CSA Global
Mining Industry Consultants

Unlocking Iran's Mineral Potential through Excellence & Innovation

Geology, Exploration and Resource Estimation

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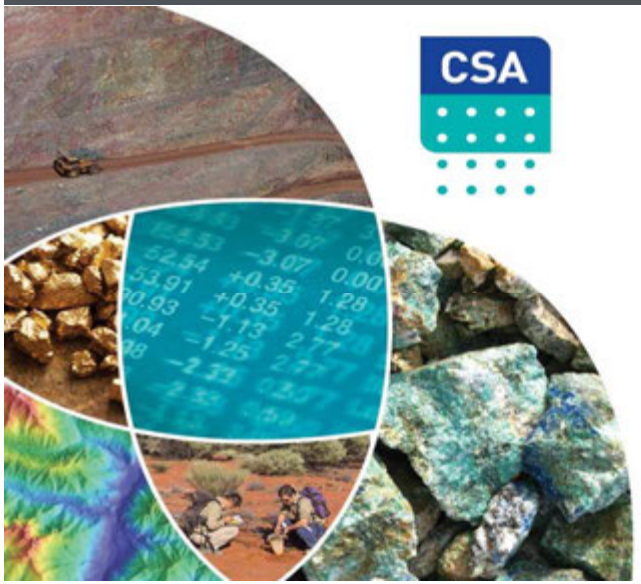
IMIS 2016, Tehran

CSA Global - Mining Industry Consultants
30 YEARS
1984 - 2014

About CSA Global



CSA Global

Mining Industry Consultants

EXPLORATION | RESOURCES | MINING | TECHNOLOGY | CORPORATE

CSA Global is a leading geological, mining and management consulting company which provides high quality solutions to our clients in the global minerals industry. Our staff include geologists, mining engineers, project managers, data management professionals and technical personnel.

Our History

1984 : CSA Group was founded in Ireland.

1986 : Australian branch setup in Perth, later incorporated as CSA Australia.

1990 : Lisheen discovery, first international growth phase.

2000 : Diversification strategy – commodities, services, regions.

2006 : Acquisition of Finore P/L, CSA Consulting International established.

2008 : CSA Australia renamed as CSA Global, CSA Global UK office opened.

2009 : Additional Australian branch office opened in Darwin, Northern Territory.

2010 : Indonesian office opened, new headquarters in West Perth, Western Australia.

2011 : Third Australia branch office opened in Brisbane, Queensland.

2012 : Opened an office in Johannesburg, South Africa and a branch office in South Australia. Acquired Revelation Geoscience Ltd in Vancouver, Canada.

2013 : Established CSA Global Rus in Moscow to service the CIS region.

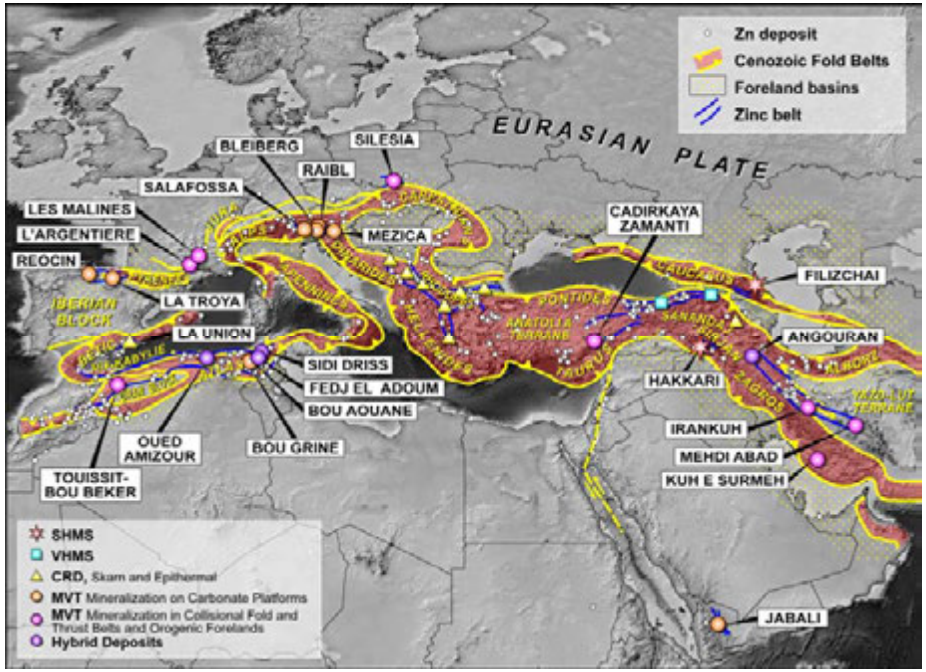
2014 : CSA Global Singapore office established.

2016 : CSA Global Toronto and Dubai offices established.

