Benha Journal of Applied Sciences (BJAS) print: ISSN 2356–9751
Vol. (10) Issue (2) (2025), (111-113) online: ISSN 2356–976x
https://bjas.journals.ekb.eg/
Applied and Basic Science

Mountain of the Dead: A remarkable geoheritage site for sustainable socio-economic development in Siwa Oasis, Egypt

Nada A. Ayoub and Emad S. Sallam
Department of Geology, Faculty of Science, Benha University, Benha, Egypt
E-mail: nadaabdelfattah932@gmail.com

The geological heritage sites in the Great Sahara in northern Africa have an extreme importance as they offer a lot of socio-economic benefits and employment opportunities to the inhabitants of this desolate desert. Additionally, these heritage sites provide significant scientific, educational, cultural and aesthetic values [1–17]. Among these interesting sites is Siwa Oasis, which is located in the far west of Egypt along the Libyan Desert. The oasis tolerates some forms of life in this hyper-arid desert. Finding new geology-related resources is very necessary for sustainable development of such remote oases in the Sahara. Geologically, Siwa Oasis is a large naturally excavated depression originated primarily through long periods of karstification and severe erosion, which left some residual hills behind [18–20]. These hills constitute several spectacular geomorphological landforms such as buttes, mesas, inselbergs and mushroom rocks, which are scattered on the floor of the depression.

Fig. 1. Mountain of the Dead (Gebel Al-Mawta) at Siwa Oasis.

Located at Siwa Oasis, the Mountain of the Dead (Gebel Al-Mawta in Arabic; Fig. 1) is a splendid heritage site that contains common geological (including geomorphological, paleontological, sedimentological and palaeogeographical types) and cultural (principally archaeological) heritage criteria [21]. It is an isolated, conical-shaped hill formed mainly by differential weathering, the process by which the softer rocks have been removed away, whereas the harder rocks were left behind. The hill consists of middle Miocene siliciclastic-carbonate sediments (~80 m thick), which were deposited in a neritic shallow-marine environment [22]. These sediments contain abundant invertebrate fossils of mollusks, benthonic foraminifers and coral reefs. They also contain numerous biozones of ichnofossils *Thalassinoides*, which were produced predominantly by thalassinideans of decapod *crustaceans* [23], forming a three-dimensional rigid framework of branched cylindrical burrows interconnected by vertical and oblique shafts [24]. Such fossil diversity gives ample information about coastal and shallow-marine paleoecosystems [22–25]. Geomorphosites aid significantly to understand the development of earth sciences involving geological, palaeogeographical and paleoenvironmental disciplines [26]. In this sense, the Mountain of the Dead provides important clues to the origin and geological evolution of the Siwa Depression and the other geologically similar depressions in northern Africa [27].

Considering its archaeological value, some residual hills on the floor of Siwa Oasis were suitable sites for building temples and ancient towns, e.g., the Amun Temple on the Aghormi hill and ancient Shali and Aghormi towns. Noteworthy that the houses and other buildings of the ancient Shali town (fortress) were built from the evaporite stone, locally called the *kerchief*, which is a specific natural substance consisting of wet mud-brick mixed with rock-salt and straw, and then dried in the sun [28–30].

On the other hand, some other residual hills were used as cemeteries to entomb the dead. In this regard, the Mountain of the Dead was used as a burial cemetery dating back to the Pharaonic era (Twenty-sixth Dynasty: 663–535 B.C.), and it is believed that burials in this hill continued until the end of the Roman time. The hill is pockmarked with thousands of tombs carved in all its sides and at different levels, which give the hill a characteristic beehive structure. The architecture of the tombs varies from small pits to large burial rooms. The site is famous for four superb tombs, namely the Si-Amun, Mesu Isis, Niperbathot and Crocodile, which are aesthetically decorated with exquisite ancient wall reliefs and paintings.

Given its conspicuous geological and archaeological values, the Mountain of the Dead is an attractive and promising site that promotes cultural and geoheritage conservation, and ensures sustainable socio-economic development of Siwa Oasis in the eastern Sahara Desert.

