C-7 SPATIO-TEMPORAL DISTRIBUTION PETROLOGICAL CHARACTERISTIC OF THE VARIOUS MAGMATIC PHASES IN TUNISIA

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Sammary

The study concerns the magmatic rocks found in the various structural domains of Tunisia. The recent deposit, mineralogical, geochimical, isotopic and radiochronological data permit the definition of the spatio-temporal distribution of the various magmatic phases, their importance, the mode of their formation, their petrological characteristics as well as the geodynamic contexts.

Keywords: Mediterranean, Tunisia, magmatism, mineralogy, geochemistry, Rare Earths, geochronology, isotopes.

In Tunisia, magmatism is represented by several episodes ranging from the Precambrian to the Messinian (Laridhi Ouazaa, 1994):

1- The ante-Cambrian magmatism is represented by calco-alkaline granitoids generated in a post or late tectonic context and formed in a compressive regime. Geodynamically, they constitute a witness of the Panafrican granitization phase, dated at about 550 Ma (Bajanik, 1971) and resulting from a continental collision with subduction between the regid west African craton and a more plastic east african bloc.

2- The magmatism associated to the lower Paleozoïc series of the saharian plateform is less important. These are spilitized vein basalts with geochemical features typical of alkaline lavas and formed in a distensive context. They are typical of polyphased magmatism which is well developed in the neighbouring regions and related to the Caledonian orogenesis.

3- The Triassic magmatism is represented by differentiated submarine effusive formations (basalt-trachyte) and by intrusive basic rocks (dolerites) formed between the Scytian and the Carnian. In spite of the initial paragenesis retromorphose, the typically alkaline character of this rocks is demonstated by the mineralogical study of the relic magmatic phases (clinopyroxenes), by the presence of analcime and by the trace elements geochemistry, namely

Rare Earth. This alkaline magmatism, associated to a typical distensive, is formed in a border context wich is relatively stable and with an essentially evaporitic sedimentation. The contemporaneity of the sedimentation and of an effusive, explosive, jerky and repetitive volcanism may be explained by the play of a deep fracture zone oriented E-W. This triassic magmatism is part of an essentially sedimentary province to the east of the 0 meridian where the alkaline volcanic materials are reduced and represent but a little part of the basins filling. It is earlier than continental tholeiites of West Africa and would mark the very begining of rifting leading to the migration of Africa eastwards.

4- The known witnesses of Jurassic magmatic rocks are represented by an alkaline gabbro with salites, kaersutites, plagioclases, micas and analcime. This magmatism, reduced in Tunisia,is probably related to the local accidents plays, acting in parallel with rifting. It is slightly later than the continental dolerites formed as early as the begining of the Jurassic on the border of western Africa.

5- During the Cretaceous, a polyphased and fissural magmatism was active in eastern Tunisia, as indicated by great structuro-magmatic fractures oriented E-W and N 140. Its petrologic study reveals two magmatic lineages:

- An effusive tholeiitic magmatism represented by slightly fractured basalts. Geodynamically, this lineage is related to the begining of a fractured domain functioning of the rift type located on a crustally brittle zone.

- An effusive and intrusive alkaline magmatism represented by basalts and by their trachytic differentiated products. Lava fractioning is in relation with the installation of superficial magmatic reservoirs promotted by more and more complex tectonic structure of the aborted rift type.

The tholeiitic and alkaline character of magmatism emphasizes the distensive structuring of the eastern tunisian domain during the Cretaceous and geodynamically, constitutes one of the markers of Syrte grabens opening and of Iberia sliding towards S-E between 110 and 85 Ma.

From the Late Senonian on, the expolsive dynamisms are dominant and indicate the installation of superficial magmatic reservoirs promoted by more and more complex structures in relation with a tectonic style change at the begininig of the plates of Africa and Europe closing up.

6- The Latemost-Cretaceous explosive volcanism, of the Paleocene and the Ypresian (Beji Sassi et al.,1996) represented by quartz pumices might either represent an extreme stage of the Cretaceous basaltic magmas or still constitute the first witnesses of a calco-alkaline-type compressive episode.

