

WADI NA'AM STRUCTURE: A POSSIBLE CONCEALED IMPACT FEATURE FROM CENTRAL SOUTHWEST SAUDI ARABIA.

A. T. Al-Mishwat¹, ¹ Department of Earth and Environmental Sciences, Kuwait University, P.O.Box 5969 – Safat, Kuwait 13060, Fax: 965 4816487, almishwat@kuc01.kuniv.edu.kw

An occurrence of a geologic feature that displays some of the characteristics of concealed multi-ring impact structures is reported from central southwest Saudi Arabia and is called the Wadi Na'am Structure. It is located at the southern reaches of the Wadi Na'am, about 35 kilometers northeast of the town of Hamdhah, and is centered on N 19° 08' and E 44° 00' [1]. The structure is situated directly east of the boundary between the Arabian Shield crystalline basement and its Phanerozoic sedimentary cover. The Wadi Na'am Structure is near circular and is roughly 17 kilometers in diameter, with possible several annular ring structures of increasing diameters.

Regional structures in the area of the Wadi Na'am Structure are dominated by a northeast-oriented fracture system and a northwest-trending fault system. The fracture system is represented by a long and widely spaced swarm of northeast-trending regional fractures, but other subordinate fracture directions also occur in the area. The fault system is characterized by several long northwest-trending normal faults that systematically displace units downward to the northeast.

The Wadi Na'am Structure is masked by the overlying regionally-horizontal Cambro-Ordovician Wajid sandstone. Most of the structure is covered by the upper member of the quartz arenite sandstone formation, the Ilman Member, which forms the sedimentary cover in the area [2]. A 2 km northeast-trending elongated, but topographically low, area in the center of the structure is underlain by the lower Shum Member of the same formation. Within this depression in the central area are several small outcrops of gabbro which are detached from the basement below the sandstone; the largest of these gabbro pieces reaches 1/2 km meters in diameter.

In contrast to the regionally horizontal Wajid sandstone outside the Wadi Na'am Structure, the sandstone within it displays radial variations in dip, showing progressively shallower dip outward from the center [2]. Dip of the sandstone in the interior of the structure varies progressively outward from about 50° to 30°. In the remaining roughly outer half of the structure the dips decrease radially from 10° to 5°. The sandstone eventually becomes horizontal at the extreme edge of the structure and merges with the regional horizontal pattern.

A conspicuous and exclusive feature of the Wadi Na'am Structure is a system of circular fractures that occur through the Wajid sandstone within it and which center on the central inlier of gabbroic masses [2]. These fractures are vertical to sub-vertical and dissect the sandstone in a series of nested circles of expanding diameter. These fractures are more profuse in the northeastern part of the structure. In addition, a local system of tight folds occurs along the northeastern fringe of the structure [2]. Folds belonging to this system are oriented north, but they rotate at their southern terminus in parallel with the arcuate curvature of the structure periphery. Similar, though less developed, curvature of the folds also occurs along the northern rim of the structure. The average length of these folds is approximately 3 kilometers, and their average wavelength is roughly 200 meters.

An arcuate and continuous wadi drainage defines the outer edge of the structure along the entire southern half of its perimeter [1]. Other patches of discontinuous drainage occur along the structure's northern perimeter, although the

drainage curvature there is less obvious. Exposures of a biotite monzogranite belonging to the Precambrian basement unconformably below the sandstone crop out in the drainage south of the structure, possibly indicating a thin cover of the Wajid sandstone over the structure.

The Wadi Na'am Structure is interpreted as a possible concealed impact feature of Precambrian age that is buried under the lower Paleozoic sedimentary supra-crustal cover rocks. Localized post-Ordovician reactivation of the structure and its sedimentary mask is invoked in order to produce the observed surface expressions of the underlying geometry. In this interpretation, the folds are viewed as mimics of the underlying topography of the outer rim of the structure, which is thought to possess annular multiple rings configuration. The circular fractures most plausibly reflect surface manifestations of circular normal faults common within many impact structures [3]. Gradual radial decrease in the dip of the sandstone within the structure is accounted for by a more intense central rejuvenation of such faults than at the periphery. The central gabbro masses represent the possible upper tip of a central uplift whose elevated central position inside the structure may have been accentuated by the proposed subsequent reactivation. All of the above features are utilized as general criteria for recognition of impact structures [3]. Future investigations, including drilling, petrography and SAR interferometry, will aid in the documentation and verification of the Wadi Na'am Structure.

References: [1] Fuller F. J. (1984) Sheet 19G, Geoscience Map GM-76B, Kingdom of Saudi Arabia. [2] Greenwood W.R. (1985) Sheet 19G, Geoscience Map GM-76C, Kingdom of Saudi Arabia. [3] French A. B. [1990] EOS, 71/17, 411-414.