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ISSN: 2616-7441 (Online)
ISSN: 2616-6232 (Print)
ISSN: 2616-7220 (USB)
INTERNATIONAL IDENTIFIER FOR SERIALS

Journal port Science Research
Available online www.jport.co
Volume 5, No:3. 2022

PRODUCING DIGITAL MAPS FOR THE DISTRIBUTION OF MINERALS IN IRAQ USING GEOGRAPHIC INFORMATION SYSTEMS (GIS)

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Abstract Considering the huge amount of information, it becomes so difficult to deal with and understand only in condition they were organized, classified and saved as data base that can be deal with automatically and to make use of it without interfering with its meaning and significance. Here comes the need to invent new methods and systems to save such information and deal with. An example of such systems is Management Information System and Geographic Information System. The ability of geographic information systems to prepare the geographic database and represent it as digital maps is verified by processing mineral data. This research aims to produce digital maps of mineral materials in Iraq by converting a paper map (geological map) at a scale (1:1000000) into a digital map using the survey process and modifying the coordinate system for this map using the georeferencing process. Then the layers are extracted from this map using the digitization process, and these layers are represented, and the proportion of these materials on these layers is represented as a circular sector. The purpose of a geodatabase is to create features in GIS datasets and to determine the relationship between features that are shown on maps as layers, where each layer represents a specific type of feature that was used for spatial analysis.

Crossref 10.36371/port.2022.3.4

Keywords: *Geographic; database; digital; maps; survey; layers; mineral; spatial*

1. INTRODUCTION

Geographic information system is a science of collection, introduction, processing, analysis, display, and output geographic information and qualifying for specific objectives [1-3]. This definition includes the ability of systems to introduce geographic information (maps, images, spacecraft) and descriptions (names, tables), processed (mistakes), storage, retrieval, analysis (and statistical analysis) and displayed on the computer screen on reports and graphs [4,5]. Mineral resources represent the main focus of many studies, especially political, economic and military studies, because minerals are the ones that control the power of states and their economies, their material needs and the development of their civilization.

The nature of the geological conditions in Iraq, which is located within the region of the Arab pavement mineral, has directly affected the quality of mineral wealth, which was characterized as sedimentary ores of origin, as well as on its quantity and geographical distribution. Various minerals have been found in Iraq with very huge reserves that made Iraq occupy an advanced position in many of them in terms of production at the international level, and the most prominent of these minerals is phosphate, which is one of the strategic minerals in Iraq, and its industry was established for strategic accounts rather than economic accounts. The mining sector is the option and the future bet for economic development in Iraq, and great attention should be paid to this important sector in an optimal manner as one of the sources of national income along with oil and other sources such as industry, agriculture, tourism and others, given that the mining sector contains multiple investment opportunities.

This study aims to come up with a map showing the distribution of minerals on the spatial space of Iraq by employing geographic information systems technology, which helps planners and decision-makers in directing appropriate plans, policies and development decisions for the governorates and regions according to their capabilities, by introducing the largest possible number of variables that describe the natural capabilities of the governorates which It has 18 spatial units. The study also aims to employ the technical capabilities of geographic information systems in the field of design and mapping in terms of storing a huge amount of data in a fast and orderly way and the great speed in retrieving, displaying and extracting data and maps from the computer, making adjustments to the maps and updating

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them accurately in a fast, cost-effective and direct way In analyzing the data, it is difficult to provide it by manual methods and to provide an easy method for analyzing and linking spatial information and giving a comprehensive view of the geographical location and its characteristics.

2. METALLOGENIC HISTORY

The mineral stratigraphy of our beloved Iraq is complicated by the lack of geology. Incomplete or nonexistent accurate knowledge and dating of mineralization. Few isotopes

Histories exist for some Zn-Pb deposits, but the country's rough rock relationship has been used mostly. Estimating the age of mineralization, with its relationship to major tectonic events and fiery activities in the region, which are attributed to regional stages of origin. The mineral wealth of the Kurdistan Region. Low-temperature hydrothermal vein deposits of zinc, lead, copper, ba, pyrite and siderite. Common in the Permian, Triassic and Late Cretaceous carbonates of the Ura region. While, Zn-Pb ores associated with synthesis layers (at the current level of knowledge) are limited to. Triassic carbonate. It is believed that the most important recent deposits (Sergoza) are concomitant, within Triassic dolomite and comparable to other layers of Zn-Pb. Sediments of the same age in the Mediterranean belt based on lead isotopic dating, Geochemical properties and morphology of the ores. Figure1 is shown Minerogenic map of Iraq.

