



MINISTRY OF NATURAL RESOURCES | KURDISTAN REGIONAL GOVERNMENT  
حکومه‌تی هه‌ریمی کوردستان | وهزاره‌تی سامانه سروشتیه‌کان



## OCCURRENCES OF METALLIC DEPOSITS IN THE KURDISTAN REGION - IRAQ

Kurdistan Region - Iraq



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June 2016

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## **INTRODUCTION**

The Kurdistan Region's mineral profile is characterized by the occurrence of diverse metallic mineral deposits, such as Lead (Pb), Zinc (Zn), Copper (Cu), Chrome (Cr) Nickel (Ni), Cobalt (Co), Manganese (Mn) and Iron (Fe) which are believed to have derived from magmatic, hydrothermal and sedimentary origins, beside or in association with some other non-metallic mineral deposits like Barite, Talc & Asbestos.

Most of the metallic deposits are in the suture zone which is related to various phases of the plate tectonic history (Neo-Tethys Oceanic event) of the region, where igneous activities with deep-seated fault are more probable for the origin of mineralization to the north east of the region, while hydrothermal activities are the likely cause of metallic deposits to the north of the region.

The Region is covered by 1:100,000 and 1:20,000 geological mapping for more promising areas (Duri Serguza, Marapasta & Mawat area).

According to the existence and concentration of metallic ore deposits and the availability of the information and data (Annex A), the Region is divided in to seven (7) blocks for exploration and investment as follows: Figures A, B, C.

### **DUHOK GOVERNORATE**

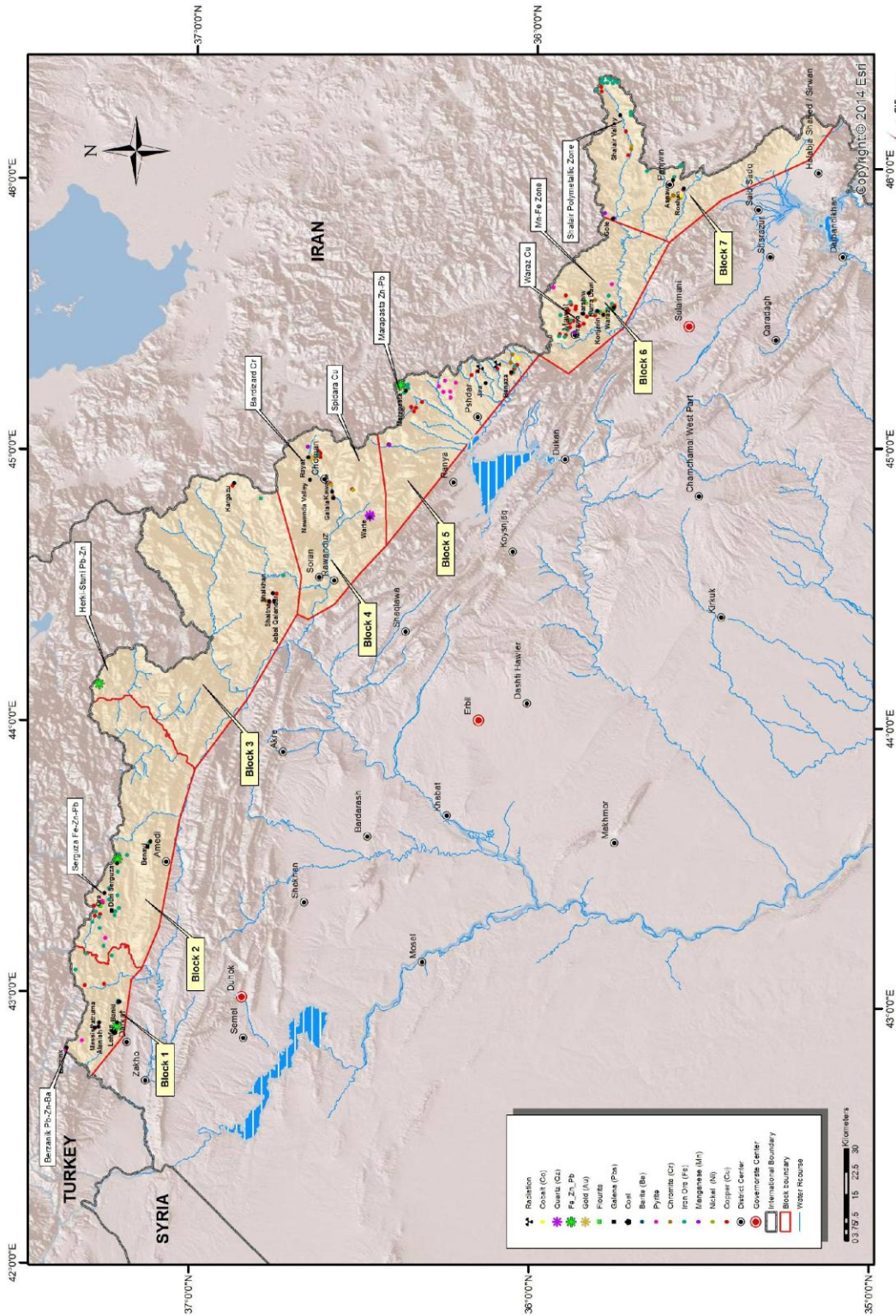
- 1- BLOCK 1
- 2- BLOCK 2

### **ERBIL GOVERNORATE**

- 1- BLOCK 3
- 2- BLOCK 4

### **SULAYMANIA GOVERNORATE**

- 1- BLOCK 5
- 2- BLOCK 6
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Kurdistan Regional Government

Figure A Mineral Blocks of Kurdistan Region



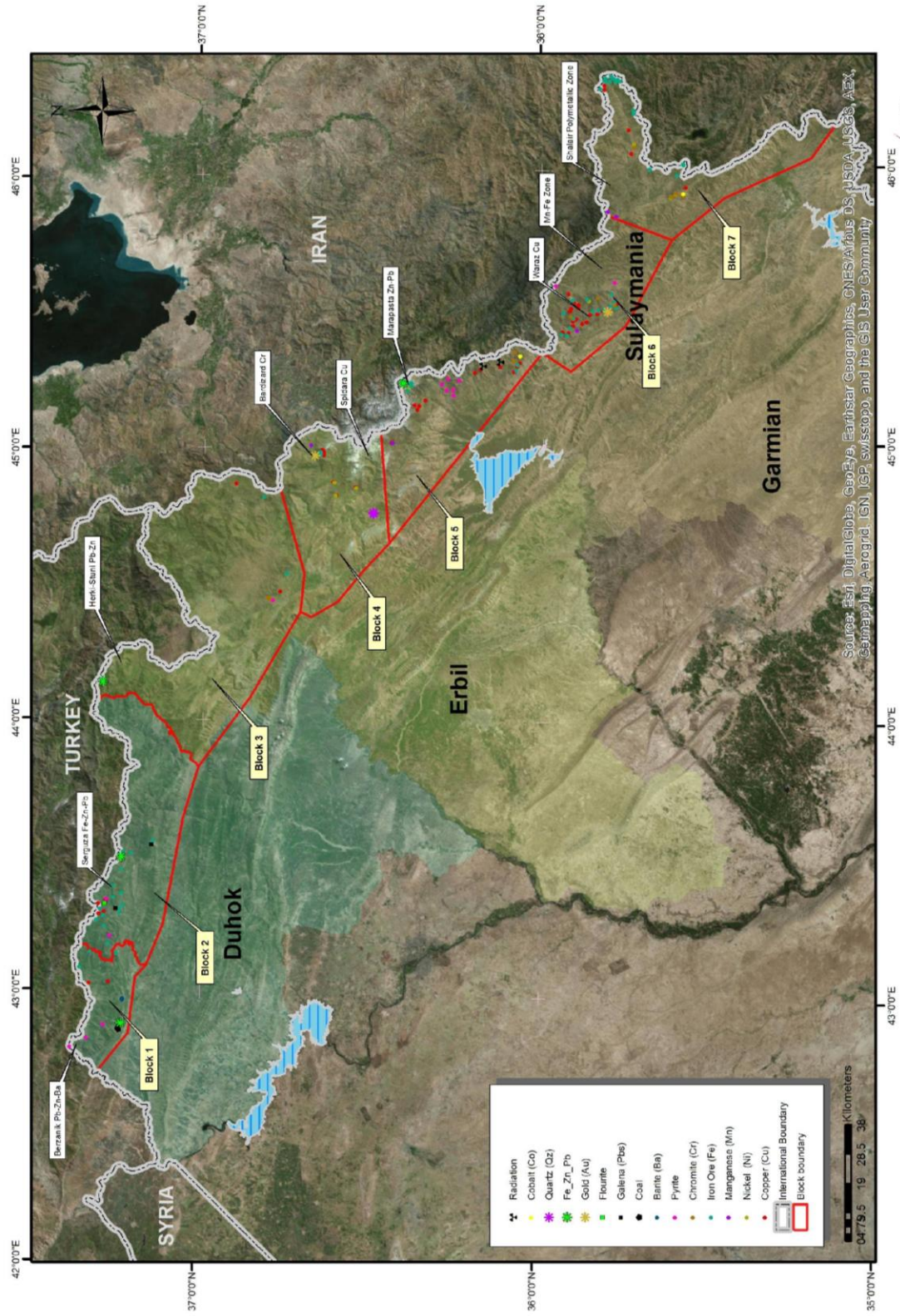


Figure B Mineral Blocks of Kurdistan Region (Satellite)



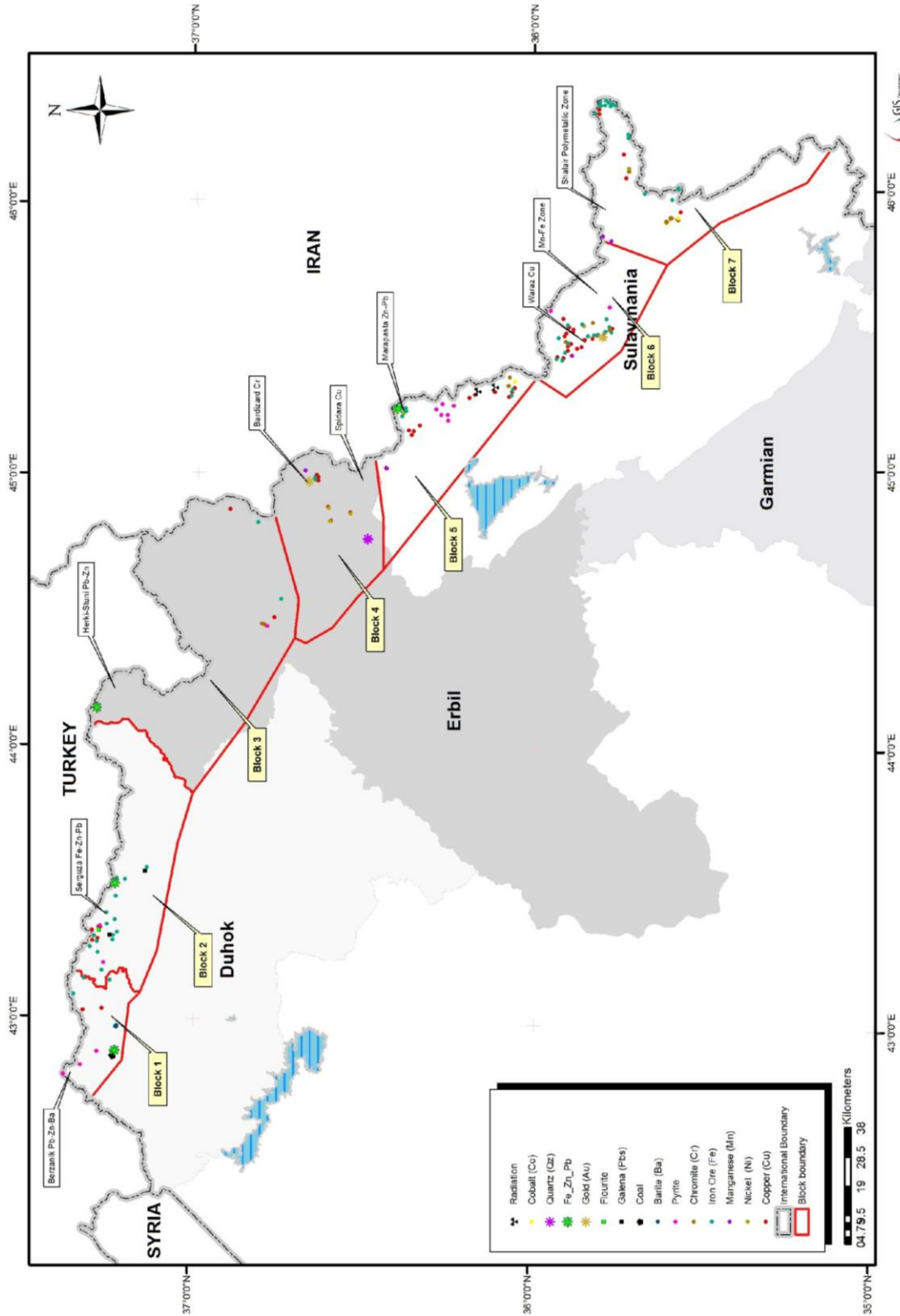


Figure. C Mineral Blocks of Kurdistan Region Based on Governorates

## DUHOK GOVERNORATE

BLOCK 1

BLOCK 2

**BLOCK 1**

**Location:** Duhok Governorate, North East of Zakho district

**Area:** 598.71 km<sup>2</sup>

**Coordination:**

Point ID	X	Y
<b>A</b>	295511.84	4130840.97
<b>B</b>	308652.61	4120189.37
<b>C</b>	327009.07	4117790.51
<b>D</b>	330717.62	4114265.49
<b>E</b>	338083.70	4136047.21

The Iraqi-Turkish international boundary forms the northern boundary of the block. The Khabur River represents the eastern boundary of the block. Figure 1.1

**Deposits and Occurrences:** (Figures 1.2, 1.3, 1.4)

#### **Berzanik Pb-Zn deposits and Barite**

Three Gossan outcrops with Barite of 75m long and 3m width, along thrust fault separating Permian from Triassic rocks of hydrothermal veins origin. The mineral assemblages are Galena, Sphalerite, Smithsonite, Calcite, Sidrite, and Ankerite. Ref. (2, 6, 7)

#### **Alanish Pb-Zn deposits, SE of Berzanik occurrences,**

The mineralized body of 600m long and 3-5m wide exists along fault zone within Chia-Zairi limestone. There are a few Gossan outcrops in the shear zone composing of brownish and reddish gangue, associated with Barite. Ref. (1, 7)

#### **Patruma- Massis Pb deposits,**

Mainly existing in a mineralization zone related to tectonic contact of late Triassic (Kurra Chine) to the early Cretaceous. The mineralized zone 5km extension, discontinuous, coincides with major WNE-ESE fault. The mineralogy of ore is composed of Siderite, Barite, Limonite, Orpiment and Galena. Ref. (1, 2)

#### **Note:**

There are significant indications of Copper at Patruma, and indications of Fe oxides (Gossans) distributed mainly to the east of the block.

#### **Lehfan Pb-Zn deposits,**

Exists within Cretaceous carbonates in high folded zone, and consisting of Barite veins, Galena. Sphalerite, Smithsonite and Siderite.

