

Geology of Jordan: An overview

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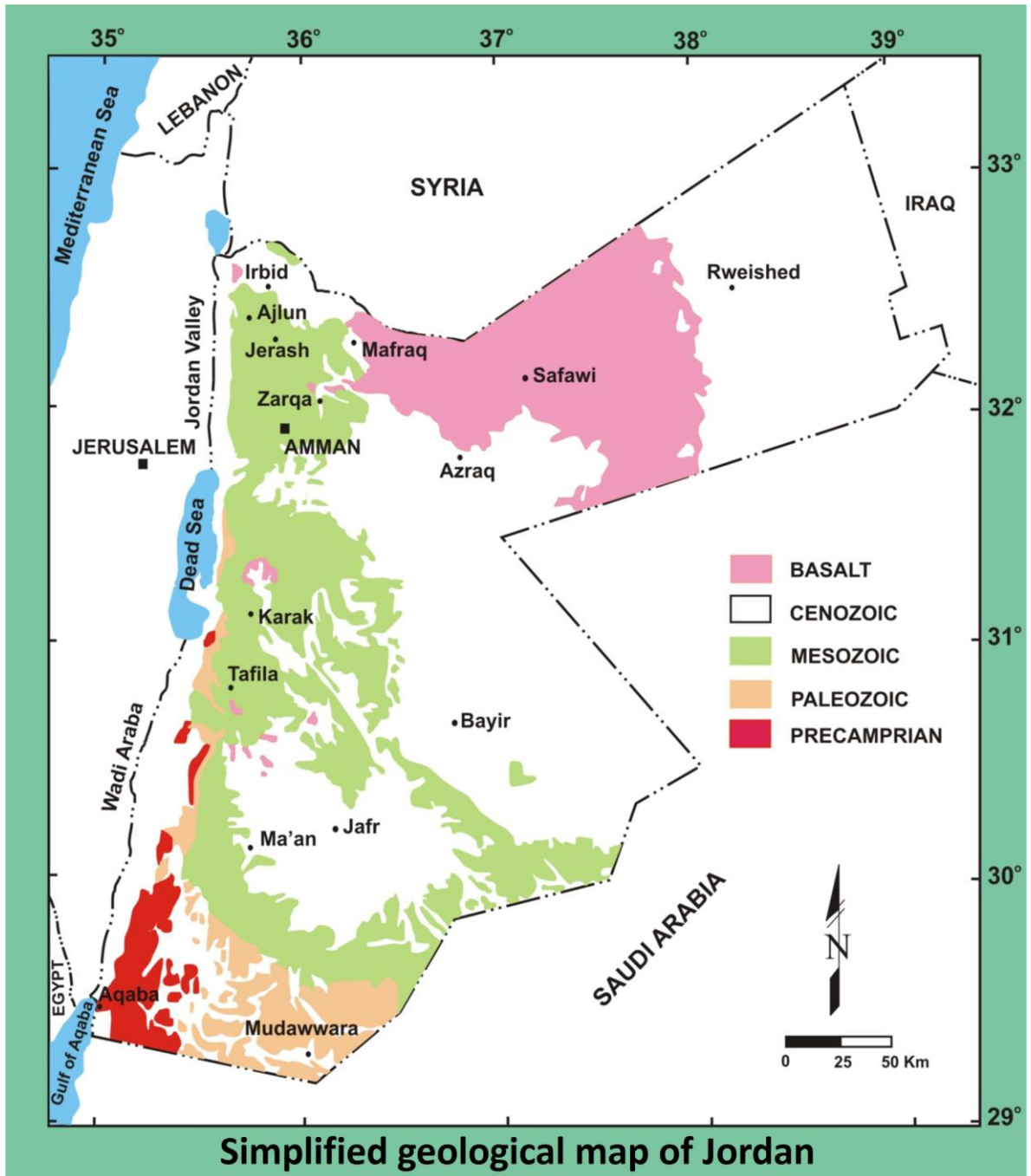
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Introduction

Jordan is distinguished by the existence of many naturally outstanding geological sites. This is clear through the diversity of geological features and rocks for most of the geological periods from the late Proterozoic basement rocks to the present-day sediments including a thick sequence of Phanerozoic rocks. Jordan is located along the western border of the Arabian Plate and includes part of the African Rift Valley that encloses the Dead Sea “the lowest point on the Earth”. The geological structures in Jordan are influenced by the NNE movement of the Arabian Plate.

