Journal of Geosciences and Geomatics, 2022, Vol. 10, No. 3, 139-152
Available online at http://pubs.sciepub.com/jgg/10/3/3
Published by Science and Education Publishing
DOI:10.12691/jgg-10-3-3

The Birimian Granitoids of the Toumodi-Fetekro Belt in West African Craton (Côte d'Ivoire): Petrogenetic Overview and Link to Mineralization

T. K. Lionel-Dimitri Boya[1,*], Martial P. K. Adingra[1], Allou Gnanzou[1], Gbele Ouattara[2], Apo Ryana L. Diane[1], Yacouba Coulibaly[1]

[1]Geology, Mineral and Energy Resources Laboratory, Training and Research Unit in Earth Sciences and Mineral Ressources, Félix HOUPHOUËT-BOIGNY University, Abidjan, Côte d'Ivoire
[2]Department of Earth Sciences and Mineral Resources, School of Mines and Geology, National Polytechnic Institute HOUPHOUËT- BOIGNY, INP Sud BP 1093 Yamoussoukro, Côte d'Ivoire
*Corresponding author: lionelboya2000@yahoo.fr

Received September 01, 2022; Revised October 02, 2022; Accepted October 10, 2022

Abstract The Toumodi-Fètêkro belt in Côte d'Ivoire is a one of its greenstone belts which has given rise to several mines in operation, with research or development work still in progress. This study based on a compilation of existing data acquired in different sectors, aims to contribute to the improvement of knowledge on the granitoids of this area. The geochemical data have therefore been reprocessed with a view to a global interpretation of the entire belt. Terranes are formed by granodiorites, granites, granophyres and tonalites with granodiorite and granophyres like host rocks. The peraluminous and metaluminous nature of magma shows that the granitoids come from mantle and crustal sources, with type I and S granites. The main anomalies noted indicate for these granitoids a character typical of volcanic arc magmas, an enrichment in K, or even a continental source. The deposits known in the Toumodi-Fètêkro belt are linked to several hydrothermal alterations. The control of the mineralization is litho-stuctural, with hydrothermalism being of major importance.

Keywords: *petrogenetic synthesis, birimian granitoids, mineralization, Toumodi-Fetekro, Côte d'Ivoire*

Cite This Article: T. K. Lionel-Dimitri Boya, Martial P. K. Adingra, Allou Gnanzou, Gbele Ouattara, Apo Ryana L. Diane, and Yacouba Coulibaly, "The Birimian Granitoids of the Toumodi-Fetekro Belt in West African Craton (Côte d'Ivoire): Petrogenetic Overview and Link to Mineralization." *Journal of Geosciences and Geomatics*, vol. 10, no. 3 (2022): 139-152. doi: 10.12691/jgg-10-3-3.

1. Introduction

Côte d'Ivoire belongs to the West African craton, precisely to the Man ridge. It is mostly constituted by a metamorphosed Precambrian basement, containing formations of lower Proterozoic age, known as birimian formations. These birimian formations contain deformed and elongated volcanosedimentary terrains, forming grooves or belts of greenstone, sometimes intruded by basin-type or belt-type granitoids. The Birimian formations are from Lower Proterozoic age, dated between 2150 and 1600 million years (Ma) [1-5].

These formations are structured in the form of rock belts of which 17 are counted in Côte d'Ivoire ; they have the particularity of containing a large number of mineral substances of which gold is the most sought after. The Toumodi-Fètêkro belt, our study area, has been the subject of several studies, in particular some authors [6-10] who describe several lithologies. This paper will be particularly interested in the granitoids of this belt which often constitute the host rocks of mineralization. What are the petro-geochemical characteristics of the granitoids of the Toumodi-Fètêkro belt and what may be their link with mineralization?

The general objective of this study is to contribute to the improvement of knowledge on the geology of the Toumodi-Fètêkro Birimian belt. The specific objectives are to establish a petrographic synthesis of the granitoids, to carry out a comparative geochemical characterization; and highlight their relationship with the mineralization.

2. Geological Context

Côte d'Ivoire is located in the southern part of the West African Craton and in the southern part of the Man-Leo ridge (Figure 1). The territory has two geological units, a Precambrian basement that constitutes 97.5% of its territory and a sedimentary basin of 2.5%. The Precambrian basement is subdivided into two domains: the Kénéma-Man domain, which is located west of the Sassandra fault, where the geological formations are of Archean age, and the Baoulé-Mossi domain, which is located east of the Sassandra fault and is characterized by formations of Proterozoic age. The

Kénéma-Man domain constitutes 20% of the basement and is formed of grey tonalitic and trondhjemitic gneisses, charnockites, metamorphosed green rocks in granulite facies, magnetite banded quartzites and biotite migmatites [11,12]; the Paleoproterozoic domain is characterized by the presence of volcanosedimentary rocks intercalated between granitoid batholiths. The structures of this domain result from tangential tectonics at the origin of N-S to NNE-SSW oriented structures [13] and transcurrent deformation, which is marked by the emplacement of large granitoid complexes around 2.1 Ga [14,15]. 17 ivorian greenstone belts are found in this domain, including the Toumodi-Fètêkro.

This belt is located in Côte d'Ivoire and extends from south to north over an area of about 4908 km² and passes through the towns of Dabakala, Toumodi and Divo. The Toumodi-Fètêkro belt has within it birimian formations that contain deformed and elongated volcanosedimentary terrains, sometimes intruded by basin-type or belt-type granitoids (Figure 2).

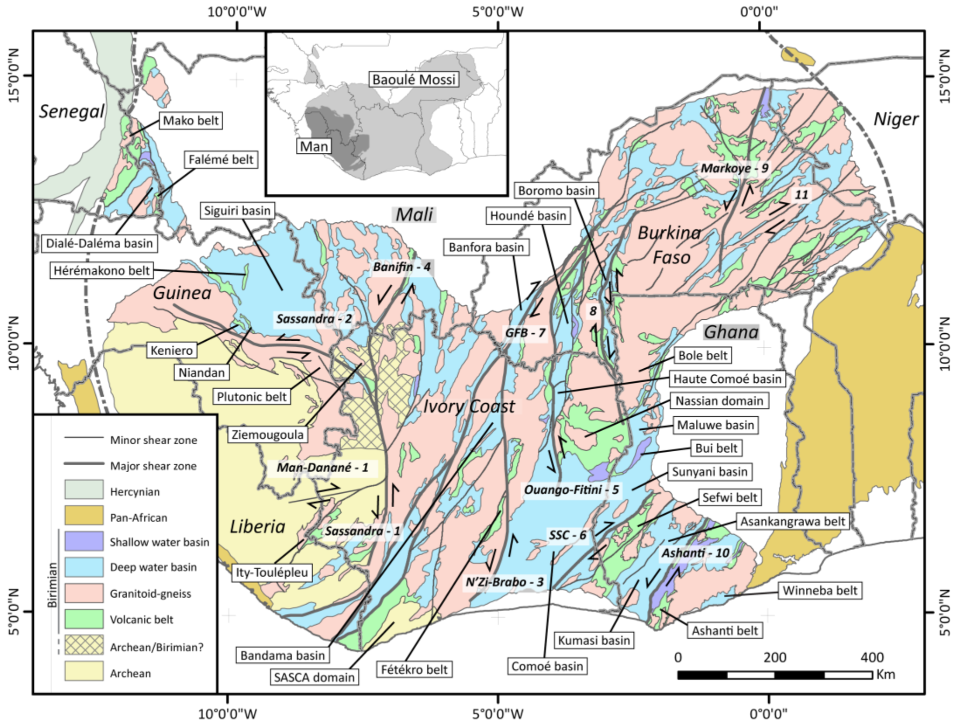

Figure 1. Schematic geological map of the Man-Leo Ridge, Kedougou-Kéniéba (KKI) and Kayes (KI) inliers [16]

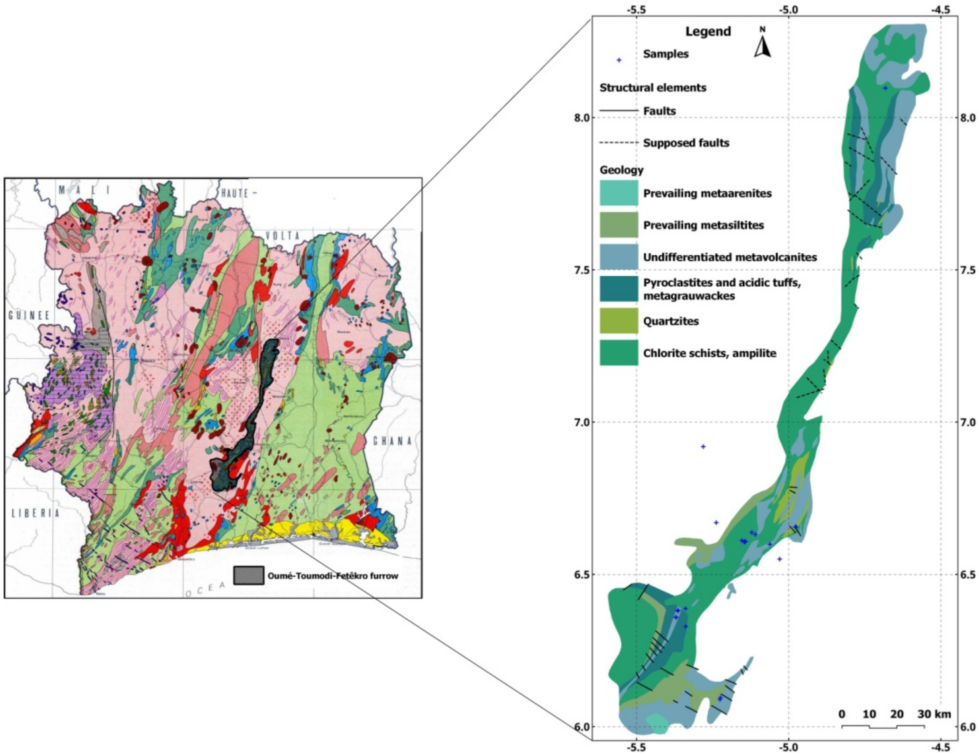

Figure 2. Location in Côte d'Ivoire and geological map of the Toumodi-Fètêkro belt (extract from geological map of Côte d'Ivoire to 1/4000000)

3. Analytical Methods

The petrographic data were collected by previous authors from the preparation of thin sections of rock and their observation under a polarizing to identify the main minerals and the nature of the rock. The rock samples, transported to the analysis laboratory, were crushed and then pulverized before the analysis of their content in major elements by the X-ray fluorescence spectrometer, and in trace and rare earths elements by the inductively coupled plasma mass spectrometer (ICP-MS). In view of a global approach on the entire belt, we processed all the geochemical data (58 samples from south, center and north) using various diagrams: (i) $Na_2O + K_2O$ (wt %) versus SiO_2 (wt %) classification diagram [17] to determine the nomenclature of granitoids, (ii) the discrimination diagram [18] to determine the type of granite (I or S) and the aluminous nature of the different granitoids, (iii) K_2O versus SiO_2 diagram [19] to determine the magmatic lineages or series of the granitoids studied and the particular tectonic environment of the setting up of the magma, and (iv) the multi-elements diagrams normalized to the primitive mantle to study the behavior and mobility of elements in the fusion liquid..

