

Geochemical Signatures of Séguéla Peridotites in the West African Craton

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Abstract

The present study deals with peridotites found in the paleo-proterozoic domain of the Leo Man Shield, Séguéla region, west-central of Côte d'Ivoire. Results show that Séguéla peridotites are composed of lherzolites, dunites and harzburgites. However, iherzolites are the most abundant. The phenocrysts in these rocks are olivine most often serpentinised, and pyroxenes, represented by diopside and enstatite. Amphiboles are divided into two groups: magmatic amphiboles and those from the destabilization of clinopyroxene. Spinels have CrO₃ content which varies between 28% and 37%, Al₂O₃ between 33% - 41% and MgO is equal to 18%; they are poor in TiO₂ and do not contain zinc oxide. Séguéla peridotites are characterised by a negative anomaly in Nb-Ta, associated with an enrichment of lithophilic elements and light rare earth elements with a fractionation rate (La/Yb) which varies between 46.22 and 150.72 and heavy rare earth elements, and HFSE depletion, which may suggest that were formed in an art context, that is, a mantle enriched by fluids from a subduction zone. However, another hypothesis could be considered, that of the interaction between the mantle and magmas in a subduction zone context.

Keywords

Geochemestry, Peridotites, Lherzolite, West African Craton, Séguéla, Côte d'Ivoire

1. Introduction

Precambrian ultramafic rocks, such as peridotites, komatiites and associated rocks, have been extensively studied worldwide for their Ni and Cr content but also for platinum group elements (Begg et al., 2010; Groves & Bierlein, 2007;

Naldrett, 1999). The vast majority of mantle peridotites are associated with komatiitic lava flows, or plutonic layered intrusions (Cameron, 1978; Maier, 2005; Mathison & Ahmat, 1996; McCallum, 1996; Myers, 1976; Rosengren et al., 2005). In Côte d'Ivoire, notably in the Archean domain of the Man Ridge, mafites and ultramafites were first described and mapped by Bolgarsky (1950). Several years later, Ouattara (1998) and Gouedji (2014) have conducted research in the regions of Biankouma and Marabadiassa respectively, and Allialy (2006) in the Seguéla region. The study conducted by Gouedji (2014) revealed that the Samapleu intrusion was of Paleoproterozoic age. Furthermore, in the Paleoproterozoic domain, the Alékro ultramafics show MORB signatures (Ouattara, 1998). On the basis of isotopic arguments, it has been demonstrated that the rocks in the Séguéla region belong to the Archean-Paleoproterozoic transition zone of the West African Craton (Kouamelan, 1996). The Séguéla region is also well known for its kimberlite field. Allialy (2006) has compared the kimberlites of this region with those already known in the sub-region and resulted in the finding of small, well-preserved kimberlitic diatremes. However, even if the kimberlites of Séguéla are the focus of detailed studies (e.g., Allialy, 2006; Allialy et al., 2011; Allialy et al., 2017), the fact remains that there is very little knowledge about the peridotites found in the region. Consequently, there is a need for a geochemical study to contribute to a better understanding of these rocks in this region.

2. Geological Settings

Côte d'Ivoire belongs to the West African Craton (WAC) that stabilised 1.9 Ga ago, precisely at the Man Dorsal, the southern part of this craton (Bessoles, 1977). It is located on the Leo Ridge. On the basis of new geochronological data published by Boher et al. (1992), Kouamelan (1996), Kouamelan et al. (1997) and Doumbia (1997), Côte d'Ivoire is made up of four geological zones: the Archean zone, the transitional zone (Archean-Birimian transition), the Paleoproterozoic zone (or Birimian zone located east of the Sassandra fault) and the sedimentary basin (located in the southern part of the country). The Séguéla region in west-central Côte d'Ivoire falls within the Archean-Proterozoic transitional zone to the east of the Archean zone and the Sassandra Fault, and on the western edge of the Paleoproterozoic zone sensu stricto. It is known for its diamond field fed by kimberlite and lamproite dykes. These dykes, undeformed and unmetamorphosed, cross two granite plutons separated by small panels of amphibolite belonging to the Birimian formations (Figure 1). They are monzonitic granites with biotite and hornblende showing their differentiated pegmatitic and aplitic dome and porphyroid rims (Allialy, 2006). Their N170° orientation is controlled by the structured contact between the Archean and Paleoproterozoic lithospheres of the West African craton.

