

Lineament Extraction using Gravity

Data in the Abu-Hadeer Basin- Southern Desert of Iraq

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استخلاص الخطيات باستخدام بيانات الجاذبية في حوض أبو حضير-الصحراء

الجنوبية للعراق

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مديرية تربية المثنى

Abstract

Lineament is one of the most essential properties for detecting structural weaknesses, like faults. This study aims to identify underlying lineament trends in the Abu-Hadeer Basin utilising automatic lineament and gravity data. Utilizing satellite gravity data, a subsurface lineament was created. Upward continuation filters were employed to distinguish between (regional and residual anomalies) in satellite gravity data, residual anomaly gravity data was used to analyze subsurface lineaments. Lineament was created with (CET Grid software) to extract subsurface lineament from gravity residual 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: Lineaments; Gravity methods; Abu-Hadeer Basin; Southern Desert; 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. Gravity data provide information on rock densities at depth, a sudden change in the area, especially along a line, may indicate a fault. The lineaments produced by CET (The Centre for Exploration Targeting) will be compared to the spatial change in the gravity map to determine which lineaments have a subsurface control (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, Southern Desert 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- Muthanna Governorate - Southern Desert of Iraq. The data was processed using the Oasis Montaj™ Data Processing and Analysis System (Montaj, 2008).

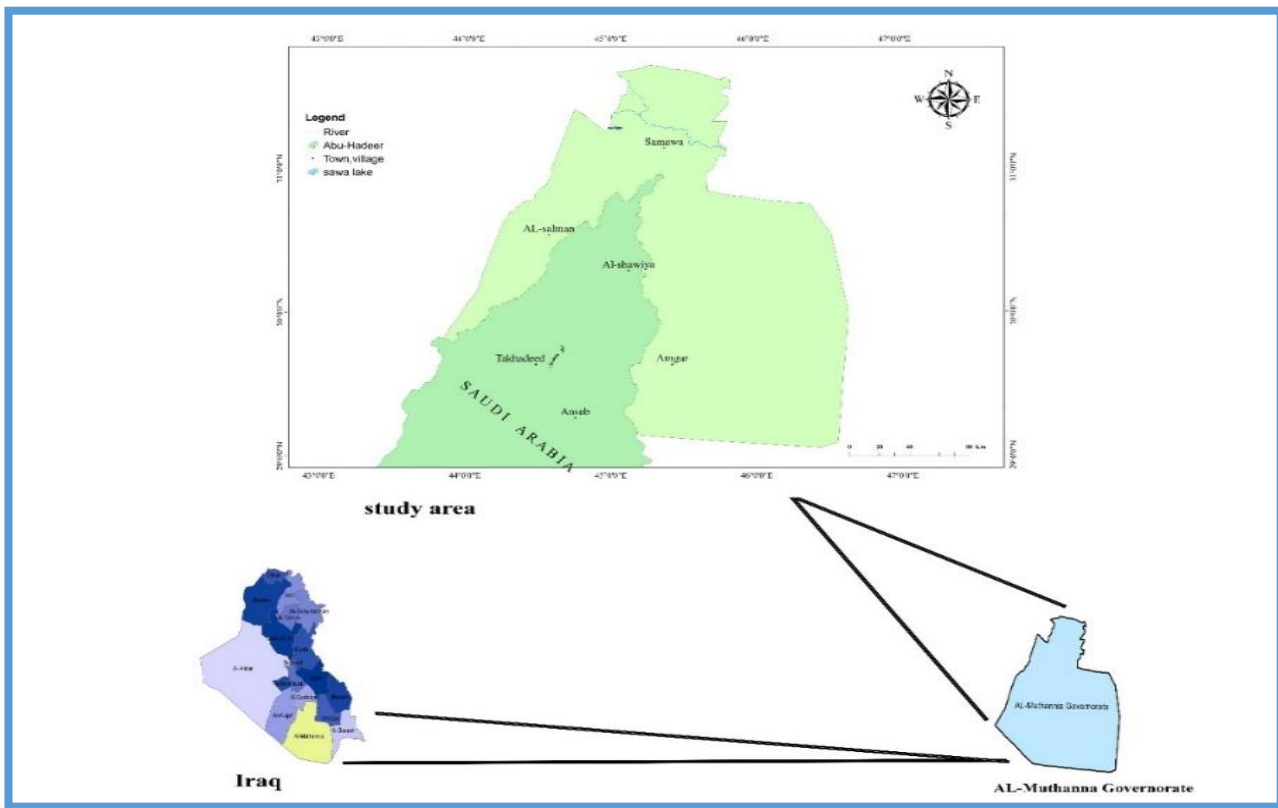


Fig.1. Study area map.

