MAGMATIC RESPONSES TO ACTIVE SPREADING RIDGE SUBDUCTION : MULTIPLE MAGMA SOURCES IN THE TAITAO PENINSULA REGION (46°-47°S, CHILE TRIPLE JUNCTION).

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INTRODUCTION

During the Pliocene, the subduction of the Chile ridge beneath the South American margin was coeval with the emplacement of magmatic suites and possible ophiolite obduction close to the trench axis (Taitao Peninsula). The chemical characteristics of the plutons and volcanic rocks indicate that magmas originated either from mantle sources, or from slab melting, or directly from the subducted spreading center interacting with the overlying Chile margin continental crust.
Based on field data and geochemical characteristics, 5 categories of magmatic products can be distinguished among the plutonic-volcanic suites exposed in the Taitao region.

1. The Bahia Barrientos ophiolite. The Bahia Barrientos ophiolite includes mantle peridotites, gabbros and rare doleritic dikes. The gabbros show depleted N-MORB REE pattern (i, fig.2). Precise geochronological data from the ophiolitic rocks are not available yet, 2 K/Ar ages around 13 Ma and 6 Ma have been obtained on a hornblendite vein and a doleritic dike respectively (Bourgois et al., 1993; Le Moigne, 1994). Elements of the ophiolite complex are also found as exotic fragments of various size included in later intrusions. Gabbros and doleritic lenses are included in the Seno Hoppner pluton. Dolerites are present as inclusions in granodiorite magmatic breccias well exposed along the western coast of the Tres Montes Peninsula. Numerous decametric fragments of gabbros and dolerites are included in the acidic dike complex exposed in the central part of the Taitao Peninsula.
2. The volcano-sedimentary units. The Pliocene Chile Margin unit (CMU) (Fig. 1), 4-6 km thick, consists of interbedded sedimentary and volcanic material showing numerous evidences for deposition in shallow-water environment. It unconformably overlies the pre-Jurassic metamorphic basement of the Chile margin. The Main Volcanic Unit (MVU) consists of pillow-lavas and associated sediments that accumulated also in a shallow water environment. It differs from the CMU by a well developped greenschist metamorphic overprint and the lack of pyroclastic material. The MVU and CMU flows show a large range of composition including N-MORB, E-MORB, and calc-alkaline lavas (h,k,l, fig. 2). The MVU and CMU volcanic suites result of eruptions of magmas originating from the downgoing active spreading center buried at shallow depths, and uprising through the Chilean continental basement. These magmas were affected by various degrees of upper crustal contamination coupled with fractional crystallization during their ascent and possible storage within the Chilean continental crust (Lagabrielle et al., 1994).
3. The acidic dike complex (central area). A sheeted dike complex is exposed in the central part of the Taitao Peninsula. The dikes intruded the gabbros and associated dolerites of the Bahia Barrientos

ophiolite. They show dacitic to rhyolitic compositions and have REE pattern typical of calc-alkaline series (g, fig.2). Polymict volcanic breccias with a rhyolitic matrix exposed in the central part of the dike complex were emplaced subsequently above the previously eroded dikes. They include angular fragments of granite and subordinate coarse grained ophiolitic dolerites (Fig.1).

4. The Taitao plutonic intrusions. The plutonic suite includes 5 plutons (Cabo Raper, Seno Hoppner, Bahia Barrientos, Estero Cono and Tres Montes). Contact between intrusions and surrounding units are tectonic at many localities, but primary magmatic relationships are preserved locally. Granite fragments present within the rhyolite breccias (Fig. 1) belong to the plutonic suite. The Cabo Raper pluton, located less than 17 km landward from the trench axis, is a biotite and hornblende bearing granodiorite. K/Ar data on separate biotite from two samples yield ages of 5±1 Ma and 4.8±0.3 Ma. The chemical characteristics of the Cabo Raper pluton and samples from the Tres Montes intrusives are similar to those of adakitic or TTD suites which are believed to derive from partial melting of metabasalts under amphibolite-eclogite transition PT conditions (Kay et al., 1993). The Seno Hoppner pluton is a fine to medium grained granite. It displays typical characteristics of calc-alkaline series and most probably originated from the partial melting of the forearc mantle wedge. K/Ar ages obtained from biotite and feldspar are 5.9±0.5 Ma and 6.8±0.2Ma respectively. The present day location of the intrusions at less than 30 km from the trench axis is a possible result of strong tectonic erosion in relation with ridge-subduction (Bourgois et al, in press).