References

[1] Sallam, E.S., Ruban, D.A. (2017). Palaeogeographical type of the geological heritage of Egypt: anew evidence. *Journal of African Earth Sciences*, 129: 739-750.

[2] Sallam, E.S., Ruban, D.A. (2019). Ancient tufa and semi-detached megaclasts from Egypt: evidence for sedimentary rock classification development. International *Journal of Earth Sciences*, 108 (5): 1615-1616.

[3] Sallam, E.S., Fathy, E.E., Ruban, D.A., Ponedelnik, A.A., Yashalovam, N.N. (2018). Geological heritage diversity in the Faiyum Oasis (Egypt): A comprehensive assessment. *Journal of African Earth Sciences*, 140: 212-224.

[4] Al-Dhwadi, Z., Sallam, E.S. (2019). Spheroidal "Cannonballs" calcite-cemented concretions from the Faiyum and Bahariya depressions, Egypt: evidence of differential erosion by sand storms. *International Journal of Earth Sciences*, 108: 2291-2293.

[5] Abd-Elhakim, R., Elsamee, M.A., Sallam, E.S. (2021). The Dababiya Quarry (southeast Luxor, Egypt): a unique palaeogeographical geosite. *International Journal of Earth Sciences*, 110, 1349-1352.

[6] Ruban, D.A., Sallam, E.S., Wanas, H.A. (2019). Middle–Late Jurassic sedimentation and sea-level changes on the northeast African margin: A case study in the Khashm El-Galala area, NE Egypt. *Journal of African Earth Sciences*, 156, 189–202.

[7] Ruban, D.A., Sallam, E.S., Khater, T.M., Ermolaev, V.A. (2021). Golden Triangle Geosites: Preliminary Geoheritage Assessment in a Geologically Rich Area of Eastern Egypt. *Geoheritage*, 13 (3): 54.

[8] Sallam, E.S., Abd El-Samee, M.A., Bobrysheva, O.R., Yashalova, N.N., Ruban, D.A. (2020). Geological heritage of Luxor and its vicinities, Egypt: a new assessment and geotourism perspectives. *Arabian Journal of Geosciences*, 13: 76.

[9] Sallam, E.S., Ruban, D.A., Mostafa, M.T., Elkhodery, M.K.H, Alwilily, R.L., Molchanova, T.K., Zorina, S.O. (2020). Unique desert caves as a valuable geological resource: first detailed geological heritage assessment of the Sannur Cave, Egypt. *Arabian Journal of Geosciences*, 13: 141.

[10] Sallam, E.S., Ruban, D.A., Ermolaev, E.A. (2022). Geoheritage resources and new direction of infrastructural growth in Egypt: From geosite assessment to policy development. *Resources Policy*, 79: 103127.

[11] Sallam, E.S., Abou-Elmagd, K. (2021). Paleospring freshwater tufa carbonates of the Kurkur Oasis Geosite (southern Egypt): archives for paleoenvironment and paleoclimate. International Journal of Earth Sciences 110: 1073-1075.

[12] Sallam, E.S. (2022). Speleothems of the Wadi Sannur cave (Eastern Desert, Egypt): a well-preserved archive of paleoenvironmental and palaeoclimatic changes. *Int J Earth Sci (Geol Rundsch)*, 111: 1269-1271.

[13] Mashaal, N.M., Sallam, E.S. (2023). Mid-Eocene (Bartonian) composite alluvial paleosol succession in NE Egypt: a key to terrestrial paleoenvironmental and palaeoclimatic reconstruction. *International Journal of Earth Sciences*, 112: 1311-1314.

[14] Mousa, F.A., Abu El-Hassan, M.M., Wanas, H.A., Sallam, E.S., Ermolaev, V.A., Ruban, D.A. (2023). Geoheritage meaning of past humidity in the central Western Desert of Egypt. *International Journal of Geoheritage and Parks*, 11: 331-348.

[15] Mousa, F.A., Ruban, D.A., Abu El-Hassan, M.M., Sallam, E.S. (2024). Late Mesozoic–

Cenozoic geoheritage resources of the Kharga Oasis (Egypt): Novel assessment, exploitation perspectives, and policy implications. *Resources Policy,* 91: 104959.