There is a borehole of 36m depth drilled at 1990 in Lehfan location. The Ore bearing Limestone of 19m thick was discovered with an average 8.65% Zn and 0.8% Pb. The Ore contained 200g/ton of Silver. Ref. (1, 2, 3, 4)

**Banki Pb-deposits,**

These are related to Late Cretaceous Aqra-Bekhma formations, as an oxidized material associated with Barite. Ref. (3, 7, 8)

**Note:**

The presence of highly rich bitumenes shales and limestone beds of upper Jurassic & lower Cretaceous formations; outcropping at Banki village extending around 18km to the west of Shiranish Islam village. Ref. (5, 8)

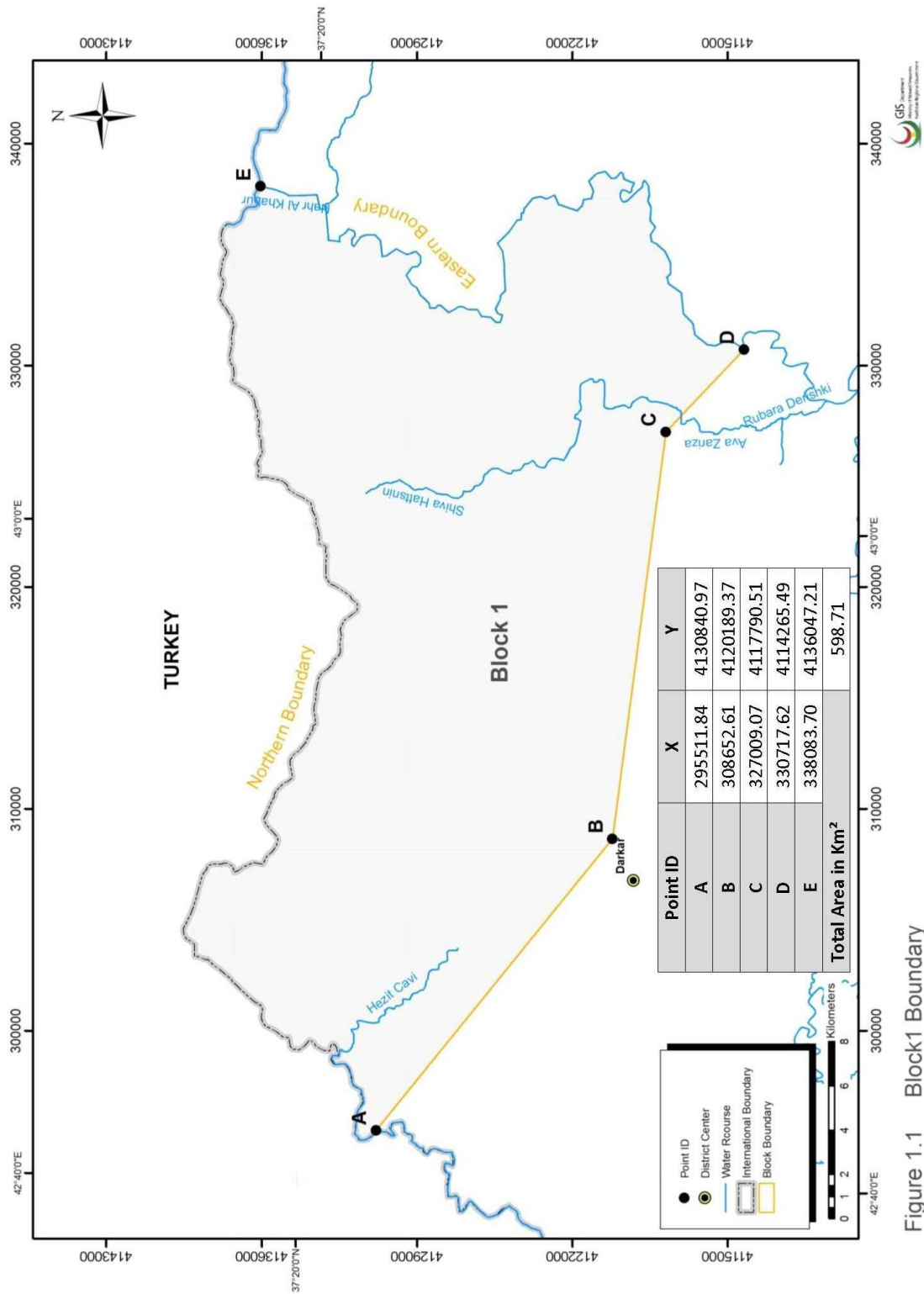


Figure 1.1 Block1 Boundary

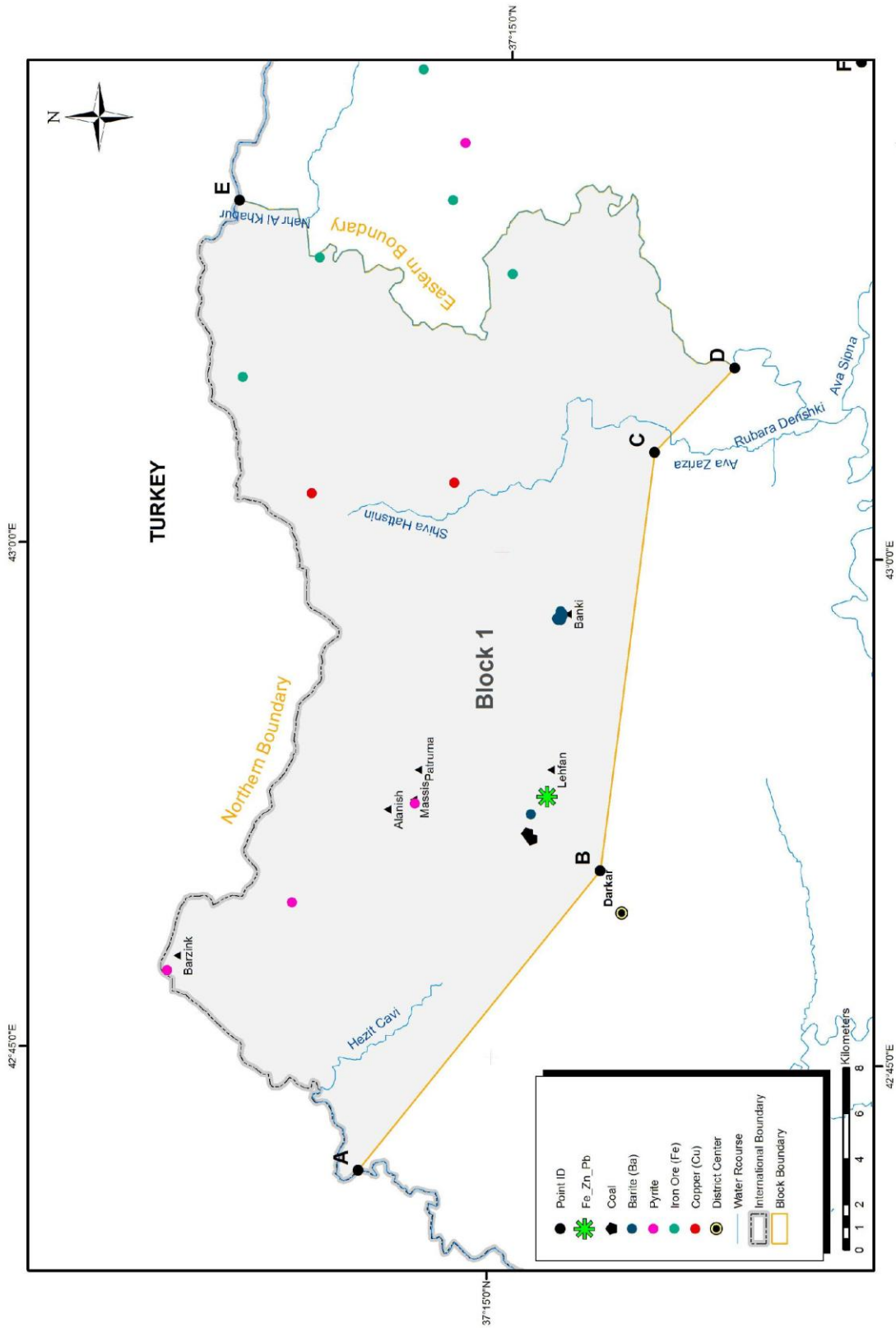


Figure 1.2 Block1 Mineral Deposits



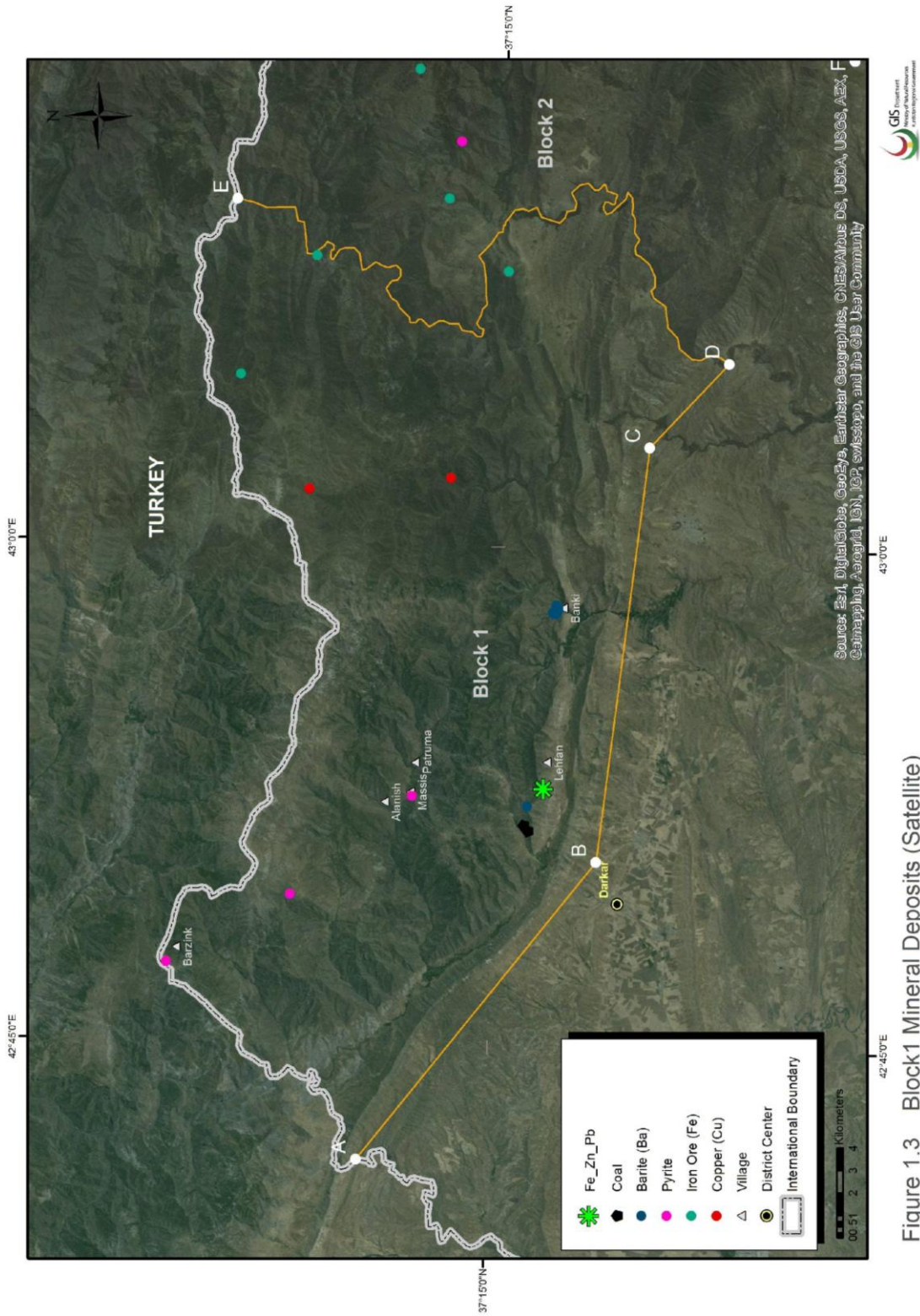


Figure 1.3 Block1 Mineral Deposits (Satellite)

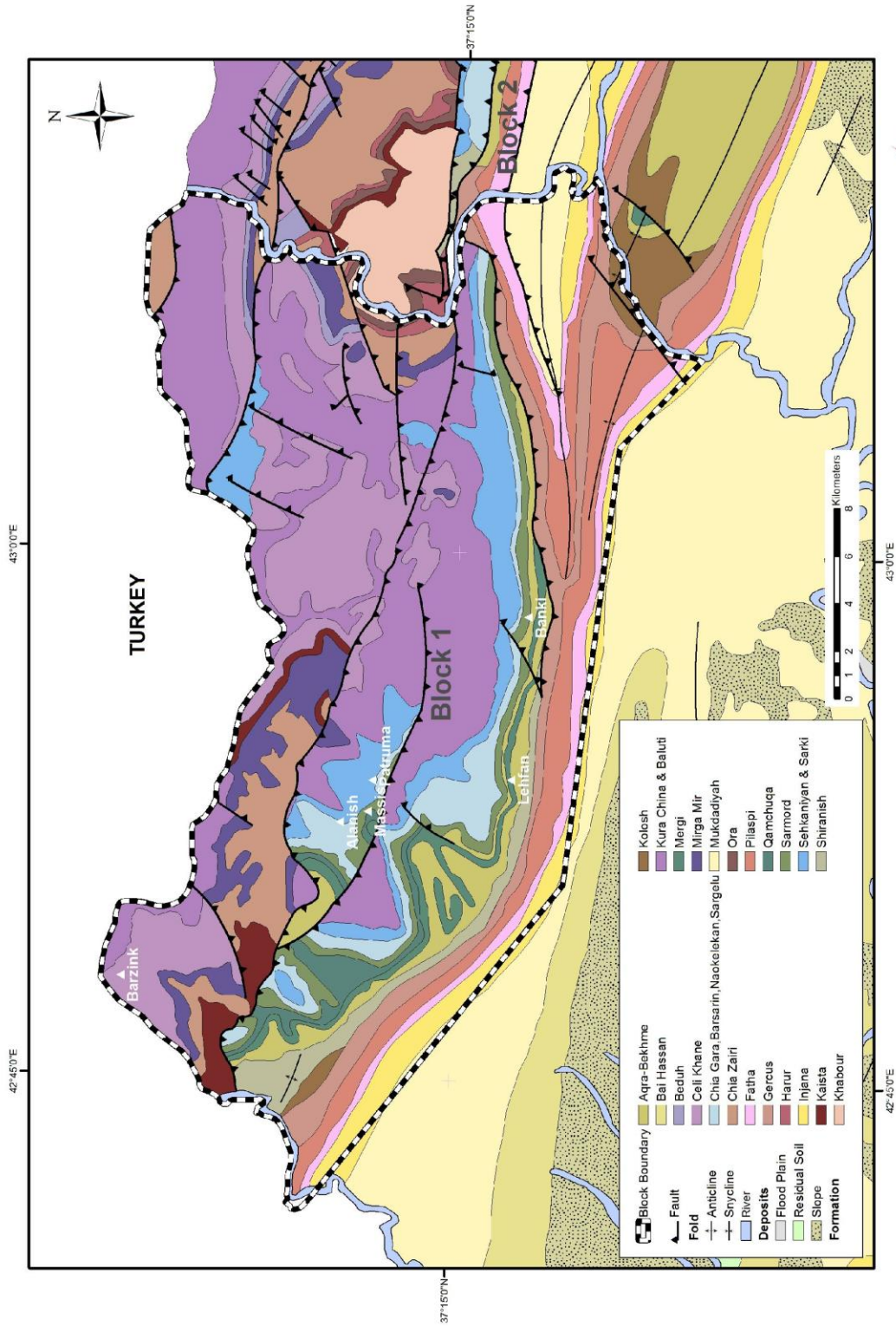


Figure 1.4 Block1 Geology

## BLOCK 2

**Location:** Duhok Governorate, north and north east of Amadia district

**Area:** 1775.24 km<sup>2</sup>

**Coordination:**

Point ID	X	Y
E	338083.70	4136047.21
D	330717.62	4114265.49
F	344144.06	4108695.09
G	379213.20	4101949.85
H	395654.43	4096944.02
I	417366.63	4130182.79

The Iraqi-Turkish international boundary forms the northern boundary of the block.

Figure 2.1

**Deposits & Occurrences:** (Figures 2.2, 2.3, 2.4)

This is one of the most significant deposits for (Pb-Zn-Fe) Sulphide of hydrothermal origin in the region.

### Serguza Pb-Zn deposits,

Exists within Triassic limestone and dolomite, thrust controlled. Mineralization of Sphalerite, Galena and Pyrite with indications of secondary minerals such as Limonite, Goethite, Cerussite and Smithsonite. Many Siderite veins of several meter thickness observed in the location.

Estimation of ore deposit reserves is around 3.57 million tones, with average Pb, Zn contents of 1.83% & 2.18% respectively. Ref. (1, 2, 4, 5, 6, 7, 9, 10, 11)

### Ora Cu-Pb deposits,

Veins of 1m thick at contact of Chiazari & MirgaMir formations consisting of Malachite, Azurite, Chalcocite, and Galena. In addition to veinlets of Fluorite is Quartz as crystals and Barite. Ref. (3)

### Benavi Galena occurrence,

Exists as Galena fragments to Benavi valley.