Global Office Locations & Projects

CSA Global in Iran & MENA

- More than 20 years experience in the MENA region
- Extensive experience in Turkey's Tethyan metallogenic belt
- Recent 2014-16 geology, resource and reserve support at Sungun Copper Mine



From Reynolds & Large, 2010, SEG Special Publication 15

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Geology, Metallogeny, & Mineral Potential in Iran

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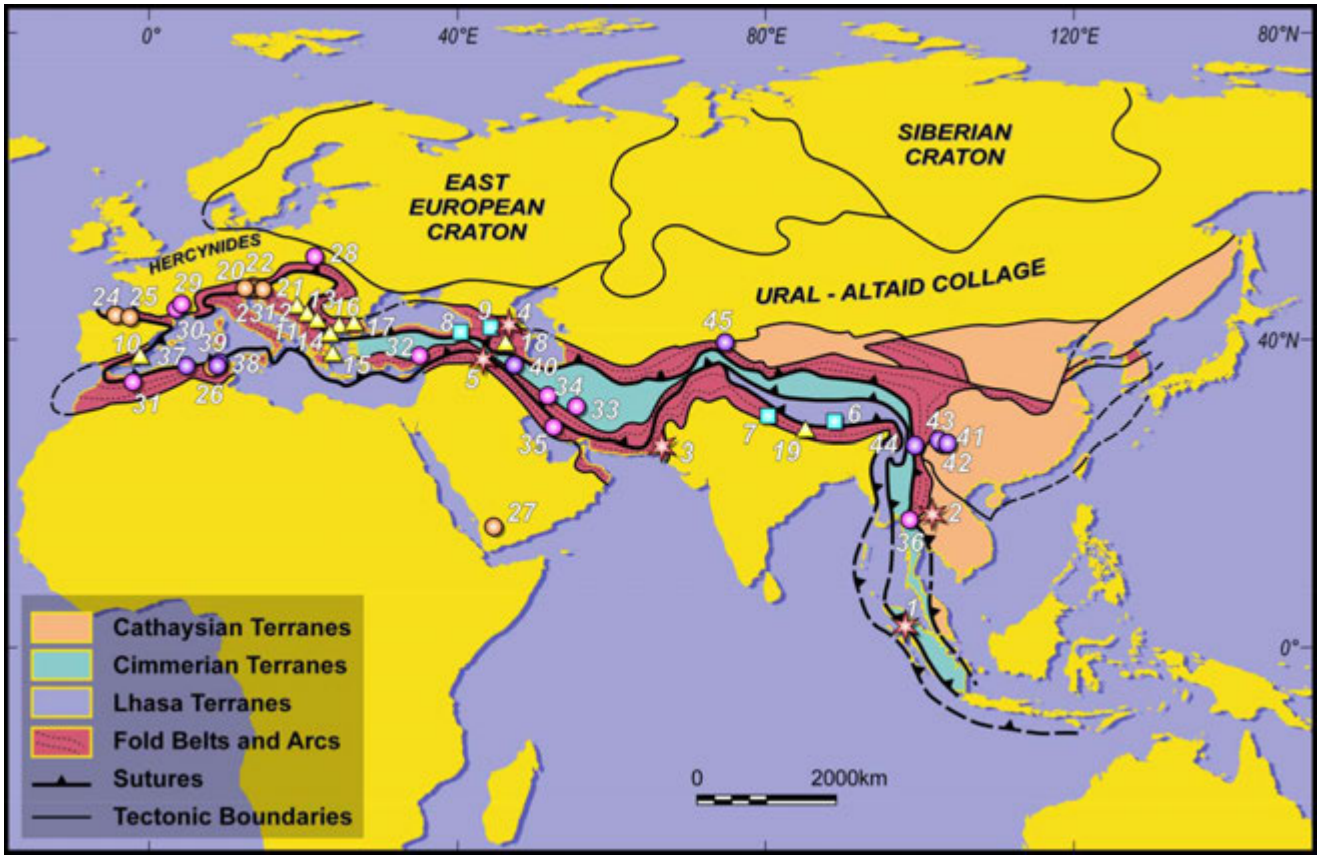
Geotectonic Setting

- Iran occupies a central position in the Tethyan belt, a long-lived Palaeozoic to Neogene orogenic belt
- Important metallogenic belt, accretionary terrains with volcanic arc belts and micro-continental blocks