Precambrian :

Precambrian rocks (900-541 Ma) in southwest Jordan represent the northern rim of the Arabian Nubian Shield. It is exposed at the eastern margin of the Rift Valley from Aqaba in the south to the southeastern part of the Dead Sea in the north. East of the rift, Precambrian rocks are dipping north-eastwards underneath thick Phanerozoic sediments. Its lithologies include metamorphics, granitoids, volcanics and conglomerates. These rocks are intruded by numerous dykes of different types. Copper, gold, feldspar, precious metal (i.e. garnet) and decoration stones are the main mineral resources of these rocks.





Palaeozoic Rocks :

A thick sequence of fluvial and marine sediments of Palaeozoic age unconformably overlie the basement rocks and represented by two main groups: 1) Ram Group (Cambrian-Ordovician) is predominantly continental sandstones with restricted marine sandstones and carbonates. 2) Khrayim Group (Ordovician-Silurian) is predominantly marine and contains alternating sandstones, siltstones and clays. The Cambrian-Silurian rocks are of high economic value for Jordan considering the presence of silica sand, copper, manganese, rare earth elements, zirconium, clay and hot shale. Meanwhile, these sediments are potential water reservoirs and possible targets in oil exploration. There are no records of Devonian and Carboniferous periods in Jordan. Permian rocks are represented by restricted exposures of terrestrial siliciclastics.



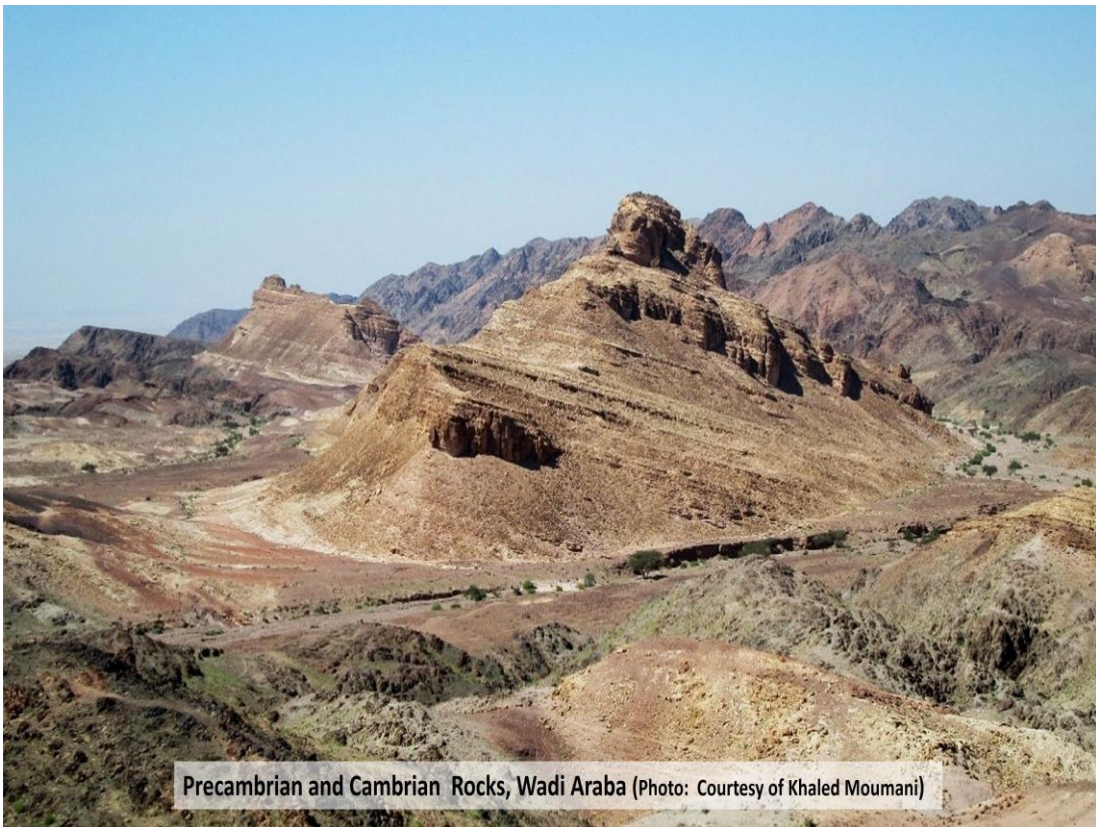
Ordovician sandstones, Wadi Ram (Photo: Courtesy of Khaled Moumani)



Cambrian sandstones, Wadi Ram (Photo: Courtesy of Mohammad Abdelghafoor)



Ordovician sandstones and siltstones, south Jordan (Photo: Courtesy of Khaled Moumani)



Precambrian and Cambrian Rocks, Wadi Araba (Photo: Courtesy of Khaled Moumani)