Furthermore, iron ore body of sedimentary origin consisting mainly of Hematite, Limonite is enclosed by Cretaceous age. Veins of Galena with Calcite observed at Kurra-Darman valley. Ref. (3, 8, 12)



**Note:** Considerable indications of Iron Oxides (Gossans) in most of the area such as following locations Mayi, Kani Massi, Benavi, Seriru and Noola. Ref. (3, 8)

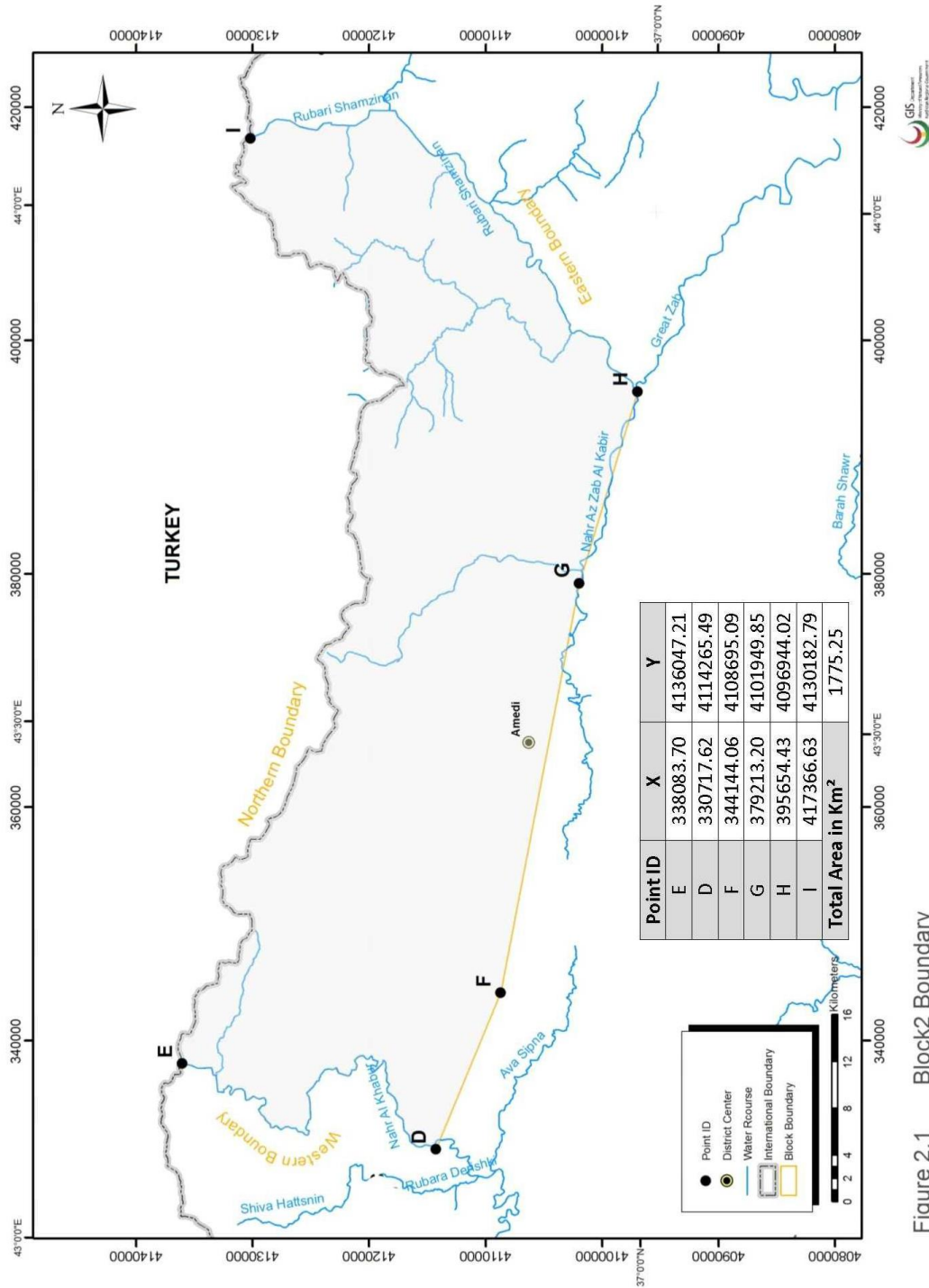


Figure 2.1 Block2 Boundary

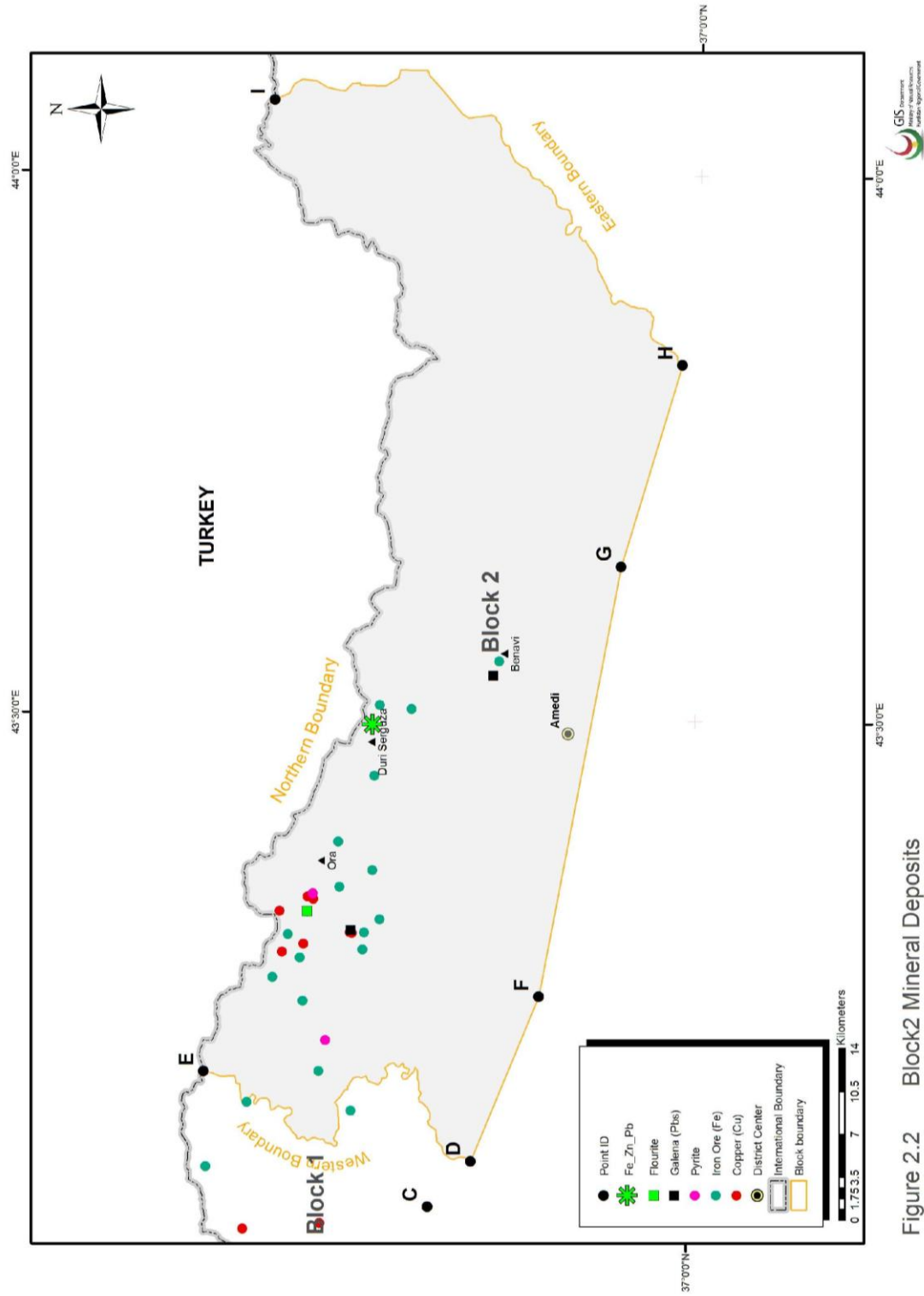


Figure 2.2 Block2 Mineral Deposits

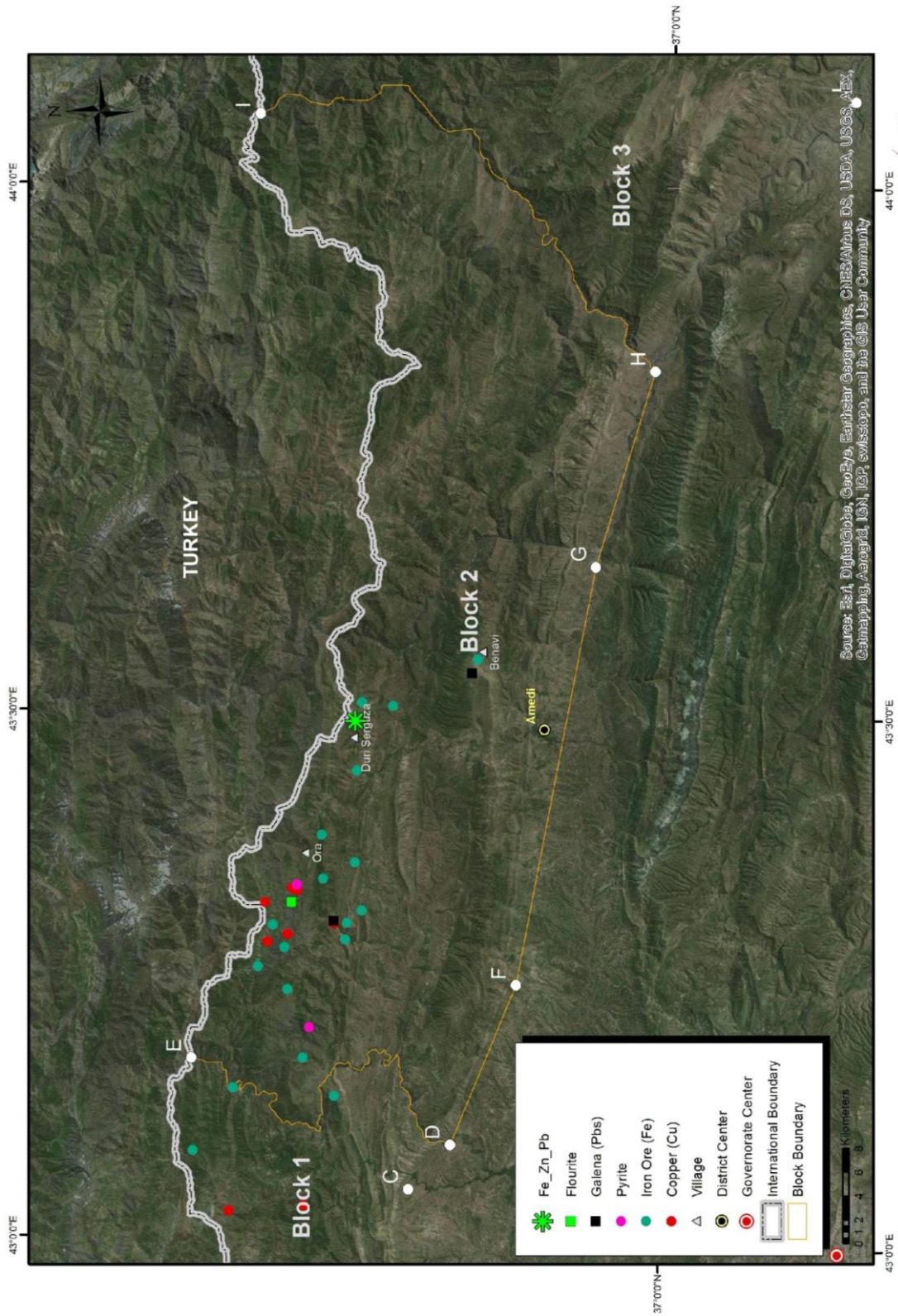


Figure 2.3 Block2 Mineral Deposits (Satellite)



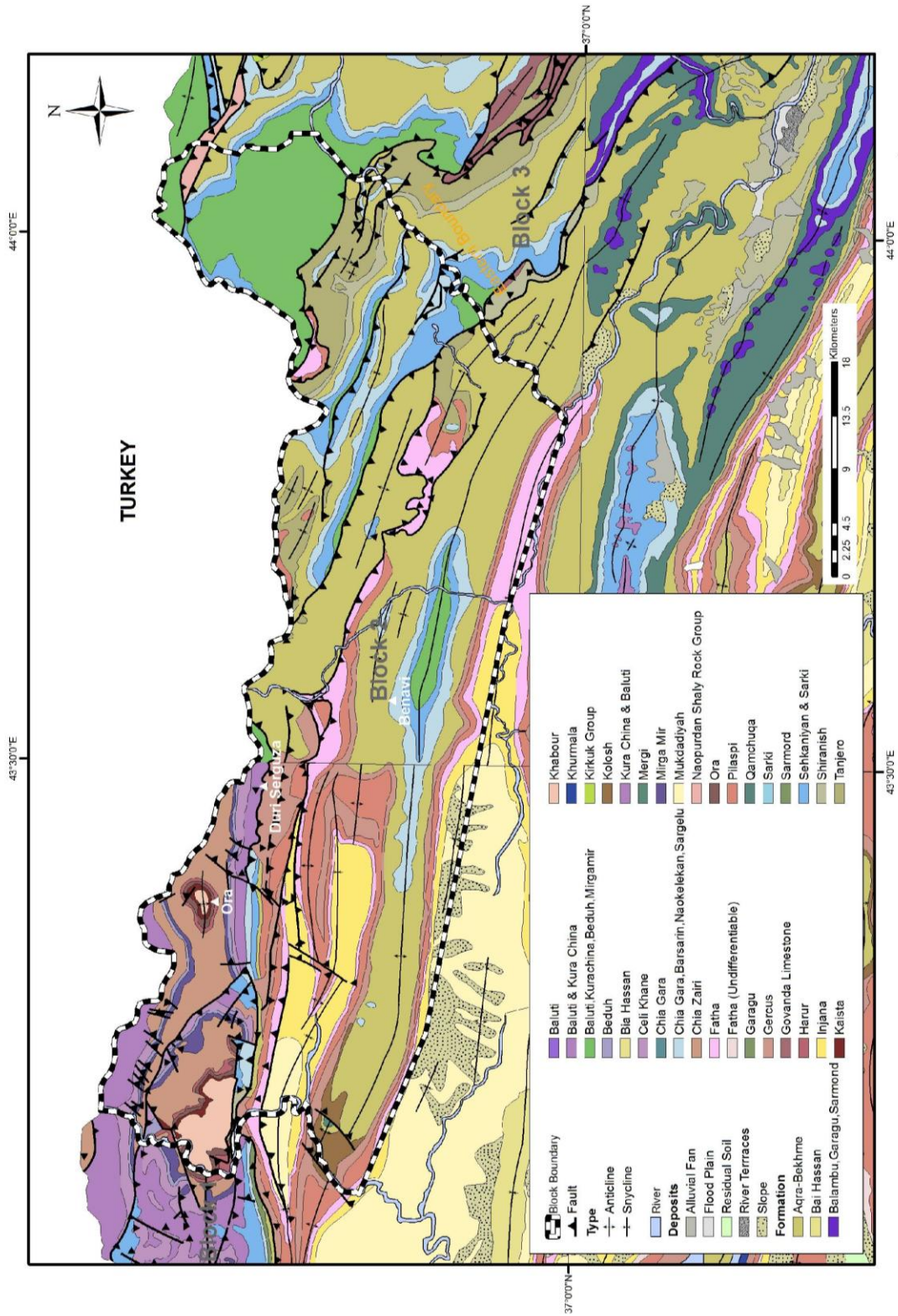


Figure 2.4 Block2 Geology

## ERBIL GOVERNORATE

BLOCK 3

BLOCK 4

## BLOCK 3

**Location:** Erbil Governorate, north and northwest of Soran district.

**Area:** 3359.04 km<sup>2</sup>

**Coordination:**

Point ID	X	Y
I	417366.63	4130182.79
H	395654.43	4096944.02
J	418226.49	4080010.53
K	446116.01	4063615.29
L	458551.45	4062292.37
M	486680.34	4070208.94

The Iraq-Turkey international boundary forms the northern boundary of the block; while the Iraq-Iran international boundary forms the eastern boundary of the block.

Figure 3.1

**Deposits & Occurrences:** (Figure 3.2, 3.3, 3.4)

### **Shaitna- Shaikhan Cr. deposits,**

Chromite mineralization in the serpentinized peridotite hosted by Naoperdan- Walsh Series.

