INTERNATIONAL GEOLOGICAL CORRELATION PROGRAMME (IGCP) PROJECT 315

CORRELATION OF RAPAKIVI GRANITES AND RELATED ROCKS ON A GLOBAL SCALE

SYMPOSIUM ON RAPAKIVI GRANITES AND RELATED ROCKS

EXCURSION GUIDE:

THE RAPAKIVI GRANITES OF THE RONDONIA TIN PROVINCE AND ASSOCIATED MINERALIZATION

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Belem 1995

THE SERRA DA PROVIDÊNCIA AREA

TUESDAY 08.08.95 (Second day)

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7.00 a.m. Bus leaves Cacoal along the route BR-364, towards Minister Andreazza town region. The whole day will be devoted to the rapakivi granites. We shall arrive at Ji-Paraná city by 19.00 p.m.

Accommodation: Vitória Hotel

Dinner: at Restaurante Braseiro , at 20.30 p.m.

The purpose of this visit is to examine, in detail, the rapakivi granites of the Serra da Providência batholith (Figs. 2, 3, 11) and associated mafic rocks (gabbros and diabases). On this second day the excursion will make a long continuous profile starting at first on points 1 and 2 at Ministry Andreazza and, then from at the western batholith margin (point 4) across the settlement LINE-86. We will inspect a variety of rapakivi phases in the following sequence: rapakivi porphyries → pink medium-grained granite → coarse-grained grey to pink biotite granites → transitional porphyritic to pyterlite granites and pyterlites and wiborgites.
Editors comments: A new mapping project is under way and the study of the batholith is in its infancy. For this reason no up-to-date detailed geological map of the entire batholith is available, no and further detailed petrological and geochemical information will be provided. At all outcrops we would appreciate very much a thorough discussion with colleagues on rapakivi nomenclature as well as magma mingling and mixing vis-à-vis to the textural and structural features locally observed.

The Serra da Providência Batholith

The Serra da Providência Batholith (140x40 km; Figs. 2, 3, 11) is part of the Serra da Providência Intrusive Suite which encompasses both this batholith and approximately 40 stocks and isolated small bodies (Leal et al., 1978). The suite is emplaced into basement rocks of the Juruena Province (1.75-1.55 Ga) at 1.57 Ga, U/Pb preliminary zircon ages (oral communication by Dick Tosdal, 1995).
The batholith is composite, made up of different granitic rocks and associated basic rocks, mainly gabbros, diabases and also porphyry dykes. Outside the batholith coeval charnockite/ mangerite plutons are present but they will not be visited on this trip.
The entire complex has been affected by a brittle shear episode represented mainly by a NNE shear system and associated breccias.
The bulk of the mapped sector of the Serra da Providência batholith consists of at least four granitic phases of syeno to monzogranitic composition exhibiting variable textures and mineralogical compositions besides mutual transitional contacts. Normal pyterlite rapakivi and porphyritic rapakivi granites, almost akin in texture and composition to the classic pyterlites, are the most predominant rocks though grading locally to very minor wiborgites. Grey-pink porphyritic rapakivi varieties, even-grained dark hornblende and pink even-grained biotite rapakivi granites besides porphyry dykes are the subordinate types. The basic rocks are represented by strongly altered grey to green porphyritic gabbros besides diabase dykes of medium to fine grained character whose intrusion was controlled by NE-trending fracture system.
The preliminary geochemical data indicated that the rapakivis have relatively high SiO_2, K/Na, Fe/Mg, K/Rb (100 to 300), Rb/Sr (1 to 10) ratios and low Al_2O_3, MgO and CaO. The rocks have metaluminous to slightly peraluminous character, and subalkaline characteristics akin to intra-plate A-type granites.

Pyterlite rapakivi transitional to wiborgite rapakivi

Stop 8.1 - 10.6 km east of Mario Andreazza town

The rock is dominantly a pyterlite rapakivi (syeno to alkali-granite) with transitions to dark wiborgite rapakivi portions, monzo to syenogranitic in composition. The rocks vary in color and texture is coarse grained, rarely exhibiting magmatic flux structures defined by E-W aligned K-feldspar ovoids (mesoperthitic microcline). These zoned megacrysts vary up to 6 cm in diameter and contain biotite, quartz and plagioclase inclusions. The groundmass is formed by xenomorphic albite-oligoclase crystals intergrown with quartz. Quartz is present as subhedric phenocrysts, as inclusions in K-feldspar and also as intergrowths with plagioclase within the groundmass.

Iron-rich varieties of biotite, hornblende (altered to biotite, sometimes with pyroxene cores), besides allanite, are common mafic mineral accessories.