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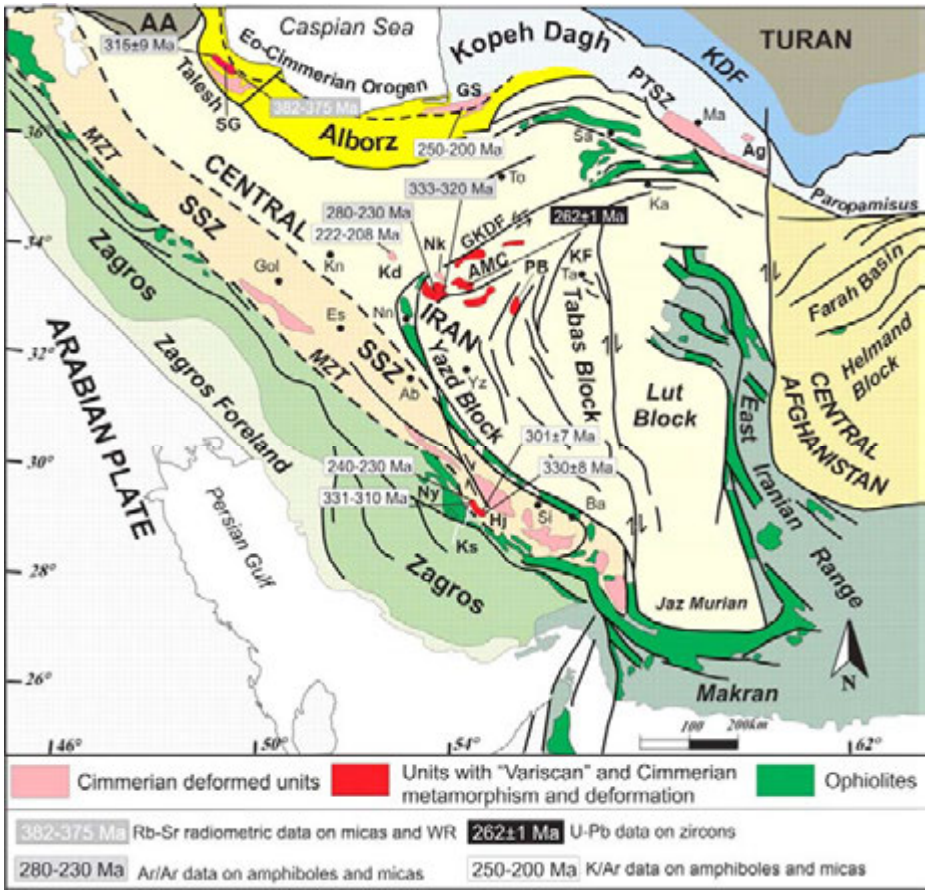
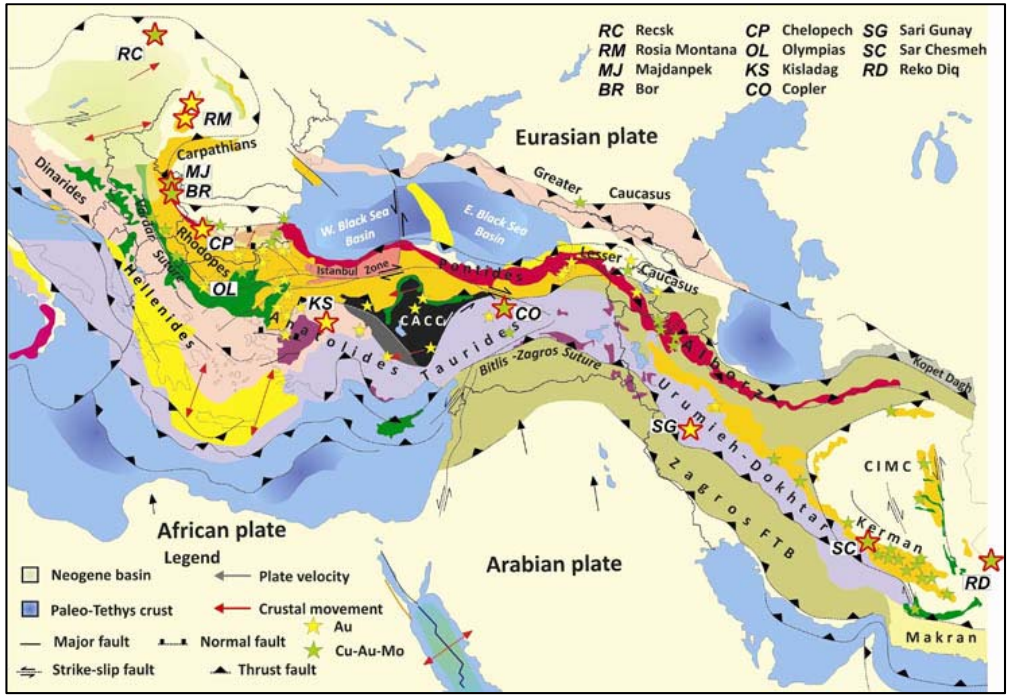
Geotectonic Setting

