masses of granites occupy mainly the southern part. The batholith is transversed by many tributaries running in different directions. The previous granitic rocks are cut by post-granite dykes consisting of granite, andesite and basalt. Numerous

* Present address: Department of Geology, University of San'a, Yemen.

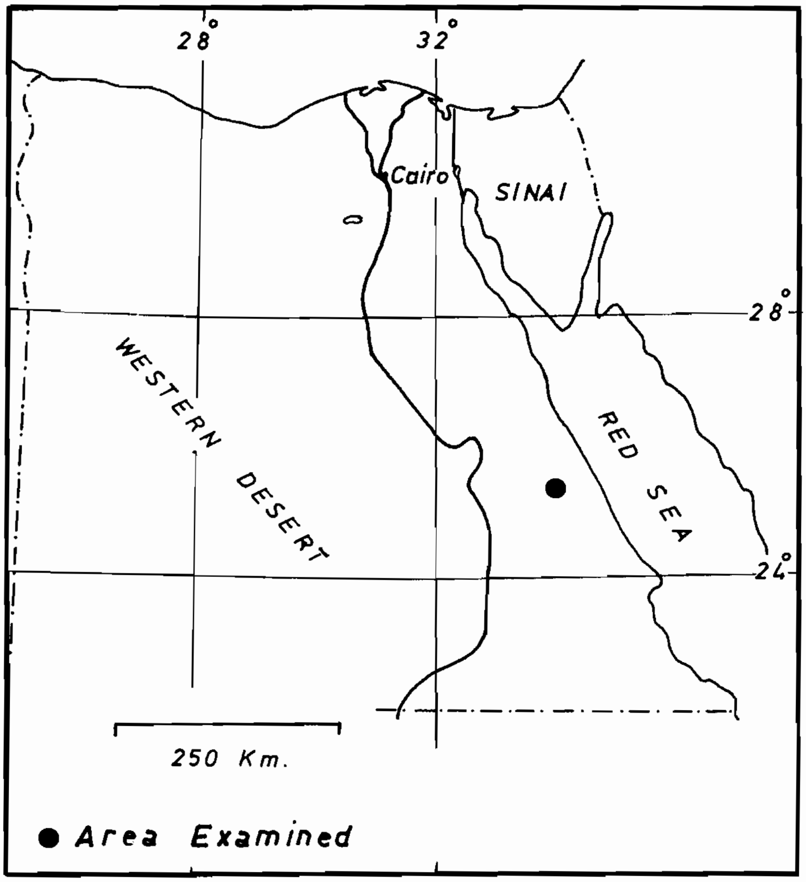


Fig. 1. Location map

quartz, feldspar and epidote veins also dissect Ras Barud granitic rocks. All the granitic rocks grade imperceptibly into each other with rather indefinite contacts (Fig. 2). Microscopic study gives rise to 45 petrographic varieties through the examined granitic rocks. The textural variations of Ras Barud granitic rocks are represented by perthitic and graphic intergrowths.

TEXTURAL VARIATIONS

Textural variations of the examined granitic rocks comprise detailed studies of perthitic and graphic intergrowths from which a great deal of information about the genesis of these granitic rocks can be concluded.

I. PERTHITIC INTERGROWTH

Classification of perthite

According to the distribution of data points and petrologic source of feldspars, Tuttle (1952) has pointed out that the feldspars fall into four series:

