

Industry Spotlight on the Western Tethyan

***NOTE: The following presentation is an update
of a similar presentation given by the author
at the SEG 2016 Annual Conference***

Source: <https://minexconsulting.com/overview-of-exploration-in-the-tethyan/>

Richard Schodde

Managing Director, MinEx Consulting

Adjunct Professor, Centre for Exploration Targeting , UWA

5th Annual Tethyan Belt Session, PDAC 2021

9th March 2021, Zoom Webinar

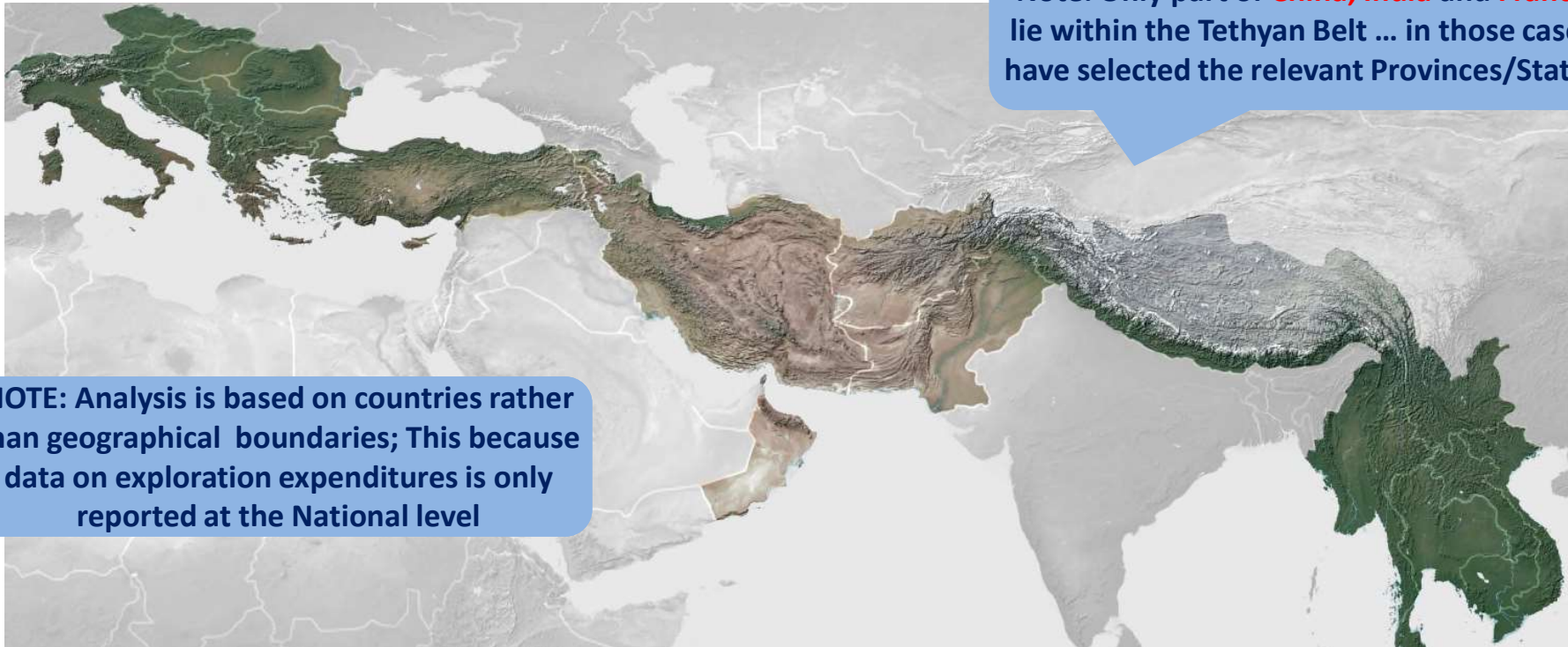
Overview

1. Countries covered in the analysis
2. Trends in exploration spend
3. Number of discoveries made – *How many were found and what metal?*
4. Location of deposits – *Where were they found?*
5. Mineral endowment – *How “fertile” is the Belt?*
6. Location of discoveries made in last 50 years
7. Trends in unit discovery costs – *\$/oz costs are rising over time*
8. Time Delays and conversion rates for discoveries – *not all discoveries turn into mines, and of those that do, it can take several decades to happen*
9. Conclusions

The Tethyan Belt spans across 33 countries across 2 continents

1. COUNTRIES COVERED IN THE ANALYSIS

The Tethyan Belt spans across 33 countries



Note: Only part of **China**, **India** and **France** lie within the Tethyan Belt ... in those cases have selected the relevant Provinces/States

NOTE: Analysis is based on countries rather than geographical boundaries; This because data on exploration expenditures is only reported at the National level

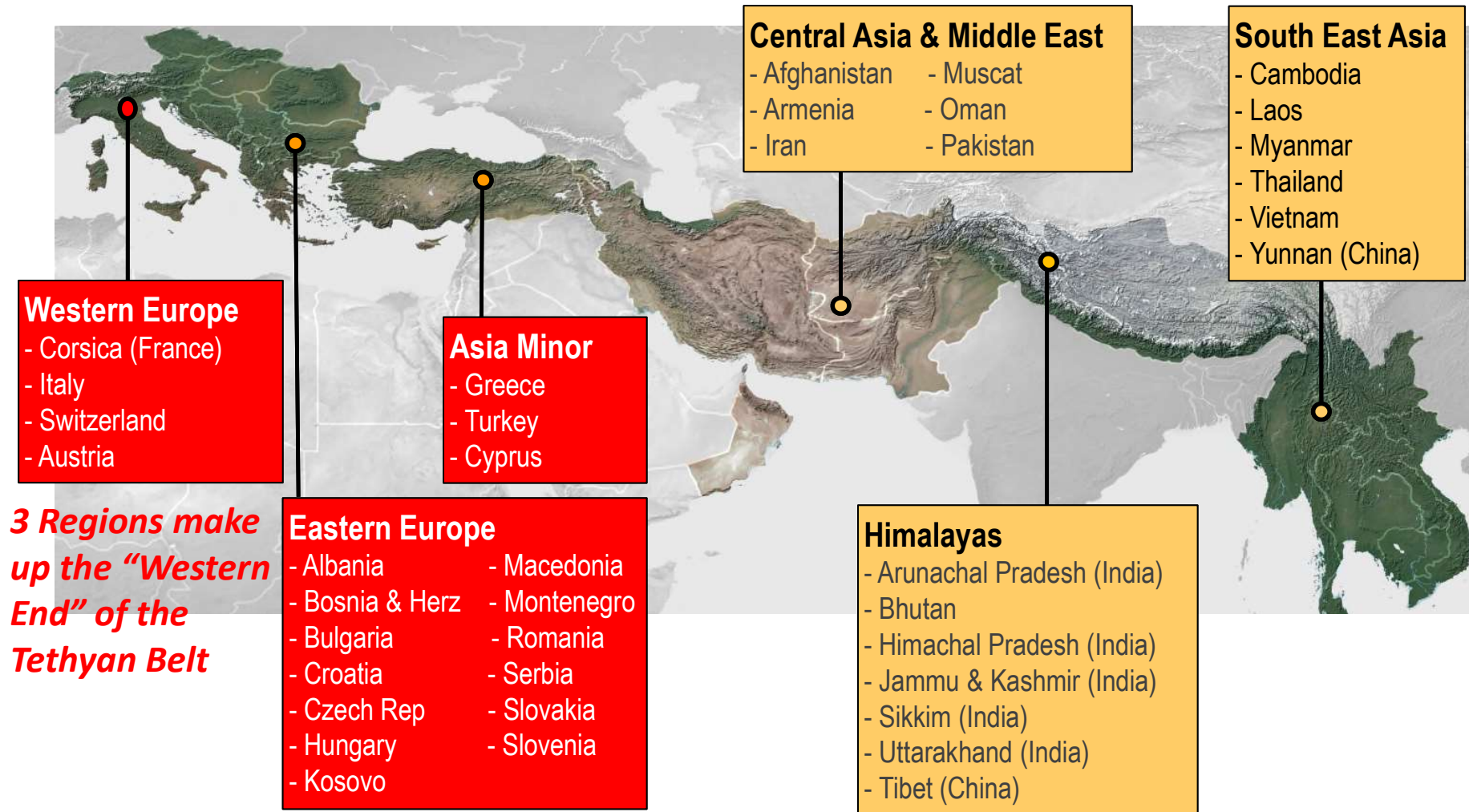
Includes ...