- Iran's geology and metallogeny results from accretion of continental fragments rifted from Gondwana and accreted to Asia between the Triassic and Tertiary
- Neoproterozoic to Cambrian basement – limited distribution
- Gondwana rifting
- Triassic Cimmerian orogeny – closure of Palaeo-Tethys
- Jurassic-Cretaceous culmination of Cimmerian phase
- Tertiary Alpine-Himalayan orogenesis; closure of Neo-Tethys and Arabian collision



Metallogeny

- Metallogeny and mineral endowment is intimately related to cycles of rift, drift, convergence and collision
- Cimmerian and Alpine-Himalayan rifting & accretionary cycles; optimal setting
- Zn-Pb endowment largely related to Cimmerian cycle
- Cu-Au endowment largely related to the Alpine-Himalayan cycle
- Understanding mineral potential depends on understanding of tectonic evolution and related mineral systems
- **Understanding mineral potential on a metallogenic belt and mineral-system basis** provides a guide to **explorers** and **policy makers**



From UBC MDRU http://www.mdru.ubc.ca/home/research/tethyan/mapx2.jpg

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Mining Industry in Iran

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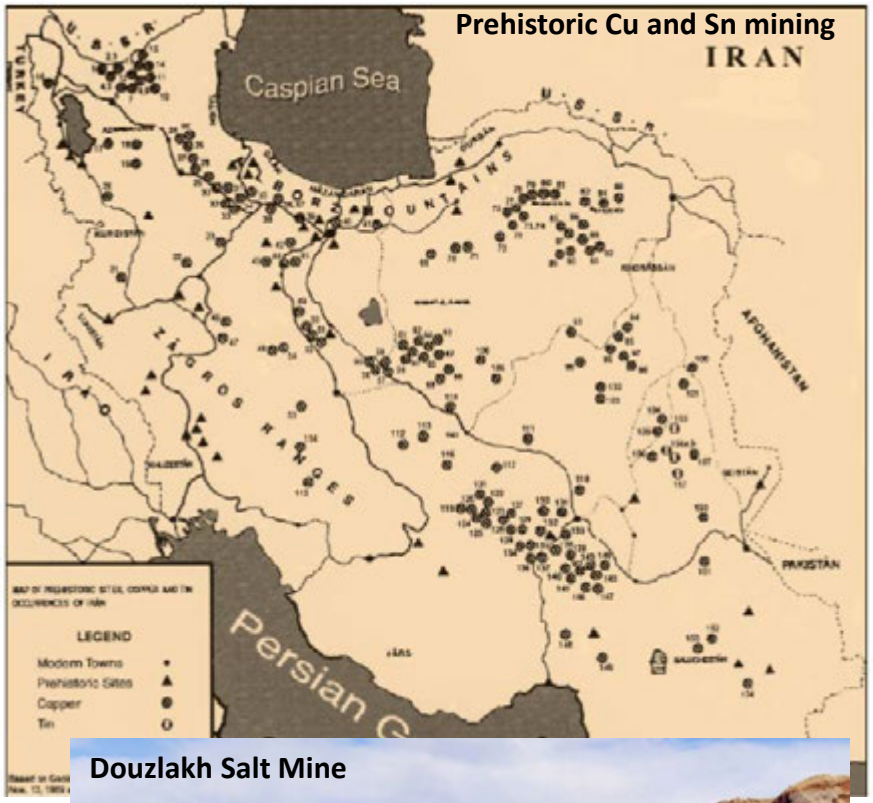
Mining in Iran - Historical

Historical

- History of mining since the Bronze Age
- Underpinned ancient civilisations

*Iran has been the pioneer of mining exploration and techniques for several millennia. The **knowledge and talent of primeval Iranians** on one hand and **high potential of mineral deposits**, their diversity and absence of dense vegetation cover on the other hand, as well as the country's position at the crossing of various cultures and civilizations, have led to **prosperous mining activities in ancient times and even after the renaissance, which still amaze the mining engineers about the Iranian expertise in mining**.*

Ghorbani, 2012



Mining in Iran

Historical

Ore and mineral deposits of Iran, especially those of copper, are hardly matched in the world. However, Iranians are way behind the world technologically and cannot use the tools purchased from Europeans - Khudzco, c. 1800

- Modern mining commenced in 19th century – Qajar Period
- First foreign investment in copper c. 1815 – Sheyk Darand
- 1909 – Anglo-Persian Oil Company ushered in period of foreign control of Iranian oil industry
- Pahlavi Period – modernisation of Iranian economy; coal, copper, zinc-lead mines developed
- Government & domestic investment, limited foreign investment
- Continuing dominance of the petroleum industry
- 1979 revolution and nationalisation
- Slow growth in mining sector, but minimal contribution to GDP

THE MINING SECTOR IN GDP, 1997-2002,
BASED ON CURRENT PRICES (RLS. BILLIONS)