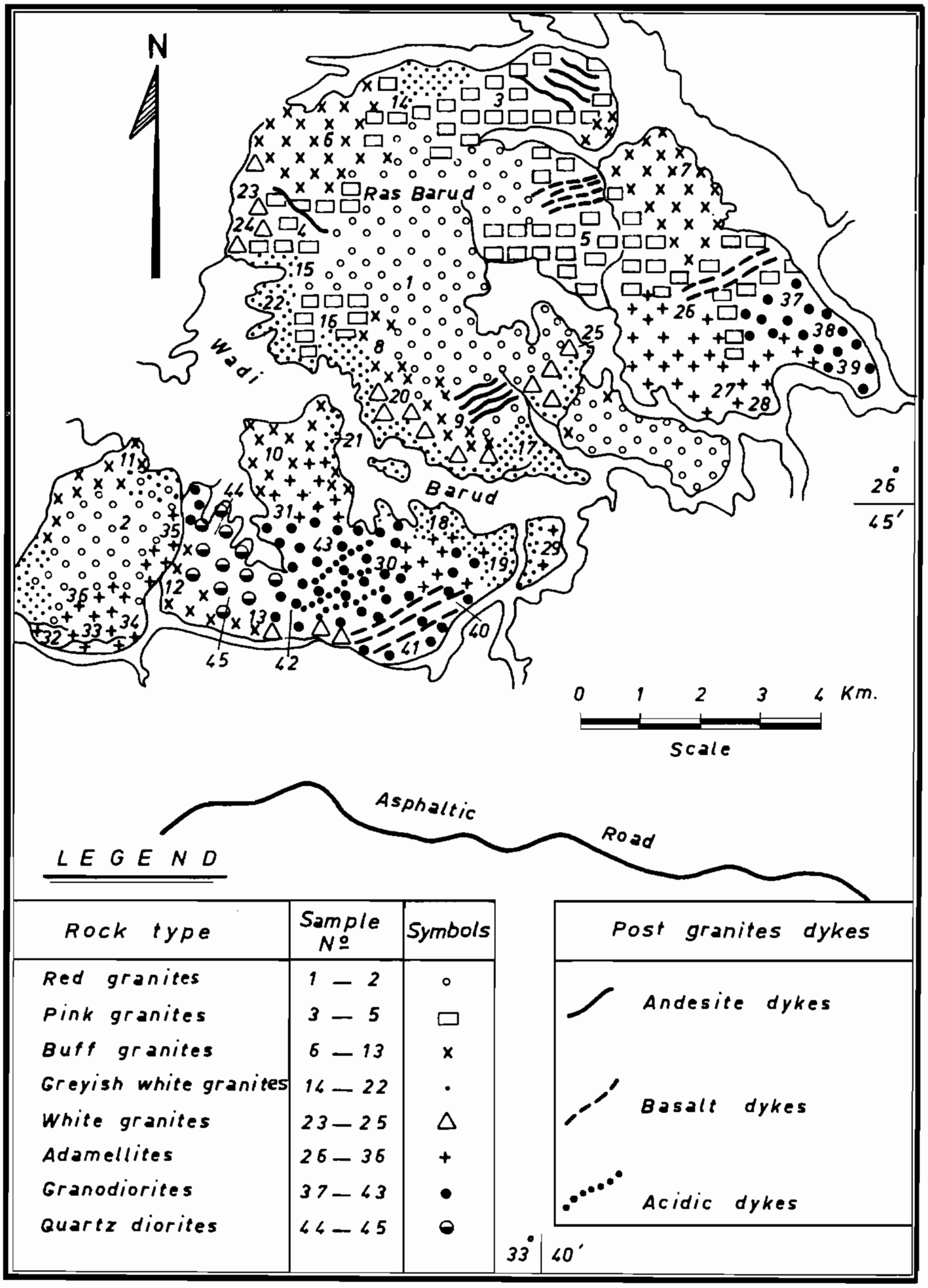


Fig. 2. Generalized geological map of Ras Barud area showing granitic rocks and sample location.

1. Microcline cryptoperthite
2. Orthoclase cryptoperthite
3. Sanidine anorthoclase cryptoperthite
4. High sanidine high albite (homogeneous).

