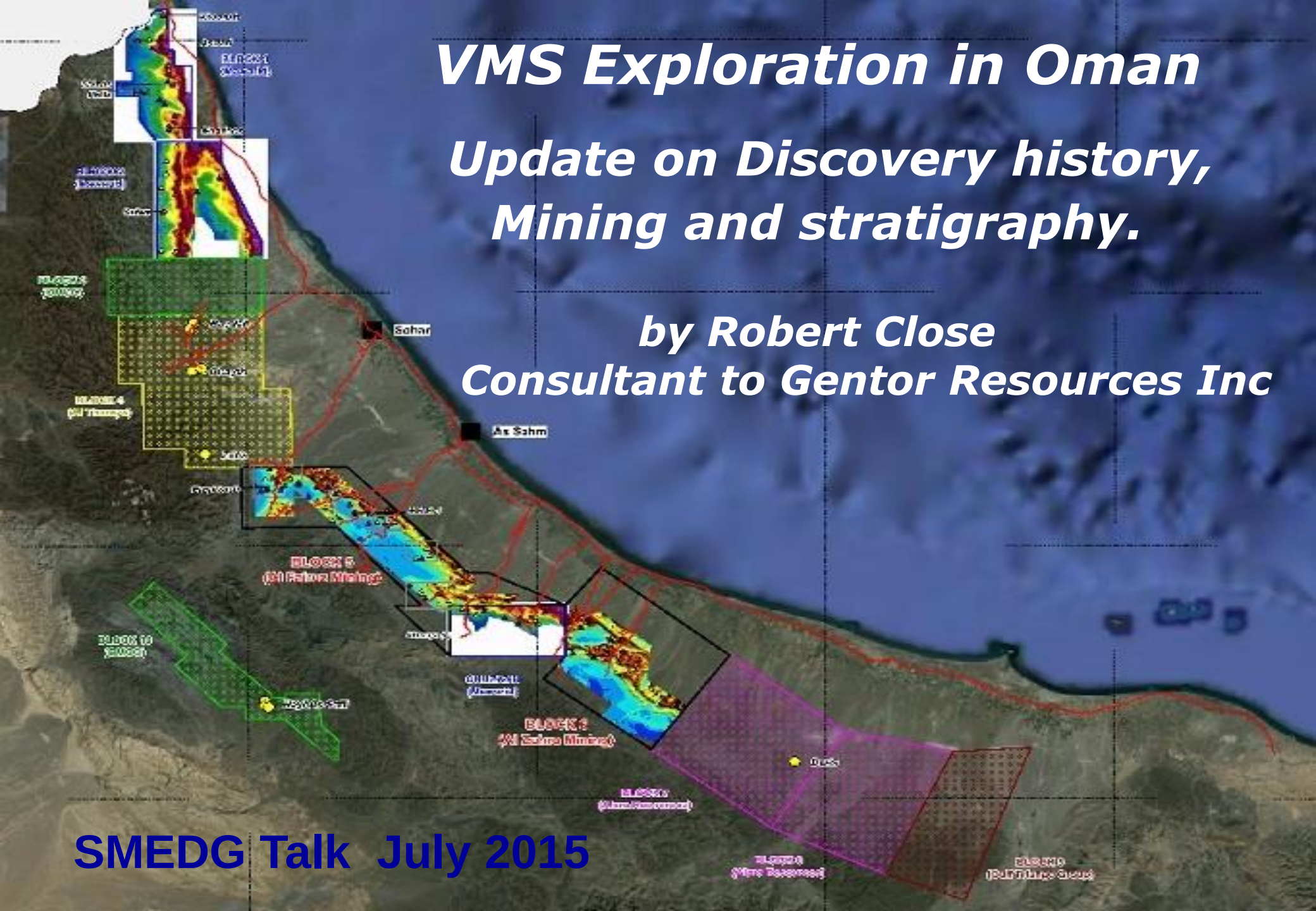


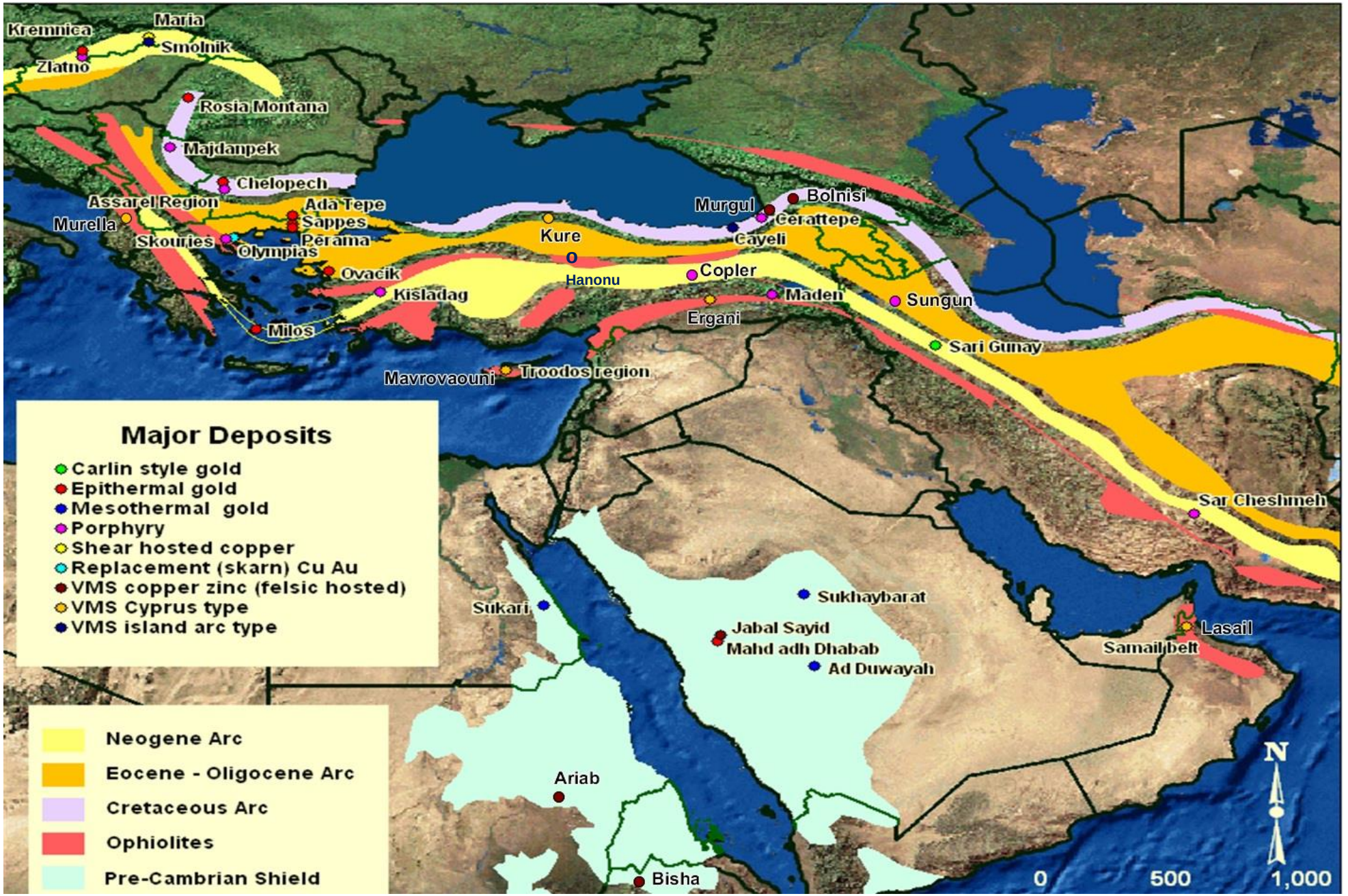
VMS Exploration in Oman

Update on Discovery history, Mining and stratigraphy.

by Robert Close
Consultant to Gentor Resources Inc

SMEDG Talk July 2015

Tethyan Orogeny and ME Regional Metallogeny



WESTERN TETHYAN REGION'S VMS HERITAGE

- **Copper and related gold mining commonly from basaltic VMS deposits sustained several early civilisations** in the Middle East-Mediterranean(MEM) region, **key copper centres were in Cyprus, Turkey, Iran and Oman**.
- **Island Arc related VMS deposits formed during early Tethyan extension through to late post closure subduction tectonics**, particularly in Turkey.
- **Cyprus-type Ophiolitic deposits were mostly related to early Tethyan seafloor spreading** and were preserved in large obduction sheets mostly onto the northern edge of the Pan African Arabian Platform during the Cretaceous.
- The Ophiolites and copper deposits in the **Troodos Massif of Cyprus and the Semail Ophiolite of Oman are among the best exposed and least-deformed** examples of Cyprus-type VMS mineralisation in the world**.**
- However, **Ophiolitic terrains have not been a prime target** for modern International investment due to **perceived low potential for major Cu or Au deposits compared to Porphyry systems**.

Proterozoic Arabian-Nubian Shield Deposits

Exploration companies in this region have generated significant enterprise value for their shareholders mainly from subduction-related Cu-Zn VMS deposits:

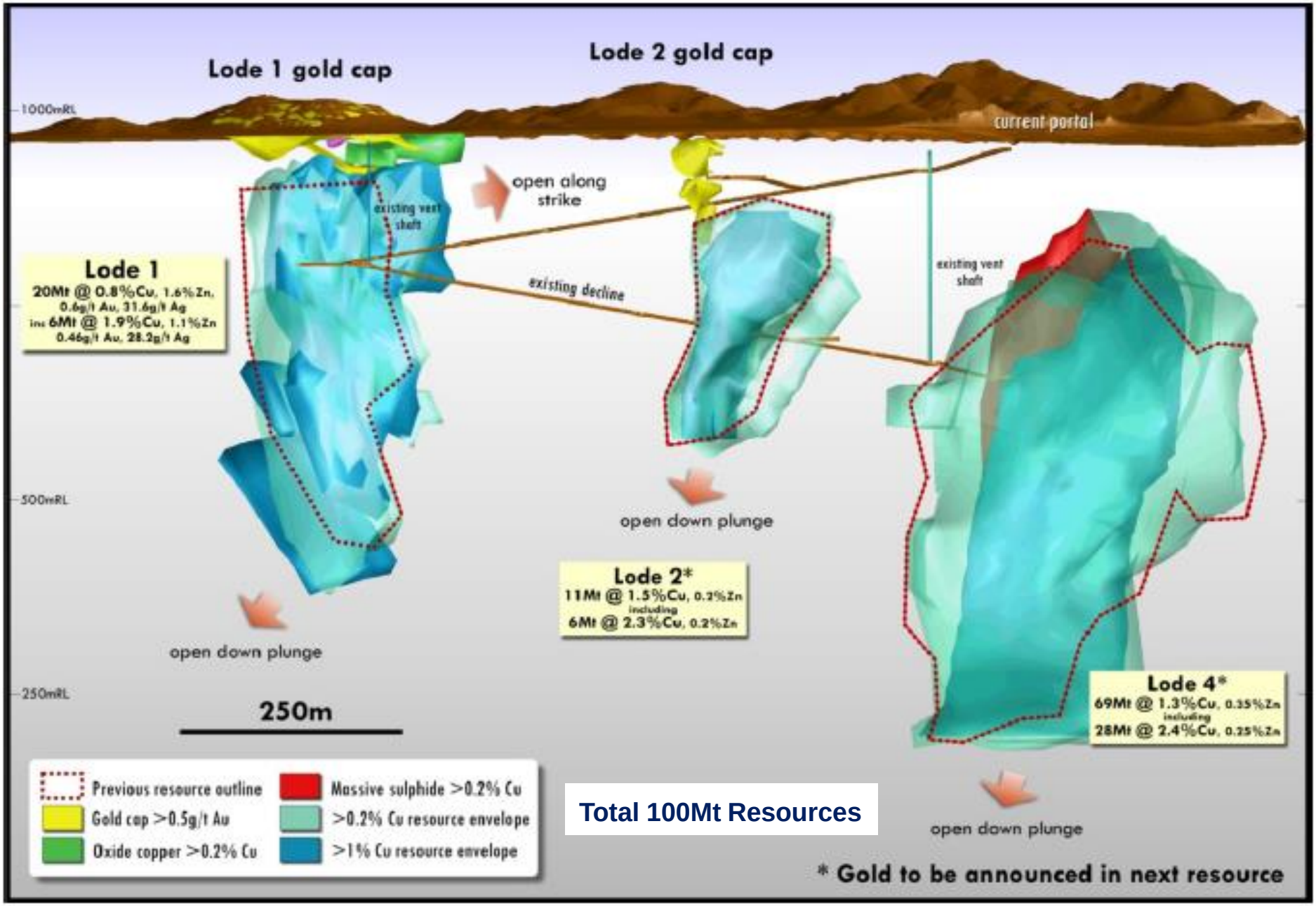
A few examples:

Jabal Sayid Cu-Zn VMS (Saudi Arabia), was acquired for AUS $1.2 billion by Equinox Resources (now controlled by Barrick Gold)

Hassai Cu-Au VMS (Sudan), was the main deposit acquired for $493 million by Weather II Fund (Sawiris Family)

Bisha Cu-Zn-Au VMS (Eritrea), generated a market capitalization for Nevsun Resources from $650 million to $1.4 billion

Jabil Sayid, Saudi Arabia- Mineral Resources



Bisha District Eritrea - Mineral Resources

High-grade copper and zinc

Combined Bisha & Harena Reserves (Effective December 31, 2013)

Zone	Tonnage	Copper	Zinc	Gold	Silver
Supergene	7,400 kt	3.57 %		0.61 g/t	27 g/t
Primary	19,550 kt	1.00 %	5.54 %	0.67 g/t	45 g/t

27.5Mt Reserves

Based on **$2.90**/lb Copper, **$0.92**/lb Zinc, **$1175**/oz Gold and **$20**/oz Silver

