



## **Cavity and Fracture Detection Using GPR and EM Methods: Comparison with Surface Features of the Rus Formation, KFUPM campus, Saudi Arabia**

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This study was conducted to detect subsurface cavities using GPR (Ground Penetrating Radar) and EM (Electro Magnetic Method). GPR data were acquired using GSSI equipment with both 100 MHz and 400 MHz antenna and EM data by Geonics EM 31. Over the last 15 years GPR has gained extensive importance for mapping and characterizing the different near surface geological features such as faults and cavities. The power of this technique is its high-resolution output, low cost, faster operation, and portability of equipment. This technique is based on contrasts in relative permittivity (dielectric constant) between subsurface bodies. The EM 31 is also useful to detect shallow subsurface geological features like faults and cavities. A GPR survey was conducted in a 3D grid consisting of 27 survey lines (16 inline, 11 crossline) with 1 meter spacing. An EM survey was carried using a Geonic EM 31. For accurate and relevant results, the survey zone is divided into two grid areas of data acquisition. The first grid zone was 10m×10m with a 2-meter line spacing and the second grid was 10m×15m with 1-meter line spacing. A total of 1092 data points were recorded. GPR data was processed and interpreted using radan7 software. Subsurface cavity was estimated from hyperbolic anomaly from point reflection and discontinuity of the planar reflection. The two-hyperbolic anomalies found at the position of (i) line 24, 6 m from the starting point, 6 m depth and (ii) line 19, 7 m from the starting point, at 1.8 m depth. The hyperbolic anomaly could be interpreted as a cavity where dielectric constant 4.31 and 4.4. A contour map of conductivity was prepared from the acquired data using surfer software and three data points were identified as cavity which has a conductivity range from 3.5 to 4.5 S/m and a skin depth of 1.9 m. The result is compared with surface geology data which correlates well with numerous cavities seen in the outcrop.