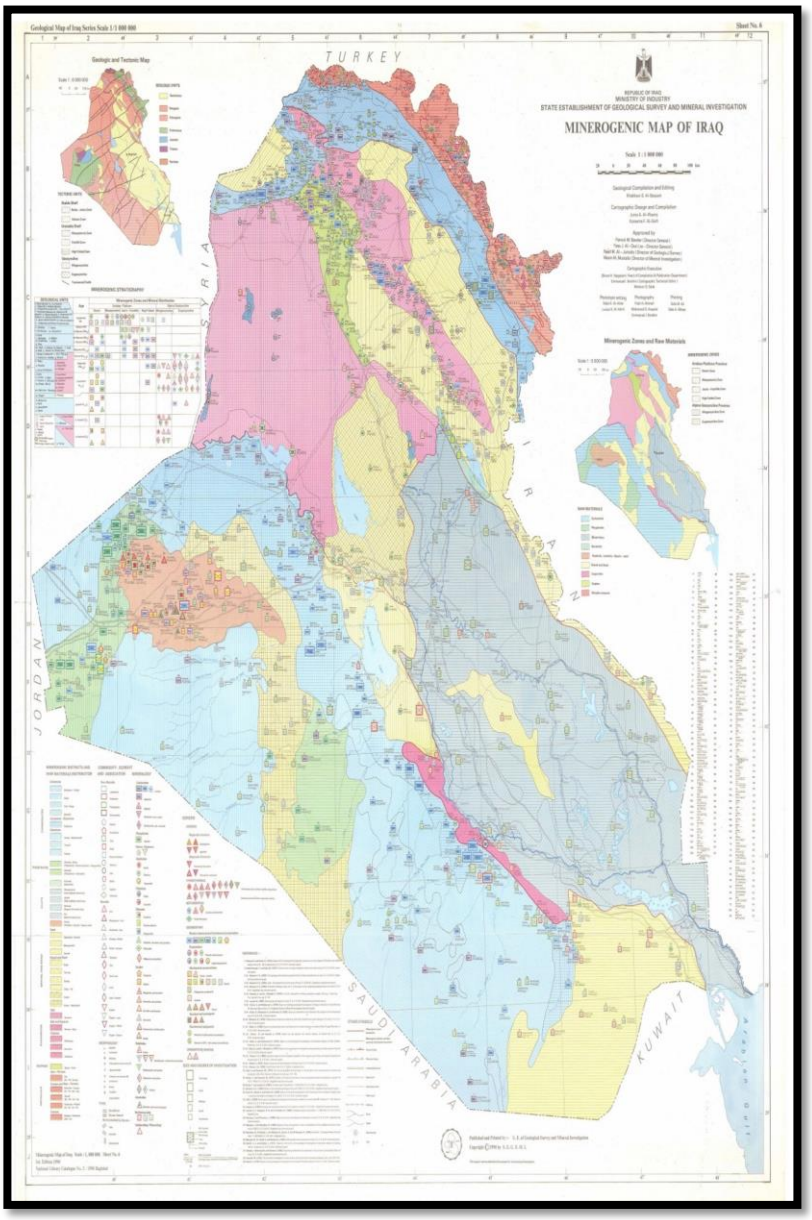

***Figure1**: Minerogenic map of Iraq*

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3. GEOGRAPHICAL INFORMATION SYSTEM

GIS System of geographic data storage and retrieval Geodatabases (descriptions of events impacted by geographic location) and software tools for organizing, analyzing, and displaying geographic data are included under this category of databases [6,7]. Human users and support staff, procedures and workflows, a body of knowledge of applicable concepts and methodologies, and institutional institutions are all part of such a system in a larger sense. It is the same as geo informatics, and it is a subset of the more considerable geospatial discipline, including GPS, remote sensing, and other geographic information systems, among other technologies. Geographic information science (GIScience) is a frequently used abbreviation in academic circles to refer to the academic discipline that analyzes these systems and the geographic concepts as shown in figure 2. [8-10].

Geographic information systems (GIS), it is possible to bring previously separate information together in a single location by using the place as the "key index variable." The x, y, and z coordinates (showing longitude (x), latitude (y), and elevation (z)) can be used to record locations and extents found in Earth's spacetime as well as the date and time of occurrence. The x, y, and z coordinates can be used to record locations and extents found in Earth's spacetime and the date and time of the event. The x, y, and z coordinates. Eventually, it will be necessary to make comparisons between earth-based spatial-temporal references, as well as between earth-based location and extent references, and between earthbased location and extent references and "real" physical location or extent references. Because of this fundamental property of its design, geospatial information systems (GIS) have begun to open up a new scientific inquiry and research domains. Figure (3) show the opening of the map in the GIS program.