4. Results

4.1. Petrographic Data

The granitoids found in the belt are composed of granodiorites, granophyres, granites, tonalites, and microgranodiorites.

The granite, observed at Dougbafla, Toumodi and Bobosso is a leucocratic grainy rock, rich in plagioclase, quartz and microcline, with incidental muscovite, biotite and chlorite minerals as well as oxides. There is pseudomorphism of feldspars into epidote, sericite and carbonates [10]. The Dougbafla granite remains less widespread, with biotite often altering to chlorite, and accessory minerals such as apatite [9].

Granophyre, observed at Dougbafla, is a massive, leucocratic, fine-grained porphyry micrograin rock. It consists of phenocrysts of plagioclase, quartz, albite, muscovite and biotite. The accessory minerals are orthoclase, epidote and the metalliferous paragenesis is composed of magnetite, hematite, pyrite, arsenopyrite and pyrrhotite often accompanying gold

The tonalite, observed at Dougbafla, is a massive and grainy rock. It is composed mainly of plagioclase feldspars, quartz in various forms (micro-grains to macro-grains), calcite and biotite. The accessory minerals are apatite, chlorite and epidote.

Granodiorite, observed at Bonikro, Dougbafla, Toumodi and Bobosso is a massive grainy to grainy porphyritic, mesocratic rock, composed of very abundant plagioclase and/or microcline feldspars, quartz, amphibole, biotite, chlorite, sericite, epidote, albite and sphene. The presence of ferro-titanium oxides was noted [10].

Microgranodiorite, observed Dougbafla and Bobosso, is a massive homogeneous, mesocratic, micrograined rock, characterized by abundant phenocrysts of quartz in aggregates, orthoclase and plagioclase, biotite as well as chlorites, accompanied by sphene.

4.2. Geochemical Data

The results of the geochemical data are presented in the appendix. The geochemical studies have highlighted in the analyzed granitoid samples, relatively low contents of alkalis (Na_2O+K_2O) varying between 2.81% and 8.75%.

It has been noted too a diversity of compositions in these formations: mostly tonalitic, granodioritic and granitic, with some samples from the Center with quartz monzonitic composition and just only one sample from the South having a monzonitic composition (Figure 3). Moreover, three magmatic lines were highlighted: tholeic, calc-alkaline and shoshonite, with calk-alkaline dominance (Figure 4).

The granitoids in south, center and north of the belt are predominantly I type (Figure 5). Only 3 samples in south from Dougbafla and 2 samples each from center and north are S type granite. S type granitoids show that the magma is derived from the melting of sediments while type I granitoids are derived from the melting of a crystalline rock from the mantle.

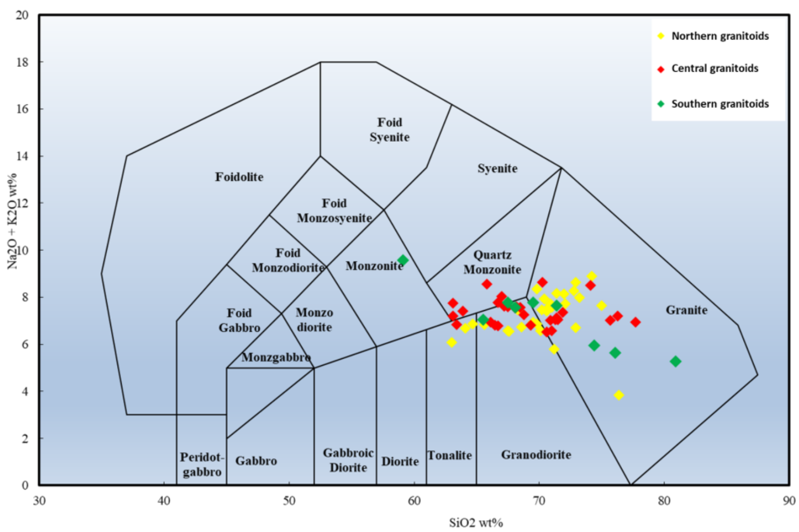

Figure 3. Na_2O+K_2O (wt %) versus SiO_2 (wt %) classification diagram [17] applied to Toumodi-Fètêkro belt granitoids

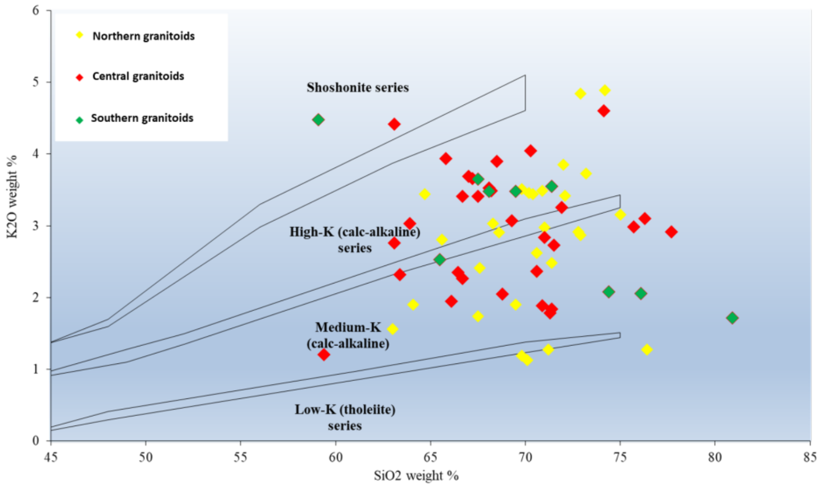

Figure 4. K_2O versus SiO_2 diagram [19] to the Toumodi-Fètêkro belt granitoids

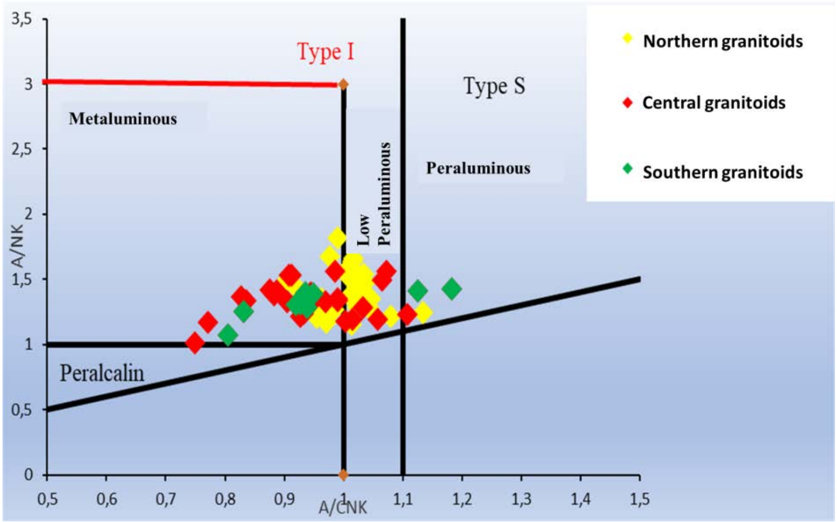

Figure 5. Discrimination diagram [18] applied to the granitoids of the Toumodi-Fètêkro belt

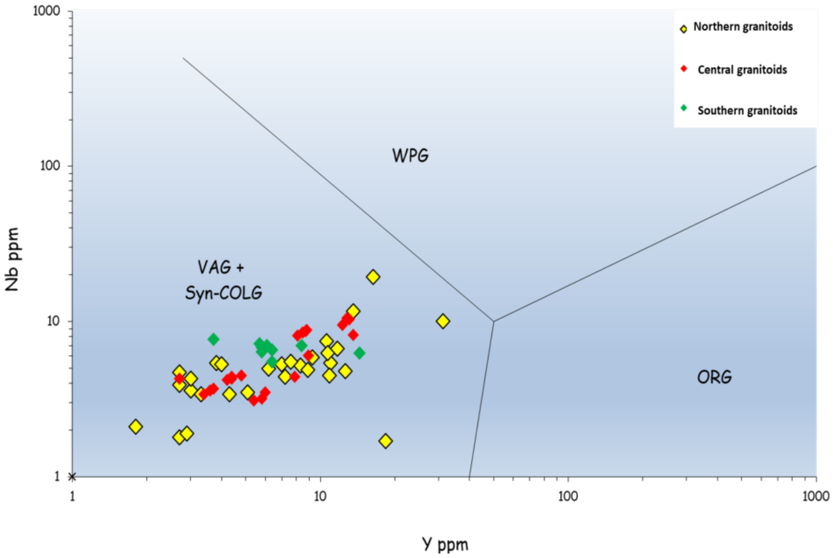

Figure 6. Trace elements discrimination diagram [20] Nb versus Y applied to granitoids

In south, center and north of the belt, the granitoids are peraluminous to meta-aluminous in composition (Figure 5), suggesting that the magmas that produced the protoliths are hybrid. These granitoids would thus come from crustal and mantle sources.

The Nb versus Y diagram [20] was used to investigate the geotectonic environment of the rocks (Figure 6). Because of their low Y content, all granitoids are found in the volcanic arc granite (VAG) fields and also fall within the syn-collisional granite (Syn-COLG) domain.