Semail Ophiolite Nappe VMS Northern Oman

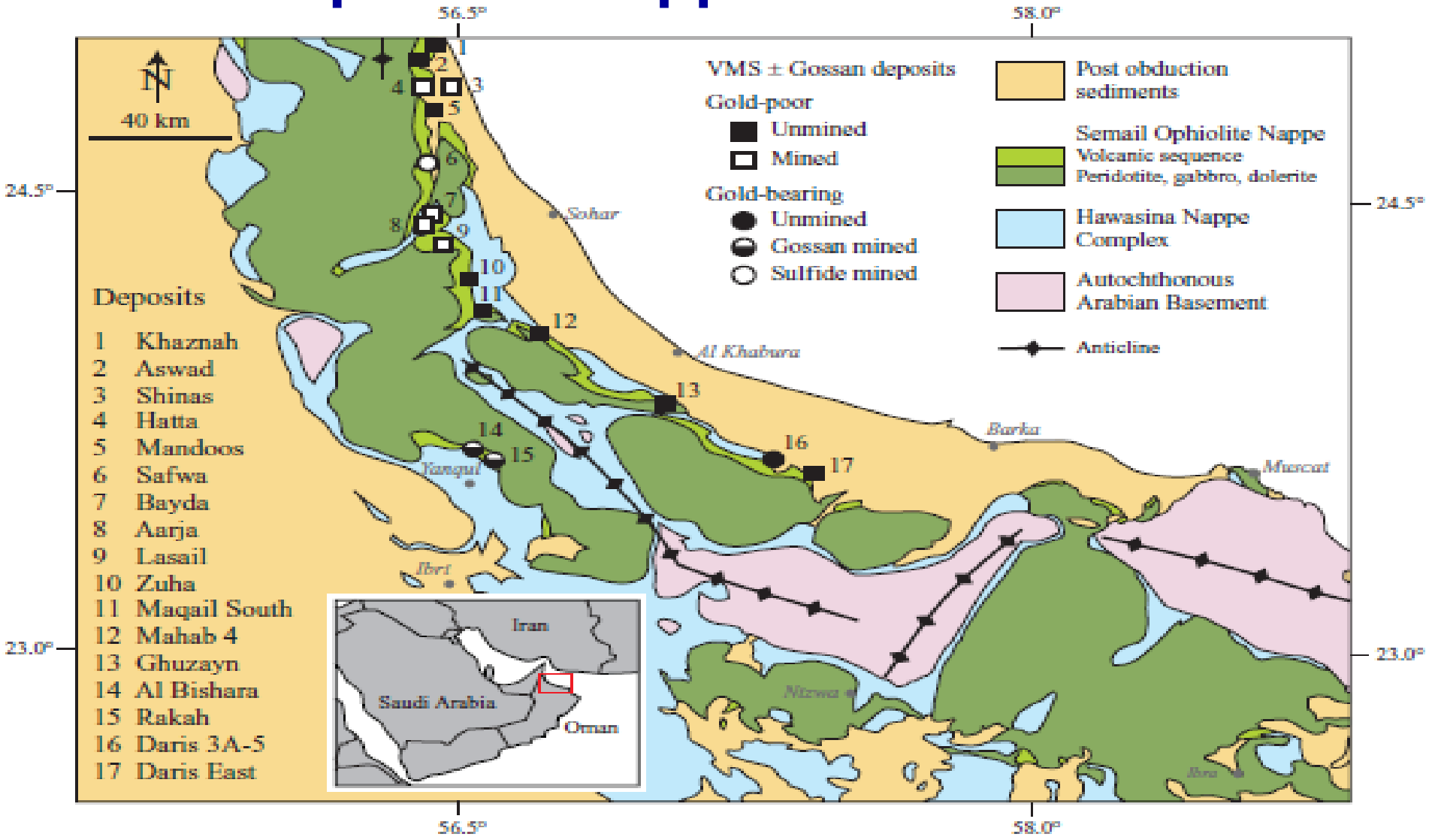
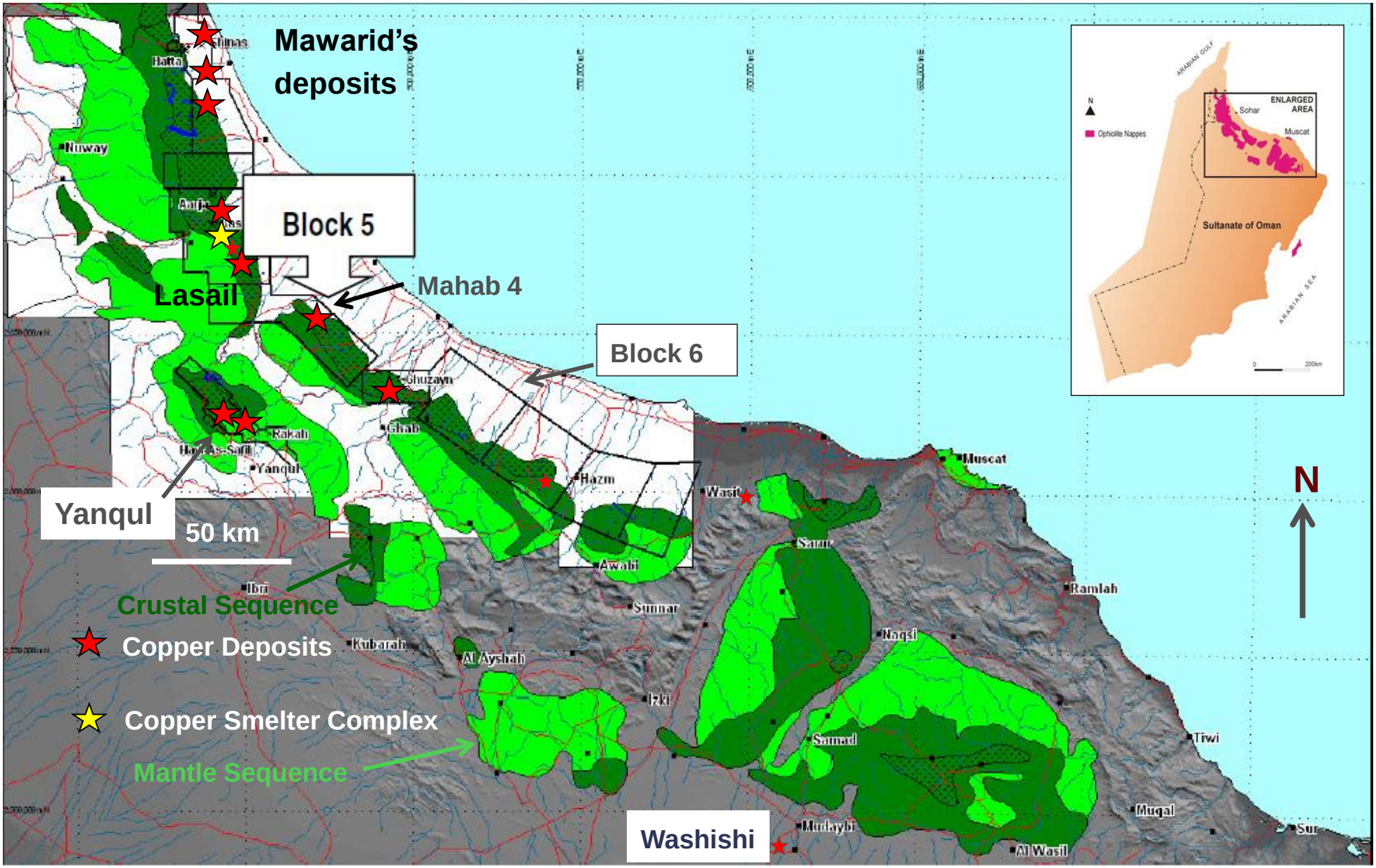
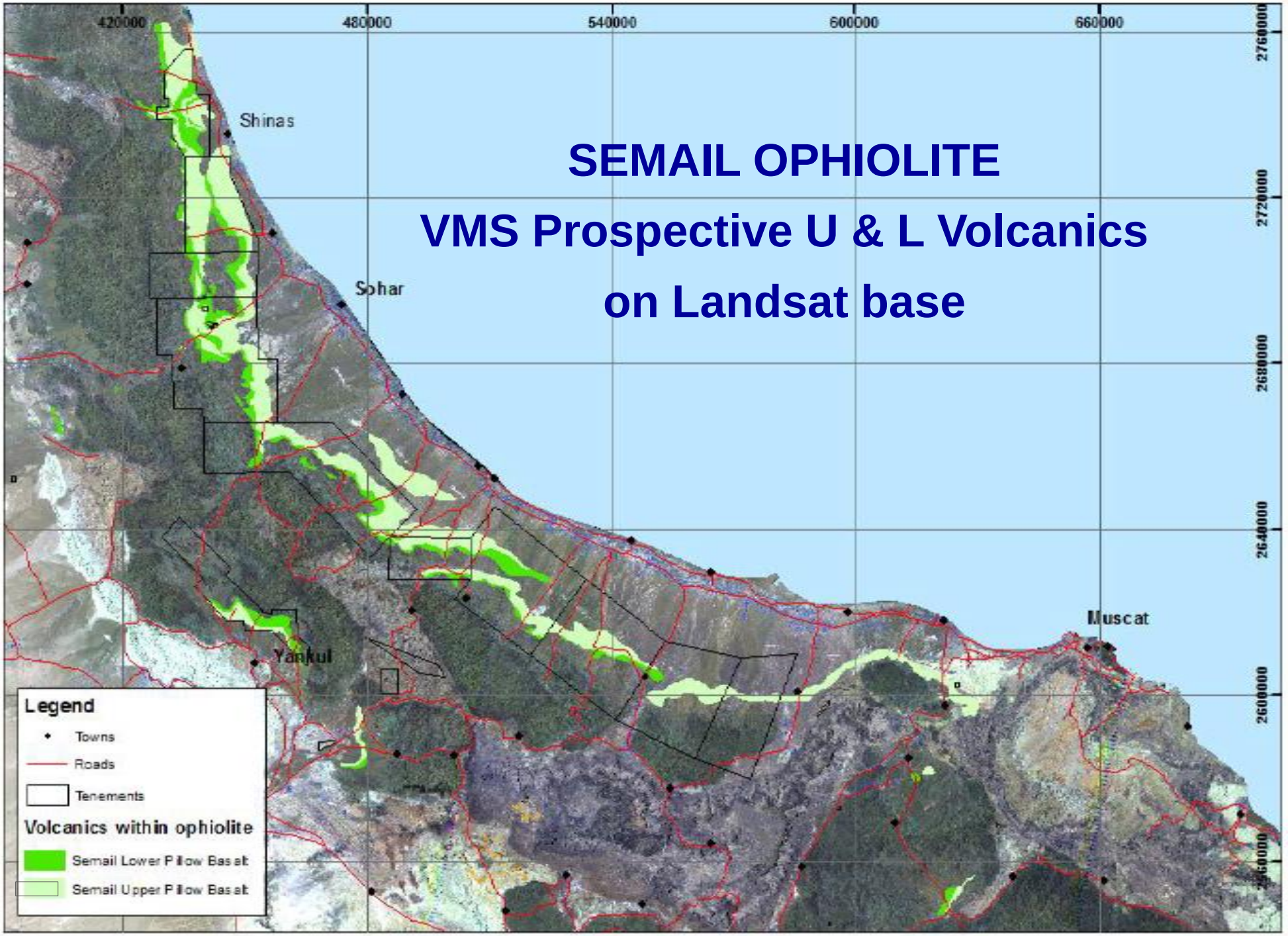


FIG. 1. Simplified geologic map of the Semail ophiolite in northern Oman (modified from Calvez and Lescuyer, 1991), showing the main VMS and gossan deposits associated with Late Cretaceous seafloor volcanism. Deposit symbols denote gold contents.

Jabil Achdar Ranges Northern Oman

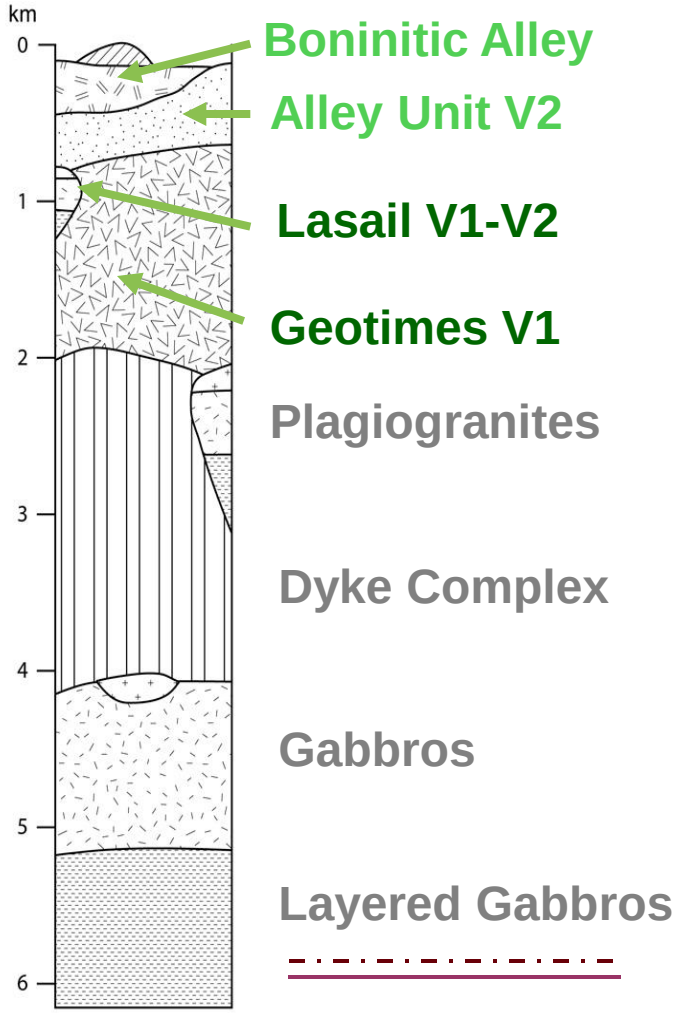
Oman Ophiolite – Summary Geology & Exploration Blocks




SEMAIL OPHIOLITE
VMS Prospective U & L Volcanics
on Landsat base
420000
480000
540000
600000
660000
2760000
2720000
2680000
2640000
2600000
2560000
Shinas
Sohar
Yankul
Muscat
Legend
Towns
Roads
Tenements
Volcanics within ophiolite
Semail Lower Pillow Basalt
Semail Upper Pillow Basalt

Crustal Stratigraphy - Revised Mineralised Units

- Deposits occur at various stratigraphic horizons within the dominant basalt pillow lava sequences
  - **Near and at top of Geotimes** (V1) * Lower Volcs
  - Within and top of Lasail (V1-V2)
  - Within and top of Alley (V2) Upper Volcs
  - Within Boninitic Alley (V2)
- Sequences may be difficult to identify in field but have magnetic and Imagery characteristics related to mineralogy
- Clear identification possible only with geochemistry
  - Whole rock geochemistry
  - Clinopyroxene relicts
  - Trace element patterns

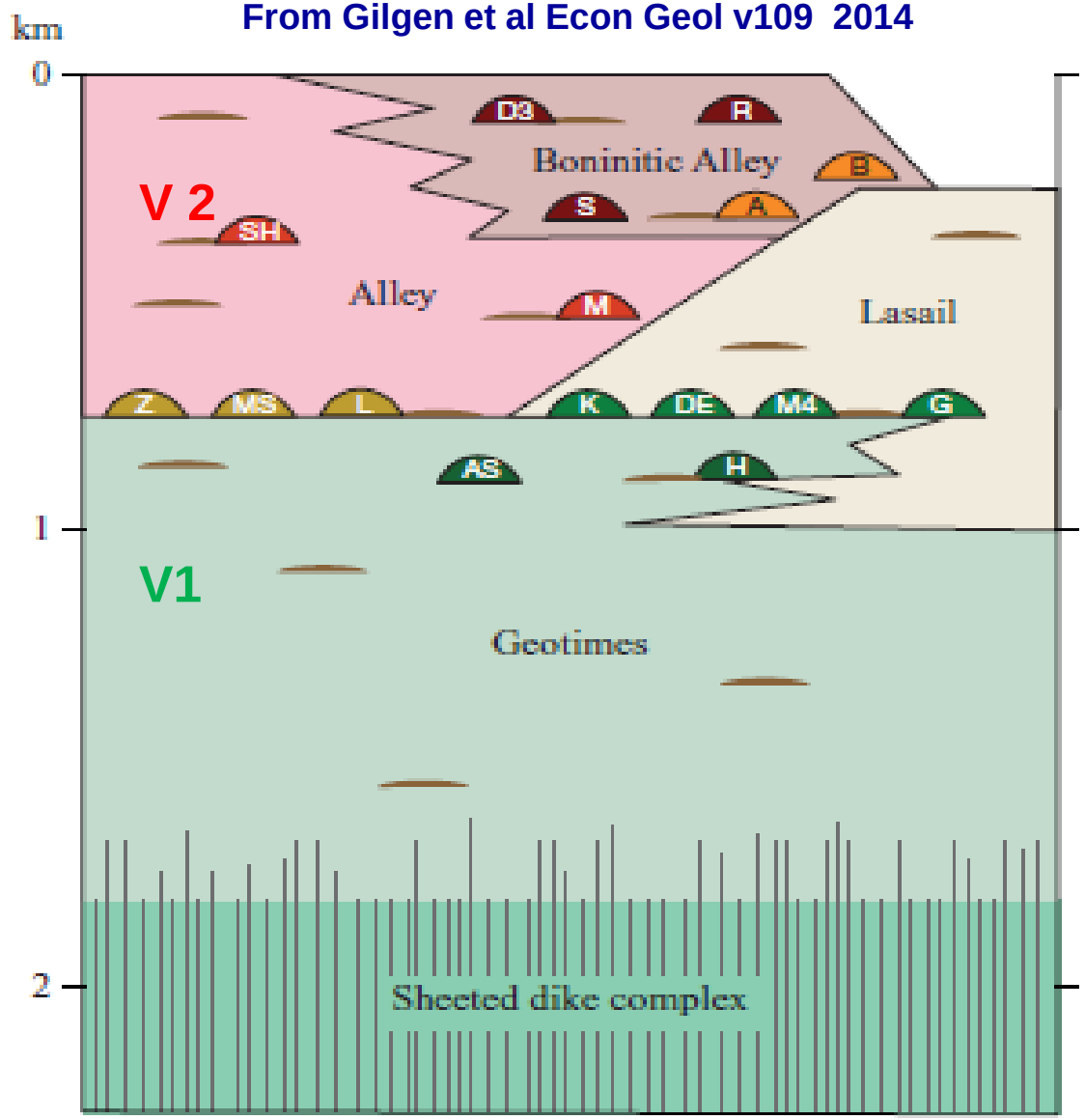


After Gilgen et al Econ Geol v109 2014

OMAN OPHIOLITE – VMS Deposit Stratigraphy

VOLCANOSTRATIGRAPHIC CONTROLS ON MASSIVE SULFIDE DEPOSITS IN THE SEMAIL OPHIOLITE, OMAN

From Gilgen et al Econ Geol v109 2014

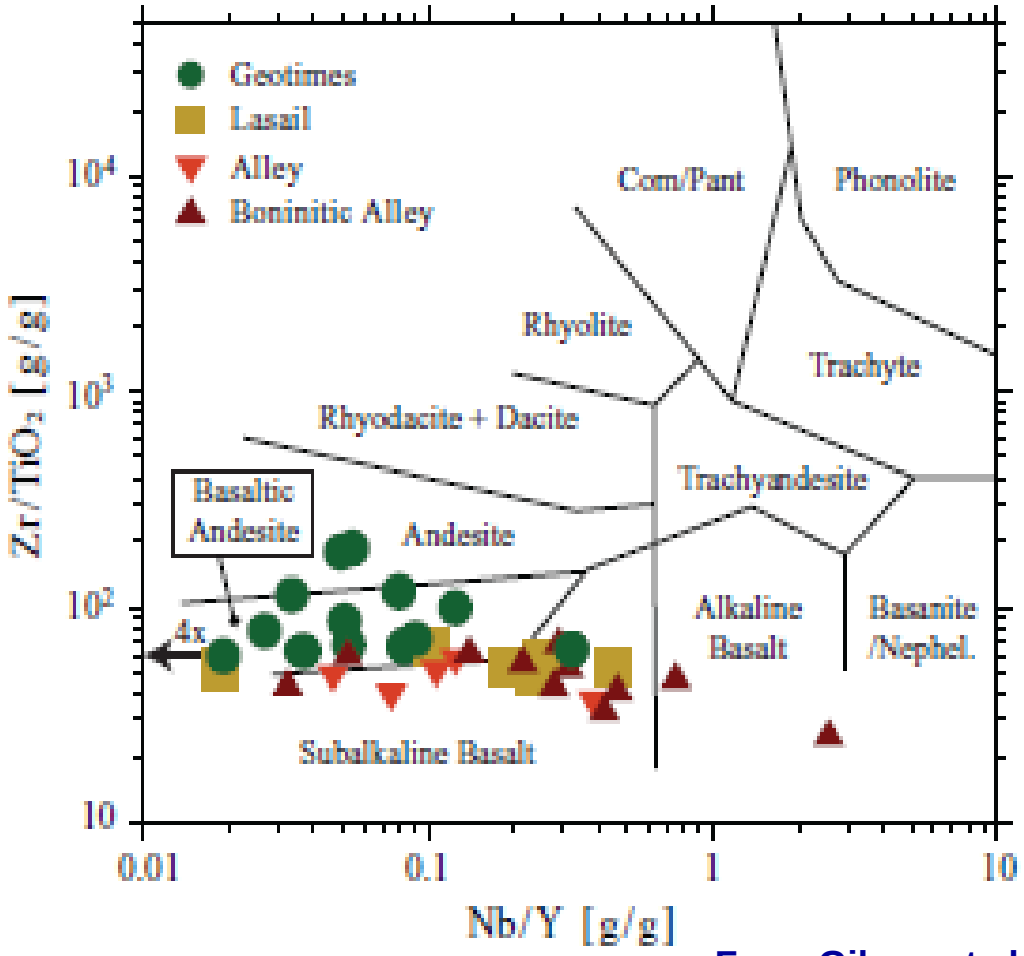


VMS DEPOSITS

- D3 Daris-3A-5
- R Rakah
- S Safwa
- A Aarja
- B Al-Bishara
- SH Shinas
- M Mandoos
- Z Zuha
- MS Maqail South
- L Lasail
- K Khaznah
- DE Daris East
- M4 Mahab-4
- G Ghuzayn-1/3
- AS Aswad
- H Hatta