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

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.

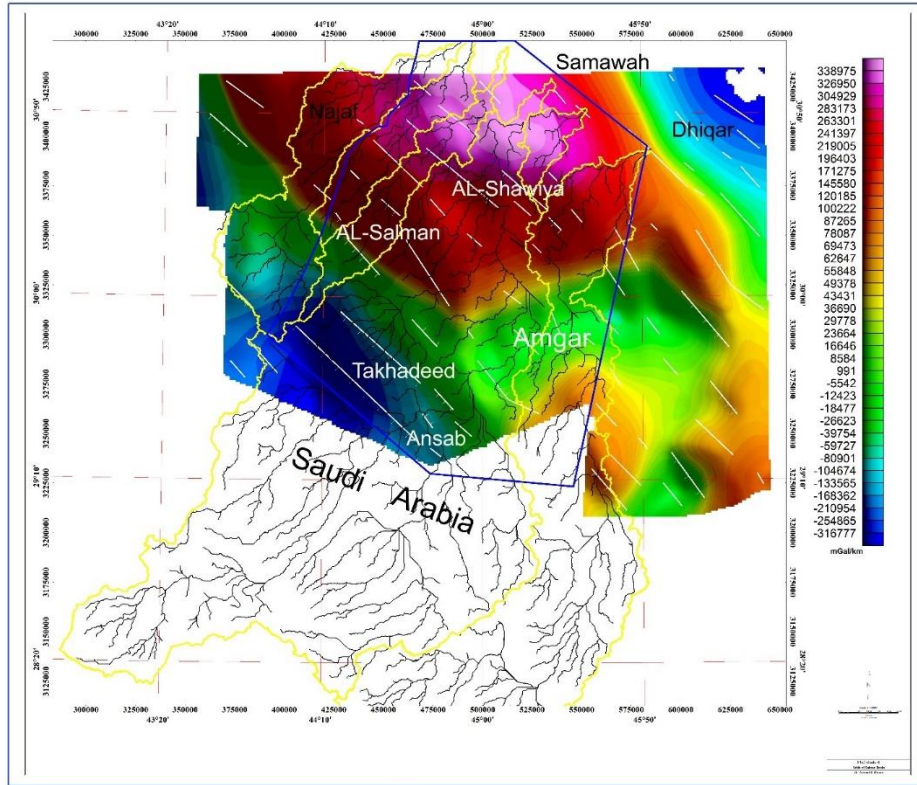


Fig.2. Regional anomalies- (Bouguer gravity) and NW lineaments of study area.

