Chapter 3
The Variscan Belt

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This chapter is a tribute to Jacques Destombes and Solange Willefert, and to the memory of Henri Hollard, whose names are associated to the deciphering of the Paleozoic stratigraphy of Morocco. We want to also evoke the name of Martin Burkhard who renewed our understanding of the Anti-Atlas tectonics.

In the western Maghreb, the Variscan (Hercynian) belt extends into the Meseta and Atlas domains, being widely exposed in the large Paleozoic massifs of the Moroccan Western Meseta and Western High Atlas, whereas it forms smaller massifs in the Eastern Meseta, Middle Atlas and Central-Eastern High Atlas (cf. Chap. 1, Fig. 1.11). Altogether, these massifs define the Meseta Domain, whose late Paleozoic evolution was accompanied by significant metamorphism and magmatic intrusions. This domain is also referred to as the Meseta Block (although it was not a single block until the end of the Variscan Orogeny) and corresponds to the south-westernmost segment of the Variscan belt of Europe.

Another strongly deformed Variscan segment is present within the Adrar Souttouf and Dhlou (Ouled Dehlim) massifs of south-western Morocco. These massifs are entirely distinct from those of the Meseta Domain, both geographically and structurally, and correspond to the northern tip of the Mauritanide belt.

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The Anti-Atlas belt extends south of the Meseta Domain and east of the hypothetic northern continuation of the Mauritanides beneath the Tarfaya coastal basin (Fig. 1.11). The Anti-Atlas Paleozoic series were also affected by the late Paleozoic orogeny, although more weakly than those of the neighbouring Variscan segments. Thus, the Anti-Atlas can be regarded as the common foreland fold belt of both the Mesetan Variscides and northernmost Mauritanides. The Anti-Atlas belt connects to the east with the coeval, intracontinental Ougarta belt that extends essentially into the Algerian territory.

Finally, Variscan units are also exposed in the Alpine nappes of the Internal Rif. These nappes formed at the expense of an allochthonous terrane (Alboran Domain), whose pre-Alpine relationships with the Meseta Domain are debatable. They are described in the chapter of this book dedicated to the Rif Orogen (Chap. 5).

3.1 The Anti-Atlas Fold Belt

3.1.1 An Ancient Fold Belt Exposed in a Young Mountain Range

References: In addition to the classical data presented in Choubert (1952), Michard (1976), Piqué and Michard (1989), and Fabre (2005), this introduction is based mainly on the recent works by Frizon de Lamotte et al. (2000), Missenard et al. (2006), Robert-Charrue (2006), Gutzmer et al. (2006), and Malusà et al. (2007), who emphasize the importance of the Mesozoic-Cenozoic events. Concerning the Triassic intrusions, the general framework is given in Chap. 1 (this volume), whereas the problem of the “pseudo-folded” sills (described by Hollard, 1973) is discussed by Smith et al. (2006) on examples from SW Algeria. See also Chap. 7, this volume.

The Anti-Atlas mountain range parallels the High Atlas at the northern border of the Saharan platform (Fig. 3.1). Both mountain ranges are in direct contact in the Siroua-Ouzellarh area, whereas they are separated by narrow Neogene basins west (Souss Basin) and east (Ouarzazate and Errachidia-Boudenib Basins) of the Siroua plateau. The elevation of the Anti-Atlas axis is generally close to 2000–2500 m (up to 2700 m in the J. Sagho), except in the Siroua area, which is topped by a Neogene volcano culminating at 3300 m. Therefore, the Anti-Atlas can clearly be considered as a young mountain range, uplifted contemporaneously with the High Atlas as the result of both plate convergence and asthenosphere uplift (see Chap. 1, Sect. 1.5). Recent volcanism is widespread in the Siroua and Sagho massifs, as in the Middle Atlas and Missour Basin regions (see Chap. 4).

However, the Anti-Atlas is also a large Paleozoic fold belt, characterized by numerous inliers of Precambrian basement, the so-called “boutonnières” (see Chap. 2), cropping out all along the mountain range axis, which is, in fact, shifted toward the northern border of the fold belt. Each inlier corresponds to a more or less faulted antiform where Precambrian rocks are exposed due to post-Variscan erosion (cf. Chap. 2, Figs. 2.2 and 2.9). In the following account we describe, first, the