An alteration of mafic & ultramafic rocks to Serpentinite with nine (9) small lenses of Chromite with Magnetite observed at Shaitna- Shaikhan location. Ref. (1, 2)

### **Harki-Stuni Pb-Zn deposits,**

Occurs as sulphides as Chalcopyrite, Limonite, and Pyrite in Shiranish formation, locating 2.5km South of Harki village. Ref. (1)

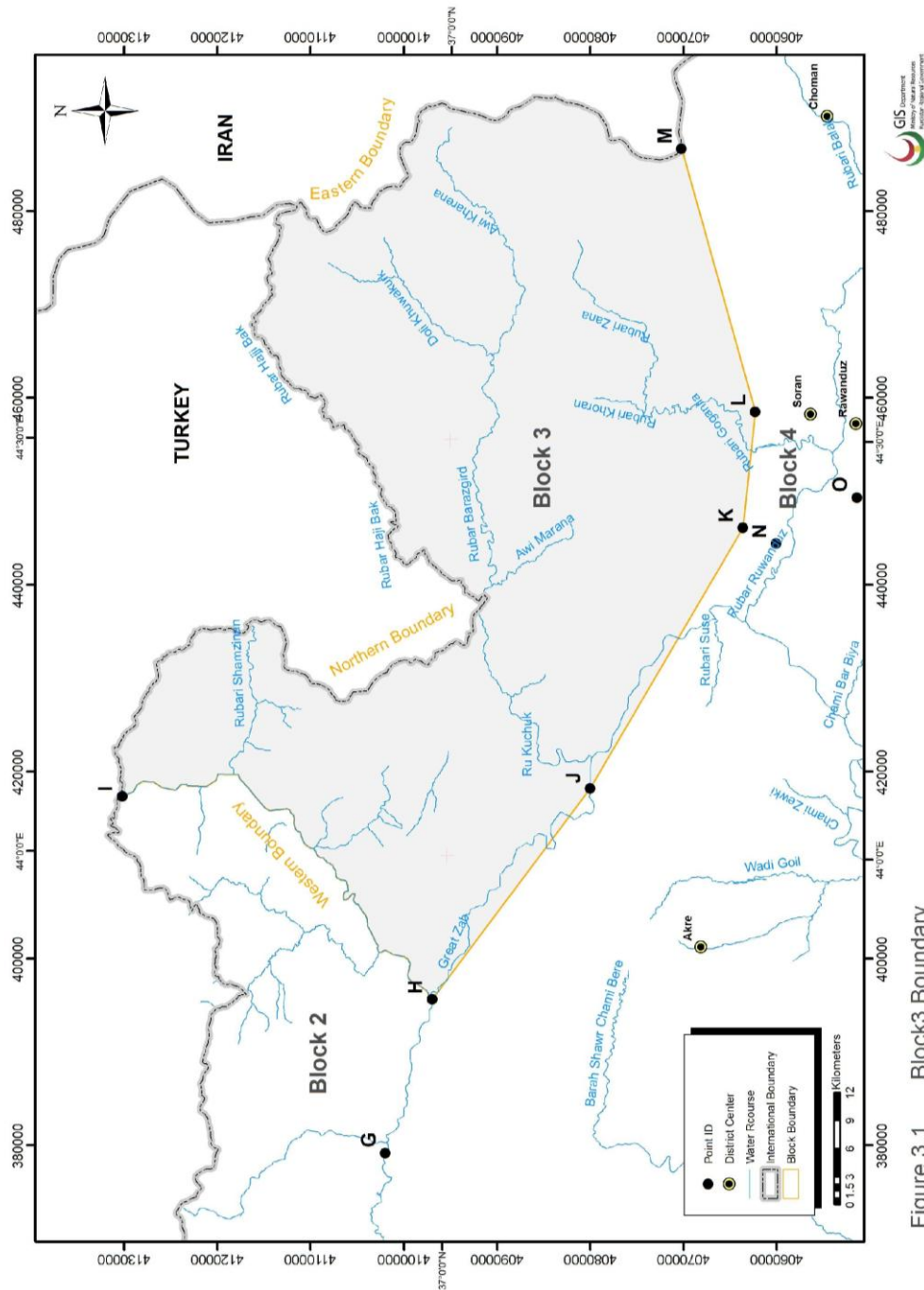
### **Jabal Qalandar, north and northeast of Piran,**

Presence of Cu as Chalcopyrite related to Noaperdan-Walash Series. Ref. (1)

### **Kargazu & Warbastir deposits,**

Native Copper, Cuprite, Tenorite & Malachite exist in argillite of Naoperdan-Walash Series. Ref. (1)

It should be noted that Qulqula Group is a highly promising area for the presence of metallic deposits, such as Mn-Fe, to the North & East of Sidakan. Ref. (1)



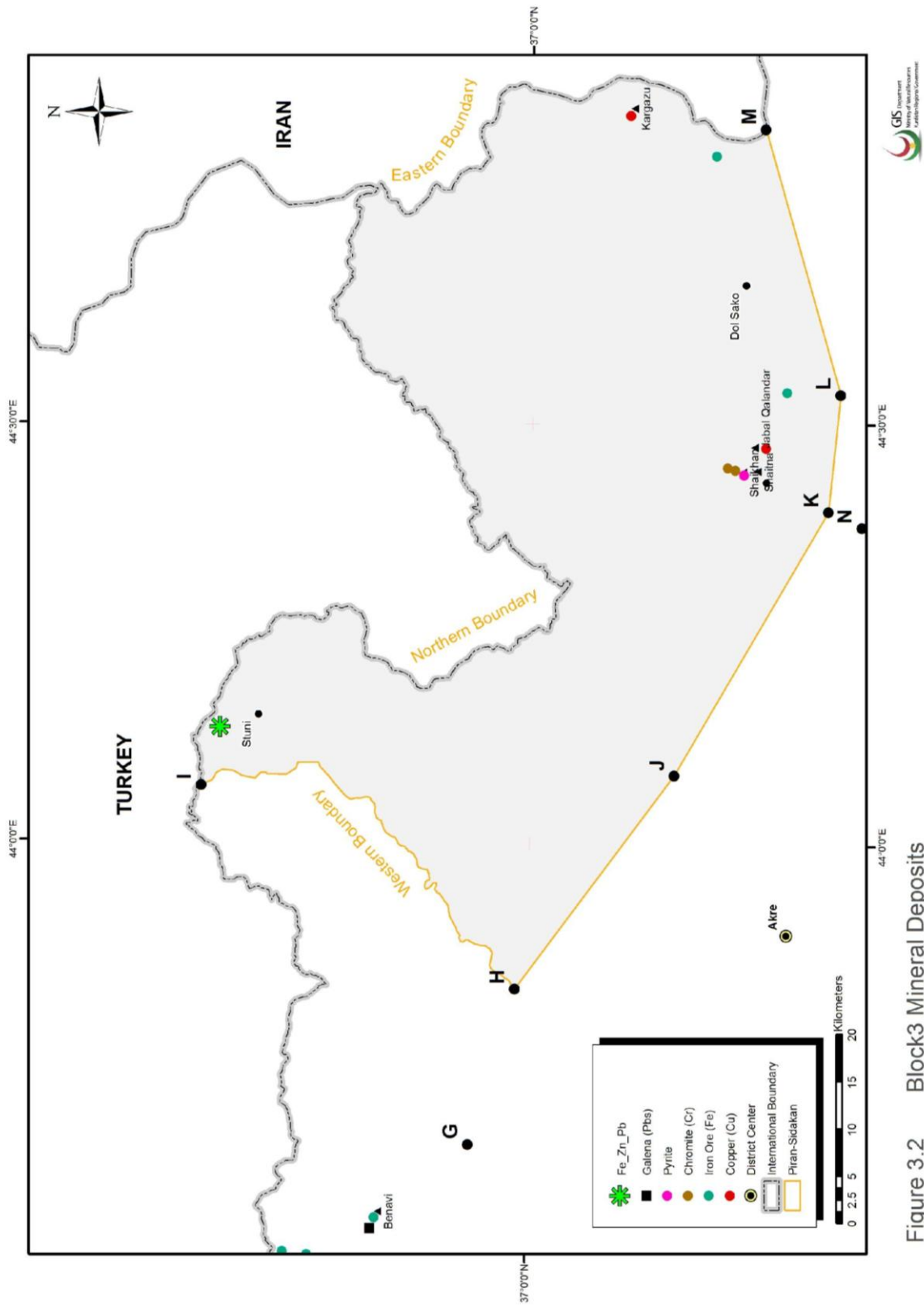


Figure 3.2 Block3 Mineral Deposits



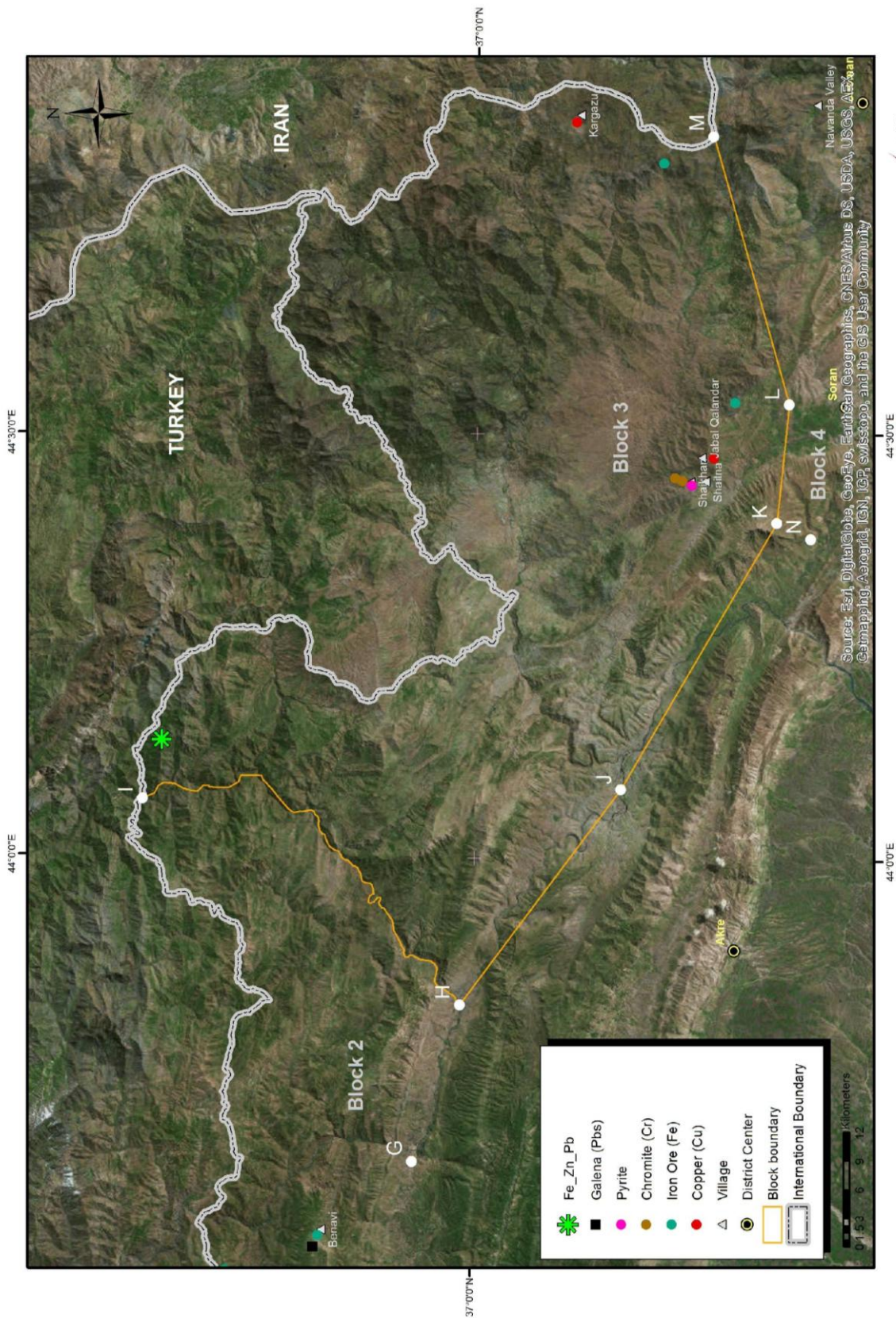


Figure 3.3 Block3 Mineral Deposits (Satellite)



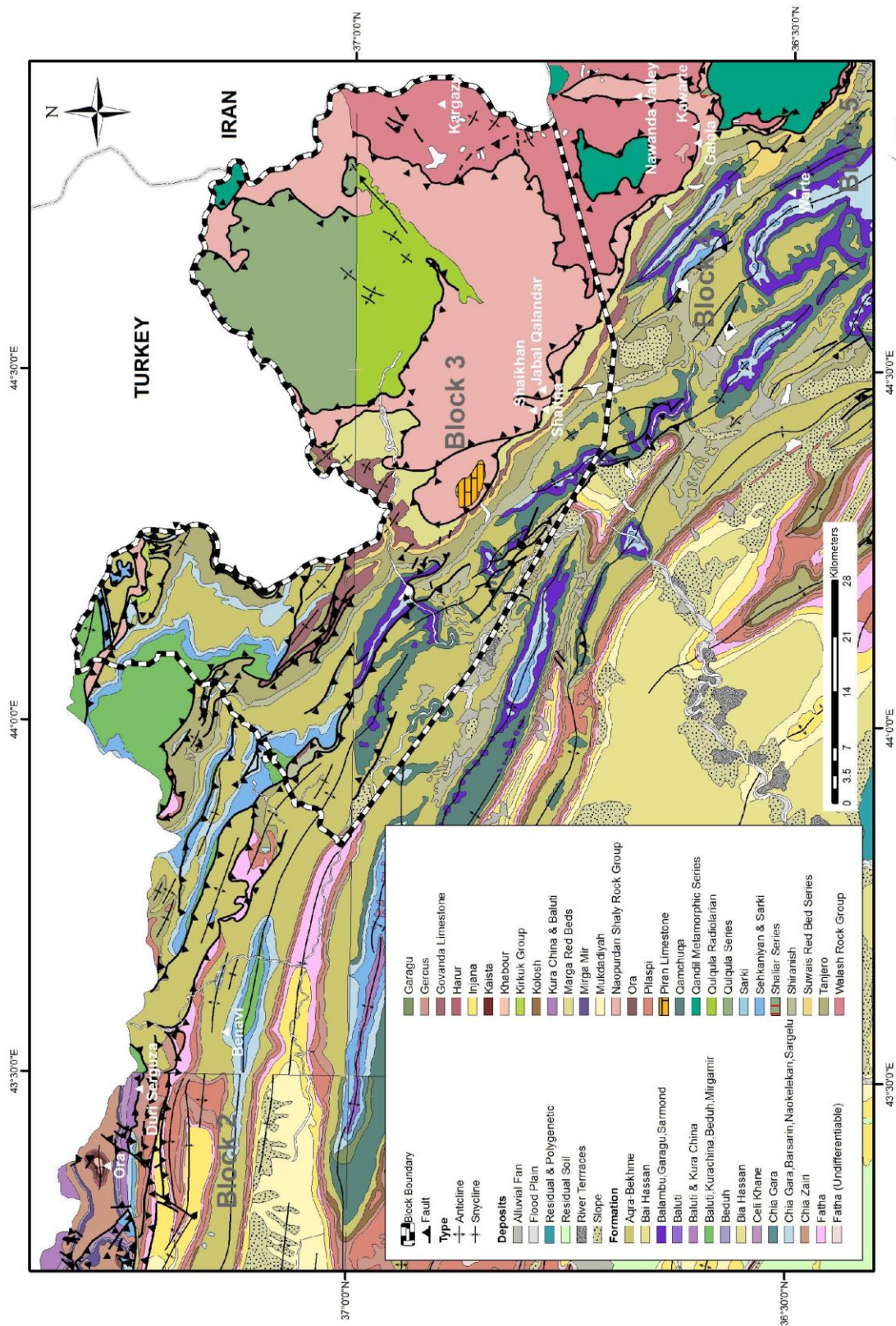


Figure 3.4 Block3 Geology

## BLOCK 4

**Location:** Erbil Governorate, northeast and east of Rawanduz district.

**Area:** 1591.62 km<sup>2</sup>

**Coordination:**

Point ID	X	Y
M	486680.34	4070208.94
L	458551.45	4062292.37
K	446116.01	4063615.29
N	444429.28	4060050.02
O	449344.02	4051393.53
P	459252.61	4043213.02
Q	468490.83	4034499.69
R	504896.93	4037348.22

The Iraq-Iran international boundary forms the eastern boundary of the block. Figure 4.1

**Deposits & Occurrences:** (Figures 4.2, 4.3, 4.4)

### Galala Cu-Ni deposits,

Reported and remarked in serpentinite bodies for 8km extending. Ref. (1)

### Rayat Cr deposits,

Eight (8) bodies of podiform Chromite in serpentinites observed within Walsh group, also there are indications of Cu-Ni in serpentinite bodies in Darband Rayat (Bardazard). Ref. (3, 4, 6)

Worth noting here, based on collaboration plan between the USGS and Ministry of Natural Resources, Kurdistan Regional Government (May 2010), is that serpentinite sliver in Tertiary volcanic rocks of the Walsh Group which are characterized by abundant Iron mineralization is also a potential target for Gold (Au).

### Nawanda valley,

Cu & Ni mineralizations are reported in samples near Dilza village. Ref. (1)

### Kawarte Village,

Characterized by presence of Cu+Ni deposits. Ref. (1)

**Warte location,**

MNR filed observations indicating presence of Quartz mineral; as complete crystal of different sizes & colors.

MNR filed observations recorded Rare Earth Elements (REE) at Warte location.

