Geochemistry and geochronology of the Méiganga metadiorite: implications on the timing of D2 deformatonal phase in Adamawa Yadé Domain in Cameroon

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ABSTRACT

The metadiorite of Méiganga forms an ovoid body intruding metasedimentary gneisses in the area of Méiganga city. It shows schistosity, banded structure and is made up of green hornblende, biotite, antiperthitic plagioclase, quartz, zircon, opaque minerals and chlorite. Imprints of D2, D3 and D4 deformation phases are identical in the metadiorite and the amphibole biotite gneiss, leaving no doubt as to the syn-D2 emplacement and crystallization of the protolith of the metadiorite. The metadiorite samples display high-K calc-alkaline to shoshonitic characteristics and possess features of I-type granitoids. They exhibit relative low enrichment of LREE with respect to HREE, \((\text{La/Yb})_N = 9.5-11.3\), and moderate negative Eu anomalies \((\text{Eu/Eu}^*) =0.80-0.83\). Optical features of the zircon grains of the metadiorite and its syn-D2 emplacement and crystallisation indicate that the zircon evaporation \(^{207}\text{Pb}/^{206}\text{Pb}\) ages \((614.1 \pm 3.9\) Ma and \(619.8 \pm 9.8\) Ma) of this rock date the D2 deformation phase in the Méiganga area. Comparison with other sectors of the Adamawa Yadé Domain (AYD) shows the close synchronic character of the D2 deformatonal phase in central Cameroon (Méiganga, Tibati, Ngaoundéré areas) and the diachronic character of this phase in central and western Cameroon. We found that a similar chronological evolution has been demonstrated in the Macururé Domain of the Sergipano Belt (NE Brazil).

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Keywords: syn-D2 granitoid; \(^{207}\text{Pb}/^{206}\text{Pb}\) age; Central Pan-Africa Fold Belt; Sergipano Belt.

INTRODUCTION

The main structural feature of the Central Africa Fold Belt (CAFB) is the presence of regional transcurrent shear zones. These unconformities have been used to fix the boundaries between different domains of the belt: the Tcholiliré-Banyo shear zone (TBSZ) is considered as border between the west Cameroon domain (WCD) and the Adamawa-Yadé domain (AYD), whilst the Sanaga shear zone (SSZ) separates the AYD from the Yaoundé domain (YD) (Toteu et al., 2004) (Figure 1). In Cameroon, those unconformities have also been used to differentiate the Panafircn basement into a northern, central and southern domain (Nzenti, 1994).

The AYD is characterised by the widespread occurrence of granitoids, which have been classified according to deformation...
state into syn-tectonic, late tectonic and post-
tectonic intrusives (Lassere, 1961; Toteu et al., 2001). Syn-tectonic metadiorites are
widely distributed in the cameroonian portion of the AYD. The basement of the AYD
consists of Paleoproterozoic metasedimentary rocks and orthogneissess which are preserved
as remnants in the Mbé and Méganga areas (Penaye et al., 1989; Ganwa, 2005). Detailed
petrographic and geochronologic studies exist for a few plutons in the southwestern part of the
AYD (Nguiesi Tchankam et al., 1997; Tagne-Kamga et al., 1999; Tagne-Kamga, 2003; Nzolang et al., 2003; Djouka Fonkwé et al., 2007). In the Tibati area in central
Cameroon, and in western Cameroon, few syn-kinematic plutons crop out in close
vicinity to the Panafican Adamawa ductile shear zone (Central Cameroon Shear Zone: CCSZ; Nzenti et al., 2006; Njanko et al., 2006, 2010; Kwekam et al., 2010). They are
high-K calc-alkaline plutons and show geochemical similarities to other Panafican
high-K calc-alkaline syn-kinematic plutons from western Cameroon. Three main
successive tectonic events associated with the Panafican collisional and post-collisional
evolution are identified in Cameroon: (i) crustal thickening (ca. 630-620 Ma); (ii) left
lateral wrench movement (ca. 613-585 Ma), and (iii) right lateral wrench movement (ca.
585-540 Ma) (Ngako et al., 2008).

This paper presents the results of
geochemistry and a single zircon Pb
evaporation study of a metadiorite from the
Méganga area. The aim was to constrain the age of the D2 deformation in the study area and, on a larger scale, to characterize its evolution in the AYD, given that the D2 is the most important deformational phase in the
Panafican metamorphic history in Central
Africa.

