

GLACIATIONS IN THE ARABIAN PENINSULA

By

HAMED A. EL-NAKHAL

Department of Geology, Faculty of Science,
University of Sana'a, Sana'a, Yemen Arab Republic.

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ABSTRACT

Glaciations affected the Arabian Peninsula three times. This was during the Late Ordovician, the Late Carboniferous-Early Permian, and the Pleistocene. Recorded evidence of Paleozoic glaciations in Arabia, includes tillites, striated pavements and gravels, erratic boulders, dropstones, and varves. The presence of Pleistocene glacial activity is based on the occurrence of polygonal cracks similar to those found in the present tundra and subarctic regions, in sandstones and pyroclastics in the mountainous regions of the Yemen Arab Republic.

The occurrence of Late Paleozoic glaciations in this part of Asia helps to complete the picture of Gondwana glaciations.

INTRODUCTION

The first record of the glacial activity in the Arabian Peninsula was provided by S.B. Henry and R.A. Bramkamp in 1950 (in Powers and others, 1966), whom described Late Paleozoic glacial deposits in southern Saudi Arabia. Further evidence for this was provided by Hudson (1958), Morton (1955), Helal (1963, 1965), Roland (1978), McClure (1980), Braakman and others (1982), Kruck and Thiele (1983), El-Nakhal (1984), and Clark (1987). In 1978, McClure referred to the presence of Early Paleozoic glaciation in north central Arabia. Recently, El-Nakhal (1985) described cracks in the sandstones of the Kohlan Group (Jurassic), which he assigned to the effect of frosting during the Pleistocene Epoch.

The present study aims to compile the available information on the glaciation in the Arabian Peninsula which has been accumulating during the last four decades.

PALEOZOIC GLACIATIONS IN THE ARABIAN PENINSULA

Available information indicate that the Arabian Peninsula was effected by two Paleozoic glacial episodes one of which was during the Early Paleozoic, whereas the other was during the Late Paleozoic. A brief discussion of each of these episodes is given below.

The Early Paleozoic Glacial Episode

Early Paleozoic glaciation in Arabia was recorded by McClure (1978), who described igneous cobbles and boulders in the top of the Ordovician portion of the Tabuk Formation in the Qasim area, north-central Arabia (Fig. 1). This is the single record of the occurrence of Early Paleozoic glaciation in Arabia. Depending on the striations found on the pavements and gravels in the Qasim area, McClure (1978), interpreted the ice movement as being in a north-northeasterly direction from a "South Pole" then located in central Africa.

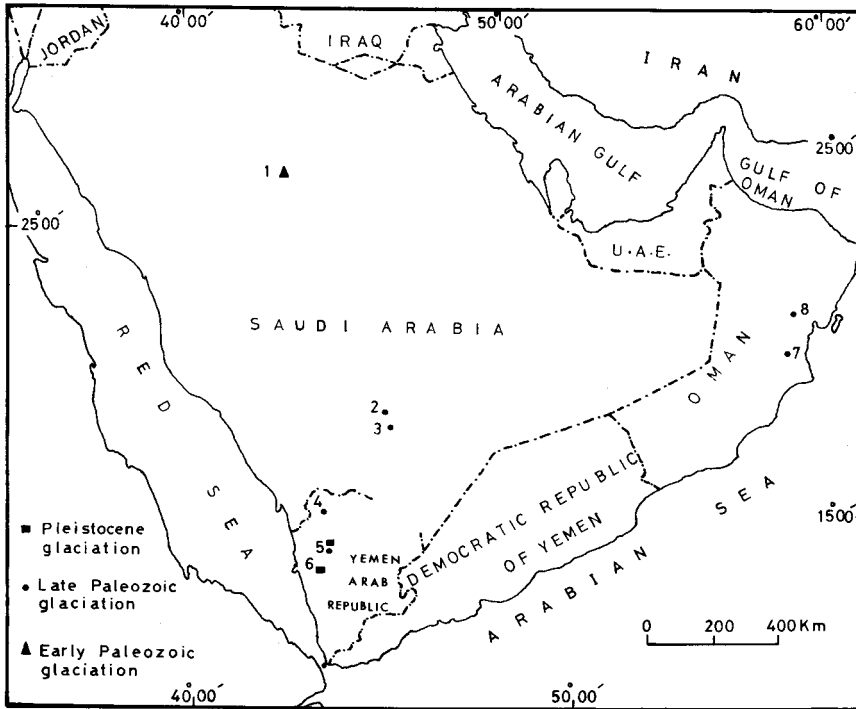


Fig. 1: The Arabian Peninsula, location map showing the areas with Paleozoic glacial deposits: 1. Qasim; 2. Jebal Umm Ghiran; 3. Khasm Khatma; 4. Sa'dah; 5. Kohlan; 6. Jabal El-Nabi Shu'ayb; 7. Khalata; 8. Haushi.