Multi-element spectra of the southern and central granitoids show negative anomalies in K, P and Ti while positive anomalies in Pb (which is a mobile element) are well marked in the northern granitoids and in U throughout the belt (Figure 7). Negative Nb and Th anomalies are found in south and center, and a negative Sr anomaly.

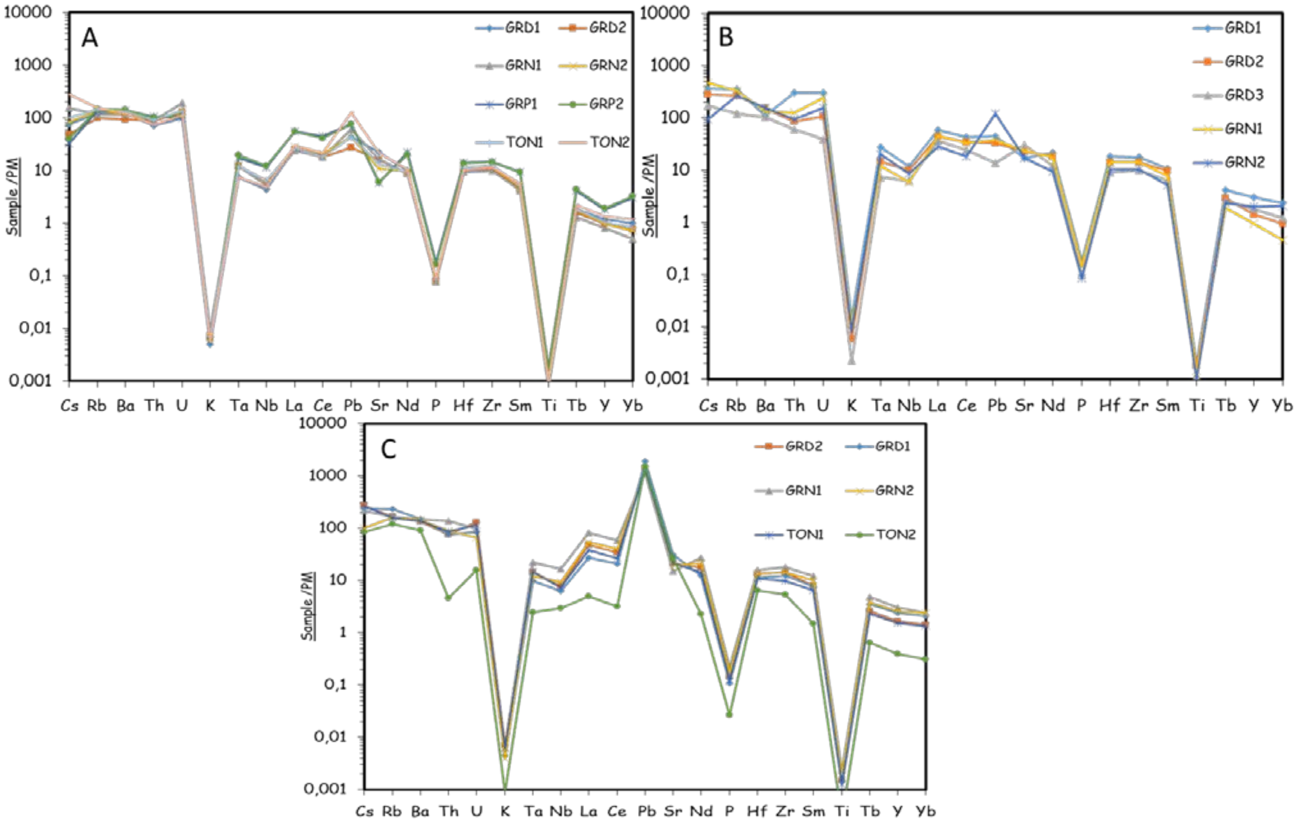

Figure 7. Multi-element spectra normalized to the primitive mantle applied to the granitoids (plutonites) of Toumodi-Fètêkro belt (A: southern part, B : central part, C : norther part)

Table 1. Summary of data on the various deposits in the Toumodi-Fètêkro belt

Deposit and Location	Type of mineralization and association	Alteration (type and nature)	Structures	Host rocks	Gold paragenesis	Control factor
South: **Agbahou deposit**	Vein type associated with quartz veins Hydrothermal	Hydrothermal: carbonation; sericitization; silicification; sulfudation, chloritization.	Shear (Shear corridor and schistosity N040-50 SE)	Basalt-andesite contact and pyroclastic unit intersected by basic sills and acid dykes	Calcite and pyrite	Structural
South: **Bonikro deposit**	Disseminated by the distribution of sulfides in silicates Vein associated with sheeted, planar and transverse veins	Hydrothermal: sericitization; albitization; silicification and hematization	Schistosities, foliations and boudins of similar directions a folding	Granodioritic intrusive	Molybdenite, scheelite, pyrite, tetradymite and sulfotellurides	Lithological Structural pervasive
Center-West: **Dougbafla-Bandama deposit**	Disseminated in sulfides Filonian associated with quartz veins in sheets	Hydrothermal: carbonation, sulfudation, hematization	Shear (of shear corridors N030 N035)	Felsic intrusives (granophyres N 45 and granodiorites)	Hematite, dolomite and pyrite	Lithological Structural
North: **Bobosso deposit**	Carbonation; Sericitization; silicification ±calcite ±tourmaline	Hydrothermal (Pervasive): carbonation; sericitization, chloritization	Shear with structures (fractures; faults) Schistosity N044	Andesitic-basaltic rocks and lapilli tuffs intruded by series of banded granitoids (microgranite and microgranodiorite)	Pyrite chalcopyrite pyrrhotite and iron sulfides	Structural
North : **Lafigué deposit**	Disseminated associated with hydrothermal Alteration veinlets associated with quartz-carbonate veins ± tourmaline ±sulfides ±visible gold	Hydrothermal : carbonation; sericitization; silicification, biotization and disseminated sulfides	Shear-zone ENE-WSW Shear N70	Granodiorite, gabbro and basalt	Pyrrhotite, arsénopyrite and pyrite	Structural

4.3. Mineralization

The prospects of all Toumodi-Fètêkro belt have hydrothermal alteration that has led to significant deposits. Most of these deposits are either hosted by granitoids, mainly granodiorites, or intruded by granitoids (plutonic or volcanic rocks). They are controlled by lithology or tectonics and have practically the same accompanying minerals (sulphides, calcite, hematite, pyrrhotite, arsenopyrite, chalcopyrite, dolomite and pyrite) except for the Bonikro deposit, whose gold-bearing paragenesis is composed of molybdenite, scheelite, tetradymite and sulphotellurides The 5 major deposits encountered in the belt are Agbahou, Bonikro, Dougbafla-Bandama, Bobosso and Lafigué from south to north, 4 of which (Bobosso excepted) led to mines in operation or under construction.

5. Discussion

Petrographic work carried out in the Toumodi-Fètêkro belt reveals a diversity of granitoids, especially in the center of the belt. They consist of granites, granodiorites and porphyroid granodiorites. Some first works [8] are confirmed by most recents studies [10] which described practically the same rocks in both the south and the center of the sillon. It has been noted an abundance of granite, granodiorite, porphyroid microgranite, granophyre and tonalite for granitoids in the northern part of the belt, in the Dabakala area and in its southern part, in the Oumé area located on the belt. In the northern part, some older studies [21] reported plutonic rocks, intrusive, discordant or concordant granodiorites and synkinematic granites sometimes with two micas. The Agbahou formations are composed of three lithological sets: volcanoplutonites, pyroclastites and metasediments, and discordant acid lava intrusions [6]. According to that, the first two sets would form the greenstone belt of the Oumé-Fètêkro chain, also known as Toumodi-Fètêkro belt.

Geochemical data show a diversity of compositions for the granitoids of Toumodi-Fètêkro furrow. Indeed, these formations are mostly granitic in composition, we could observe tonalitic, granodioritic with some quartz monzonitic sample compositions and a single sample of monzonitic composition in the South. This quartz monzonitic and monzonitic composition hadn't been described in Bonikro [8], where granitoids are of three compositions, i.e. granitic, granodioritic and tonalitic. This work highlighted the monzonitic composition in southern part.

Three magmatic lineages were identified: *(i)* the calc-alkaline lineage observed in the majority of the granitoids, *(ii)* the shoshonitic lineage observed only in two samples, one from southern part and the other from central part, *(iii)* the tholeiitic lineage where are from four Dabakala samples and a sample from southern part. These results allow us to affirm that these granitoids would come from the same calc-alkaline magmatic lineage as the other granitoid samples.

These characteristics have already been reported for the granitoids of the Dabakala area in the north of the sillon and the Oumé-Hiré area in the south of the sillon. Indeed, the latter are all metaluminous to peraluminous, suggesting a hybrid source for these granitoids. This is what some works [7,9] have emphasized by evoking a dual origin (crustal and mantle) in the genesis of the granitoids.

Geochemical data also show that granitoids are derived from two geotectonic environments. Indeed, granitoids characterize both volcanic and syn-collisional arc environments, indicating their mantle sources with crustal components. This is consistent with a study [20] which states that granitoids in volcanic arcs have depleted mantle sources modified by a component of subducted oceanic crust and sediments and syn-collisional granitoids are characterized by pure crustal sources or by mantle sources containing large subducted crustal components

Excepted some rare samples which present a few differences in anomalies tendance, almost all granitoids in the Toumodi-Fètêkro belt are characterized by a positive zirconium anomaly, indicating a continental source [22]. Furthermore, the negative Nb anomalies are typical of subduction zone magmas [23]. Multi-element spectra normalized to the early mantle showed almost similar profiles in the south and center, slightly different from those in the northern part of the belt. Negative P and Ti anomalies are specifically noted in each part of the furrow, implying crystallization of apatite, ilmenite and titaniferous minerals in the melt, respectively. This also indicates crustal contamination in a mantle source, with potassium enrichment in these different rocks [24], expressed by the negative K anomaly. In addition, spider diagrams show positive Pb anomalies; Pb being a mobile element, it is taken up in the melt due to magmatic differentiation and radioactive decay of U to Pb. The negative Sr anomalies observed can be assimilated to a source change/modification or to the splitting of a phase [25]. The well-marked negative Th anomaly to the south and center of the furrow marks a lithological differentiation that may be of mining interest and potentially indicate the presence of ancient alterites (paleo laterites, [26]). Rare earths highlight differences between granitoids of the belt, a significant fractionation of rare earths in the Dabakala granitoids in the north has been noted while those of the southern and central granitoids is relatively low

Mineralization in all the deposits of the Toumodi-Fètêkro furrow is controlled by shear generating large shear corridors oriented along the birimian direction (N030-N035 and N040-50 SE). This induces hydrothermal fluids causing hydrothermal alteration with accompanying minerals mainly pyrite, pyrrhotite, arsenopyrite, chalcopyrite and sulfotellurides. Thus, mineralization seems to be associated with structural control.