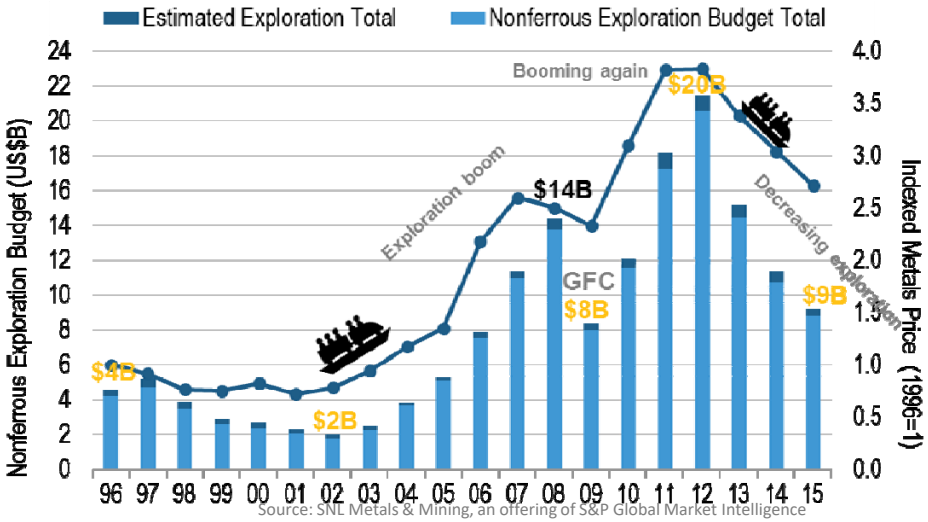
	Year					Growth Rate over Previous Year (Percent)	
	1997/98 [1376]	1998/99 [1377]	1999/2000 [1378]	2000/01 [1379]	2001/02 [1380]	2000/01 [1379]	2001/02 [1380]
Mining Sector	1,522.2	1,914.0	2,397.7	2,943.1	3,667.1	22.7	24.6
The Whole Country	231,615.2	265,590.9	353,651.5	468,865.3	553,364.9	32.6	18.0
Mining as a Percentage of Total GNP	0.66	0.72	0.68	0.63	0.66	-	-

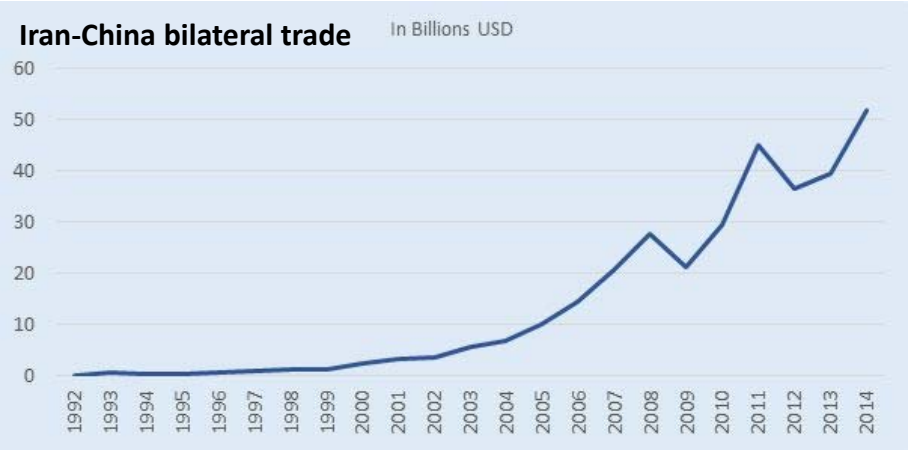
Source: Economic Trends of the Central Bank of the Islamic Republic of Iran (various issues).

Mining in Iran

2005-2012 Commodities 'Supercycle' Boom, & Crash

- 2002 Foreign Investment Promotion and Protection Act (FIPPA)
- Commodities driven to peaks by China growth, and other developing markets
- Investment in Iranian mining industry hampered by international sanctions
- China investment accelerated from 2004; mainly petroleum and infrastructure
- Limited Chinese investment in mining





Summary and Implications

- Iran missed the 1980's boom, the 1990's boom, the 2005-2012 'Supercycle' boom, and the crashes ……
- Despite developing a domestic self-contained industrial and mining base, Iran's mining industry has been starved of capital; minimal contribution to national GDP
- Limited investment in exploration historically, and recently with modern technology
  - Most known deposits are outcropping and many have been mined for 100's or 1000's of years
  - innovation did occur (e.g. sulphidised flotation at Angouran) but generally deprived of international interaction
  - well-educated expertise has been maintained
- **Opportunity to meld Iranian geological expertise & mining innovation with international technology and risk capital**

ATTRACT RISK CAPITAL INVESTMENT – DOMESTIC AND INTERNATIONAL

- OPTIMISATION AND RECAPITALISATION OF EXISTING OPERATIONS
- CAPITAL TO DEVELOP NEW OPERATIONS
- HIGH-RISK INVESTMENT IN EXPLORATION IS FUNDAMENTAL – PIPELINE OF PROJECTS

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Investment Drivers and International Perception of Iran

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2015 Exploration Budgets

- Worldwide non-Fe exploration budgets fell by 19% in 2015
- MENA region attracts a tiny and falling proportion of global exploration budgets
- Iran exploration budget is insignificant in global terms

87 other countries and regional allocations account for 12.5%.

