Tectonic Evolution and Architecture of Dammam Dome

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Abstract

The Dammam Dome, a significant geological feature in the Eastern Province of Saudi Arabia, covers an area of about 150 square kilometers. This dome, positioned along the eastern border of the Arabian Peninsula, has been at the center of geoscientific debates for a considerable period. The formation of this unique structure has been explained according to two main theories: one considers the effect of salt diapirism, and the other the folding stress caused by tectonic activities.

Our extensive study aims to illuminate the sequence of events and geological dynamics that have shaped the Dammam Dome. In our detailed investigation, we focused on four specific outcrops located within the limits of the dome from which we meticulously documented and analyzed a total of 740 fractures. We conducted thorough measurements of the patterns, orientations, intensities, and densities of these fractures. This detailed data collection was critical in constructing a timeline for the dome's evolutionary process. Furthermore, we identified key stratigraphic layers and fault lines from five seismic lines that cut across the dome. These seismic lines were aligned with various geological layers, enabling us to examine the dome's development both temporally and spatially.

The data compiled from this study points to the existence of various phases of folding, each characterized by unique styles, suggesting a complex and multifaceted process of formation. Initially, the evidence indicates a salt- cored structure, wherein a rising salt diapir elevated the overlying rock layers. After the exhaustion of the salt source, the structure experienced a collapse, leading to the formation of a distinct salt-cored configuration. The ongoing deposition of sediment and the compressive stresses exerted on Eastern Arabia contributed to the further folding of the strata above the dome.

Observations of the current structure of the Dammam Dome imply that the forces behind its creation are still in effect. This ongoing process is demonstrated by the gradually diminishing angles of folding over time, which is a clear sign of continuous stress accumulation. Additionally, the fracture network within the dome exhibits patterns that are not radial, differing from those typically observed in standard salt domes. The presence of minor reverse faults also points to a deviation from a typical domal structure. These varied characteristics highlight the complex geological history of the dome and the interplay of diverse geological forces in its formation.

In summary, the Dammam Dome's formation is a result of intricate geological processes. Our study not only provides a deeper understanding of these processes but also contributes to the broader knowledge of geological formations in similar environments. The results of this study offer valuable insights to geologists and researchers interested in the dynamics of dome formations and the geological history of.