MATERIALS AND METHODS
Analytical methods
Major and trace elements were analysed by X-ray fluorescence (XRF) at the University
of Tübingen, Germany. Rare-earth elements were analysed by Inductively Coupled
Plasma–Atomic Emission Spectrometry (ICP–AES) at the CRPG (Centre de recherches pétrographiques et géochimiques, Vandoeuvre-lès-Nancy, France). Analytical
precisions are typically better than 2% for major elements except for P and Mn which have precisions better than 15%, and 5–10% for most trace elements. Zircon grains were separated from the 63-200 µm sieved rock fractions by standard separation techniques (milling, wet shaking table, magnetic and heavy liquid separation) and finally handpicking under the binocular microscope. Cathodoluminescence images were performed on an electronic microscope LEO Model 1450
VP (variable pressure) 4-Quadrant BSE-
Detector working with an accelerating voltage of 10 kV. For zircon Pb evaporation, single
zircon grains were analysed using a double Re
filament configuration. Principles of the
evaporation method were described by Kober
(1986, 1987). Measurements were done using a Finnigan MAT 262 mass spectrometer
equipped with a MassCom ion counter at the
University of Tübingen. All
$^{207}\text{Pb}/^{206}\text{Pb}$ ratios
were corrected for common Pb according to Cocherie et al. (1992), and the error for a single zircon age was calculated after Siebel et al. (2005). Repeated measurements on natural zircon from Phalaborwa, South Africa (Kröner and Willner, 1998), and from zircon standard 91500 of ‘Kuehl Lake’ (Canada) (Wiedenbeck et al., 1995) were performed for geologically realistic age and error treatment (Chen et al., 2002). The results were similar to those obtained by previous authors (Kröner and Willner, 1998; Wiedenbeck et al., 1995).

Petrography and structural characteristics
of the metadiorite
The metadiorite constitutes the
basement of Méganga town and its
neighbourhood (Figure 2). It forms an ovoid
body stretching in NE-SW direction. The magmatic body intrudes amphibole biotite
gneisses (ABGn) and spatially associated to
pyroxene-amphibole-biotite granites (PABGr)
and biotite-muscovite granites (BMGr). With
Figure 1: Geological sketch map of East Adamawa showing the Méiganga area. Patterns are as follows: grids, Congo craton (CC); dark grey, Adamawa–Yadé Domain (AYD); medium grey, Yaoundé Domain (YD); light grey, West Cameroon Domain (WCD); Central Cameroon Shear Zone (CCSZ); heavy dots, Cameroon Line; light dots, Mesozoic sediments. The square in the inset localizes the large figure. Cameroon (C.), Central African Republic (C.A.R.)

respect to the state of deformation, the granites are posterior to the metadiorite. Studies on the various host rocks have been performed by Ganwa (2005).

The metadiorite is medium grained and shows a schistosity and a banded structure defined by quartzofeldspathic layers as a result of migmatization. Plagioclase is antiperthitic and contains submicroscopic inclusions. Quartz is partly recrystallised and forms polycrystalline ribbons parallel to the schistosity. Chlorite and opaque minerals are formed at the expense of biotite.

The metadiorite has been affected by three deformation phases (D2, D3, D4), contrary to the host gneisses which were also affected by D1. The metadiorite shows a penetrative S2 foliation marked by alternation of ferromagnesian minerals (biotite, amphibole) and quartzofeldspathic minerals. S2 in the metadiorite is parallel to S2 in the host gneisses with few exceptions. It dips between 30° and 90° towards NW to N or S to SE (Figure 2). The L2 lineation is characterized by stretching of quartz, elongate aggregates of quartz and feldspar, and the alignment of amphibole and biotite. L2 has a weak to moderate angle of plunge (up to 40°) towards NE or SW. Moreover, it shows the same orientation as in the host gneisses (Figure 2).

In the metadiorite and the host gneisses, D3 is represented by folds (F3) and an axial plane foliation (S3). The folds also affected the granite dykes. It is likely that previous schistosity planes were transposed by S3 and behave as composite S2/S3 surface.

