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GEOQUIMICA DE ELEMENTOS MAYORES DE VOLCANITAS ANDINAS DEL TERCIARIO INFERIOR (34° - 36° S)

MAJOR ELEMENT GEOCHEMISTRY OF EARLY TERTIARY ANDEAN VOLCANICS (34° - 36° S)

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During the Late Cretaceous and Tertiary, a major igneous event affected most of western South America. The extrusive products of this event occur throughout the Central Andes, and range in composition from basalts to rhyolites.

This paper deals with the petrology and geochemistry of Andean volcanics which have been little studied since Backlund (1923) describen them and Groeber (1946-47) established their stratigraphy. This sequence developed in the Cordillera Principal of Argentina and Chile, on a basement consisting of Permo-Triassic volcanics and Lias-Early Cretaceous marine sediments, developed in an important basin which presented a lowstand during the Kimmeridgian. From the Neocomian onwards thick clastic sediments were deposited in elongated intermountain basins.

From the Late Cretaceous onwards, the volcanic sequence developed mainly in the western slope of the Cordillera and continued during Early Tertiary times in the eastern section of the Andes.

The rocks here described were and previously called "Mollelitense" by Groeber (1946-47). Outcrops with similar lithological and structural features were included in this paper although they considered younger by Groeber (1946-47) and subsequent authors.

The Early Tertiary Andean Volcanic Association (ETAVA) is broadly distributed in the segment of the Cordillera situated between 34° and 36° S.L. (Fig. 1). ETAVA consists of thick volcanic flows and shallow intrusives which comprise minor stocks and scattered bodies. Field relations of the extrusives and intrusives show a recurrency of magmatic events. The first stages are represented mainly by volcanics while the last ones are represented mostly by intrusive. The extrusives consist of lava-flows, sills, dykes, rare intercaled pyroclastic-breccias and volcanic conglomerates near eroded effusive centers and their cinder fields.

Effusive rocks predominate in the south and intrusive rocks in the north, controlled by the erosion level reached.

Petrography

The volcanic rocks studied are mainly phenoandesitic flows with scarce phenodacites and rare phenorhyolites, all with porphyritic textures. Phenoandesites contain phenocrysts of plagioclase (An_{60}-An_{30}), olivine and clinopyroxene as mafic minerals in the basic samples, and hornblende, orthopyroxene and clinopyroxene in the siliceous