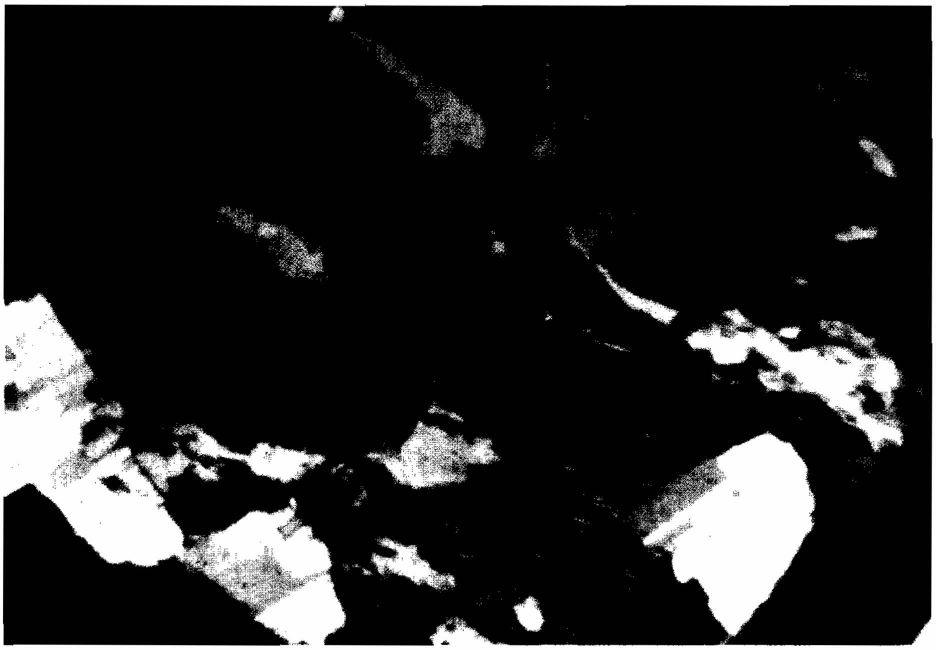


Fig. 3. Feldspar in granite showing macro and micro bands of perthite. C.N. × 50

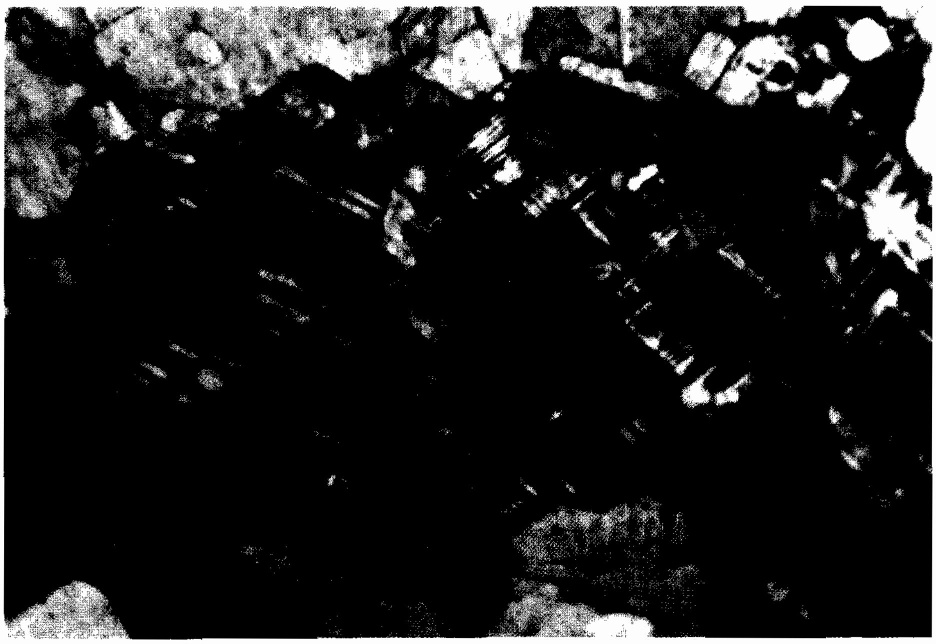


Fig. 4. Microcline perthite containing twinned albite crystals forming poikilitic albite texture. C.N. × 45

Fig. 5. Quartz and microcline perthite containing muscovite flakes, albite and quartz crystals. C.N. × 50

According to Tuttle's classification of feldspars which is based on the simple optical properties, the examined granites comprise microcline perthite and orthoclase perthite.