China: Provinces of Tibet and Yunnan

India: States of Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh

France: Corsica

The 33 countries were then consolidated into 6 regions along the belt

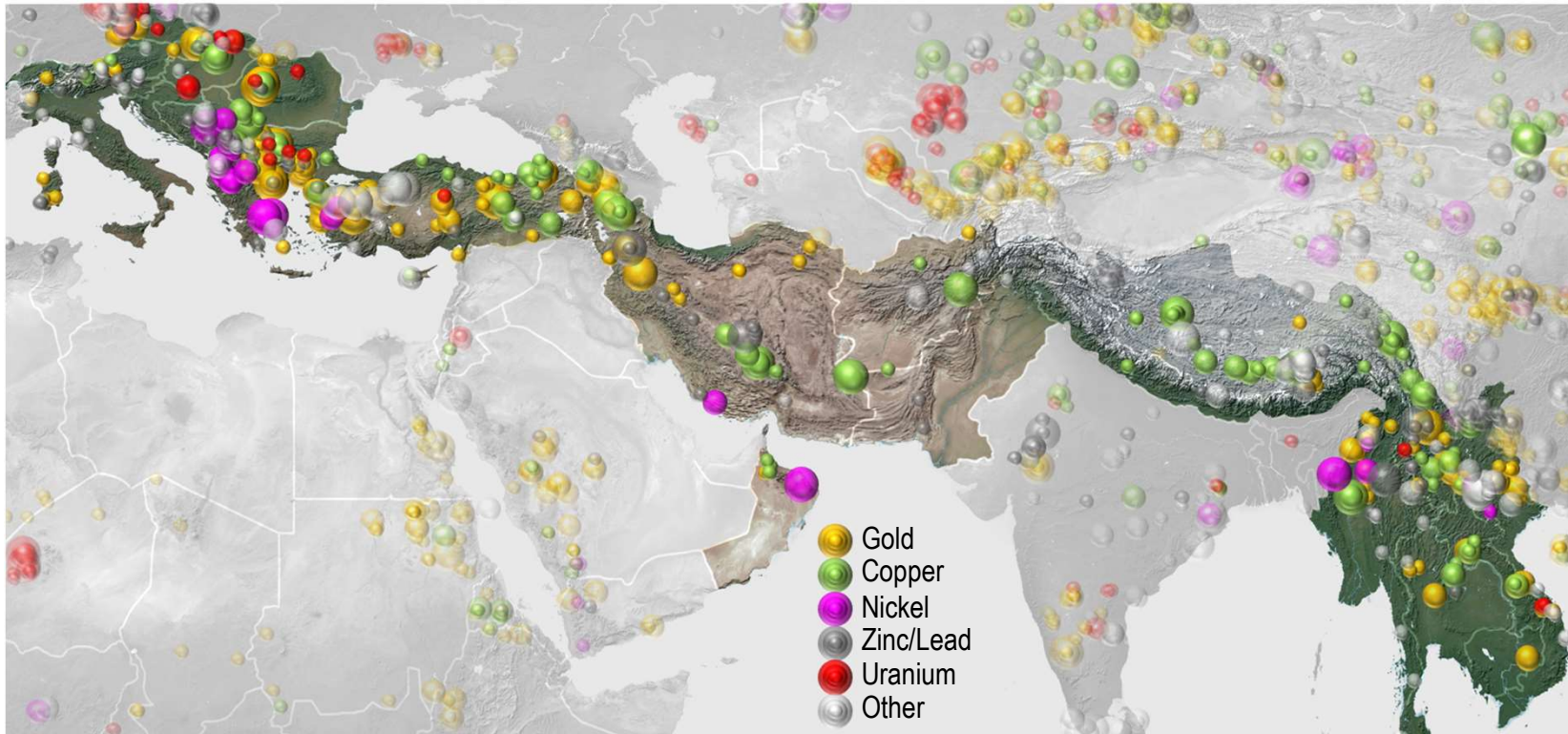


Known deposits in the Tethyan Belt

Have data on 545 significant deposits within the Tethyan Belt (out of a total of 8949 for the World)

The TB countries covers 7.3% of the World land area and contains 6.1% of all known deposits

The Western-end of the TB has the highest density of deposits



Note: Bubble size refers to whether it is a Moderate-, Major- or a Giant-deposit

Note: Excludes Bulk Mineral discoveries (ie bauxite, coal and iron ore)

“Moderate” >100koz Au, >10kt Ni, >100Kt Cu equiv, 300kt Zn+Pb, >5kt U₃O₈

“Major” >1Moz Au, >100kt Ni, >1Mt Cu equiv, 3Mt Zn+Pb, >25kt U₃O₈

“Giant” >6Moz Au, >1Mt Ni, >5Mt Cu equiv, 15Mt Zn+Pb, >125kt U₃O₈

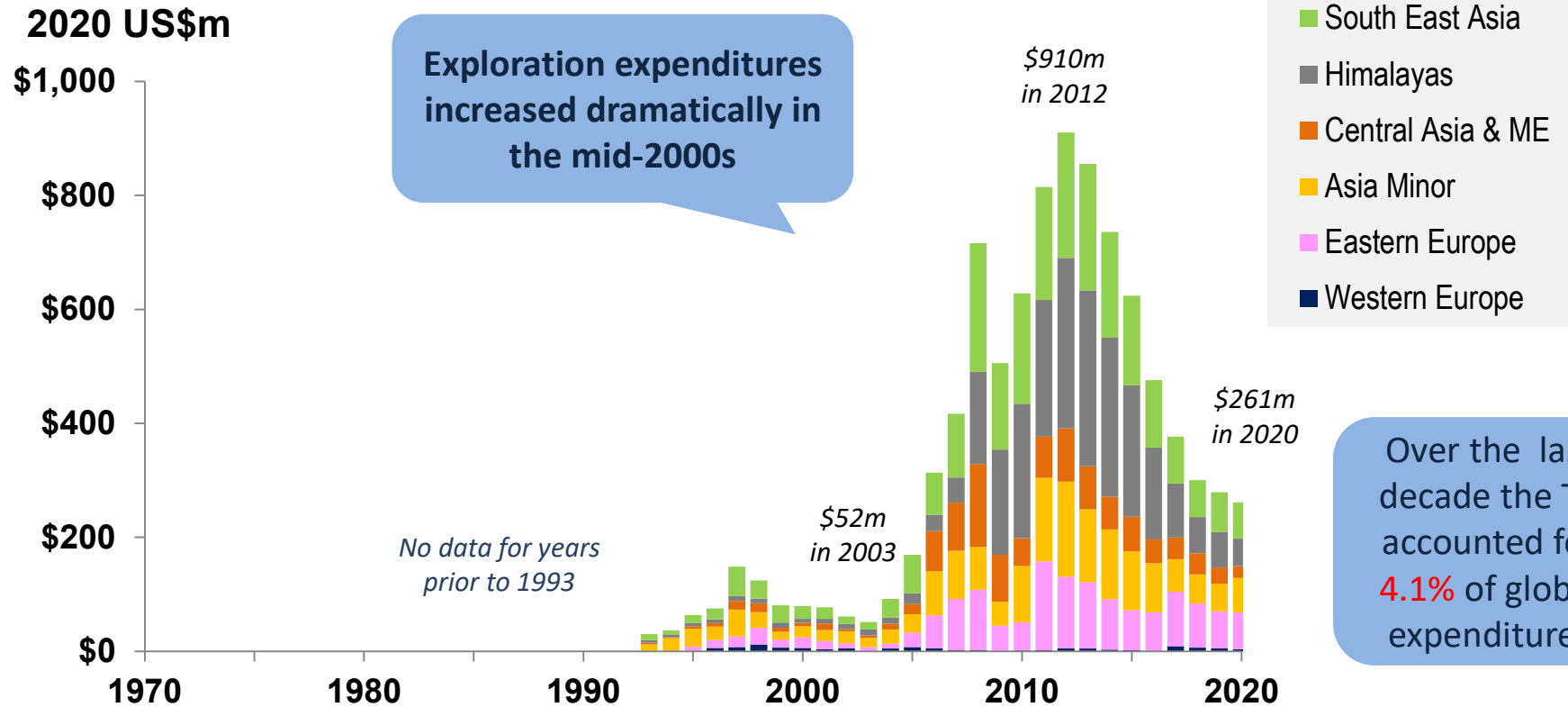
Source: MinEx Consulting © March 2021

Exploration expenditures have increased dramatically

2. TRENDS IN EXPLORATION SPEND

Exploration Expenditures by region

Entire Tethyan Belt: 1993-2020

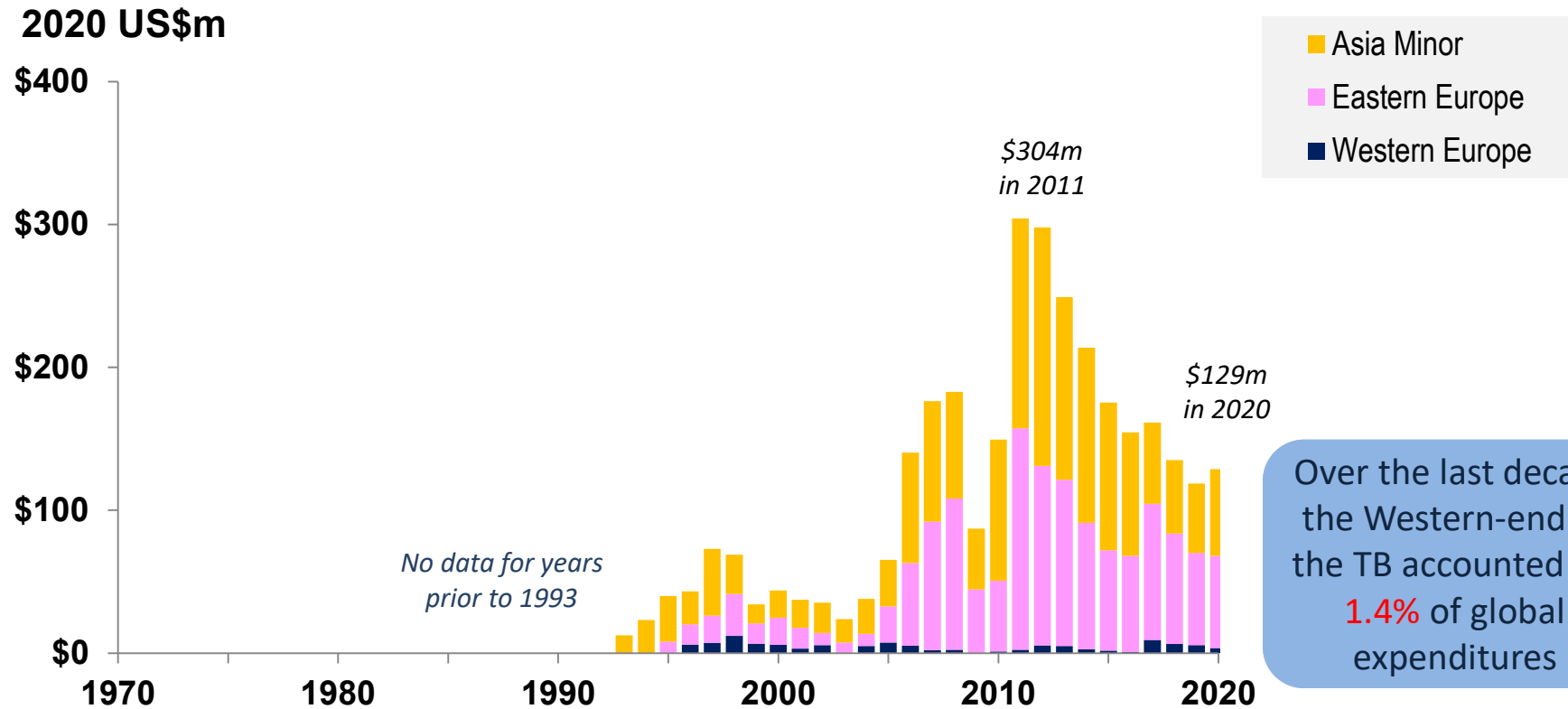


Note: Excludes Bulk Minerals (such as bauxite, coal and iron ore)