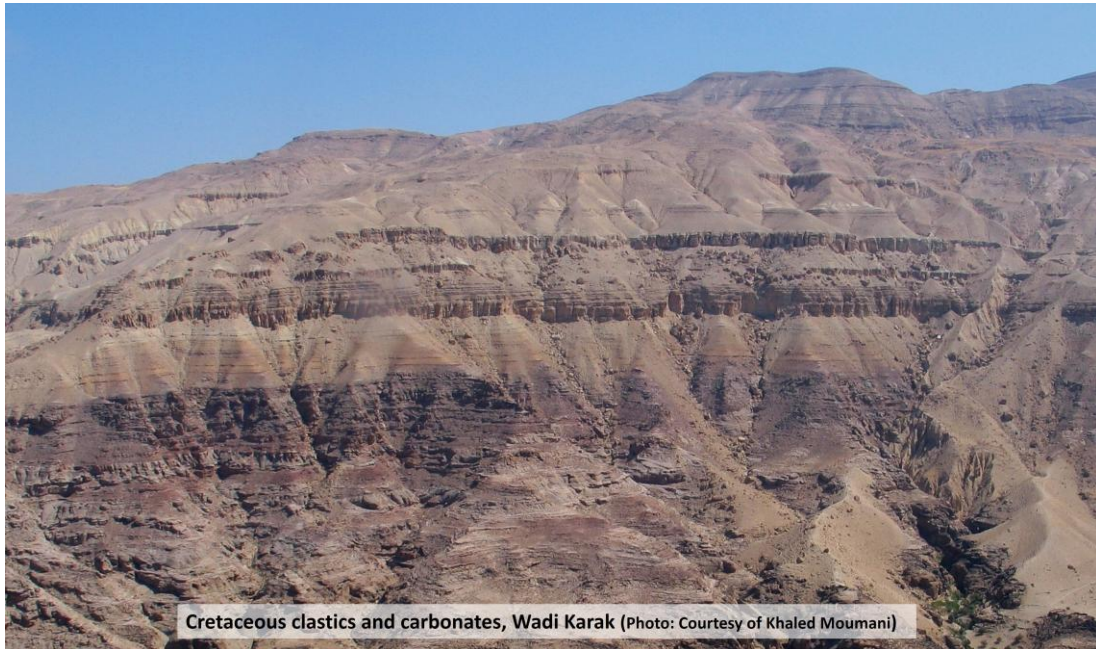
Mesozoic Rocks

Triassic rocks in Jordan are represented by Zarqa Main Group and exposed to the east of the Dead Sea and locally in the western part of River Zarqa. The marginal marine sandstones and siltstones dominate the lower part. Marine carbonate sediments represent the middle part, whereas evaporites are present in the upper part. The Triassic rocks are of high economic value considering the presence of thick gypsum (80 m), which is used for cement industry. **Jurassic rocks** in Jordan are restricted to the east of Jordan Valley side wadis in a region extending for 20km southwards of River Zarqa in northwest Jordan. **Jurassic rocks** are presented by Azab Group, which comprises alternating sandstones, siltstones and limestones that were deposited in a marginal to open marine environments.

Cretaceous rocks :

cover broad areas in Jordan (60 %). It is conventionally divided into four lithostratigraphic groups bounded by regional unconformities. These are Kurnub, Ajlun, Belqa and Batn Al Ghul groups. The early Cretaceous siliciclastics of Kurnub Group overlie Palaeozoic, Triassic and Jurassic strata with a regional unconformity. Throughout most of Jordan, a major transgression of the Tethys Ocean covering most of the country and deposited marine carbonates of Ajlun Group and pelagic sediments of Belqa Group. Marine lithofacies of this period include chalk, marl, limestone, chert and phosphate. Lateral variations across Ajlun Group and the lower part of Belqa Group determine that these units integrated, laterally in southeast Jordan to a coeval mixed terrestrial and marine siliciclastics and carbonates of Batn Al

Ghul Group. Cretaceous rocks are of high economic value for Jordan considering the presence of gypsum, phosphates, oil shale, tar sand, pure carbonates, building stones, uranium, kaolin, dolomite, marble, sandstones, clay and chalk.





