

Integrating mapping groundwater quality Index for irrigation and Gravity Data of the Slabiat depression southern Iraq

## Integrating mapping groundwater quality Index for irrigation and Gravity Data of the Slabiat depression southern Iraq

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## **Abstract**

Mapping groundwater quality Index for irrigation is of great importance for agricultural issues. As groundwater is a vital source of water for domestic and agricultural activities in southern Iraq area, where the study area represents the extreme eastern part of it, evaluation of groundwater quality and its suitability for irrigation is important. This study aims to develop decision support tools for identifying the optimal locations of groundwater regarding its quality to meet the future demands of the study area. The indices used in the quality assessment were the sodium adsorption ratio (SAR), sodium percentage (%Na<sup>+</sup>), magnesium hazard (MH), and irrigation water quality index (IWQI), incorporating the spatial variation using the GIS-based multi-criteria system highlighted the spatial variation of groundwater quality for irrigation in the study area. This spatial distribution indicated that groundwater is generally of moderate quality in the study area.

The study area, which is between 15 and 400 meters above sea level, lies along the Iraqi–Saudi Arabian border, while the elevation ranges between 20 and 150 meters above sea level runs along with Samawa City and the Euphrates River.

The studied area is a part of the Salman Zone, which is located within the stable shelf of the African-Arabian Platform. The gravity data had been corrected and the Bouguer anomaly was calculated along each point. The analysis of gravity data performed using Geosoft software. To investigating Lineaments Tracing were applied Centre for Exploration Targeting (CET). Upward continuation filters were employed to distinguish between (regional and residual anomalies) in satellite gravity data.

The results reveal that lineaments occur in four directions (EW, NS, NE, and NW) for both residual and regional maps of the studied area.

A high-density lineament could be connected to upstream fractured volcanic rock of the Abu-Hadeer Basin, high-density fractures can be connected to intensive tectonics and volcanism, while low-density lineaments are linked to low-density sediment.

**Keywords:** Gravity Data; Slabiat depression ; Iraq

## **1-Introduction**

The research region is located at in the Southern of Iraq, between northeast Dhiqar, west of Najaf Governorate, Southwest (Al-Samawa City, Euphrates River) and Saudi Arabia's southern border with Iraq Fig.1. The total area of the Wadi Abu Hadair Basin is 35,173.27 km<sup>2</sup>, of which 14,033.84 km<sup>2</sup> is within the southern desert of Iraq (Badia of Al-Muthanna Governorate) and 21,139.43 km<sup>2</sup> is within Saudi territory, with a length of 392.13 km<sup>2</sup>. Gravity data provide information on rock densities at depth, a sudden change in the area, especially along a line, may indicate a subsurface folds, contact, fracture, or faults (Kearey et al., 2002). The study area is located within the eastern boundaries of the southern desert, Tar Al Jil Fault Zone runs along the Iraqi-Saudi border bounded the study area at Southwest side, The Safawi-Samawa Fault bounded at west side, Takhadeed suq Alshoyokh Amara fault, Ansab- Al-Busaya- Qurna Fault located within and East side in the study area (Figure 2), and the Euphrates Fault located N-NE of the study area. Lineaments are extended mappable straight or curvilinear highlights of a surface whose segments adjust in straight or about straight connections and maybe the expression of subsurface folds, contact, fracture, or faults, these properties can be mapped at distinctive scales, from nearby to continental, and utilized in mineral, oil, gas, and groundwater exploration research (O'leary et al., 1976). The gravity anomalies are resulted from lateral variations in the density of subsurface materials and the distance to these bodies from the measuring points. The gravity method is one of the best ways to discover the subsurface structures and recognize the variations in the thickness of sedimentary cover so it has been used in this study (Eldosouky et al., 2017). This study includes the analysis of gravity data to delineate and locate any structures and faults in the study area (Nazan, 2023). The amplitudes of gravity anomalies induced by large regional sources are depth independent, therefore they are essentially the source of regional gravity anomalies which must be removed from the required residual anomalies (Hinze et al., 2013). The goal of using (CET Grid software) is to discover any faults or fractures that may exist within the study region (Montaj, 2008), as well as to determine such features (faults) of the Abu-Hadeer Basin, in Badia of Al-Muthanna Governorate.