The dark wiborgite rapakivi portion of the outcrop exhibit plagioclase mantled K-feldspar as well as high grey-blueish oval to ellipsoidal shaped quartz, enclosed in a fine ground mass built up of biotite, hornblende and subordinate quartz, plagioclase and feldspar.

The wiborgite portions contain elongated oval shaped elongated grey porphyritic enclaves (up to 3x0,20 m) of tonalitic to quartz-diorite composition sometimes aligned/oriented following the magmatic flux direction. They are composed of round drop-like quartz phenocrysts with embayed margins, enclosed in a fine-grained groundmass constituted by quartz, microcline and albite. Recrystallized mafic aggregates are composed of hornblende (epidotized) and green biotite with titanite, epidote and fine apatite needles as important accessories. This mafic enclaves might represent good evidence for interaction of contrasting mafic magma and a crystallizing felsic end-member.

In some places pink oval shaped fine-grained granitic bodies with quartz-feldspathic composition are found and are considered to be late granitic differentiates.

Stop 8.2 - Coarse-grained porphyritic gabbro 11.5 km west of Mário Andreazza town

Boulders of a dyke of gabbro cross this road over about 30 meters. The dyke cuts pyterlite and porphyritic rapakivi granites, though its total extension completely and relationship exposed contact and sections are very little known due to weathering.

The dyke seems to be younger than the rapakivi intrusions, though it is not currently dated.

The gabbro is grey-greenish in color and mostly coarse-grained to porphyritic (idiomorphic whitish plagioclase phenocrysts), subophitic to diabasic in texture. Zones of coarse-grained mega-subophitic patches occur. Sometimes cumulate plagioclase laths are seen in a fine groundmass.

At a microscopic scale the rock shows strong evidence of late-magmatic autometamorphism. The original pyroxenes and subordinate amphibole (primary or not) are almost transformed into aggregates of actinolite and chlorite needles. Plagioclase is commonly altered to epidote and sericite. Ilmenite or magnetite exhibit phlogopite and rarely titanite-bearing altered rims. Quartz, together with epidote and chlorite, either fills small fractures or is interstitial dispersed within the ground mass.

Stop 8.3. Porphyry granite at Line 86 - 33.5 km from Ji-Paraná town.

The small hill is made of sub-rounded granitic boulders. The rock is a pink to slightly red medium- to fine-grained porphyritic granite, with numerous subrounded granitic to quartz-dioritic enclaves, 5 to 10 cm in diameter. Some of the enclaves have K-feldspar ovoids without plagioclase mantles and are ocelli (?) bearing. Whether these features resulted from an earlier mixing is a matter of future studies. The porphyry is a rapakivi granite which contains sparsely distributed hypidiomorphic or ovoid shaped but seldom mantled K-feldspar phenocrysts. It has a xenomorphic granular to microporphyritic texture and the groundmass consists of quartz, K-feldspar which form graphic intergrowths with quartz, plagioclase, biotite and epidote. The earlier K-feldspars are perthitic and

