PETROLOGY AND GEOCHEMISTRY OF THE TAITAO OPHIOLITE VOLCANIC-PLUTONIC SUITE (CHILE TRIPLE JUNCTION REGION)

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Résumé : Nous présentons les résultats d'une série d'analyses géochimiques conduite sur les principaux termes de l'ophiolite de Taitao. Les arguments de terrain permettent de distinguer deux unités dans l'ensemble volcano-sédimentaire étudié : (1) une unité essentiellement volcanique (OVU) métamorphisée dans le faciès des schistes verts qui pourrait constituer les termes supérieurs de l'ophiolite et (2) une unité volcanique et sédimentaire (CMU) à conglomérats et pyroclastites qui repose en discordance sur le socle métamorphique de la marge du Chili. Les résultats de notre étude pétrographique et géochimique confirment cette distinction et nous amènent à rediscuter l'origine des ophiolites.

KEY WORDS : Taitao ophiolite, Chile Triple Junction, volcanic rocks, geochemistry.

An ophiolitic and an intrusive suites have been discovered recently at 47°S on the Taitao Peninsula, Southern Chile (Forsythe *et al.*, 1986, Mpodozis *et al*, 1985), 50 km southward of the Chile Triple Junction and only 17 km from the Chile trench. The ophiolite and the intrusions have been first considered of Pliocene to Pleistocene age and are supposed to be the result of ridge subduction and collision. Indeed, a portion of the active spreading Chile ridge between the Taitao fault zone and the Tres Montes fault zone collided with the continental margin around 2.5 Ma - 4 Ma (Cande *et al.*, 1987).

The results of a field study conducted in the Taitao Peninsula in 1992 led us to distinguish at least two sequences within the volcano-sedimentary sequence previously interpreted as the stratigraphic cover of the so-called ophiolitic suite (here refered as the Bahia Barrientos Ophiolite, BBO). These two sequences are named the Ophiolite volcanic Unit (OVU) and the Chile Margin Unit (CMU) (Bourgois *et al.*, 1992).

(1) The OVU could represent the upper part of the ophiolite. It consists of a thick volcanic sequence of pillowed and massive lavas showing greenschist facies metamorphic overprint interbedded with marine sedimentary rocks. No microfauna allowing age determination was found in the sediments. This unit has been studied in three separate localities : Rio Oxxean Tres, Estero Lobo and Estero Cono. The corresponding sequences are named respectively : Oxxean Tres, E. Lobo and E. Cono sequences.

(2) The CMU is a thick, vertical, volcano-sedimentary unit. It includes conglomerates and pyroclastic rocks and uncomformably overlies the metamorphic basement of the Chile margin. No pebbles of ophiolitic origin have been found in the coarse detrital levels of this unit. Nannoplankton assemblages give an age ranging from Early Pliocene to Early Pleistocene.

Sixty-one samples of various volcanic rocks from the three distinct volcanic sequences of the OVU and from the CMU have been analyzed for major and trace elements as well as for rare earth elements using unductively coupled plasma emission spectrometry (ICP-ES), except Rb which has been analyzed with flame atomic emission spectrometry. Thirty-one samples have been collected in the Oxxean Tres sequence, nine are from the E. Lobo sequence, five from the E. Cono sequence, and three samples are fresh glass from undetermined origin. Three serpentinized peridotites and eleven gabbroic samples were also analyzed.

The collected volcanics are dominantly pillowed basalts, but massive lavas, dolerites, tuffs, pyroclastic breccias, isolated dikes and other intrusive have also been sampled. The rocks are dominantly

basic lavas (basalts, basaltic andesites and andesites), but three dacitic rocks and one rhyolite are present. SiO_2 content ranges from 46 to 76,8% with LOI (loss of ignition) varying from 1% to 9%. The volcanic sequence of the CMU is characterized by the abundance of pyroclastic facies, the occurrence of fresh glass within pillows and the lack of greenschist facies metamorphic overprint in all the lavas. By contrast, the volcanics of the OVU sequences show frequent greenschist facies metamorphism with crystallization of actinolite, chlorite and the albitization of plagioclase. However, as shown in a SiO_2 *vs* LOI diagram, there is no striking difference in the LOI ranges of both series.