Sources: MinEx Consulting estimates based on data from S&P, OECD (for Uranium) and MLR (for China)

Exploration Expenditures

Western Tethyan Belt Countries: 1993-2020

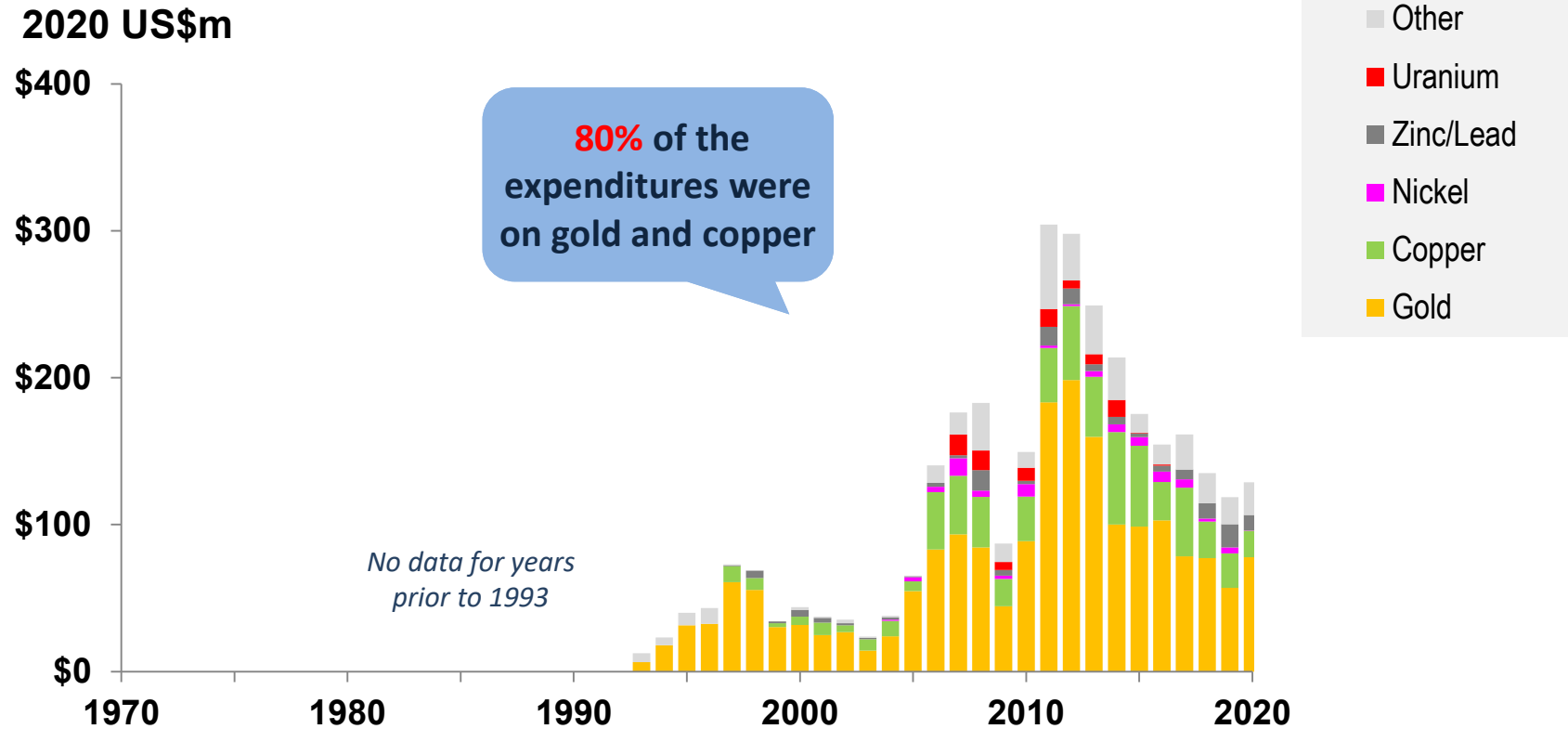


Note: Excludes Bulk Minerals (such as bauxite, coal and iron ore)

Sources: MinEx Consulting estimates based on data from S&P and OECD (for Uranium)

Exploration Expenditures by commodity

Western Tethyan Belt Countries: 1993-2020



Note: Excludes Bulk Minerals (such as bauxite, coal and iron ore)

Sources: MinEx Consulting estimates based on data from S&P and OECD (for Uranium)

Breakdown of Exploration Expenditures in the Western Tethyan : 2010-19

Region	Country	Exploration Expenditures 2010-19 (2020 US\$m)				Area [km ²]	Unit Spend [\$/km ²]
		Gold	Copper	Other	Total		
WESTERN EUROPE	Austria	\$9	\$1	\$11	\$21	83,879	\$253
	Corsica	na	na	na	na	8,680	na
	Italy	\$1	\$1	\$14	\$16	301,338	\$53
	Switzerland	\$3	\$0	\$0	\$4	41,285	\$86
	Sub-Total	\$13	\$1	\$26	\$41	435,182	\$94
EASTERN EUROPE	Albania	\$7	\$13	\$7	\$28	28,748	\$968
	Bosnia & Herz	\$0	\$0	\$6	\$6	51,197	\$124
	Bulgaria	\$74	\$17	\$4	\$95	110,994	\$857
	Croatia	na	na	na	na	56,594	na
	Czech Republic	\$0	\$0	\$9	\$9	78,866	\$113
	Hungary	\$1	\$0	\$15	\$15	93,030	\$166
	Macedonia	\$39	\$30	\$16	\$84	25,713	\$3,275
	Montenegro	\$0	\$0	\$2	\$3	13,812	\$205
	Romania	\$97	\$22	\$2	\$122	238,391	\$510
	Serbia + Kosovo	\$132	\$141	\$178	\$450	88,361	\$5,098
	Slovakia	\$36	\$5	\$56	\$97	49,035	\$1,968
	Slovenia	na	na	na	na	20,273	na
Sub-Total	\$386	\$229	\$295	\$909	855,014	\$1,064	
ASIA MINOR	Cyprus	\$4	\$4	\$0	\$8	9,251	\$859
	Greece	\$61	\$18	\$38	\$117	131,957	\$888
	Turkey	\$680	\$146	\$59	\$885	783,562	\$1,129
	Sub-Total	\$746	\$168	\$97	\$1,010	924,770	\$1,092

Minimal effort in
Western Europe

Serbia and
Macedonia are
currently both
“hot spots” for
exploration

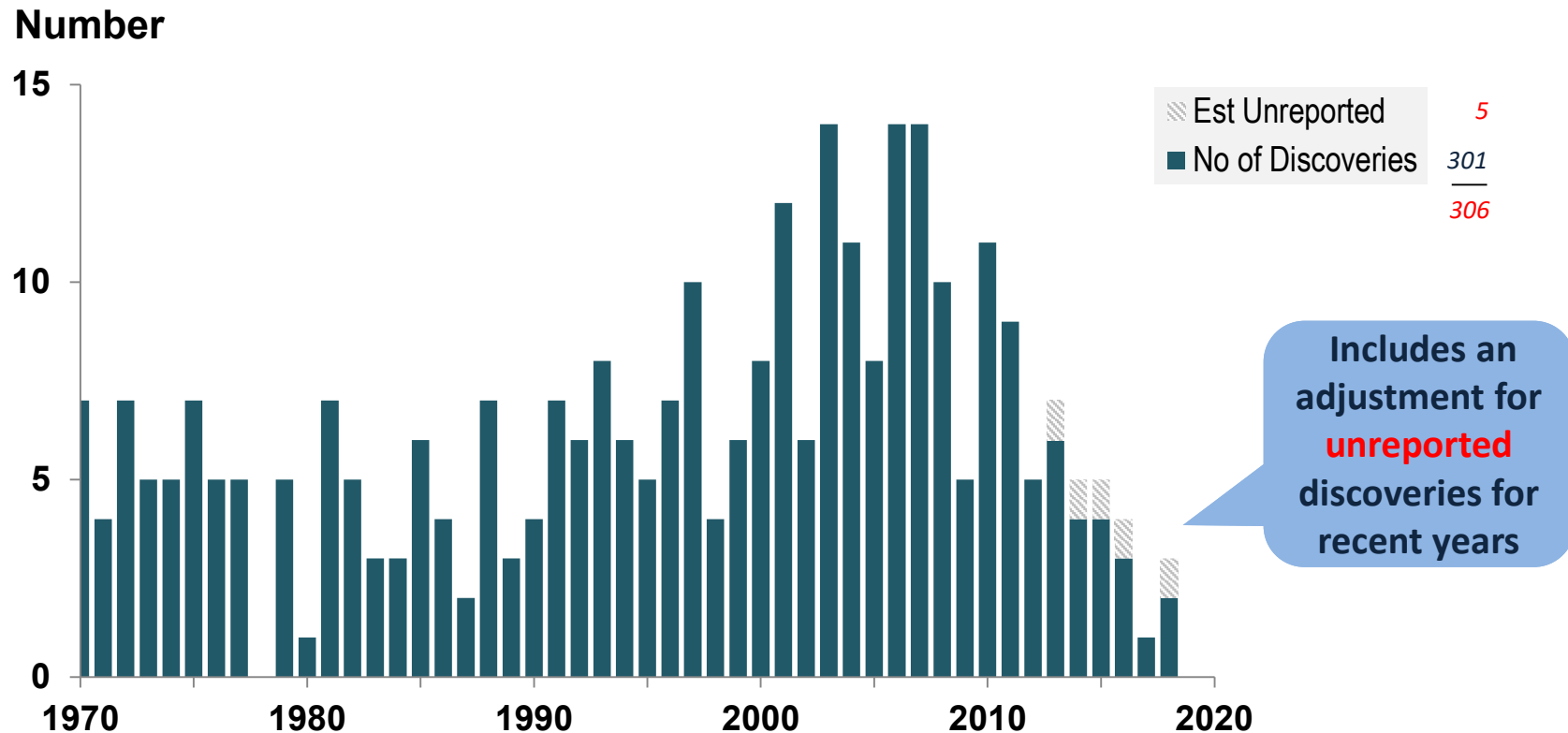
Note: Excludes Bulk Minerals (such as bauxite, coal and iron ore)