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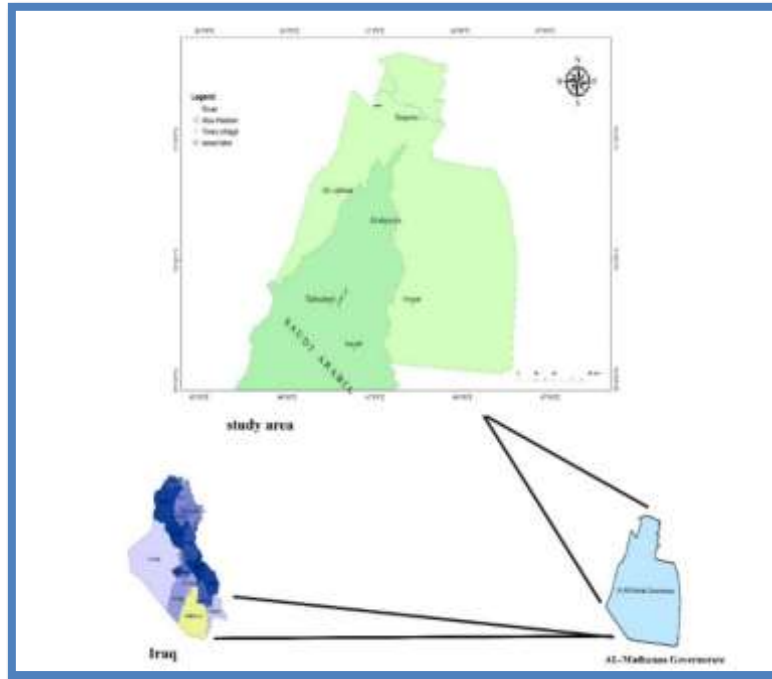


Fig.1. Study area map.

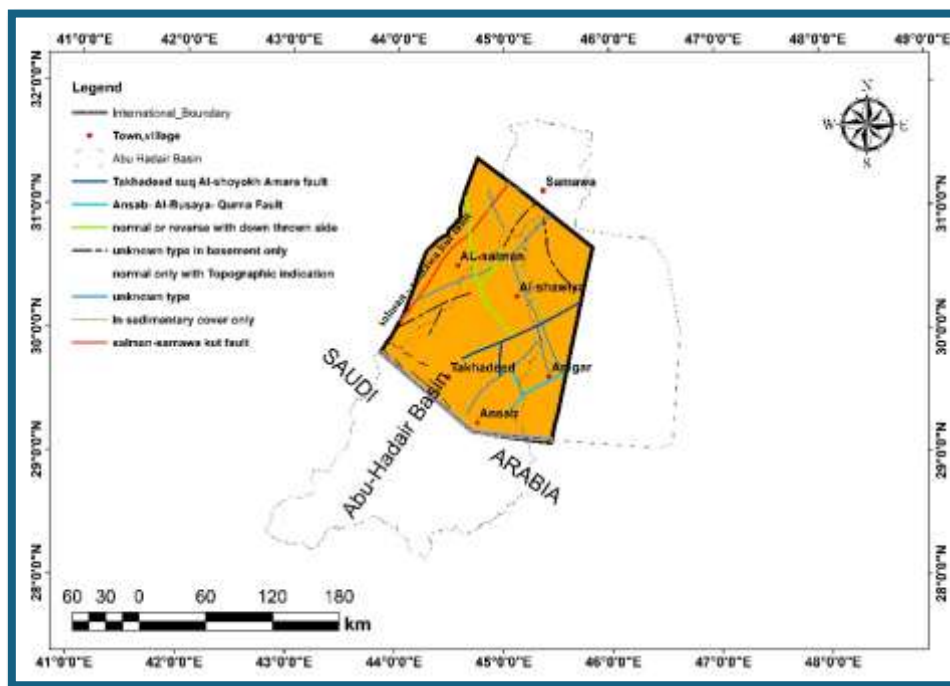


Fig.2. Structural map of the studied area (modified from GEOSURV. 1996, Tectonic map of Iraq).