The last deformation phase D4 was brittle. This phase produced joints and faults present at outcrop scale in all rock types. The faults are normal dextral strike-slip faults. They indicate a NE-SW distensional movement.
The lack of the D1 imprint in the metadiorite indicates that its emplacement post-dates this deformational phase. The tectonic transposition of the D1 phase by the second phase of deformation does not allow to precise its orientation. At map scale (Figure 2), the metadiorite shows an elongated shape parallel to the orientation of the L2 lineation and to the S2 schistosity strike; this points to the syn-D2 emplacement of the magmatic body. Furthermore, the intense solid state deformation of the metadiorite and the fact that it shows the same structural characteristics as the gneiss, with respect to the D2 phase implies that the metadiorite was emplaced during the D2 deformational phase. Following D2, the metadiorite and the host gneisses experienced the same structural evolution; the distribution of S2 poles in the stereonet display, both in the metadiorite and the gneisses, regional folds with NE-SW trending axes (Figure 2). The orientation of D1 is difficult to determine; it could correspond to the N-S kinematic direction during the early Panafriican tectonic evolution which includes thrusting and shortening leading to crustal thickening (Ngako et al., 2008). The regional main strain direction during the D2 deformational phase was NE-SW as revealed by the orientation of the L2 stretching lineation. As the D3 is concerned, the major stress is orientated NW-SE, perpendicular to the regional F3 axial plane.
RESULTS

Geochemistry and \(^{207}\text{Pb}/^{206}\text{Pb}\) geochronology

Chemical data of representative metadiorite samples are presented in Table 1. SiO\(_2\) contents range from 46 to 66 wt%. In the SiO\(_2\) versus (Na\(_2\)O + K\(_2\)O) diagram (Figure 3a), the samples were scattered but are mainly plotted in the fields of diorite and quartz diorite. The Na\(_2\)O/K\(_2\)O ratio varies between 1.35 and 2.55 with the exception of samples Me1b and Me1c which show ratios of 0.20 and 0.45, respectively. The metadiorite samples define a medium- to high-K calc-alkaline suite (again with the exception of samples Meb1 and Me1c with plots in the shoshonitic field in Figure 3b). ASI (A/CNK = [Al\(_2\)O\(_3\)/(CaO+Na\(_2\)O+K\(_2\)O) mol %]) (Table 1) varies from 0.6 to 0.9, pointing to an I-type character (White and Chappell, 1977).

The studied samples showed a wide variation of trace element contents (Ni: 17-70 ppm; Cr: 66-178 ppm; Y: 22-62 ppm; Pb: 8.8-24 ppm; Rb: 40-108 ppm; Sr: 188-630 ppm; Ba: 935-1424 ppm). The K/Rb ratio is 775 for Me1b and between 201 and 374 for the other samples, and the Rb/Sr ratio was less than 0.6. Normalized trace element and REE patterns are shown in Figure 4. The samples displayed negative anomalies in Nb, Ta, and Ti and a positive anomaly in K (Figure 4a). They exhibited moderate enrichment in LREE with respect to HREE (Figure 4b): (La/Yb)\(_N\) = 9.5 – 11.3, (La/Sm)\(_N\) = 2.8-3.0, (Gd/Yb)\(_N\) = 1.9-2.1 and had moderate negative Eu anomalies (Eu/Eu* =0.80-0.83) and similar total REE concentrations (∑REE = 174-195 ppm).

Photographs and CL images of representative zircon grains of the metadiorite are shown in Figure 5a. The zircons are euhedral to subhedral in shape with euhedral oscillatory zonation and high-luminescence rims in some grains. They showed no obvious core domains and revealed many inclusions, probably of Th-rich minerals such as thorite (ThSiO\(_4\)) or thorianite [(Th,U)O\(_2\)]. The results of Pb evaporation of representative zircon grains are shown in Tables 2a and 2b. U/Th ratios varied from one grain to another and from one heating step to another. With the exception of two grains (3 and 6 of sample Me), the U/Th ratios generally increased with increasing heating temperature. In contrast, sample ZGo1 showed a decrease of the U/Th ratio in the higher heating steps. The \(^{206}\text{Pb}/^{206}\text{Pb}\) ratios were generally <0.001. The \(^{207}\text{Pb}/^{206}\text{Pb}\) ages ranged from 601.3 ± 0.8 Ma to 628.9 ± 4.7 Ma. In sample ZGo1, the \(^{207}\text{Pb}/^{206}\text{Pb}\) ages ranged from 582.1 ± 7.8 Ma to 633.2 ± 3.9 Ma. There is a good reproducibility of the \(^{207}\text{Pb}/^{206}\text{Pb}\) ages of the different heating steps, which allowed the determination of weighted mean ages of 614.1 ± 3.9 Ma (sample Me) and 619.8 ± 9.8 Ma (sample ZGo1) (Figure 5b, 5c; Table 2a, 2b).