On the basis of texture study, a size classification of perthite is illustrated by Laves & Soldatos (1963) as follows:

1. Macroperthite
2. Microperthite
3. Cryptoperthite.

The distinction among the three previous varieties of perthite is clarified by Niggli (1926, p. 533.) He pointed out that the thickness of the macro-type bands is more than 0·05 mm while the thickness of the micro-type bands is less than 0·05 mm. The cryptoperthite is not distinguished by the optical microscope, but it can be defined by means of X-ray diffraction, electron microscope methods or observation of iridescence (Smith 1974). The perthite in the examined granites is considered as macro-types and micro-types ranging in band thickness from 0·04 to 0·08 mm (Fig. 3).

Review of perthite mechanism in the examined granites

The microcline perthite of the buff granite originated mainly from exsolution at high temperature and partly from replacement at low temperature. The investigated microcline perthite contains albite inclusions forming a poikilitic albite texture (Fisher 1971). These albite inclusions have polysynthetic twinning and vary from 0·3 to 0·5 mm in length and from 0·2 to 0·4 mm in breadth (Fig. 4). The microcline perthite forms fine fingers or tooth patterns of albite with the poikilitic albite margin. The present

Fig. 6. Graphic intergrowth in the pink granite showing perfectly oriented triangles of quartz. C.N. × 50

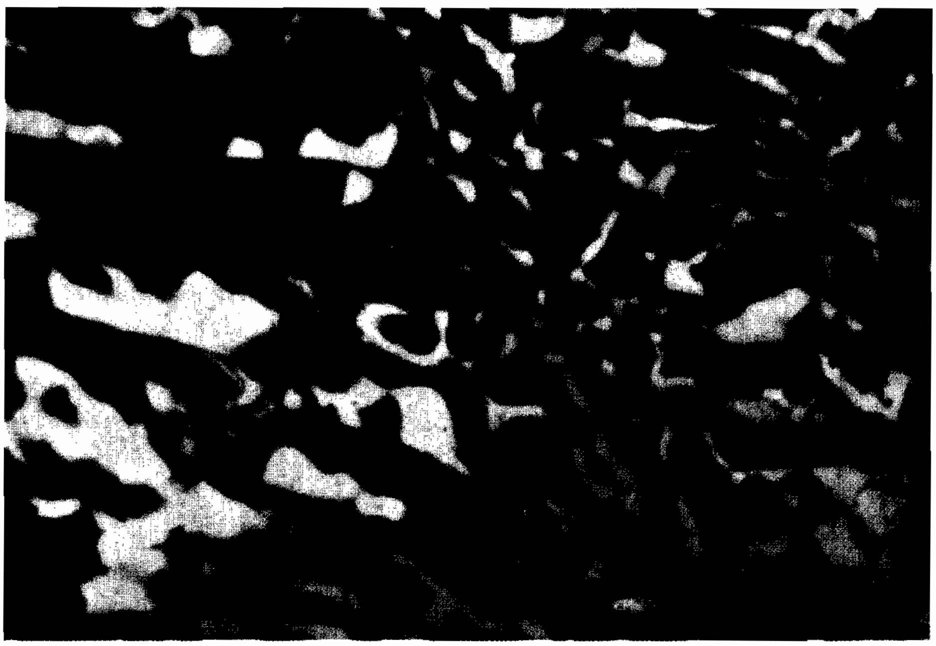


Fig. 7. Graphic intergrowth in the red granite showing tree-like shape of quartz and feldspar. C.N. × 50