Granitoids are represented throughout the Toumodi-Fètêkro belt, with some lithological variability. From one area to another, similarities have been noted, materialized among others by the presence of granodiorite and microgranite in the south, center and north of the belt. Differences were also noted, materialized by certain rocks observed only in certain zones; this is the case of granophyre observed to the north and south of the belt.

The presence of granitoids closely related to the mineralization has been noted: these are granodiorites, microgranodiorites and granophyres [7,8]. They are either in contact with the mineralized rock or in intrusion and carrying the mineralization themselves. Only the Agbahou deposit showed no apparent link with a granitoid [6]. This work has shown that granitoids are likely to contain significant mineralization; they can control mineralization and host an immense deposit. In the Toumodi-Fètêkro belt, several rocks are encountered, as in other Ivorian belts, but few have granitoids as host rocks or whose mineralization is controlled by granitoids.

This synthetic study shows a particularity of certain granitoids in the Toumodi-Fètêkro belt: they present a potential for gold mineralization, contrary to those of other Ivorian or West African birimic belt. The examples of deposits in the Mana district of Burkina Faso clearly shows that the host rocks for the mineralization are birimian greenstone belts and basaltic rocks, as well as those of Yaho (Houndé birimian belt) or the deposits.

6. Conclusion

At the end of this study on the granitoids of the Toumodi-Fètèkro belt, it appears that the granitoids contained in the whole belt have mostly similar characteristics, with some exceptions.

At the petrographic level, we can mention plutonic rocks (granodiorites, granites, tonalites) and vein rocks (microgranites and microgranodiorites).

A similarity can be seen between all the lithologies of the belt. The studied granitoids are peraluminous and metaluminous and come from two sources, namely mantle and crustal, with calc-alkaline to tholeic and shoshonitic affinities. They present a variability in their compositions: tonalitic, monzonitic, granitic and granodioritic. They are in the typical context of volcanic arc magmas and syn-collisional with two types of granites S and I.

The Nb, Ti and P anomalies show that these rocks are typical of volcanic arc magmas and indicate the crystallization of titaniferous minerals in the melt, a crustal contamination in a mantle source. Positive Pb anomaly indicates magmatic differentiation and radioactive decay of U to Pb and positive K anomalies indicate potassium enrichment. The zirconium anomaly highlights a continental source for granitoïds in the furrow, while Th anomaly indicates a mining interest and the presence of ancient alteration (paleo laterites).

At the level of mineralization, we have as host-rocks granodiorites and granophyres, then felsic intrusives which are in contact with basic materia. They are affected by deformations which favour the circulation of hydrothermal fluids with minerals such as chalcopyrite, pyrrhotite, arsenopyrite, hematite, dolomite and mainly pyrite.

Acknowledgements

We would like to thank the various collaborators who provided the data and assisted us in addressing our scientific concerns.

References

[1] Abouchami, W., Boher, M., Michard, A. and Albarede, F. *A major 2.1 Ga old event of mafic magmatism in West Africa: An early stage of crustal accretion*. J. Geophys. Res., Lett. Vol. 95 (1990). 17605-17629.

[2] Boher, M. *Croissance crustale en Afrique de l'Ouest à 2,1 Ga. Apport de la Géochimie isotopique*. Doctorat, Univ. Nancy I (1991), 180 p.

[3] Taylor, P.N., Moorbath, S., Leube, A. and Hirdes, W. *Early Proterozoic crustal evolution in tehe Birimian of Ghana: constraints from geochronology and isotope geochemistry*. Precambrian Res., 56 (1992): 97-111.

[4] Hirdes, D., Davis, D. W., Lüdtke, G. et Konan, G. *Two generations of Birimian (Paleoproterozoïc) volcanic belts in northeastern Côte d'Ivoire (West Africa): consequences for the Birimian controversy*. Precambrian Research 80 (1996): 173-191.

[5] Lompo, M. *Structural evolution of Paleoproterozoïc belts (Eburnean event) in the Man-Leo Shield, West African Craton. Key structures for vertical to transcurrent tectonics*. Journal of African Earth Sciences, 58 (2010): 19-36.

[6] Houssou, N. N. *Etude pétrographique, structurale et métallogénique du gisement aurifère d'Agbahou, Divo, Côte d'Ivoire*. Doctorat, Université. Félix HOUPHOUET- BOIGNY, Abidjan, Côte d'Ivoire (2013), 177 p.

[7] Gnanzou, A. *Etude des séries volcanosédimentaires de la région de Dabakala (Nord-Est de la Cote d'Ivoire) : genèse et évolution magmatique. Contribution à la connaissance de la minéralisation aurifère de Bobosso dans la série de la Haute-Comoé*. Doctorat, Univ. PARIS-SUD XI, France et Univ. F. H. B, Abidjan (2014), 303 p.

[8] Ouattara, Z. *Caractères lithostratigraphique, structural, géochimique et métallogénique du gisement d'or de Bonikro, sillon birimien de Fètêkro, centre-sud de la Côte d'Ivoire*. Doctorat, Université Félix HOUPHOUET-BOIGNY, Abidjan, Côte d'Ivoire (2015), 256 p.

[9] Ouattara A. S. *Le gisement aurifère de Dougbafla-Bandama (Sud du sillon birimien de Fètêkro, Oumé, Côte d'Ivoire): Pétrographie, déformation, géochimie et métallogénie*. Doctorat, Université Félix HOUPHOUET-BOIGNY, Abidjan, Côte d'Ivoire (2018), 252 p.

[10] Coulibaly, I. *Pétrographie des volcanites et plutonites de la partie Sud du sillon volcano- sédimentaire de Toumodi-Fètêkro*. Thèse Univ. Felix Houphouët Boigny d'Abidjan (2018). 221 p.

[11] Yacé, I. *Initiation à la géologie. L'exemple de la Côte d'Ivoire et de l'Afrique de l'Ouest*. Edition CEDA (2002), Abidjan, Côte d'Ivoire, 183 p.

[12] Camil, J. *Pétrographie, chronologie des ensembles granulitiques archéens et formations associées de la région de Man (Côte d'Ivoire): implication pour l'histoire géologique du craton Ouest-Africain*. Doctorat d'Etat, ès Sciences Nat. Université. Abidjan (1984), 306 p.

[13] Feybesse, J.L., Milesi, J.P., Johan, V., Doget, A., Calvez, J.Y., Boher, M., Abouchami, W. *La limite Archéen / Protérozoïque inférieur de l'Afrique de l'Ouest: une forme de chevauchement majeure antérieure à l'accident de Sassandra; l'exemple de la région d'Odienné et de Touba (Côte d'Ivoire)*. C.R. Acad. Sci. Paris, 1. 309 (1989), série II, 1847-l853.

[14] Lemoine S. *Evolution géologique de la région de Dabakala (NE de la Côte d'Ivoire) au protérozoïque inférieur. Possibilités d'extension au reste de la Côte d'Ivoire et au Burkina Faso*. Thèse ès Sci., Univ. Clermont-Ferrand (1988), 388 p.

[15] Feybesse, J.L. & Milesi, J.P. *The Archean/Proterozoic contact zone in west Africa: a mountain belt of decollement thrusting and folding on a continental margin related to 2,1 Ga convergence of Archean cratons*, Precambrian Res., 69 (1994): 169-227.

[16] Grenholm, M. *The Birimian event in the Baoulé Mossi domain (West African Craton) - regional and global context*. PhD. thesis, Lund University, (2014) 116 p.

[17] Middlemost, E. A. K. *Naming materials in the magma/igneous rock system*. Earth Science Reviews, 37 (3-4), 1994, 215-224.

[18] Chapell, B. W. and White, A. J. R. *Two contrasting granite types*. Pacific geology (1974), 8: 173-174.

[19] Pecerillo, A. and Taylor, S.R. *Geochemistry of Eocene calc-alkaline volcanic rocks from the Kastamonu area, Northern Turkey*. Contribs. Mineral. Petrol., 58 (1976): 63-81.

[20] Pearce, J. A. *Source and settings of granitic rocks*. Episodes, 19 (1996): 120-125.

[21] Vitali, G. *Contribution à l'étude géologique du Birimien. Stratigraphie et structure du complexe volcanosédimentaire de Fètêkro (Côte d'Ivoire)*. Note BRGM (1970), 26 p.

[22] Zhong, S., Seltmann, R., Qu, H., Song, Y. *Characterization of the zircon Ce anomaly for estimation of oxidation state of magmas: a*

revised Ce/Ce method*. Mineralogy and Petrology (2019) 113: 755-763.

[23] Kalfoun, F. *Géochimie du Niobium et du Tantale : distribution et fractionnement de ces deux éléments dans les différents réservoirs terrestre*s. Thèse doctorale, (2001), Université de Montpellier 2, France, 300 p.

[24] Jahn, B. H., Shih, C. Y. et Murthy, V. R. *Trace element geochemistry of Archean volcanic rock and its implications for the chemical evolution of the upper mantle*. Bull. Soc. Géol. France, 6 (1974): 1259-1269.

[25] Blundy, J. and Wood, B. *Partitioning of trace elements between crystals and melts*. Earth and Planetary Science Letters 210 (2003): 383-397.

[26] Billa, M., Gloaguen, E., Melleton, J., Tourlier, E B. *Consolidation des anomalies géochimiques et géophysiques du territoire métropolitain*. Rapport final. BRGM/RP-66416-FR (2016), 419 p.