## **2. Materials & Methods**

### **2.1 Processing and Interpretation of Gravity Data**

Gravity data collected from satellites with gravity obtained with authorization from the Iraqi Geological Survey (GEOSURV), which is used to examine the boundaries of geological subsurface structures. Gravity data was analyzed using Geosoft software. The gravity data is separated into residual and regional maps.

### **2.2 Gravity Data Maps: Regional and Residual**

Gravity anomalies are caused by a combination of residual and regional characteristics, as a result, the residual anomaly section emphasizes anomalies induced by upper crustal geology while minimizing the impact of deeper geological sources.

### **2.3. Extracting Lineaments from Gravity Data**

The (CET Grid GX) extension was created by the University of Western Australia. The goal of using (CET) is to detect faults that may occur within the studied region. Two processes are included: one for evaluating areas with muted gravity data responses, in which texture analysis may improve local data contrast in order to detect discontinuities, and another for recognizing data edge structures. Texture analysis describes the local area surrounding each image point (Labusch, 2016). The study employed (CET Grid software) to detect any faults in the study area, as well as to display all of the Abu-Hadeer Basin lineaments inside the AL-Muthannia Governorate - Southern Desert of Iraq. The data was processed using the Oasis Montaj™ Data Processing and Analysis System (Montaj, 2008).

## **3- Result and Discussion**

lineaments are irregular earth characteristics that can be detected on the ground. In qualitative interpretations of geophysical methods (gravity data), lineaments this type of anomaly could indicate underlying contacts, faults and other tectonic phenomena (Zhang *et al.*, 2006). In general, the major features utilized to distinguish faults based on gravity anomalies are linear gradient trends and anomaly boundaries. Four lineament systems were used to draw and drop lineament trends onto residual and regional maps. These sets of data are obtained in the directions perpendicular to the extensional structures (NW, NE, NS, and EW)

(Fig.2,3,4,5 and Fig.6,7,8,9 respectively). As a result, linear trends and associated parametric information are critical for interpreting gravity data. Typically, gravity linear anomalies are frequently manually identified by interpreters based on field features and personal knowledge, and Previous studies of the subject area such as (Sissakian *et al.*, 2012), (Al-Shaikh & Al-Mashhadani, 2014), when zones of localised weathering, enhanced

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permeability, and porosity are found beneath lineaments, it was discovered that there is a relationship between the occurrence of groundwater and fracture traces for carbonate aquifers. Additionally, there is a relationship between surface running water and water percolating through subsurface rocks, which has generated solution holes and cavities of all sizes and shapes at various depths.