Umber (metalliferous sediment)

Oman Ophiolitic extrusives- Petrogenic Stratigraphy



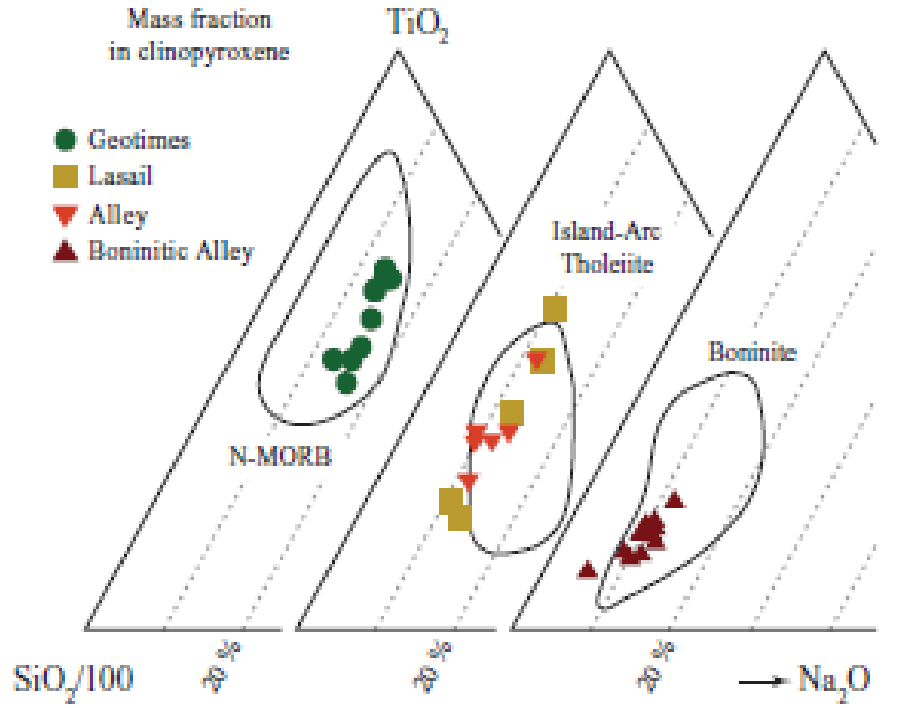
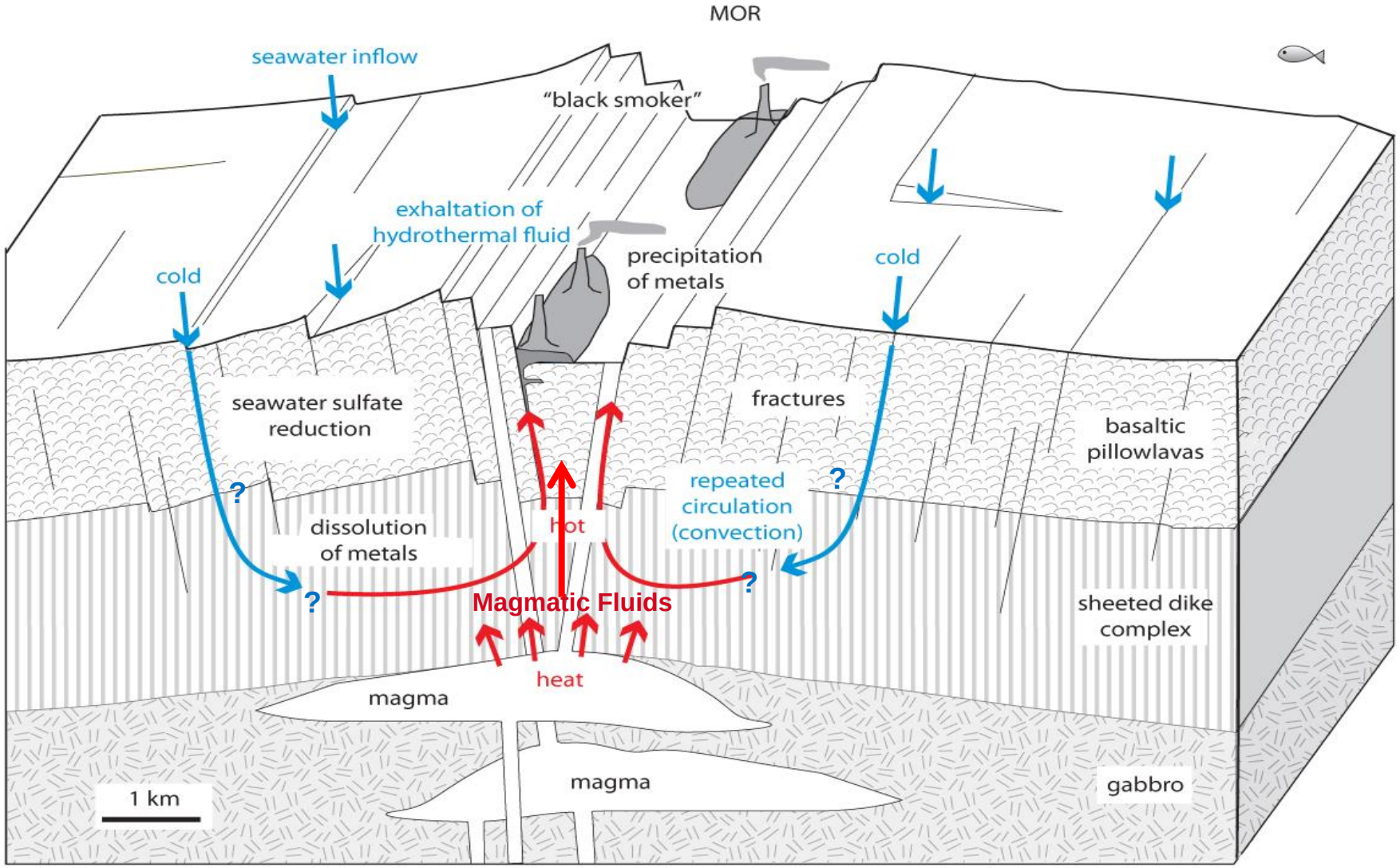


FIG. 8. Compositions of clinopyroxene phenocrysts in basaltic lavas. Fields encompass clinopyroxenes in modern tectonic settings, according to Beccaluva et al. (1989). Symbols: electron-microprobe analyses of lavas hosting VMS deposits in the Semail ophiolite (this study). Colors of symbols denote volcanostratigraphic classification (Table 6).

From Gilgen et al Econ Geol v109 2014

VMS Deposits : MORB Cyprus-Type genetic model



modified from L. Diamond

Outline for the two stage Genesis of Oman VMS deposits

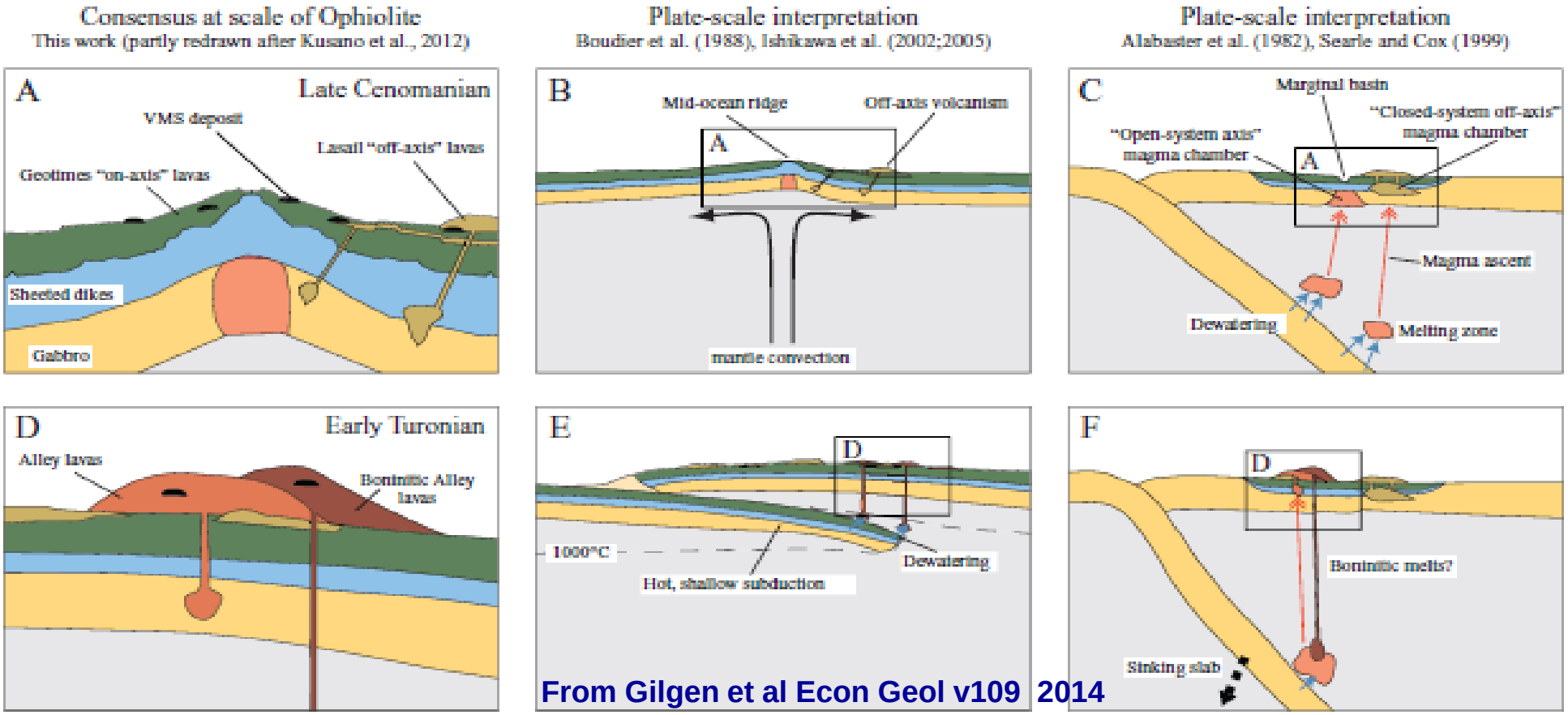
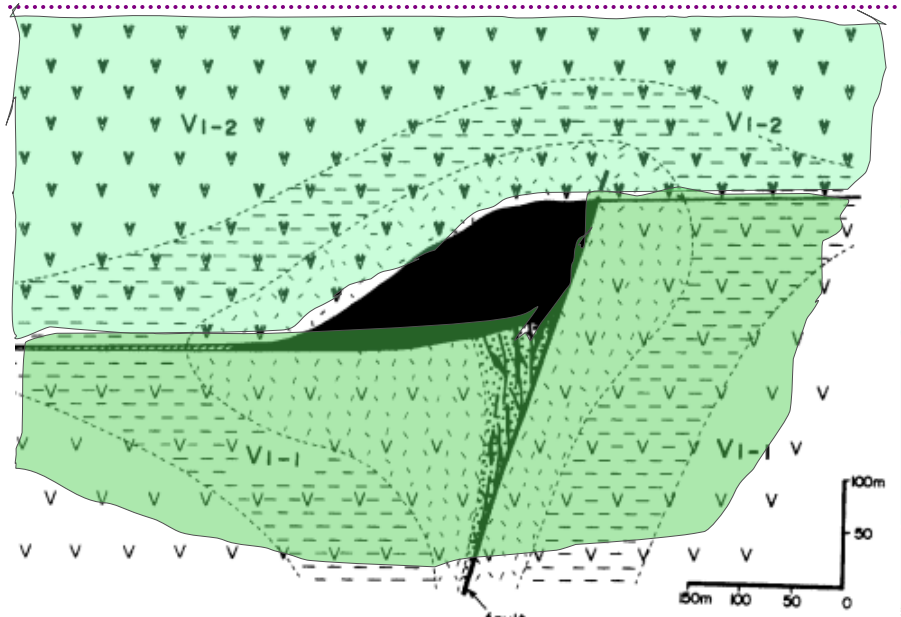


FIG. 10. Schematic plate tectonic context of the two major phases of hydrothermal activity leading to VMS deposits in the Semail ophiolite. A. The first phase of hydrothermal activity formed deposits (black mounds) within and on top of Geotimes lavas in an oceanic spreading setting. Two different plate-scale interpretations place this spreading in (B) a true mid-ocean ridge setting (e.g., Boudier et al., 1988; Ishikawa et al., 2002, 2005) or (C) a suprasubduction zone setting in a marginal basin (e.g., Alabaster et al., 1982; Searle and Cox, 1999). D. The second phase of hydrothermal activity formed deposits (black mounds) within the Alley and Boninitic-Alley units. The two different plate-scale interpretations suggest either (E) shallow, hot subduction near the former spreading ridge or (F) long-lived, steeper subduction. Figures based on Alabaster et al. (1982), Boudier et al. (1988), Ishikawa et al. (2005), and Kusano et al. (2012).

Oman Ophiolite – Typical VMS Deposit Styles



Cyprus- type half graben model

massive sulphide ore body

stockwork ore body

intense argillization and silicification

epidotization and slight silicification with pyritization

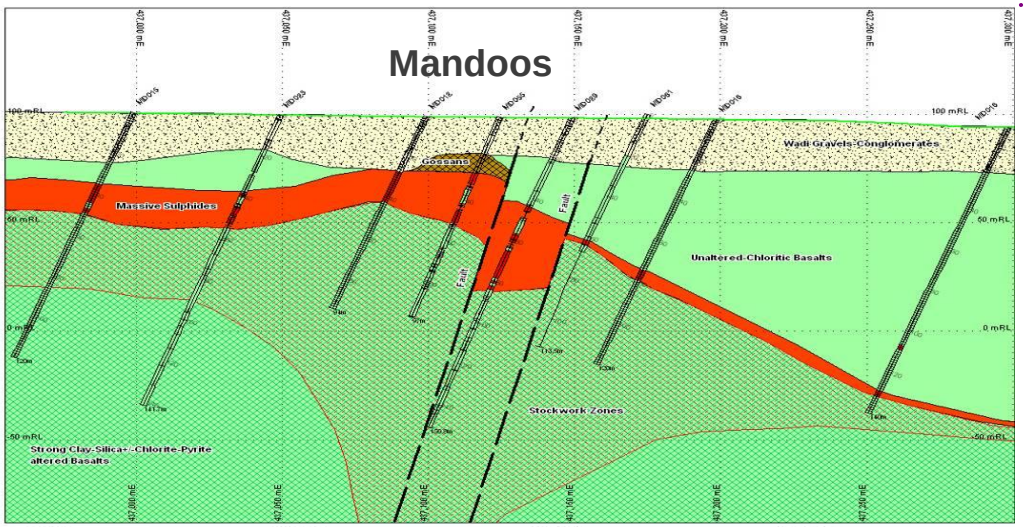
slight silicification with pyritization

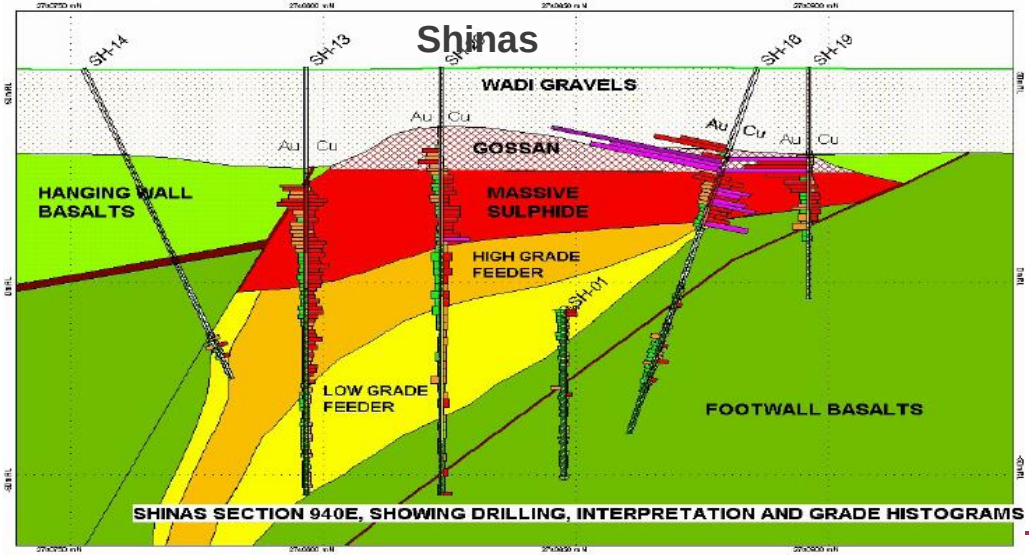
VI-2 upper basaltic pillow and massive lava

VI-1 lower basaltic pillow and massive lava

metalliferous sediments

After JICA





Hayl As Safil (footwall) Gossan and surrounding VMS deposits

Ruined Mining village in Sohar region

Oman Ophiolite – Exploration & Mining History

+6000 Years	VMS Copper deposits mined in Oman since the Bronze Age
1970s-1990s	Modern Multinational exploration discovered >44Mt of 1-2% Cu
1973-1979	Prospection Ltd (Can) explored Ophiolite Belt - discovered 6 deposits
1983-1994	Government-owned Oman Mining Company (OMCO) mined Lasail, Aarja and Bayda – built & still run Copper Smelter & Lasail Refinery
1996-2002	JICA (Japanese) regional exploration with >150 copper prospects: ➢ discovered Ghuzayn (14Mt), improved Feasibility of Yanqul (17Mt)
2000/2013	Mawarid Mining (NMC)–100% privately owned by Omani MB Pet Group ➢ *acquired Exploration Blocks 1, 2 and Ghuzayn* ➢ *found 5 outcropping VMS in <6mths - Shinas & Hatta (4x): 3.5Mt @ 2.5% Cu with a 3-4yr mine life – processing @ 1Mtpa ore at Lasail 20 km from port* ➢ *Open* pit mining commenced at Hatta in 2007– free cash US$60m in Yr1 ➢ *VTEM survey in 2009 - 5 new discoveries,3 being mined or under development*
2010-2013	Gentor Resources uses VTEM to discover 2 deposits Mahab - drilled resources Alara Resources upgrades Daris and Washishi - drilled resources
2014-2015	Savannah Resources takes over Gentor's projects and Block 4

