The Precambrian basement of Morocco (Sahara, Anti-Atlas and Meseta): a review

André Michard*
Université Paris-Sud, Orsay 91405, France
*E-mail: andremichard@orange.fr

Morocco is the most uplifted part of North Africa, and as a consequence its Precambrian crust is widely exposed. During the last couple of decades a lot of detail geological mapping including U-Pb age measurements have been performed that greatly improved our knowledge of its evolution. In the present review of the state of the art we consider the autochthonous domains of Morocco from south to north (Fig. 1), leaving aside the northernmost Rif domain whose Precambrian rocks belong to an Alpine European allochthon. *The Sahara Domain* exposes to the east (Awserd) the Archean part of the Reguibat Rise of the West African Craton (WAC), with a 3.03-2.96 Ga greenstone belt surrounded by TTG formed between 3.1-3.0 Ga and intruded at 2.46 Ga by high-K feldspathoid syenites. To the west, the Variscan Mauritanide thrust nappes of the Oulad Dlim massif include varied Precambrian units, some of them derived from the Archean autochthon intruded by 1,85 Ga carbonatites whereas the others are made up of Pan-African metagabbros and charnockites dated between 635-605 Ma. Further to the NE, the *Anti-Atlas Domain*, which is the foreland of both the Mauritanides and Meseta Variscan belts, exposes two types of Precambrian terrains beneath a common, weakly deformed Late Ediacaran-Paleozoic unconformable cover. The southern inliers of the central and western Anti-Atlas expose Paleoproterozoic rocks comparable to those of the eastern Reguibat Rise (Algeria). They shows calc-alkaline granites dated at 2180 Ma, likely emplaced in a subduction framework, and synorogenic, 2050-2030 Ma peraluminous granites. Metasedimentary (Birimian) screens including felsic lavas have been locally dated at 2072 Ma. These Eburnian massifs are overlain by folded remnants of their detached, previously unconformable siliciclastic and carbonate cover, labeled the Taghdout Group, recently dated between 1800-1600 Ma. Cross-cutting, 1760-1630 Ma-old dolerites are observed both in the Eburnian basement and its detached cover, suggesting a major Mesoproterozoic extensional regime along the northwestern WAC margin. In contrast, the northern and eastern Anti-Atlas inliers expose rock units typical of the Neoproterozoic Pan-African Belt, thrust over the WAC margin. The suture zone is underlined by the Bou Azzer and Siroua dismembered supra-subduction ophiolites, with accretion ages scattered between 761-697 Ma. They are associated with orthogneissic remnants of two island arcs dated at 770-760 Ma and 755-750 Ma, respectively. Two collision phases are dated by syntectonic intrusions at ca. 700 and 650 Ma. Thick orogenic greywackes (Saghro Group) accumulated between ca. 620-600 Ma next to a new volcanic arc. They were folded by the last, >580 Ma Cadomian phase of the Pan-African cycle. The cycle is sealed by the Late Ediacaran Ouarzazate Group volcaniclastic formations, whose andesite breccias, felsic ignimbrites, domes and granite intrusions are dated between 580-541 Ma. The Pan-African Anti-Atlas Belt connects with the Trans-Saharan Belt to the southeast with some differences in chronology, fold orientation and metamorphic grade. In the second case, the colliding continental block is the eastern Hoggar metacraton (LATEA), whereas in the first case it is the Cadomian Block that today forms the basement of the *Meseta Domain*. The latter domain corresponds to the Variscan basement of the Atlas System. Precambrian outcrops are scarce beneath the folded and metamorphic Paleozoic units. However, 625-590 Ma rhyolites and granites are exposed in some uplifted zones, and inherited zircons at 2 Ga and 700 Ma testify for the widespread occurrence of a typical Gondwana deep crust. An outcropping sliver from the Western Meseta Shear Zone also yielded a 2.05 Ga age. Hence the Meseta Domain drifted away from Gondwana during the Early Neoproterozoic before coming back at home during the Cryogenian-Ediacaran. The only Meseta unit of more exotic origin is possibly indicated by a sample of charnockite collected at 2600 m depth on the Mazagan escarpment

and dated by K-Ar at 900-1000 Ma. This sample could correspond to a piece of Grenville basement left by Laurussia on the Gondwana Atlantic margin during the Pangea breakup.