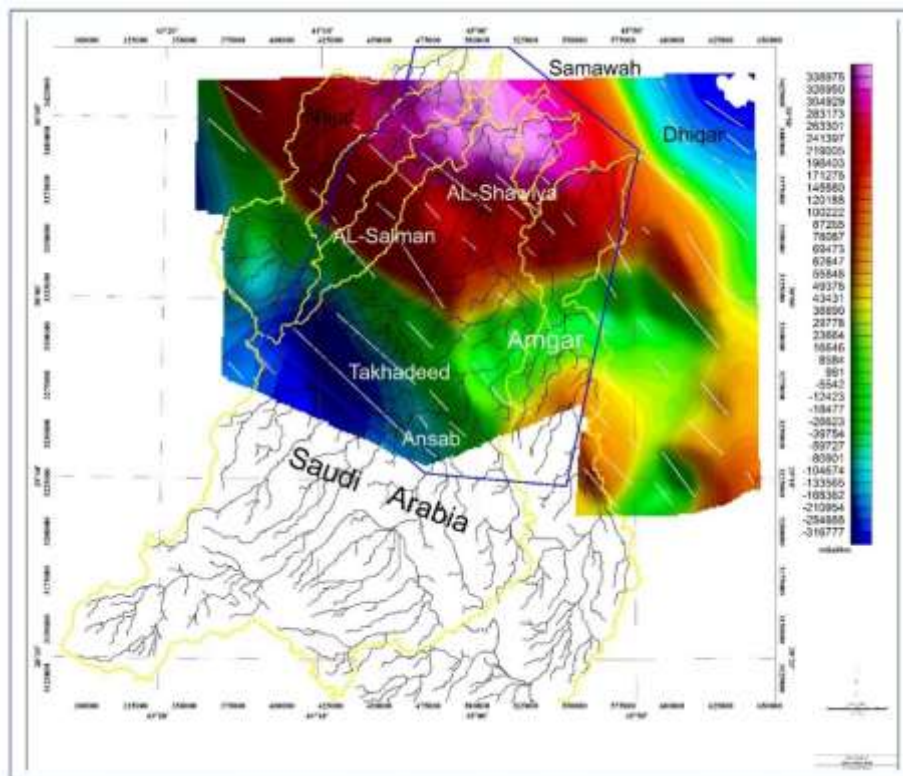


Fig.2. Regional anomalies- (Bouguer gravity) and NW lineaments of study area.

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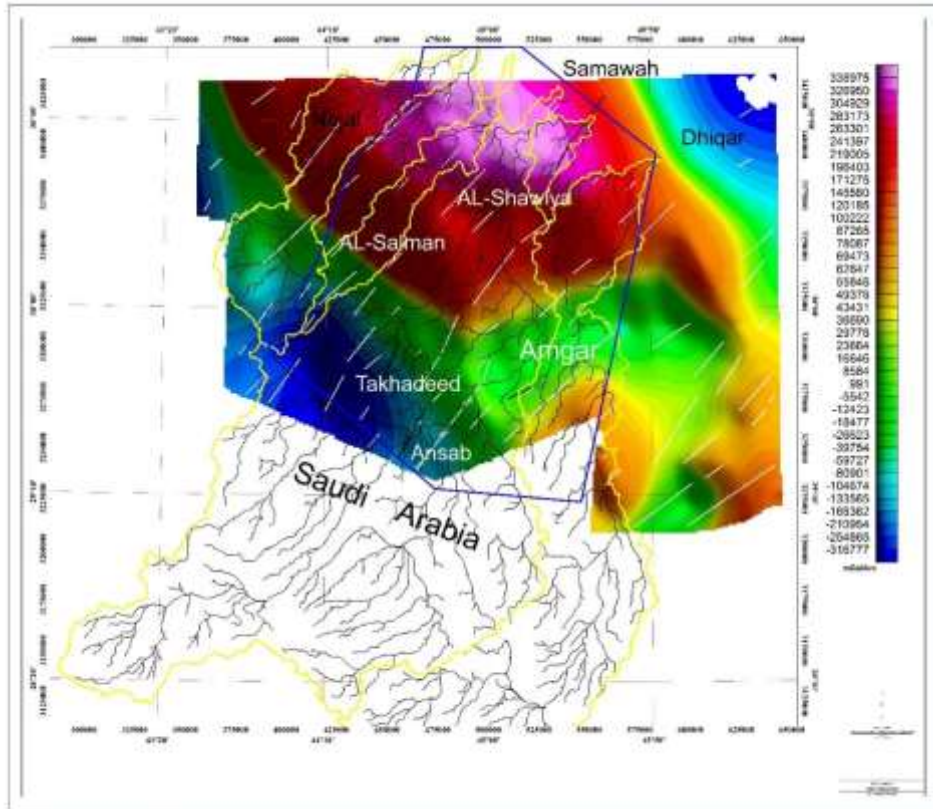


Fig.3. Regional anomalies- (Bouguer gravity) and NE lineaments of study area.