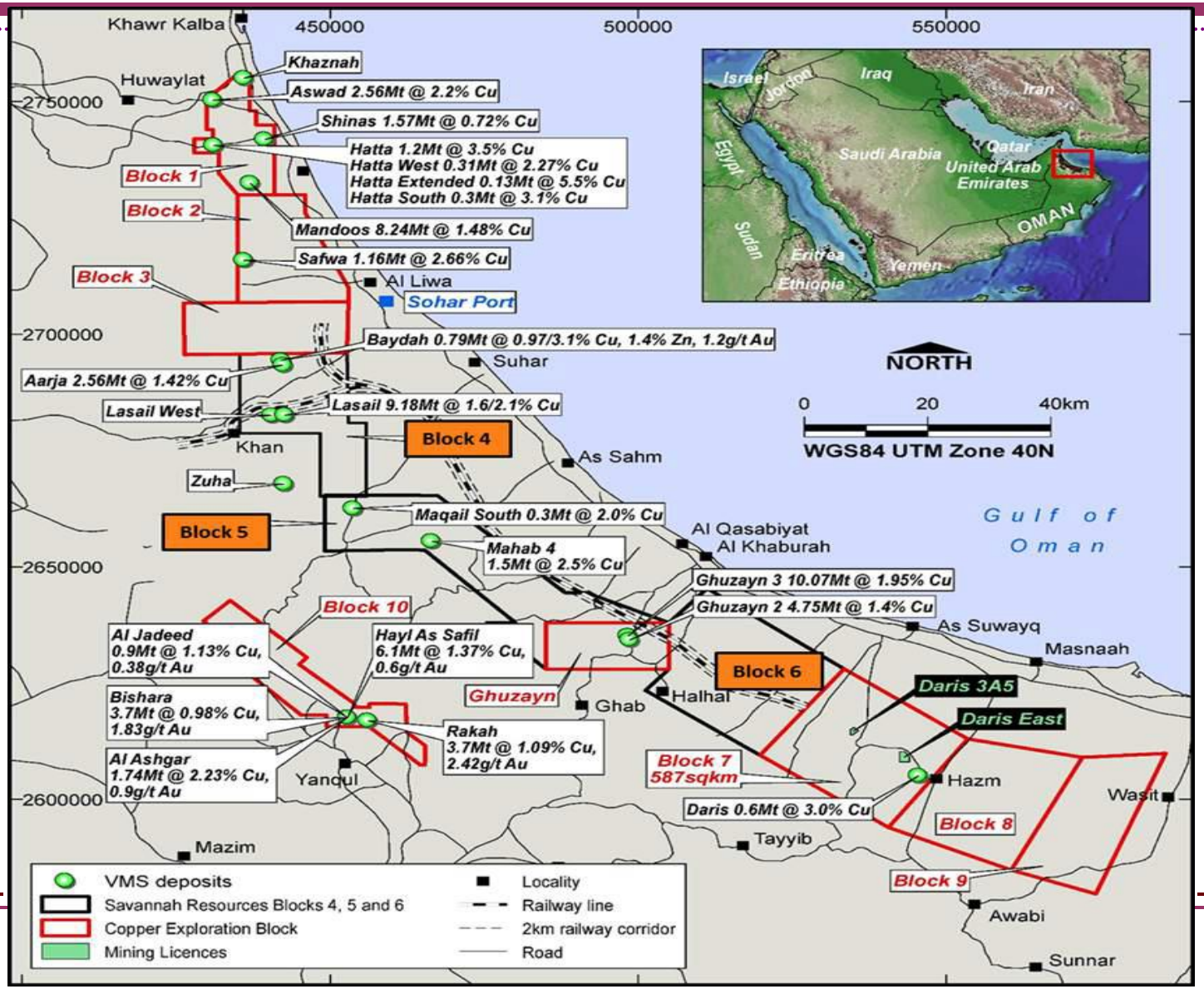
Copper Production in Oman at 2013

Oman Ophiolite VMS Deposits				
	Mined Out		Resources	
	Mt	*%*	*Mt*	*%*
OMCO				
Lasail	12.99	2.01		
Yanqul			16.20	1.90
Mawarid				
Shinas	3.57	1.16		
Hatta	1.94	3.38		
Safwa	**1.16**	**2.66**	1.16	2.66
Mandoos			8.24	1.48
Aswad			2.56	2.20
Khazah			0.35	1.00
Ghuzayn			20.52	1.81
Gentor				
Mahab 4			1.50	2.50
Maqail S			0.30	2.00
Allara **Washishi**			6.89	0.90
Darius			0.60	3.00
Total	18.50	1.99	**57.13**	**1.60**
Grand Total	**69.93**	**1.88**		

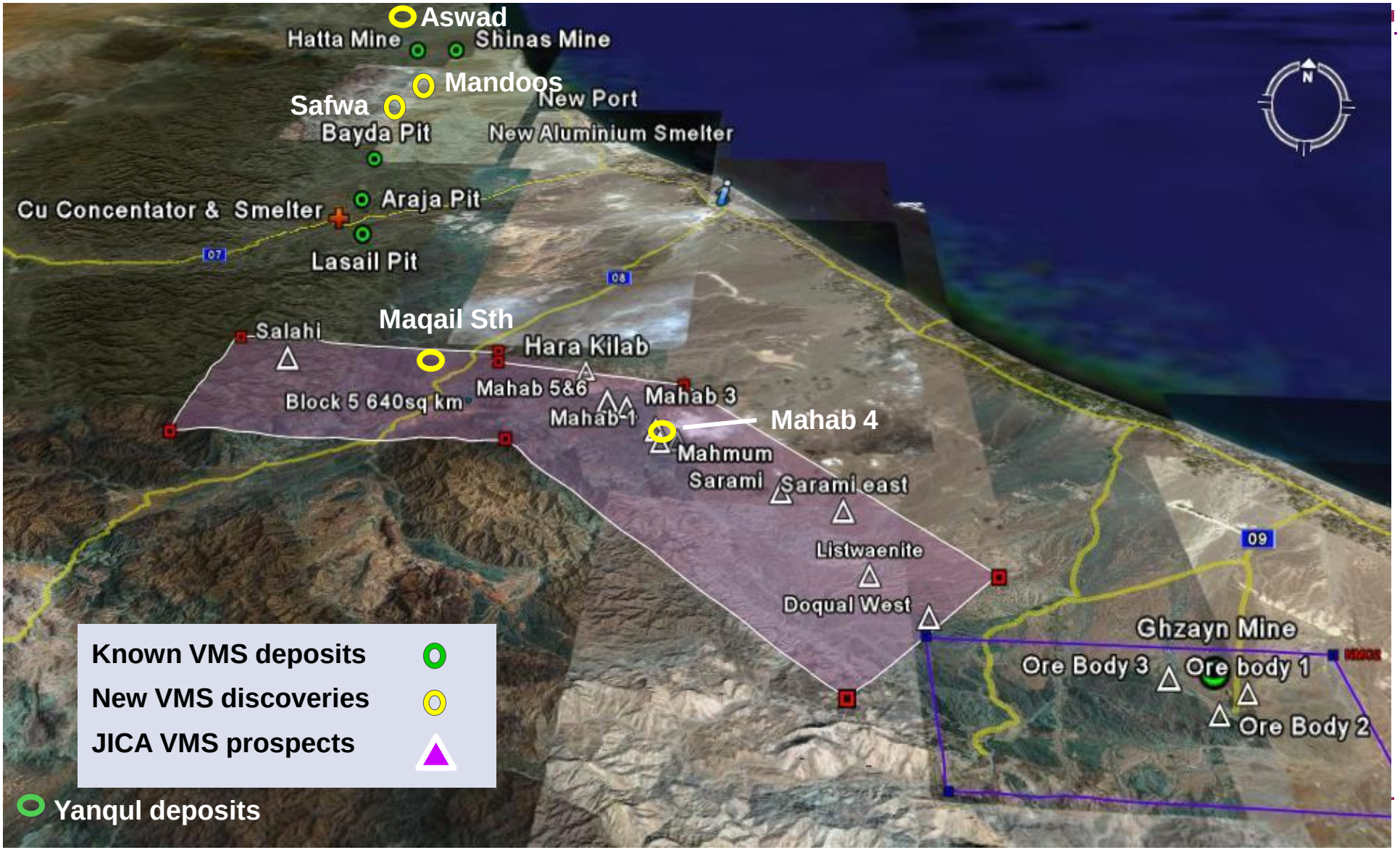
- 3,000- 4,000BC – Mesopotamian Era Production from Magan – unknown size
- 1000-1700 AD – Islamic and Portuguese mining in Sohar district - production unknown
- 1983-1994 – **OMCO Mines** and Cu Smelter - **Lasail district deposits**
- **1994-2003 Low copper price stymied production**
- 2007- 2015 – **Mawarid / NMC** open pit mining of **Shinas, Hatta, Safwa, Mandoos**; UG development of **Ghuzayn, Aswad** ?
- **2016– Yanqul copper development by Mawarid** ?
- **Near Future – Mahab 4, Maqail S, Washishi**
- **New Deposits at depth under cover**

Current Oman Exploration Blocks and VMS deposits

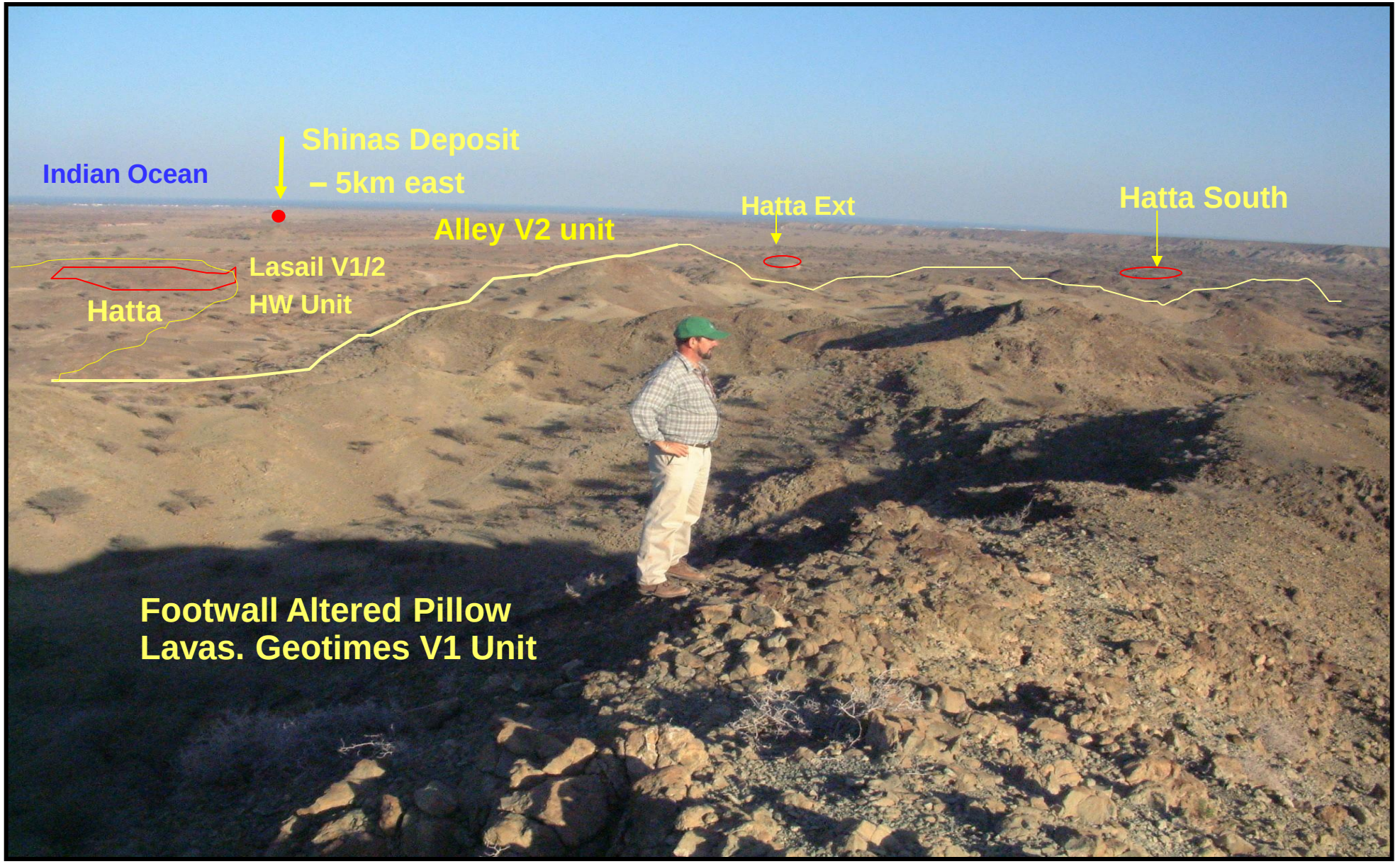
- from Savannah Resources 2015



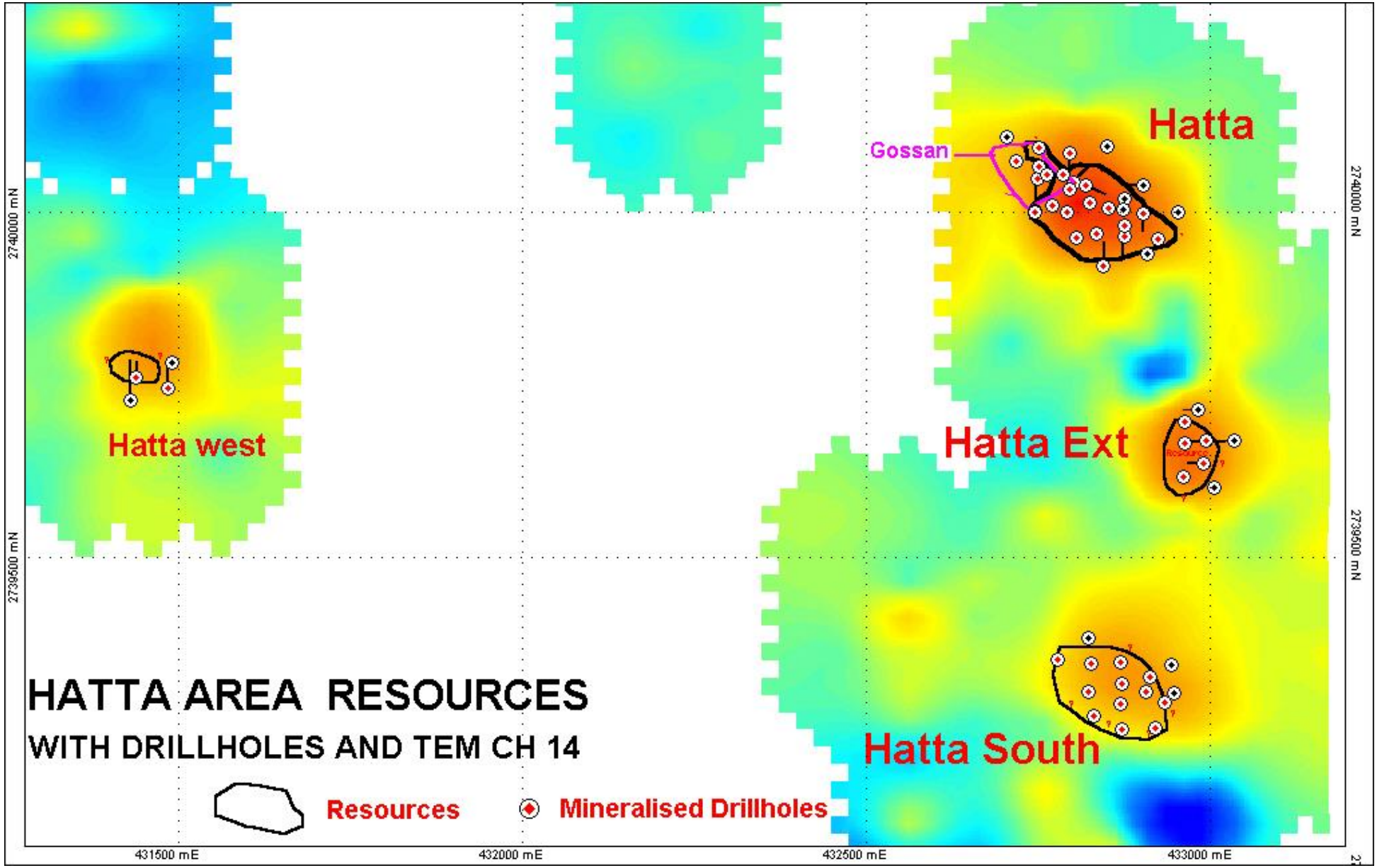
Sohar Region VMS Deposits & JICA Targets