7- The petrologic study of Miocene magmatism in northern Tunisian shows the spatio-temporal coexistence of two mantellic and crustal magmas (Metrich, 1976; Mauduit, 1978; Halloul, 1989; Laridhi Ouazaa, 1994). Three magmatics episodes are thus defined.

A first volcanic episode during the Early Miocene (Aquitanian-Early Langhian) with the formation of alkaline basalt. Tectonics is clearly distensive (opening of the Siculo-Tunisian straits) and the ejected magmas correspond to the fusion of a primary mantle of chondritic composition.

The second volcanic episode (14 to 8 Ma: from Serravalian to the early Tortonian), controlled by a compressive tectonics in relation with the system blocking following Alpine or Atlasic pinching. This tectonics promotes the creation of magmatic reservoirs and the possibility of differentiation for this magmas. The crustal anatexis processes play an important part in the magma genesis and the variety of eruptive dynamisms is thus enhanced. Fusion is promoted by shearing movements between the Africa-Europe plates within a zone characterized by a crustal thinning up and a welling up of isotherms, the first manifestations belong to a magmatism presenting affinities with potassic calco-alkaline series and rocks are rich in enclaves. they are followed by ryodacites orinating from a pure crustal fusion (Aïn Deflaïa) and by rhyodacites with traces of a mixture with a mantellic potassic magma (Jebel Haddada and Oued Belif). They are potassic and hyperaluminous rocks, including trace elements and Rare Earth distributions similar to sedimentary rocks; isotopic ratios (Sr, Pb and Nd) (Juteau et al., 1986) are in accordance with a crust sediment fusion.

A third episode (8-6 Ma:Late Tortonian-Messinian) where the system resumes its distensive character. This episode is at the origin of formation hawaites and mugearites. The basic lavas correspond to two lineages evolving from two different primary liquids by means of a fractionated crystallization process. They are contaminated and exhibit geochemical characteristics intermediate between the distensive and compressive sites. The still later basic hawaite of Jebel ez Zebs (Mogods) originated from the direct fusion of a mantellic source whose chemical characteristics are of the chondritic type; they have formed in a distensive geotectonic context.

This study shows that the magmatic history of Tunisia (Table 1) is marked, during the Paleozoïc-Latemost Cretaceous, by a succession of magmatic manifestation indicating distensive regimes. However from the Late Cretaceous on, the fine field analyses together with the various laboratory methods have made it possible to detect a fondamental change in the volcanic activity. This change is reflected by the appearance of more and more differentiated facies occuring with an explosive volcanism indicating the formation of superficial magmatic reservoirs containing acid, gaz-rich magmas. This tendency is confirmed and amplified during the Miocene when the explosive activity was preponderant. The role of the continental crust in the genesis of acid rocks and in the contamination of basic lava constitutes the main feature of Miocene magmatism.

We have shown that the magmatic history of Tunisia from the Latemost Precambrian to the Miocene illustrates the major different tectono- magmatic phases which have marked the various periodes at an inter-regional scale (Pangea fragmentation, opening of the central Atlantic and of Tethys, translation and rotation of Iberia, opening of Syrte grabens and Africa-Europe collision).

Table 1- Kinematic evolution of magmatism and regional constraint in Tunisia.

Age	Kinematic Fault EW-NS	Magmatism	Regional constraint
NEOGENE	Transpression Transtension	Calc-alkaline Alkaline	⤢ ⤡
PALOGENE	Transpression	Alkaline Very differentiated	↘↖
MAASTRICHTIAN UPPER CRETACEOUS	Transpression Transtension	Alkaline Alkaline, tholeiitic	⤢
LOWER CRETACEOUS	Transtension	Alkaline, tholeiitic	↔
JURASSIC	Transtension	Alkaline	⤡
TRIASSIC	Transtension	Alkaline	↕
PALEOZOÏC	Transtension	Alkaline	↕
UPPER PRECAMBRIAN	Transpression	Calc-alkaline	→←

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