The alkaly contents of the basaltic lavas are often high, higher than expected for typical MORB. The Na_2O+K_2O content varies from 2 to 9 % with the highest values found in basalts and basaltic andesites from E. Cono and E. Lobo sequences. Such variations require special attention to the possible effects of the alteration on the composition of the lavas. But no clear correlations can be established between the LOI and the abundance of major elements, moreover, the highest Na_2O and K_2O values are found in lavas showing low LOI contents suggesting that high alkaly values could be of primary origin. In a simple Na_2O+K_2O *vs* SiO_2 diagram (Fig. 2), two groups of composition can be distinguished : the rocks from the CMU show relatively slight alkaly enrichment for increasing silica contents whereas rocks from the OVU are characterized by high alkaly contents at lower SiO_2 values.

Based on rare earth elements behaviours, different groups can be distinguished among the samples from the OVU. Our preliminary study shows that at least three different groups do exist : a E-MORB group with a La/Nb ratio =1 (Fig. 3), a group with calk-alkaline affinities and a group of intermediate affinity with high SiO_2 and low K_2O contents. The mafic volcanic rocks of the CMU have REE patterns similar to that of slightly enriched MORB. The siliceous rocks of this unit show similar pattern with higher trace elements abundances and Nb, Ti and V negative anomalies probably in relation with fractionation of titanomagnetite and amphiboles.

The plutonic rocks of the Bahia Barrientos Ophiolite include isotropic and cumulate gabbros, gabbro-norites, Fe-Ti gabbros, wherlites and various intrusives such as andesite dikes and silicic anastomozing veinlets. The mineralogy of the gabbros is similar to that of oceanic gabbros (Ol, Pl, Cpx, Opx, Fe-oxides). Primary amphibole was found only in few samples. Some samples contain sulfides. The gabbros have very homogeneous geochemical compositions with silica content varying from 47% to 52,8% and very low K_2O and Na_2O contents.

These preliminary results indicate that the presumed upper volcanic sequence of the BBO, *i.e.* the OVU, is not typical of volcanic sections found at mid-oceanic ridges. Therefore, the Taitao complex cannot be regarded as a section of oceanic lithosphere simply obducted during ridge-trench collision. A more complex scenario is now needed to explain both obduction of ophiolitic rocks and the near trench Pliocene-Pleistocene magmatism registered in the CMU sequence and in the Chaicayan islands region.

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Figure captions :

Fig. 1 - Geological map of the Taitao Peninsula established on our observations.

Fig. 2 - $Na_2O + K_2O$ versus SiO_2 diagram. Dark squares, open squares, dark lozenges and open lozenges are for the Ophiolite Volcanic Unit (OVU). Black triangles are for the gabbroic and serpentinized rocks (BBO). Open triangles are for the lavas of the Chile Margin Unit (CMU).

Fig. 3 - La versus Nb diagram. Same symbols as fig. 2.

