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Polygonal Faults Newtworks in North Al-Subiyah, Kuwait

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Abstract

This thesis investigates the polygonal fault systems (PFS) in North Al-Subiyah, Kuwait, a region known for its distinctive sedimentary structures, especially the interconnected faults forming polygons. These faults are primarily observed in fine-grained sediments, and the study focuses on their formation conditions, mechanisms, and evolution. Employing a multi-disciplinary approach, including field study, petrographic analysis, geochemistry, and stable isotope studies. The findings put forward that the PFS in Al-Subiyah are the result of liquefaction-triggered soft-sediment deformation (SSD) caused by a combination of processes including chemical diagenesis, microbial activity, and seismic activity, particularly from moderate-to-high magnitude earthquakes originating from the nearby Zagros Fold-Thrust Belt. The study postulates that these seismic events induced the vertical emission of gas-rich fluids, contributing to the formation of the PFS. The isotopic data supports the theory of microbial activity occurring in conjunction with diagenetic processes, leading to the expulsion of fluids through the rock fractures. These fluids were subsequently sealed by later diagenetic events, indicating that the fault systems are prone to reactivation. Using planet Mars as an analog for this study and its findings, it provides a unique geological perspective where polygonal fractures and fluid expulsion processes, like those observed in Al-Subiyah, suggest shared formation mechanisms and evolution. Methane emissions measured in the Martian atmosphere indicate some form of microbial life on Mars that play a role in the ecological framework similar to Al-Subiyah's. This study contributes to furthering the understanding of the geological evolution of the region and highlights the significance of diagenetic and seismic processes in shaping the PFS in Al-Subiyah and how it relates to the Martian polygonal terrain.

Keywords: Polygonal Fault Systems (PFS) – Soft-sediment Deformation Structures (SSDS) – Diagenesis – Liquefaction – Mars