The Late Paleozoic Glacial Episodes

Glacial deposits of Late Carboniferous-Early Permian age have been recorded in Arabia by several authors. All of these records are restricted to southern Arabia lying in southwestern Saudi Arabia, Yemen Arab Republic and Oman (Fig. 1). A brief description of these deposits in the above mentioned localities is given below.

Saudi Arabia

Late Paleozoic glaciation in Saudi Arabia was first referred to by S.B. Henry and R.A. Bramkamp in 1950 (in Powers and others, 1966), who recorded granitic erratic boulders in the Wajid Sandstone (Permian or older) in the Khashm Khatma and Jebel Umm Ghiran area, southwestern Saudi Arabia (Fig. 1). Helal (1962, 1965) concluded that these boulder beds represent tillites of Permian-Carboniferous age. Similarly, McClure (1980) accepted the glacial origin of these beds on the basis of the spores and pollen analysis, as well as the stratigraphical relationships, he assigned them to the Late Carboniferous-Early Permian.

Yemen Arab Republic

Roland (1978) described erratic striated boulders in the shales of Kohlan in the Sa'dah area, northern Yemen Arab Republic (Fig. 1). He explained these boulders as ice rafted glacial material drifted northward from Gondwana, and he considered the shales of Kohlan to be of Late Paleozoic age.

Kruck and Theile (1983), and El-Nakhal (1984), provided definitive evidence of glaciation. Those authors referred to the occurrence of tillites, striated pavements and gravels, grooves, dropstones and varves (Figs. 2-7), in the shales of the Kohlan Group in Kohlan area, central Yemen Arab Republic (Fig. 1). On the basis of their stratigraphical position and the recorded pollens, these beds were assigned to the Permian.

The direction of the striations, grooves and elongated boulders found in the shales of Kohlan Group which has been recently measured by the present author, indicates that the ice was moving in this area towards the north-northwest.

Oman

Hudson (1958), and Morton (1959), reported boulder beds in Haushi Formation in the Haushi area of southeastern Oman (Fig. 1). These beds were considered to be of glacial or aquaglacial origin, and on paleontological grounds they were assigned to the Early Permian. In 1982, Braakman and others, found good exposure of striated pavements on Precambrian dolomite which is directly overlain by diamictites of Haushi Group in the Khalata area (Fig. 1). This occurrence in addition to the presence of rhythmically laminated definite sandstones and shales with occasional large clasts, was considered by that author to represent strong evidence of a continental glaciation in Oman during the Late Paleozoic. On the basis of the recorded microflora, Braakman and others (1982), assigned the diamictite sequence of the Haushi Group to the Late Carboniferous-Early Permian.



Fig. 2: Exposure of a thin tillite bed, Kohlan area, Yemen Arab Republic.

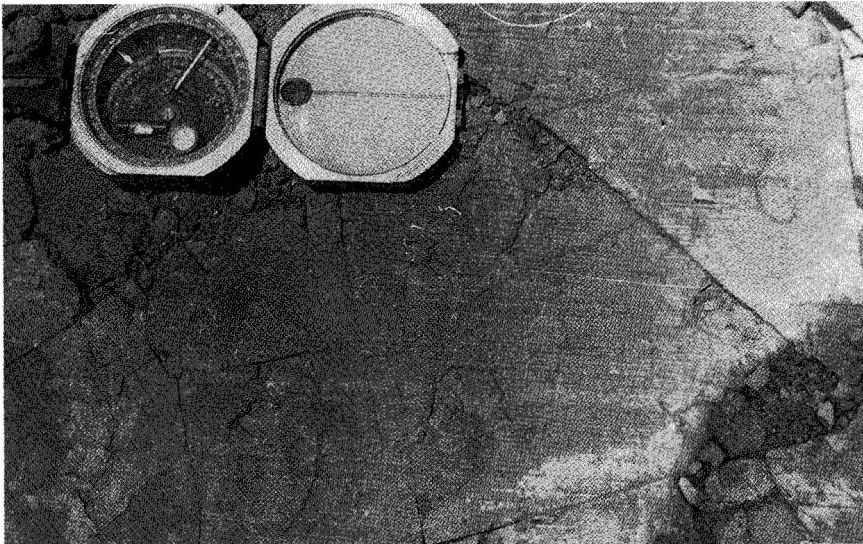


Fig. 3: Parallel striations on pavements of siltstone, Kohlan area, Yemen Arab Republic.



Fig. 4: Parallel grooves on pavements of siltstone, Kohlan area, Yemen Arab Republic.