Over the last 50 years, 306 significant deposits were found in the Tethyan Belt, including 131 in the Western Tethyan

3. NUMBER OF DISCOVERIES MADE

Number of significant discoveries

Entire Tethyan Belt : 1970-2019

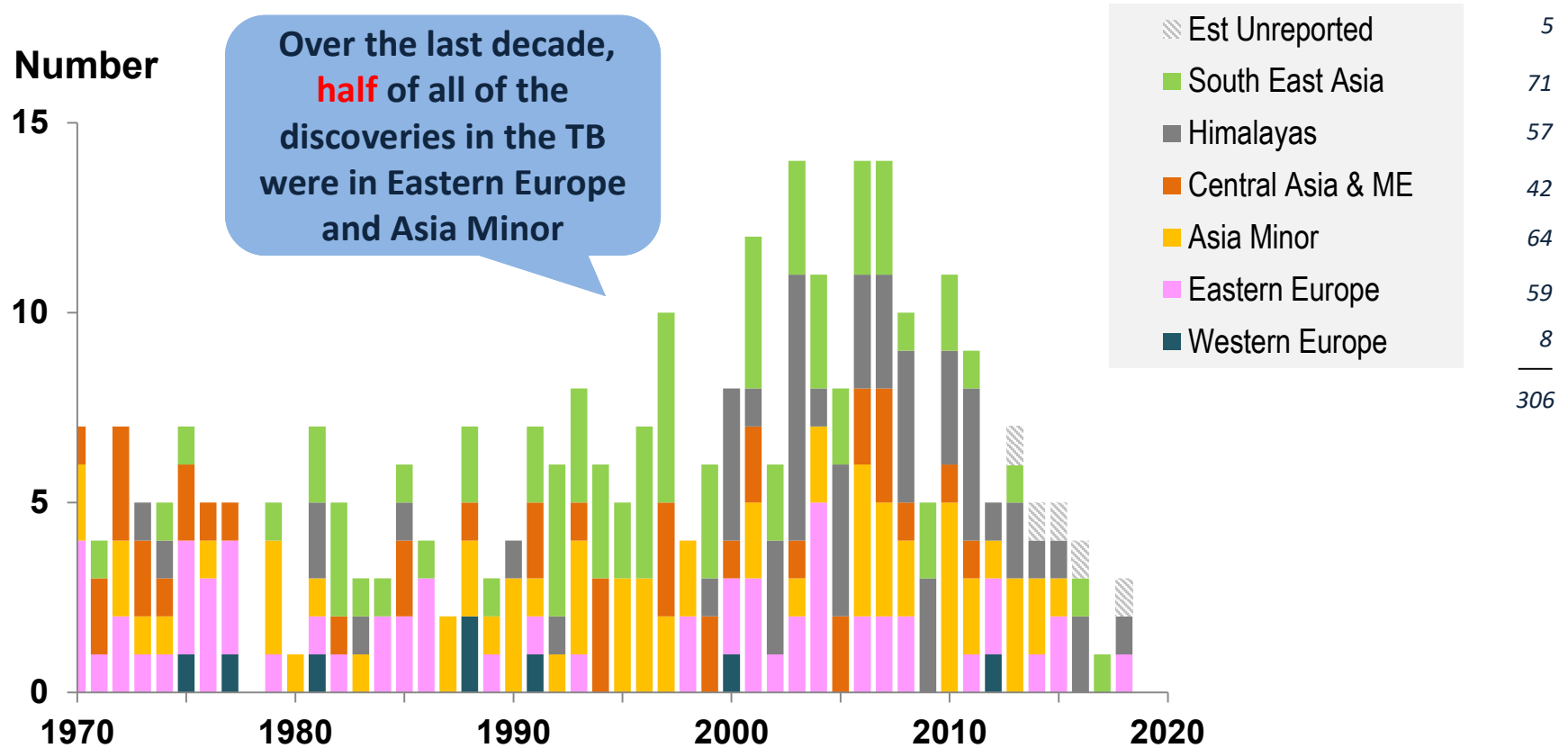


Note: Excludes Bulk Mineral discoveries (ie bauxite, coal and iron ore)
 Excludes satellite deposits in existing camps
 Significant deposits defined as those >="Moderate" in size
 i.e. >100koz Au, >10kt Ni, >100Kt Cu equiv, 300kt Zn+Pb, >5kt U₃O₈

Source: MinEx Consulting © March 2021

Number of significant discoveries by location

Entire Tethyan Belt: 1970-2019

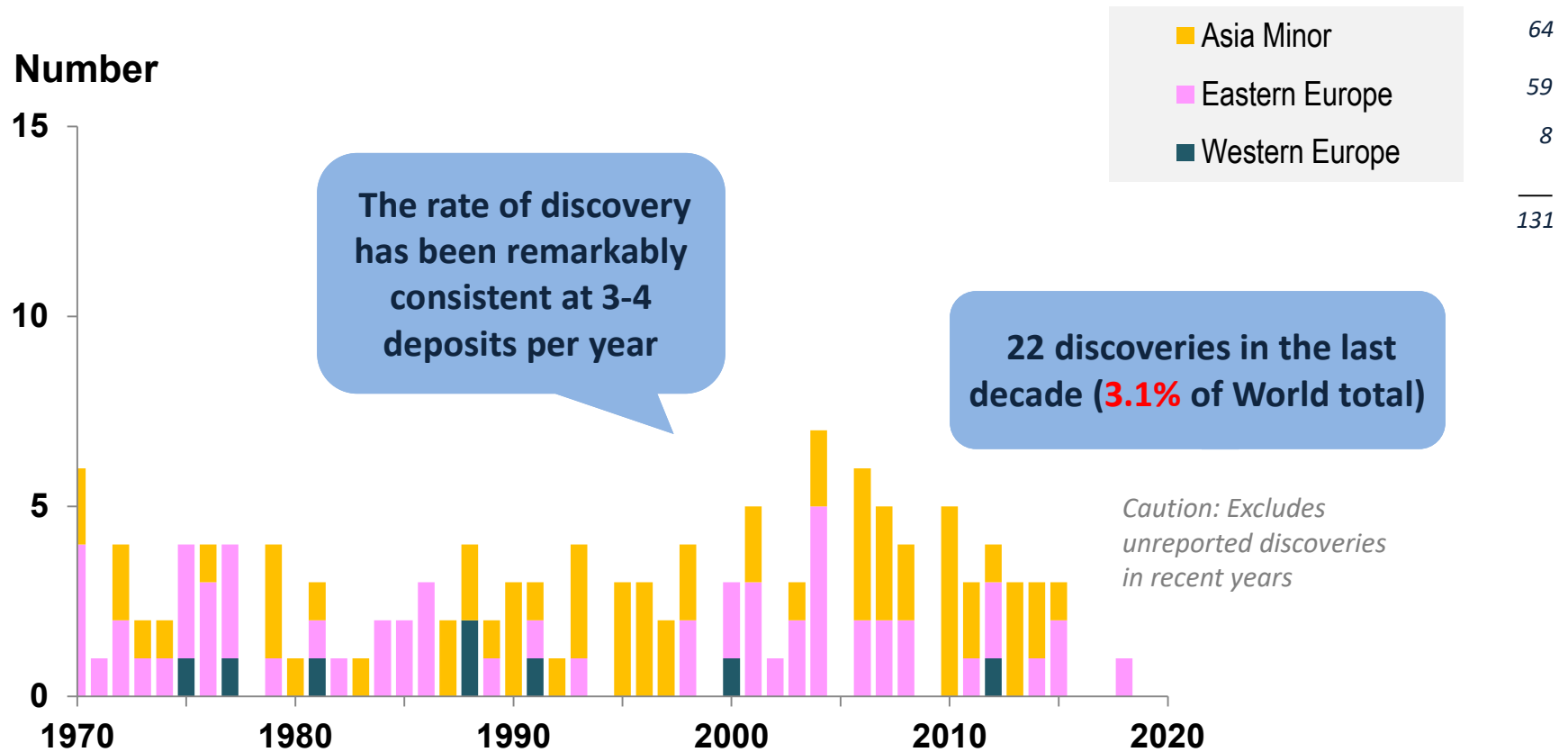


Note: Based on Moderate-, Major- and Giant-sized deposits
 Excludes Bulk Minerals (such as bauxite, coal and iron ore)
 Excludes satellite deposits in existing camps