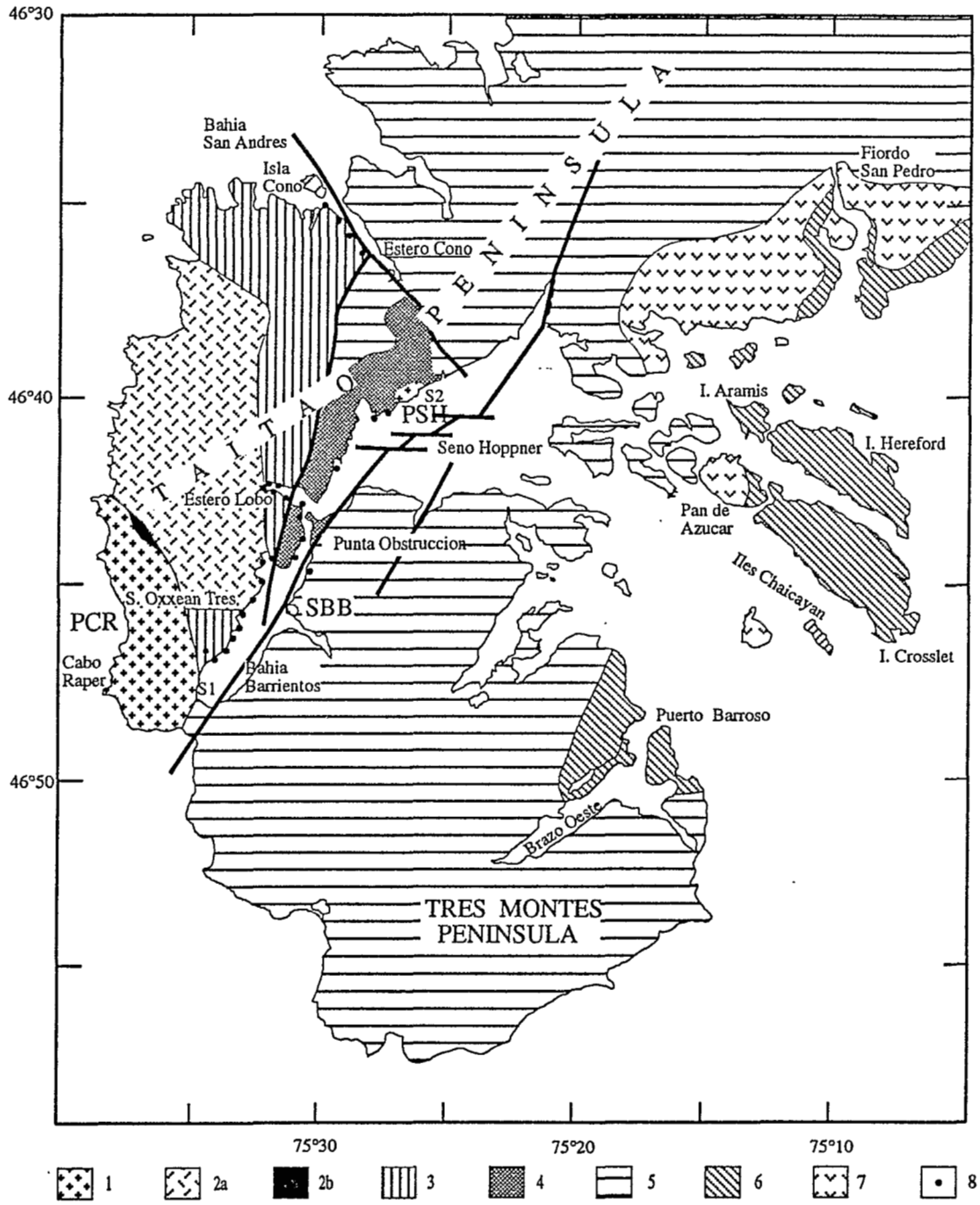


Fig. 1 - Structural diagram of the Taitao Peninsula :

1- Pliocene Taitao intrusive suite (3.2 - 5.5 Ma) ;
2- BBO : Bahia Barrientos Ophiolite suite : 2a- ophiolitic complex ; 2b- serpentine ;
3- associated volcanism OVU;
4- CMU : Chile Margin Unit ;
5- Pre-Jurassic metamorphic basement ;
6- Golfo Tres Montes Unit ;
7- calc-alcalin volcanism (0.8 - 5.3 Ma) ;
8- localisation of analyzed samples ;
F1, F2 : hot springs. CRP : Cabo Raper Pluton. BBS : Bahia Barrientos Stock. SHP : Seno Hoppner Pluton.