5. The Pliocene volcanic edifices. Volcanic and hypo-volcanic edifices (volcanoes, stocks, calderas) are present in the eastern part of the studied area in a region lacking extensive deformation. Radiometric ages obtained on two edifices (Pan de Azucar, the Fiordo San Pedro Caldera) range from 3.8±0.8 Ma to 5.1±1.3 Ma (Mpodozis, 1985). The geochemical compositon of the Pan de Azucar and Fiordo San Pedro volcanoes are similar to that of the Cabo Raper pluton with typical HREE low values.

CONCLUSION

The Mio-Pliocene Taitao magmatic suites are characterized by a wide range of chemical affinities and display a large number of possible sources (MORBs, contaminated MORBs, slab melting-derived magmas, calc-alkaline magmas). The origin of the various magmatic component is closely linked to the active ridge subduction which occured between 6 and 2 Ma. The Taitao Peninsula units allow to better constrain (1) the sources of near-trench plutons and associated volcanic rocks, (2) the massive removal of forearc material from the overriding plate, both being two major consequences expected from spreading-ridge subduction.

REFERENCES

Bourgois, J., Martin, H., Lagabrielle, Y., Le Moigne, J., and Frutos Jara, J., Subduction-erosion related to spreading-ridge subduction : Taitao Peninsula (Chile margin triple junction area). *Geology*. in press.

Bourgois, J., Lagabrielle, Y., Le Moigne, J., Urbina, O., Janin, M.C., and Beuzart, P., 1993a, Preliminary results of a field study of the Taitao ophiolite (Southern Chile): Implications for the evolution of the Chile triple junction: Ofioliti, v. 18, p. 113-129.

Cande, S.C., and Leslie, R.B., 1986, Late Cenozoic tectonics of the southern Chile trench: Journal of Geophysical Research, v. 91, p. 471-496.

Forsythe, R.D., Nelson, E.P., Carr, M.J., Kaeding, M.E., Hervé, M., Mpodozis, C.M., Soffia, M.J., and Harambour, S., 1986, Pliocene near trench magmatism in southern Chile: A possible manifestation of ridge collision: Geology, v. 14, p. 23-27.

Lagabrielle, Y., Le Moigne, J., Maury, R.C., Cotten, J., and Bourgois, J., 1994, Volcanic record of the subduction of an active spreading ridge, Taitao peninsula (southern Chile): Geology, v. 22, p. 515-518.

Le Moigne, J., 1994. Subduction d'une dorsale océanique active : géologie des ophiolites de Taitao (point triple du Chili). Thèse de doctorat, Universté de Bretagne Occidentale, Brest.

Mpodozis, C.M., Hervé, M., Nasi, C., Soffia, M.J., Forsythe, R.D., and Nelson, E.P., 1985, El magmatismo plioceno de Peninsula Tres Montes y su relacion con la evolucion del punto triple de Chile austral: Revista Geológica de Chile, v. 25-26, p. 13-28.

Kay, S.M., Ramos, V.A., and Marquez M., 1993, Evidence in Cerro Pampa volcanic rocks for slab-melting prior to ridge-trench collision in southern south America: The Journal of Geology, v. 101, p. 703-714.