![Figure 3a: Classification of the studied samples in the SiO\(_2\) vs K\(_2\)O diagram (Wilson, 1989).](image-url)
**Figure 3b:** Distribution of the Méiganga metadiorite samples in the $K_2O$ versus $SiO_2$ diagram with compositional domains of the different calc-alkaline series, after Rickwood (1989).

**Figure 4a:** Primordial normalised trace elements pattern for the metadiorite of Méiganga. Normalisation values are from Mc Donough et al. (1992).

**Figure 4b:** Chondrite-normalised REE pattern for the Méiganga metadiorite. Normalisation values are from Mc Donough and Sun (1995).
Figure 5a: Cathodoluminescence images of representative zircon crystals of the metadiorite (sample Me). Scale bar corresponds to 20µm.

Figure 5b and 5c: Histograms showing the distribution of radiogenic $^{207}\text{Pb}/^{206}\text{Pb}$ ratios obtained from evaporation analyses of zircons grains (5b: sample Me, 5c: sample ZGo1).

Table 1: Geochemical composition of the Méiganga metadiorite.

| Rock type | Me1    | Me1b   | Me2   | ZGo-1 | Me-1p  | Me1c  | Yob1  |
|-----------|--------|--------|-------|-------|--------|-------|-------|
| SiO$_2$   | 61.44  | 55.66  | 65.24 | 55.01 | 61.72  | 46.11 | 62.93 |
| TiO$_2$   | 0.84   | 1.07   | 0.72  | 1.04  | 0.83   | 1.85  | 0.61  |
| Al$_2$O$_3$| 16.23  | 13.44  | 15.38 | 16.36 | 16.41  | 12.47 | 14.23 |
| Fe$_2$O$_3$| 6.88   | 7.97   | 5.36  | 9.20  | 6.00   | 16.43 | 6.67  |
| MnO       | 0.12   | 0.12   | 0.103 | 0.16  | 0.11   | 0.285 | 0.115 |
| MgO       | 3.31   | 4.41   | 2.60  | 4.18  | 3.10   | 7.91  | 2.49  |
| CaO       | 5.40   | 6.35   | 4.48  | 7.75  | 5.18   | 7.85  | 6.21  |
| Na$_2$O   | 3.54   | 1.40   | 3.57  | 3.69  | 3.57   | 1.40  | 3.78  |
| K$_2$O    | 2.60   | 6.92   | 2.27  | 1.45  | 2.33   | 3.13  | 2.10  |
| P$_2$O$_5$| 0.25   | 2.09   | 0.192 | 0.23  | 0.24   | 0.537 | 0.688 |
| LOI       | 0.51   | 0.73   | 0.41  | 0.42  | 0.70   | 0.86  | 0.43  |
| Sum       | 101.16 | 101.21 | 100.56| 99.66 | 100.42 | 99.12 | 100.65|
| Na$_2$O+K$_2$O| 6.14  | 8.32   | 5.84  | 5.14  | 5.90   | 4.53  | 5.88  |
| Na$_2$O/K$_2$O| 1.36  | 0.20   | 1.57  | 2.54  | 1.54   | 0.45  | 1.80  |
| A/CNK     | 0.9    | 0.6    | 0.9   | 0.8   | 0.9    | 0.6   | 0.7   |

