# A brief review on Iran (by the aspect of mining activity) and Opportunity of mutual cooperation

## **Mining provinces in ancient Iran**

### Home to one of the world's oldest civilizations

رزارت متت. عدان و تجارت سازمان زمین شناسی و اکتشافات معدنی کشور

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Locality	Type of mine	Locality	Type of mine
Ahangaran	Copper, iron, lead, and mercury	Abbas Abad	Copper
Ahar	Gold, copper, and iron	Anarak	Copper, lead, mercury, and gold
Ardebil	Copper	Bafq–Kuh Banan	Copper, gold, and iron
Damghan	Gold, copper, and turquoise	Daran–Najaf Abad	Lead-zinc
Esfahan	Lead-zinc	Kharestan	Lead, mercury, and gold
Kerman	Copper, gold, and turquoise	Kuh Sorme	Lead-zinc
Lar-Asaji	Copper and gold	Masoule	Iron
Neiriez	Iron	Neishabour	Turquoise and gold
Qal'e Zari	Copper	Qom–Kashan	Copper, gold, and iron
Shams Abad (Lorestan)	Lead, gold, silver, iron, and tin	Tarom	Copper, gold, and lead
Takab	Gold, arsenic, and mercury	Torbat	Gold and arsenic
Zanjan	Iron and gold	Zarrin	Gold













## **History of Mining**



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1 Ahar area (Cu, Au, Fe), 2 Ardabil area (Cu), <u>3</u> Masooleh area (Fe), 4 Takab area (Shiz) (Au, As, Ag), 5 Zanjan area (Fe, Au), 6 Tarom area (Cu, Au, Pb), Abbas Abad area (Cu), 8 7 Neyshabour area (Tr, Au), 9 West of Damghan (Au, Cu, Tr), 10 Torbat areas (Au, As), 11 Ahangaran - Shamsabad (north area of Lorestan) (Pb, Au, Ag, Fe, Sn), <u>12</u> Qom - Kashan area (Cu, Au, Fe), 13 Anarak area (Cu, Pb, Ag, Au), 14 Daran - Najaf Abad (Pb, Zn), 15 Esfahan area (Zn, Pb), 16 Zarin area (Ardakan) (Au), 17 Ahangaran area (Cu, Fe, Pb, Ag), 18 Bafq - Kuh Banan (Zn, Pb), 19 Ghaleh Zari area (Cu), 20 Lar - Asagi area (Cu, Au), 21 Neyriz area (Fe), 22 Kerman area (Cu, Au), 23 Kharestan area (Pb, Ag, Au), 24 Kuh Sormeh area (Pb, Zn)



## **Some Indicators:**



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Area: 1,648,195 square kilometers (the second-largest nation in the Middle East and the 18th largest in the world)

Population: 80 million (Second largest population, after Egypt, in the Middle East and North Africa, 19th in the world)

- GDP (ppp): 1.334 trillion US\$ (2014) (19th in the world)
- **GDP** per capita (ppp): 17100 \$ (2014)
- GDP growth rate 2014: 3%
- Age below 54 years old: 88%
- Literacy: 87%
- Labor force: 28.4 million

# Iran ranks 2<sup>nd</sup> in the world in natural gas reserves and 4<sup>th</sup> in proven crude oil reserves.





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#### **Gold Deposits**







Metallic minerals	Nonmetallic minerals	Nonmetallic minerals	Building materials	Fossil fuel
Copper	Turquoise	Sepiolite	Building and decorative stone	Oil
Iron	Phosphate	Bitumen	Gypsum	Gas
Manganese	Salt	Orpiment	Rubble stone	Condensate
Chromite	Sulfur	Asbestos	Pumice	Coal
Gold	Sodium sulfate	Sylvite	Perlite	
Molybdenum	Kaolinite	Chalk	Pozzolan and pozzolanic tuff	
Lead	Bentonite	Vermiculite	Scoria	
Aluminum	Talc	Borax		
Antimony	Mica	Barite		
Arsenic	Feldspar	Magnesite	1 1 1 1 1 110	
Mercury	Silica	Celestite	<b>13</b> Metalli	С
Silver	Fluorite	Garnet		
Polymetal	Alunite	Dolomite	43 Nonme	tallıc
Pyrite	Nepheline syenite	Zeolite		
Uranium	Limestone	Diatomite		
Zinc	Ochre	Agate		
Tungsten	Fireclay	Bauxite		