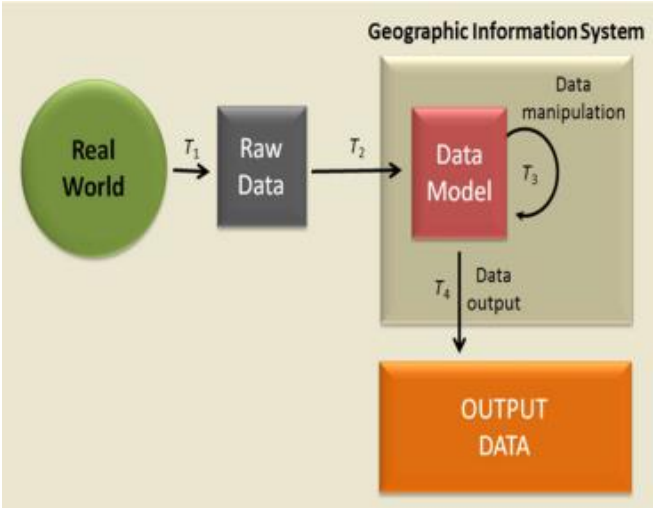

Figure 2: *Basic GIS concept*

In Figure (3), the paper map has been opened to be converted into a digital map through these steps using the GIS program through the following steps:

Start Arc Map if it isn't already running. Click File and click Open.Click the Look in drop-down arrow and navigate to the folder that contains the map.Click the map you want to open.

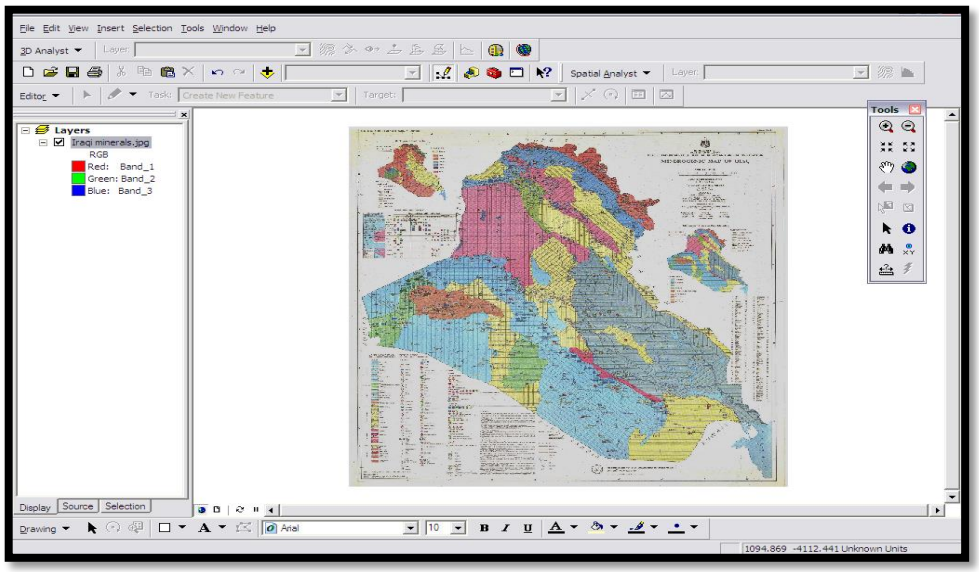

Figure 3 *shows the opening of the map in the GIS program.*

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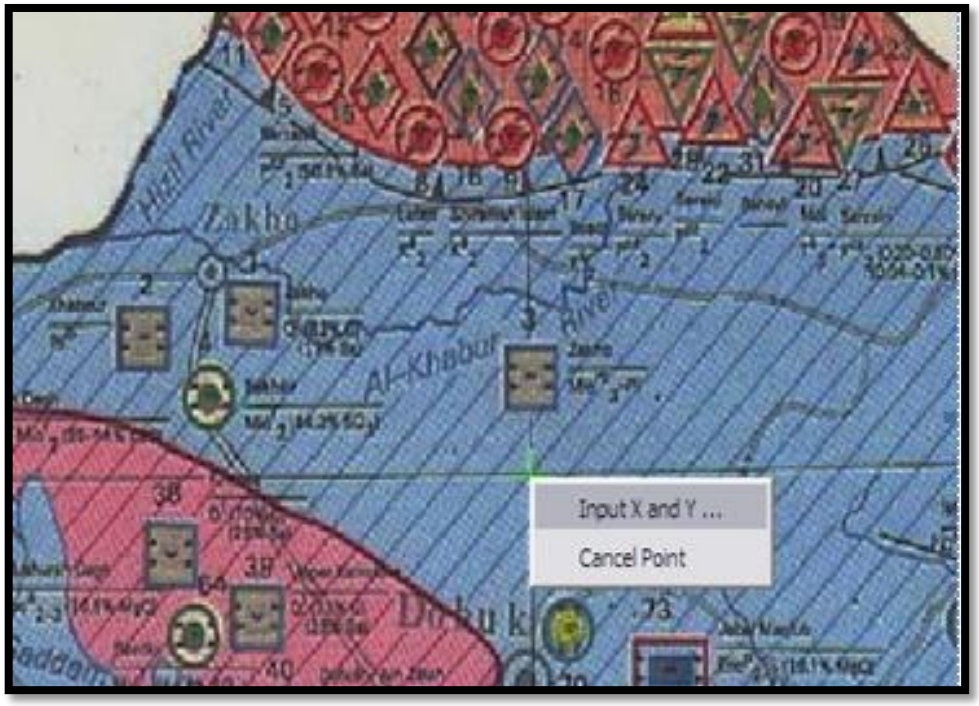