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Drivers of MINEX Investment

Macro factors

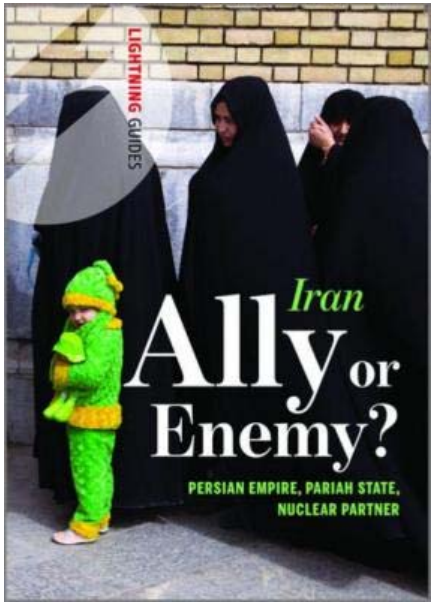
- Provide operating paradigm but cannot be locally influenced, e.g.:
  - World economy – *growth, urbanisation, standard of living*
  - Commodity prices – *growth* & *demand / supply issues*
  - Access to capital – *market sentiment driven*

Local factors

- Not influenced by economic development & policy settings, e.g.:
  - Geological – *well endowed in economic minerals*
  - Prospectivity – *track-record or under-explored*
- Influenced by local economic conditions and policy settings, & **investor perception (*not always linked to reality)***
  - Regulatory & Operational, Sovereign Risk
    - Regulatory environment – *laws, regulations, policy etc.*
    - Ease & cost of business set-up and administration
    - Data – *access to regional geological & exploration data, pre-competitive data availability*
    - Bureaucracy & corruption – *minimise for efficient operation*
    - Infrastructure framework – *transport, power, etc.*
    - Services & workforce – *availability and cost*
  - Security & health risks – *security, civil unrest, disease*

How does Iran rate?

- Iran is not covered by Fraser Institute Survey of Mining Companies or similar indexes
- To 'western' and international companies, while US banking restrictions and sanctions continue, investment in Iran is problematic
- Geologically, international companies recognise the huge discovery and development potential
- But, international investor perception of Iran has been coloured by nearly 40 years of distrust
- Opportunity for Iran is to maximise return from massive mineral potential through foreign investment while developing the domestic mining and service industry sector
- **Foreign investment can be a foundation for the 'resistive economy'**



Mining Investment Drivers

- ✓ Diverse endowment
- ✓ World-class deposits
- ✓ Positive investment regime *but*

  Resource nationalism? Positives and negatives ……

- X **Investment perception – track record, sanctions, past failed investments**
- X Responsible mining to world's best standards …. aspirational?