[16] Mousa, F.A., Abu El-Hassan, M.M., Sallam, E.S. (2024). Terminal Holocene palaeolake mud pans (playas) of Farafra Oasis, Western Desert, Egypt: palaeoenvironmental and palaeoclimatic implications. *International Journal of Earth Sciences*, 113, 657–660.

[17] Errami, E., Sallam, E.S., El-Ekhfifi, S.S., Kamh, S.Z., Muftah, A.M., Ben Ismail-Lattrache, K., El Hamidy, M., El Kabouri, J., El Kaichi, A., Chatir, A., Bendaoud, A. (2024). Geoheritage, Geotourism, and Geoparks in North Africa: Current State. In: Z. Hamimi et al. (eds.), The Geology of North Africa, Regional Geology Reviews, 631-660.

[18] Plyusnina, E.E., Sallam, E.S., Ruban, D.A. (2016). Geological heritage of the Bahariya and Farafra oases, the central Western Desert, Egypt. *Journal of African Earth Sciences*, 116: 151-159.

[19] Sallam, E.S., Ponedelnik, A.A., Tiess, G., Yashalova, N.N., Ruban, D.A. (2018). The geological heritage of the Kurkur-Dungul area in southern Egypt. *Journal of African Earth Sciences*, 137: 103-115.

[20] Mashaal, N.M., Sallam, E.S., Khater, T.M. (2020). Mushroom rock, inselberg and butte desert landforms (Gebel Qatrani, Egypt): Evidence of wind erosion. *International Journal of Earth Sciences,* 109: 1975-1976.

[21] Sallam, E.S., Abd El-Aal, A.K., Fedorov, Y.A., Bobrysheva, O.R., Ruban, D.A. (2018b). Geological heritage as a new kind of natural resource in the Siwa Oasis, Egypt: The first assessment, comparison to the Russian South, and sustainable development issues. *Journal of African Earth Sciences*, 144: 151-160.

[22] Abdel-Fattah, Z.A., Kora, M.A., Ayyad, S.N. (2013). Facies architecture and depositional development of Middle Miocene carbonate strata at Siwa Oasis, Northwestern Egypt. *Facies*, 59: 505-528.

[23] Myrow, P.M. (1995). "*Thalassinoides* and the enigma of Early Paleozoic open-framework burrow systems". PALAIOS. 10 (1): 58–74.

[24] El-Sabbagh, A., El-Hedeny, M., Al Farraj, S. (2017). *Thalassinoides* in the Middle Miocene succession at Siwa Oasis, northwestern Egypt. *Proceedings of the Geologists' Association*, 128: 222-233.

[25] Ruban, D.A., Sallam, E.S. (2016). Bajocian-Bathonian (Middle Jurassic) sea-level changes in northeastern Egypt: Synthesis and further implications. *Journal of African Earth Sciences*, 120, 141-145.

[26] Ruban, D.A. (2017). Geodiversity as a precious national resource: A note on the role of geoparks. *Resources Policy*, 53: 103-108.

[27] Gindy, A.R., El-Askary, M.A. (1969). Stratigraphy, structure, and origin of the Siwa Depression, Western Desert of Egypt. American Association of Petroleum Geologists Bulletin 53: 603-625.

[28] Rovero, L., Tonietti, U., Fratini, F., Rescic, S. (2009). The salt architecture in Siwa oasis - Egypt (XII-XX centuries). *Construction and Building Materials,* 23: 2492-2503

[29] Abdel-Motelib, A., Taher, A., El Manawi, A.H. (2015). Composition and diagenesis of ancient Shali city buildings of evaporite stones (kerchief), Siwa Oasis, Egypt. *Quaternary International*, 369, 78-85.

[30] Ruban, D.A., Tiess, G., Sallam, E.S., Ponedelnik, A.A., Yashalova, N.N. (2019). Combined mineral and geoheritage resources related to kaolin, phosphate, and cement production in Egypt: conceptualization, assessment, and policy implications. *Sustainable Environment Research*, 28: 454-461.