Figure 4 *illustrates the method of entering (x,y) values on the original map in the GIS program*

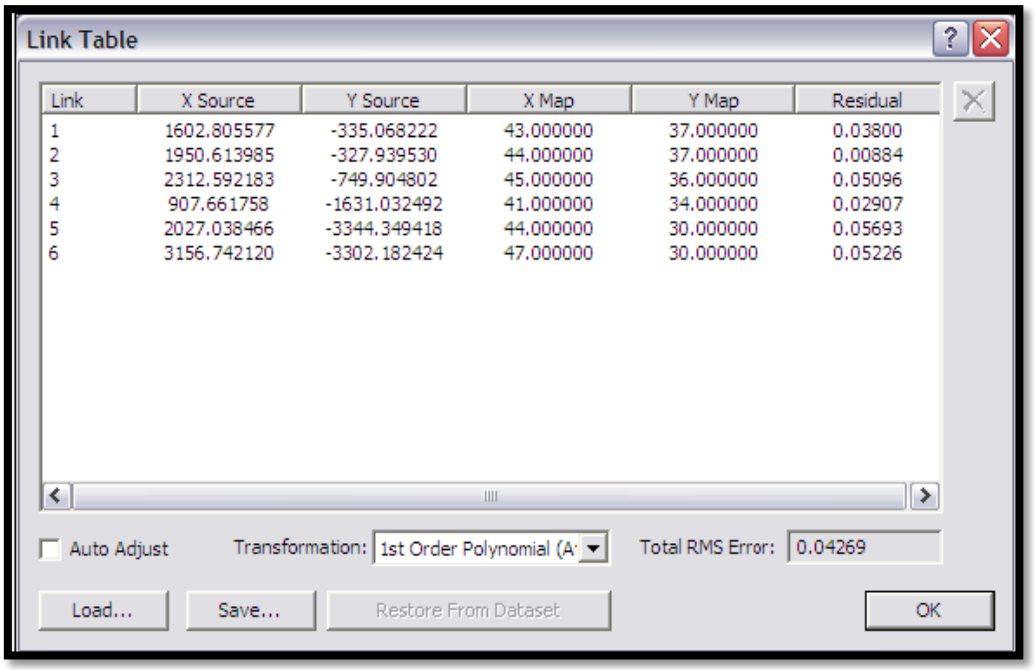

Figure 5: *(Table of x,y) values and the value of the total error in the GIS program*