3. Methodology

This work was carried out in two steps, a fieldwork and a laboratory stage. All these different stages are described in the following sections.



Figure 1. Geological map of the Séguéla region (Pouclet et al., 2004).

3.1. Petrography

The petrographic study involved collecting rock samples from the Toubabouko and Bobi sites. Each lithology is described macroscopically based on different characteristics such as rock texture, structure, colour, degree of weathering and mineralogical composition before being taken to make thin sections.

3.2. Crystallochemistry

A number of peridotite samples were taken from the Toubabouko and Bobi sites in the Séguéla region. These rock samples were used to make thin sections. An analysis of the minerals was carried out using the Microbeam "CAMEBAX" microprobe of the BRGM-CNRS-University of Orléans joint laboratory under the following conditions: 15 kV for the acceleration voltage, 10 or 12 nA for the current intensity and 10 seconds of counting time. The analysis was performed on the silicate minerals and oxides of the sampled rocks which consist of olivine, orthopyroxene, clinopyroxene, amphibole, and spinel.

3.3. Geochemistry

This research is based on twenty-four rock samples analysed for their major and trace element concentrations. It should be noted that the analyses of major elements were carried out using plasma emission spectrometry (ICP-ES) and trace elements using inductively coupled plasma mass spectrometry (ICP-MS). Additionally, the loss on ignition, which corresponds to the mass loss of the sample (escape of water and volatiles), is determined after heating to 1000°C.

Fourteen samples collected in Toubabouko were analysed for major elements $(SiO_2, Al_2O_3, Fe_2O_3, MnO, MgO, CaO, Na_2O, K_2O, TiO_2 and P_2O_5)$, trace elements (n = 30: Ba, Be, Bi, Cd, Co, Cr, Cs, Cu, Ga, Ge, Hf, Mo, Nb, Nd, Ni, Pb, Rb, Sb, Sn, Sr, Ta, Th, U, V, W, Y, Zn, Zr, Li and Ti) and rare earths (n = 14: La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu).

The remaining ten samples from Bobi were analysed for major elements (SiO₂, Al₂O₃, Fe₂O₃, MnO, MgO, CaO, Na₂O, K2O, TiO₂ and P₂O₅), trace elements (n = 30: Ba, Be, Bi, Cd, Co, Cr, Cs, Cu, Ga, Ge, Hf, Mo, Nb, Nd, Ni, Pb, Rb, Sb, Sn, Sr, Ta, Th, U, V, W, Y, Zn, Zr, Li and Ti) and rare earths.

4. Results

4.1. Petrography

Microscopic observation has shown that Séguéla peridotites are mainly composed of olivine, pyroxene, amphibole, spinel as well as phlogopite (Figure 2) which have been chemically analysed.

4.2. Mineral Chemistry

4.2.1. Olivines

Olivine remians the abundant mineral in Séguéla peridotites, and these olivines are essentially forsterites (89 to 91 Fo) and have a high Mg content that varies from 47% to 49% (Table 1). Nevertheless, they show low NiO contents (<0.12%). According to Allialy (2006), the presence of higher magnesian olivines (Fo = 91%) would suggest a primitive magma input into the magma chamber where the magnesian olivines crystallise. As a result, it can be stated that the Seguela complex is not the result of the crystallisation of a single magma injection.

4.2.2. Pyroxenes

1) Orthopyroxene

The orthopyroxenes (Opx) found in the Séguéla peridotites are highly magnesian with a Mg# = (Mg/Mg + Fe²⁺) ratio that varies between 0.84 and 0.96. In the classification diagram of pyroxenes proposed by Morimoto (1988), they all have an enstatite composition (**Figure 3**). Indeed, the enstatite percentages vary from 46.29% to 87.83% with a very low proportion of Na₂O, K₂O, and TiO₂ (< 0.60%).



Figure 2. Microscopic photographs (A, B, C and D) of the Séguéla peridotites. (A) Olivine-orthopyroxene and phlogopite association; (B) Spinel-olivine and amphibole association; (C) Orthpyroxene-clinopyroxene-olivine and spinel association; (D) Olivine-spinel association. (Ol: olivine, Opx: orthopyroxene, Spl: spinel, Phl: phlogopite, Amph: amphibole).



