PETROLOGICAL MULTIPLICITY OF THE COLOMBIAN ANDES OPHIOLITES

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RESUMEN. En los Andes del suroeste de Colombia, terrenos oceanicos de edad Cretacica-Terciaria temprana componen el basamento del la Cordillera Occidental y la Zona de Romeral hasta el flanco occidental de la Cordillera Central. Las rocas volcanicas mostran caracteristicas petrologicas y geoquimicas de T-MORB, IAT y de sequencia calco-alcalina de arco intraoceanico de islas. Las rocas ofioliticas de origen plutonica que se encuentran en la Zona de Romeral son similares a las sequencias generadas en zonas supra-subduccion.

KEY WORDS: ophiolites, Mesozoic, petrology, geochemistry, Colombian Andes.

INTRODUCTION

The Andean belt of Colombia is characterized by accreted oceanic terranes whose age of formation is referred to the early Cretaceous (or late Jurassic)-early Tertiary interval. Their emplacement is debated with respect to timing and mechanism. Petrological data on the primary features of the magmatic rocks are here presented and addressed mainly to the geodynamic setting of the magmatism and the reconstruction of the pre-collision history.

GEOLOGIC SETTING

In southwestern Colombia, Mesozoic oceanic sequences are present in the Serrania de Baudo along the Pacific coastal range (Goossens et al. 1977) and the Western Cordillera (Millward et al. 1984). To the east the oceanic sequences are bounded by the NNE trending Romeral fault system exposing fragments of mafic-ultramafic plutonics and mafic and ultramafic extrusives (Barrero 1979, Espinosa 1980, Spadea et al. 1987, 1989) and high-pressure metabasic rocks (Orrego et al. 1980). The Romeral Zone, extending from the Cauca-Patia graben to the western flank of Central Cordillera, is thought to represent a suture marking a Cretaceous ocean/continent boundary.

The Romeral Zone ophiolites and the volcanic sequences from Central Cordillera are interpreted as an oceanic terrane accreted onto the continental

margin before approximately 110 Ma (Bourgois et al. 1985) or 120 Ma ago (Aspden and McCourt 1986), while the Western Cordillera volcanic sequences are considered as an allochtonous terrane accreted onto the continental edge about 80-75 Ma (Bourgois et al. 1985) or 65-60 Ma ago (McCourt et al. 1984).

PETROCHEMICAL FEATURES

Some typical magmatic sequences occurring in the area between Buga to the north and the Colombia-Ecuador border to the south have been studied.

In Western Cordillera, the volcanic rocks known as Diabase Group (Volcanic Formation of the official geological map at the scale 1:100.000) include petrologically distinct magmatic asemblages, that are:

1. tholeiitic basalts, mostly aphyric or containing sparse olivine and pyroxene phenocrysts, moderately fractionated (mg number 63-45), relatively rich in Nb and similar in REE contents to mid-ocean ridge basalts, slightly light REEs-depleted. Their chemical features indicate affinities with T-MORB, as recognized by Millward et al. (1984);
2. basalts, aphyric or plagioclase-clinopyroxene phyric, basaltic andesites and andesites, mostly highly plagioclase- and clinopyroxene- or amphibole-phyric similar in chemistry to tholeiitic and calc-alkaline lavas from island-arcs. Evidences for these affinities are a low values of high field-strenght elements, a strong enrichment of LREEs, and lack of heavy REEs fractionation as shown in figure 1.

Plutonic rocks primarily associated and cogenetic with the two assemblages include ferrogabbro and plagiogranite (assemblage 1), and diorite-quartz diorite (assemblage 2).

In the Cauca trough and western Central Cordillera (Romeral Zone), basaltic to picritic extrusives and mafic-ultramafic plutonic sequences, interpreted as dismembered ophiolites, occur.

The volcanic sequences, previously referred to the Diabase Group (partly identified as Amaime Formation in the official geological map), include:

3. tholeiitic basalts sparsely olivine- and/or plagioclase phyric, with chemical characteristics of T-MORB. Lavas composed of highly olivine phyric picrites (atr Rio Boloblanco: Spadea et al. 1989) are associated with these basalts;
4. picritic basalts and picrites, mostly highly olivine phyric, characterized by relatively high contents of Ti and transition elements (at El Encenillo: Spadea et al. 1989) and strongly LREEs enrichments;
5. tholeiitic basalts, aphyric or sparsely augite phyric, low in Ti and high field--strenght elements, with IAT affinities.