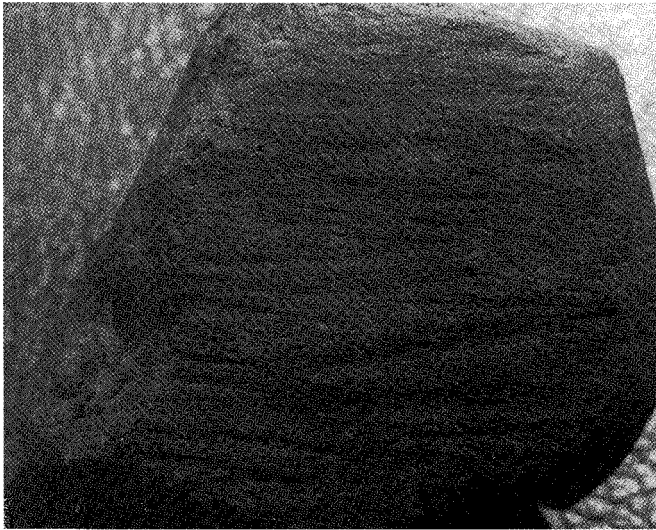


Fig. 5: Striated erratic cobbler, Kohlan area, Yemen Arab Republic, length of the cobbler is about 12 cm.

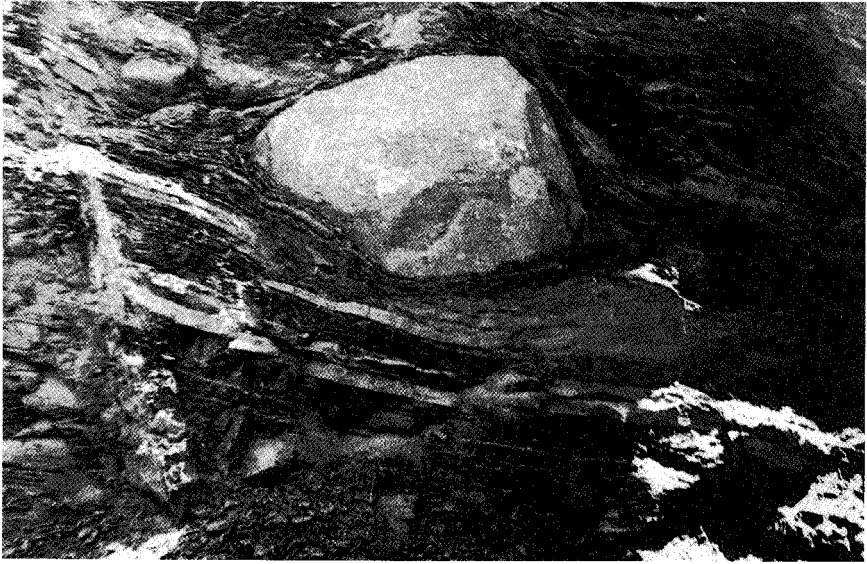


Fig. 6: Dropstone in rhythmically laminated silt shale showing bending of laminae at the lower contact, Kohlan area, Yemen Arab Republic; length of the dropstone is about 50 cm.

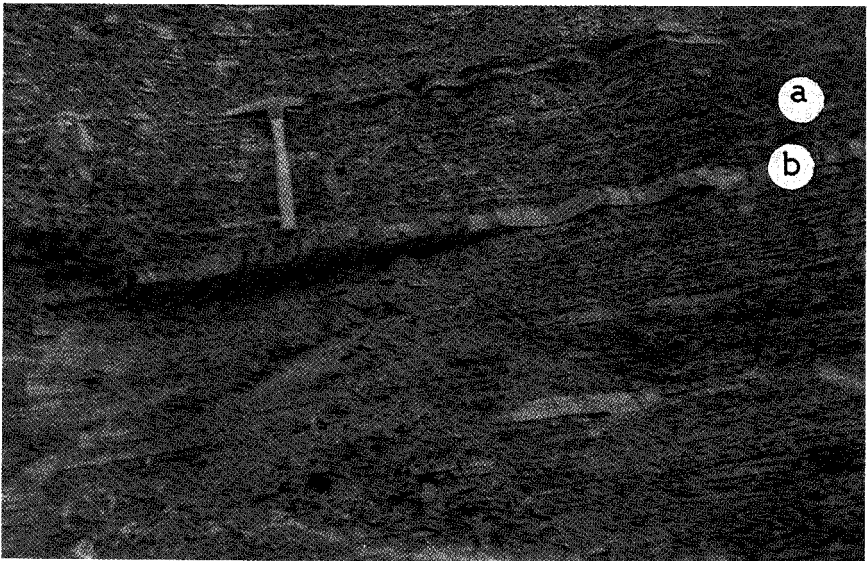


Fig. 7: Section through rhythmically laminated silt shale sequence showing varves (a), and thin siltstone interbed (b), Kohlan area, Yemen Arab Republic.