**Note:**

Radiation up to 400cps and up to 56 ppm of Uranium (U) had been reported in Naokalekan and Barsarin formations. Ref. (1, 2)

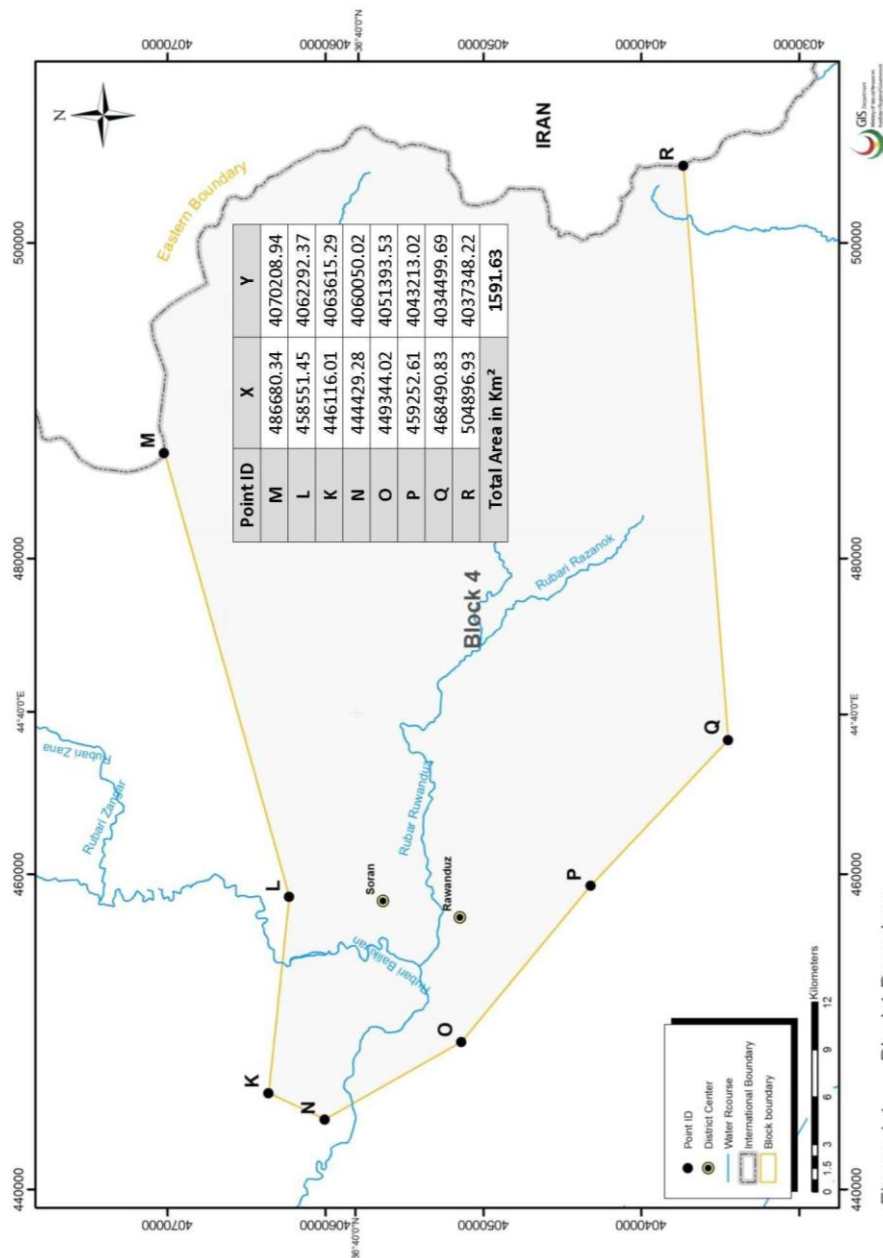


Figure 4.1 Block4 Boundary

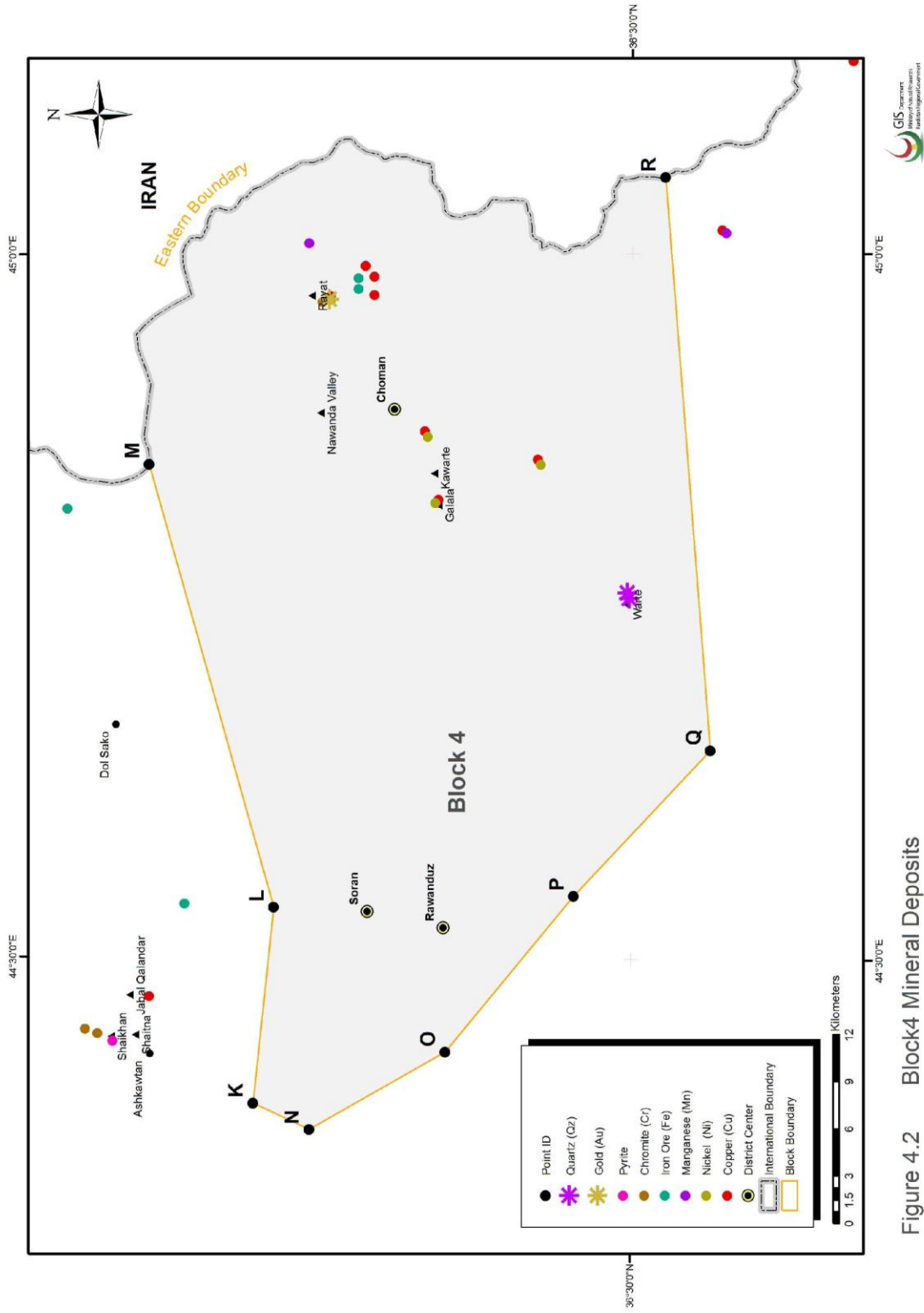


Figure 4.2 Block4 Mineral Deposits



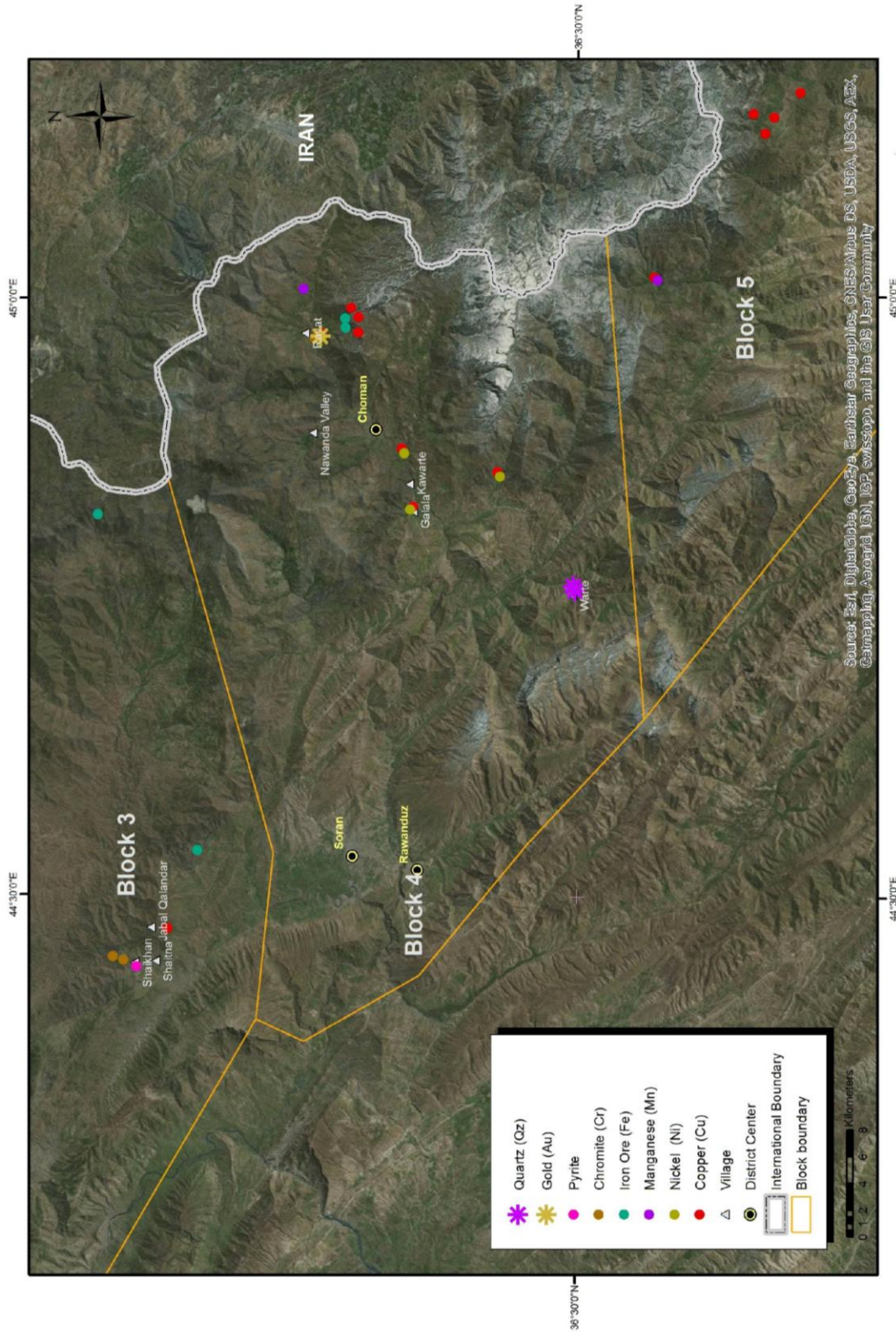


Figure 4.3 Block4 Mineral Deposits (Satellite)



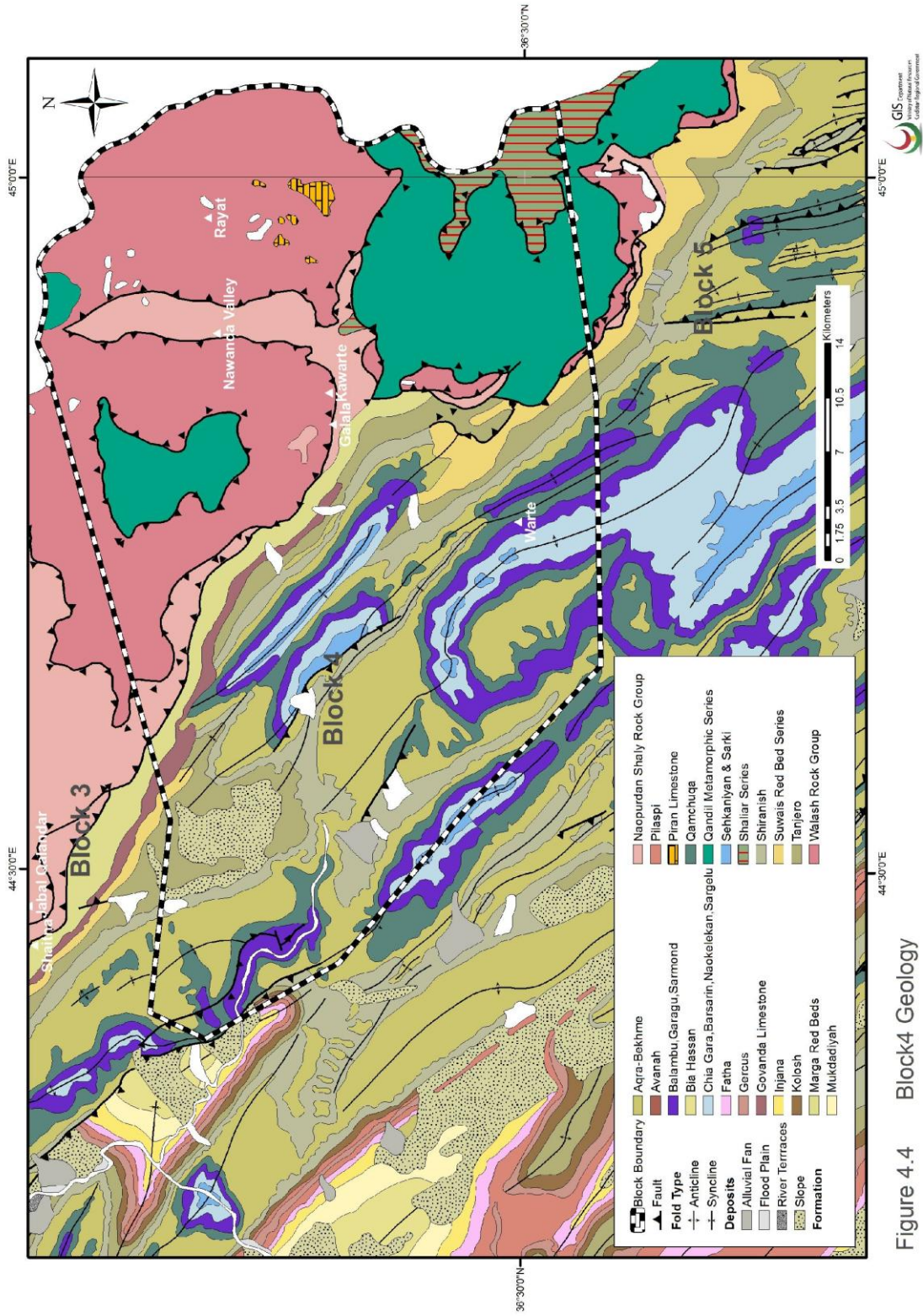


Figure 4.4 Block4 Geology

## SULAYMANIA GOVERNORATE

BLOCK 5

BLOCK 6

BLOCK 7



## BLOCK 5

**Location:** Sulaymania Governorate, North & East Qala Dizah district.

**Area:** 1379.37 km<sup>2</sup>

**Coordination:**

Point ID	X	Y
R	504896.93	4037348.22
Q	468490.83	4034499.69
S	530729.32	3984445.86

The Iraq-Iran international boundary forms the eastern boundary of the block. Figure 5.1

**Deposits & Occurrences;** (Figures 5.2, 5.3, 5.4)

### Marapasta Zn-Pb-Fe deposits,

Represent the main reserves so far in the region. There are two mineral assemblages as origins for Zn-Pb-Fe as bellow;

- Galena, Sphalerite, Pyrrhotite, Pyrite, Marcasite & Arsenopyrite.
- Skarn type assemblages, as magnetite, Willemite, Gahnite and nickline, while Cerussite and Smithsonite are representing secondary minerals. Ref. (1, 2, 3, 4, 8, 9, 10, 11, 12, 13, 14, 15)

Zinc and lead reserves estimation is as follows:

- C1: 60895 tons of ore deposits contain 100520 tons of Zn and 18117 tons of Pb.
- C2: 141000 tons of ore contain 23265 tons of Zn 4230 tons of Pb.

### Jira Cu deposits East of Qala Dizah,

Observed as, Malachite, Cu bearing Pyrite in association with Sericite-Chlorite in Epidote schist rocks of Walsh group. Ref. (1, 3, 4, 7)

**Note:** Cr, Ni, Co mineralization also had been observed in serpentinized ultramafic rocks southeast Bauza village SE Qala Dizah, and along the main suture zone.

### Bir Ahmnda- Benaza deposit,

Related to the Bulfat massif body, Chalcopyrite, Chrysocolla, Malachite, Limonite (after Pyrite), are associated with Sericite, in Schist of the Walsh Group. Also Cu of hydrothermal origin had been reported in Pisht Ashan valley close to Spidareh village. Ref. (3)

Copper of secondary origin found near Qulqula village and in Suragla village in the form of Malachite & Azurite (11.8 % concentration reported).