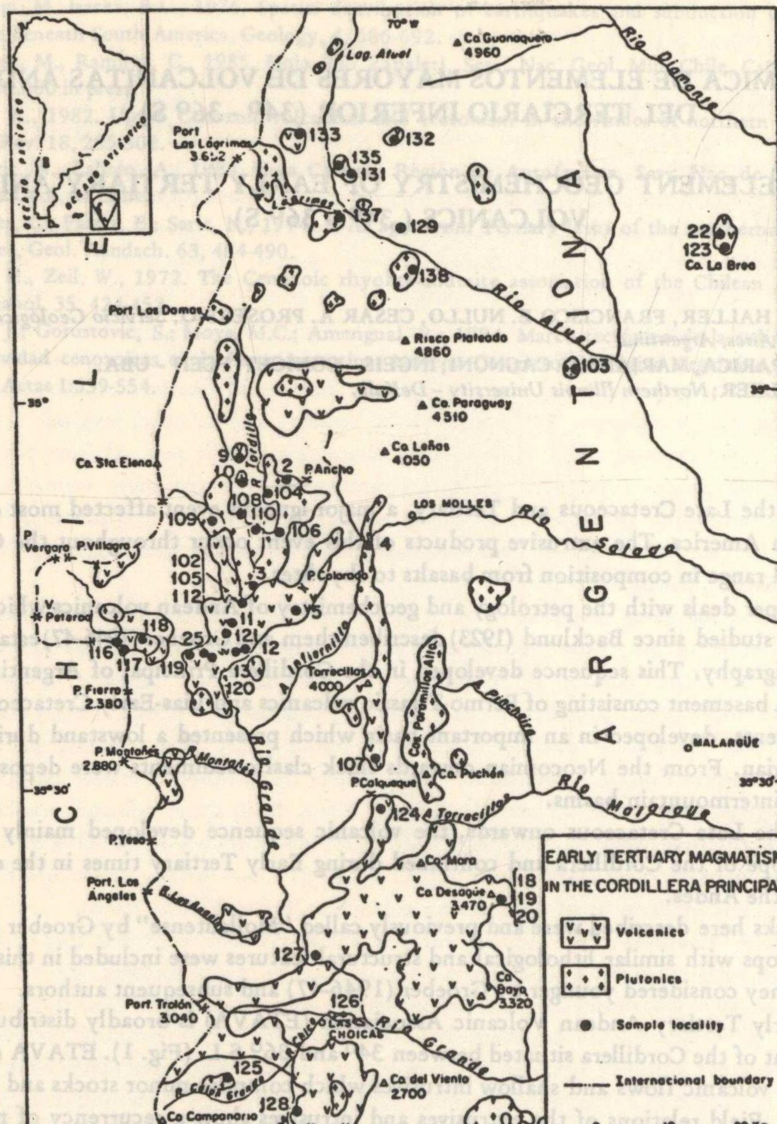

Fig.1. Distribution and sample locations of the Early Tertiary Volcanic Association.

Fig.1. Distribución y localidades muestreadas de la Asociación Volcánica Terciaria Inferior.

ones. The groundmass usually shows pilotaxitic and intersertal texture, containing plagioclase (An_{50}-An_{30}) microlites, occasionally with pyroxene and interstial glass, or less commonly quartz and alkali feldspar, plagioclase (An_{50}-An_{40}) and quartz microlites. The phenorhylites show plagioclase (An_{50}-An_{20}) in a felsitic groundmass with alkali feldspar and quartz.

The phenoandesitic rocks frequently show hydrothermal alteration with development of carbonates, sericite, clay minerals, zeolites, albitization of plagioclases, chlorites, serpentine, epidote and occasionally pyrite.

The intrusives are subvolcanic bodies and shallow plutonic. Their emplacement coincides with the regional structures and sometimes occupies the anticlinal cores. The intrusives consist of similar proportions of phenoandesites, phenodacites and phenorhyolites with rare rocks of dioritic and tonalitic composition. Xenoliths of volcanic and sedimentary rocks are frequently found and some basic and ultrabasic inclusions have been observed (Haller et al. 1985).

Phenoandesitic intrusives have porphyritic textures with phenocysts of plagioclase (An_{60}-An_{30}), abundant hornblende and in minor proportion clinopyroxene or biotite. Plagioclase (An_{50}-An_{30}) and hornblenda or clinopyroxene form the groundmass. Predominant textures are pilotaxic with microlites with constant sizes. Porphyritic textures with phenocrysts of plagioclase (An_{50}-An_{30}), hornblende and minor biotite are shown in phenodacites; the groundmass shows coarse microgranular to granophyric textures and less commonly micrographic textures.

Diorites and tonalites show non-equigranular hypidiomorphic textures with plagioclase (An_{50}-An_{30}) scarce alkali feslspar and quartz, this last mineral more commonly in the tonalites. Hornblende and biotite are the principal mafic minerals.

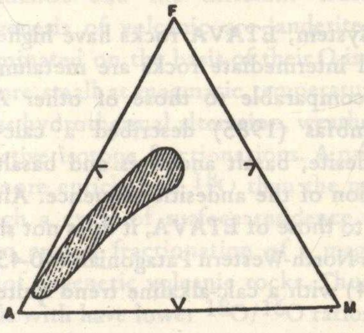

Fig. 2. AFM diagram showing the distribution of the Early Tertiary Volcanic Association.

Fig. 2. Diagrama AFM que muestra la distride la Asociación Volcánica Terciaria Inferior.