Figure 3. Disposition of pyroxenes from the Séguéla peridotites in the diagram of (Morimoto, 1988).

2) Clinopyroxene

Based on the diagram of pyroxene classification of Morimoto (1988), the clinopyroxene types are mainly composed of diopside. This diagram indicates a moderate enrichment in iron (2% to 6%) which is linked to magmatic differentiation (Khan, 1989). The clinopyroxenes of Séguéla are highly magnesian with MgO contents ranging from 15.12% to 34.40%.

SÉGUÉLA											
OLIVINES											
n° éch	T-25								T-26		
n° anal	34	41	42	43	52	59	64	15	20	35	36
SiO ₂	40.10	39.94	39.94	40.17	40.19	41.07	40.54	40.89	41.74	41.23	41.82
TiO_2	0.22	0.15	0.10	0.20	0.03	0.25	0.17	0.05	0.25	0.01	0.03
Al_2O_3	0.00	0.01	0.00	0.00	0.00	0.00	0.03	0.40	0.01	0.00	0.04
FeO	7.80	9.60	8.00	8.00	7.90	7.90	7.50	7.80	7.60	7.80	9.50
MnO	0.38	0.13	0.24	0.26	0.29	0.28	0.16	0.38	0.21	0.12	0.28
MgO	48.50	47.80	48.25	48.00	48.50	48.15	48.30	47.00	47.50	47.20	49.00
CaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NiO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	97.00	97.64	96.53	96.63	96.92	97.65	96.70	96.51	97.30	96.36	100.67
Si	1.00	1.00	1.01	1.01	1.01	1.02	1.01	1.03	1.04	1.03	1.01
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Fe ²⁺	0.16	0.20	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.19
Mn	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.01
Mg	1.81	1.79	1.81	1.80	1.81	1.78	1.80	1.76	1.76	1.76	1.77
Ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	2.99	3.00	2.99	2.99	2.99	2.98	2.98	2.97	2.96	2.97	2.99
% Fo	91.35	89.75	91.25	91.19	91.34	91.29	91.83	91.10	91.56	91.40	89.92
% Fa	8.65	10.25	8.75	8.81	8.66	8.71	8.17	8.90	8.44	8.60	10.08
Mg+Fe ²⁺	1.98	1.99	1.98	1.97	1.98	1.95	1.96	1.93	1.92	1.93	1.97
$Mg/Mg + Fe^{2+}$	0.91	0.90	0.91	0.91	0.91	0.91	0.92	0.91	0.92	0.91	0.90

Table 1. Representative analyses of olivines.

4.2.3. Amphiboles

The amphiboles of the Séguéla peridotites are very magnesian; their Mg# varies from 0.65 - 0.89. They contain little titanium (TiO₂ = 0.06% - 2.50%) and their Al₂O₃ content varies from 0.01% - 7.04%. Chemistry shows a distinction between magmatic amphiboles and those resulting from the destabilisation of clinopyroxene. Magmatic amphiboles have a sum of Na and K cations in the A site (Na + K)_A > 0.50; between 0.50 and 0.58. This sum remains low for secondary amphiboles (0.06 to 0.26). Magmatic amphiboles have AlVI contents between 0.10 and 0.92. The Si content, which varies from 6.24 to 7.61, reveals four types of amphiboles. In the classification of amphiboles are: tremolite-actinote, tschermakite, pargasite, and magnesiohornblende (**Figure 4**). Magmatic amphiboles correspond



Figure 4. Disposition of amphiboles in the Séguéla peridotites in the amphibole classification diagram (Leake et al., 1997).

to pargasites. Secondary amphiboles are characterised by tremolites and those resulting from the destabilisation of clinopyroxene, namely magnesiohornblende and tschermakites.

In the Na versus $Al^6 + Ti + Fe^{3+}$ diagram from Zhao & Zhou (2006), the Séguéla amphibole species are located in the high- and low-pressure domains (**Figure 5**). This could suggest that magmatic and secondary amphiboles would be formed at high and low pressure respectively during magma crystallisation.



Figure 5. Amphibole arrangement of the Séguéla peridotites in the Na versus $Al^6 + Ti + Fe^{3+}$ diagram of (Zhao & Zhou, 2006).

