

vegetation. This situation is also supported by the reconstruction of the NAO pattern during the Holocene from the mass balance of glaciers in Norway (Nesje et al., 2001).

11. GEOMORPHOLOGY, SEDIMENTOLOGY AND PETROGRAPHY OF QUATERNARY TRAVERTINES (TETOUAN-NORTHERN MOROCCO): IMPLICATIONS FOR DEPOSITIONAL PALAEOENVIRONMENTS AND CLIMATIC CONTEXT

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The continental carbonates, such as travertine, are among the sediments recording climate change mainly during quaternary times. Their lithofacies and petrofacies are useful for reading related hydrologic, geomorphologic, climatic processes and depositional palaeoenvironments. Thus, the present work deals with analysis and interpretation of the main facies association of Tetouan city travertine cliffs and terraces. According to morphologic, sedimentologic and petrographic investigations coupled with 1/5000 scale mapping, four main facies associations were recognized and show from the top to bottom: *i*) barrage and cascade limestones, *ii*) base of the cascade limestone breccias and blocks, *iii*) lacustrine detrital deposits and *iv*) carbonate pedogenic crusts.

The first facies association of barrage is characterized by travertinous limestones with a wide textural features: *i*) massive micritic limestone, *ii*) brecciated limestone with remnants of calcified leaves, stems of macrophytes and mollusks, *iii*) thin-layered parallel calcite sheets (probably algal mats) or calcite layers to remnants of herbaceous plants, *iv*) soft black pocket marls with remnants of calcified leaves, stems and mollusks (i.e. terrestrial and fresh water gasteropods).

The second facies association of base of the cascade, located at the east and the central part of the escarpment, is made of fallen blocks embedded in multi-colored crystalline travertine bands.

The third facies association is constituted by detrital sediment strata with an obvious contribution from barrage and cascade limestones.

The fourth facies association shows mainly crusts usually topping outcrops of lacustrine sediments, erosive surfaces on or within cascade limestones. Vertical NNE-SSW fracture sets are found in the Oued Martil slope, fulfilled by carbonate crust-like.

Tetouan travertine petrofacies are mainly represented by: *i*) rolled crusts made of different morphological types: cylindrical, oncolites, flat and corrugated crystallized around various nucleus. *ii*) detrital fine to medium grained calcareous sands, *iii*) homogenous micritic facies with primary micrite precipitation occurred during lower flow and calmer waters probably in relation to microbial activities *iv*) Micrite-coarse banded crystalline sheets consist of palisade calcite crystals related to cyclic changes in chemical, physical and/or environmental