Palaeogeographical Significance of the Late Paleozoic Glaciation in the Arabian Peninsula

The occurrence of the Late Paleozoic glaciation in the Arabian Peninsula helps to complete the picture of the Gondwana glaciation in southwestern Asia. A reconstruction of Gondwana at the beginning of the Permian showing the paleolatitudes, regions with known tillites, and the direction of ice movement is shown in (Fig. 8).

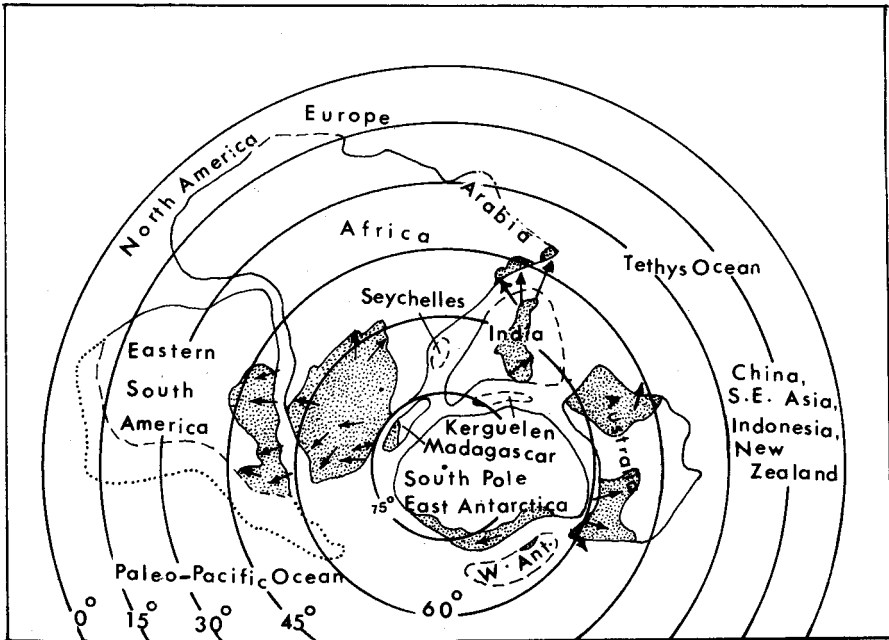


Fig. 8: Reconstruction of Gondwana at the beginning of the Permian, showing paleolatitudes; stippled regions are of known tillite and arrows show directions of ice flow. The direction of ice movement from India to southern Arabia is based on the present study (after Hamilton and Krinsley, 1967, slightly modified).

PLEISTOCENE GLACIATION IN THE ARABIAN PENINSULA

El-Nakhal (1985), recorded polygonal cracks of two orders of size similar to and smaller than those found in the present tundra and subarctic regions (Fig. 9), in the sandstones of the Kohlan Group in the central mountainous regions of the Yemen Arab Republic (Fig. 1). El-Nakhal (1985), attributed these polygons to the frost action during the Pleistocene Epoch.



Fig. 9: Polygonal cracks of two orders of size in the sandstones of the Kohlan Group, Kohlan area, Yemen Arab Republic.

Similar polygonal cracks have been recently recorded by the present author, in Jabal El-Nabi Shu'ayb which lies about 28 km. west-southwest of Sana' (Fig. 1). Jabal El-Nabi Shu'ayb consists of pyroclastic and basaltic flows (Tertiary Yemen Volcanics), and it represents the highest mountain in the Arabian Peninsula reaching an elevation of 3620 m above the sea level. The recorded cracks are restricted to the pyroclastic beds, and they were found in eight different horizons the highest of which lies at the top of the mountain. The occurrence of these cracks in Jabal El-Nabi Shu'ayb is considered as an additional evidence which substantiates the concept that the Pleistocene glaciation affected this area. Also, it is believed that this effect included most of the highlands in the Arabian Peninsula.

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الجليديات في شبه الجزيرة العربية

حامد أحمد النخال

أثرت الجليديات على شبه الجزيرة العربية ثلاث مرات كان ذلك في نهاية العصر الأردفيسي ، ونهاية العصر الكربوني - وبداية العصر البرمي ، وعهد البليستوسين . ومن الأدلة على وجود جليديات حقب الحياة القديمة في الجزيرة العربية ، وجود صخور الحراث ، والأرصفة الصخرية المخدشة ، والجلاميد المخدشة ، والجلاميد التائهة ، والحجارة الساقطة . والصخور الرقائقية . أما وجود النشاط الجليدي في عهد البليستوسين فقد أُستدل عليه من وجود شقوق عديدة الأضلاع شبيهة بتلك الموجودة في الوقت الحاضر في التندرا والمناطق شبه القطبية . في بعض الصخور الرملية والصخور الفتاتية البركانية في المناطق الجبلية في الجمهورية العربية اليمنية . أن وجود جليديات حقب الحياة القديمة المتأخرة في هذا الجزء من آسيا سيساعد على استكمال صورة جليديات جوندوانا .