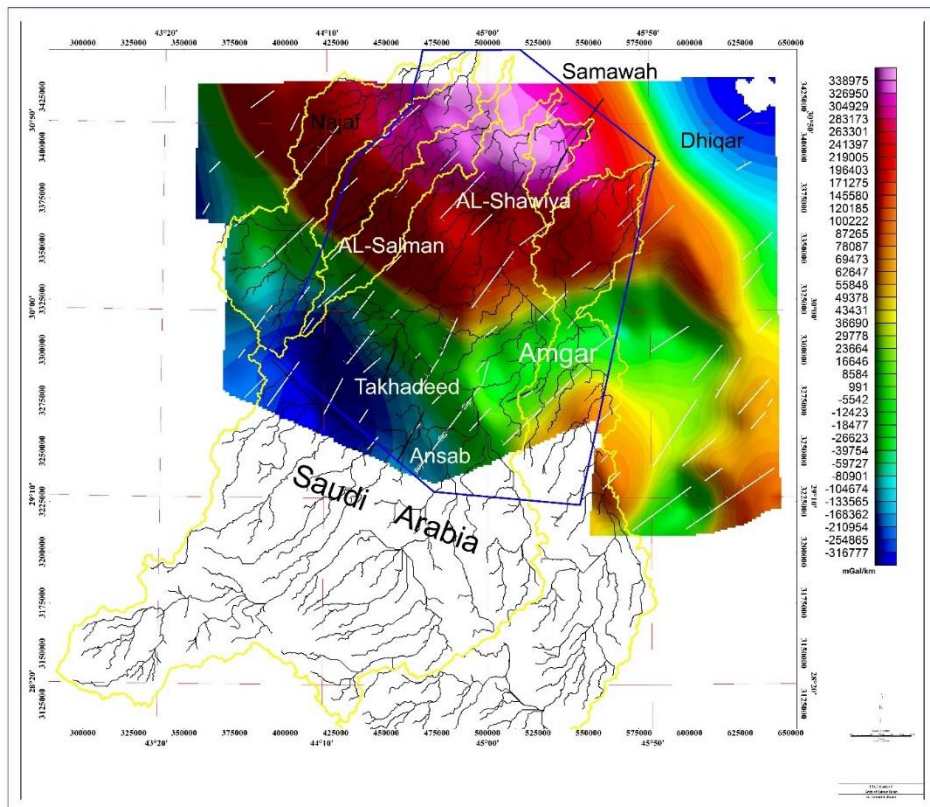


Fig.3. Regional anomalies- (Bouguer gravity) and NE lineaments of study area.

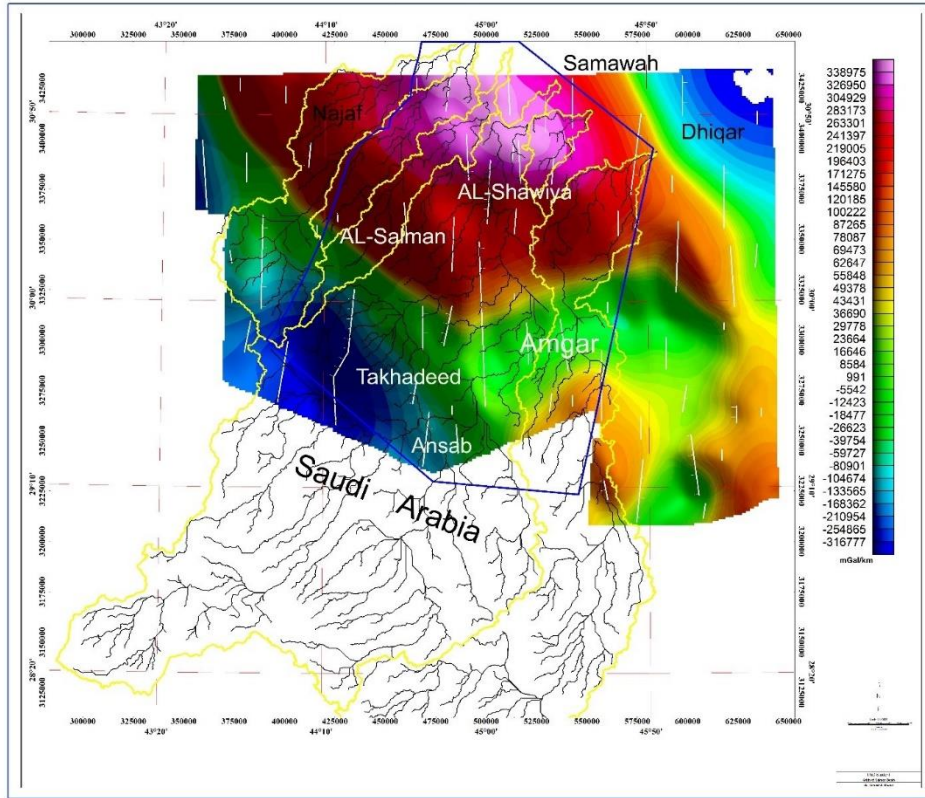


Fig.4. Regional anomalies- (Bouguer gravity) and NS lineaments of study area.