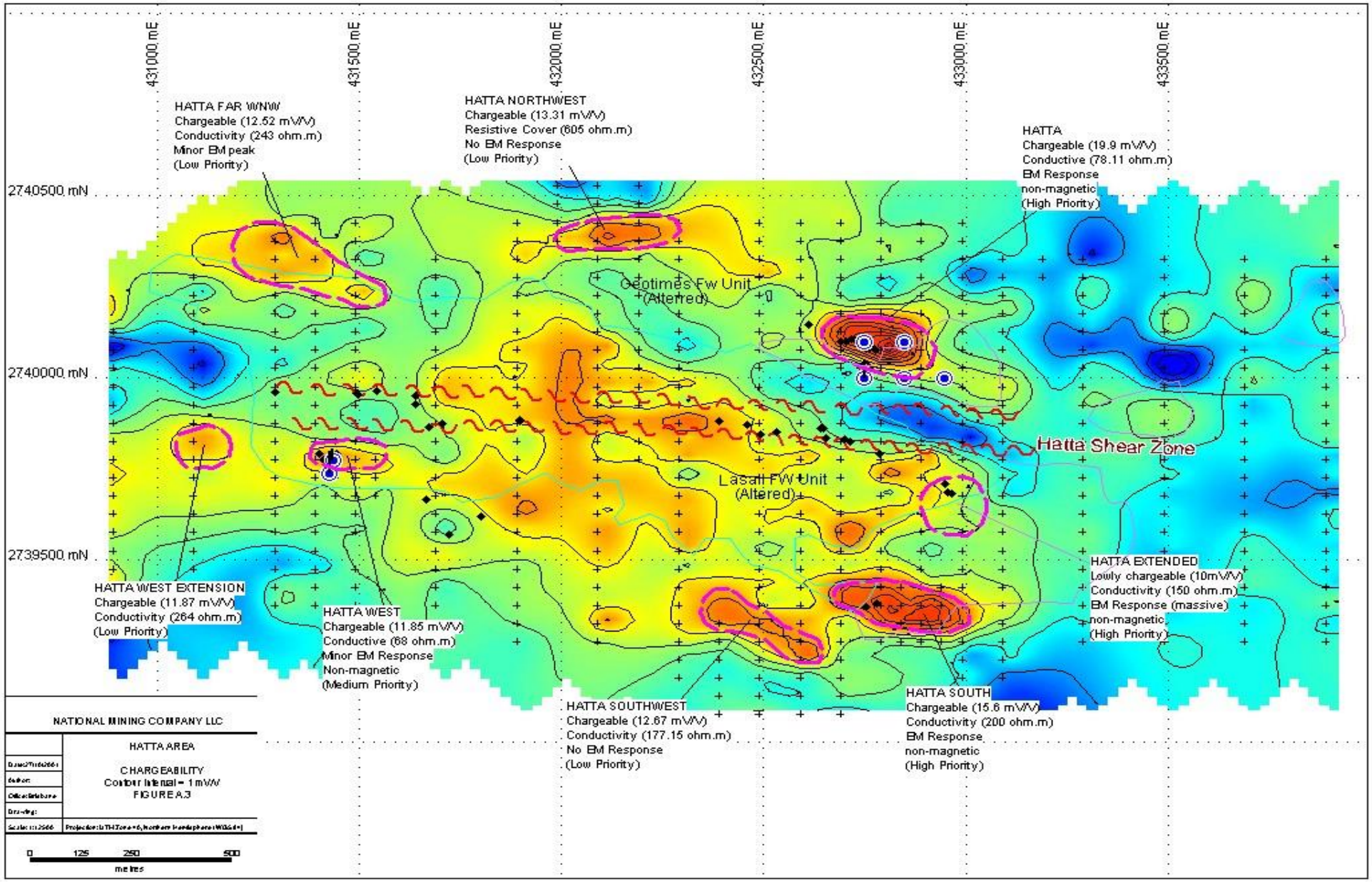
Shinas and Hatta Area Deposit Locations



Hatta TEM coverage over gossans



Hatta area GA IP anomalism over gossans and footwall zone



Hatta Gossan - 80m long in Wadi wall

Hatta MS Gossan Discovery day June 2000

Hatta gossan with incorporated BRGM exhalite - 2003

Hatta Mine Pit in 2011 two years after completion

Hatta Massive sulphide – Chalcopyrite rich mound breccia chimney fragments

Typical V2 Alley Unit Outcrop in Wadi Hatta near Shinas.

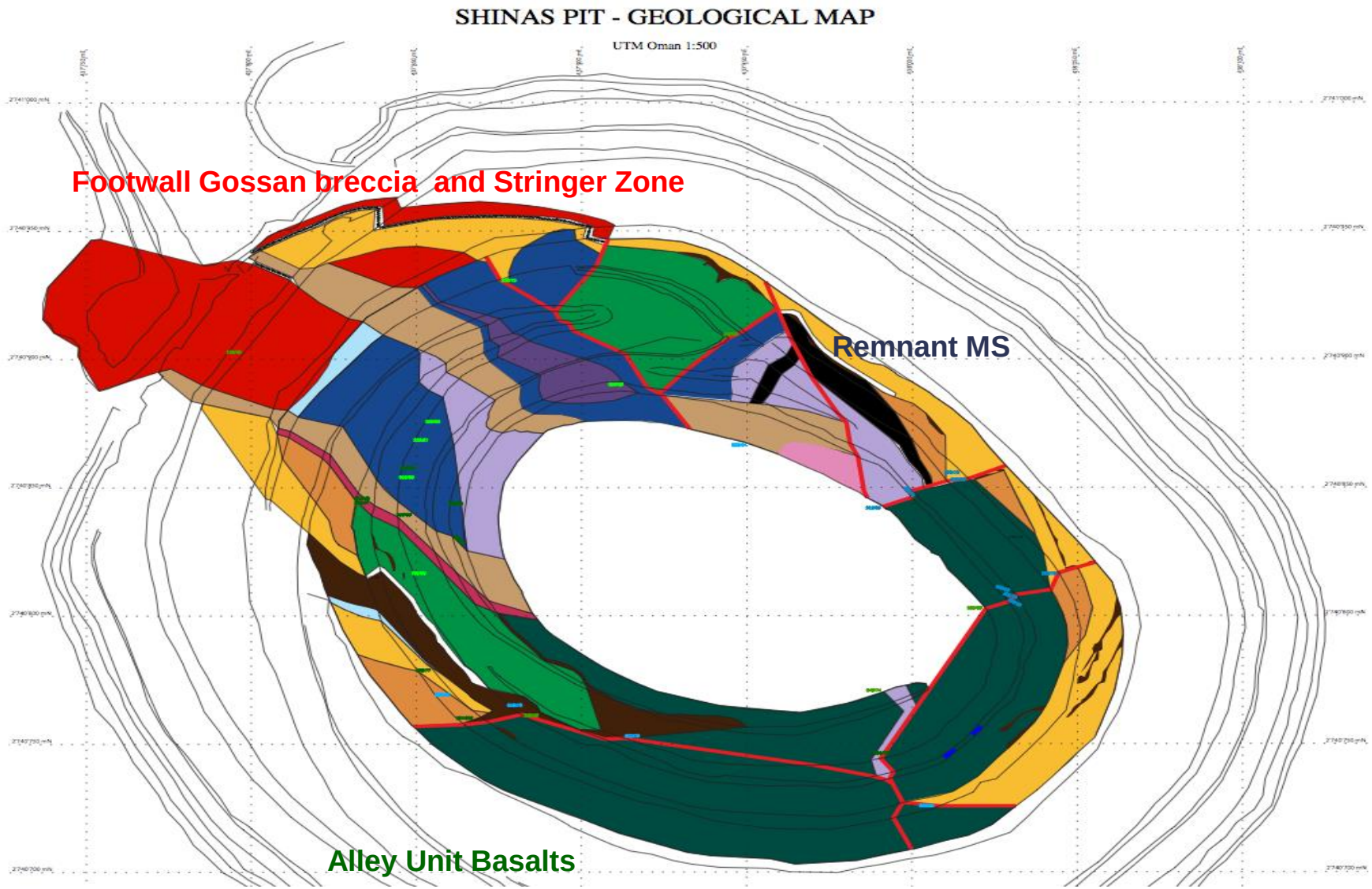
Unaltered well developed vesicular pillow lavas at base and columnar jointed lava flow above dipping 25deg east.

This unit contains the Shinas deposit one km to the north.

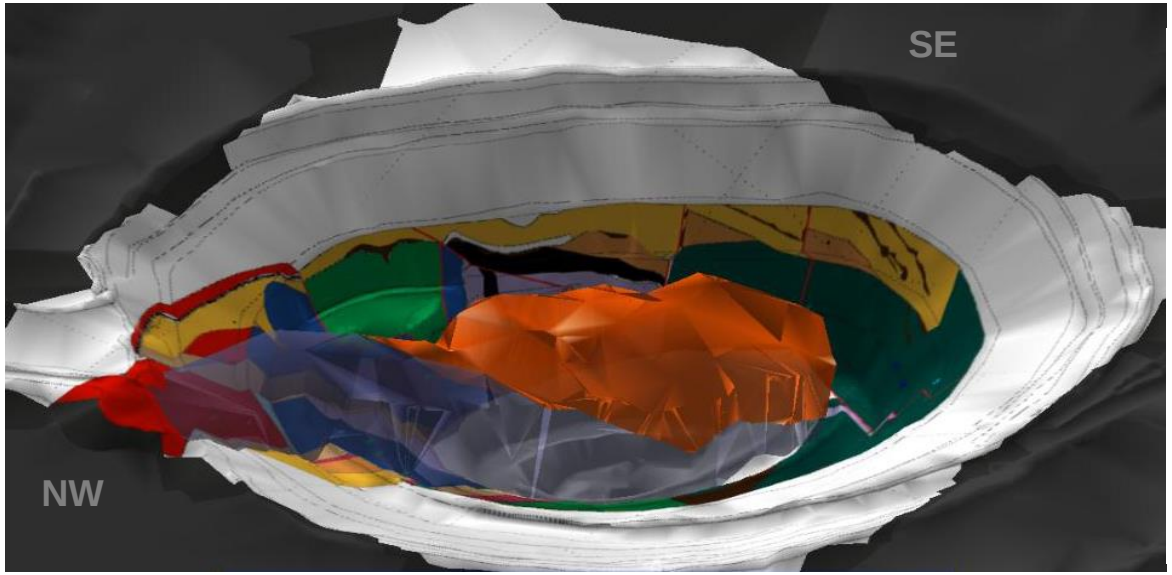
Shinas Deposit FW Gossan - Early Drilling 2001

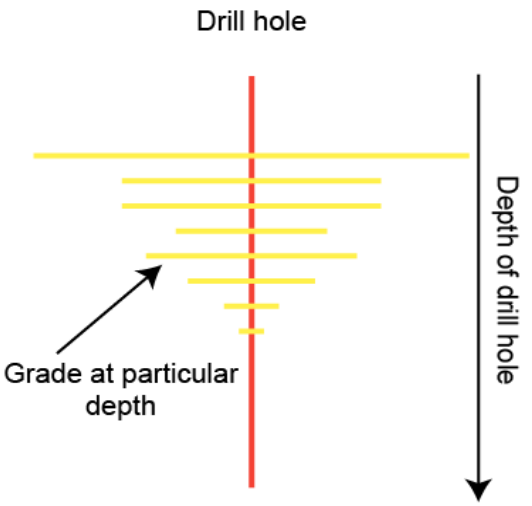
Mawarid Mining's Shinas open pit in 2012