## Natural Resource of Iran

metric ton	Total (incl. Bauxite)	Iron, Ferro-alloys	Non-Ferrous Metals	Precious Metals	Industrial Minerals	Mineral-Fuels
IRAN	394 134 886	26 013 805	817 059	50	28 884 962	337 645 310
World	17 559 932 134	1 614 487 630	96 308 035	31 193	791 299 011	14 767 562 915



20 largest producer countries 2015 (without construction minerals, in Million metr. t)

Million U	S\$ Total (incl. Bauxite)	lron, Ferro-alloys	Non-Ferrous Metals	Precious Metals	Industrial Minerals	Mineral-Fuels
IRAN	95 562	2 856	2 392	113	1 514	88 312
World	3 584 418	277 404	245 988	140 799	85 277	2 694 182



20 largest producer countries 2015 (without construction minerals, in Billion USD)

Commodity	Rank	Share %	Commodity	Rank	Share %	Commodity	Rank	Share %
Iron	13	1.14	Bentonite	9	2.41	Vermiculite	13	0.28
Chromium	9	1.44	Boron	9	0.02	Steam coal	46	<0.01
Manganese	15	0.35	Diatomite	14	0.43	Coking coal	17	0.1
Molybdenum	7	2.42	Feldspar	6	3.9	Gold	68	0.06
Aluminum	22	0.63	Fluorspar	11	1	Silver	58	<0.01
Antimony	15	0.25	Gypsum	2	12.49	Gas	4	4.73
Arsenic	8	0.2	Kaolinite	11	2.6	Oil	7	4.08
Bauxite	17	0.27	Magnesite	12	0.66			
Copper	16	1.04	Perlite	6	1.92			
Lead	16	0.72	Phosphate	27	0.15			
Mercury	9	0.64	Salt	23	0.74			
Zinc	16	0.96	Sulfur	9	3.13			
Barite	8	3.16	Talc	14	1.15			



• 13 commodity between first 10 countries

• 27 commodity between first 20 countries

Commodity Group	Share %	Mineral Reserve
Metallic	10	
Nonmetallic	19	
Decorative stone	4	
<b>Constructional material</b>	67	
Precious metal	<1	



Commodity Group	Share %	<b>Mines Production</b>
Metallic	29	
Nonmetallic	7	
<b>Decorative stone</b>	4	
<b>Constructional material</b>	60	
<b>Precious metal</b>	<1	





#### **TECTONOSTRATIGRAPHIC UNITS**

#### FACIES



#### Metallogenic provinces of Iran are as not

- 1. Central Iran
- 2. Urumiyeh–Dokhtar metallogenic province
- 3. Sanandaj–Sirjan metallogenic province
- 4. Northeast metallogenic province (Taknar, Kavir, Sabzevar Belts)
- 5. Alborz metallogenic province
- 6. Southeast and east of Iran metallogenic province
- 7. Zagros oil and gas province
- 8. Kopet–Dagh oil and gas province

### Metallogenic (mining) belts of Iran ar as ollows:

- 1. Malayer–Isfahan lead and zinc belt
- 2. Kerman copper belt
- 3. Esfandagheh–Faryab chromite ophiolitic belt
- 4. Khash–Nehbandan Belt (with chromium, copper, and magnesium deposits)
- 5. Qom-Naein Belt (manganese, barite, copper deposits)
- 6. Kavir-Sabzevar Belt (copper, chromium, gold, iron deposits)
- 7. Taknar Belt (copper, gold, arsenic deposits)
- 8. Tarom–Hashtjin Belt (copper, iron, lead, zinc, gold depesits)
- 9. Maku-Khoy-Urumiyeh Belt (gold, mercury, copper, produm, iron deposits)