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| Element | Mg# | 0.50 | 0.52 | 0.49 | 0.47 | 0.51 | 0.90 | 0.87 |
|---------|-----|------|------|------|------|------|------|------|
| Ba      | 966 | 1012 | 936  | 447  | 1009 | 935  | 1424 |
| Co      | 21.2| 41.3 | 15.7 | 28.1 | 18.7 | 44.6 | 58.9 |
| Cr      | 81.8| 162.1| 126.4| 163.0| 65.8 | 177.7| 124.4|
| Ni      | 30.1| 70.0 | 54.0 | 44.7 | 17.3 | 56.1 | 60.9 |
| Rb      | 77.74| 74.06| 93.5 | 39.7 | 75.3 | 107.50| 46.70|
| Sr      | 556 | 513  | 469  | 313  | 576  | 187  | 630  |
| V       | 135.5| 138.1| 104.0| 215.2| 118.2| 347.6| 97.3 |
| Y       | 22.9| 21.8 | 23.6 | 30.9 | 22.0 | 61.8 | 29.1 |
| Zn      | 90.1| 94.7 | 64.1 | 110.3| 73.9 | 208.7| 73.2 |
| Zr      | 237 | 189  | 172  | 108  | 189  | 265  | 323  |
| K       | 21574| 57426| 18859| 12044| 19308| 25965| 17465|
| La      | 34.01| 28.66| 37.90| 45.0 | 48.4 | 42.0 | 102.6|
| Ce      | 71.81| 62.42| 59.0 | 77.9 | 91.4 | 124.6| 198.6|
| Pr      | 8.58 | 7.67 |      |      |      |      |      |
| Nd      | 33.38| 30.47| 30.6 | 38.2 | 42.1 | 72.1 | 71.5 |
| Sm      | 6.60 | 6.03 | 6.0  | 6.5  | 7.3  | 10.6 | 11.3 |
| Eu      | 1.61 | 1.53 | 1.4  | 1.4  | 1.8  | 1.6  | 2.2  |
| Gd      | 5.26 | 4.91 |      |      |      |      |      |
| Tb      | 0.77 | 0.71 |      |      |      |      |      |
| Dy      | 4.27 | 4.01 |      |      |      |      |      |
| Ho      | 0.79 | 0.75 |      |      |      |      |      |
| Er      | 2.18 | 2.11 |      |      |      |      |      |
| Tm      | 0.31 | 0.31 |      |      |      |      |      |
| Yb      | 2.05 | 2.04 | 2    | 2.9  | 1.8  | 5.5  | 2.2  |
| Lu      | 0.30 | 0.31 |      |      |      |      |      |
| Hf      | 6.03 | 4.81 |      |      |      |      |      |
| Ta      | 0.60 | 0.71 |      |      |      |      |      |
| W       | 7.36 | 185.3|      |      |      |      |      |
| Pb      | 19.05| 14.69| 23.7 | 15.8 | 8.8  | 12.2 | 20.2 |
| Th      | 2.22 | 1.11 | 7    | 4.3  | 6.3  | 0.9  | 15.8 |
| U       | 0.57 | 0.17 | b.d.l.*| b.d.l.| b.d.l. | b.d.l. | 1    |
| Nb      | 9.75 | 8.93 | b.d.l.| b.d.l.| b.d.l.| b.d.l.| 32.5 | 37.6 |
| Be      | 2.22 | 2.07 |      |      |      |      |      |
| Cs      | 1.27 | 0.79 |      |      |      |      |      |
| Cu      | 14.32| 44.96|      |      |      |      |      |
| Ga      | 22.59| 21.3 |      |      |      |      |      |
| Ge      | 1.5  | 1.41 |      |      |      |      |      |
| Mo      | b.d.l.| 1.19 |      |      |      |      |      |
| Sn      | 2.11 | 2.21 |      |      |      |      |      |
| ΣREE    | 194.89| 173.79|      |      |      |      |      |
| K/Rb    | 277 | 775  | 202  | 303  | 256  | 241  | 374  |
| Rb/Sr   | 0.14 | 0.14 | 0.20 | 0.13 | 0.13 | 0.57 | 0.07 |
| Th/U    | 3.88 | 6.49 |      | 5.73 | 15.8 |
| Sr/Y    | 24.23| 23.50| 19.89| 10.14| 26.19| 3.03 | 21.64|
| Lu<sub>b</sub>/Yb<sub>N</sub> | 11.28| 9.54 |      |      | 5.19 | 31.68|
| Eu/Eu*  | 0.80 | 0.83 |      |      |      |      |      |

* below detection limit
### Table 2a: Zircon evaporation data including radiogenic $^{207}\text{Pb} / ^{206}\text{Pb}$ ratios and corresponding ages for sample Me.