Fig. 8. Perthite intergrowths with quartz rods forming graphic texture in the greyish-white granite. C.N. × 50

authors have confirmed the explanation of Laves & Soldatos (1963) concerning the origin of poikilitic albite. Laves & Soldatos (1963) suggested that poikilitic albite was formed through the action of sodium-bearing solutions which penetrated the fissures of the unmixed perthite giving rise to dissolution of potassium feldspar and precipitation of sodium feldspar. It is probable that sodium feldspar replaces the potassium feldspar because the latter would be unstable against sodium solution. In some adamellites of the examined area, albite, quartz and muscovite may accompany the microcline perthite in the cracks (Fig. 5), suggesting deposition from external solutions in which the remaining magmatic solutions are communicated with the bulk rocks through the ubiquitous contraction cracks. Initially, these solutions dissolve microcline, and then albite and quartz inclusions are trapped during primary crystallisation. Microcline is recrystallised from the solution, facilitating its replacement by albite, and forming microcline perthite.

II. INTERGROWTH OF FELDSPARS WITH QUARTZ MINERALS

The feldspar and quartz intergrowths provide important information about the reaction sequences in granites. The present authors prefer to use the term 'graphic' which is commonly used, instead of the terms 'hieroglyphic, cuneiform and runic'. The examined granites are characterised by two main intergrowths between feldspars and quartz:

1. Graphic intergrowth
2. Granophyric intergrowth.

Fig. 9. Quartz fingers penetrating microcline perthite forming graphic texture in the buff granite. C.N. × 45

