

U-Pb Zircon Geochronological and Petrologic Constraints on the Khenifra Volcanic Field, (Western Meseta, Morocco)

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The Permian Khenifra Volcanic Field (KVF), part of the European North West African Magmatic Province (EUNWA or EUNWAMP) [1], formed during the Carboniferous-Permian as a result of the gravitational collapse of the Variscan orogenic belt, marking the early fragmentation of Pangaea. KVF's volcanic history consists of three distinct stages.

The first stage involved extrusive and effusive andesitic magmatism. In the western KVF, rhyodacitic pyroclastic breccias were deposited, followed by the formation of a composite cumulo-dome with hybrid lavas and widespread andesitic flows. The second stage was primarily rhyolitic and explosive, beginning with aerial fallout deposits, followed by rhyolitic explosion breccias, dacitic flows, and pyroclastic deposits. The third stage involved late dolerite dike intrusions. The first two stages display a calc-alkaline orogenic signature, while the final reflects a transitional anorogenic event [2].

Previous age determinations include a K-Ar whole-rock age of 264 ± 10 Ma from a rhyolitic breccia at Jbel Bou Hayati, with fossil wood at the same site indicating an early Permian age [2]. Further LA-ICP-MS U-Pb zircon dating refines the chronology [3]. A dacite from Jbel Taghat's lower lava flows dates to 295.1 ± 2.9 Ma, marking the earliest volcanic activity. The Sidi Tir dome provided ages of 290.3 ± 2.1 Ma (rhyolite) and 287.9 ± 3.8 Ma (hybrid lavas), suggesting about 2 million years of emplacement. Rhyolitic pyroclastic fall deposits at Sidi Tir show two age clusters: 307.3 ± 2.6 Ma and 290.6 ± 2.6 Ma, with the latter as the eruption age. The upper dacitic lavas at Talat Mechtal, dated to 280.3 ± 2.1 Ma, mark the final volcanic pulse, consistent with lithostratigraphic data suggesting post-Cisuralian sedimentation at Khenifra [2].

[1] Doblas et al. (1998). Permo-Carboniferous volcanism in Europe and northwest Africa: a superplume exhaust valve in the centre of Pangaea? *Journal of African Earth Sciences*, Volume 26, Issue 1, 89-99.

[2] Youbi et al. (1995). Volcano-tectonical history of the Khénifra permian massif (Southeastern of Central Morocco). *Geodinamica Acta*, Volume 8, Issue 3, 158–172.

[3] Domeier et al. (2021). On the Early Permian shape of Pangea from paleomagnetism at its core. *Gondwana Research*, Volume 90, 171-198.