Appendix 1. Composition in major elements (%) and traces (ppm) of granodiorites and granites from the central part of the Toumodi-Fètêkro volcano-sedimentary furrow (Coulibaly, 2018)

	Granodiorite		Granite	
SiO_2	66,44	68,49	70,27	74,12
Al_2O_3	15,13	14,35	15,32	14,048
Fe_2O_3	4,26	4,1	2,12	1,578
CaO	3,69	2,72	1,6	0,707
MgO	2,09	1,33	0,66	0,165
Na_2O	4,45	3,66	4,58	3,893
K_2O	2,35	3,9	4,05	4,605
MnO	0,06	0,06	0,02	0,0367
TiO_2	0,44	0,48	0,32	0,143
P_2O_5	0,14	0,13	0,13	0,059
Cr_2O_3	0,01	<0,01	<0,01	-
PF	0,52	0,35	0,88	1,424
Total	99,65	99,66	100,07	100,778
Ba	713	761	913	1094
Be	<1	2	2	2,117
Co	12,1	9,1	4,5	2,244
Cs	3,9	8,4	10,6	2,138
Ga	19,4	18,2	22,6	14,98
Hf	2,8	5,6	4,4	3,177
Nb	4,4	8,2	4,2	6,056
Rb	77,2	218,7	205,5	166,4
Sn	1	2	1	1,234
Sr	623,9	358,2	484,8	359,8
Ta	0,3	1,1	0,5	0,807
Th	5	25,2	10,3	7,759
U	0,8	6,2	5	3,27
V	71	62	35	15,94
W	<0,5	<0,5	<0,5	34,03
Zr	111	195,9	158,6	114,3
Y	7,9	13,6	4,2	8,934
La	25,6	40,8	31,9	19,92
Ce	43,7	76,5	61,1	33,54
Pr	4,76	8,56	6,83	3,655
Nd	16,3	28,8	23,7	12,87
Sm	2,77	4,65	3,48	2,302
Eu	0,84	0,99	0,74	0,56
Gd	2,13	3,55	2,16	1,691
Tb	0,28	0,45	0,2	0,251
Dy	1,48	2,54	0,87	1,376
Ho	0,27	0,45	0,11	0,275
Er	0,63	1,28	0,28	0,815
Tm	0,08	0,18	0,03	0,131
Yb	0,58	1,12	0,22	0,996
Lu	0,1	0,19	0,01	0,168
Mo	0,2	0,5	<0,1	1,064
Cu	19,9	16,7	48,8	5,984
Pb	2,5	8,2	6,9	22,3251
Zn	47	50	43	23,97

Appendix 2. Major and trace element composition of the Bonikro granodiorites (Ouattara, 2015)

	Granodiorite								
Sample	**BME10**	**BME11**	**BME12**	**BME24**	**BME26**	**BME33**	**BME34**	**BME35**	**BME36**
%	wt								
SiO_2	65,5	76,1	74,4	59,1	68,1	80,9	69,5	67,5	71,4
Al_2O_3	14,2	11,6	12,2	17,3	14,6	8,27	13,55	14,15	13,6
Fe_2O_3	3,84	2,5	2,24	5,27	3,48	2,11	2,88	3,74	2,76
CaO	2,76	0,92	1,22	3,07	2,69	1,4	3,01	2,48	2,15
MgO	1,02	0,55	0,41	0,96	0,83	0,45	0,65	0,86	0,63
Na_2O	4,51	3,59	3,87	5,1	4,08	3,56	4,29	4,13	4,09
K_2O	2,53	2,06	2,08	4,48	3,48	1,72	3,48	3,65	3,55
Cr_2O_3	0,005	0,005	0,005	0,005	0,05	0,05	0,05	0,05	0,05
TiO_2	0,44	0,28	0,24	0,28	0,5	0,26	0,38	0,51	0,39
MnO	0,06	0,03	0,03	0,17	0,05	0,03	0,05	0,05	0,04
P_2O_5	0,13	0,14	0,06	0,11	0,14	0,07	0,11	0,14	0,11
PF	4,41	2,44	2,41	4,53	2,1	1,85	3,35	2,92	2,31
Total	99,40	100,21	99,16	100,37	100,1	100,67	101,3	100,18	101,08
ppm									
Ba	936	731	924	1310	1040	536	909	1045	922
Ce	110	47	78,1	60,4	65,1	31,5	52,7	61,5	61
Cr	30	40	20	50	30	40	30	30	30
Cs	3,69	3,21	3,15	3,25	9,99	1,13	2,57	6,39	6,08
Dy	1,84	1,1	1,3	2,66	1,5	0,78	1,23	1,4	1,26
Er	0,78	0,47	0,61	1,59	0,55	0,34	0,52	0,59	0,52
Eu	1,25	0,69	0,99	1,33	1,09	0,58	0,89	1,08	0,88
Ga	20,8	17,5	15,3	15,7	22,7	12,8	20,1	21,5	20,9
Gd	3,16	1,79	2,19	2,85	2,74	1,44	2,05	2,65	2,26
Hf	5,4	3,2	3,3	3,1	4,3	2,7	3,9	4,3	4,4
Ho	0,32	0,19	0,23	0,55	0,24	0,14	0,2	0,23	0,21
La	60,2	24	40,7	29,9	33,3	16,3	28,4	30,9	33,6
Lu	0,1	0,07	0,09	0,25	0,07	0,04	0,07	0,07	0,07
Nb	6,4	6,3	6,1	13,1	6,9	4	5,8	7,1	6,6
Nd	35,6	16,5	25,7	20,1	25,8	12,1	19,3	24,9	22,1
Pr	11	4,87	7,99	5,92	7,37	3,59	5,74	7,06	6,66
Rb	104	78,7	70	174	156	48,9	115	165	150,5
Sm	4,74	2,64	3,4	3,38	4,29	2,11	3,29	4,28	3,62
Sn	1	0,5	0,5	1	2	1	1	2	1
Sr	454	295	280	663	497	221	392	483	401
Ta	0,4	0,5	0,6	0,7	1,1	0,5	0,5	0,6	0,7
Tb	0,38	0,22	0,27	0,45	0,32	0,17	0,24	0,31	0,26
Th	10,5	9,51	9,7	14,6	6,02	4,42	9,72	7,19	11,2
Tl	0,25	0,25	0,25	0,7	0,6	0,25	0,25	0,7	0,6
Tm	0,11	0,06	0,09	0,25	0,1	0,07	0,09	0,09	0,09
U	1,61	2,7	1,93	5,38	1,65	1,28	2,72	2,2	3,34
V	65	43	29	56	61	36	52	66	55
W	104	16	14	10	59	317	282	44	15
Y	8,4	5,7	6,1	14,4	6,4	3,7	5,8	6,4	5,8
Yb	0,67	0,44	0,59	1,66	0,47	0,3	0,45	0,45	0,44
Zr	220	140	130	150	162	102	138	155	152
As	14,9	16,1	48,2	250	2,6	3,6	10,4	5,1	2
Bi	1,94	3,69	1,93	0,17	0,17	2,17	0,5	0,36	0,16
Hg	0,089	0,012	0,009	0,009	0,061	0,459	0,369	0,059	0,015
Sb	1,17	0,3	0,33	3,2	0,29	0,5	0,22	0,31	0,19
Se	0,4	0,6	0,3	0,4	0,2	0,2	0,3	0,3	0,2
Te	0,54	1,17	0,27	0,04	0,03	1,58	0,23	0,2	0,11
Ag	0,25	0,8	0,25	0,25	0,25	0,5	0,25	0,25	0,25
Cd	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25
Co	7	4	3	13	8	6	6	8	6
Cu	81	86	12	39	22	17	36	20	8
Mo	55	880	3	1	60	4	2	4	1
Ni	2	2	1	12	4	2	0,5	3	1
Pb	8	20	5	26	7	6	5	6	7
Zn	67	22	11	74	50	40	13	46	47
Au	0,44	0,06	0,14	0,02	0,15	19,1	0,29	29,5	0,16

Appendix 3. Major and trace element composition of granodiorites from the Bonikro gold deposit (Ouattara, 2015)