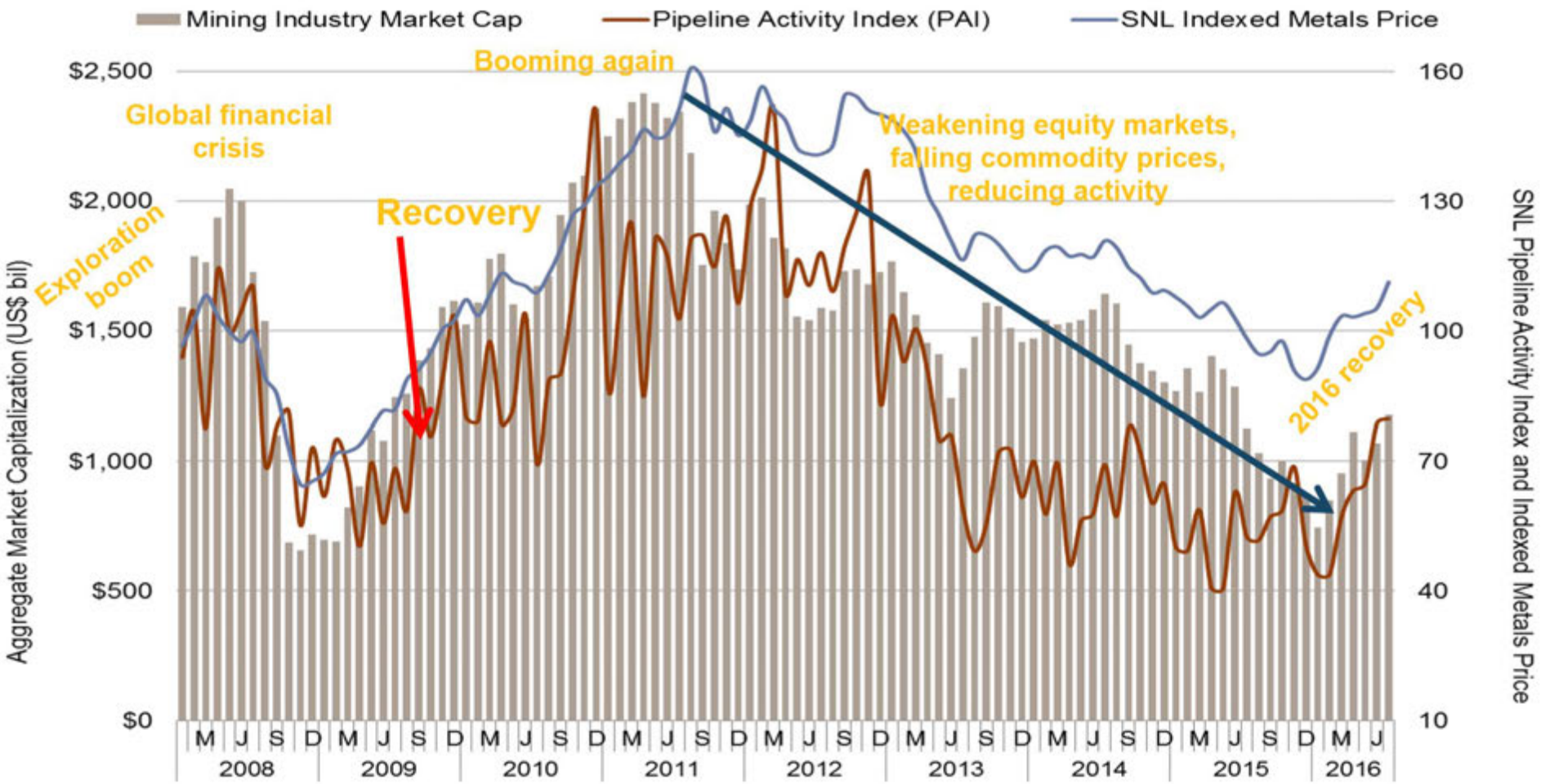
- ? Environmental and community impact?
- ? Community understanding and support?

The negatives can be overcome to bring risk investment

- **Bring mineral projects to world best standard**
- ✓ **Leverage natural resources for economic benefits especially regional growth**
- ✓ **Maximise Iran's return on foreign investment**
  - ✓ **Maximise value of projects**
  - ✓ **Build local mining and service industry capability**

Mining in Iran

The next cycle is starting – Iran can capitalise on its mineral potential



SNL Metals & Mining

Excellence & Innovation in Discovery & Project Definition

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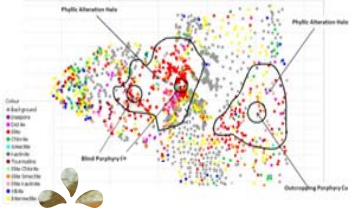
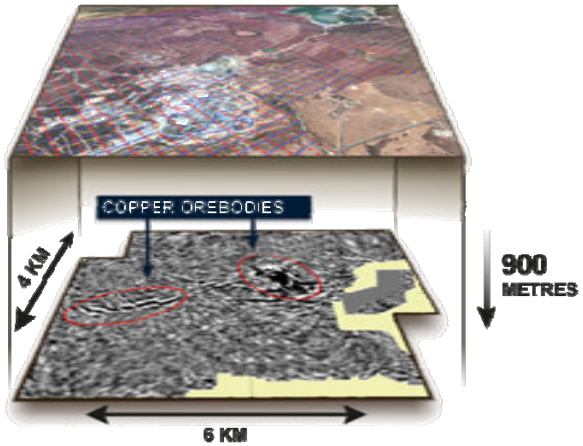
Geology and Exploration

Technology developments

- Cost-effective **multi-element geochemistry** & mineralogy
- Field-portable **XRF** analysis; **hyperspectral** scanners and **XRD** for **mineralogy**
- Routine scanning of drill samples
- Down-hole and on-rig analysis
- Satellite & airborne hyperspectral scanners
- Geophysics
  - High-powered deep penetrating multi-channel IP, airborne and ground EM
  - Airborne gravity
  - 2D & 3D seismic in mineral exploration
  - Passive seismic for low-cost mapping of cover
- Drones in data capture, especially geophysics





