# I. The lower Miocene orogeny (Alpine orogeny, Maghrebide belt)

## I.1 Introduction

During the Lower Miocene period, North African countries, has been object to a critical event of tectonic compression and nappe emplacement along the southern Mediterranean margin. This event ' Alpine-orogen', originate from the subduction and closing of the Tethyan Ocean, as well as the interaction between the European and African tectonic plates.


Figure 1a: the Alpine orogenic segments across the Mediterranean sea.

This arcuate (Arc form), mostly continuous fold-and-thrust belt encircles back-arc basins generated by the lateral evolution of two arcs (Gibraltar to the west, Calabria to the east). The back-arc extension commenced approximately 30 to 35 million years ago.

The North African segment, or the so called 'Maghrebide chain', stretches over 2000 km from Southern Spain to the Calabro-Sicilian arc. It is subdivided into internal domain, the external domain those separated by flyschs basins.

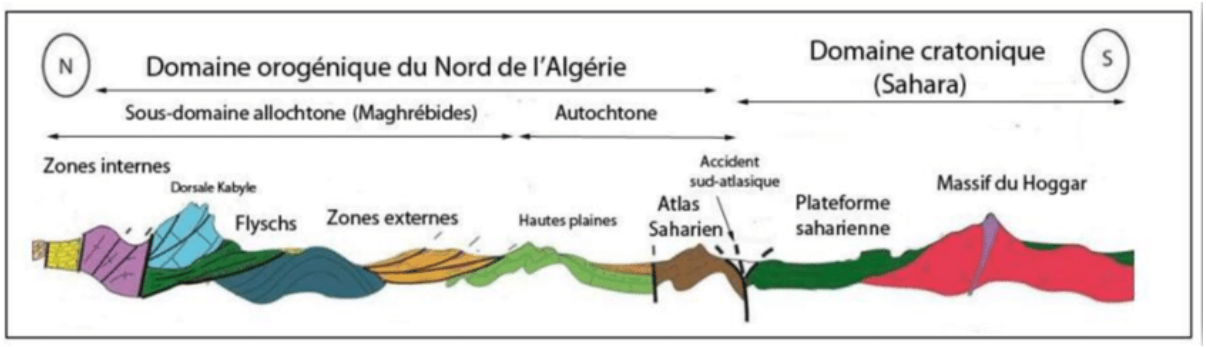


Figure 1b: Hierarchical structuration of different geologic domain of Algeria from north to south

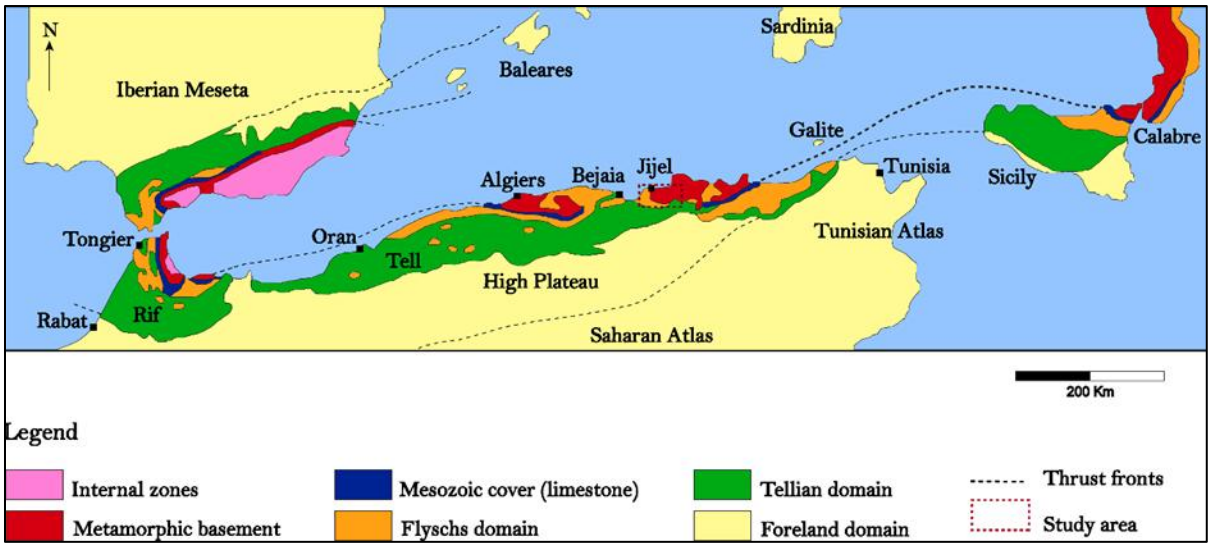


Figure 2: Sketch map showing the extention of the Maghrebide chain across the southern miditerranean ridge (Durand-Delgua, 1980)

## I.2 THE INTERNAL DOMAIN: THE KABYLIDES

The internal domain comprises the Kabylian basement (metmorphic massifs) and its sedimentary cover (limestone mesozoic cover or dorsal)

### I.2.1 The Kabylian basement

The kabylian basement domain is represented by a number of metamorphic basements that stretch from west to east across multiple metamorphic massifs, those of Tenès, Chenoua, Algiers, Great Kabylia, Lesser Kabylia, and Edough. These massifs are belived to be formed during the Paleozoic era, but particularly the panafrican age for the Edough massif.

The latter spanning approximately 120 km in length and 30 km in width. The massifs, due to North-South Miocene compression are believed to be displaced a long at least 30 Km southward, hence, leading to the thrusting of recent nappes and units such as flyschs formations.