	Granodiorite								
Sample	**BME40**	**BME43**	**BME47**	**BME48**	**BME49**	**BME50**	**BME52**	**BME54**	**BME58**
%	wt								
SiO_2	68,1	68,2	67,2	65,8	66,7	59,4	67	71,9	67,5
Al_2O_3	14,1	14,5	13,9	13,9	14,75	16,5	14,8	12,5	14,1
Fe_2O_3	3,23	3,38	3,2	3,24	3,33	3,1	3,19	2,31	3,31
CaO	2,49	2,68	2,31	3,37	2,66	3,18	2,57	1,76	2,5
MgO	0,75	0,82	0,74	0,81	0,84	0,93	0,78	0,53	0,78
Na_2O	4,01	4,11	3,96	4,63	4,37	9,08	4,35	4,11	4,18
K_2O	3,53	3,49	3,66	3,94	3,41	1,21	3,69	3,26	3,41
Cr_2O_3	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05
TiO_2	0,46	0,5	0,45	0,45	0,53	0,53	0,49	0,31	0,47
MnO	0,05	0,05	0,05	0,08	0,05	0,06	0,05	0,04	0,05
P_2O_5	0,14	0,13	0,13	0,15	0,17	0,13	0,17	0,1	0,16
PF	3,05	3,12	2,65	4,04	2,78	3,88	2,54	2,11	3,49
Total	99,96	101,03	98,3	100,46	99,64	98,05	99,68	98,98	100
ppm									
Ba	1125	1145	1120	1160	1095	350	1115	941	1070
Ce	65	67,9	70,3	61,9	64,1	68,5	67,1	47,5	62,4
Cr	30	30	30	20	20	20	20	20	20
Cs	10,9	9,17	10,65	2,61	4,63	0,28	7,98	2,56	3,94
Dy	1,38	1,51	1,35	1,5	1,42	1,39	1,41	1,14	1,4
Er	0,56	0,59	0,57	0,56	0,52	0,5	0,54	0,52	0,54
Eu	1,05	1,12	1,01	1,2	1,17	1,3	1,17	0,75	1,11
Ga	21,3	22	21,4	19,2	21,6	24	21,2	16,7	20,7
Gd	2,65	2,86	2,58	2,68	2,77	2,86	2,86	2,05	2,65
Hf	4,6	4,7	4,3	4,5	4,7	4,5	4,3	4,1	4,6
Ho	0,24	0,24	0,23	0,23	0,22	0,21	0,23	0,19	0,22
La	34,6	35,7	37,6	33,8	35,5	38,1	37,8	27,2	34,8
Lu	0,08	0,07	0,08	0,08	0,07	0,06	0,07	0,08	0,07
Nb	7	7,2	7	6,3	6,6	7,7	6,8	5,5	6,4
Nd	24,9	26,2	25,9	26,1	27,6	29	28	19,1	26,5
Pr	7,24	7,67	7,73	6,91	7,37	7,7	7,53	5,27	7,12
Rb	168	154,5	154,5	167,5	167,5	30	149,5	95,9	154
Sm	4,05	4,56	4,19	4,2	4,46	4,54	4,44	2,99	4,12
Sn	1	1	2	1	1	1	1	1	1
Sr	466	498	497	432	512	428	533	462	473
Ta	0,7	0,6	0,7	0,8	0,6	0,8	0,6	0,5	0,6
Tb	0,31	0,32	0,3	0,33	0,33	0,32	0,33	0,25	0,32
Th	8,04	6,87	9,43	9,43	7,45	7,71	8,35	8,12	8,6
Tl	0,7	0,6	0,6	0,6	0,5	0,25	0,5	0,25	0,5
Tm	0,1	0,11	0,09	0,08	0,07	0,07	0,07	0,08	0,07
U	2,17	1,96	2,48	3,05	2,07	1,94	2,34	2,28	2,3
V	59	63	56	50	56	29	51	33	51
W	10	100	6	29	5	82	1	21	12
Y	6,4	6,9	6,4	7	6,1	6	6,2	5,7	6,1
Yb	0,5	0,55	0,47	0,49	0,42	0,41	0,46	0,47	0,47
Zr	174	176	162	156	169	159	152	141	176
As	1,7	1,2	0,7	2,2	2,3	10,2	5,8	6,4	7,1
Bi	0,08	0,08	0,05	0,73	0,1	1,37	0,26	0,97	0,16
Hg	0,01	0,103	0,005	0,009	0,0025	0,01	0,0025	0,0025	0,006
Sb	0,24	0,26	0,19	0,48	0,31	0,12	0,32	0,35	0,45
Se	0,1	0,2	0,2	0,2	0,2	0,3	0,4	0,3	0,2
Te	0,005	0,02	0,005	0,41	0,07	1,59	0,07	0,85	0,03
Ag	0,25	0,25	0,25	0,7	0,25	0,6	0,5	0,5	0,25
Cd	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25
Co	6	7	8	8	8	5	6	5	7
Cu	6	6	7	12	7	3	22	39	12
Mo	3	10	0,5	0,5	0,5	0,5	7	0,5	29
Ni	0,5	2	5	4	3	4	4	3	4
Pb	7	6	9	13	6	7	9	7	5
Zn	51	54	66	38	71	31	56	35	48
Au	0,02	0,1	0,02	0,36	0,02	3,44	0,05	0,82	0,27

Appendix 4. Chemical composition of granites and granophyres (Ouattara, 2018)

Sample	Granites				Granophyres			
	OA007	**OA008**	**OA009**	**OA031**	**OA035**	**OA036**	**OA039**	**OA041**
				Major elements (% wt)				
SiO_2	71,3	71,4	70,9	71	77,7	75,7	71,5	76,3
Al_2O_3	14,3	14,2	14	14,4	11,65	11,65	12,45	12,1
Fe_2O_3	2,11	2,18	2,06	2,61	1,93	2,59	2,26	2,31
CaO	2,12	2,17	2,02	2,32	0,94	0,95	1,81	0,73
MgO	0,95	0,83	0,76	0,97	0,38	0,3	0,61	0,41
Na_2O	5,25	5,29	5,12	3,73	4,01	4,04	4,32	4,11
K_2O	1,79	1,84	1,89	2,84	2,92	2,99	2,73	3,1
Cr_2O_3	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
TiO_2	0,27	0,25	0,24	0,33	0,21	0,22	0,29	0,25
MnO	0,02	0,02	0,02	0,03	0,04	0,05	0,04	0,04
P_2O_5	0,07	0,04	0,08	0,09	0,05	0,03	0,05	0,04
SrO	0,03	0,04	0,04	0,03	0,02	0,01	0,02	0,02
BaO	0,08	0,08	0,09	0,09	0,11	0,11	0,11	0,11
PF (%)	2,8	3,18	3,21	3,26	1,49	1,37	2,38	1,56
Total	101,09	101,52	100,43	101,7	101,45	100,01	98,57	101,08
				Trace elements (ppm)				
C	0,49	0,68	0,68	0,5	0,2	0,2	0,39	0,12
Ag	<0,5	0,6	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5
As	108,5	22,4	9,9	25,1	1,4	1	1,7	1,2
Ba	725	727	799	829	960	991	939	978
Bi	0,2	1,14	1,2	0,16	0,08	0,07	0,04	0,07
Cd	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5
Co	5	4	5	6	3	3	3	4
Cr	30	30	20	30	20	20	10	20
Cs	1,65	2,51	3,54	1,93	0,75	0,91	1,79	1,04
Cu	18	72	45	13	16	14	11	12
Ga	19,3	19,5	19,6	19,2	13,7	14,9	15,9	15
Hf	3	3,1	3	3,3	4,3	4,2	5,1	4,1
Hg	0,007	0,015	0,013	0,034	0,006	<0,005	0,009	0,006
Mo	<1	1	2	<1	<1	<1	<1	<1
Nb	3,6	3,4	3,7	4,4	8,1	8,7	8,5	8,8
Ni	14	13	11	7	6	8	7	6
Pb	6	6	11	8	14	14	8	11
Rb	50	61,9	72,3	87,5	86,7	91,4	95,3	94,1
S	0,16	0,73	0,53	0,16	0,02	0,01	<0,01	<0,01
Sb	0,63	1,35	0,67	1	0,2	0,23	0,13	0,28
Se	<0,2	0,3	0,2	<0,2	<0,2	<0,2	0,2	0,2
Sn	1	1	1	1	1	1	1	1
Sr	258	295	346	230	123,5	126,5	152	128
Ta	0,5	0,5	0,5	0,5	0,7	0,8	0,7	0,7
Te	0,04	0,28	0,26	0,02	0,05	0,04	0,01	0,04
Th	6,65	6,9	7,35	7,88	8,91	8,55	7,91	8,38
Tl	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5
U	3,47	4,58	3,98	2,77	2,09	2,26	2,07	2,01
V	33	35	34	44	13	13	21	14
W	9	24	8	6	1	1	1	1
Y	3,6	3,4	3,7	4,4	8,1	8,7	8,5	8,8
Zn	34	28	34	42	39	40	42	36
Zr	110	110	110	130	160	160	210	150
	REE (ppm)							
Ce	30,4	29,6	33,1	37,5	81,9	74,3	82,5	76,7
Dy	0,66	0,65	0,61	0,86	2,37	2,53	3,21	2,45
Er	0,29	0,31	0,3	0,41	1,52	1,53	1,84	1,48
Eu	0,5	0,45	0,47	0,55	0,65	0,71	1,22	0,76
Gd	1,34	1,25	1,29	1,54	3,01	3,15	4,42	3,17
Ho	0,11	0,11	0,12	0,16	0,5	0,52	0,65	0,51
La	15,9	15,2	17	19,9	39,2	38,2	44,9	39,6
Lu	0,04	0,04	0,04	0,06	0,25	0,25	0,28	0,24
Nd	11,4	11	11,9	13,4	29,5	27,2	35	28,1
Pr	3,26	3,17	3,52	3,93	8,88	8,61	10,6	8,85
Sm	1,79	1,72	1,84	2,13	4,19	4,13	5,68	4,36
Tb	0,14	0,14	0,14	0,19	0,44	0,46	0,61	0,45
Tm	0,04	0,04	0,04	0,06	0,22	0,24	0,28	0,23
Yb	0,25	0,25	0,24	0,34	1,48	1,57	1,68	1,44

Annexe 5. Chemical composition of granodiorites and tonalites (Ouattara, 2018)

