# 5.8 RECONSTRUCTION OF THE 3D SUBSURFACE OF THE AL-HASSA OASIS, EASTERN SAUDI ARABIA

**A. Khogali[1], P. Kirmizakis[1], K. Chavanidis[1], A.L. Ashadi[1], A. Stampolidis[2], M.E. Candansayar[3*], P. Soupios[1]**

*[1]Department of Geosciences, College of Petroleum Engineering & Geosciences, King Fahd University of Petroleum & Minerals, Dhahran 31261, Saudi Arabia.*
*[2]Aristotle University of Thessaloniki, Thessaloniki 54124, Greece.*
*[3]Geophysical Engineering Department, Ankara University, Ankara, Türkiye*
**Corresponding author e-mail: candansayar@ankara.edu.tr*

**ABSTRACT**

Al-Hassa city contains the largest oasis in Saudi Arabia and one of the world's largest naturally irrigated land. 280 natural springs provided massive groundwater discharging and watering of agricultural land. Moreover, the water in some of the springs is used to be warm. The quality was also spatially varied. The characteristics above indicate a complex subsurface that has to be characterized. Four geophysical methods were applied to reconstruct a 3D subsurface for the study area. Four non-seismic geophysical methods were applied, to reconstruct with the highest accuracy, a 3D model of the subsurface of the study area. Five hundred seventy-one gravity stations were acquired, covering the whole Al-Hasa Oasis, an area of 353 Km2. 52 magnetotelluric-MT stations, 12 audio-magnetotelluric-AMT stations, and 25 transient electromagnetic-TEM stations, were acquired within the Al-Hasa National Park to reconstruct a 3D subsurface model. All EM soundings were processed and combined to achieve the highest resolution from the surface till the maximum depth of investigation. Gravity data were processed and lately integrated with the final 3D EM model. Preliminary 1D modeling of the TEM data till the maximum depth of 200m shows a lateral discontinuity of resistivity, which agrees with spatial variation of the EC of groundwater samples in the study area. 2D and quasi-3D modeling of the MT data acquired along a N-S profile and 2 E-W profiles clearly show a salt dome structure that agrees with the low resistivity (brine) shallow water analysis and previously published paper. 3D modeling of the gridded gravity data acquired covering the whole Al-Hasa Oasis, agrees with the expected NNW-SSE and ENE-WSW fracture zones that probably act as pathways or barriers to groundwater. All acquired geophysical data and collected geochemical data in the broader study area will be imported into PETREL and integrated to provide a more precise indication of the complexity of the study area. The 3D geophysical subsurface modeling of Al-Hasa Oasis reveals a complex underground structure. The integration of various geophysical data sets, including TEM, MT, and gravity data, uncovers lateral discontinuities in resistivity, a salt dome structure, and fracture zones acting as pathways or barriers to groundwater flow. This comprehensive modeling approach provides valuable insights into the subsurface dynamics of the oasis, contributing to a better understanding of its hydrogeological characteristics and potential water resources management strategies.

**KEY WORDS :** EM modeling, Gravity/Magnetic, Basin Analysis