4.2.4. Spinels

In the Séguéla peridotites, the spinels are represented by hercynite, which is sometimes associated with chromium spinel. The hercynite crystallises after the chromiferous spinel which is more enriched in chromium. These two spinels crystallize before pyroxenes and amphiboles, and are contemporary to earlier than olivine. Cr_2O_3 contents vary between 28% - 37%; Al_2O_3 contents are between 33% - 41% and MgO contents are around 18%. They are poor in TiO₂ (**Table 2**). The ratios $Cr# = (Cr/[Cr + Al] \times 100)$ ranging from 31% to 42%), $XFe^{2+} =$ $(Fe^{2+}/Fe^{2+} + Mg)$ ranging from 21% to 31% and $XFe^{3+} = (Fe^{3+}/Fe^{3+} + Cr + Al)$ ranging from 0% to 19% are relatively low. These spinels do not contain zinc oxide.

It is accepted that the Cr# ratios of spinels are related to the activity of the aluminium. This activity, which depends on the crystallisation temperature, indicates that XFe³⁺ remains sensitive to the variation in oxygen fugacity during spinel crystallisation (Dick & Bullen, 1984; Fisk & Bence, 1980; Irvin, 1967). Low XFe³⁺ < 20% is evidence of crystallisation under low oxygen fugacity. The positive correlations between Cr# and XFe²⁺ and between XFe³⁺ and XFe²⁺ reflect a combined decrease in total pressure and temperature during the spinel crystallisation phase.

4.3. Geochemistry

The geochemical data were inserted into the MAGMA software and provided the proportions of olivine, orthopyroxene and clinopyroxene in these rocks. In the classification diagram of ultramafic rocks by proposed by Streckeisen (1976), the Séguéla peridotites appear to be composed mainly of lherzolites, dunites and harzburgites (Figure 6). On this diagram, the lherzolites located in the central zone, seem to be the most dominant on the whole of our peridotites (fifteen in

SÉGUÉLA											
n° éch	K03-B2										
n° anal	54	55	56	58	59	60	65	68	69	70	
SiO ₂	0.07	0.05	0.03	0.02	0.03	0.05	0.02	0.02	0.06	0.01	
TiO ₂	0.02	0.01	0.00	0.00	0.02	0.02	0.00	0.01	0.02	0.15	
Al_2O_3	33.40	34.12	33.63	33.94	33.92	33.71	40.89	39.62	40.39	40.18	
Cr_2O_3	36.72	36.15	36.65	36.32	37.12	36.31	28.02	28.97	28.77	29.79	
V_2O_3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
FeO*	10.14	10.42	10.66	10.20	10.53	10.19	12.89	11.90	11.45	11.64	
FeO	9.36	9.47	9.87	9.48	9.47	8.98	11.73	9.09	9.77	10.50	
Fe_2O_3	0.88	1.06	0.89	0.81	1.18	1.35	1.29	3.12	1.86	1.27	
MnO	0.14	0.05	0.11	0.07	0.11	0.13	0.18	0.22	0.07	0.23	
MgO	17.95	18.07	17.68	17.93	18.24	18.27	17.27	18.95	18.64	18.25	
ZnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Total	98.43	98.87	98.75	98.48	99.97	98.68	99.27	99.70	99.40	100.26	
Si	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.00	
Al	9.10	9.23	9.15	9.23	9.10	9.14	10.81	10.37	10.59	10.51	
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	
Fe ³⁺	0.15	0.18	0.15	0.14	0.20	0.23	0.22	0.52	0.31	0.21	
Fe ²⁺	1.81	1.82	1.90	1.83	1.80	1.73	2.20	1.69	1.82	1.95	
Mg	6.18	6.18	6.08	6.16	6.19	6.26	5.77	6.28	6.18	6.04	
Mn	0.03	0.01	0.02	0.01	0.02	0.03	0.03	0.04	0.01	0.04	
Cr	6.71	6.56	6.69	6.62	6.68	6.60	4.97	5.09	5.06	5.22	
Zn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
V	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Total	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	
%Magn	0.95	1.14	0.96	0.88	1.26	1.46	1.36	3.26	1.95	1.33	
%Herc	57.01	57.79	57.21	57.70	56.94	57.21	67.57	64.90	66.35	65.90	
%Chro	42.04	41.07	41.82	41.42	41.80	41.33	31.06	31.84	31.70	32.77	
$\mathrm{Fe}^{3+}/\mathrm{Fe}^{2+}$	0.08	0.10	0.08	0.08	0.11	0.14	0.10	0.31	0.17	0.11	
Fe ²⁺ /S2	0.23	0.23	0.24	0.23	0.23	0.22	0.27	0.21	0.23	0.24	
Fe ³⁺ /S3	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.02	0.01	
Cr#	42.45	41.55	42.23	41.79	42.33	41.94	31.49	32.91	32.33	33.21	
Mg#	77.37	77.28	76.15	77.13	77.43	78.38	72.41	78.79	77.27	75.61	