Manganese had been reported within Qulqula Radiolaria chert in Sirma & Pisht Ashan village. Ref. (3, 5, 6)

**Note:**

Anomalous radiation of Uranium (U) & Thorium (Th) had been recorded in several areas near Qala Dizah Town, such as Shakha Rash, Qala Deza (Perus peak), Dwaiza mountain (5.5km NE of Hero village), Kani Muesh (1km NE of Beklo), Wadi Nisi (3.5km NE of Hero village). Ref. (3, 5, 6, 8)

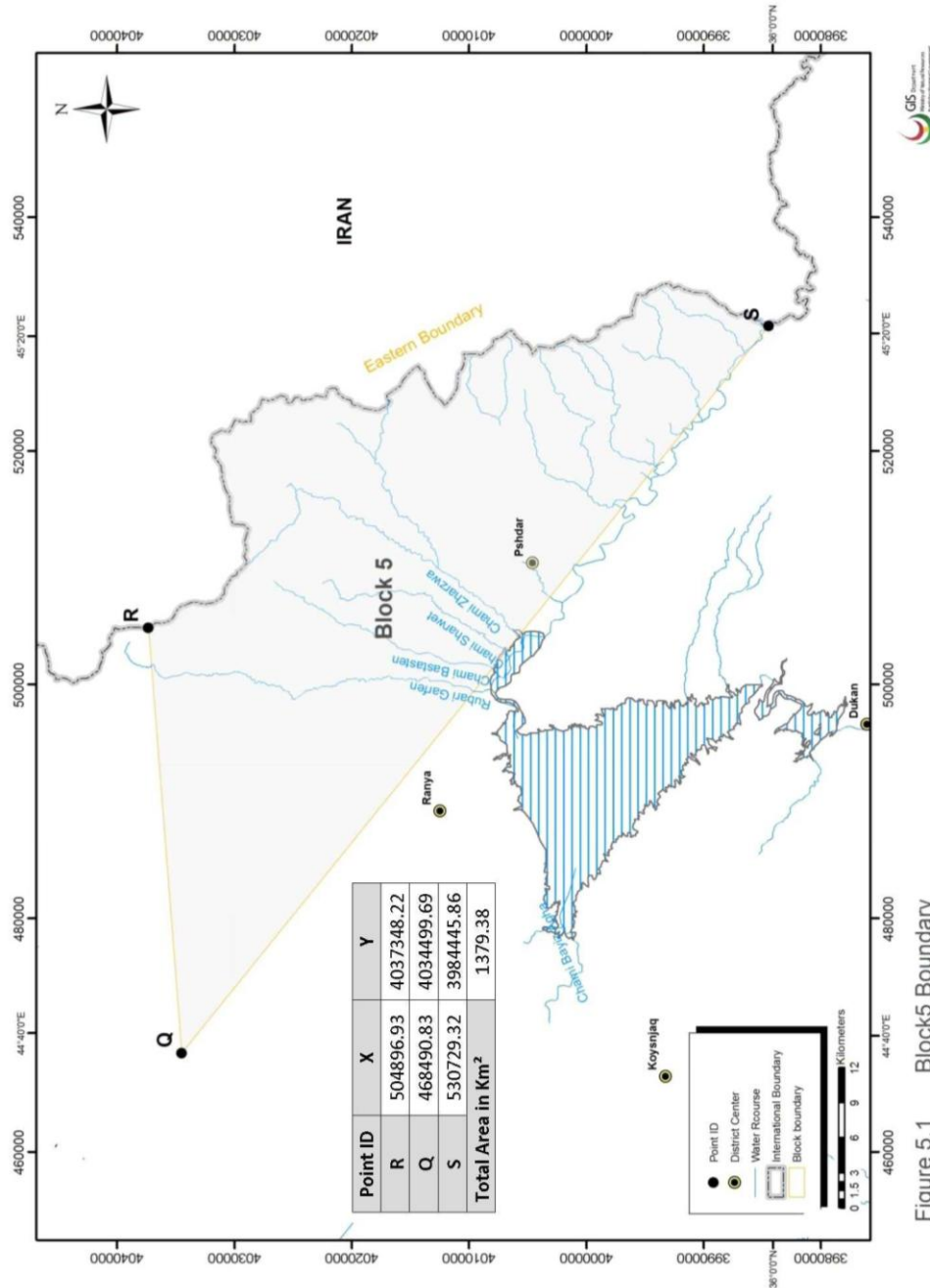


Figure 5.1 Block5 Boundary

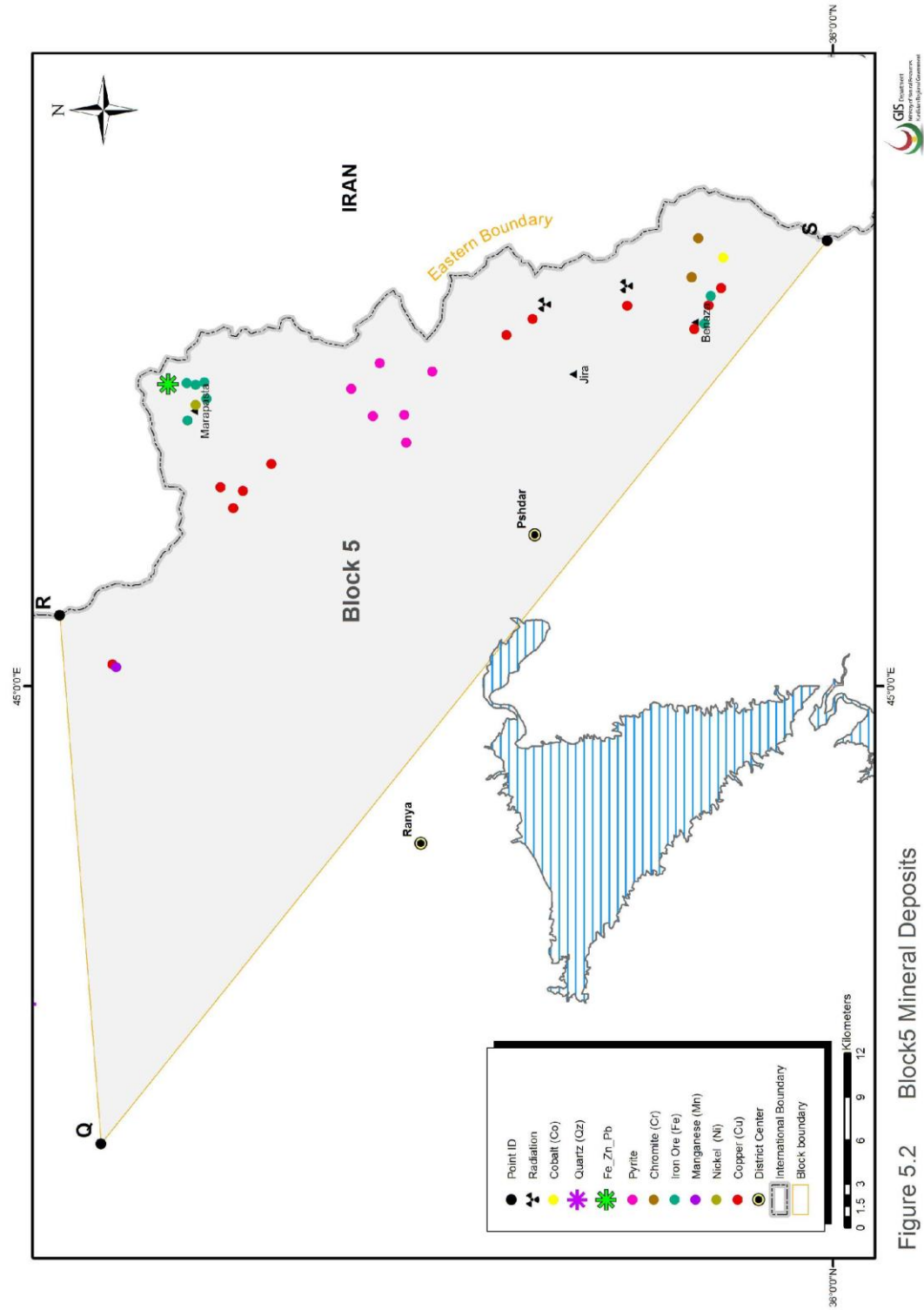


Figure 5.2 Block5 Mineral Deposits

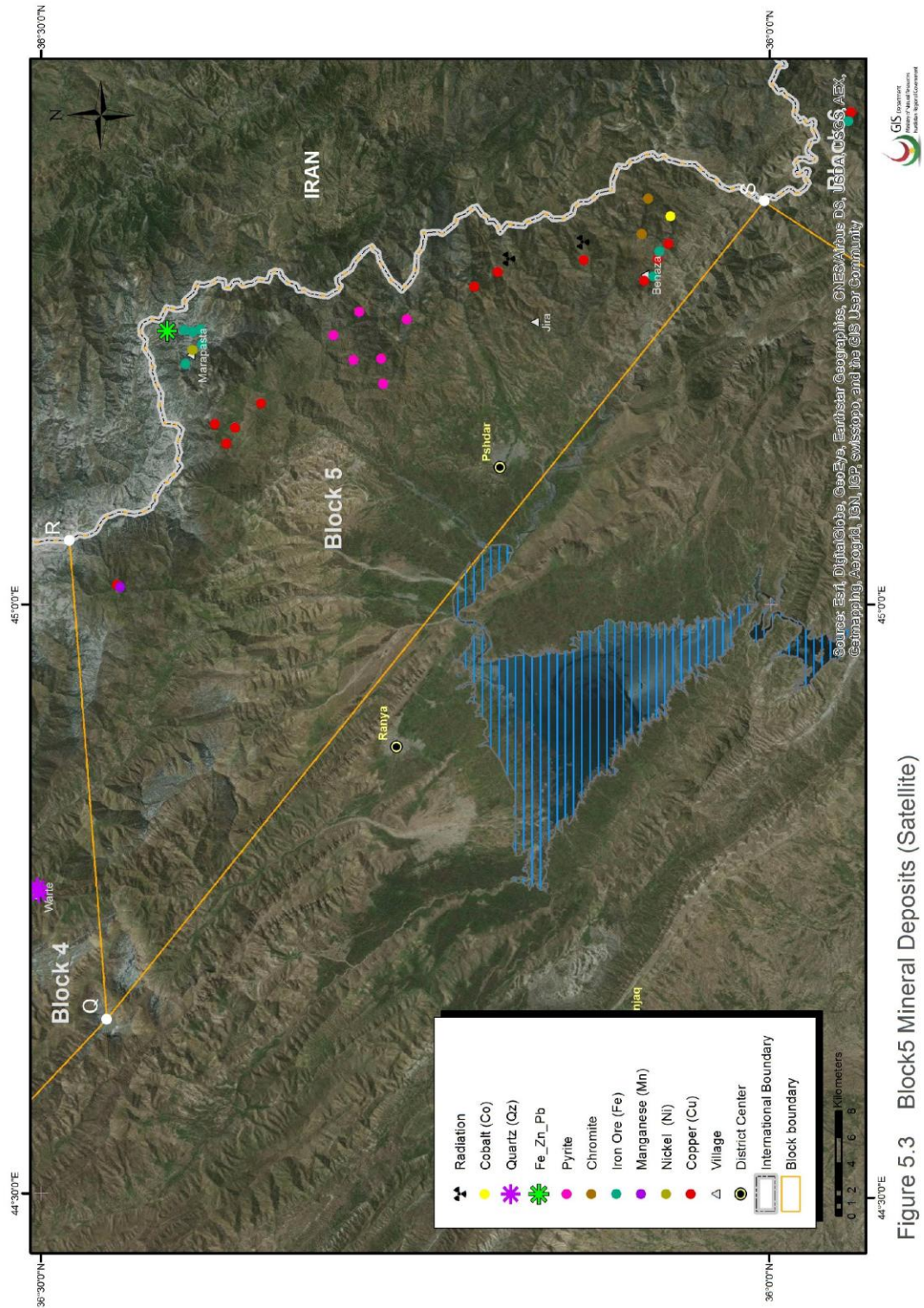


Figure 5.3 Block5 Mineral Deposits (Satellite)



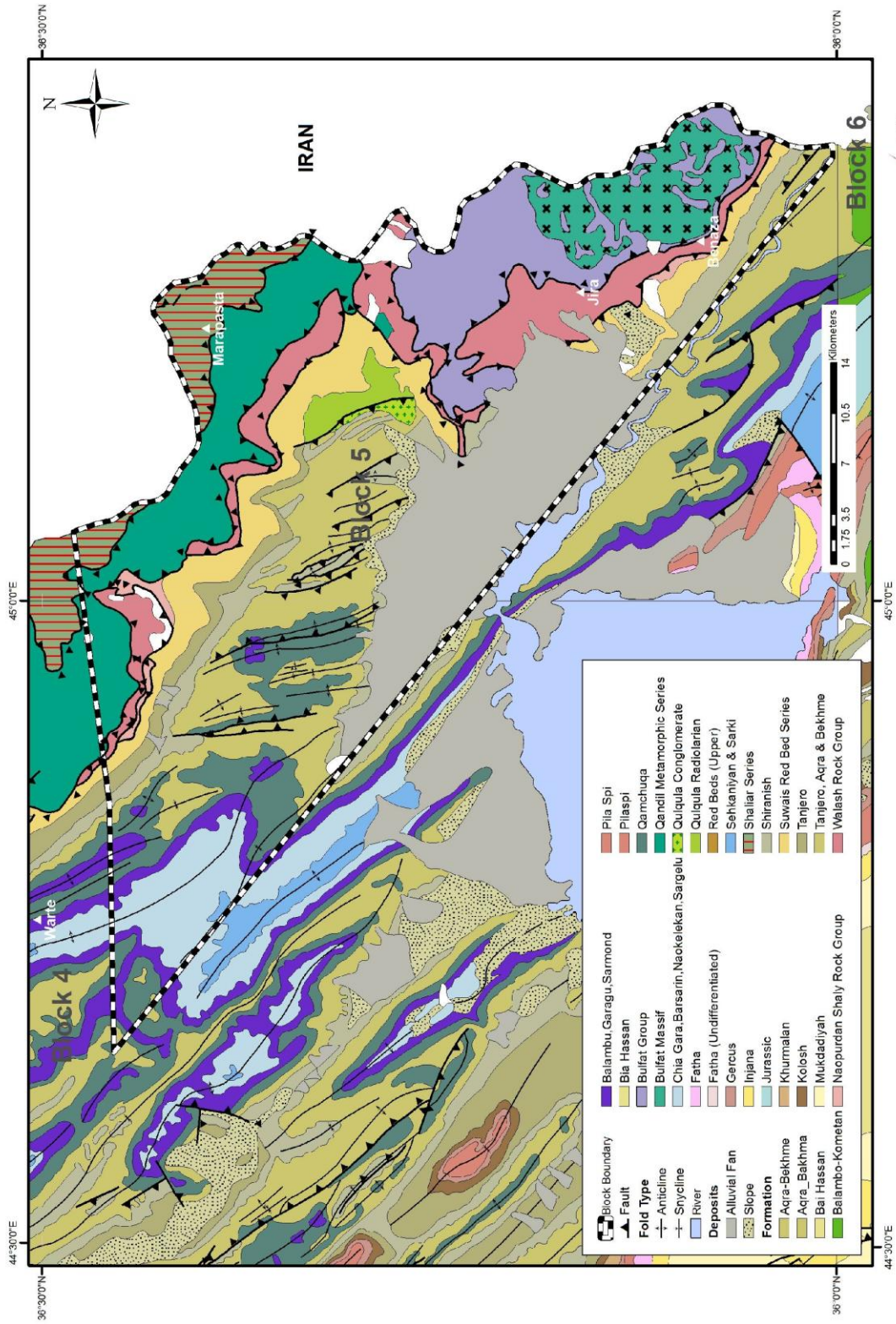


Figure 5.4 Block5 Geology



## BLOCK 6

**Location:** Sulaymania Governorate, Mawat district

**Area:** 1135.04 km<sup>2</sup>

**Coordination:**

Point ID	X	Y
S	530729.32	3984445.86
T	524497.49	3975035.19
U	539525.85	3957043.49
V	567469.84	3942063.84
W	575541.04	3963495.42

The Iraq-Iran international boundary forms the northern and eastern boundary of the block. Figure 6.1

**Deposits & Occurrences;** (Figures 6.2, 6.3, 6.4)

### Waraz Cu deposits,

One of the most significant Cu deposits in the area. The deposits exist as Malachite in meta-basaltic rocks of around 600m thick body (East Mawat). Twelve (12) lenses of secondary mineralization of Chalcopyrite & Pyrite with Copper (Cu content 0.4%-5.4%) reported to the South of Mawat. Ref. (1, 5, 7, 15, 16)

### Mawat Mn-Fe deposits,

A concentration of 47.5% of Mn deposit in Clayey Chert surrounding Mawat town has been reported. Ref. (2)

### Cu deposits

Accrues as Chalcopyrite, Pyrite and Malachite in Gabbro rocks, at Mirawa & Kurra Dawi villages.

Cr-Ni, Co deposits are observed in Gabbro & serpentized peridotite in Mawat body, more than 10 podiform Chromite in Sershau.

Veins of Quartz Feldspar in Konjarin village show value of 0.36 ppm & 2.59 ppm of Gold (Au). Ref. (3, 4, 6, 7, 8, 9, 10, 11, 12, 14)

**Note:** Based on the collaboration plan between the USGS and Ministry of Natural Resources, Kurdistan Regional Government:

High prospectivity of Platinum Group Elements (PGE) has been observed at the based part of ultramafic bodies relating to Mawat complex.

Possibility of Gold in Aplite dykes.