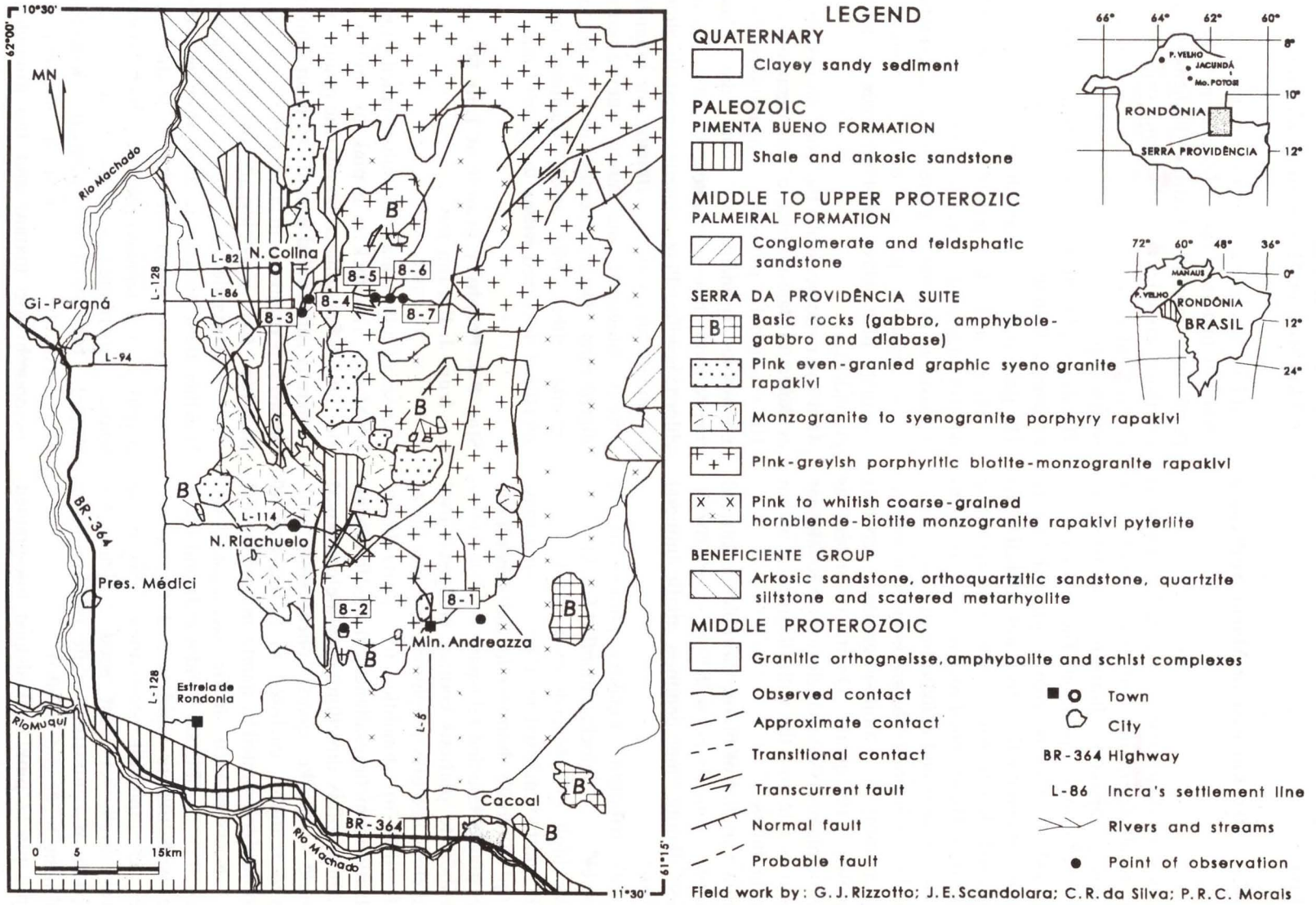

Figure 11 - Geological map of the southern part of the Serra da Providência Batholith and adjacent areas.

the plagioclase (oligoclase-andesine?) crystals are greenish in color due to post-magmatic alteration into epidote, sericite, carbonate and minor chlorite. Abundant green biotite flakes are present with and seem to be related to post-magmatic alteration.
Fluorite and zircon are the most common accessory minerals.

Stop 8.4. Pink medium-grained rapakivi granite at Line 86 - Km 36.7

This outcrop is made of subrounded blocks of rocks and continuous large flat outcrops on top of a hill of pink medium-grained rapakivi syenogranite. The mineralogical and chemical compositions are similar to that of the pyterlite (Stop 8.1). Here and there, mantled alkaline feldspar ovoids are encountered. In texture the even-grained biotite rapakivi granite groundmass is seldom xenomorphic and characterized by a micrographic texture.
The granite is cut by millimetric pink aplitic dykes and miarolitic cavities (2 to 5 cm) filled with quartz, K-feldspar and biotite which are quite common. These features suggest a water-saturated late magma rich in fluids under low confining pressure.
Perthitic K-feldspar microcline with quartz, biotite and opaques inclusions, plagioclase altered to epidote and sericite besides biotite, altered to chlorite, are the major constituents. Zircon, fluorite and minor apatite are the typical accessory minerals.
The field relationship, textural and mineralogical features besides the presence of miarolitic cavities and lack of micro-enclaves, suggest that this is a late phase granite in the batholith.

Stop 8.5. At Line 86 - Km 45.6

The granite in question is the most predominant type in the batholith. This is a coarse grained biotite-hornblende rapakivi granite with sparsely scattered subhedric K-feldspar phenocrysts (1 to 3 cm), sporadically plagioclase mantled. A feature, also common in this granite, is the presence of round to oval enclaves of quartz-dioritic to granodioritic composition, which measure 15x10 cm in diameter. In texture they are granular xenomorphic or aplitic, seldom micrographic. Agglomerates of green biotite and epidote besides minor pegmatitic pods containing K-feldspar biotite and ilmenite are also encountered.
In texture the granite is mesoperthitic with frequent graphic intergrowths. Quartz, K-feldspar, plagioclase and biotite are the essential minerals, whereas hornblende, zircon, ilmenite, allanite, apatite, fluorite and epidote are common accessories.

Stop 8.6.

