Petrology of the Lower Triassic Anorogenic Granites in the High Andes (30°S.L.), Chile (チリー・ハイアンデスの下部三畳紀非造山期花崗岩類の岩石学的研究)

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ABSTRACT

Despite no concluding evidences are available about the relative age of the different anorogenic granite plutons, some field observation allow to group them in two cronological units: Older and Younger granites. According to a Rb-Sr age in the Younger granites, both units are considered as belonging to a single Lower Triassic magmatism (between the Hercynian and Andean orgenies).

The Older granites include biotite granites and two-mica granites which constitute small bodies piercing the Hercynian granitoids (Carboniferous). The younger granites constitute lens-shaped epizonal plutons of leucogranites. They are preferably located along the western boundary of the Hercynian granitic mass. Three type of leucogranites have been distinguished: coarse-grained leucogranites (type I), medium-grained leucogranites (type II) and porphyry leucogranites (type III). The types of leucogranites apparently correlate with the slightly different levels of intrusion. The type I granites of Monte Grande pluton exhibit the conspicuous association of subsolvus-hypersolvus granites.

The emplacement of the type II and III granites had a clear structural control. The NS, NNW and NNE regional faults and lineaments apparently had a significative influence in the magma rising. Piece-meal stopping through mechanical replacement seemed to be the dominant mechanism of the shallower intrusions.

The Older and Younger granites constitute a peraluminous-metaluminous suite. The Older granites are peraluminous and represent the less differentiated rocks.

The more noticeable variations in mineral composition of the Older granites are the Fe/Fe+Mg ratio and the Al content in biotite. The iron and alumina-rich biotites occur in the less differentiated rocks where small metapelitic xenoliths coexist in equilibrium with the host. The best pressure estimate for the crystallyzation of the Older granites, based on coexisting feldspar pairs and on celadonite content in primary muscovite, is about 5 kb. The Whitney and Stormer's (1977) geothermometer gives a temperature of crystallization of 650°C, whereas the stability curves of biotite indicate oxidizing conditions.

The Younger granites (metaluminous) represent the more differentiated rocks. Type I granites of Monte Grande pluton show variation in whole rock and mineral compositions from subsolvus to hypersolvus varieties. Subsolvus granites have higher Ca content than hypersolvus ones which correlate with differentiation. Moreover, variation in coarsening of perthite in hypersolvus rocks correlates with the higher An component of the exsolved albite. Furthermore, magmatic fluid-mineral interaction is considered to play an important

role in the perthite microstructure variation and in the albitization process as well.

Oxygen fugacity values for iron-titanium oxide equilibration slightly decrease from subsolvus to hypersolvus granites. The oxygen fugacity conditions are substantially less oxydizing than those of the Older granites (which comparatively are less differentiated) and are buffered similar to the NNO buffer curve. Consequently, amphibole compositions of Monte Grande show a significant increase in Fe content from subsolvus to hypersolvus granites. Assuming a pressure of 1 kb, the best estimate for the temperature of feldspar crystallization of the Younger granites is about 700°C.

According to Vance's proposal, the resorption features of the early plagioclase phenocrysts from Younger granites are interpreted as a product of sudden drops in pressure (due to magma rising) of the water-deficient magma. On the other hand, reverse zoning of the late plagioclase phenocrysts of type II granites, may be considered as a result of meteoric water absorption from H_2O-undersaturated magma emplaced at shallow depth. Surrounding water influx to the magma chamber took place through the pre-existing structures.

The Sr^{87}/Sr^{86} initial ratio (0.7078) of the Younger granites together with the presence of xenoliths of metapelitic rocks into the Older granites, suggest that in the magma generation crustal materials were involved.

Descompression of the lower crust through deep regional structures, is considered as one of the more important factors to promote the fusion of the source rocks. The difference in magma composition between Older and Younger granites, results from different degree of partial melting at high pressure and in water-deficient environement. The equilibrium partial fusion of high grade metapelites is considered as a suitable mechanism for the magma production. The Older granites represent the first melt formed at H_2O-saturated conditions, whilst the Younger granites represent the liquids generated after the available water was consumed to saturate the Older granite magmas. This proposal account for the higher water content estimated for the Older granites and the dry history to explain the shallow level of emplacement of the Younger granites.

The contrasting estimate for the crystallization pressure of 5 and 1 kb for Older and Younger granites respectively, is consistent with a rifting related emplacement of this anorogenic magmatism; important crustal movements brought together different bodies which apparently decrease in depth of intrusions toward the related regional stractures.

Finally, it is possible to extend the rifting domain southward, including the Frontal Range belt of Permotriassic granites and related rhyolites of the Sanrafaelino-Pampeana Geologic Province. The magmatic rocks of this province apper closely related to NNW-

trending tectonic basins of Triassic age, therefore, these rocks may be considered as a initial continental rifting magmatism.

論文審査の結果の要旨

チリー，ハイアンデス(南緯30°)一帯にはRb-Sr年代と産状から，ヘルシニアンとアルプス造山作用の間(三畳紀)に貫入した非造山期の花崗岩質岩類が分布している。これらの花崗岩類の詳細な地質調査，顕微鏡観察，主成分元素の定量分析および構成鉱物のEPMAによる定量分析を行い，岩石学的地球化学的性質を明らかにしたものである。

これらの花崗岩類は古期と新期の2つに大別される。前者はヘルシニアン花崗岩類(石炭紀)を貫く黒雲母花崗岩類と複雲母花崗岩類から成る小規模岩体，一方後者は優白質花崗岩類のレンズ状岩体であり，主としてヘルシニアン花崗岩類の西縁に分布している。新期花崗岩類は粗粒(タイプI)，中粒(タイプII)と斑状(タイプIII)に細分される。このうちタイプIIとIIIは明瞭な構造支配を受けている。

新期と古期花崗岩類の化学組成は共に過～中アルミナ質系列のもので，後者は前者ほど分化が進んでいない。

古期花崗岩類の結晶作用時の圧力は斜長石一アルカリ長石と初生白雲母中のセラドナイト量から約5 kbarであったと推定され，温度はホイットニーとストーマーの地質温度計から650°C，更に黒雲母安定領域からやゝ高い酸素分圧条件であった。

新期花崗岩類ではアルカリ長石はサブソルバス型からハイパーソルバス型へと変化し，前者は後者よりもCaが多い。これら花崗岩類の結晶作用時の温度圧力は1 kbar, 700°Cと推定される。

この地域の花崗岩類の化学組成，構成鉱物組成，Srアイソトープ比や変泥質岩捕獲岩等から，花崗岩マグマは地殻物質の部分融解によって生成されたと考えられる。また二畳紀一三畳紀に活動した花崗岩類と関連流紋岩類は当時の北北西構造堆積盆に密接な関係があって，これらは初期の大陸上昇に伴う火成活動の産物であると推察される。

以上の新知見は博士学位論文として適当であると認められる。また著者が自立して研究を行うに十分の能力を有することを示している。よってミゲル・アンヒル・パラダ提出の論文は理学博士の学位論文として合格と認める。