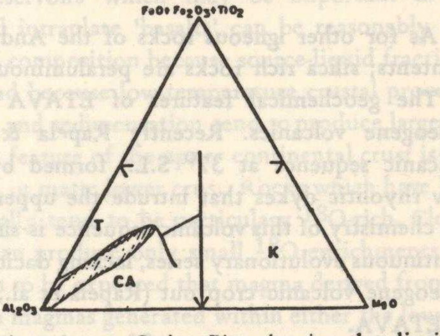

Fig. 3. Jensen Cation Plot showing the distribution of the Early Tertiary Volcanic Association

Fig. 3. Proyección catiónica de Jensen mostrando la distribución de la Asociación Volcánica Terciaria Inferior

Geochemistry

From a geochemical point of view, the lavas are the least siliceous group. Their composition ranges from basaltic andesite to andesite with scarce rhyolite (Fig. 4). SiO_2 content varies from 52% to 74% and FeO* from 17% to 9,5%. Alkali contents show a positive correlation with SiO_2. On the other hand, TiO_2, Al_2O_3, FeO*, MgO and CaO decrease with increasing SiO_2 contents. Shallow intrusives are the most envolved rocks from the Early Tertiary: intrusive rocks average 65% SiO_2 and range from 55% to 76% SiO_2. Most of the rocks have "high" K contents in the K vs SiO_2 plot. On the other hand, the K-Na relationship shows that the intrusive rocks are mainly mildly potassic.

Hydrothermal alteration is show geochemically by high ignition loss and Na-gain.

Sample distribution on a AFM diagram (Fig. 2) is characteristic of a calc-alcalic suite. A Jensen cation plot (Fig. 3) —independent of K_2O, Na_2O, Ca_2O and SiO_2—

which may be affected by hydrothermal alteration also shows a calc-alkalic distribution and a calc-alkalic trend.

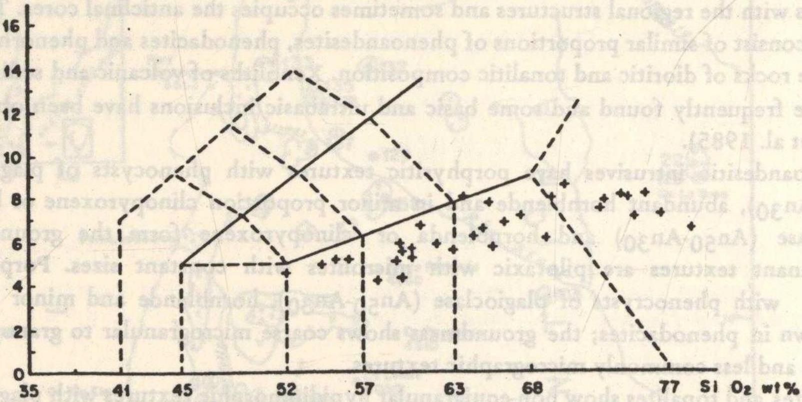

Fig.4. TAS diagram of the Early Tertiary Volcanic Association.

Fig.4. Diagrama TAS de la Asociación Volcánica Terciaria Inferior.

As for other igneous rocks of the Andean System, ETAVA rocks have high Al_2O_3 contents; silica rich rocks are peraluminous and intermediate rocks are metaluminous.

The geochemical features of ETAVA are comparable to those of other Andean Paleogene volcanics. Recently Rapela & Llambías (1985) described a calc-alkalic volcanic sequence at 37^o S.L., formed by andesite, basalt andesites and basalts, and few rhyolitic dykes that intrude the upper section of the andesitic sequence. Although the chemistry of this volcanic sequence is similar to those of ETAVA, it does not show a continuous evolutionary series, lacking dacites. In North-Western Patagonian (40-43^o S.L.) Paleogene volcanic crop out (Rapela et al., 1984) with a calc-alkaline trend quite similar to ETAVA.

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