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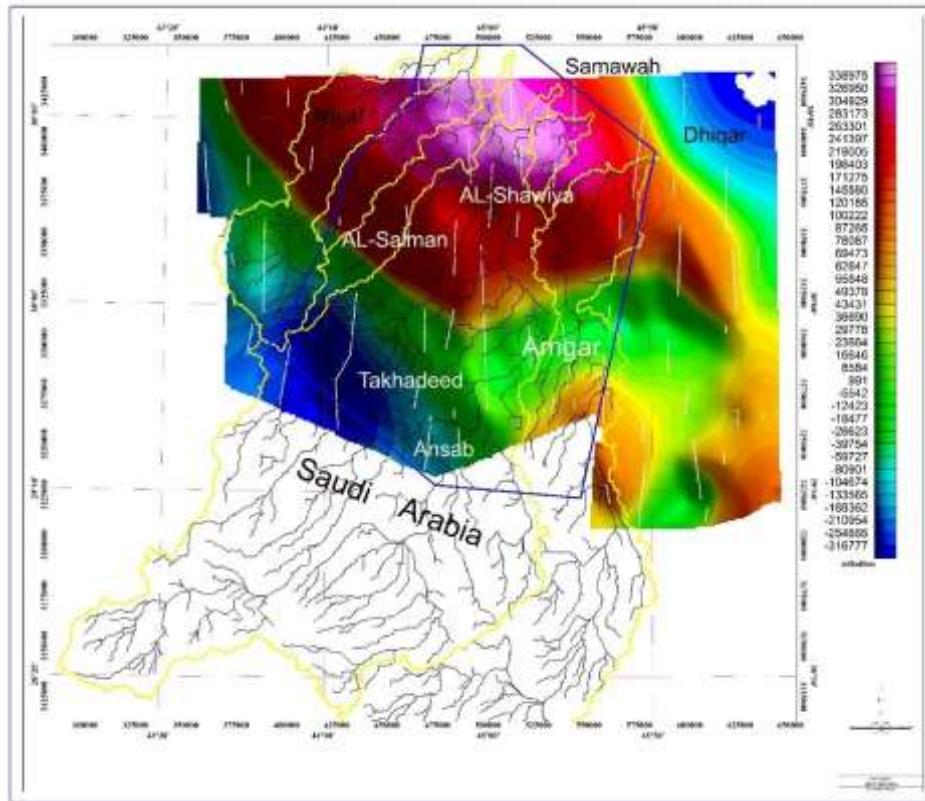


Fig.4. Regional anomalies- (Bouguer gravity) and NS lineaments of study area.

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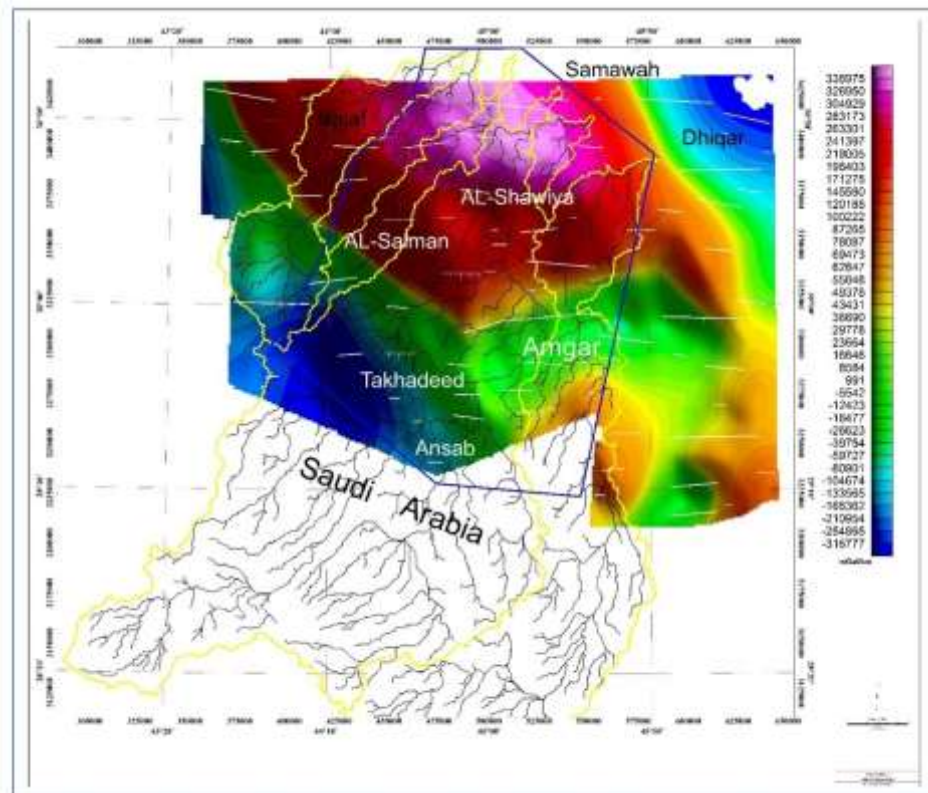