Table (1)*: coordinates of the selected points*

Point No.	α	λ
1	43	37
2	44	37
3	45	36
4	41	34
5	44	30
6	47	30

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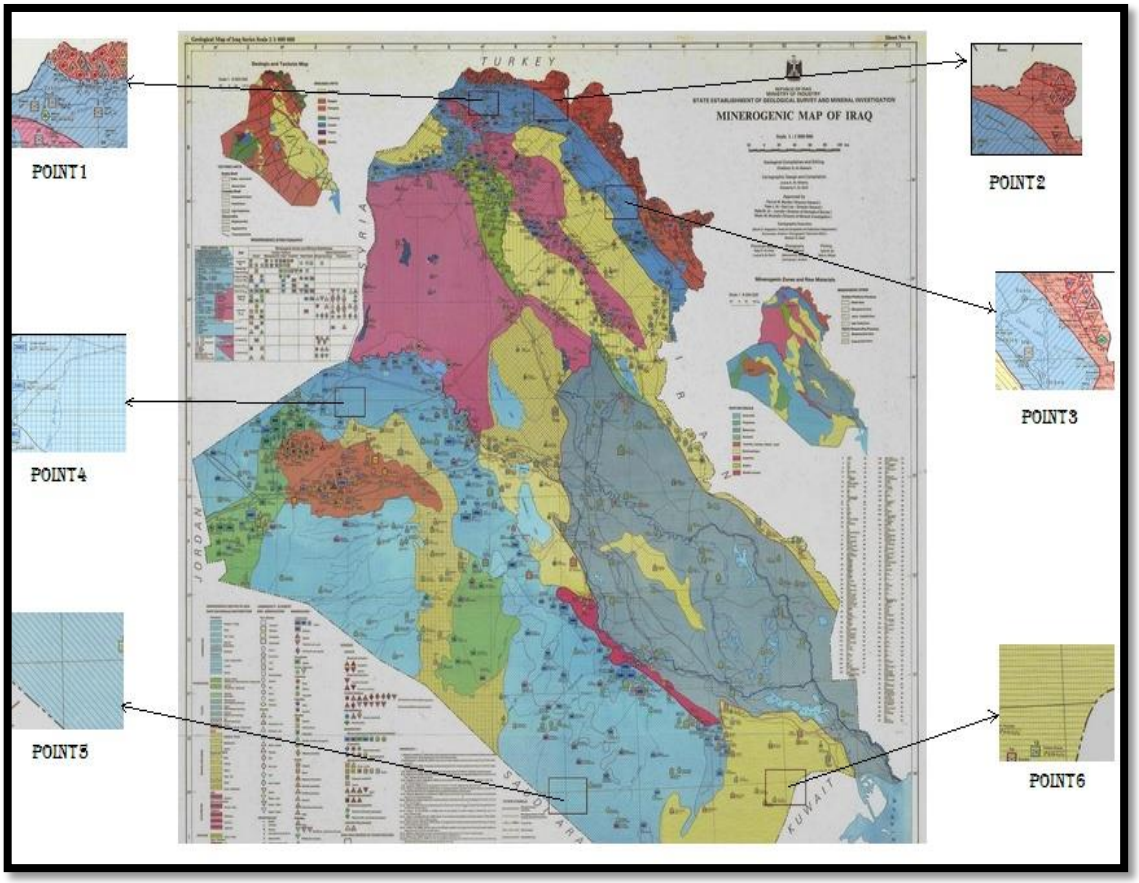

Figure 6: *The entered map shows the location of each point in relation to the original map.*

Distribution of Minerals in Iraq

Mineral wealth has great economic importance for many countries. The development of mineral wealth was the basis on which the economy was based in all countries, and there are many countries that were able to solve the problem of unemployment through the extraction of minerals, in addition to that mineral wealth is a basis for building the national economy in Different number of countries in the world. The mineral wealth is the artery feeding all kinds of industries. The importance of mineral wealth is also that minerals are used for a wide variety of purposes either directly or after processing using multiple processing methods and converting them into other useful products as they enter the manufacture of chemicals, fertilizers, building materials and others. [11]

Iraq is country rich in its diverse mineral wealth, which is spread in many governorates of Iraq, such as Anbar, Kurdistan, Nineveh, Najaf, Karbala, Wasit, Maysan, and others. The geographical distribution of minerals is closely related to the conditions of the geological formation, and determining the types of mining ores and estimating their reserves, locations and specifications can open the way for local and foreign investment. Iraq's governorates contain important minerals with distinct reserves that made Iraq in some of them occupy advanced positions in terms of reserves and production at the international level. Reports indicate Iraq's occupation of the world's first reserve of free sulfur and the second after Morocco of phosphate, as well as huge reserves of silica sand, ceramic clay and raw materials suitable for the manufacture of cement and other building materials, and Iraq can export the surplus of these wealth, especially phosphate fertilizers.

Iraq contains many minerals such as free sulfur in the governorates of Nineveh and Salah al-Din, phosphate in Akashat / Anbar governorate, sodium sulfate in Salah al-Din governorate, limestone in Anbar, Muthanna, Najaf and Kurdistan Region, salt in the governorates of Muthanna and Nineveh, and in the Al-Faw salina in Basra. Dolomite is also found in Anbar, Al-Muthanna, Al-Jybasm in Nineveh, Kirkuk, Salah Al-Din and Al-Anbar, in addition to the wide spread of sand in Iraq and in different regions, which has many uses. As for quartzite, it is found in the Western Desert of Anbar in the form of rock masses that are resistant to weathering and erosion, with the presence of clays in most of the governorates located in the sedimentary plain and Anbar region. There is also bauxite in Anbar, lead and zinc in Dohuk and Sulaymaniyah, copper in Sulaymaniyah, iron and manganese in Sulaymaniyah, Duhok and alabaster in Sulaymaniyah and Erbil.