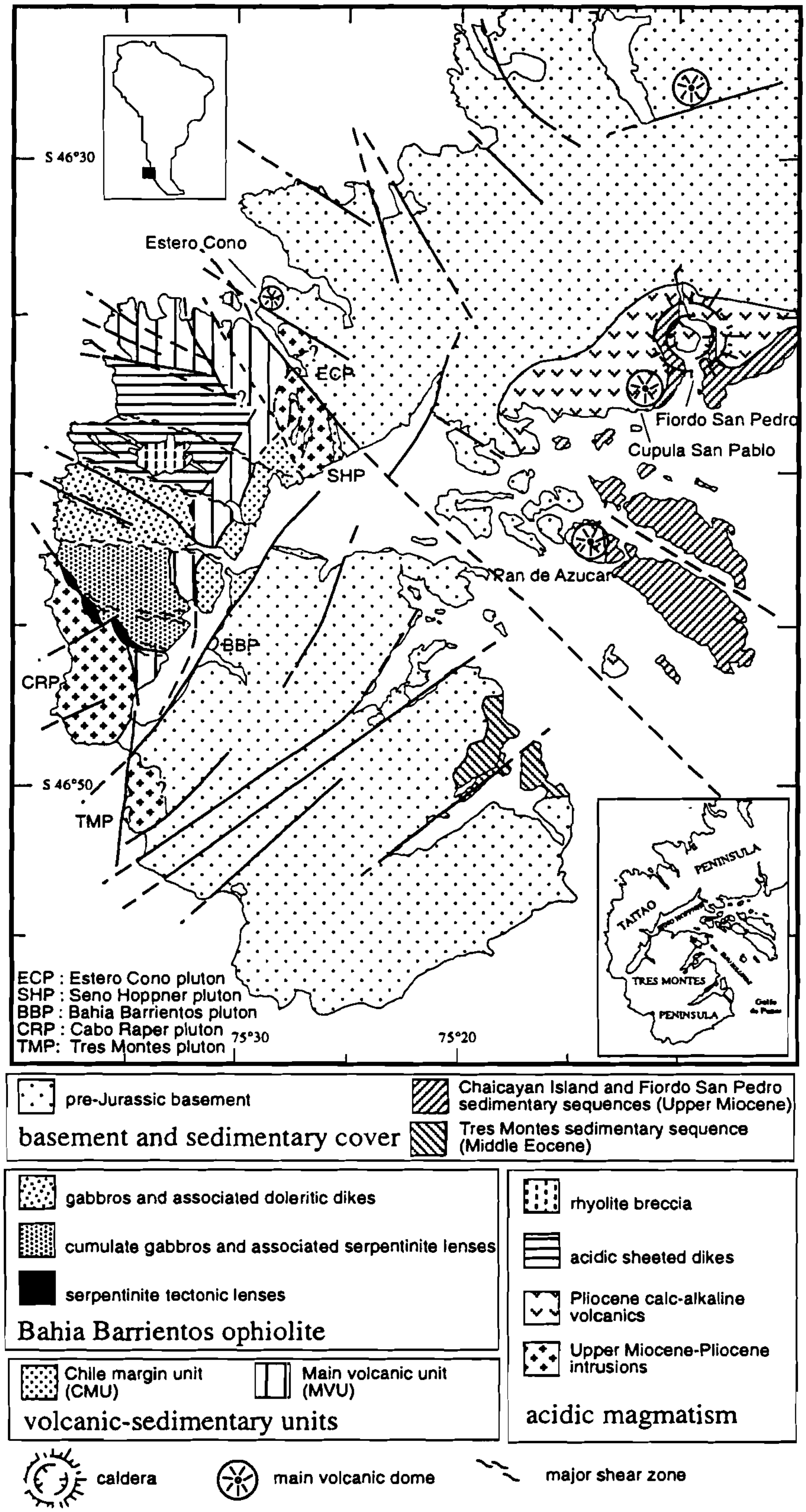

Fig. 1 : Preliminary geological map of the Taitao and Tres Montes Peninsula.

