



## **Outcrop and Subsurface Gamma Ray Investigations of the Wajid Group in Wadi Al-Dawasir, SW Saudi Arabia: Implications for Stratigraphic Discrimination into Formations**

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The Wajid Group in Wadi Al-Dawaser, southwest Saudi Arabia, is composed mainly of sandstones and consists of four formations; from base to top the Dibsiyah, Sanamah, Khusayyayn, and Juwayl formations. They were deposited in shallow-marine, glacial, and glaciofluvial environments. In Wadi Al-Dawasir, the Wajid Group forms a single aquifer (Wajid Aquifer); however, in areas located east and south of Wadi Al-Dawasir, the Wajid Aquifer is divided into lower and upper aquifers that are separated by the Qalibah Formation (low permeable siltstones and shales). Stratigraphically, the lower Wajid Aquifer is represented by the Dibsiyah and Sanamah formations, while the upper Wajid Aquifer is composed of the Khusayyayn and Juwayl formations. Due to the absence of the Qalibah Formation in Wadi Al-Dawasir, this study intended to use natural gamma ray signatures in Wajid outcrops to establish a lithological and stratigraphical discrimination of the four formations. A portable gamma ray spectrometer was used to detect the natural gamma ray radiation in the outcrops. Detailed sedimentological and stratigraphical measurements were carried out, and a petrographic study was conducted to define the texture and mineral composition of the studied sandstones. The outcrop-based natural gamma ray readings showed that the Khusayyayn Formation displays higher gamma ray values (average 47 API), and higher uranium concentrations (average 6.6 ppm) compared to other formations. This distinct gamma ray signature could be traced to the subsurface where they can be used to define the stratigraphic boundaries between the Juwayl, Khusayyayn, and Qalibah formations. Based on petrography, the Khusayyayn Formation sandstone shows a significant amount of K-feldspar, which most probably is the source of the high gamma ray radiation. Moreover, the sandstones of the upper Dibsiyah Formation shows gamma ray values slightly higher than its basal part, and the sandstones of glacial origin of the Sanamah and Juwayl formations. Hence, based on the results of gamma ray investigations and petrographic analysis, the boundaries between the Wajid formations in the subsurface can be identified.