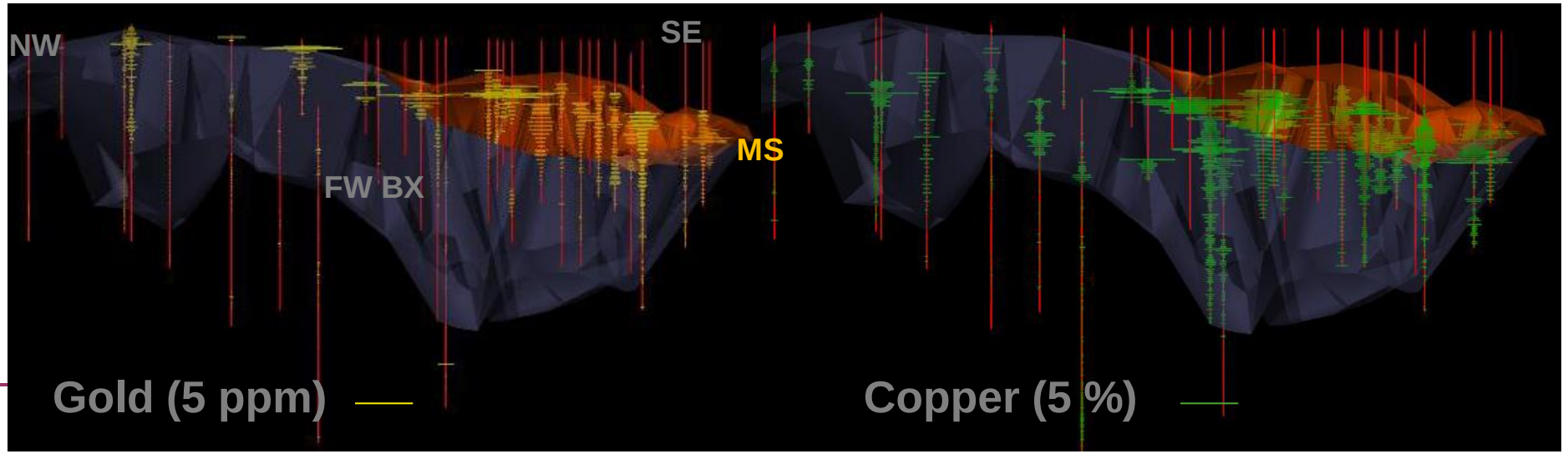
Shinas VMS deposit - Pit Geology 2012



Gold distribution in selected deposits : Shinas

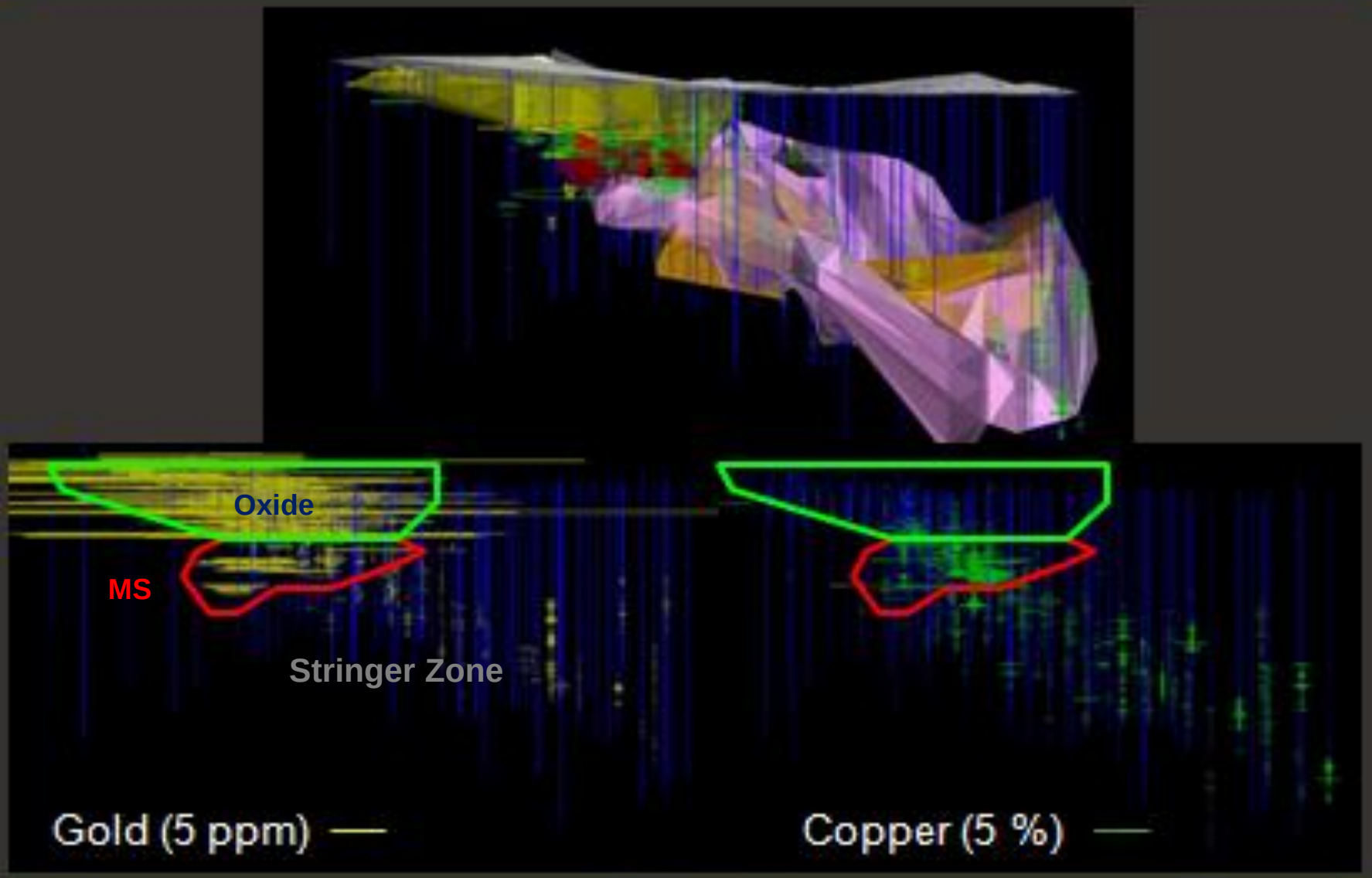






From Gilgen 2011

Gold distribution in selected deposits: Rakah



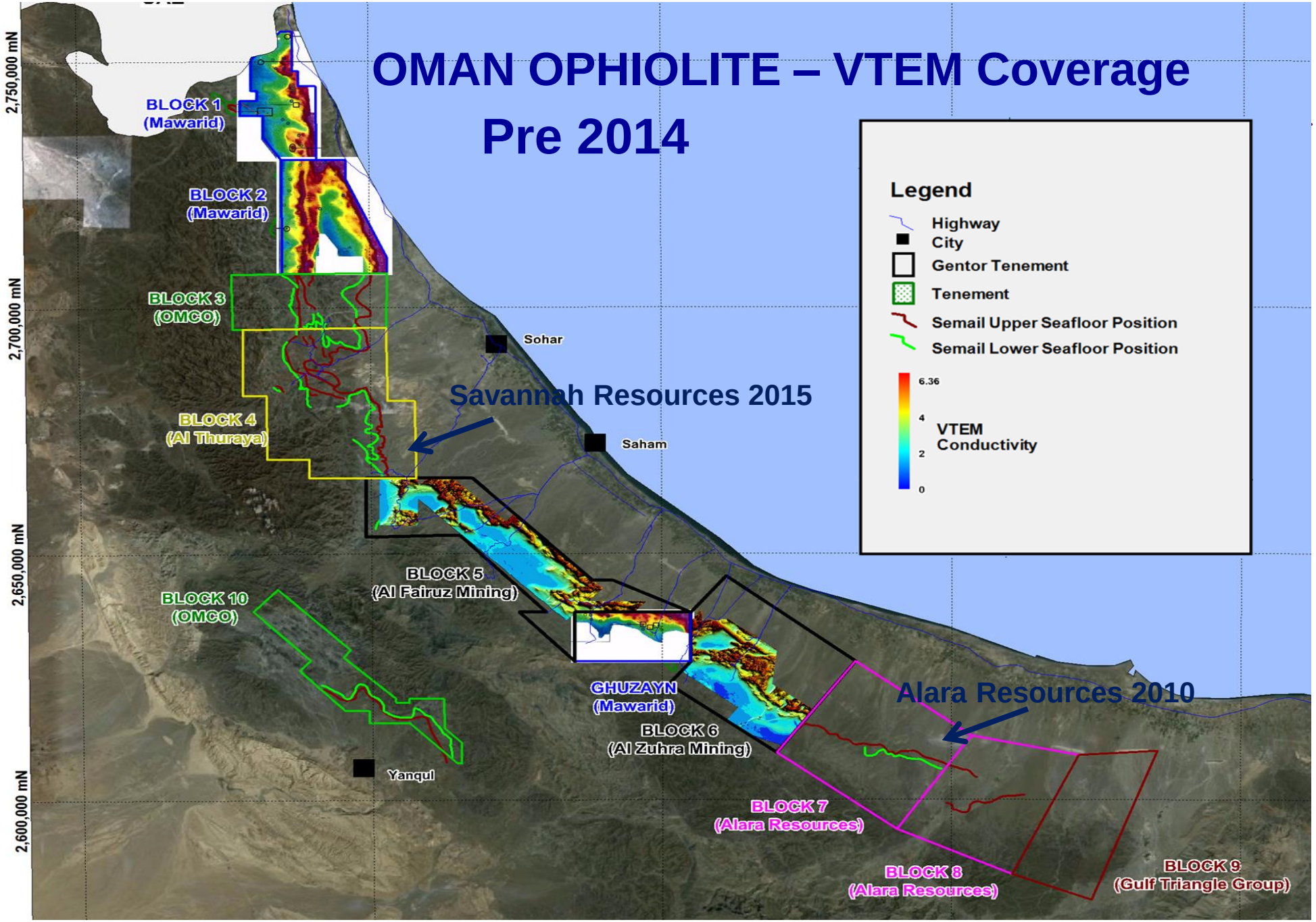
Mawarid Mining excavating Safwa open pit 2010

Gentor Resources – Oman Strategic Summary

- **Targeting open pittable, low cost, copper/gold operations**

- **Cyprus type VMS deposits represent a low geological risk**
  - Clusters of numerous 1Mt -15Mt deposits typical
  - Opportunity for accelerated discovery and development
  - Initial assets – 2 copper blocks in the producing Sohar region
  - Excellent exposure and geological maps

- **Operating targets - highly profitable with low embedded costs**
  - Open cut resources with low waste: ore ratios sought
  - **Metallurgically simple ores** – marketable copper concentrate produced
  - Low personnel, power & fuel costs, rapid development potential
- **Excellent infrastructure, attractive fiscal terms, safe environment**
  - Close to port, roads, power & water
  - 5 year tax holiday, then 12% corporate tax, 5% royalty
  - **Relatively benign Government approvals process**


OMAN OPHIOLITE – VTEM Coverage
Pre 2014
Legend
Highway
City
Gentor Tenement
Tenement
Semail Upper Seafloor Position
Semail Lower Seafloor Position
6.36
4
2
0
VTEM
Conductivity
2,750,000 mN
2,700,000 mN
2,650,000 mN
2,600,000 mN
BLOCK 1
(Mawarid)
BLOCK 2
(Mawarid)
BLOCK 3
(OMCO)
BLOCK 4
(Al Thuraya)
BLOCK 5
(Al Fairuz Mining)
BLOCK 6
(Al Zuhra Mining)
BLOCK 7
(Alara Resources)
BLOCK 8
(Alara Resources)
BLOCK 9
(Gulf Triangle Group)
BLOCK 10
(OMCO)
GHUZAYN
(Mawarid)
Sohar
Saham
Yanqul
Savannah Resources 2015
Alara Resources 2010

Geophysical signatures of Mandoos and Safwa Deposits

from Mawarid Mining

1. Geophysical Survey (VTEM and Magnetic)

At both Mandoos and Safwa the EM signatures directly indicate the presence of Massive Sulphide. Magnetic data were used as well to interpret possible structures and zone of alteration both of which from zone of low magnetization (figure 10 and figure 11).

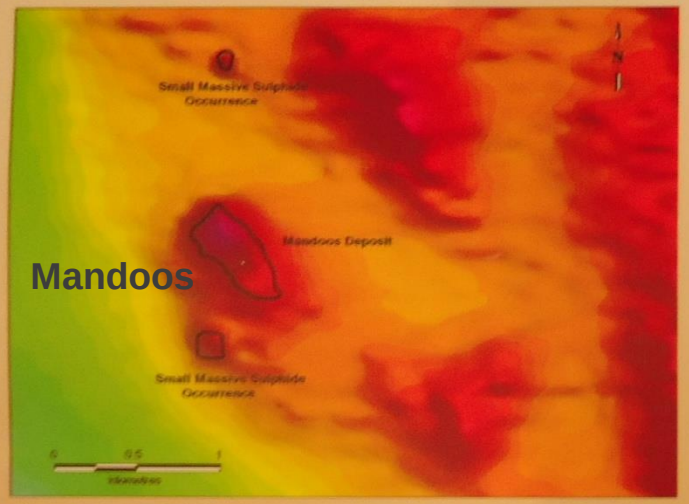


***Fig. 8** - Mandoos on conductivity channel 25*

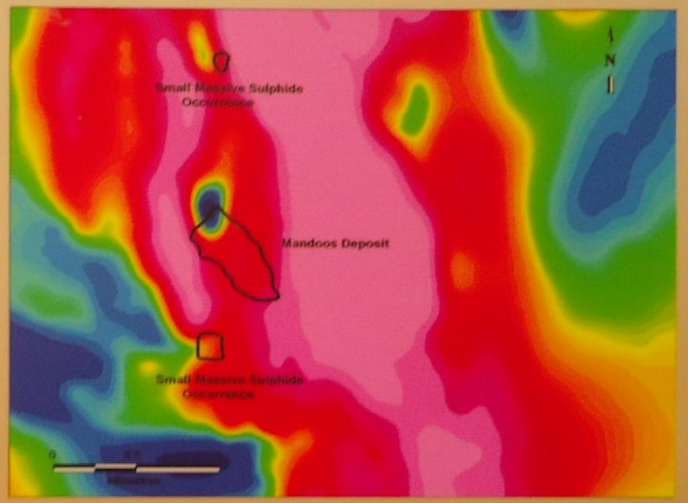
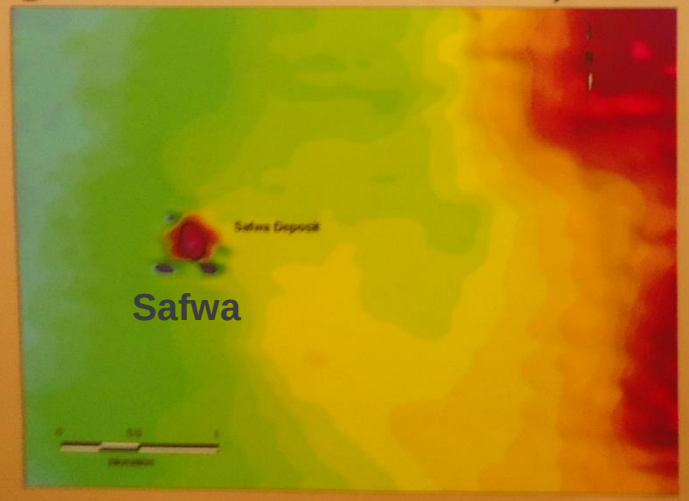
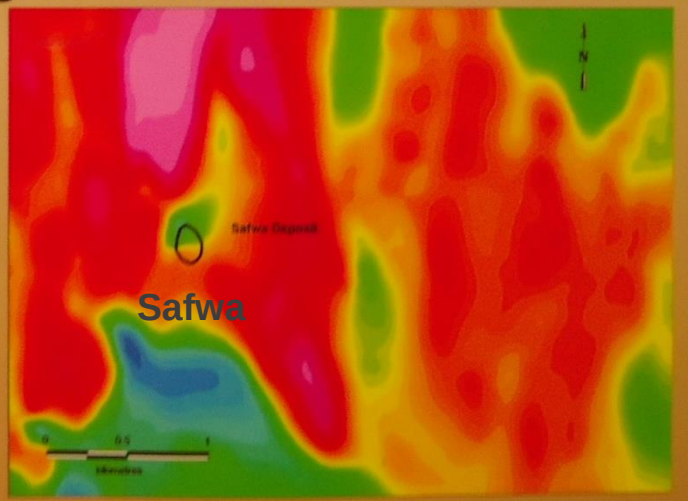
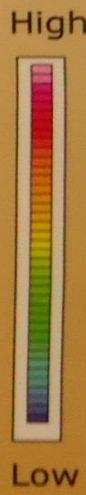


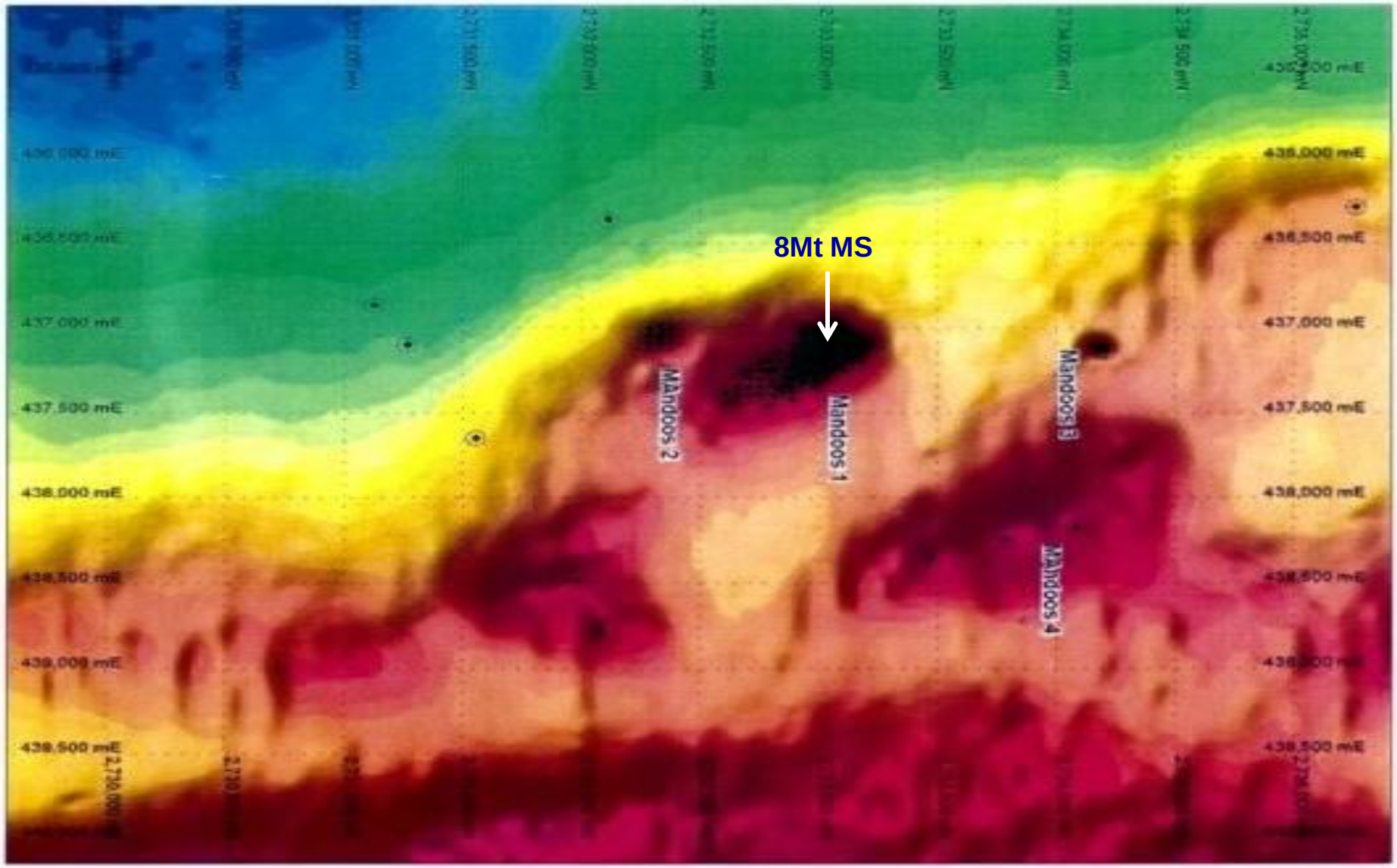
***Fig. 10** - Mandoos on Reduced to Pole TMI*







Mawarid Mining VTEM data Ch 25 showing Mandoos deposits under Wadi cover within Alley Unit