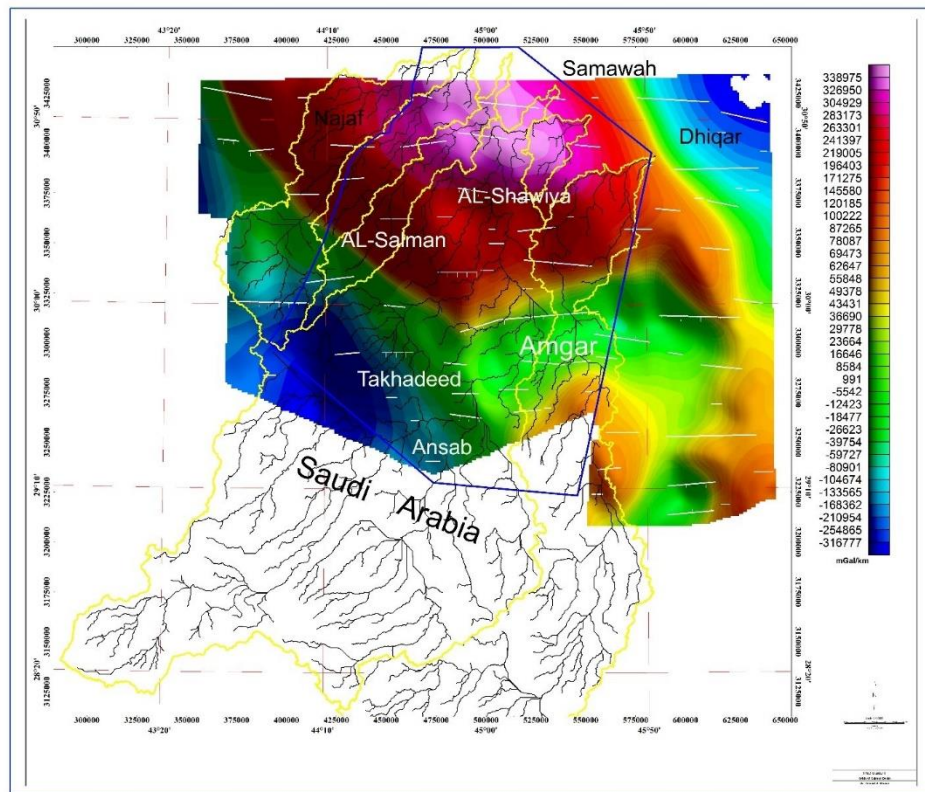


Fig.5. Regional anomalies- (Bouguer gravity) and EW lineaments of study area.