Fig.5. Regional anomalies- (Bouguer gravity) and EW lineaments of study area.

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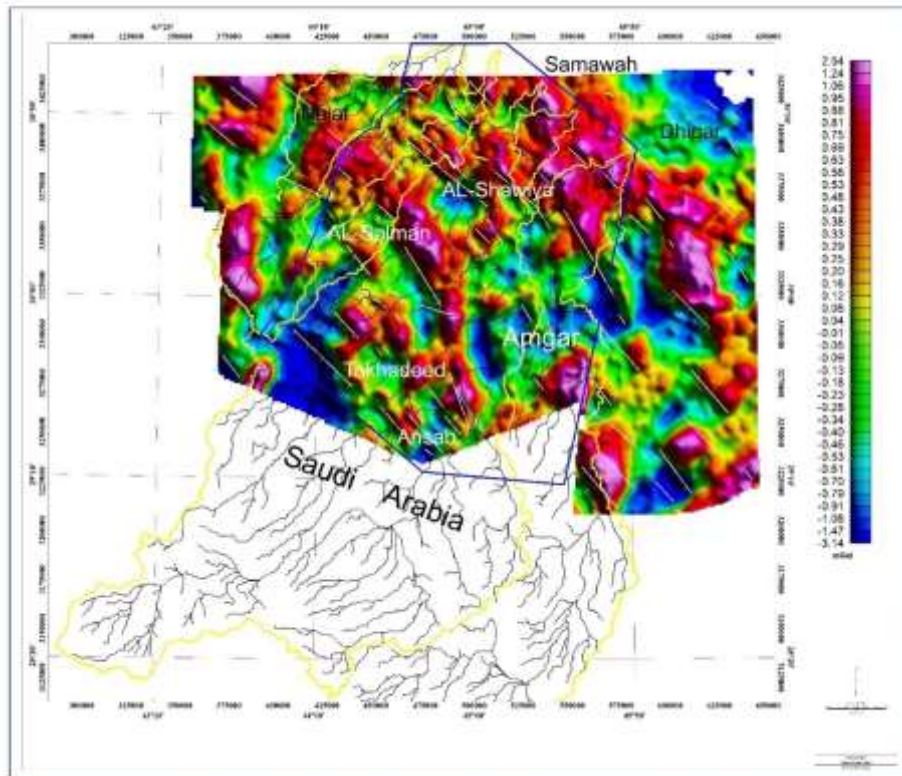


Fig.6. Residual anomalies- (Bouguer gravity) and NW lineaments of study area.