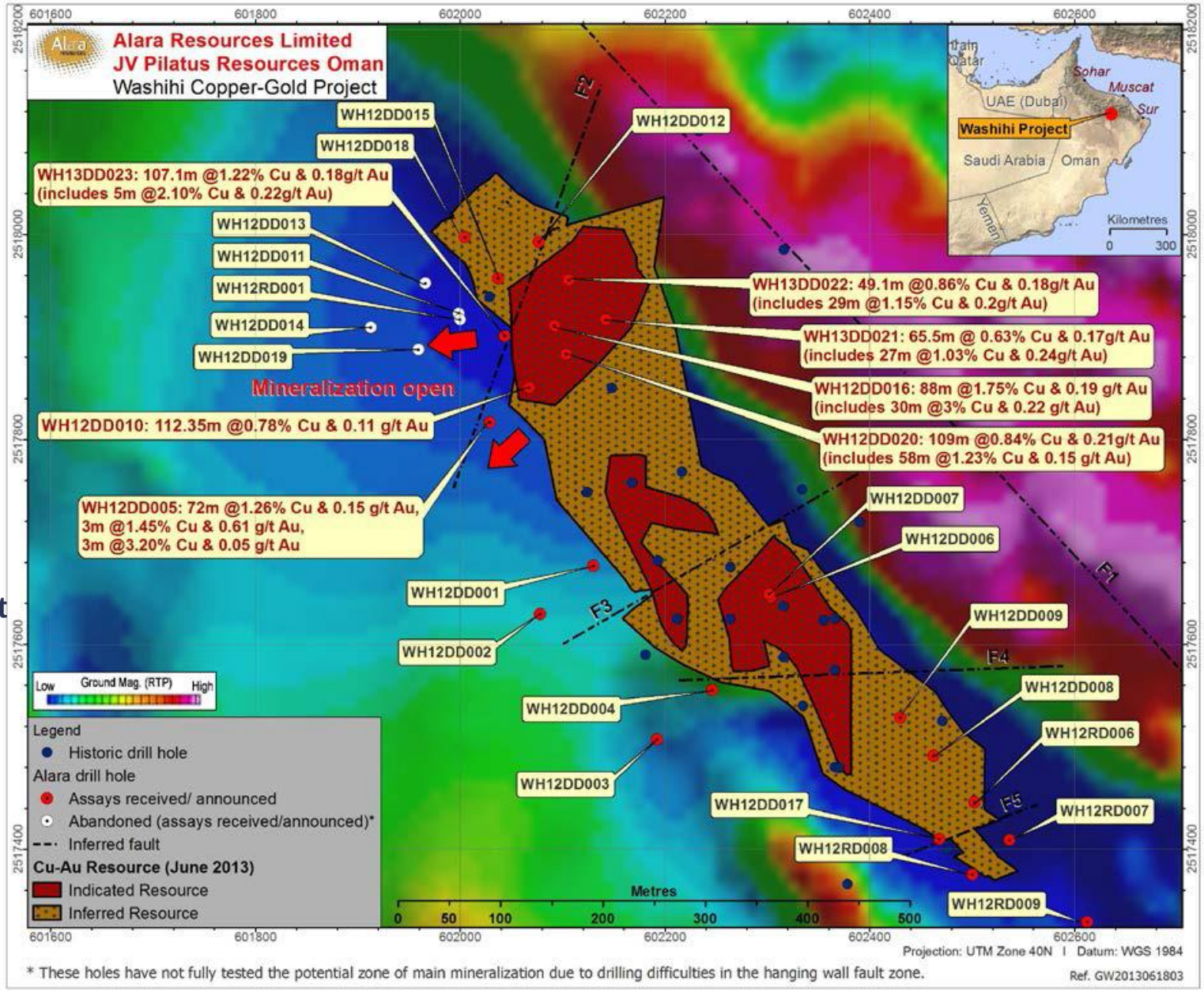


Washishi Resource outline on magnetic base
from Alara Resources

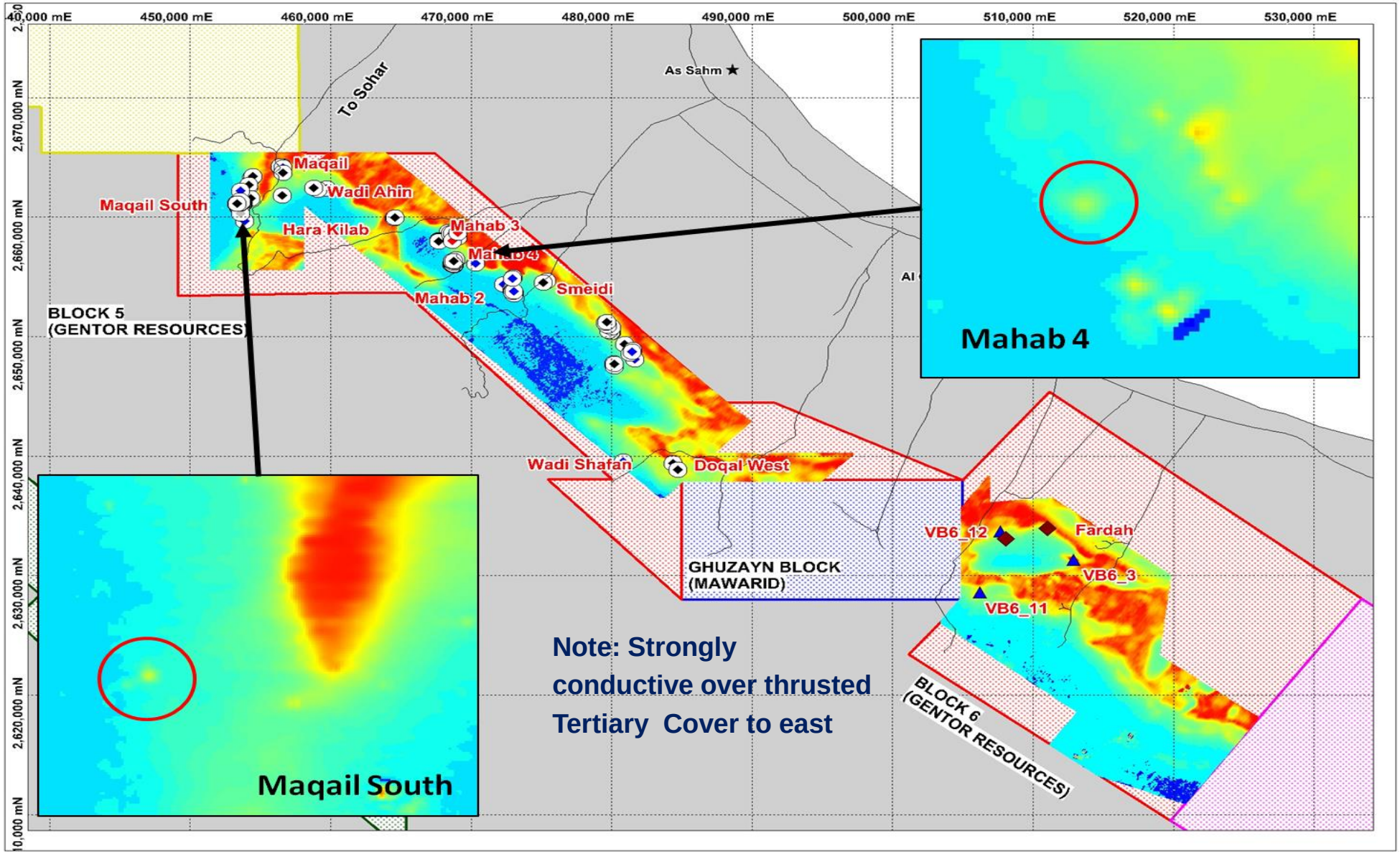
In 2013 Drilling upgraded the deposit to JORC Mineral Resource status:

- 6.84Mt Indicated at 0.90% Cu and 0.17g/t Au
- 7.27Mt Inferred at 0.71% Cu and 0.20g/t Au
- At 0.25% Cu cut off

- ❑ Feasibility underway
- ❑ Heavy media ore separation then trucking of sulphide to Sohar plant
- ❑ Development partners sought - Mawarid deal likely

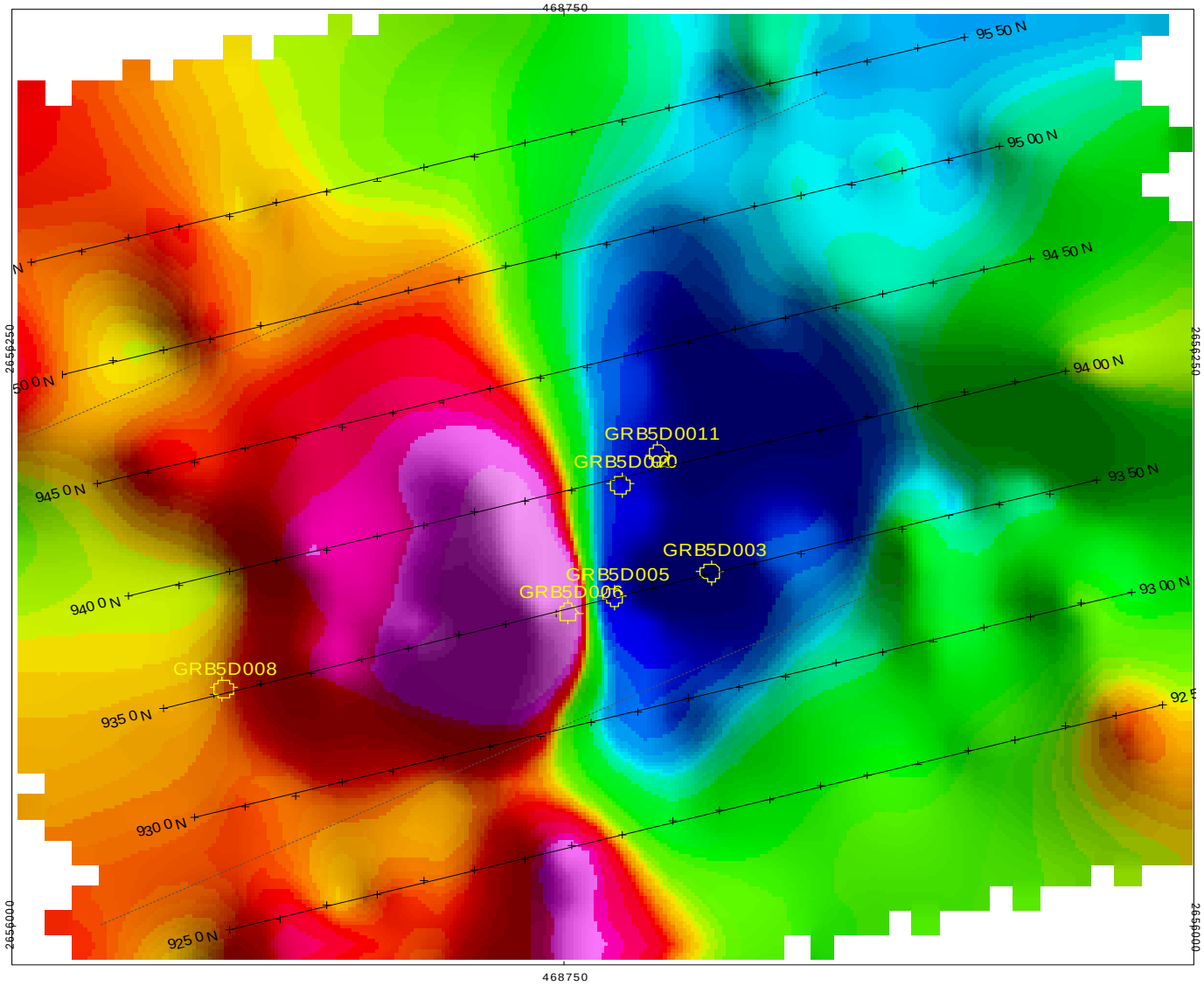


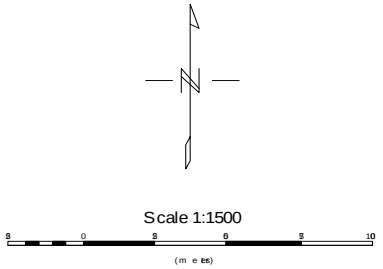
Gentor Resources Block 5/6 Heli-borne VTEM Survey



Mahab 4 Deposit Discovery Site

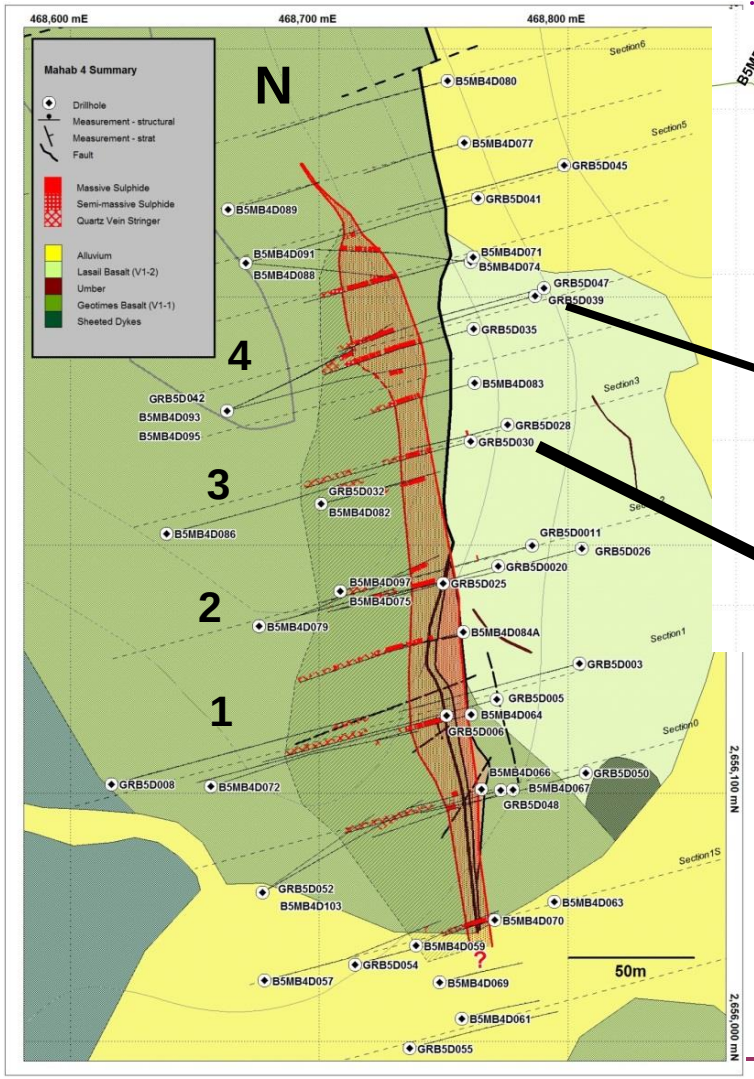
Mahab 4 – TEM Gridded Z channel 10

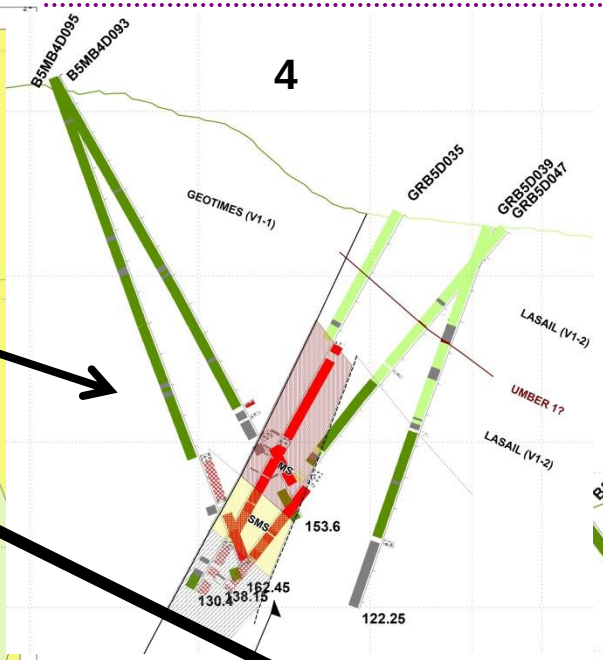


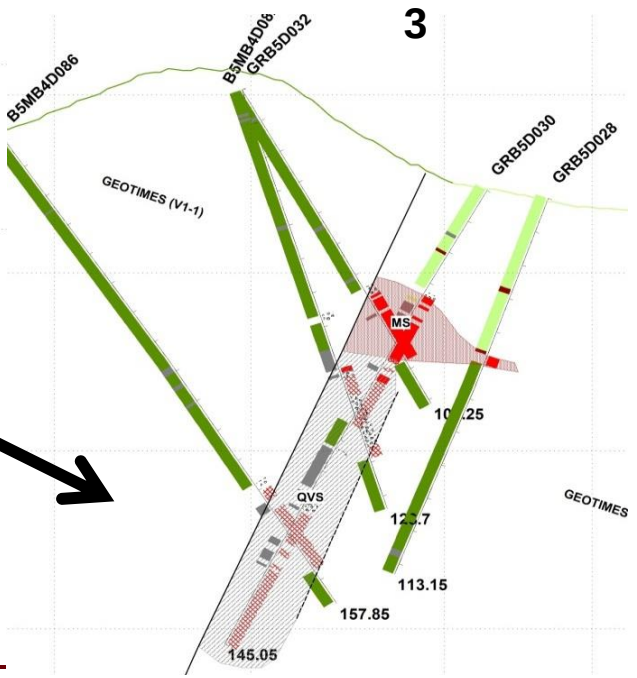


Gentor Resources Oman
Protem TEM57 Survey **Mahab 4** **Gridded Channel Z10**
GRS

Mahab 4 – Geology Plan & Cross Sections







Resource of 1.5 Mt drilled out on 25m-50m spaced sections.

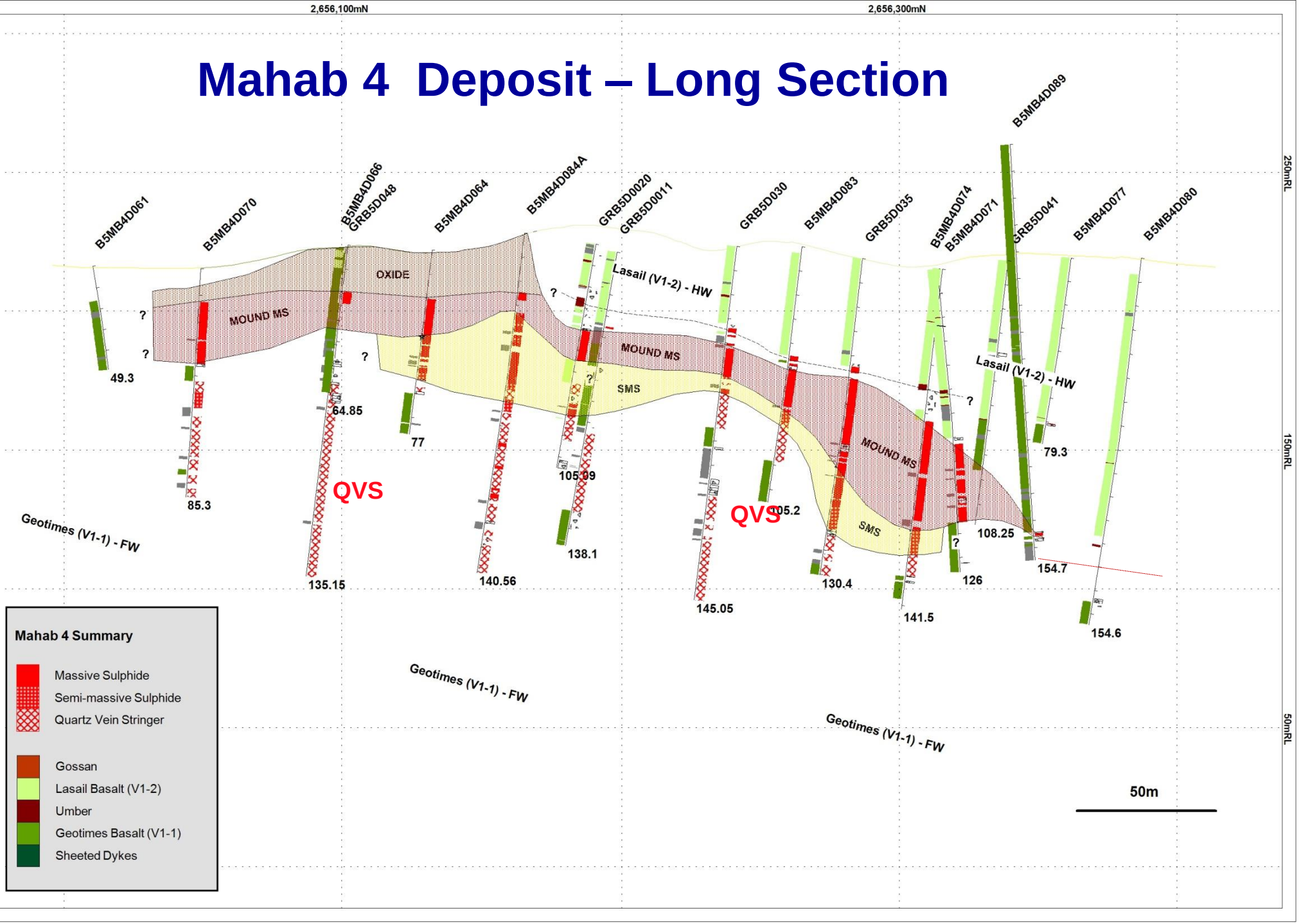
At open pittable depth (20-100m).