#### Metallogenic areas are as follows:

- 1. Takab area (gold, arsenic, antimony, mercury, lead, zinc oly-metal depo
- 2. Bafgh area (iron, lead, zinc, apatite, REE deposits)
- 3. Anarak area (copper. lead. zinc. gold. iron. antimonv. arsenic deposits)

# There are **6** distinct phases of mineralization in Iran from

the Early Cambrian to the Quaternary



1-Arasbaran metallogenic area, 2- Tarom-Hashtjin

metallogenic belt, 3- Takab metallogenic area, 4-



100000F **Presently there are >10 active copper mines in Iran whose** amount to 3Bt of ore, containing 30Mt Cu reserves comprising 9% of the world's known copper reserves. Total estimated value of US\$700bn □ Iran accounts for approximately 2,600 million tons of copper reserves, or about 4% of the world's total (17th largest reserve globally) NAME Copper ore production in Iran accounts for 75% of the total production in the Middle East **Standing in 2<sup>nd</sup> position in Asia after Indonesia** 12-00'E 15-50 E 18'00'E 57900E (0500 E 6390 PE 66900 E 51-00 E

SPOOPE















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## Some Highlights

- □ Holds 7% of the total world's minerals
- □ One of the 10 countries with large Cu, Pb, Zn, Fe reserves
- □ World class copper deposits
- □ Significant supplier of iron ore and chromite
- □ 4<sup>th</sup> largest producer of Cement
- □ 10<sup>th</sup> largest producer of Steel
- One of the 10<sup>th</sup> producer of Molybdenum, Feldspar, Fluorspar, Lime stone, Dimensional stone and Barite.
- $\Box$  More than 5800 mine in operation & >2800 abandoned mine
- One of the leading mineral producers in the Middle East by 450Mt extraction
- □ Iran is one the 15 most mineral rich countries in the world
- □ employing >100,000 people directly

# Some Highlights



- □ There are 68 types of mineral, with an estimated value of \$700 billion
- □ Total proven reserves of metallic and non-metallic deposits are estimated at 55 billion tons
- □ Iran with roughly 1% of the world's population and area holds more than 7% of the world's total mineral reserves.
- □ Metals and minerals contribute a mere 1.2% to the country's GDP, despite Iran being the 15<sup>th</sup> most mineral rich country
- Before sanctions Iran exported to 159 countries including China, India, Iraq, the United Arab Emirates and Afghanistan
- □ More than 12000 known mineral occurrences
- □ Iran ranks 2<sup>nd</sup> in the world for natural gas reserve and 4<sup>th</sup> in oil reserve
- □ Iran has the largest and most diverse manufacturing base in the Middle east

# Some Highlights



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- □ Young educated people, Iran has strong labour force with >55% skilled workers
- Large domestic market
- Developed infrastructure, telecommunications and energy
- □ 12000 Km railways
- □ 220000 Km road network
- □ 11 commercial ports
- □ 54 airport



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Bordered by 15 countries (Armenia, Azerbaijan, Kazakhstan, Russia, Turkmenistan, Afghanistan, Pakistan, Turkey, Iraq, U.A.E., Oman, Qatar, Kuwait, Bahrain, Saudi Arabia)



2<sup>nd</sup> largest nation in the Middle East and 18<sup>th</sup> largest in the world

## GDP prediction for 2050 (billions US\$)

Pos	sition 2050	Country	2050	2040	2030	2020	2015
1		China	70.710	45.022	25.610	12.630	8.133
2		USA	38.514	29.823	22.817	17.978	16.194
3	-	India	37.668	16.510	6.683	2.848	1.900
4	۲	Brazil	11.366	6.631	3.720	2.194	1.720
5	4	Mexico	9.340	5.471	3.068	1.742	1.327
6		Russia	8.580	6.320	4.265	2.554	1.900
7	-	Indonesia	7.010	3.286	1.479	752	562
8	•	Japan	6.677	6.042	5.814	5.224	4.861
9		Iran	5.945	3.085	1.673	994	716
10		United Kingdom	5.133	4.344	3.595	3.101	2.835