Source: MinEx Consulting © March 2021

Number of significant discoveries by location

Western Tethyan Belt: 1970-2019

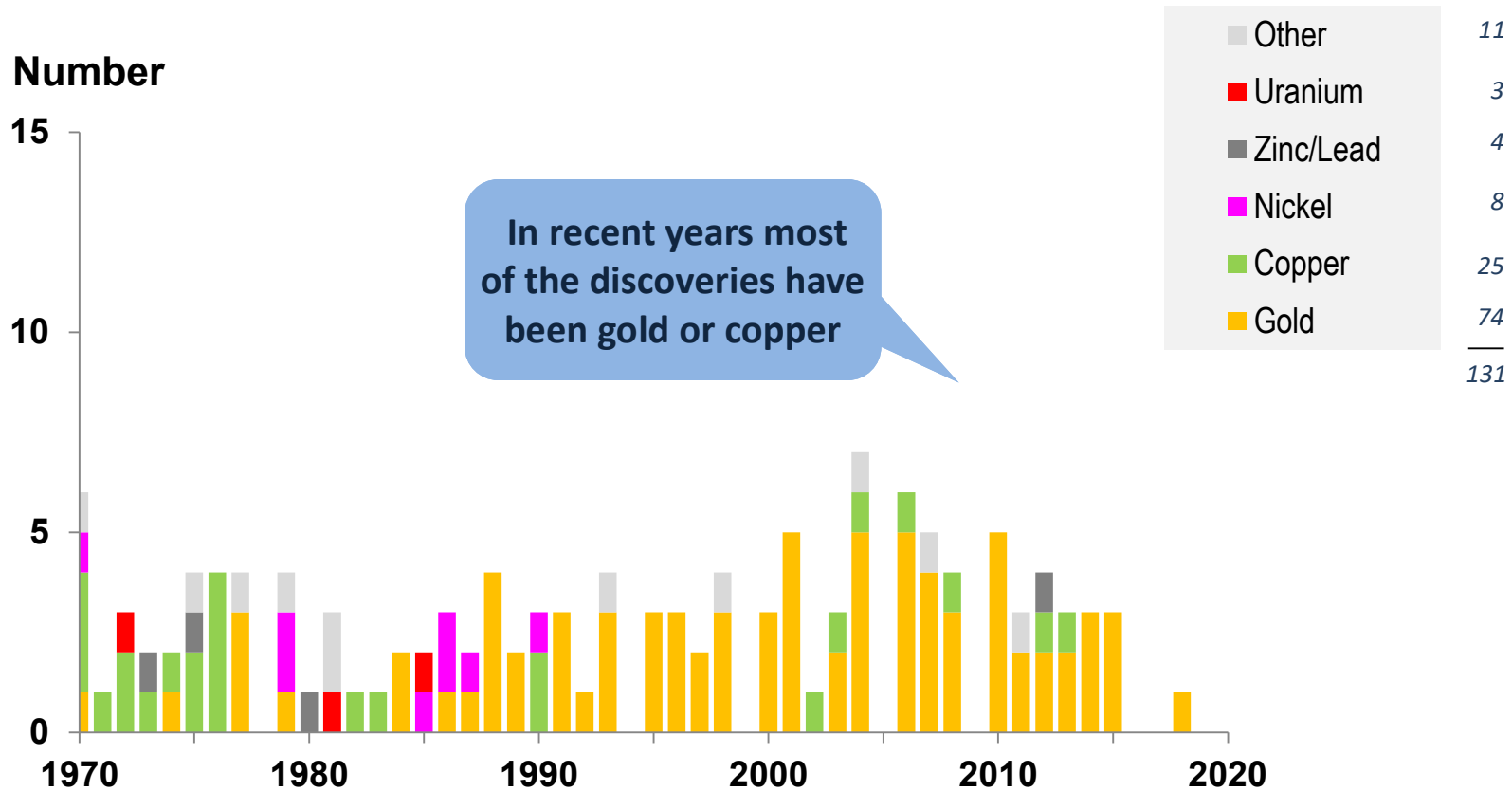


Note: Based on Moderate-, Major- and Giant-sized deposits
Excludes Bulk Minerals (such as bauxite, coal and iron ore)
Excludes satellite deposits in existing camps

Source: MinEx Consulting © March 2021

Number of discoveries by commodity

Western Tethyan Belt: 1970-2019



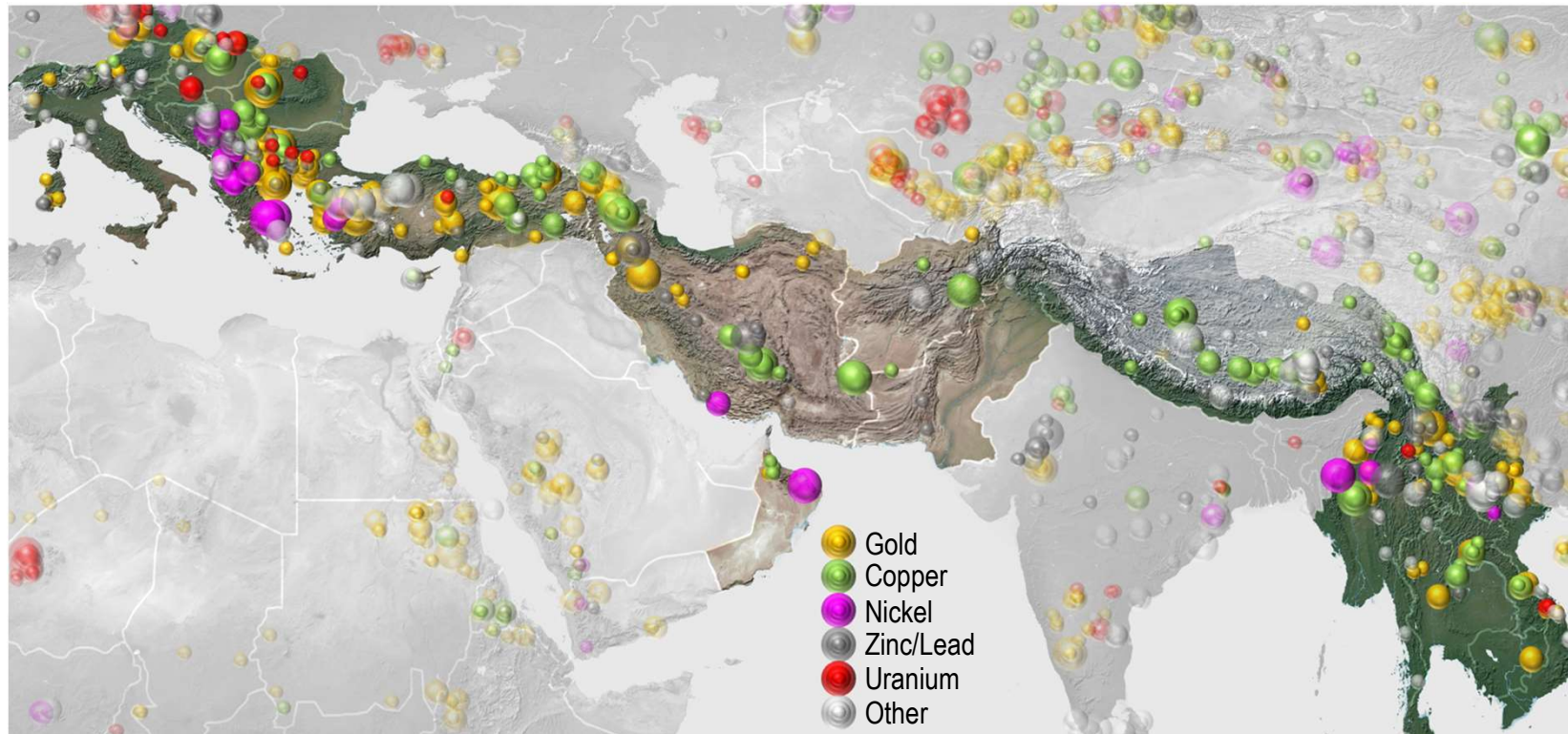
Note: Based on Moderate-, Major- and Giant-sized deposits
 Excludes Bulk Minerals (such as bauxite, coal and iron ore)
 Excludes satellite deposits in existing camps
 No significant discoveries reported in the Belt in 1978, 1984 and 2009

Source: MinEx Consulting © March 2021

545 significant deposits have been identified in countries along the entire Tethyan Belt. 287 of these are in the Western TB

4. LOCATION OF DEPOSITS

Discoveries in the Tethyan Belt : All Years



Note: Bubble size refers to whether it is a Moderate-, Major- or a Giant-deposit

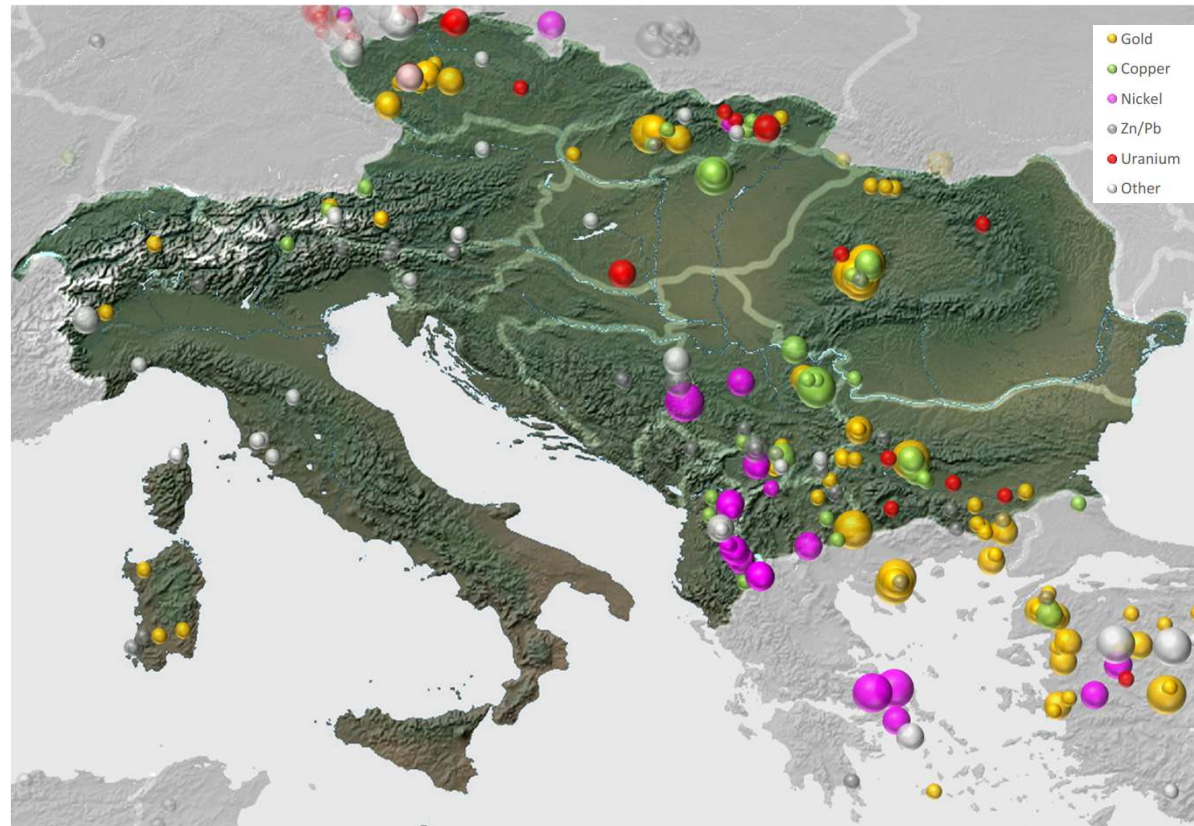
Entire Tethyan Belt

	Au	Cu	Ni	Zn/Pb	U	Other	TOTAL
No.	185	146	34	61	23	96	545
Metal	478 Moz	269 Mt	15.9 Mt	182 Mt	326 kt U	xx	