Total of 50 core holes for 6,123m

330m long massive sulphide body

10-50 m thick MS wedge +QVS below

Mahab 4 Deposit – Long Section



Mahab 4 - High Grade Massive Sulphide Results

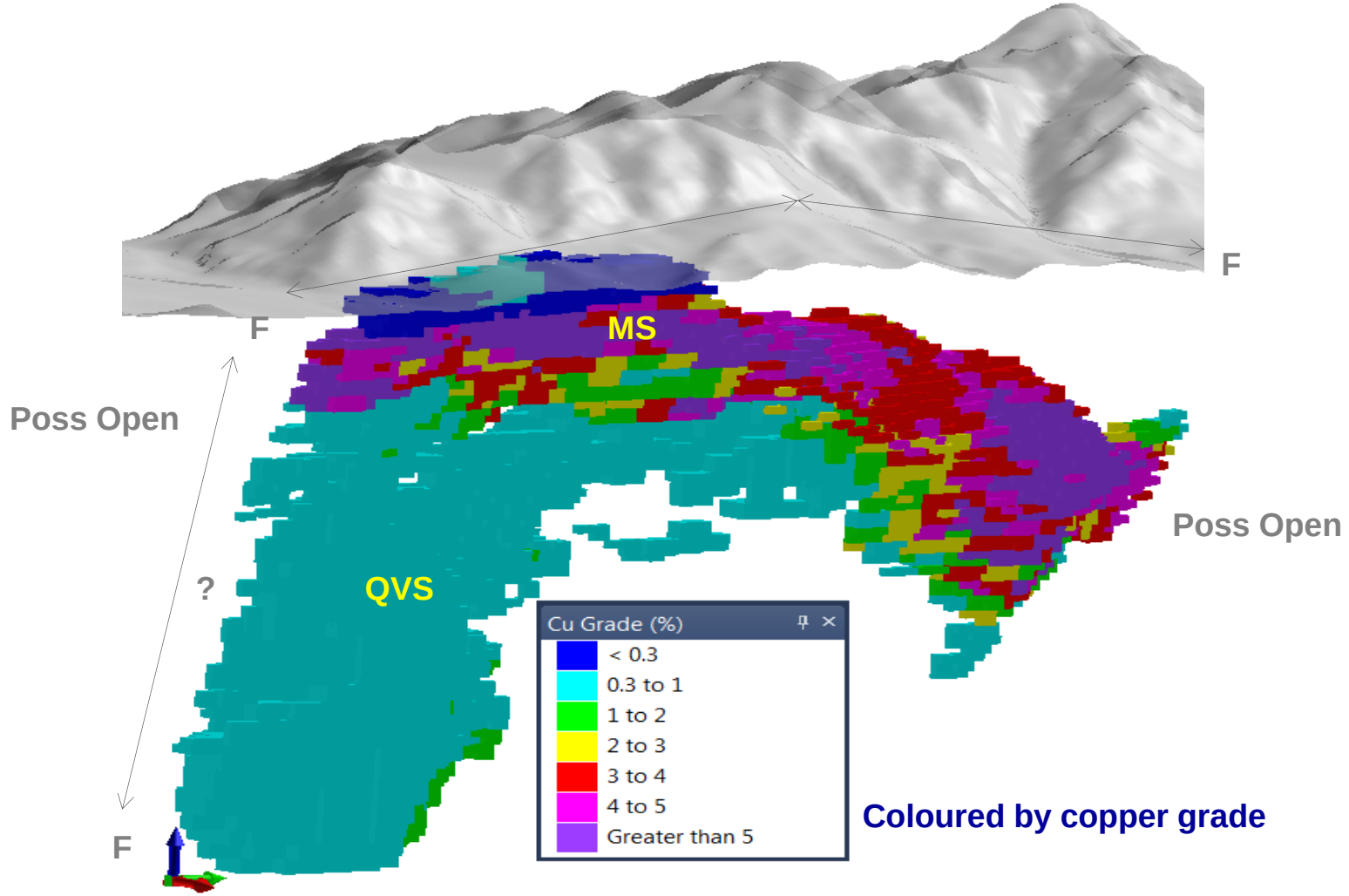
Mahab 4 Drill Results Summary (to January 2012)

Hole No.	*From*	*To*	*Mineralisation*	*Intercept*	*Copper*	*Gold*	*Zinc*	*Silver*
Mahab 4	m	m		m	%	g\t	%	g/t
GRB5D020	40.15	55.55	**MS**	15.40	7.40	0.17	0.91	7.90
GRB5D030	32.05	63.00	**MS + SMS + QVS**	30.95	3.16	0.28	1.29	17.40
GRB5D032	67.15	87.45	**Jasper + MS**	20.30	5.79	0.37	2.42	22.00
GRB5D035	44.42	98.61	**MS + SMS + QVS**	54.19	4.97	0.19	0.85	9.60
B5MB4D059	33.50	43.69	**MS**	10.19	6.69	0.48	3.20	20.00
B5MB4D064	13.50	53.00	**GOS/MS/SMS**	39.50	4.81	0.25	0.38	16.70
B5MB4D070	12.42	36.46	**MS**	24.04	6.32	0.49	1.10	24.2
B5MB4D071	63.15	120.00	**MS + SMS**	56.85	6.21	0.22	0.90	10.4
B5MB4D074	70.35	105.44	**MS**	35.09	4.82	0.38	17.70	0.85
B5MB4D083	45,15	88.44	**MS + SMS + QVS**	43.29	3.62	0.24	0.90	11.8

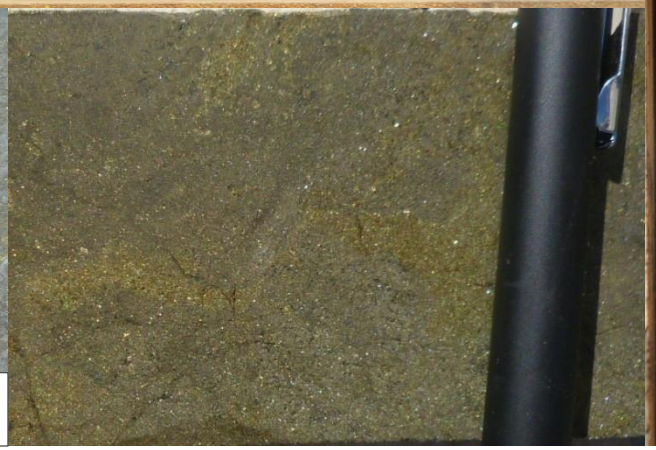
Codes (Umber = Fe sediment, Jasper, MS = Massive Sulphide, SMS = Semi-massive Sulphide, QVS = Quartz Vein Stringer, GOS = Gossan)

Oblique view of the Mahab 4 block model Resource

- strike extensions may be open across faults at depth



Coloured by copper grade

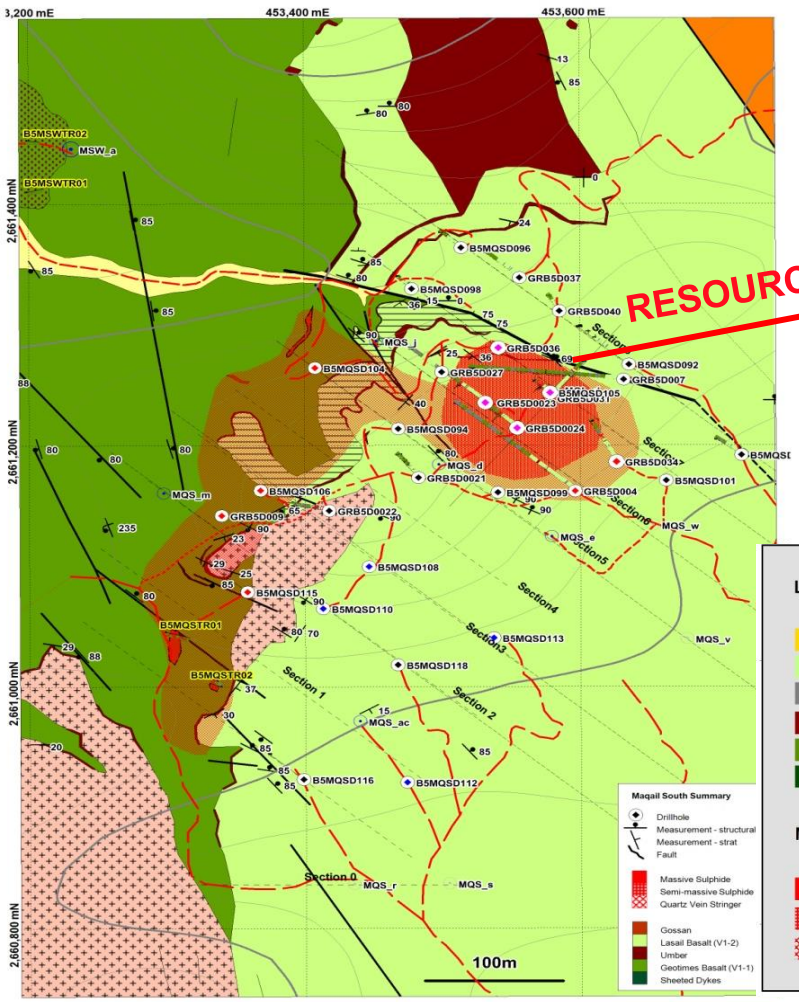


Mahab 4 MS

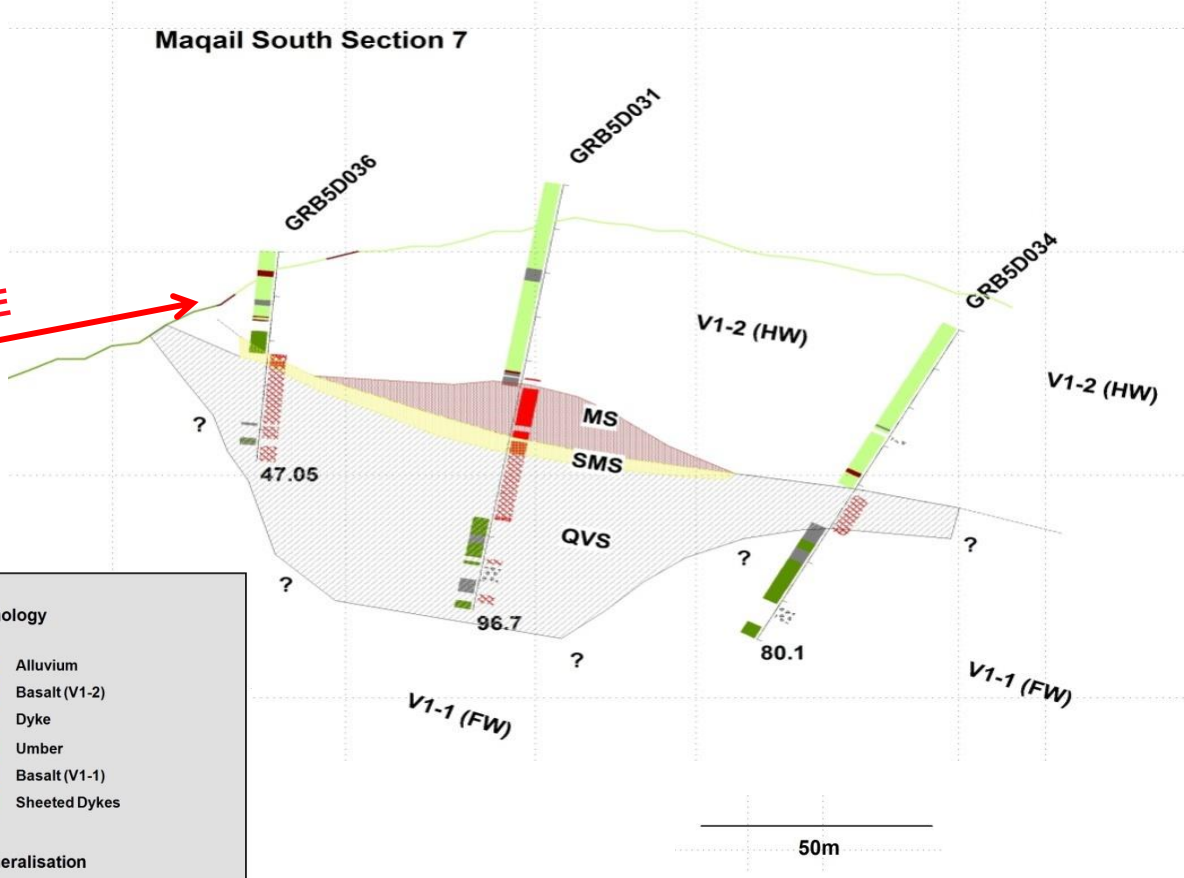
Mahab village 500m away is a development issue

Alturnate prospect discovery technique – using a magician

Maqail South – Geology & Cross Section



RESOURCE



Lithology

- Alluvium
- Basalt (V1-2)
- Dyke
- Umber
- Basalt (V1-1)
- Sheeted Dykes

Mineralisation

- Massive Sulphide
- Semi-massive Sulphide
- Quartz Vein Stringer

Maqail South Prospect

Maqail South Drill Results Summary (to December 2011)

Hole No.	From	To	Mineralisation	Intercept	Copper	Gold	Zinc	Silver
Maqail South	m	m		m	%	g\t	%	g/t
GRB5D0023	68.02	74.27	**MS**	6.25	3.30	0.16	0.02	2.69
GRB5D0024	63.71	70.39	**MS**	6.68	7.42	0.29	0.03	4.95
GRB5D031	43.86	57.46	**MS**	13.60	3.22	0.08	0.02	0.76

Codes (MS = Massive Sulphide, SMS = Semi-Massive Sulphide, QVS = Quartz Vein Stringer)

Gentor's Oman Resources

Gentor commissioned H&SC to make an independent resource estimation its Oman deposits in April 2012 and they assigned estimated resources at Mahab 4 and Maqail South to the Inferred and Indicated Resource categories as tabulated below, in accordance with NI 43-101 guidelines.

Oxide Resources at Mahab 4 at a gold cut-off of 0.3 g/t

		Tonnage (kt)	Density (t/m3)	Cu (%)	Au (g/t)	Ag (g/t)	Pb (%)	Zn (%)
Total	Inferred	28	2.4	0.2	1.0	11.5	0.03	0.04

- **Sulphide Resources at Mahab 4 and Maqail South at a copper cut-off of 0.3%**

Deposit	Tonnage (kt) Sulphides		Density (t/m^3))	Cu (%)	Au (g/t)	Ag (g/t)	Pb (%)	Zn (%)
Mahab 4	Indicated	916	3.5	2.8	0.2	8.5	0.080	0.54
Mahab 4	Inferred	590	3.3	0.9	0.1	2.5	0.012	0.14
Maqail South	Inferred	160	3.6	3.8	0.1	2.4	0.002	0.02
Total	Indicated	916	3.5	2.8	0.2	8.5	0.080	0.54
Total	Inferred	750	3.3	1.5	0.1	2.5	0.010	0.12

OMAN VMS – KEY EXPLORATION CRITERIA: 1

- **Seafloor control to VMS**: Identify key seafloor positions –primarily the Geotimes -Lasail position but also other stratigraphically higher positions (i.e. Lasail-Alley position (Mandoos, Aarja) and intra-Alley Unit positions (Shinas, Rakah)

- **Structural control**: Identify key syn-seafloor growth structures.

- **Heat sources**: Identify areas likely to have hosted enhanced hydrothermal systems –underlying trondhjemites and discrete volcanic centres.

- **Surface expression**: gossan, slag & footwall silica-chlorite-ep-hem alteration.

- **Geochemical anomalism** in grab samples: **Cu**, Zn**, Au** and Ag.

- **Geophysical anomalism**:
  1. Massive sulphide strong conductors identified by VTEM/ground TEM.
  2. Disseminated and stringer sulphide mainly in footwall zones is IP chargeable.
  3. Hydrothermal alteration creates magnetic lows mainly in footwall halos.

OMAN VMS – KEY EXPLORATION CRITERIA: GOLD

- Oman VMS deposits vary widely in their gold content with MORB –type deposits such as Ghuzayn commonly having low gold content
- Increasing "subduction input" in more evolved Alley lavas correlates with higher gold grades in VMS, this might be related to primary seafloor refining or sub-seafloor boiling processes but source enrichment is also a factor
- The Shinas and Yanqul deposits show similarities with the gold-bearing VMS deposits of the Cu-Au-Zn-Ag-(Pb) association (Huston 2000). Primary gold grade determines overall gold grade
- Shinas shows gold enrichment on the roof of the massive sulfide body, which could be primary or secondary, whereas feeder zones typically have low gold
- Secondary enrichment at the weathering interface appears critical in order to make gold-bearing deposits have gold-rich gossans

VMS EXPLORATION - USEFUL TARGETING TOOLS

- **Excellent regional geology maps** result from high outcrop exposure in this arid mountainous terrain, thus **detailed prospect mapping** is an important tool.
- Knowledge of **volcanic centres and units** in the host stratigraphy helps focus on specific target horizons and **key structures** controlling MS deposits.
- **Good GIS maps** with multi source data can highlight target prospectivity.
- **Rock analysis** of metalliferous seds can define prospective seafloor positions.
- **Airborne magnetics** is useful to correlate volcanic stratigraphy under cover and define blind magnetite depletion zones caused by hydrothermal alteration.
- **Heliborne VTEM** is a key regional tool for direct–shallow VMS discovery.
- **TEM and IP** are necessary for in depth evaluation of prospective sequences.
- **Downhole surveys** are important for defining near miss MS zones
- **Landsat** with Spot technology can define broad footwall alteration systems.
- **Hyperspectral** mineral mapping at visible to thermal infrared wavelengths may help refine alteration mapping and deposit targeting.

Limitations to current technology and Oman expertise

- Most past exploration has focussed on gossan exposures and developing open pit mines. **Since 1995 most discoveries were found by geophysics**.
- **VTEM appears to only see deposits down to 150m in resistive terrain** and possibly much less when there is conductive cover or thick wadi gravels.
- **No deposits have been found that start below 200m depth**, but neither has sufficient drilling or TEM been made to test underground mining targets.
- Discovery of new blind deposits at depth and under shallow cover can be aided by finding synvolcanic growth faults in hydrothermal upflow zones.
- **Multiple seafloor positions inc V2 units contain significant ore deposits**, prior to 2000 only the Lower pillow lavas (V1) were considered prospective.
- **Much of the Upper Volcanics including Alley units lie under conductive Tertiary–Recent sedimentary cover and remain relatively untested**.

Gentor's VMS expertise was moved to Turkey in 2012

This was a direct result of Gentor's inability to finalise deals on larger development properties in the region and Omani Government restrictions on tenement approvals ahead of a new Mining Act .

The Turkey Story

is for next time!

Thank you.