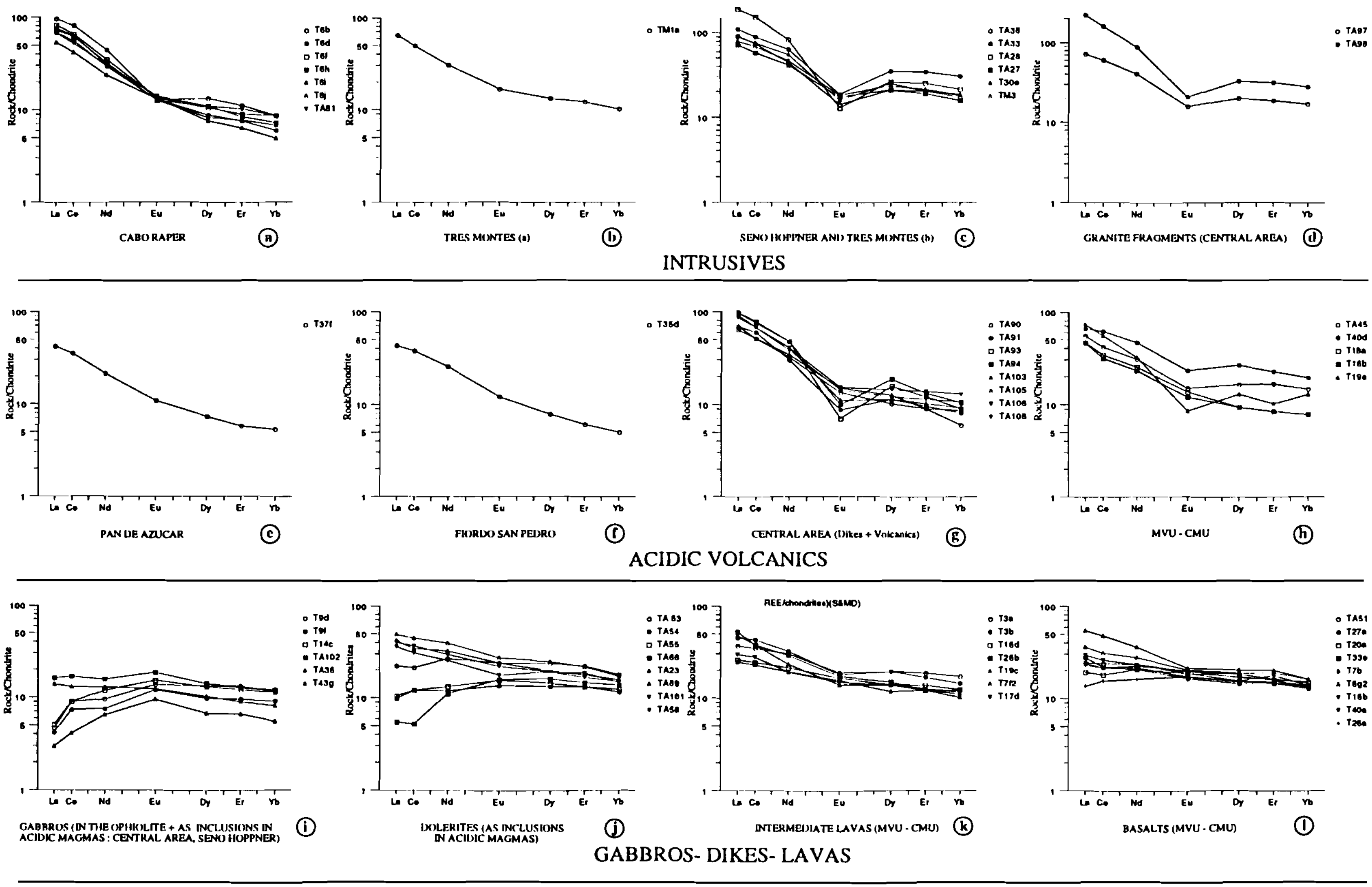

Fig. 2 : Rare Earth Element diagram

Normalization values : Sun and Mac Donough, 1989