Rare Earth Elements (REE) are expected to be in the whole area,

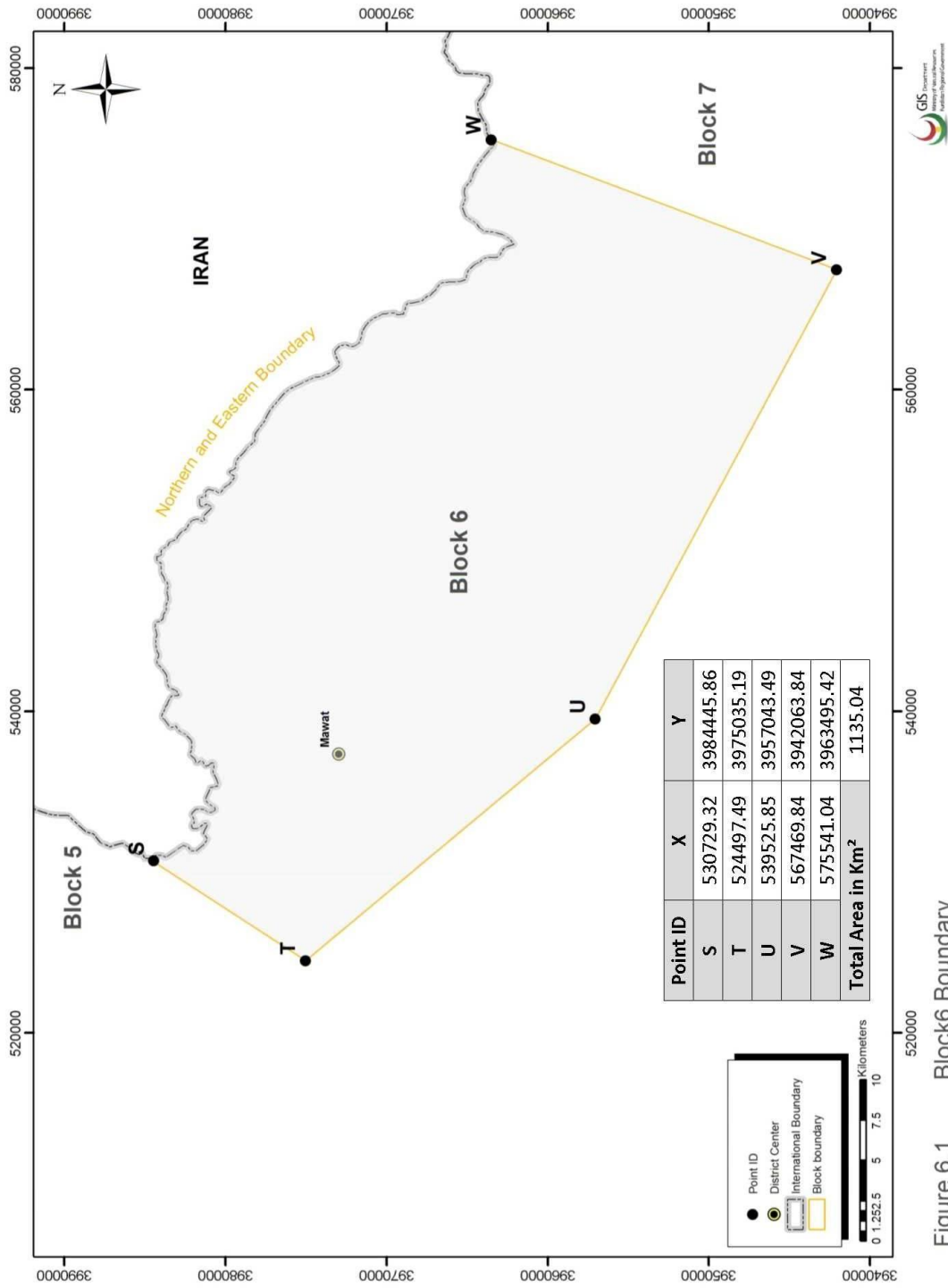


Figure 6.1 Block6 Boundary

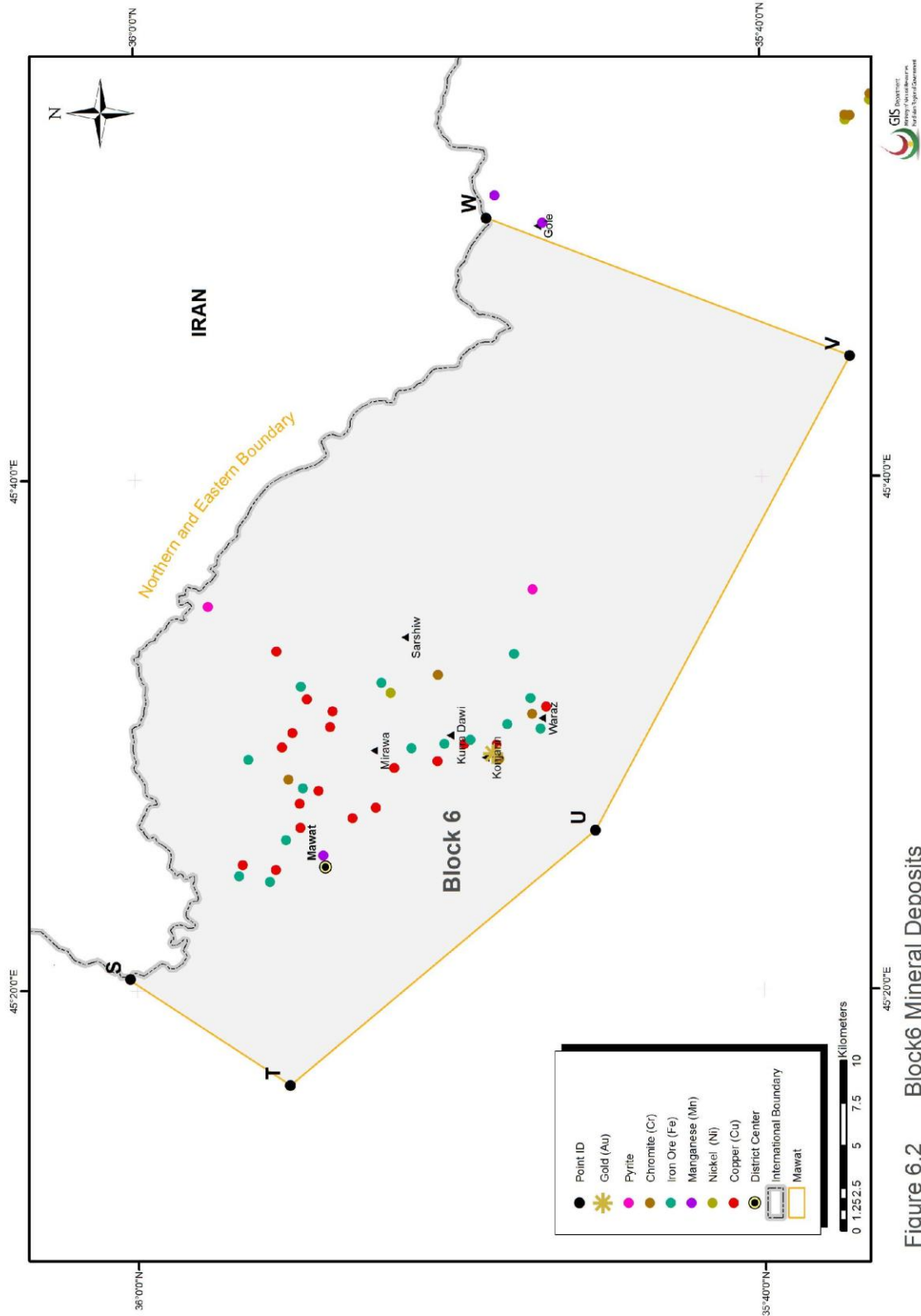


Figure 6.2 Block6 Mineral Deposits

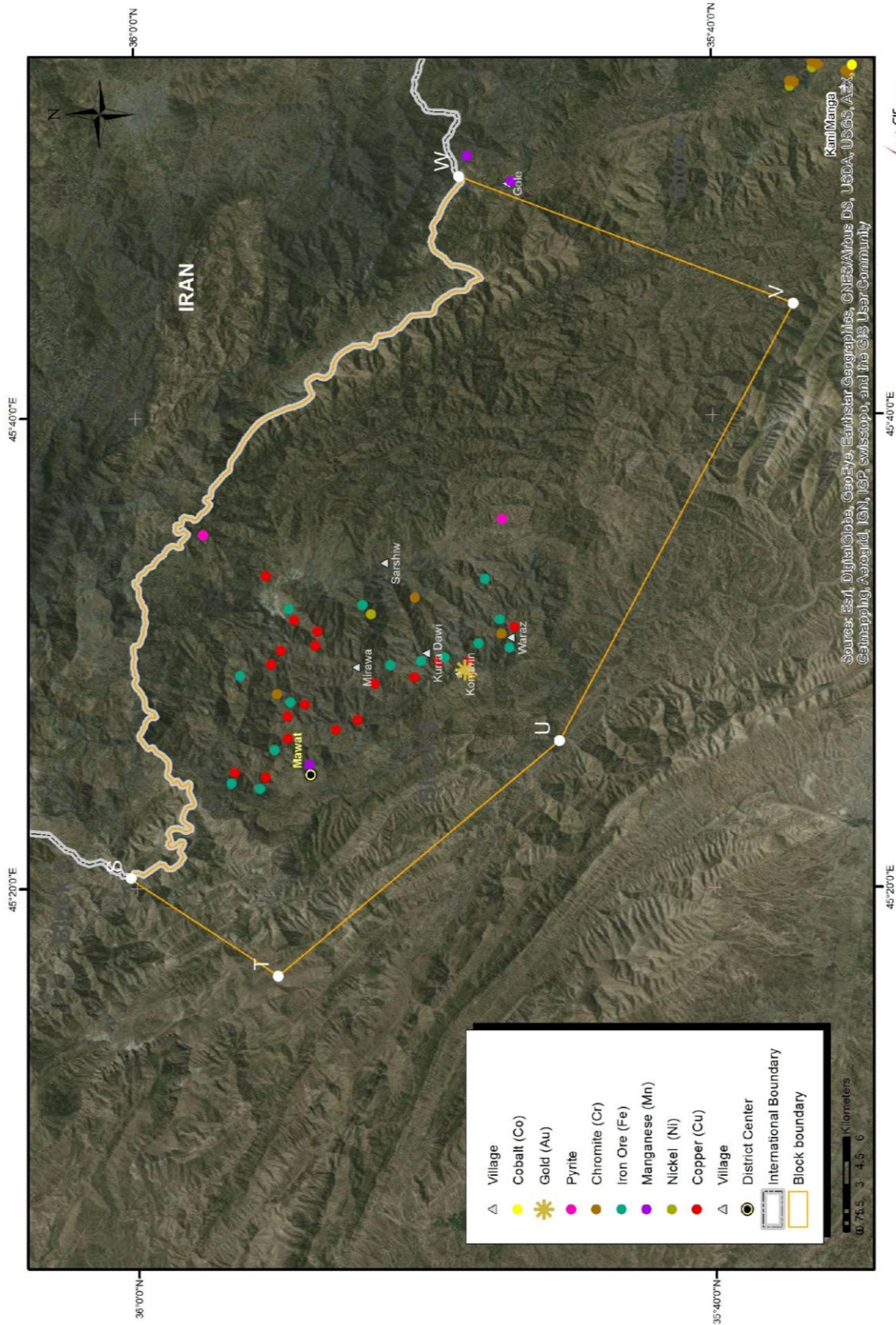


Figure 6.3 Block6 Mineral Deposits (Satellite)



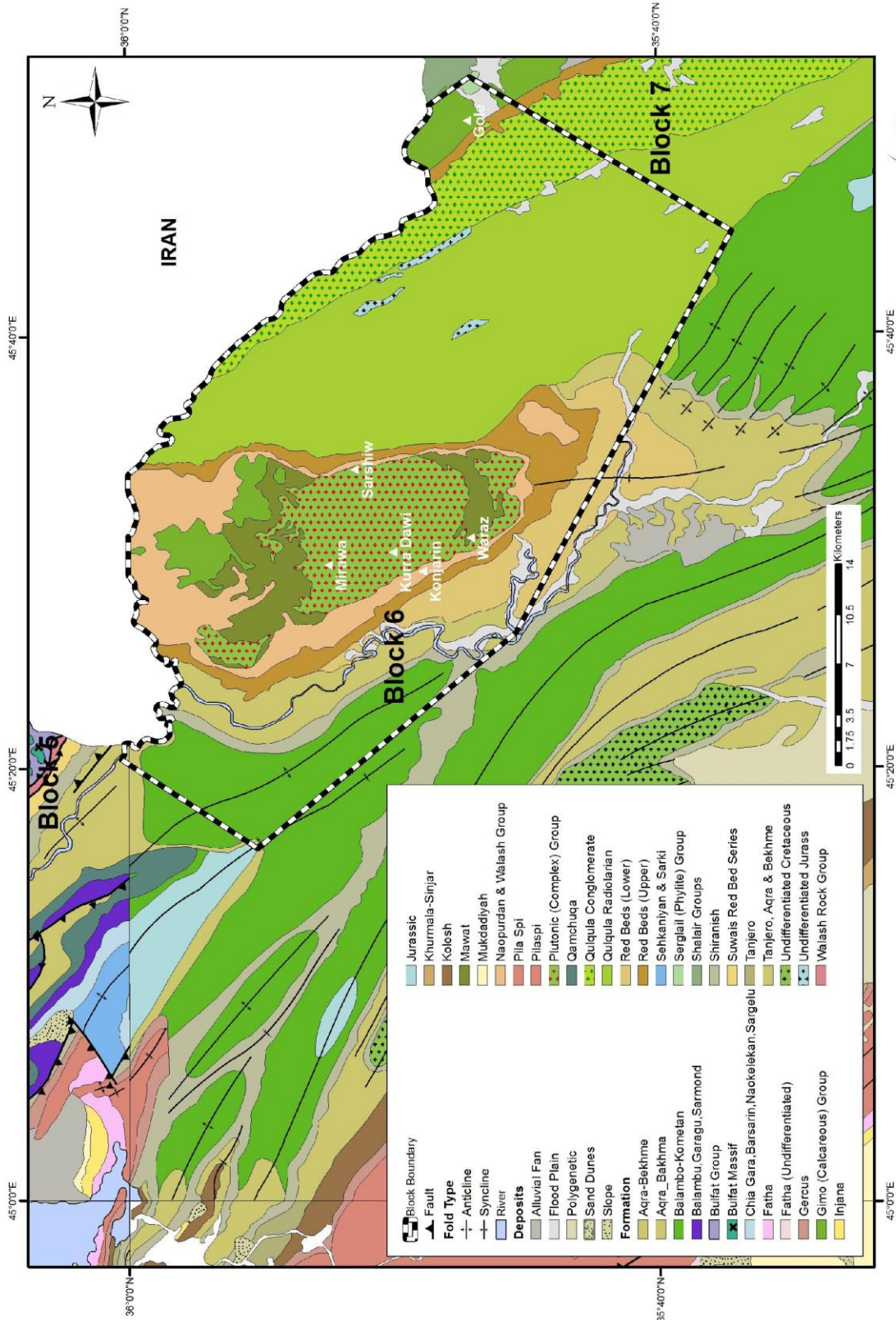


Figure 6.4 Block6 Geology



## BLOCK 7

**Location:** Sulaymania , Penjween- Halabja district.

**Area:** 1512.23 km<sup>2</sup>

**Coordination:**

Point ID	X	Y
W	575541.04	3963495.42
V	567469.84	3942063.84
X	581212.39	3924884.40
Y	594202.41	3896484.65
Z	605230.96	3888398.43

The Iraq-Iran international boundary forms the northern and eastern boundary of the block. Figure 7.1

**Deposits & Occurrences;** (Figures 7.2, 7.3, 7.4)

### **Asnawa Iron (Fe) deposits,**

Exists as a large body of Magnetite in metamorphic rocks as a result of metasomatism processes in Penjween massif. According to the preliminary studies there is around 2.5 million tons of Iron ore (as Magnetite) with concentration up to 50% of Fe deposit.

Number of Iron occurrences as lenses of Magnetite & Hematite had been reported in Mishau valley. The types of Iron Ores are mainly Magnetite and Skarn type. Ref. (1, 3, 4, 5, 6, 7, 8, 9)

### **Roshan Cu deposits.**

Exist as Malachite in serpentinized peridotite of Penjween massive near Roshan village. Ref. (2, 3, 4)

### **Gole (Gola) Mn deposits**

Exists in the upper part of Qulqula Group.

### **Penjween massive**

Deposits of Cr,Ni,Co, recorded in Penjween massive (Gabbro & Serpentinized body).

### **Shalair Valley**

Pb,Ni,Sn,Cr,Mn, deposits & Uranium had been recorded as geochemical anomalies from stream sediment samples taken from Shalair valley, with few grains of Gold (Au) in some samples.

Based on Geophysical studies there is around 125 million tons of Iron Ore had been reported. Ref. (6)

Significant concentration of Ni & Cr deposits in the Mafic rocks of the Ophiolite Body. Ref. (3, 4, 6)

**Note:** Based on the collaboration plan between the USGS and Ministry of Natural Resources, Kurdistan Regional Government:

Existence of many Quartz veins in association with intrusive rocks increases the potentiality of the area for Gold (Au) mineralization occurrences especially at Shalair valley.

High Potentiality for Iron ore deposit occurrences, which will lead to find & discover new deposits.

High possibility for existence of Platinum Group Elements (PGE), and Rare Earth Element (REE) occurrence.