Fig. 2

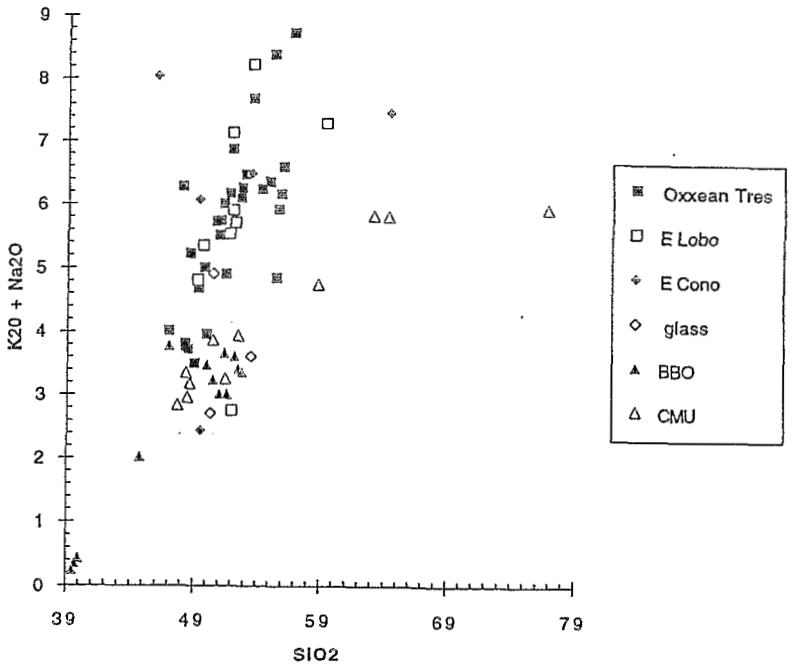
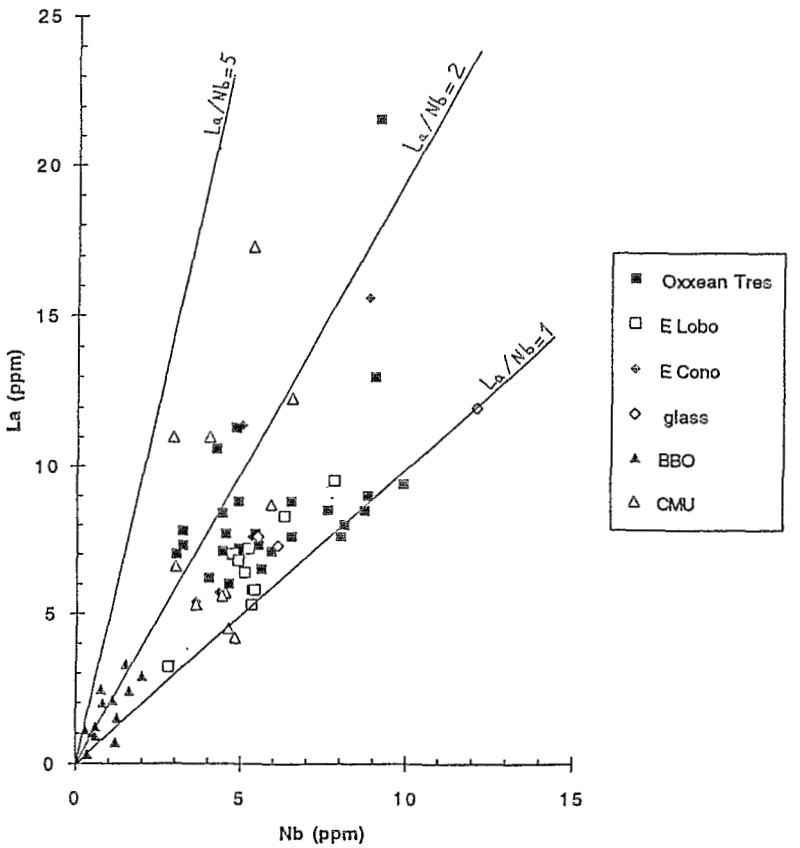

K20 + Na2O
SIO2
0
1
2
3
4
5
6
7
8
9
39
49
59
69
79
Oxxean Tres
E Lobo
E Cono
glass
BBO
CMU

Fig. 3


La (ppm)
Nb (ppm)
La/Nb=5
La/Nb=2
La/Nb=1
0
5
10
15
20
25
Oxxean Tres
E Lobo
E Cono
glass
BBO
CMU