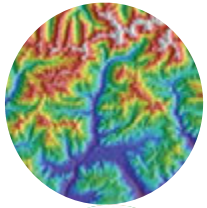
→ BIG DATA

SUPPORTS MINERAL SYSTEMS ANALYSIS AND TARGETING UNDER COVER

Geology and Exploration

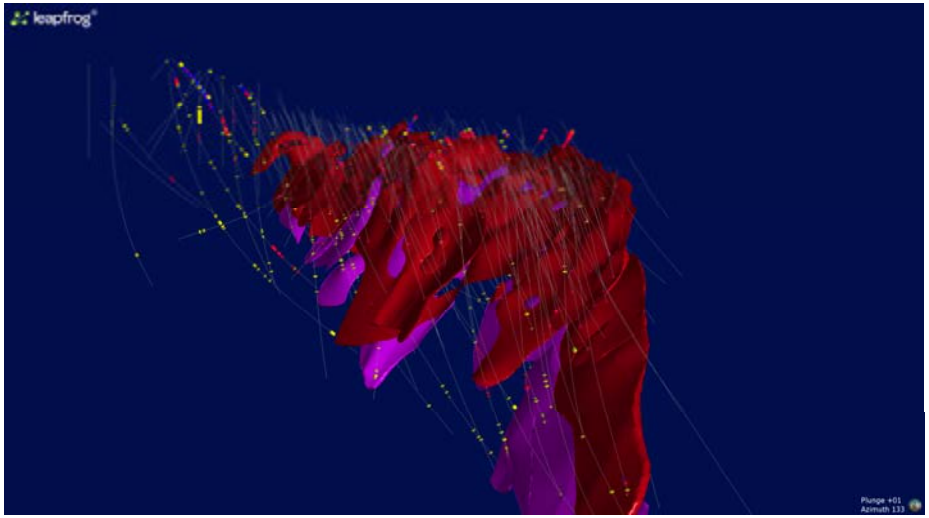
Information and Communication Technology

- Global connectivity & cloud storage
- Centralised validated databases
- Mobile computing power
- Processing power for big data analytics
- Innovative software e.g. Leapfrog implicit modelling
- 3D inversions of geophysical data
- Integrated 3D modelling



→ EFFECTIVE PROCESSING OF BIG DATA

SUPPORTS MINERAL SYSTEMS ANALYSIS AND TARGETING UNDER COVER

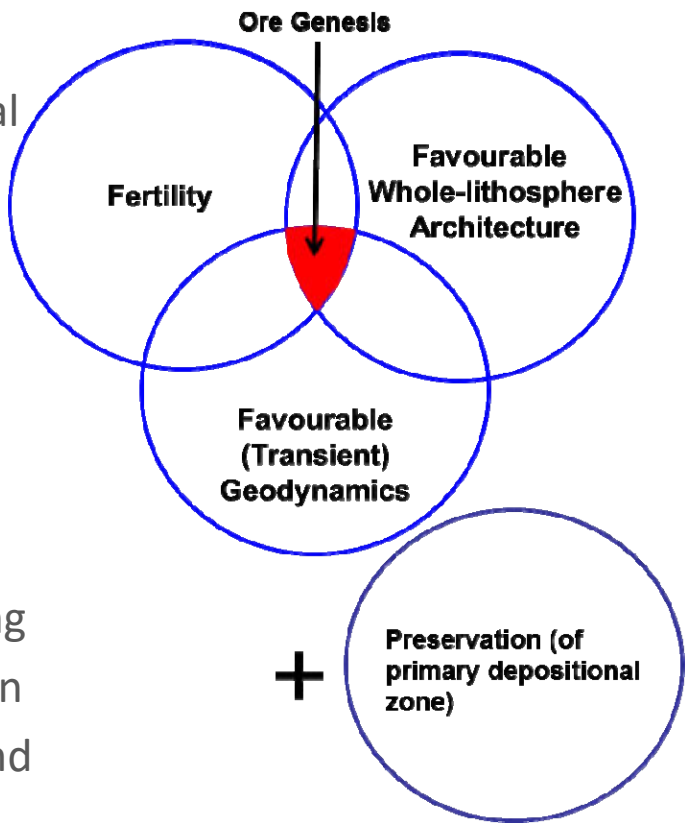


Geology and Exploration

Mineral Systems Analysis – Exploration & Deposit Optimisation

- Improved understanding of the chemistry and physics of mineralising processes
- Foundation is excellence in geology and geological mapping
- District to trend to deposit scale; analogous to petroleum system and play approach
- Supported by big data
- Geochemical, mineralogical and geophysical data support deposit-scale system interpretation & 3D models
- Optimise resource definition and extension drilling
- Basis for resource models and resource estimation
- Foundation for geometallurgical interpretation and process design and scheduling

McCuaig and Hronsky (2014)



SUPPORTS MINERAL RESOURCE ESTIMATION AND (PRE)FEASIBILITY STUDIES

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Resource & Reserve Estimation & Reporting for Investment-ready Projects

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