| Sample and zircon n° (a,b) = Temp. step | Evap. temp °C | No of ratios | U/Th* ratio | $^{206}\text{Pb} / ^{208}\text{Pb}$ ratio | $^{204}\text{Pb} / ^{206}\text{Pb}$ ratio | $^{207}\text{Pb} / ^{206}\text{Pb}$ ratio | $^{207}\text{Pb} / ^{206}\text{Pb}$ age (Ma) 2σ error |
|----------------------------------------|--------------|--------------|-------------|------------------------------------------|------------------------------------------|------------------------------------------|--------------------------------------------------|
| Me-1a                                  | 1400         | 187          | 1.11        | 3.58                                     | 0.000049                                 | 0.060406 ± 048                           | 618.2 ± 1.6                                      |
| Me-1b                                  | 1420         | 139          | 1.55        | 4.98                                     | 0.000029                                 | 0.060394 ± 053                           | 617.8 ± 1.9                                      |
| Me-2a                                  | 1420         | 140          | 2.32        | 8.25                                     | 0.000372                                 | 0.060594 ± 101                           | 624.9 ± 3.6                                      |
| Me-3a                                  | 1400         | 126          | 2.44        | 7.98                                     | 0.000072                                 | 0.059935 ± 023                           | 601.3 ± 0.8                                      |
| Me-3b                                  | 1420         | 188          | 1.88        | 6.10                                     | 0.000054                                 | 0.060223 ± 043                           | 611.7 ± 1.6                                      |
| Me-4a                                  | 1400         | 148          | 1.90        | 6.12                                     | 0.000049                                 | 0.060240 ± 040                           | 612.2 ± 1.4                                      |
| Me-4b                                  | 1420         | 185          | 1.92        | 6.60                                     | 0.000319                                 | 0.060193 ± 042                           | 610.6 ± 1.5                                      |
| Me-5a                                  | 1380         | 100          | 2.01        | 6.57                                     | 0.000076                                 | 0.060706 ± 654                           | 628.9 ± 4.7                                      |
| Me-6a                                  | 1380         | 118          | 1.82        | 5.91                                     | 0.000073                                 | 0.060155 ± 071                           | 609.2 ± 2.6                                      |
| Me-6b                                  | 1420         | 223          | 1.78        | 5.88                                     | 0.000156                                 | 0.060265 ± 054                           | 613.1 ± 1.9                                      |

Mean 1a, 1b, 2a, 3b, 4a, 4b, 5a, 6a, 6b.  

$^*$calculated

$\text{MSWD} = 0.53; \text{Probability} = 0.85$  

$614.1 ± 3.9$
Table 2b: Zircon evaporation data including radiogenic $^{207}\text{Pb}/^{206}\text{Pb}$ ratios and corresponding ages for sample ZGo1.

| Sample and zircon number (a,b,c = Temp. step) | Evap. temp °C | No of ratios | U/Th* ratio | $^{206}\text{Pb}/^{208}\text{Pb}$ ratio | $^{204}\text{Pb}/^{206}\text{Pb}$ ratio | $^{207}\text{Pb}/^{206}\text{Pb}$ ratio | $^{207}\text{Pb}/^{206}\text{Pb}$ age (Ma) | 2σ error |
|---------------------------------------------|--------------|-------------|--------------|-----------------------------------|-----------------------------------|----------------------------------|-------------------------------|----------|
| ZGo1-2a                                     | 1380         | 105         | 1.57         | 5.13                              | 0.000115                          | 0.060297 ± 161                   | 614.3 ± 5.8                |
| ZGo1-2b                                     | 1400         | 112         | 1.53         | 4.92                              | 0.000040                          | 0.060519 ± 084                   | 622.3 ± 3.0                 |
| Zgo1-2c                                     | 1420         | 108         | 1.45         | 4.69                              | 0.000040                          | 0.060643 ± 130                   | 626.6 ± 4.6                 |
| ZGo1-3a                                     | 1410         | 114         | 1.59         | 5.20                              | 0.000115                          | 0.059406 ± 210                   | 582.1 ± 7.8                 |
| ZGo1-3b                                     | 1430         | 100         | 1.42         | 4.61                              | 0.000115                          | 0.059465 ± 205                   | 584.2 ± 7.6                 |
| ZGo1-4a                                     | 1400         | 112         | 1.55         | 5.17                              | 0.000235                          | 0.060429 ± 151                   | 619.0 ± 5.4                 |
| ZGo1-4b                                     | 1420         | 109         | 1.45         | 4.69                              | 0.000071                          | 0.060828 ± 109                   | 633.2 ± 3.9                 |
| ZGo1-4c                                     | 1440         | 107         | 1.50         | 4.87                              | 0.000088                          | 0.060477 ± 133                   | 620.7 ± 4.8                 |
| ZGo1-5a                                     | 1400         | 70          | 1.16         | 3.75                              | 0.000073                          | 0.060657 ± 226                   | 627.1 ± 8.1                 |
| **Mean**                                    |              |             |              |                                   |                                   | **937**                          | **MSWD = 0.87; Probability = 0.54** | **619.8 ± 9.8** |