Sample	Granodiorite	Granodiorites	Granodiorite	Granodiorite	Tonalites	Tonalites	Tonalites	Tonalites	Tonalites
	OA010	**OA013**	**OA020**	**OA023**	**OA042**	**OA052**	**OA039**	**OA041**	**OA044**
				Major elements (% wt)					
SiO_2	66,1	70,6	63,4	68,8	69,3	66,7	63,1	63,1	63,9
Al_2O_3	13,85	14,05	14,1	14,35	14,75	13,95	14,2	15,75	14,35
Fe_2O_3	3,47	1,76	3,58	2,75	2,49	3,6	4,54	4,69	4,53
CaO	3,42	2,08	3,4	2,79	3,02	3,22	3,18	3,88	3,76
MgO	1,76	0,48	1,73	1	0,85	1,72	2,59	2,35	2,67
Na_2O	4,98	4,16	4,51	5,21	3,73	4,51	4,44	3,34	4,39
K_2O	1,95	2,37	2,32	2,05	3,07	2,27	2,76	4,42	3,03
Cr_2O_3	0,01	<0,01	0,01	<0,01	<0,01	0,01	0,01	0,01	0,01
TiO_2	0,39	0,22	0,39	0,33	0,34	0,41	0,56	0,6	0,61
MnO	0,05	0,02	0,05	0,04	0,04	0,05	0,05	0,06	0,06
P_2O_5	0,09	0,04	0,08	0,09	0,08	0,09	0,28	0,3	0,28
SrO	0,06	0,04	0,06	0,04	0,03	0,06	0,07	0,07	0,1
BaO	0,09	0,11	0,1	0,07	0,1	0,09	0,15	0,28	0,15
PF (%)	5,38	3,24	6,29	4,3	3,8	3,82	3,8	2,98	3,62
Total	101,6	99,17	100,02	101,82	101,6	100,5	99,73	101,83	101,46
				Trace elements (ppm)					
Ag	<0,5	0,7	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5
As	25,6	11	42,9	26,3	23	13,8	5	8	8,6
Ba	763	919	855	648	939	837	1285	2470	1305
Bi	0,2	0,4	0,53	0,17	0,13	16,6	0,14	0,1	0,19
C	1,26	0,63	1,37	1,03	0,64	0,79	0,66	0,33	0,67
Cd	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5
Co	11	3	11	6	6	10	12	12	14
Cr	80	10	80	20	20	70	110	80	110
Cs	1,39	3,72	1,72	1,11	2,24	6,32	3,14	1,02	2,8
Cu	24	67	69	16	15	57	16	109	20
Ga	18,8	17	18,6	18,9	20,6	20,3	18,9	20,7	20,1
Hf	3	3	2,9	3	3,4	3,1	4,8	5,5	5
Hg	0,011	0,016	0,038	0,011	0,011	0,096	0,08	0,177	0,05
Mo	<1	37	1	<1	<1	12	20	<1	<1
Nb	3,2	4,3	3,1	4,3	4,5	3,5	9,5	10,5	10,3
Ni	33	5	34	7	6	32	60	43	58
Pb	10	15	8	5	8	23	16	12	19
Rb	70,4	64,1	76,7	63,5	91	97,6	93,6	60,4	97,5
S	0,04	0,21	0,72	0,19	0,08	0,42	0,69	0,86	0,67
Sb	0,56	0,26	0,54	0,4	0,7	0,93	0,43	0,53	0,65
Se	<0,2	<0,2	0,3	<0,2	<0,2	0,2	0,3	1,1	0,4
Sn	1	1	1	1	1	1	1	1	1
Sr	452	273	456	334	277	452	505	535	808
Ta	0,3	0,7	0,3	0,5	0,5	0,3	0,7	0,7	0,7
Te	0,02	0,03	0,09	0,04	0,02	0,27	0,06	0,08	0,08
Th	6,62	9,38	5,95	7,3	7,61	6,12	13,7	14,5	13,4
Tl	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5
U	2,62	5,02	2,08	2,63	2,87	2,3	3,63	3,31	3,92
V	67	22	66	48	41	72	79	81	81
W	16	12	11	9	6	97	4	1	1
Y	5,8	2,7	5,4	4,4	4,8	6	12,3	12,8	13,1
Zn	46	32	55	30	36	57	65	43	62
Zr	120	110	110	120	140	130	210	260	220
				REE (ppm)					
Ce	40,3	30,1	36,1	32,4	33,1	39	113,5	139	110
Dy	1,05	0,56	1,01	0,8	1,02	1,18	2,35	2,37	2,64
Er	0,56	0,25	0,54	0,4	0,48	0,61	1,13	1,13	1,26
Eu	0,67	0,41	0,58	0,5	0,58	0,72	1,5	1,8	1,83
Gd	1,79	1,17	1,58	1,34	1,63	1,88	4,37	4,66	4,71
Ho	0,2	0,09	0,2	0,15	0,17	0,22	0,43	0,43	0,46
La	20,8	16,3	18,7	17,4	18,8	21	56,4	73	58,4
Lu	0,08	0,04	0,08	0,06	0,06	0,09	0,16	0,16	0,17
Nd	14,7	10,4	13,6	11,9	12,7	14,5	43,5	54,3	45,1
Pr	4,33	3,13	3,91	3,44	3,77	4,39	12,65	15,95	13,25
Sm	2,33	1,62	2,18	1,96	2,27	2,48	6,48	7,46	7,21
Tb	0,22	0,14	0,2	0,17	0,2	0,24	0,5	0,52	0,58
Tm	0,08	0,03	0,08	0,06	0,07	0,09	0,16	0,15	0,17
Yb	0,5	0,2	0,47	0,36	0,39	0,56	0,99	0,95	1,07

Appendix 6. Compositions of major (%) and traces (ppm) elements of plutonites from the Dabakala region (Gnanzou, 2014)

Samples	AG012	AG009	AG010	AG051	AG005	AG017	AG013	AG030	AG006	AG018	AG033	AG076
Lithologies	Granodiorite	Granodiorite	Granodiorite	Granodiorite	Granite	Granite	Granite	Granite	Granite	Granite	Granite	Granite
SiO_2	64,70	65,60	68,30	67,60	72,80	71,40	76,40	71,00	70,40	69,80	72,10	72,90
Al_2O_3	13,95	14,20	15,05	14,50	14,00	14,55	10,35	14,55	14,80	14,85	13,70	12,70
Fe_2O_3	4,54	3,96	3,87	4,08	1,15	1,10	5,11	1,74	3,09	2,25	2,11	1,89
MnO	0,08	0,06	0,06	0,03	0,03	0,01	0,04	0,01	0,05	0,01	0,02	0,04
MgO	2,46	1,94	1,65	1,52	0,17	0,17	0,91	0,57	0,96	0,70	0,52	0,50
CaO	2,28	3,36	3,14	2,53	1,35	1,75	0,45	1,93	2,35	2,03	1,72	1,63
Na_2O	3,43	4,04	4,44	4,14	5,35	5,69	2,56	4,60	4,50	4,85	4,31	3,83
K_2O	3,44	2,81	3,03	2,41	2,92	2,48	1,28	2,98	3,44	3,51	3,42	2,87
TiO_2	0,37	0,48	0,45	0,52	0,09	0,10	0,57	0,18	0,35	0,27	0,20	0,20
P_2O_5	0,20	0,16	0,15	0,18	0,01	0,05	0,06	0,06	0,12	0,12	0,07	0,06
Cr_2O_3	0,02	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,00	0,01	0,01	<0,01
SrO	0,07	0,07	0,07	0,04	0,06	0,07	0,02	0,06	0,06	0,09	0,03	0,02
BaO	0,11	0,12	0,11	0,11	0,07	0,07	0,04	0,13	0,11	0,12	0,07	0,07
LOI	3,68	1,26	0,83	1,91	0,86	0,61	1,78	0,95	1,11	0,68	0,96	2,38
Total	99,33	98,07	101,16	99,58	98,86	98,04	99,58	98,76	101,34	99,28	99,23	99,09
As	0,40	0,40	2,10	1,00	0,20	1,10	1,00	0,50	0,40	0,50	0,30	0,10
Au	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	0,05	<0,01	0,03	<0,01	0,02	0,04
Ba	41,60	938	1045	1045	686	1050	1015	938	783	829	811	746
Bi	0,01	0,06	0,10	0,10	0,03	0,16	0,01	0,10	0,01	0,04	0,02	0,01
C	0,01	0,06	0,49	0,08	0,02	0,16	0,08	0,03	0,05	0,01	0,02	0,03
Ce	6,10	63,80	38,90	60,30	49,50	107,50	73,10	19,50	70,00	108,00	71,00	17,60
Cr	260	20	170	60	30	40	30	560	50	30	30	30
Cs	0,20	6,20	5,45	4,75	1,62	5,01	2,31	4,86	0,95	2,81	11,30	1,09
Dy	3,09	1,42	2,01	1,99	1,43	2,59	2,15	0,94	2,09	5,75	2,70	0,57
Er	2,09	0,69	1,06	1,09	0,69	1,27	1,13	0,48	0,92	2,79	1,39	0,27
Eu	0,72	0,93	0,90	1,23	1,16	1,24	1,15	0,56	1,66	2,62	0,57	0,64
Ga	16,20	19,10	18,60	19,50	22,70	18,70	16,50	18,60	21,00	25,50	23,30	20,80
Gd	2,67	2,28	2,87	3,27	2,65	3,83	3,15	1,61	3,78	9,12	3,88	0,95
Hf	1,00	4,10	3,50	4,20	3,30	4,90	4,20	2,30	4,50	4,30	4,20	4,40
Hg	0,11	0,01	0,01	0,01	<0,005	0,01	0,01	0,01	<0,005	0,01	<0,005	<0,005
Ho	0,70	0,27	0,40	0,39	0,26	0,49	0,42	0,19	0,37	1,06	0,50	0,11
La	2,10	34,60	19,50	30,10	24,60	57,80	37,90	7,80	34,60	54,30	41,60	10,50
Lu	0,31	0,12	0,17	0,15	0,08	0,19	0,19	0,08	0,12	0,29	0,18	0,04
Nb	1,70	5,50	4,50	6,30	4,40	11,70	6,70	3,50	4,90	10,10	19,40	1,90
Nd	5,20	23,80	17,10	24,90	24,10	37,40	29,10	10,40	30,40	60,50	23,20	6,80
Pr	0,95	7,13	4,81	7,14	5,96	11,35	8,42	2,58	8,06	14,15	6,99	1,88
Rb	4,00	104	147,00	102,50	49,50	106	102	152,50	43,30	69,30	282	35
S	0,08	0,01	0,01	0,01	<0,01	0,04	0,01	0,01	<0,01	0,01	<0,01	<0,01
Sb	0,05	0,05	0,31	0,10	0,05	0,05	0,07	0,05	0,07	0,05	0,05	<0,05
Se	0,30	0,20	0,00	0,20	0,40	0,30	0,20	0,20	0,30	0,50	0,40	0,20
Sm	1,83	3,55	3,45	4,44	3,93	5,38	4,50	1,98	5,24	12,15	4,10	1,22
Sn	1	1	1	1	<1	2	1	2	1	2	3	1
Sr	84,60	451	660,00	627	871	311	414	433	917	865	262	624
Ta	0,10	0,60	0,40	0,70	0,30	0,90	0,50	0,20	0,30	1,30	2,30	0,10
Tb	0,48	0,28	0,38	0,43	0,32	0,52	0,41	0,21	0,44	1,18	0,56	0,12
Te	0,02	0,01	0,01	0,01	<0,01	0,01	0,01	0,01	<0,01	0,01	<0,01	<0,01
Th	0,18	6,41	6,41	9,23	2,36	11,70	7,51	1,97	2,34	3,99	20,30	1,15
Tl	0,50	0,50	0,60	0,50	<0,5	0,50	0,50	0,60	<0,5	0,30	1,30	<0,5
Tm	0,30	0,10	0,17	0,16	0,11	0,17	0,16	0,07	0,14	0,38	0,21	0,06
U	0,05	2,76	1,76	2,10	0,49	2,06	1,41	0,65	0,33	1,30	9,88	0,58
V	314	43	88	79	58	69	55	95	93	95	28	35
W	1	1	1	1	<1	1	1	1	<1	0,9	<1	<1
Y	18,30	7,60	10,90	10,70	7,20	13,60	11,70	5,10	8,90	31,20	16,30	2,90
Yb	2,00	0,69	1,02	0,98	0,59	1,14	1,15	0,48	0,78	2,14	1,22	0,26
Zr	50	160	140	160	130	200	160	80	160	190	140	190