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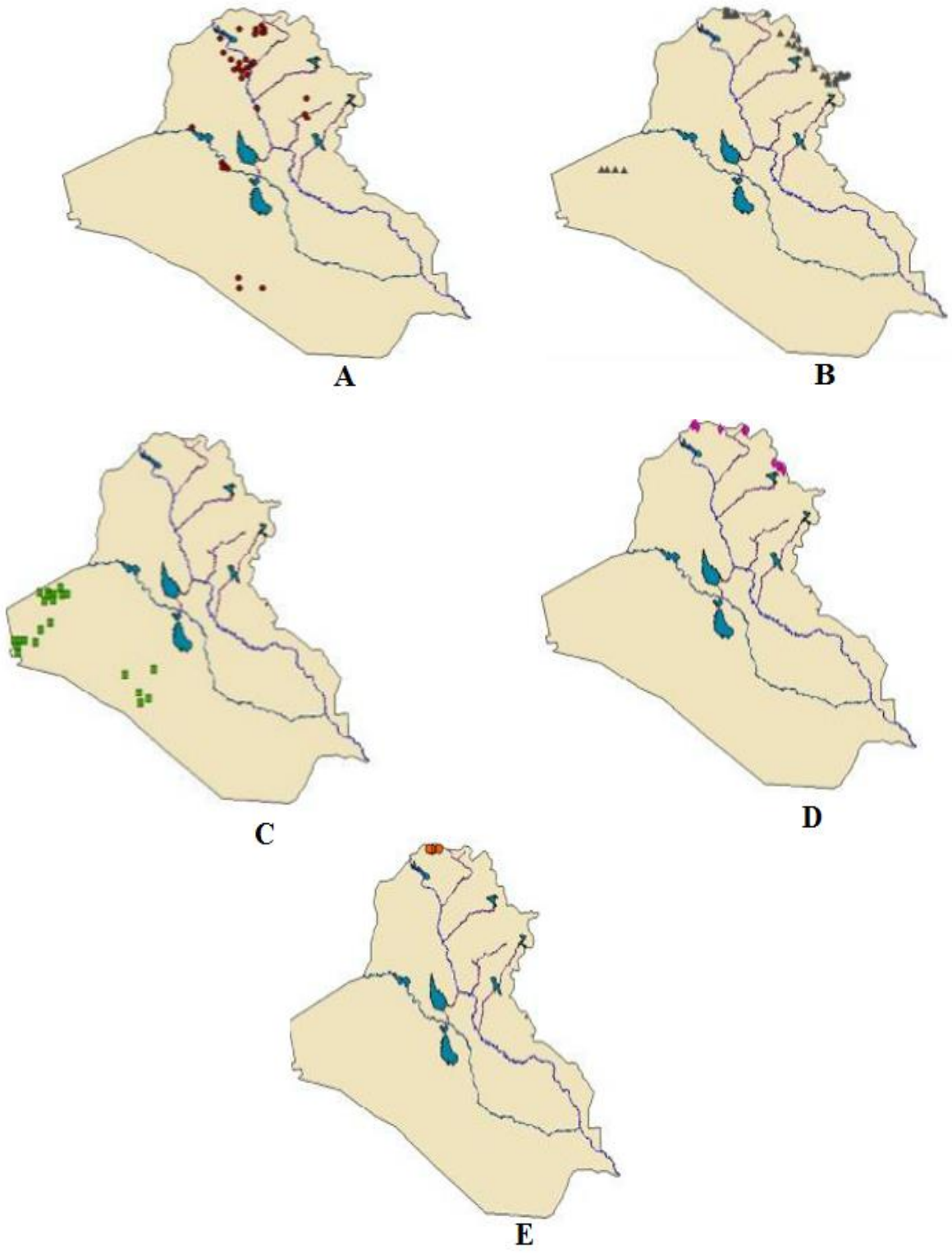

Figure 7: *Maps of Iraq showing the locations of minerals. (A: sulfur. B: iron. C: phosphate. D: Zink. E: lead*

4. AREA CALCULATION

For the purpose of calculating the area, the map must be projected on a plane projection with orthogonal coordinates (x,y) and the most suitable projection for this work is the UTM projection (Universal Transverse Merecator). Table (2) shows the percentage of the area of each mineral in relation to the total area of Iraq, as well as the area of each mineral and this is clearly shown in Figure (8), which was drawn with the help of the Excel program, where it shows the area occupied by each layer relative to the other layers. Drawing metal layers is a polygon, but it is not that simple, as there are

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a number of problems that we will confront us, such as the problem of juxtaposition between the layers, as the accuracy of the drawing, no matter how high, will be either overlab or gaps between the layers and to bypass the layers. For these problems, the Arctoolbox program was used, which has the ability to erase part of an overlapping layer with another layer to produce a new layer that is not overlapping with the other layers. As for the old layer, it can be erased because the new layer compensates for it. Now that the area for each layer of minerals has been calculated, we can collect all the data in a map that we can call the mineral distribution map in Iraq as shown in Figure (9).