*a calculated
DISCUSSION

Implications from geochemistry

The studied samples displayed chemical characteristics of medium-K calc-alkaline to shoshonitic granitoids and possessed I-type features as defined by Chappell and White (1974) and Chappell and Stephens (1988). They have a very weak anomaly negative Eu due to minor fractionation of plagioclase or to the fact that the parental magma of the diorite was in equilibrium with a plagioclase-bearing mantle source. The heavy-REE concentration of 10 to 20 times chondritic shows that garnet was absent from the original source. The negative anomalies in Nb, Ta, Ti and positive anomaly in K reflect geochemical source characteristics of the metadiorite protolith and provide evidence for the contribution of continental crustal material to the magma source (Taylor and McLennan, 1985; Barbarin, 1999). Negative Nb-Ta-Ti anomalies attest a subduction zone environment in which this crust was formed originally but these geochemical features are often retained during crustal reprocessing and can also be found in collisional-type granitoids (Pearce et al., 1984).

The syn-D2 emplacement and the $^{207}$Pb/$^{206}$Pb ages indicate that this pluton dates the D2 deformation phase. The D2 event is thus interpreted to have occurred between 619 ± 9.8 Ma and 614 ± 3.9 Ma in the Méganga region.

Regional timing of the D2 deformation event

D2 deformation and coeval magmatism in the Panafrian fold belt in Cameroon was dated at 600-580 Ma by Toteu et al. (1987, 2001). The Méganga metadiorite gives similar older ages within the error limit to the ages obtained for granites from eastern Cameroon (614 ± 41 Ma and 621 ± 15 Ma, Rb-Sr whole-rock isochron: Soba et al., 1991). A similar age of 615 ± 27 Ma (U-Th-Pb monazite) has been obtained for a biotite muscovite granite in the north of Ngaoundéré which was syn- to late-tectonically emplaced relative to D2 (Tchameni et al., 2006). Syntectonic D2 granitoids in Tibati area, 300 km west of Méganga, yield a U–Pb zircon age of 620 ± 30 Ma (Nzenti et al., 2006). Syn-D2 granitoids of western Cameroon were dated at 609-557 Ma (Kwékam et al., 2010; Ngiessi-Tchankam et al., 1994, 1997; Talla, 1995; Tagne-Kamga, 2003). This age is close to that of the syn-D3 granites dated at 601-558 Ma in the Méganga area (Ganwa, 2005). All these rocks are characterized by discrete magmatic foliation and weak solid-state deformation, as opposed to the Méganga metadiorite which shows the same penetrative solid-state deformation as the host gneisses. Nevertheless, we cannot completely rule out that granitoids of different age were generated in response to the same regional tectonomagmatic process. The D2 event could have started earlier in the Méganga and Tibati areas and might have progressed south-westward to the western Cameroon area. Such scenario would be in line with the collision model of Ngako et al. (2008) in which the Saharan rigid prong penetrated into the São Francisco–Congo Craton between 640 and 580 Ma and generated intense deformation in northwestern Cameroon. In this case, the D2 deformational phase was diachronic in the Adamawa-Yade Domain of the CAFB. Diachronism in the tectonomagmatic event has been also demonstrated in the Macururé Domain of the Serigrano Belt (Bueno et al., 2009) in the Borborema Province (NE Brazil). Such similarities suggest that NE Brazil and Central Africa underwent the same tectonomagmatic history during the Neoproterozoic era.

ACKNOWLEDGEMENTS

The German Academic Exchange Service (DAAD) is highly acknowledged for supporting the research stay of the first author (GAA) at the University of Tübingen (Germany). The anonymous reviewers are thanked for their constructive remarks.
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