In this local the outcrop consists of a "boulder field" where it is possible to investigate a transitional coarse-grained pinkish-grey rapakivi rock type between porphyritic rapakivi and a pyterlite as a large amount of porphyritic K-feldspar phenocrysts and ovoids are observed. The K-feldspar phenocrysts, frequently plagioclase mantled, contain quartz and biotite inclusions and are microfractured.
Centimetric oval or ellipsoidal shaped autholiths of granitic and quartz-dioritic composition are met with, sometimes with scattered K-feldspar phenocrysts.
Biotite is the predominant mafic mineral besides hornblende, in minor amount. Alteration minerals are epidote, sericite and chlorite.

Stop 8.7. Pyterlite rapakivi at Line 86 - Km 49.

The pyterlite is a pinkish coarse-grained hornblende biotite rapakivi monzogranite which contains sparsely distributed unmantled and plagioclase mantled ovoids (1 to 5 cm in diameter) of K-feldspar, this one in approximate proportion of 30%.
Of upmost importance is the presence of centimetric drop like or oval shaped micro-granular mafic rich autholiths, of granitoid or of dioritic composition, probably produced by mingling of mafic and felsic magmas. These micro-enclaves exhibit a finer grain size than their felsic host rock and, sometimes have fine grained recrystallized borders while the cores of the enclaves are coarser. Centimetric aplitic dykes cut the rapakivi and, locally, a foliated angular

sedimentary xenoliths are seen.
Hornblende and biotite are the predominant Fe-Mg silicates while rare clinopyroxene relicts are minor. The most common accessories are zircon, allanite and ilmenite.
Epidote, chlorite, biotite, which fill interstitial spaces, are alteration products formed during the final stage of crystallization.

THE MASSANGANA AREA

WEDNESDAY 09.08.95 (Third day)

JORGE SILVA BETTENCOURT - *University of São Paulo, SP, Brazil*
ROBERTO DALL'AGNOL - *Geoscience Center - UFPA, PA, Brazil*

Bus leaves Ji-Paraná at 7.00 a.m. (Route BR-364, km 373). We shall reach Massangana at approximately 12.00 a.m. No excursion stops will be made on the way, though the basement rocks can be seen in dozens of road cuts.

Lunch and dinner at Paranapanema Mining Company's staff lodge

Accommodation: Paranapanema Mining Company

THE MASSANGANA RAPAKIVI COMPLEX

The Massangana complex is situated in the central northern part of Rondônia state, 150 km south of Porto Velho (Figs. 2, 3, 4, 12, 13). The complex is approximately 35x25 km and intrudes the high grade basement rocks referred to as the Jamari Complex (Isotta et al., 1978) of the Rio Negro-Juruena province (1.75-1.55 Ga) and represented in the area mainly by granulitic, amphibolitic, gneissic and migmatitic rocks (Fig. 12).The geology and geochemistry of this pluton were briefly described by Waghorn (1974) and Isotta et al. (1978) and in more detail by Romanini (1982). The first two authors classified the complex as pink-coarse grained porphyroid or pegmatoid granitoid rock which exhibit angular porphyritic or ovoid perthitic microcline crystals, up to 40 mm, and plagioclase composition in the range of An_{26}-An_{35}. Typical minerals are quartz, biotite and fluorite.
Romanini (op. cit.) distinguished four petrographic facies in the granitic complex (Fig. 13) and furnished a lot of major and trace element chemical analyses of representative samples. The Massangana facies was the first to be emplaced. Very coarse porphyritic biotite-granites, with tabular and ovoid megacrysts of feldspars, resembling according to him, rapakivi textures but lacking the plagioclase rims around the phenocrysts, are the predominant lithologies present. The São Domingos and Bom Jardim facies intrude the Massangana facies (Fig. 13). São Domingos is characterized by coarse to medium grained equigranular biotite-granites, grading to porphyritic or fine grained textures only near its borders. Bom Jardim is composed of coarse-, medium- or fine-grained equigranular biotite granites, sometimes with scarce phenocrysts of potassium feldspar.
Hypersolvus granites are comparatively frequent in this facies. The Taboca facies occupies a smaller area, cuts the Bom Jardim facies and, perhaps, the São Domingos facies (some dykes intruded in this facies were doubtfully related to the Taboca phase by Romanini, 1982). Hornblende syenites, quartz-syenites and quartz-monzonites are the dominant rocks in the Taboca facies (Waghorn, 1974; Romanini, op.cit.), which is comparatively finer grained and richer in mafics than the granitic facies.
Even considering the lack of age determinations, these peralkaline rocks might be visualized as minor late-stage differentiates of the subalkaline rapakivi granites. Some basic rocks were also identified near the occurrence of the Taboca facies, and their contact relations with this and the Bom Jardim facies were not observed until now. It is certain that these basic rocks can be related to the magmatic evolution of the granitic complex, supposing a bi-modal basic-acid magmatism.
Seven samples of both Bom Jardim and São