They comprises most often two metamorphic units:

- ☑ A lower unit of hight metamorphic grade, and composed of gneisses with quartzites and amphibolites
- ☑ An upper unit of meduim to low metamorphic grade, and formed of satin schists or phyllites, sandstones, marble…etc.

### I.2.2 The sedimentary ridge cover (limestone dorsal)

- Represented by Paleozoic terms, followed by (predominantly) carbonate levels

- From the Triassic to the Eocene (Kabyle Dorsale or calcareous chain)

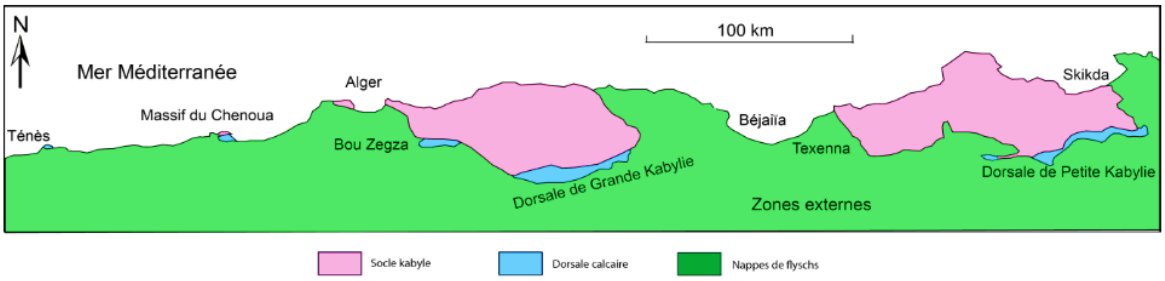


Figure 3: Distribution of outcrops of the Limestone cover (dorsale clacire) along the Algerian margin (modified from Bouillin (1992, In Abassène, 2016).

A number of units can be identified, arranged from north to south:

### I.2.2.1 The Internal Dorsal

In the Lesser Kabylia, it is represented by the Kef Sebargoud series (Skikda), showing a complete series on a Paleozoic substrate consisting of:

* Conglomerate at the bottom

* Limestone on the top (Permian-Triassic to Neocomian).

* Overlain by discordant neritic limestones rich in benthic microfauna (algae and foraminifera) from the Lower and Middle Eocene (Ypresian and Middle Lutetian).

### I.2.2.2 The median dorsal

It is mostly of Permian-Triassic, Lias, and Lower Cretaceous formations,Upper Cretaceous to Lower Lutetian marl-limestone formations containing pelagic microfauna.

### I.2.2.3 The external dorsal

In the Lesser Kabylia, it is represented by the Rhédir, Mera, and Tengout series, characterized by Upper Cretaceous and detrital lacunar Eocene deposits. It consists of silicified limestones covered by Campanian conglomerates. It is situated in anomalous contact with the Flyschs. Raoult (1974) demonstrated that the limestone chain along the Skikda-Constantine transverse experienced considerable tangential tectonics with a southern vergence from the conclusion of the Lutetian (Eocene).

### I.2.3 Paleogeographic organization of the Kabyle ridge (limestone)

The North African limestone dorsals show a segment of the southern European continental slope. It is distinguished by: Lias to Middle Eocene formations, a tectonic aesthetic in scales. These scales may also encompass Paleozoic deposits together with Upper Eocene and Oligocene strata.

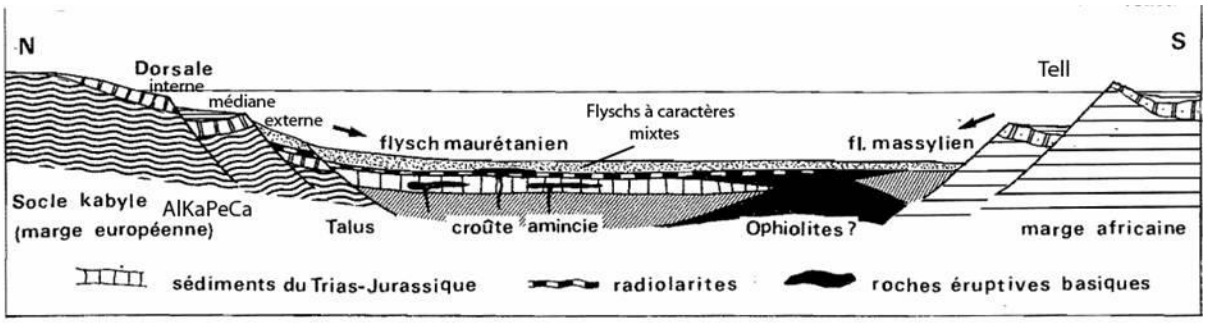


Figure 4: Distribution of the so called Limestone dorsale in N-S profile.

The varying scales of the ridge consist of clearly distinct structures. The facies indicate progressively deeper sedimentation conditions as one transitions from the internal scales to the middle scales and subsequently to the outer scales witch signifies that the three parts of the ridge exhibit a sloped area adjacent to a slender platform (inner and median ridge):

- The internal units contain coastal or epicontinental deposits.
- The middle units have more profound marly deposits ranging from the Cretaceous to the Eocene epochs.
- The external units frequently exhibit Dogger-Malm radiolarites and proximal conglomeratic flysch from the Upper Cretaceous to Paleocene-Eocene epochs.