Appendix 7. Compositions of major (%) and traces (ppm) elements of plutonites from the Dabakala region (Gnanzou, 2014)

Samples	AG084	AG107	AG139	AG106	AG173	AG112B	AG116	AG141	AG160	AG164	AG093	AG103	AG132	AAG132-B	AG167	AG115	AG130
Lithologies	Granodiorite	Granodiorite	Granodiorite	Tonalite	Tonalite	Granite	Granite	Granite	Granite	Granite	Granite	Granite	Granite	Granite	Granite	Granite	Granite
SiO_2	69,50	67,50	68,60	63,00	64,10	72,00	70,10	70,60	71,20	69,80	70,20	72,90	70,90	70,60	73,20	74,20	75,00
Al_2O_3	15,30	16,35	14,55	16,55	16,60	14,45	16,30	15,15	14,40	16,10	14,00	13,95	14,55	15,00	14,20	13,80	13,45
Fe_2O_3	2,98	3,63	3,53	5,13	5,40	2,08	2,14	2,57	3,04	1,93	3,03	1,60	2,21	2,06	1,83	1,51	0,93
MnO	0,05	0,05	0,07	0,07	0,08	0,07	0,02	0,03	0,04	0,03	0,05	0,02	0,03	0,03	0,02	0,09	0,03
MgO	0,86	1,11	1,05	1,81	1,86	0,52	0,64	0,66	0,70	0,53	1,11	0,21	0,70	0,74	0,32	0,13	0,05
CaO	2,42	3,43	2,64	4,18	3,90	1,59	3,27	2,24	2,96	2,93	2,32	0,79	1,73	2,08	1,42	0,94	0,59
Na_2O	5,04	4,84	3,83	4,51	4,77	4,29	5,45	4,87	4,51	5,67	4,00	3,79	4,24	5,06	4,25	4,02	4,48
K_2O	1,90	1,74	2,91	1,56	1,90	3,85	1,13	2,62	1,28	1,19	3,46	4,84	3,49	2,36	3,73	4,89	3,16
TiO_2	0,31	0,44	0,38	0,65	0,74	0,23	0,30	0,37	0,34	0,19	0,31	0,16	0,26	0,24	0,22	0,09	0,04
P_2O_5	0,20	0,19	0,20	0,27	0,31	0,13	0,07	0,12	0,10	0,05	0,11	0,04	0,11	0,08	0,05	<0,01	0,01
Cr_2O_3	0,01	<0,01	0,01	<0,01	0,01	<0,01	<0,01	0,01	<0,01	<0,01	0,01	<0,01	<0,01	<0,01	0,01	<0,01	<0,01
SrO	0,05	0,11	0,05	0,11	0,11	0,04	0,07	0,07	0,03	0,07	0,06	0,02	0,05	0,07	0,03	0,01	<0,01
BaO	0,10	0,08	0,11	0,09	0,09	0,10	0,08	0,14	0,03	0,03	0,11	0,10	0,09	0,08	0,12	0,04	<0,01
LOI	0,93	0,57	0,80	1,01	1,22	0,57	0,50	0,73	0,62	0,58	0,59	0,80	0,87	0,83	0,71	0,45	0,66
Total	99,64	100,04	98,72	98,94	101,08	99,92	100,07	100,17	99,25	99,10	99,36	99,22	99,23	99,23	100,10	100,17	98,40
As	0,30	0,40	0,40	0,30	0,40	0,50	1,10	0,90	0,80	0,50	1,10	0,50	0,10	0,30	0,30	0,50	0,30
Au	<0,01	<0,01	0,02	0,03	<0,01	0,02	0,04	0,02	0,01	0,03	0,02	0,20	0,05	<0,01	<0,01	<0,01	0,04
Ba	265	234	707	629	965	364	1175	1025	1075	649	619	869	106	766	671	496	1050
Bi	0,03	0,04	0,01	0,01	0,20	0,06	0,14	0,10	0,14	0,05	0,16	0,08	0,05	0,38	0,12	0,10	0,01
C	0,03	0,04	0,05	0,00	0,02	0,01	0,05	0,05	0,03	0,03	0,36	0,02	0,03	0,03	0,36	0,02	0,01
Ce	52,80	8,50	7,50	5,80	48,70	33,20	19,80	59,40	36,30	23,30	25,50	72,50	1,30	57,50	31,40	25,80	50,40
Cr	40	30	10	20	50	90	20	30	30	20	40	30	10	40	40	10	10
Cs	3,87	4,45	1,25	1,93	6,09	3,64	5,80	4,87	9,43	5,05	5,95	9,78	23,20	8,55	5,32	9,09	1,80
Dy	0,89	0,46	0,46	0,32	1,22	2,36	0,56	1,91	0,59	0,76	0,94	0,64	0,50	1,89	0,88	1,85	0,98
Er	0,37	0,27	0,26	0,16	0,68	1,39	0,26	1,05	0,21	0,43	0,61	0,29	0,32	0,93	0,39	1,15	0,52
Eu	0,73	0,38	0,25	0,23	0,81	0,89	0,47	0,87	0,65	0,40	0,40	0,57	0,30	1,11	0,64	0,52	0,63
Ga	19,60	20,30	22,10	19,20	18,80	14,70	17,50	20,40	20,40	16,60	17,10	21,00	11,70	22,30	21,70	19,00	21,40
Gd	2,06	0,74	0,69	0,55	2,08	2,72	1,04	2,74	1,38	0,97	1,21	1,55	0,30	3,35	1,72	1,70	1,86
Hf	4,80	2,70	2,80	2,00	3,40	4,00	2,30	4,70	3,10	2,90	2,90	4,10	0,20	3,60	3,00	0,90	3,80
Hg	<0,005	<0,005	0,01	0,01	<0,005	0,01	0,01	0,01	0,01	0,01	<0,005	<0,005	0,01	<0,005	<0,005	0,00	0,01
Ho	0,15	0,09	0,09	0,06	0,24	0,48	0,10	0,37	0,09	0,15	0,19	0,11	0,11	0,34	0,16	0,37	0,20
La	32,60	5,00	3,30	3,50	27,10	13,30	11,00	31,10	18,70	12,20	14,00	44,20	0,80	34,60	16,00	13,90	28,90
Lu	0,05	0,04	0,04	0,02	0,11	0,22	0,04	0,17	0,04	0,09	0,12	0,04	0,06	0,13	0,06	0,21	0,06
Nb	5,40	3,90	1,80	2,10	5,30	4,80	3,60	7,50	4,70	5,30	5,00	4,30	3,40	5,90	3,40	5,40	5,20
Nd	19,00	4,00	3,20	3,10	19,20	13,50	8,50	22,50	15,00	7,80	9,70	21,30	0,60	27,70	12,60	10,60	16,60
Pr	5,52	1,02	0,88	0,84	5,21	3,80	2,36	6,81	4,28	2,32	2,70	6,74	0,16	7,69	3,39	3,01	4,93
Rb	63,30	72,50	82,90	77,50	100,50	58,90	109,50	179	154,50	149,50	126	227	378	186,50	109	196	153
S	<0,01	<0,01	0,01	0,01	<0,01	0,00	0,01	0,00	0,01	0,01	<0,01	<0,01	0,01	<0,01	<0,01	0,00	0,01
Sb	0,06	0,06	0,05	0,05	0,08	0,27	0,09	0,08	0,11	0,08	0,11	0,07	0,05	0,07	0,05	0,10	0,06
Se	0,20	0,20	0,20	0,20	0,30	0,00	0,20	0,00	0,20	0,20	0,20	0,20	0,20	0,40	0,20	0,00	0,20
Sm	2,71	0,73	0,74	0,66	2,90	2,84	1,44	3,78	2,40	1,29	1,61	2,86	0,19	4,50	2,21	2,19	2,65
Sn	<1	1	0,9	0,9	1	1	1	1	1	1	<1	1	1	1	<1	1	1
Sr	273	572	473	564	449	175,50	493	528	705	246	211	187,50	75,30	429	569	127,50	275
Ta	0,40	0,20	0,30	0,10	0,60	0,40	0,40	0,80	0,40	0,60	0,50	0,60	1,30	0,70	0,30	0,90	0,50
Tb	0,22	0,10	0,09	0,07	0,25	0,43	0,12	0,37	0,14	0,14	0,17	0,16	0,07	0,42	0,20	0,31	0,21
Te	<0,01	<0,01	0,01	0,01	<0,01	0,03	0,01	0,01	0,01	0,01	0,07	<0,01	0,01	0,01	0,01	0,00	0,01
Th	8,22	1,44	1,19	0,39	7,16	3,47	2,88	12,30	6,34	10,20	9,01	28,30	0,26	10,75	5,52	1,15	10,55
Tl	<0,5	<0,5	0,30	0,30	0,50	0,00	0,50	0,80	0,70	0,60	0,50	1,00	1,40	0,70	<0,5	0,60	0,60
Tm	0,06	0,05	0,04	0,02	0,11	0,22	0,04	0,16	0,03	0,07	0,11	0,06	0,05	0,14	0,08	0,20	0,08
U	0,82	0,68	0,62	0,33	2,40	0,88	1,36	2,64	1,83	2,05	3,33	2,35	0,84	2,01	2,31	1,74	3,18
V	32	16	10	11	39	120	21	54	33	32	30	13	5	36	37	0	15
W	<1	<1	0,9	0,9	<1	1	0,9	0	0,9	0,9	4	<1	0,9	<1	<1	1	0,9
Y	3,80	2,70	2,70	1,80	7,00	12,60	3,00	10,60	2,70	4,00	6,20	3,00	3,30	9,30	4,30	11,00	8,30
Yb	0,29	0,23	0,26	0,15	0,65	1,32	0,29	1,02	0,21	0,54	0,69	0,27	0,37	0,83	0,39	1,37	0,41
Zr	190	90	70	60	110	160	80	180	100	80	80	130	19	130	110	30	150