Low Production Cost

Steel ≈ 300 US\$ Aluminum ≈ 1500US\$ Cement ≈ 19 US\$ Big market (local and regional)
Low price Energy resources
Vast and divers mineral resource
Suitable infrastructure
Access to international open seas
Free tax on special economic zones
....

# GEOLOGICAL SURVEY & MINERAL EXPLORATION OF IRAN





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GSI is an active member of many genuine geological commissions, groups & societies.



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## **GSI International Collaboration**

4 **Montpellier University** Pierre & Marie Curie University University of Gernoble 88.114 **Brest University** Marseille University Wuerzburg University **University of Hall Tubingen University** Erlangen university **Karlsruhe University** Frankfurt university **Gutenberg University Klistal University** Cambridge university Oxford university **Milan University Oslo University ETH of Zurich University Uppsala University Geological Survey of China Geological Survey of Denmark** National Institute of Oceanography of India **Geological Survey of Germany Tokyo University Geological Survey of Norway Geological Survey of Russia** OCEAN **Geological Survey of Finland** Geological Survey of Czech republic fugru the firsting of the sorth's robation 楔 # 忠 12 18 12 塘 10 1世 12






# **Basic Data**

### 1:2.500.000



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#### 1:1.000.000



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#### 1:250.000









# **Mineral Exploration**



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Totally 4800 Sq Km, new anomalies within 120 areas

#### Hydrogeochemistry



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#### **Identifying Promising Areas for Lithium in Iran**





#### **Producing Basic Information and completion of Geochemical Maps**





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#### **Airborne Magnetic Geophysics**

- Sampling Year: 1974-1977
- Area: whole Iran except Khuzestan Plain
- Equivalent: 251670 Km Linear
- Flight line distance 7500 m
- Sampling Height: 500 to 1000 m
- Sampling Case : Magnetometry
- Identifying Geological Structures
- Contractor: Aero Service Company





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#### Sampling carried out by Geological Survey of Iran

These services with equipping the airborne geophysical apparatus, helicopter and training personnel started in 1981 and by equipping more advanced apparatus and more complete training gradually turned into the only country in the region who carries this technology

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A brief review on Iran (by

#### 18000 Sq Km Hyperspectral Data Sampling in some regions in the East of Iran





#### 1:100.000





# Systematic Exploration

# 712 sheets scale 1:100/000

## 1<sup>st</sup> Priority Zones

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181 sheets 452500 Km<sup>2</sup>

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# 2<sup>nd</sup> Priority Zones

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168 sheets 452500 Km<sup>2</sup>

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## **Priority Zones**

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349 sheets 872500 Km<sup>2</sup>

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#### **Mineral Resource Assessment (14 commodity)**





#### Au Cu-Mo Pb-Zn







ینی اعلامی را التعلق، استولی «الروی و میستاند» می مودند، مورد ، در اینی آلک این الماری می مودند التعل می مواد و این الماری میارد الماری دلتر استان المارید در وزیرت هم فردی است التی از الرا الماری الماری الماری الماری الماری الماری الماری در وزیرت الماری و مسلورکت از المار کنده است. در مرد آمن الماری المالی بر این الماری این الماری المالی الماری المالی الماری الماری

در هکنه از که شده میکن است به دیل تطبق و دوم مرکز کرین عمودوده دو را پاره معم ماست که این اظام رگذ میروم دیدگ معط اشای داده شده باکد ول به دیل مدل مدارد در میسم <sup>177</sup> تکان مانفده کره های طالعتی به مورت مثالله می باشد