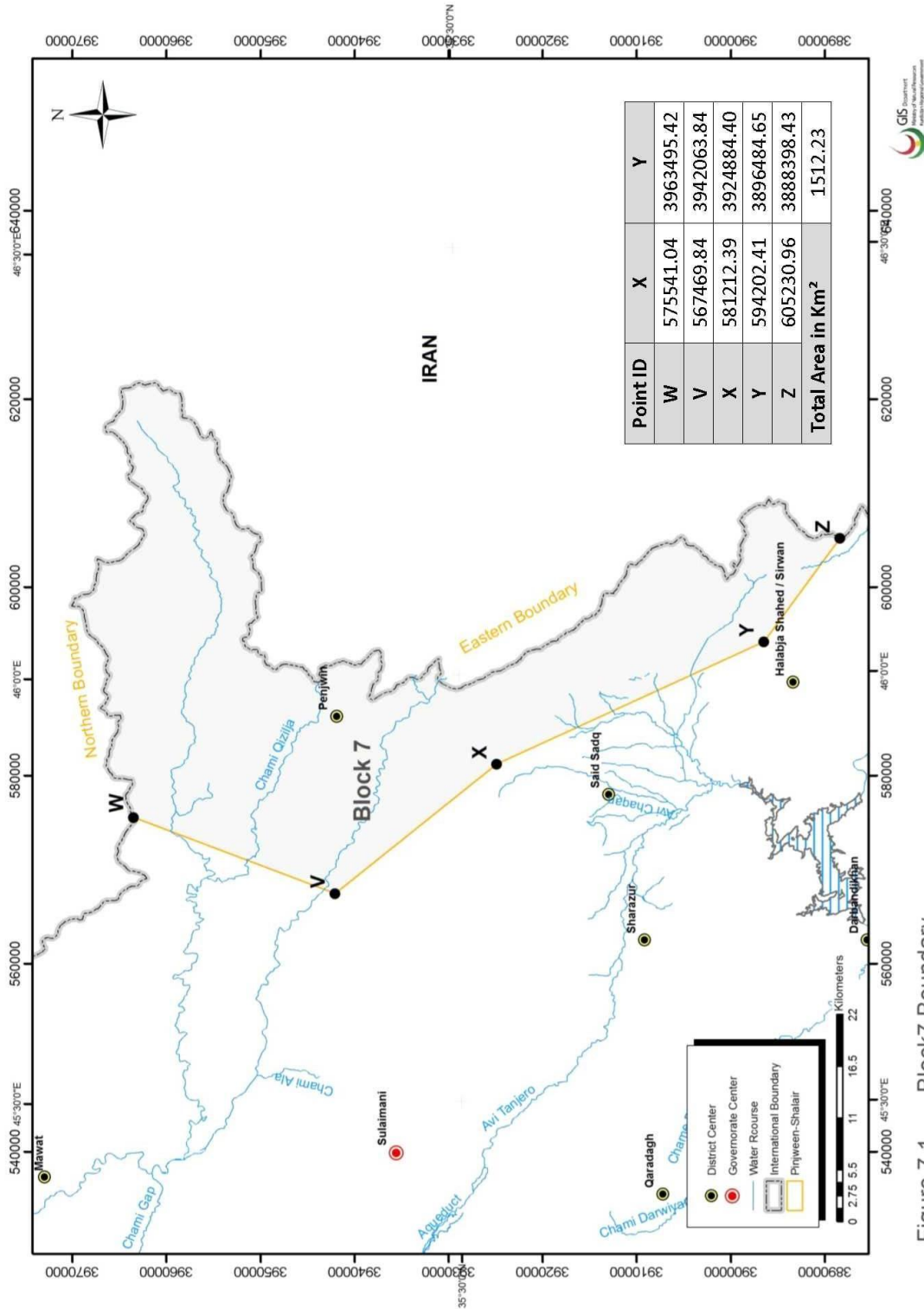


Figure 7.1 Block7 Boundary

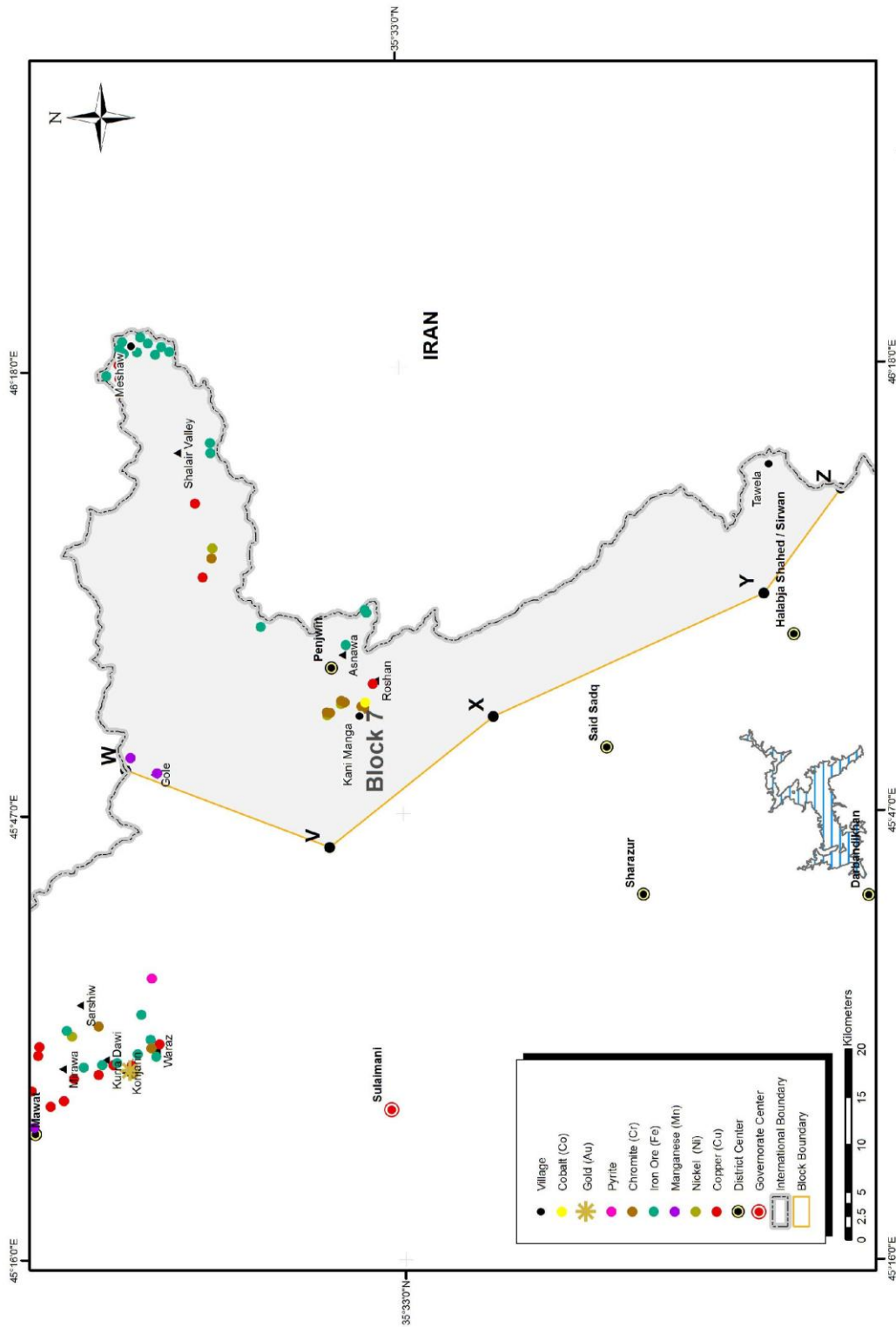


Figure 7.2 Block7 Mineral Deposits



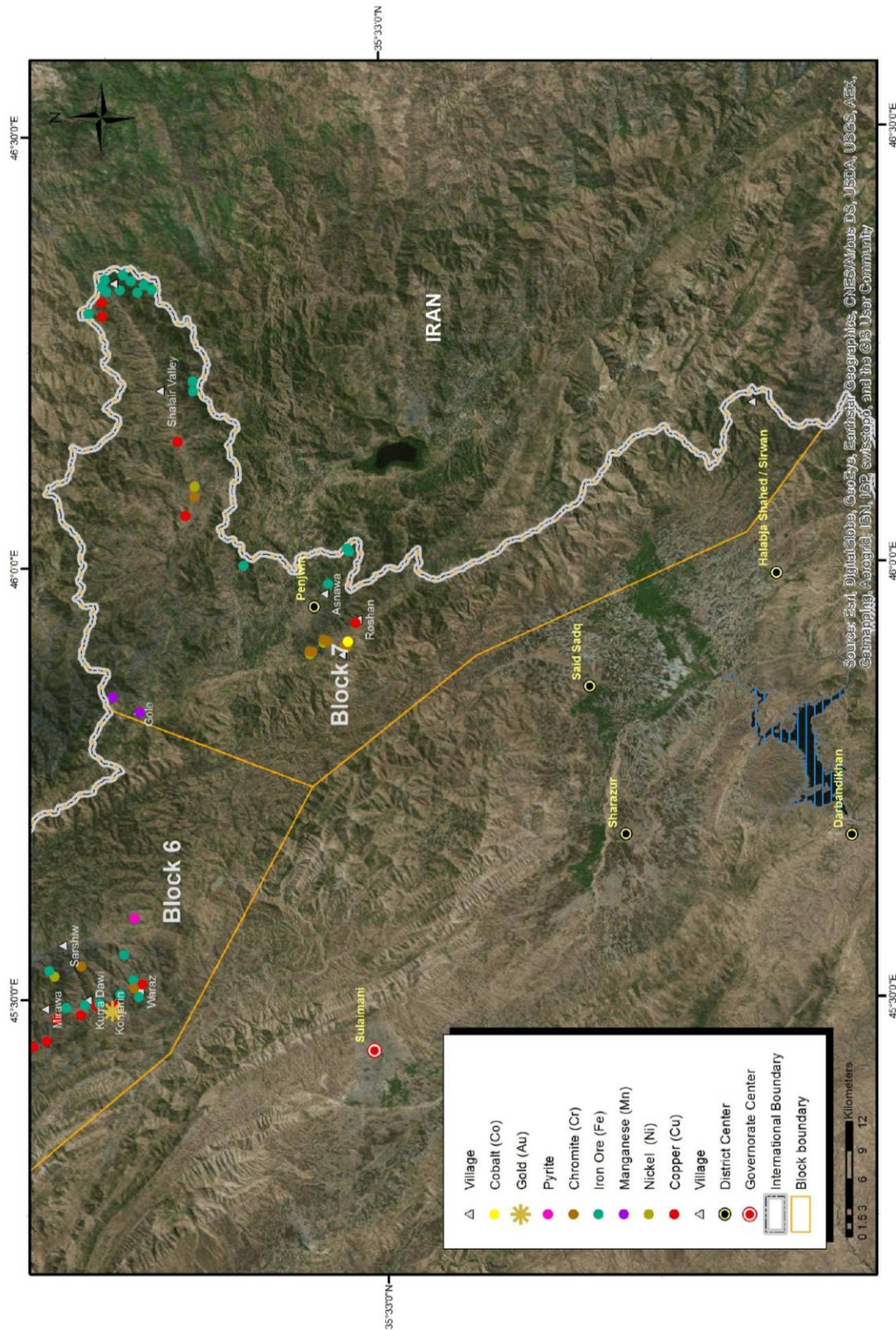


Figure 7.3 Block7 Mineral Deposits (Satellite)

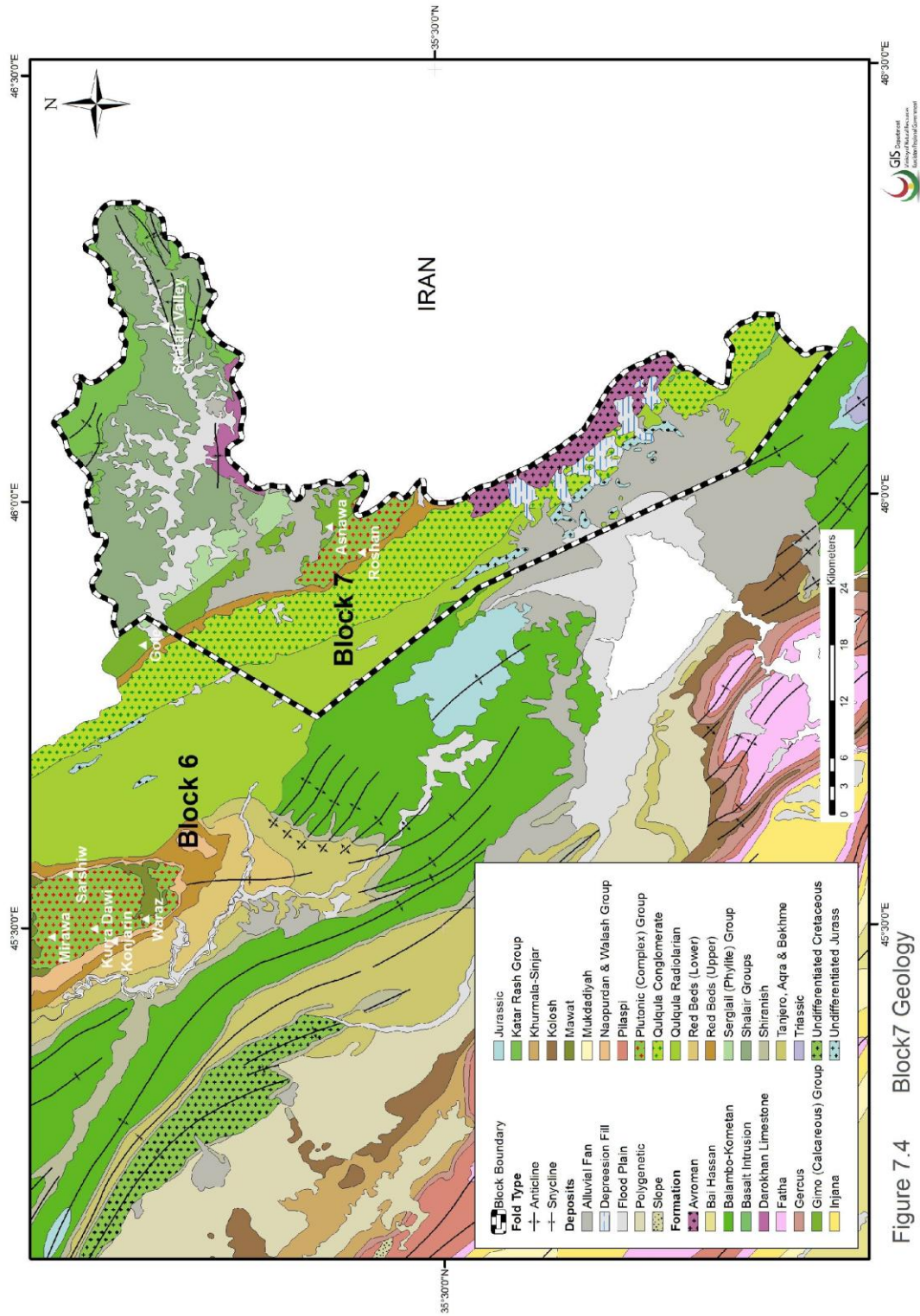


Figure 7.4 Block7 Geology

**ANNEX - A**

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## **ANNEX - B**

### MINERAL COMPOSITIONS

## Chemical Composition of the Minerals

No.	Mineral	Chemical composition
1.	Ankerite	$\text{Ca}(\text{Mg},\text{Fe})(\text{CO}_3)_2$
2.	Aragonite	$\text{CaCO}_3$
3.	Arseno pyrite	$\text{FeAsS}$
4.	Azurite	$\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$
5.	Baryte	$\text{BaSO}_4$
6.	Calcite	$\text{CaCO}_3$
7.	Cerussite	$\text{PbCO}_3$
8.	Chalcopyrite	$\text{CuFeS}_2$
9.	Chalcosine	$\text{Cu}_2\text{S}$
10.	Chromite	$\text{FeCr}_2\text{O}_4$
11.	Copper	$\text{Cu}$
12.	Cuprite	$\text{Cu}_2\text{O}$
13.	Dolomite	$\text{CaMg}(\text{CO}_3)_2$
14.	Fluorite	$\text{CaF}_2$
15.	Galena	$\text{PbS}$
16.	Goethite	$\text{FeO}(\text{OH})$
17.	Gold	$\text{Au}$
18.	Hematite	$\text{Fe}_2\text{O}_3$
19.	Magnesite	$\text{MgCO}_3$
20.	Magnetite	$\text{Fe}_3\text{O}_4$
21.	Marcasite	$\text{FeS}_2$
22.	Nikeline	$\text{NiAs}$
23.	$\text{As}_2\text{S}_3$	
24.	PGE ( Platinum Group Elements)	Six metallic elements...ex:- Platinum(Pe), Iridium(Ir), Osmium(Os)...etc.
25.	Pyrite	$\text{FeS}_2$
26.	Pyrolusite	$\text{MnO}_2$
27.	Pyrrhotite	$\text{Fe}_{0.8}\text{S}$
28.	Quartz	$\text{SiO}_2$

29.	Radiation elements	U,Th
30.	REE(Rare Earth Elements)	Eighteen elements...ex:- Cerium(Ce), Eurepiun(Eu), Erbium(Er)...etc.
31.	Siderite	FeCO <sub>3</sub>
32.	Silver	Ag
33.	Smithsonite	ZnCO <sub>3</sub>
34.	Sphalerite	ZnS
35.	Talc	Mg <sub>3</sub> Si <sub>4</sub> O <sub>10</sub> (OH) <sub>2</sub>