Upper Cretaceous siliciclastics, southeast Jordan (Photo: Courtesy of Mohammad Abdelghafoor)



Upper Cretaceous carbonates covered by plateau volcanics, central Jordan (Photo: Courtesy of Ahmad Masri)

Cenozoic Rocks :

Palaeogene sediments predominantly Eocene rocks cover broad areas in Jordan and consist of chalky limestone, chalk, bedded chert and limestone. Eocene rocks represent the last marine sedimentary phase in Jordan before the late Eocene regression of the Tethys Ocean in this region. Oligocene sediments coincide the formation of the Rift Valley and exposed in the Dead Sea area and at the rift margins are represented by Dana Conglomerate. Quaternary sediments are widespread in Jordan and show a great diversity. They range from raised coral reefs (Red Sea) to lake sediments in the Jordan Valley and Jordanian Plateau to alluvial fans predominantly in Wadi Araba and desert deposits. The most impressive of these is the Lake Lisan sediments (63-16 ka).

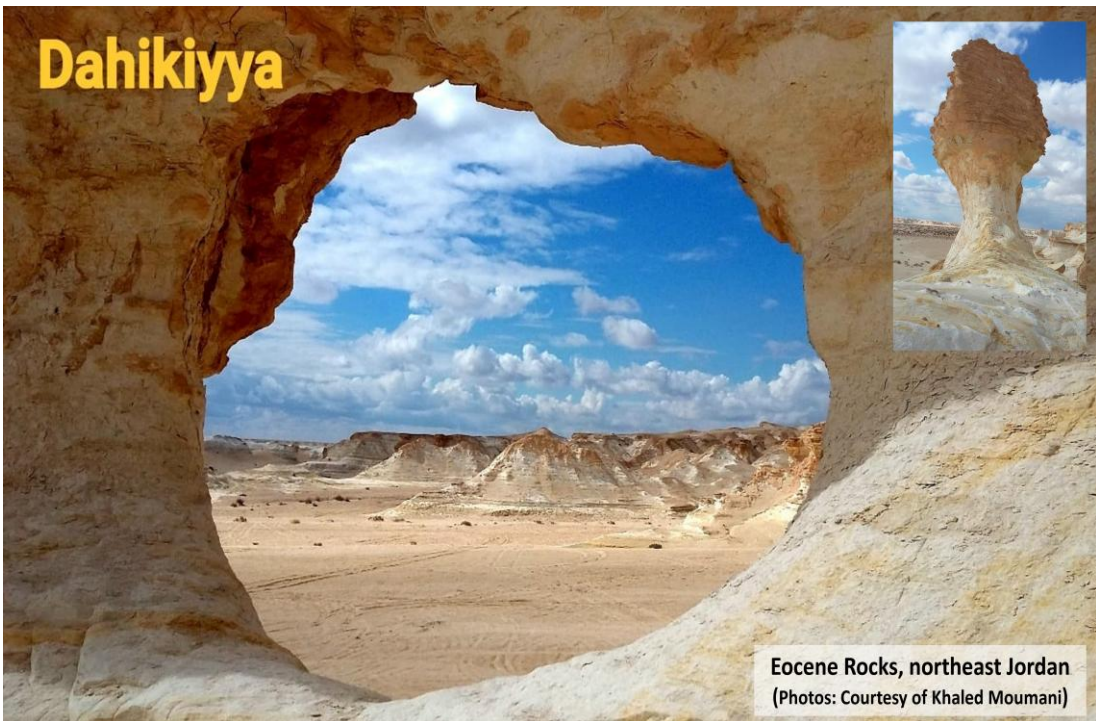


Eocene Rocks, east central Jordan (Photo: Courtesy of Mohammad Abdelghafoor)

Late Quaternary Lake Lisan laminites, Dead Sea (Photo: Courtesy of Khaled Moumani)



Dahikiyya



Eocene Rocks, northeast Jordan
(Photos: Courtesy of Khaled Moumani)

Volcanics :