6.1% of all deposits in the World

Source: MinEx Consulting © March 2021

Europe : All Years



Western Europe (Italy, Switzerland, Austria, Corsica)

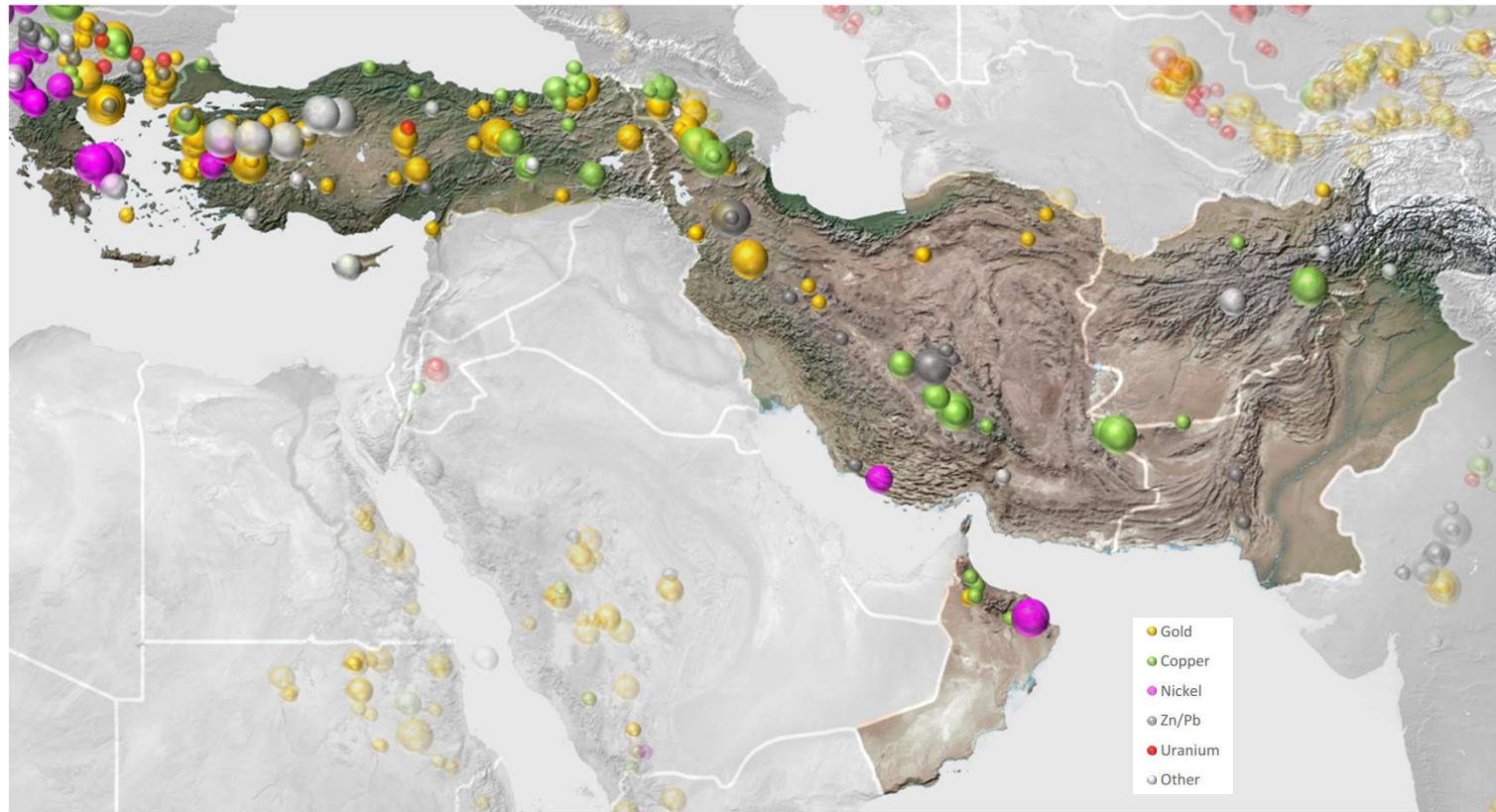
	Au	Cu	Ni	Zn/Pb	U	Other	TOTAL
No.	8	3	-	9	-	12	32
Metal	2.9 Moz	1.0 Mt	-	11.3 Mt	-	xx	

Eastern Europe (13 Countries)

	Au	Cu	Ni	Zn/Pb	U	Other	TOTAL
No.	62	28	21	19	18	15	163
Metal	177.1 Moz	58.6 Mt	6.3 Mt	26.3 Mt	299 Kt U	xx	

Source: MinEx Consulting © March 2021

Central Asia & Middle East : All Years



Asia Minor (Cyprus, Greece, Turkey)

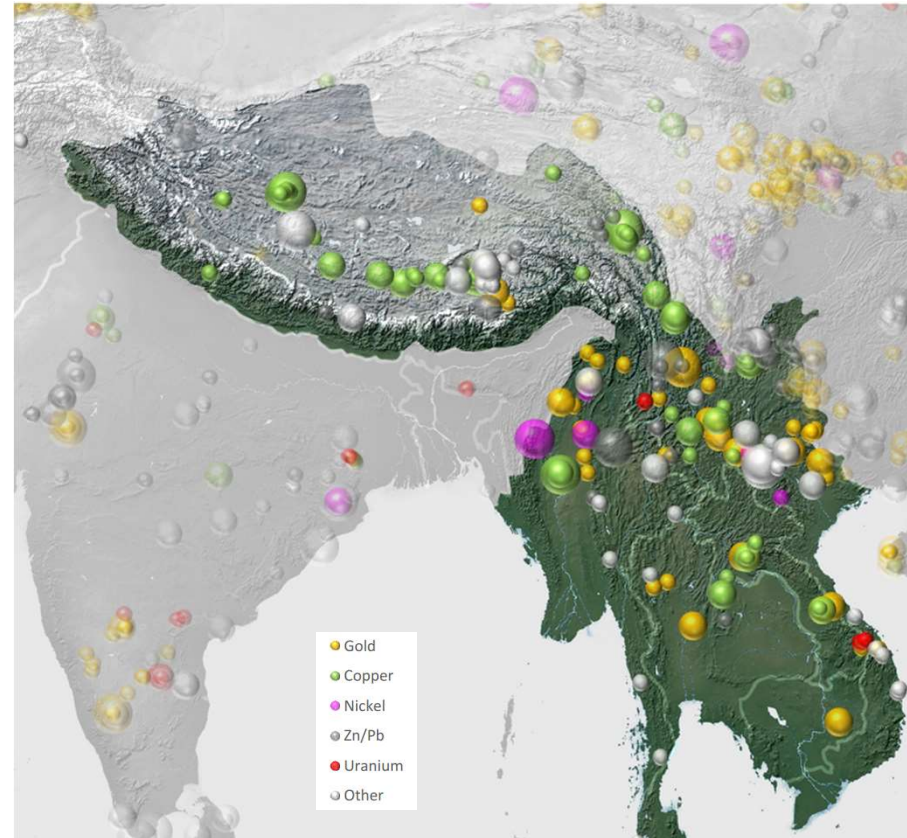
	Au	Cu	Ni	Zn/Pb	U	Other	TOTAL
No.	47	18	6	4	2	15	92
Metal	92.5 Moz	15.4 Mt	5.8 Mt	10.3 Mt	8 kt U	xx	

Central Asia + Middle East (6 Countries)

	Au	Cu	Ni	Zn/Pb	U	Other	TOTAL
No.	24	27	2	10	-	5	68
Metal	99.5 Moz	94.1 Mt	1.6 Mt	52.3 Mt	-	xx	

Source: MinEx Consulting © March 2021

Himalayas & SE Asia : All Years



Himalayas (Nepal, Bhutan, Northern Nth Indian States)

	Au	Cu	Ni	Zn/Pb	U	Other	TOTAL
No.	4	35	-	8	-	18	65
Metal	41.0 Moz	62.5 Mt	-	18.3 Mt	-	xx	

South East Asia (6 Countries)

	Au	Cu	Ni	Zn/Pb	U	Other	TOTAL
No.	40	35	5	11	3	31	125
Metal	65.3 Moz	36.9 Mt	2.3 Mt	63.0 Mt	18 kt U	xx	