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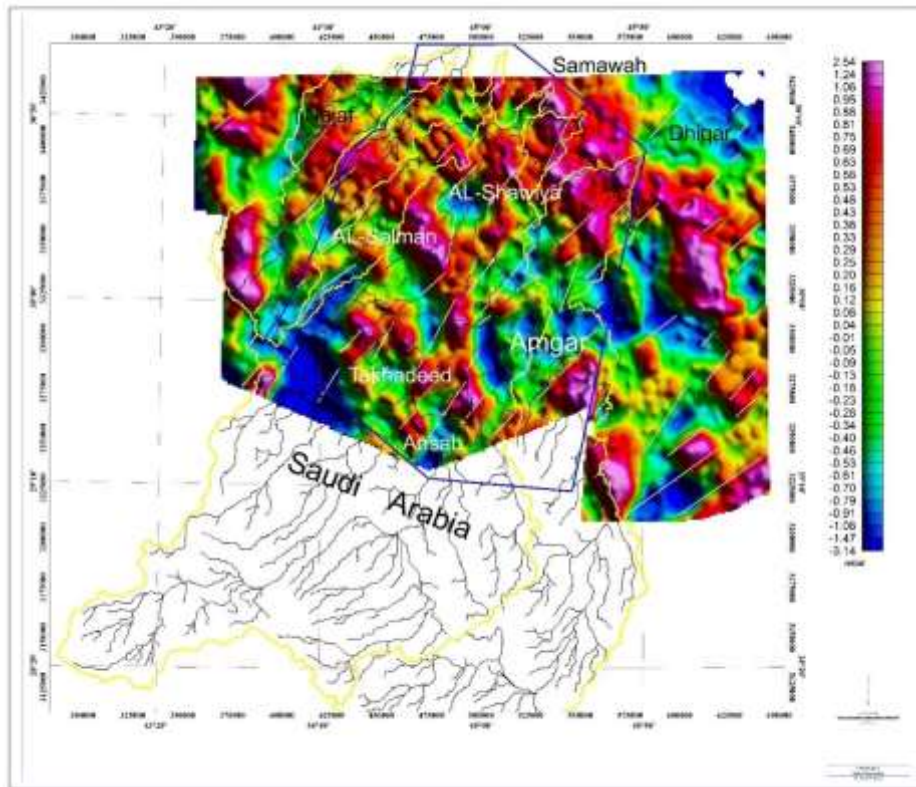


Fig.7. Residual anomalies- (Bouguer gravity) and NE lineaments of study area.

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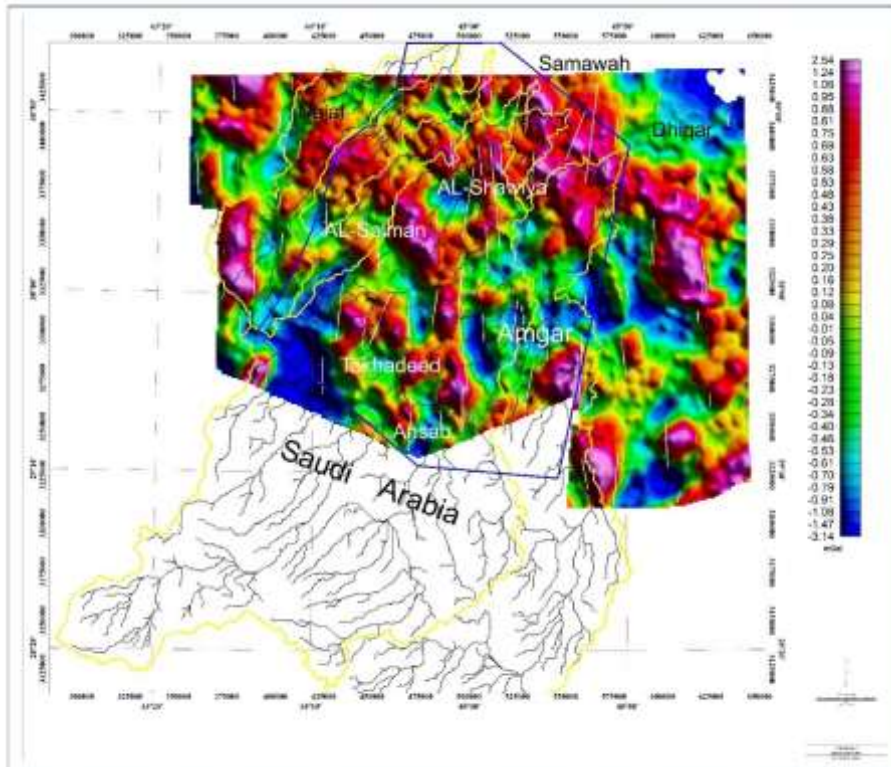


