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Transitional tholeiitic basalts in the Tertiary Bana volcano–plutonic complex, Cameroon Line

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Abstract

The Bana transitional tholeiitic basalts occurring in a Tertiary volcano–plutonic complex of the Cameroon Line, Central Africa are plagioclase-bearing and olivine-free. K/Ar dating on separated plagioclases of the transitional tholeiitic basalts yields an Oligocene age of 30.1 ± 1.2 Ma. Their clinopyroxene compositions are marked by iron enrichment and calcium depletion in the Wo–En–Fs system. The whole-rock major element compositions are characterized by Mg# ~ 36–48, normative quartz and hypersthene. The youngest alkali basalts from the same igneous complex have higher Mg# ~ 56–66. These two groups of basalt have trace element characteristics of within-plate basalt with Zr/Nb ratios of 3.7–4.5 and 7.5–9.2 respectively, and different LILE/HFSE and LREE/HREE ratios. The overall trace element characteristics suggest that the transitional tholeiitic basalts of the Bana complex were derived by high degrees of partial melting in the upper mantle at shallow depths whereas younger alkali basalts in the complex were probably produced by a small degree of melting of the same source at slightly greater depths. The transitional tholeiitic character of these basalts suggests a significant lithospheric extension and mantle upwelling below the Cameroon Line in the Oligocene.

Keywords: Transitional tholeiitic basalts; WPB; Tertiary Bana volcano–plutonic complex; Cameroon Line

1. Introduction

Oceanic and continental lavas constitute the extrusive section of the Cameroon Line (Fig. 1), a line of Eocene–Oligocene anorogenic volcano–plutonic complexes, and Oligocene to Present volcanic centers.

The Cameroon Line comprises about 60 anorogenic volcano–plutonic complexes, and a large number of polygenetic and monogenetic volcanoes extending from Pagalu Island in the Atlantic Ocean (SW) to lake Chad (NE) on the Africa continent. A number of studies of continental and oceanic basalts of the Cameroon Line have contributed to the understanding of geochemical and isotopic features of alkali basalts (Fitton and Dunlop, 1985; Fitton, 1987; Halliday et al., 1988, 1990; Lee et al., 1994; Marzoli et al., 2000; Rankenburg et al., 2005). These studies highlighted the chemical and isotopic similarities between basalts from oceanic and continental sectors, their alkaline nature and the dominance of the HIMU mantle source during their genesis (Halliday et al., 1990).

Déruelle et al. (1991) showed that extensive petrological studies of the Cameroon Line volcanic and plutonic rocks do not allow the conclusion that magmatism develops a transitional trend in that region as is the case in the East-African Rift. They discarded a transitional character of some basalts from Mt Oku, Manengouba and Principe island (Fitton, 1987), and gabbros from the Mboutou igneous complex (Parsons et al., 1986) on the basis of their high niobium contents compared with typical transitional

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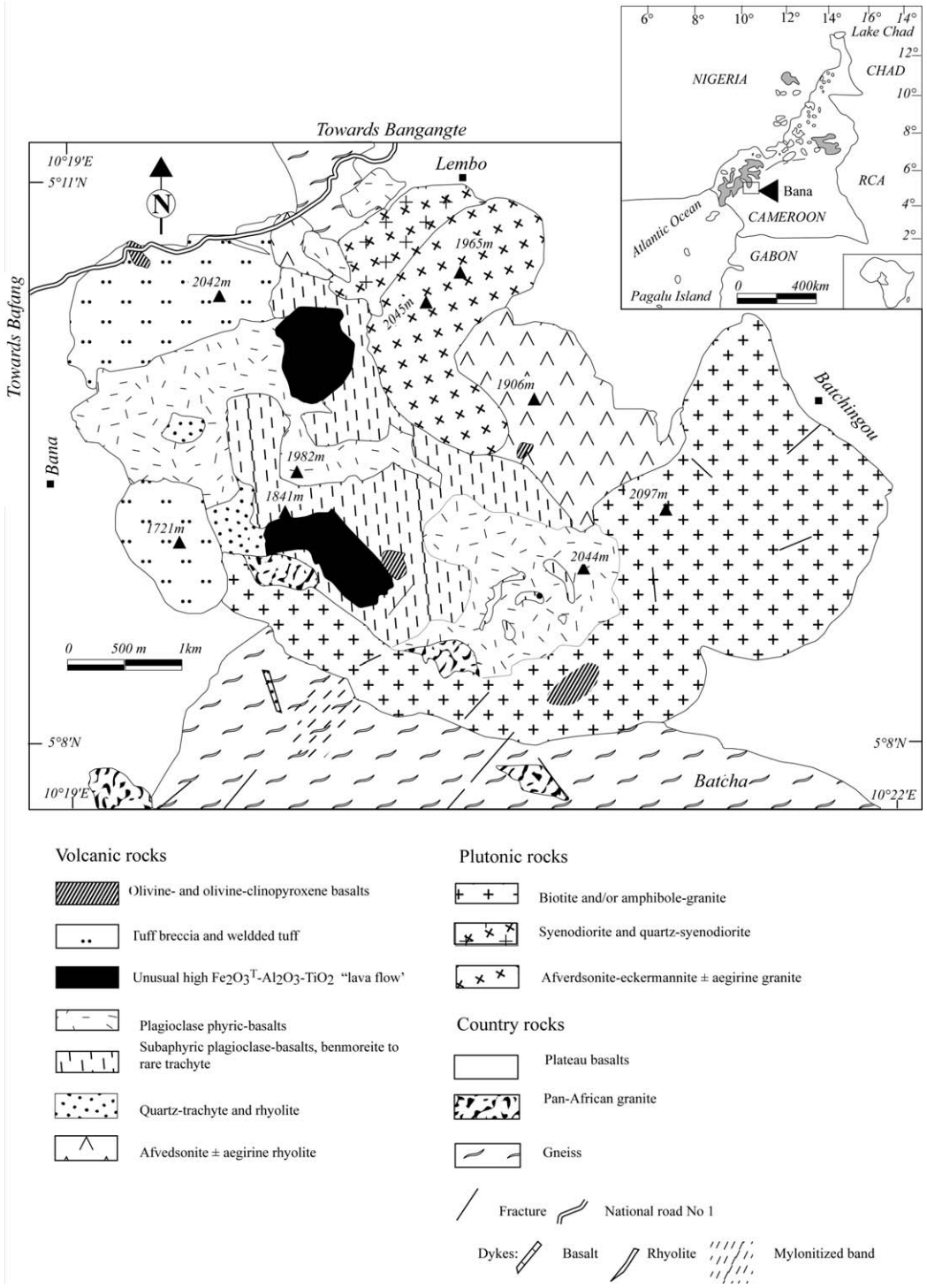

Fig. 1. Geologic map of the Bana plutono–volcanic complex (Kuepouo et al., 2004). Inset shows the position of the Bana volcano–plutonic complex in the Cameroon line.

basalts of the East-African Rift (Kampunzu and Mohr, 1991) and OIB. Further record of transitional basalts within the Cameroon Line by some workers (Kampunzu and Lubala, 1991; Moundi et al., 1996; Moundi, 2004; Fosso et al., 2005) is hotly debated.

For clarification, transitional basalts are basalts having compositions intermediate between tholeiitic and alkaline basalts, and typified by their mildly hypersthene-normative to mildly nepheline-normative character.

The objectives of this paper are: (1) to prove the occurrence of transitional tholeiitic basalts discovered within the Cameroon Line; (2) to discuss their clinopyroxene and whole-rock chemistries in comparison with those of typical alkali basalts of the Cameroon Line occurring in the same