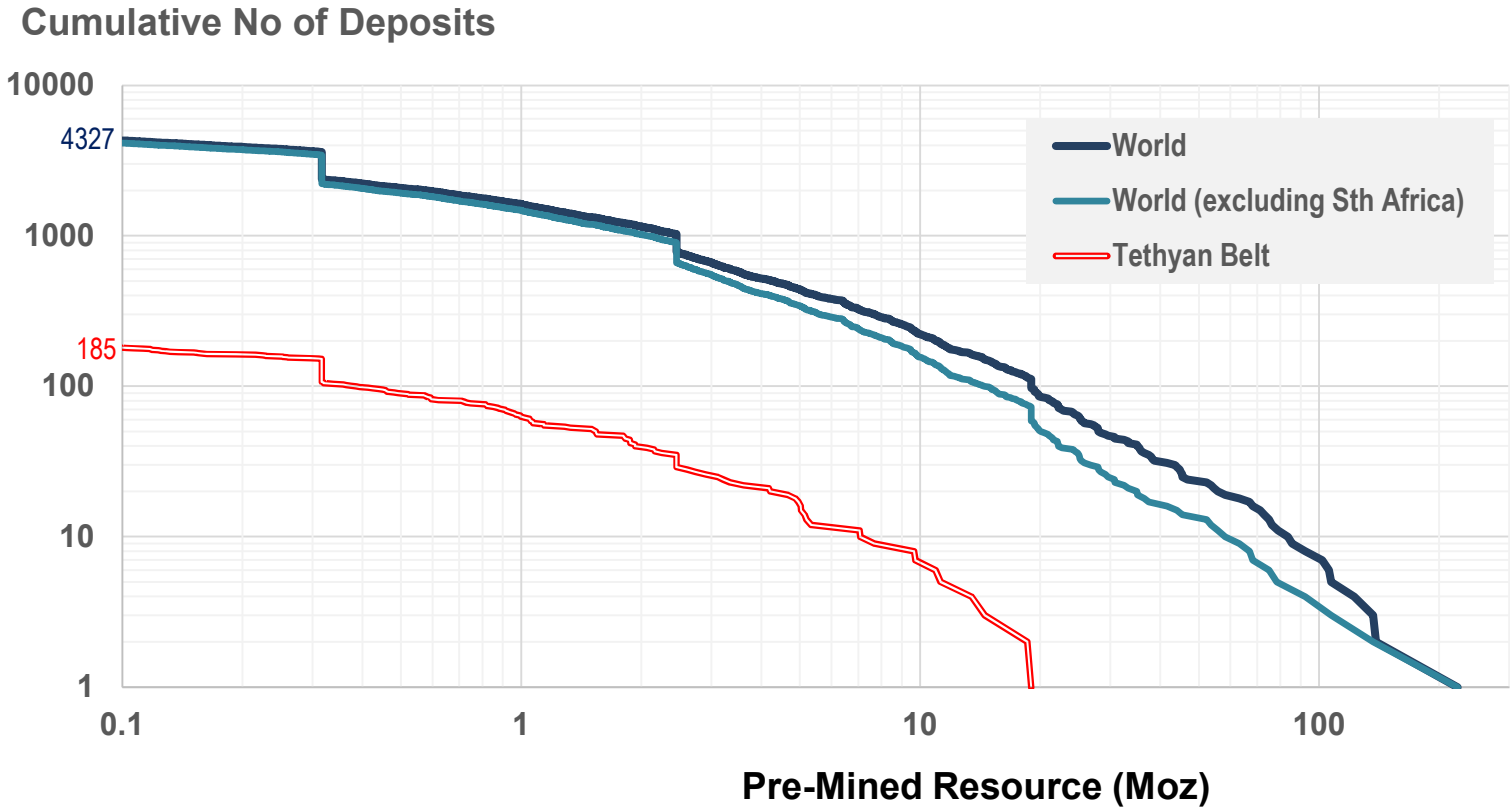
Source: MinEx Consulting © March 2021

How mineral-rich (or fertile) is the Tethyan Belt ?

5. MINERAL ENDOWMENT

Size/Cumulative Frequency Curve for Gold

Entire Tethyan Belt versus the World

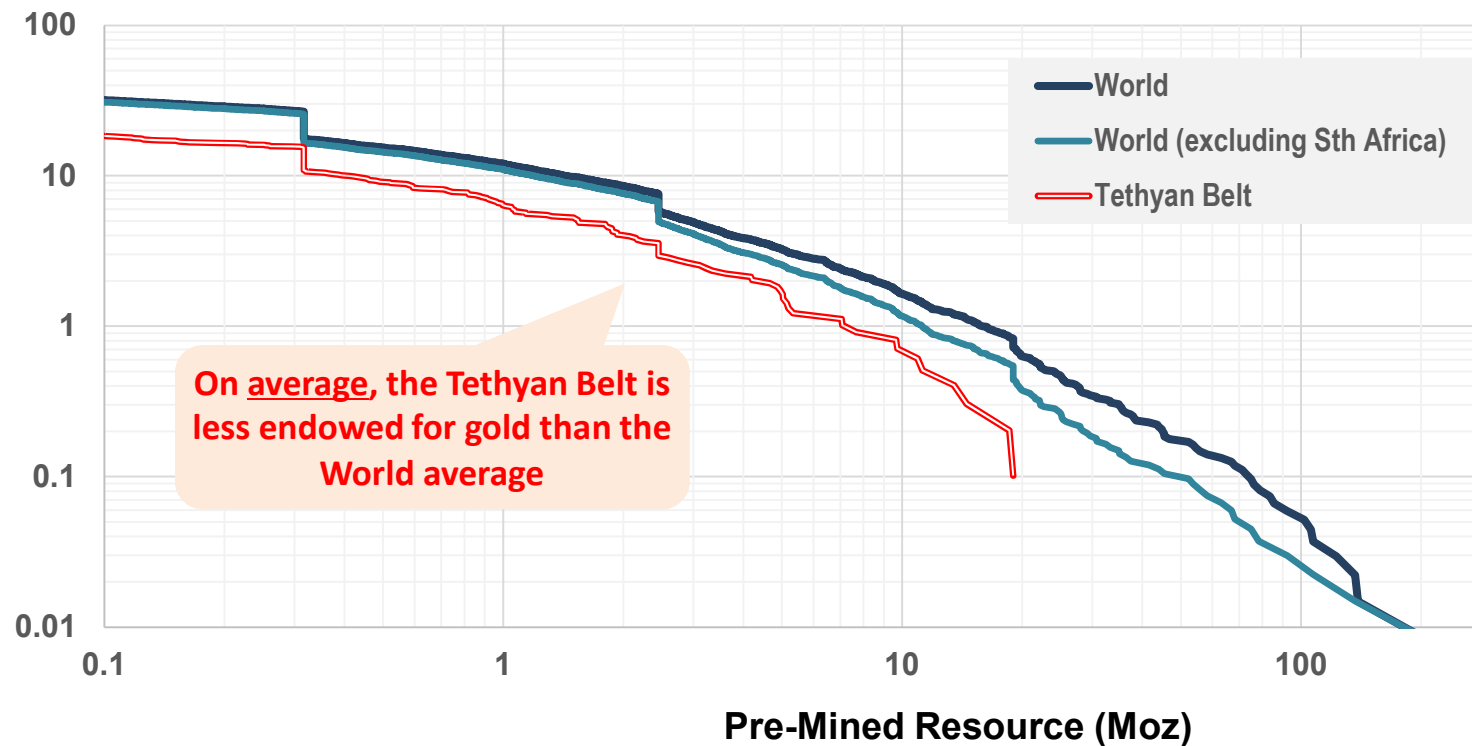


Source: MinEx Consulting © March 2021

Size/Cumulative Frequency Curve for Gold

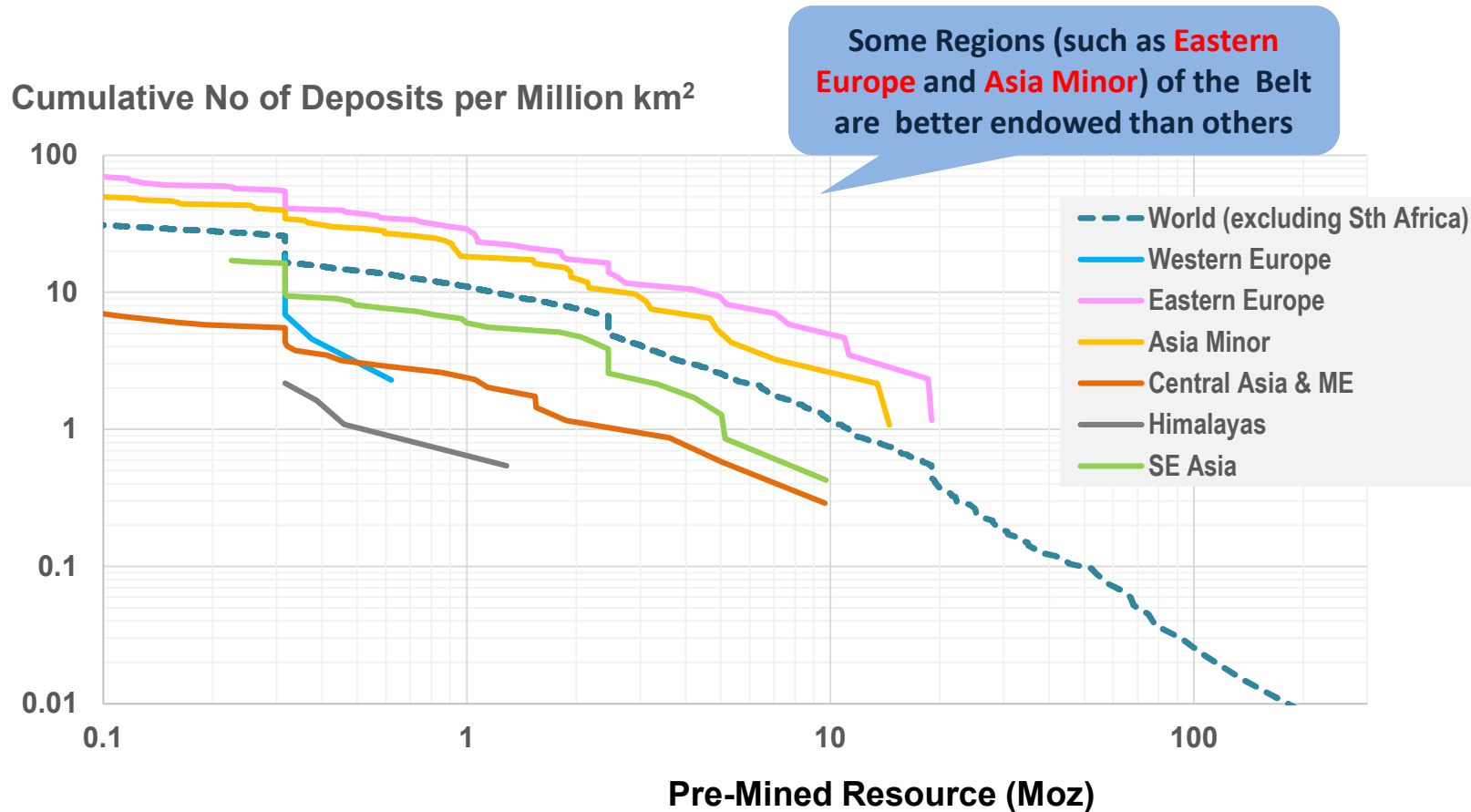
Entire Tethyan Belt versus the World – **adjusted for land area**