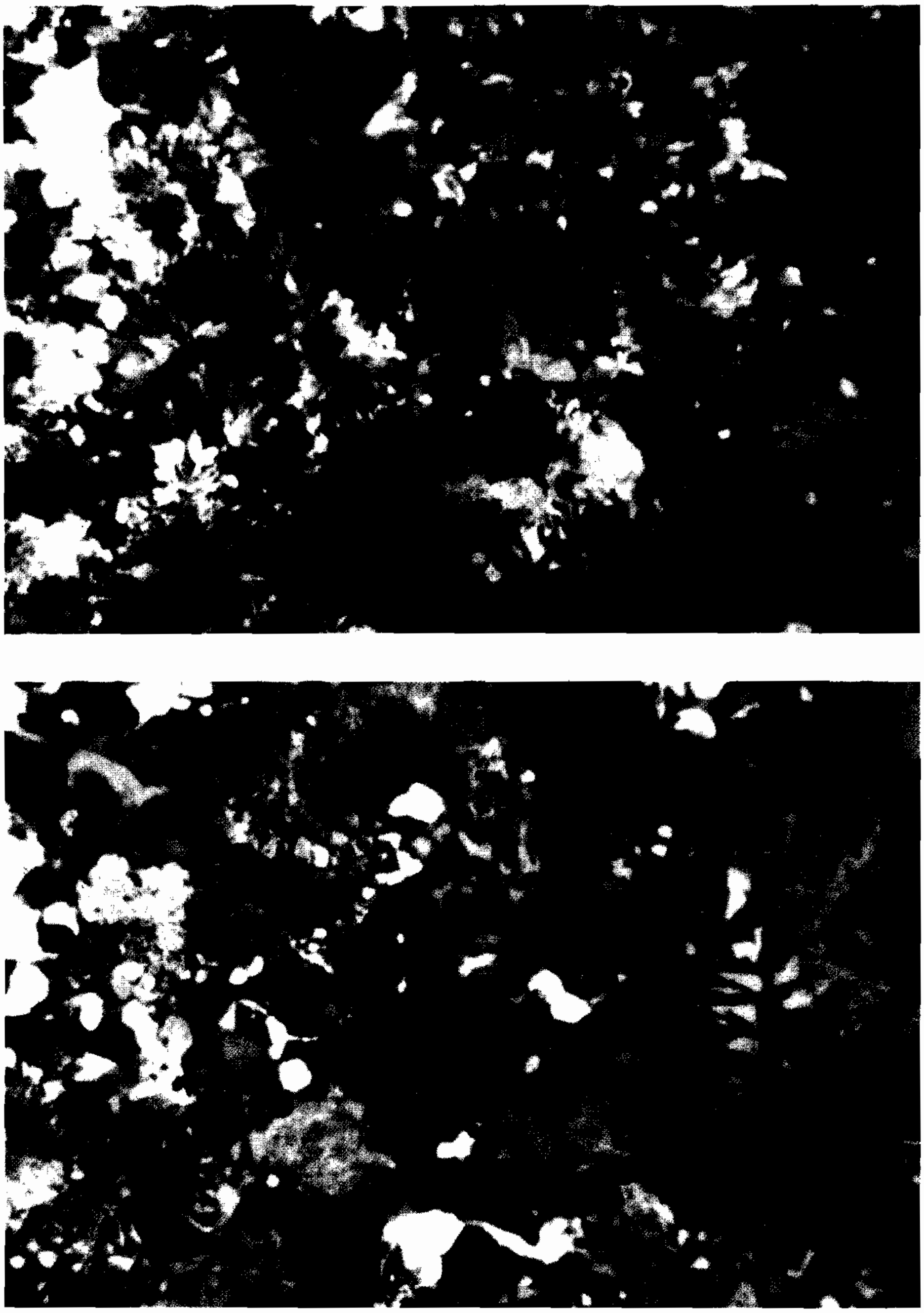
1. *Graphic intergrowth*

The microscopic studies and the chemical properties of feldspar and quartz indicate the mechanism of formation in graphic granites which, of course, reflect some information about the genesis of these granites.

Orientation and shape of the quartz crystals under the microscope. The graphic granite shows a relative angular orientation between feldspar and quartz. The graphic intergrowth in the pink granite gave rise to a good skeleton form in which the quartz forms oriented triangles (Fig. 6). The intergrowth between quartz and potassium feldspar is observed in the internal periphery of the triangles. Another form of intergrowth is observed in the red granite in which the graphic granite contains tree-like growths of quartz crystals (Fig. 7). In the greyish-white granite a complex textural feature of intergrowth is observed in which intergrowth of potassium feldspar and sodic plagioclase is also observed. Both feldspars intergrow with quartz rods (Fig. 8). Another complex intergrowth is observed in the buff granite in which the quartz rods penetrate the microcline perthite (Fig. 9).

Ratio of feldspar to quartz. The volume ratios of quartz to feldspar in the graphic varieties is determined under the microcsope. It was found that, in the greyish-white, red and pink granites quartz was more abundant than feldspars, while in the buff granite, the reverse was true. According to Gates & Scheerer (1963) the quartz/feldspar ratio is important to explain the shape and orientation of the graphic intergrowths as follows:

(*a*) *High volume percentage of quartz.* In this case the quartz inclusions occur as rods



Figs. 10 and 11. Photomicrograph showing feldspar intergrowths with quartz forming radiating fringes grading into spherulitic shape. C.N. × 50

or skeleton shapes showing typical orientation. In the graphic greyish-white, red and pink granites, quartz grains are well oriented.
(*b*) *Low volume percentage of quartz.* In this case the quartz inclusions are irregularly rounded or amoeboid, losing their parallel orientation. The examined graphic buff granite, in which the quartz content is less present than the feldspar, shows amoeboid shaped quartz without parallelism.

Composition of feldspar. In the examined graphic granites there are three main types of feldspars as follows:

Red and pink granites are represented by fresh and altered orthoclase intergrowing with quartz, giving rise to the graphic variety. The greyish-white and buff granites contain perthite and microcline perthite respectively. The two feldspars intergrow with quartz and give rise to the complex graphic granite.

Mechanism of formation of graphic intergrowth in the examined granites. The graphic intergrowths between orthoclase and quartz in the red and pink granites result during the simultaneous crystallisation of quartz and feldspar under vapour-rich conditions. The shape and nature of quartz and orthoclase intergrowth are controlled by epitaxial kinetic factors during the crystallisation of magma under rapid cooling. The previous explanation of the graphic intergrowth in the examined granite agrees to a great extent with Vadilo (1971). The complex textural features are observed in the greyish-white and buff granites in which perthite and microcline perthite respectively intergrow with quartz. The intergrowth relation between perthite and microcline perthite with quartz proposes that potassium feldspar had been invaded by sodic and silicic solutions respectively. The perthite and microcline perthite are also cut by the quartz rods forming the graphic texture.