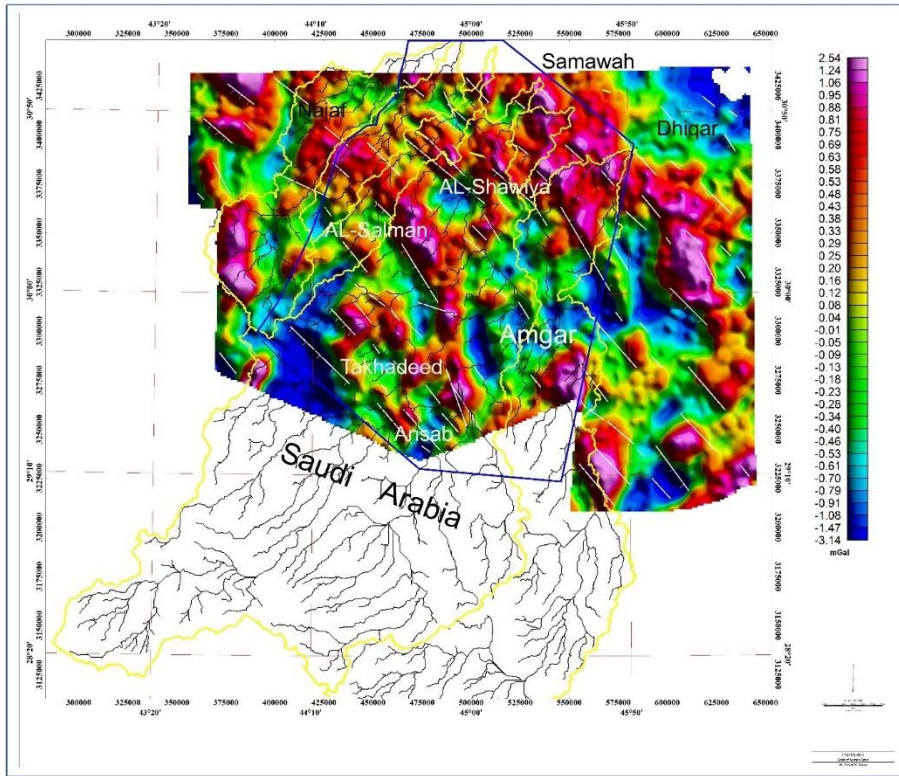


Fig.6. Residual anomalies- (Bouguer gravity) and NW lineaments of study area.

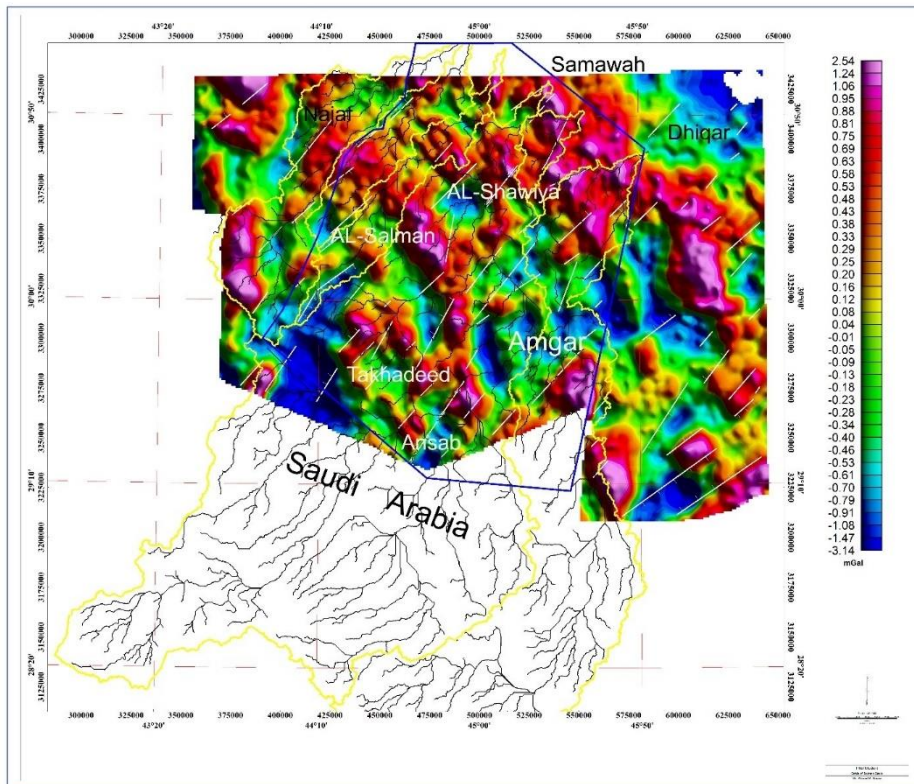


Fig.7. Residual anomalies- (Bouguer gravity) and NE lineaments of study area.