Table 2. Representative analyses of spinels.

total), composed of more than 70% olivine, followed by the dunites (seven in total) which are composed of 90% olivine and present a low proportion of pyroxenes and the harzburgites which are mainly composed of olivine and orthopyroxene (there are two).



Figure 6. Classification diagram of ultramafic rocks by (Streckeisen, 1976), based on the proportions of olivine (Ol), orthopyroxene (Opx), and clinopyroxene (Cpx).

4.3.1. Rare Earth Spectra

The peridotites have rare earth contents (Σ REE) that vary between 1.4 and 2290 ppm. They are all above the detection limit. However, the Tm contents are on the whole very low or even close to the detection limit, as is Lu.

Rare earths have been normalised to chondrite according to (Boynton, 1984). The spectra are roughly parallel for all peridotites. The lherzolites show light rare earths (LREE) enrichment of nearly 1000 times that of chondrite, with a fractionation rate (La/Yb)N that varies between 46.22 and 150.72 (Figure 7(A)) and heavy rare earths (HREE) depletion of 10 to 100 times the chondritic content. Dunites show almost identical rare earth spectra, with a variable slope and a fractionation rate (La/Yb)N between 56.52 and 158.76 (Figure 7(B)) comparable to those of the lherzolites. They display spectra enriched in light rare earths (LREE) with a slight depletion in heavy rare earths (HREE) reflecting the role of clinopyroxene in fractionation during melting and/or fractional crystallisation. Harzburgites show similar spectra to lherzolites and dunites with an enrichment in light rare earths compared to heavy rare earths (Figure 7(C)). The appearance of these spectra suggests a calc-alkaline affinity.

4.3.2. Multi-Element Spectra

The trace element compositions of the peridotites investigated are plotted on the



Figure 7. Rare earth diagrams: (A) Lherzolites; (B) Dunites; and (C) Séguéla harzburgites normalised to chondrite according to (Boynton, 1984).

normalised depleted mantle (**Figures 8(A)-(C)**) diagrams according to the values of (McDonough & Sun, 1995). In the multi-element diagrams normalised to the early mantle, the trace element spectra of the lherzolites show an enrichment in lithophile elements (LILEs; Cs, Rb, Ba, Th) and a general depression in K, Nb, Ta, Sr, Ti and P is observed (**Figure 8(A)**). The dunites show overall enrichment in LILEs (Cs, Ba, Rb), LREEs (La, Ce, Nd and Sm) and depletion in HFSE (Nb, Ta, Zr, Hf, and Y). The spectra of the harzburgites are broadly similar to those of



Figure 8. Multi-element spectra: (A) Lherzolites; (B) Dunites; and (C) Séguéla harzburgites normalized to the early mantle (Sun & McDonough, 1989).

the dunites, showing enrichments in lithophile elements (Cs, Rb, Ba, Th), depletions in HFSE (Nb, Ta, Zr, Hf, and Y) and a strong negative anomaly in K, Sr, P, Ti and a slight one in Nb, Ta and Zr. The Sr anomaly would reflect the fractionation of the plagioclase (to which Eu can be added) and the negative K anomaly would result from a post-settlement alteration phenomenon.

Geochemical results have shown that the Séguéla peridotites are composed of lherzolites, dunites and harzburgites. However, lherzolites are the most dominant formations. These rocks generally have purely komatiitic chemical characteristics that indicate their Archean origin.