Table (2) *The layers that have been formatted and the type of each layer*

Layer	Type	Percentage of metal
Polygon	Boundaries	-
Line	Rivers	-
Polygon	Lakes	-
Point	Sulphur	23
Point	phosphate	16
Point	Iron	24
Point	Copper	15
Point	Zink	7
Point	Lead	3
Point	Iron	3
Point	Chrome-Nickel	1
Point	Copper- Lead	2
Point	Cooper-Nickel	6

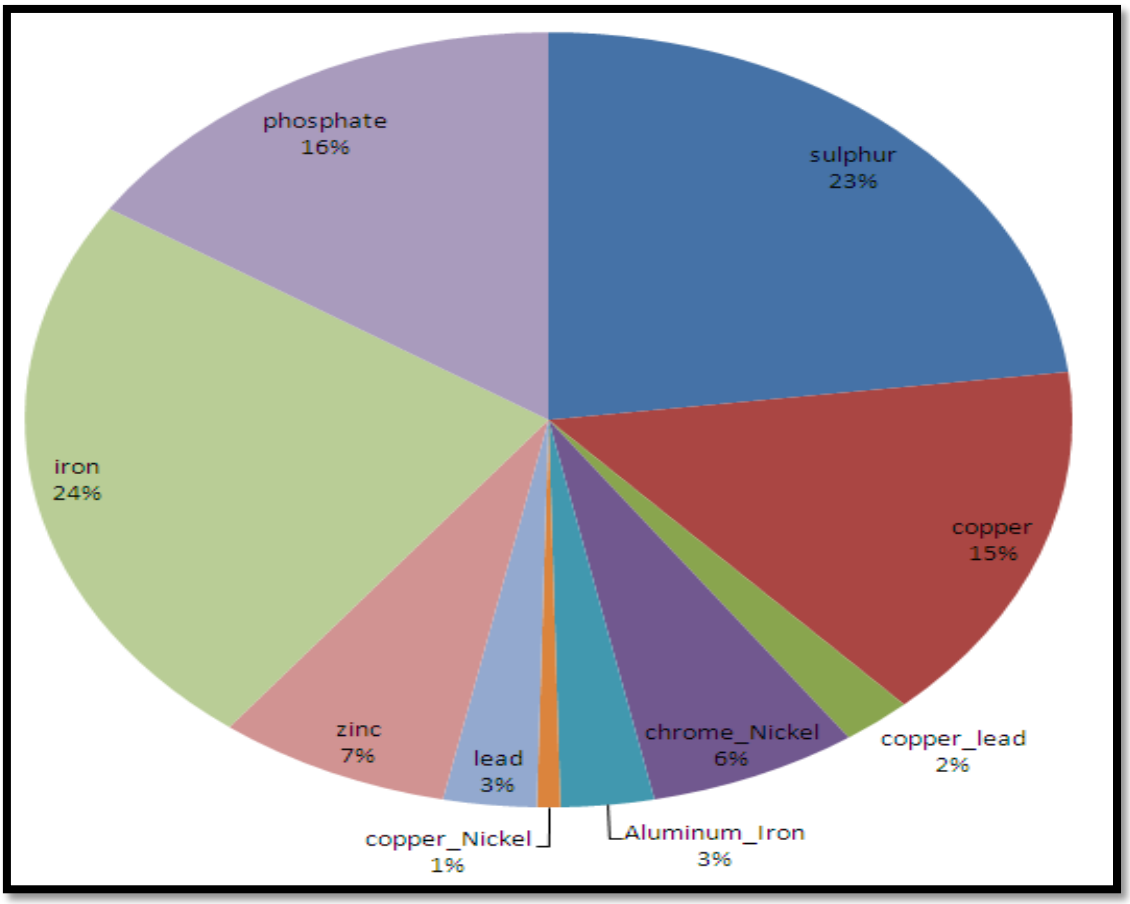

Figure 8: *Overview of the area occupied by each layer relative to the other layers.*