2. *Granophyric intergrowth*

The examined granophyric rocks are represented in the white leuco-granite. The rocks show complex textural features in which quartz, potassium feldspar and sodium feldspar intergrow with each other forming radiating fringes grading in some samples into spherulitic types (Fig. 10). Most intergrowths are developed as follows: (a) Potassium feldspar and sodium plagioclase occupy the core of the spherulite; (b) Potassium feldspar and quartz are represented in the intermediate zone; (c) Albite and quartz intergrowth occupy the outer zone of the spherulite (Fig. 11). Some spherulites show alternatively wavy extinction around the radiating fringes, but others are characterised by the hourglass texture. The examined granophyres are mostly formed due to a rapid simultaneous growth of quartz and feldspars.

REFERENCES

Fisher, D.J. 1971. Poikilitic albite in the microcline of granitic pegmatites. AM **56:** 1769–87.
Gates R.M. & Scheerer, P.E. 1963. The petrology of the Nonewaug granite, Connecticut, AM **48:** 1040–69.
Laves, F. & Soldatos, K. 1963. Die Albit/Mikroklin-Orientierungs Beziehungen in Mikroklinperthiten und deren genetische Deutung. Zk **118:** 69–102.

Niggli, P. 1926. Lehrbuch der Mineralogie, II (Spezielle Mineralogie). Berlin.
Smith, J.V. 1974. Feldspar Minerals, vol. 2. Springer-Verlag, Berlin.
Tuttle, O.F. 1952. Optical studies on alkali feldspars. Am. J. Sci. (Bowen Volume): 553–63.
Vadilo, P.S. 1971. Graphic textures and their formation characteristics. Zap. Vses. Min. Obshch. **100:** 107–8.

(*Received* 1 *May* 1976)

الخواص النسيجية للفلدسبارات
فى الصخور الجرانيتية براس بارود
سفاجه ـ الصحراء الشرقية المصرية

محمد عز الدين حلمى
قسم الجيولوجيا بكلية العلوم
بجامعة عين شمس ـ العباسية ـ القاهرة

عادل محمد رفعت
معهد التربية للمعلمين ـ العديلية
الكـــويت

* محمود لطفى كابش
معمل علوم الأرض بالمركز القومى للبحوث
بالدقـــى ـ القاهرة

زينب محمد عبد الله
معهد التربية للمعلمات ـ الشامية
الكـــويت

خلاصـــة

الغرض من هذا البحث هودراسة المتغيرات النسيجية فى الصخور الجرانيتية لراس بارود . لقد اتضح أن الميكروكلين برثيت فى الجرانيت ذى اللون اللحمى يتميز بوجود الالبيت البيوكليتى الذى تكون من اختراق المحاليل المحملة بالصوديوم لشقوق معدن البرثيت . إن شكل وطبيعة النسيج التخطيطى المكون من معدنى الكوارتز والفلدسبار القلوى فى صخور الجرانيت الحمراء محكومان بفعل عوامل حركية أثناء التبلور المتزامن لصهير متميز بحرارة منخفضة .

إن العلاقة بين البرثيت والميكروكلين برثيت والكوارتز فى صخور الجرانيت الرمادية البيضاء واللحمية اللون أيضا توضح أن المحاليل الغنية بالصوديوم والسليكون قد تخللت الفلدسبارات القلوية مكونة الميكروكلين برثيت الـذى تداخـل فيه معـدن الكوارتـز فيا بعـد مكونـا النسيج التخطيطـــى .

إن صخـور الجرانوفـير البيضـاء اللـون قد تكونـت من تبلـور متزامـن لمعدنـى الكوارتـز والفلـــدسبارات .

---

* العنوان الحالى : قسم الجيولوجيا بكلية العلوم بجامعة صنعاء ـ اليمن