5. Discussion

Crystallochemistry has shown that the Séguéla peridotites consist of the following mineral paragenesis: olivine, pyroxene, amphibole and spinel. Forsterite is more abundant in olivine, orthopyroxene is represented by enstatite, clinopyroxene by diopside and amphiboles by tschermakite, pargasite, actinote-tremolite and magnesio-hornblende. The mineral chemistry of the peridotites, particularly with olivine (89% < Fo < 91%), Opx and Cpx (negative correlation between Al_2O_3 and Mg# contents) indicates a mantle origin by fractional crystallisation. This correlates with the research of Zaki Khedr et al. (2013) in the Waki Sarami ophiolite and Gouedji (2014) found the Biankouma region. Furthermore, the forsterite contents of the olivines (89% - 91%) and the Mg# of the orthopyroxenes (84% - 96%), indicate crystallisation from a magnesian magma. The presence and abundance of amphiboles in the peridotites is indicative of the water-rich nature of this magnesian magma. These results support those of Allialy et al. (2017), and are similar to those of Gouedji (2014) and Ouattara (1998) obtained on the ultramafic and mafic intrusions of the Yacouba complex (Biankouma region). Moreover, the chemistry of the Séguéla peridotites is similar to that of the Beiyan peridotites in northern China (Hao et al., 2012). However, the Cr# ratios of the Séguéla spinels are slightly lower than those of Beiyan, with values ranging from 7.3% to 44.3%. The signature of spinels with $XFe^{3+} < 20\%$ is indicative of crystallisation under low oxygen fugacity. These conditions could be due to the early crystallisation of these spinels and sometimes even before the olivine in which they are often embedded. These results corroborate those of Allialy (2006) and Ouattara (1998) in the Biankouma region.

These facies are comparable to silica-rich komatiitic basalts (Arndt et al., 1977; Cattell & Taylor, 1990). The distribution of major elements in the peridotites suggests that the lherzolites, dunites and harzburgites are probably the result of a single primitive magma that gradually evolved. As per (Pearce & Cann, 1973), rock samples with low levels of TiO_2 (<2%) are consistent with magmatic arc rocks, but are different from intraplate basalts, which often have high levels of TiO_2 (>2%). Indeed, peridotites have TiO_2 levels below 2%. This corroborates the studies done by Ouattara (1998) and Gouedji (2014) in the Biankouma region.

Characteristics such as negative anomalies (Ta and Nb) and light rare earth enrichments are the main characteristics of the low-Ti peridotites found mostly in the Chinese northeast craton (Hao et al., 2012), and in the Oman ophiolite (Nicolle, 2014). The negative Ta-Nb anomalies observed in this study, although characteristic of a subduction context, are, together with the enrichment in Ba, Rb, Th, characteristic of a mantle plume. These observations are similar to those made by Gouedji (2014) in the Biankouma region, Côte d'Ivoire.

6. Conclusion

The present study has highlighted the petrographic background, crystallochemi-

stry and lithogeochemistry of the Séguéla peridotites in order to propose a geodynamic model of setting. Based on the results, the Séguéla peridotites are composed of lherzolites, dunites and harzburgites. The minerals within the peridotites are essentially olivine, most often associated with serpentinisation, pyroxene, amphibole, spinel and phlogopite. The crystallochemistry of these rocks indicates high levels of forsterite (89% - 91%) which proves that they have crystallised from a magnesian magma and the presence of actinote-tremolite, tschermakite, pargasite, and magnesiohornblende would indicate the water richness of this magma and the spinels show a signature of the mid-oceanic rifts. Pyroxene species in the Séguéla peridotites are mainly enstatites and diopsides. Based on their geochemistry, these rocks show calc-alkaline chemistry suggesting a single magmatic source. The spectra of the peridotites show overall enrichments in lithophilic elements and light rare earths compared to heavy rare earths and HFSEs, associated with a negative Ta-Nb anomaly that is not very marked, which proves that these rocks were emplaced in a back-arc context, i.e., a mantle enriched by fluids from a subduction zone. This could also be the result of interaction between the mantle and magmas in a subduction zone context. The enrichments of light rare earths compared to heavy rare earths would therefore indicate a metasomatic episode. The negative cerium anomalies observed would reflect the interaction of these rocks with sea water, those in K would result from a post-settlement alteration phenomenon and the depletion in certain elements such as Na, Ca and Al indicates that these elements existed in small quantities in the mantle.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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