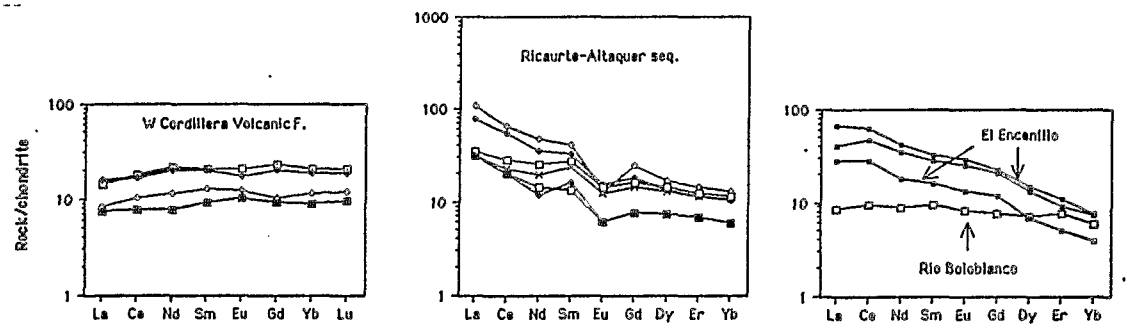

Figure 1. Typical REE patterns of Colombian Andes volcanics (assemblages 1-4).

The most conspicuous fragments of mafic-ultramafic plutonics occur in the Cauca trough near Bolivar, Ginebra and at Los Azules. The rocks show generally

well preserved magmatic features and allow to recognize different lithological assemblages characterizing petrologically each complex.

The Bolivar complex shows an about 800 meters thick sequence consisting upwards of mafic-ultramafic cumulates (interlayered dunite, websterite, wehrlite, olivine gabbronorite, gabbronorite), layered hornblende gabbronorite, metagabbro and metadiabase (now amphibolites). Remnants of mantle rocks (dunite and lherzolite: Benciolini and Spadea, in preparation) occur in the lower part. The whole sequence is intruded by pegmatitic quartz-diorite.

The Ginebra complex shows of an about 500 meters thick sequence of interlayered dunite, websterite, wehrlite and gabbronorite overlain by layered clinopyroxene metagabbro and massive metagabbro and metadiabase (now amphibolite). Metamorphosed basaltic pillow-lavas capped with volcanic siltstone occur on top of the sequence.

At Los Azules the plutonic sequence consists upwards of dunite-wehrlite cumulates, layered clinopyroxene-hornblende gabbro and massive pegmatitic gabbro. A well developed extrusive section consisting of dike swarm and lavas of basaltic to picritic composition occurs (Spadea et al. 1989).

Regarding the Bolivar and Ginebra plutonic sequences, most petrographical and mineralogical feature, particularly: a) lithological assemblage (occurrence of abundant websterite and gabbronorite in the lower cumulates), b) inferred crystallization order (olivine, clinopyroxene/orthopyroxene, plagioclase), c) mineral chemistry (particularly plagioclase up to 98% An in the gabbros), indicate a similarity with supra-subduction zone sequences. Further chemical studies will clarify if comagmatic sequences occur in the two complexes and the nature of the parental magma or magmas.

The Los Azules complex also displays some petrological features suggesting a supra-subduction zone setting. Its comagmatic origin is however suspect, and the widespread high-Mg rocks represent a distinctive features with respect to the other complexes from the Romeral Zone.

CONCLUSIONS

The volcanic sequences and the ophiolitic fragments from the Western and Central Cordillera of the southwestern Colombian Andes consist of different rock suites. Those emplaced during a younger, i. e., latest Cretaceous accretionary event, include tholeiites with T-MORB affinities and calc-alkaline and tholeiitic island-arc rocks. The volcanic rocks related to a older, i. e., early Cretaceous, accretionary event include a MORB-like, variably enriched tholeiitic suite and a island-arc tholeiitic suite. The ophiolitic fragments emplaced during the same event include plutonic sequences with characteristics of tholeiitic suites generated in supra-subduction zone.

The magmatic characteristics are consistent with some of the different settings proposed in the literature (subduction zone; oceanic plateau, as recently suggested by Storey et al , 1991). A geodynamic model, however, is difficult to infer only from the petrological data.

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