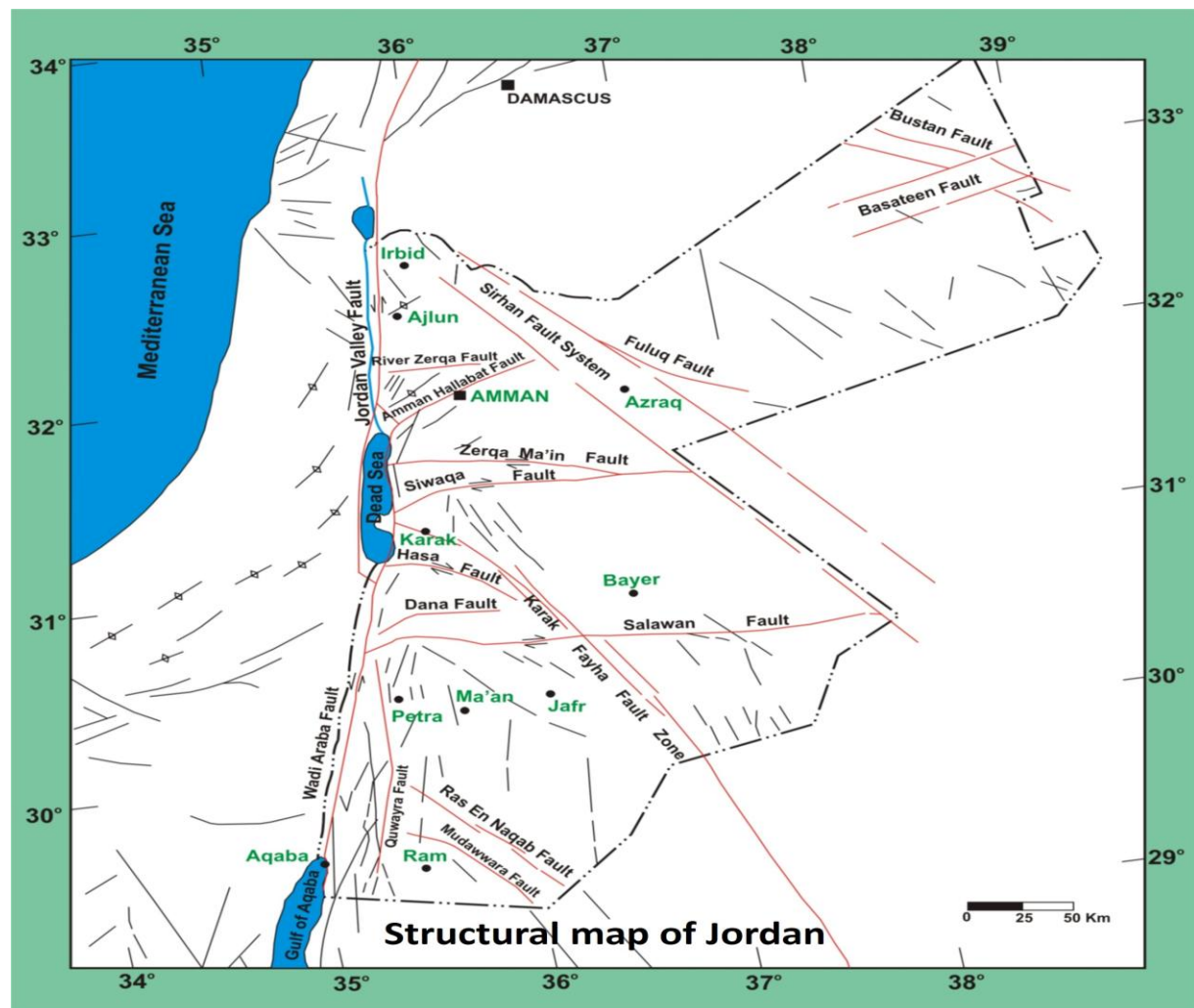
Jordan hosts extensive Neogene basaltic plateau referred to as Harrat Ash Shaam (HAS) that spans 11000 km² in Jordan of pyroclastic cones, shield volcanoes and hydromagmatic craters. HAS is part of a huge basaltic territory extends from Syria to Saudi Arabia through Jordan. The rocks of HAS belong to alkali basalt and basanites, and have been divided into five groups that were developed through three volcanic stages during Neogene-Late Pleistocene. Volcanic rocks also exist as irregular small volcanic centers along the eastern side of the Dead Sea plate boundary; in northwestern and central parts of Jordan Basalts and pyroclastics are of high economic value for Jordan.



Neogene columnar basalt, west central Jordan (Photo: Courtesy of Khaled Moumani)

Tectonics :

Jordan is located in the northwestern part of the Arabian Plate to the east of the Dead Sea Rift. Faults are the main structural elements in Jordan. The N-S faults are the most important mainly the Dead Sea Transform Fault that borders the Arabian Plate in the west and experienced 107km of sinistral movement since early Neogene, and Quwayra Fault. Dextral E-W faults are represented by Salwan, Dana, Siwaqa, and Zarqa-Ma'in faults. NW-SE faults form horsts and grabens in Jordan Plateau such as Sirhan Fault, Mudawwara Fault and Karak-Al Fayha Fault. NE-SW faults form complex structures, folds and reverse faults; the most important of these is Amman-Hallabat Fault (80 km in length) that crosses Amman city.





The Dead Sea :

The Dead Sea (DS) is one of the most spectacular natural and spiritual landscapes of the world. The DS attraction is due to its high salinity, black mud, adjacent fresh water and thermal mineral springs. The DS water is rich in minerals; mainly potash and bromine. Meanwhile, lithium is potential.