کریه در در مویریت ( توطیقین Field the down decomplice Management



Commodity	% area	
Au	15.5	
Pb-Zn	10.6	
Cu	6.8	
Fe	3.4	
Ba	4.6	
K	3	
Cr	1	
Mo	0.3	
As	2.5	
Sb	8.3	
Hg	1.4	



# Among 43 cases of natural disasters 32

# cases are in Iran

# 10 percent of the GDP of the country

350 cities in Iran are endangered by flood 97 percent of cities in Iran are endangered by earthquake



Natural Hazards Index in Iran and The World A brief review on Iran (by the aspect of mining activity) and GSI



#### **Flood Hazard**



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**Number of Casualties** 



## Desertification

![](_page_70_Figure_3.jpeg)

![](_page_71_Picture_0.jpeg)

# **Global Warming**

![](_page_71_Picture_3.jpeg)




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# **Seismic Hazard of The world**



# Earthquake



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Predicting the future behavior of faults causing earthquakes by paleoseismology in North Tehran, Taleghan, Phirooz Kouh, Damghan, Golbaf, Kahrizak, Rey & Dehshir faults

# Research in recognition of regions of Iran prone to earthquake



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### Electromagnetic earthquake precursor monitoring system

AAAAAAA

Electromagnetic anomalies in the earth has long been known as precursor for a possible carthquake. Preliminary study toward design and manufacturing of a recording system in GSI was started in early 2002.





The device was then tested under different conditions including submerging in the water, in the wells, and remote open filed were cultural noises are minimum. These data was then used to design electronic parts of the system as well as site selection for the permanent station.



Considering all required parameters, we did conclude that the best candidate for the site will be a place on the north of Tehran were we have a major seismogenic source for the city, the partir Tehran End



The site is were it is fur enough away from the city life lines. The operating power comes from solar system and data transfers to GSI through a transmitter to a receiver in the office. The data will then go online to the dedicated website.



In the office data will be processed and passed though some filters to take out real data from the environmental noise. The filtered as well as original data will be stored in a data bank. This data bank will be open to any individual scientist who wish to do further work. This is our plan to equip the site with some permanent three component seismometers which will help us to distinguish real data from environmental noises.







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#### **Marine Geology**



- **U** Has maximum marine width in south west Asia
- **Over 3000 Km sea border (except river borders)**
- **Over 300,000 Sq Km marine width ( Caspian Sea, Persian Gulf, and some part of Oman Sea)**
- □ Thousands of Square Kilometer Internal Lake (Uremia, Bakhtegan, Maharlo, etc.) and ponds and rivers.

#### **Producing Basic Geological Information of the Sea Bed**



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At the area of approximately 200,000 Sq Km of Oman Sea, Persian Gulf and Caspian Sea up to the sea borders of Iran





Marine Geology, Coast Engineering and Abiotic Resource Exploration in Marine Environments of Iran



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Identifying sea bed in order to design places where energy lines transfer

Marine Geophysics of Persian Gulf





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# **Economical Deposits of marines**



Manganese Nodules

Gas Hydrates
Placers (Heavy Minerals)
Sand and Gravel
Manganese Nodule



**Phosphates** 









**Providing the geosciences** information in the format of 50 data banks from 155 targeted data banks

منعت، معدن و تجارت

the aspect of mining activity) and GSI

اكتشافات معدني

- **Preparation and make thousands of** 2. reports topics, map and article accessible, etc.
- Responding to over 94,325,472 3. internet users (over 68,437 website visitors per day)



# **Medical Geology**

 Identifying the relationship between the environmental factors and common

✓ In 2008 became officially member of international Medical Geology Association

(IMGA)

The regional representative of this association among the Middle East countries

The convener of the first International Congress and producer of the first Atlas of

#### Medical Geology in the world

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### **Geo-Veterinary Medicine Atlas**







## The laboratorial analysis methods from the past up to the present



# Ascending Trend of the integrated Laboratory of Karaj Research Centre





# Thanks for your attention