Fig.8. Residual anomalies- (Bouguer gravity) and NS lineaments of study area.

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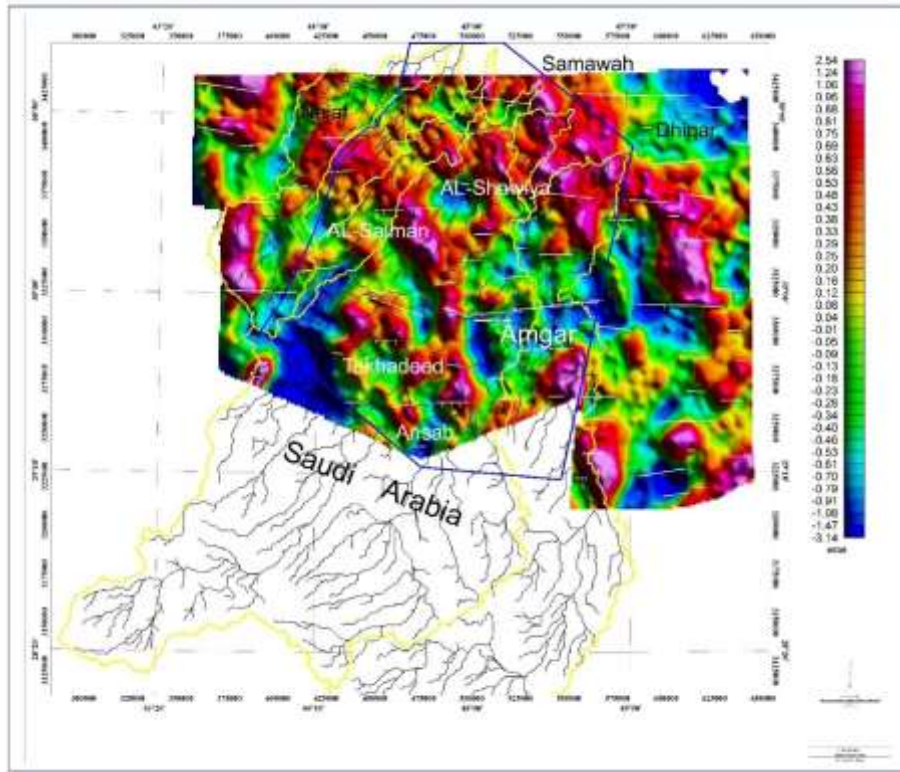


Fig.9. Residual anomalies- (Bouguer gravity) and EW lineaments of study area.

### **Conclusion**

Lineaments are markers of underlying faults and fractures that influence groundwater flow by serving as canals and reservoirs.

- The number of lineaments in a given location may reveal groundwater potential because lineaments often indicate a permeable zone.
- Areas with high lineament density may be suitable for groundwater potential zones.
- The Bouguer anomaly map illustrates a variety of high and low anomalies resulting from changes in subsurface rock density. The research area has a strong gravity gradient, which will be associated with the presence of a depression-filled study area; nevertheless, the majority of these features appear to be of minor lateral extent when compared to the projected main basin.
- The current study region has four lineament directions: The initial view is taken perpendicular to the extensional structures in the NW-NE direction, while the second is taken in the NS-EW direction.
- This study extracted a large number of normal faults and contacts, which is crucial for the tectonic investigation. It has been basically observed that the drainage pattern and the extracted lineaments are directly related.

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