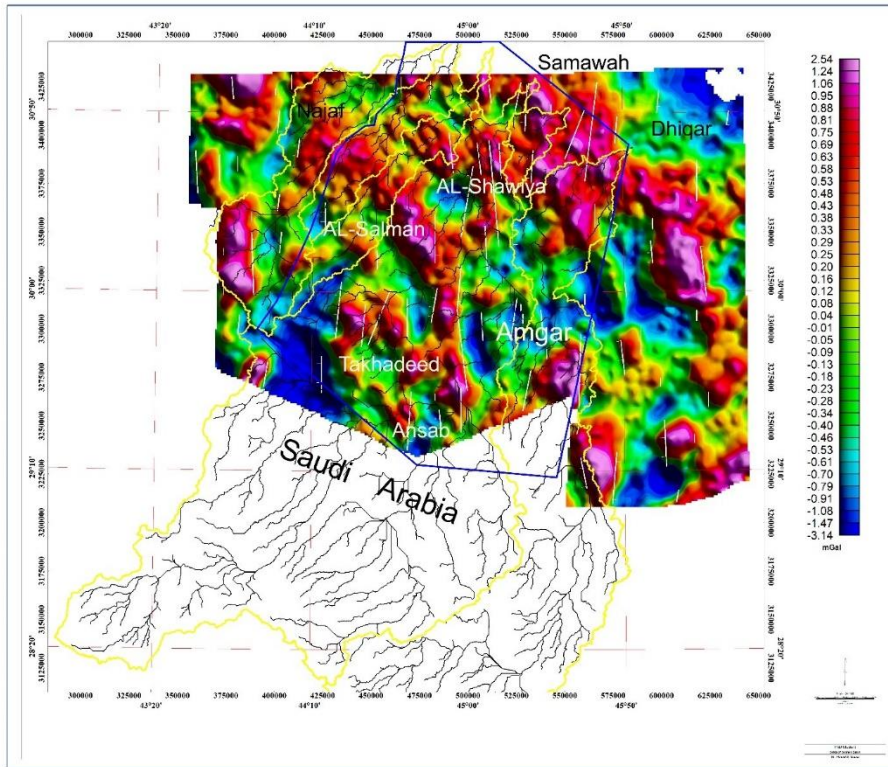


Fig.8. Residual anomalies- (Bouguer gravity) and NS lineaments of study area.

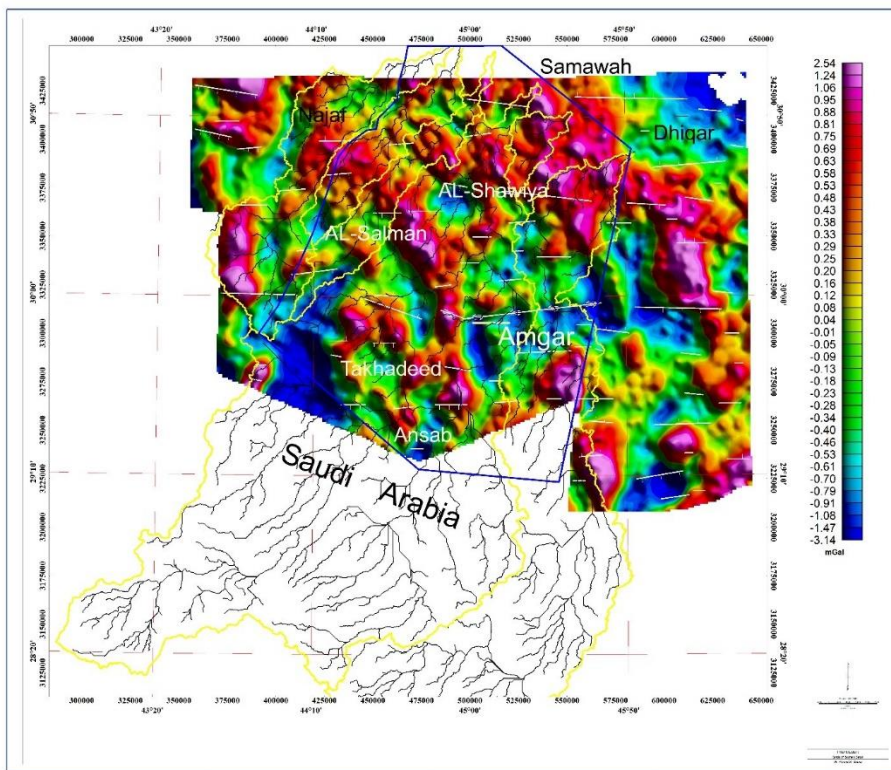


Fig.9. Residual anomalies- (Bouguer gravity) and EW lineaments of study area.

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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