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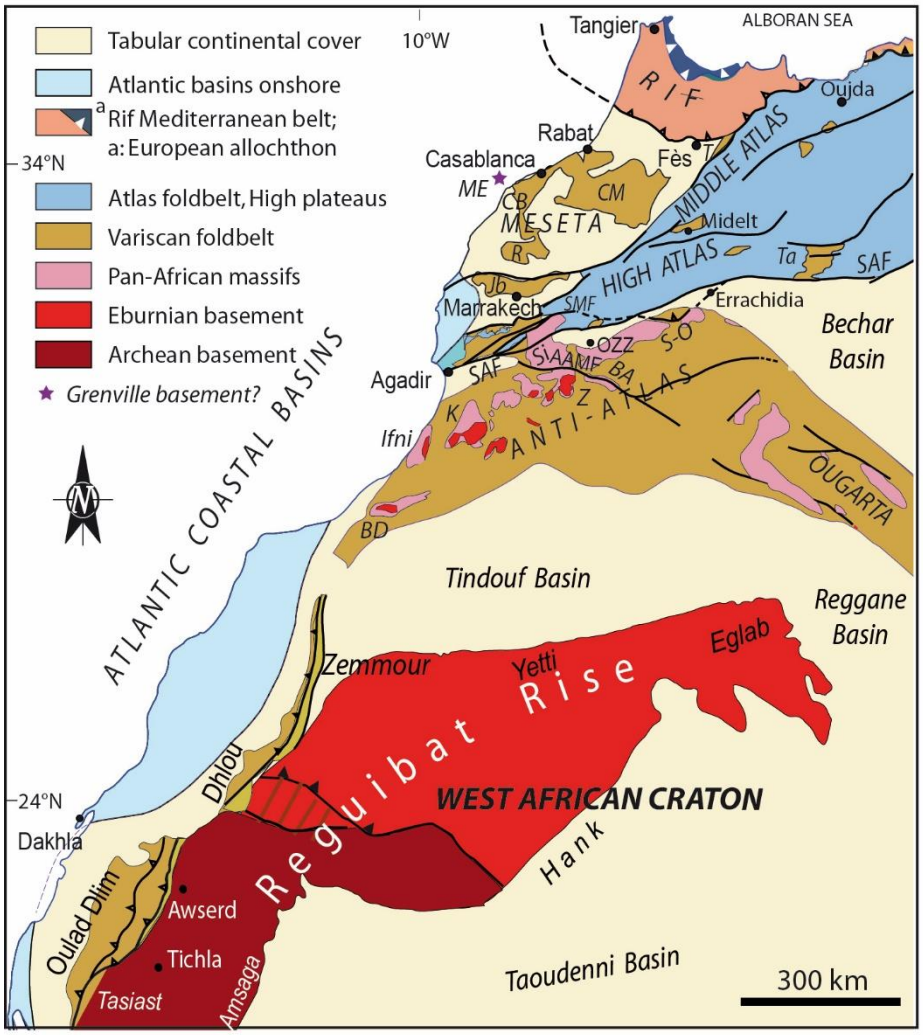

Fig. 1: The Moroccan geological domains, after Michard et al., 2017, modified. AAMF: Anti-Atlas Main Fault; BA: Bou Azzer; BD: Bas-Draa; CB: Coastal Block; CM: Central Massif; Jb: Jebilet; K: Kerdous; ME: Mazagan escarpment; OZZ Ouarzazate; R: Rehamna; SAF: South Atlas Fault; Si: Siroua; SMF: South Meseta Fault; S-O: Saghro-Ougnat; T: Tazekka; Ta: Tamlelt; Z: Zenaga.

References

Most of the references used in this review are listed in Géologues, 194 (Morocco Special Issue, sept. 2017), published by the Société Géologique de France, available at http://www.geosoc.fr/numero-actuel-geologues.html