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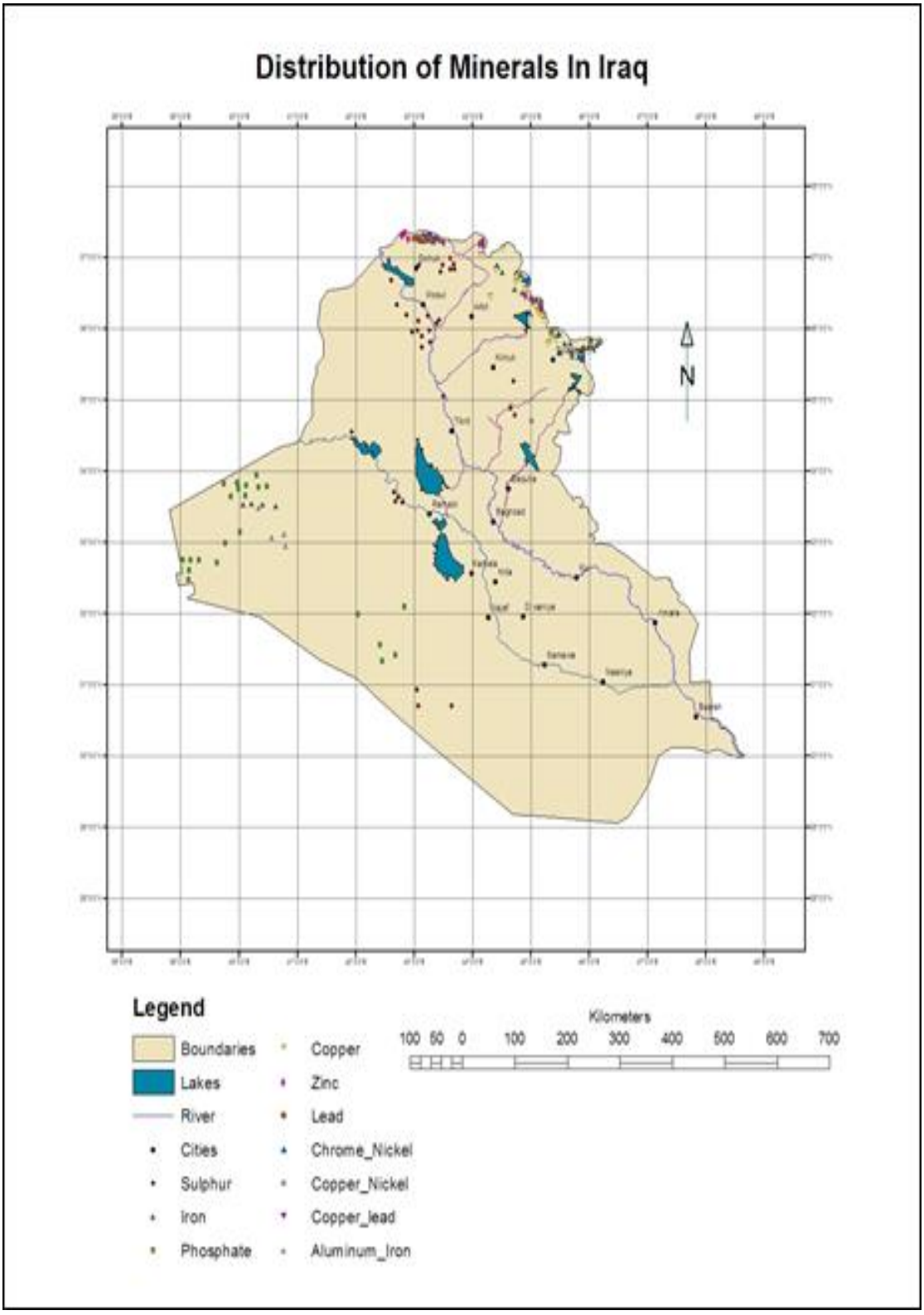

Figure 9: *Map of mineral distribution in Iraq.*

5. CONCLUSIONS

1. The geographic information systems program provides the optimal handling, processing, management, analysis and updating of information and large data, especially as it relies mainly on remote sensing data, to simplify the process of studying, analyzing and comparing it and making appropriate decisions for planning and development in the study area, and thus, the maps represent the

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quantity, quality, and high accuracy, and analytical ease for the receiving reader, especially when using graphic symbols in them.

2. Geographical information systems (GIS) techniques have provided advanced systems for the preparation and design of maps And updating and devising them, as well as analyzing them.
3. The maps prepared by GIS programs, especially (ArcGIS and Erdas)programs, have high accuracy in the geolocation system and the cartographic coding system.
4. We gave an initial idea about the types of minerals available and the locations of their spread in Iraq.
5. Through this data prepared using (ARC GIS 9.3) programs can be added to the data others to enable workers in this field to take appropriate decisions in establishing laboratories near the locations of the minerals that need them.

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