Cumulative No of Deposits per Million km²



Source: MinEx Consulting © March 2021

Size/Cumulative Frequency Curve for Gold Tethyan Belt versus the World – adjusted for land area

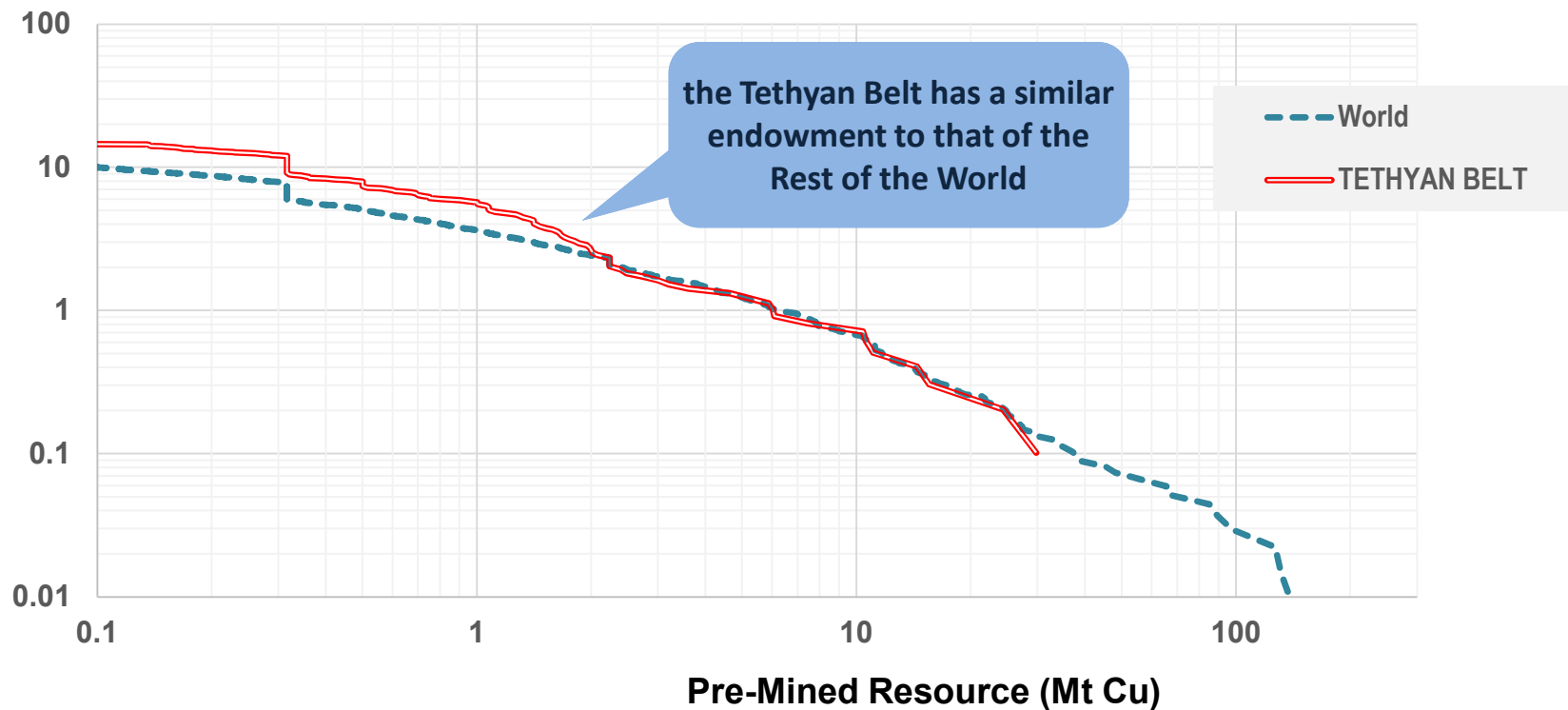


Source: MinEx Consulting © March 2021

Size/Cumulative Frequency Curve for Copper

Entire Tethyan Belt versus the World – adjusted for land area

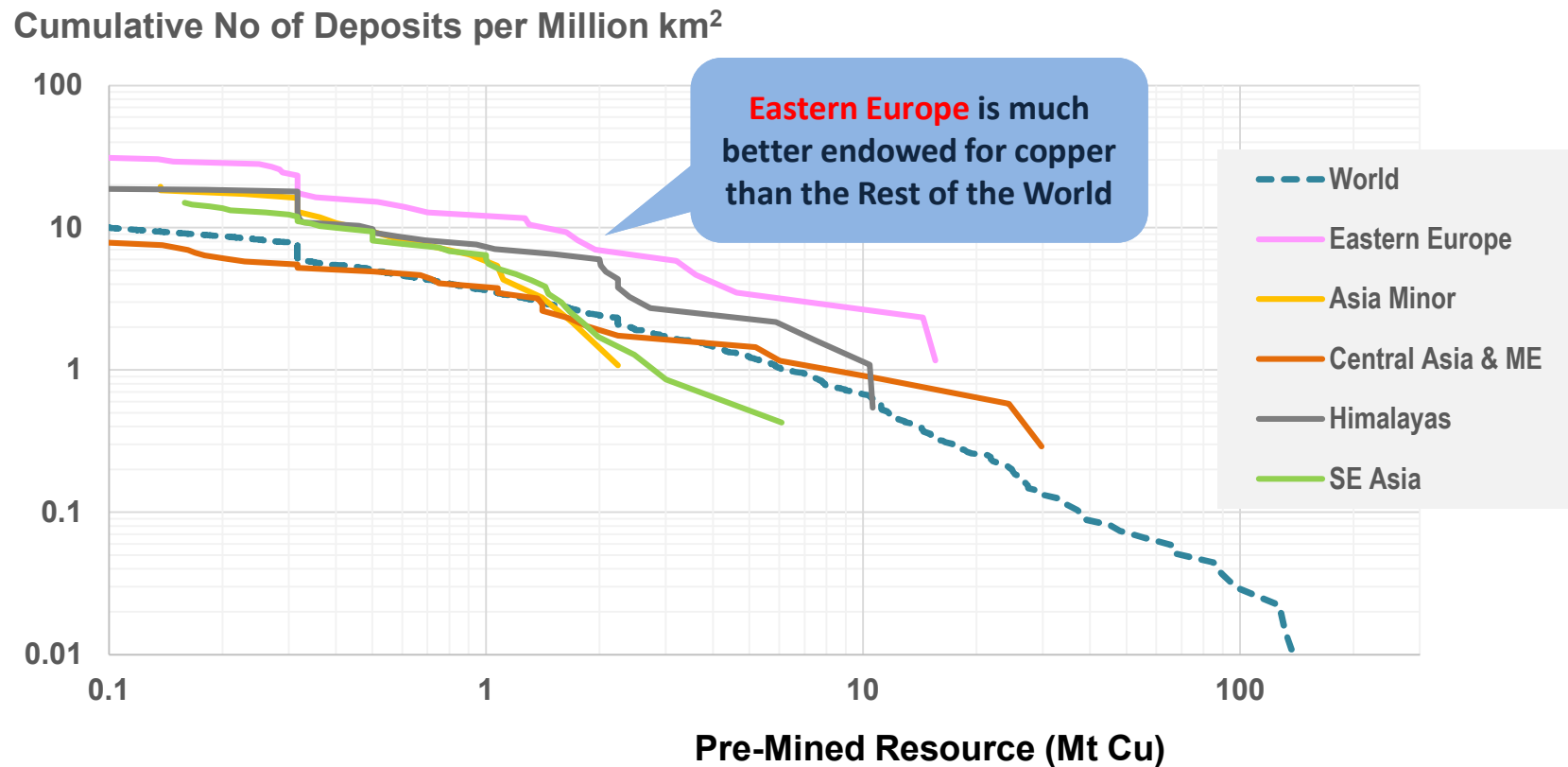
Cumulative No of Deposits per Million km²



Source: MinEx Consulting © March 2021

Size/Cumulative Frequency Curve for Copper

Tethyan Belt versus the World – adjusted for land area



Source: MinEx Consulting © March 2021

Total contained metal per km² : by region along the Western Tethyan Belt

Based on current known endowment

	Oz Au	t Cu	t Ni	t Zn+Pb	t U
WORLD ^a	79 ^b	31.2	2.8	15.6	0.12
Western Europe TB	7	2.4	- ^c	28.0	- ^c
Eastern Europe TB	201	37.3	7.1	29.8	0.34
Asia Minor TB	100	16.6	6.2	11.2	0.01

(a): Analysis based on total land area of 135 million km² for the World which excludes Antarctica (14 million km²)

(b): Gold data excludes South Africa, Including South Africa increases the global figure to 98 Oz/km²

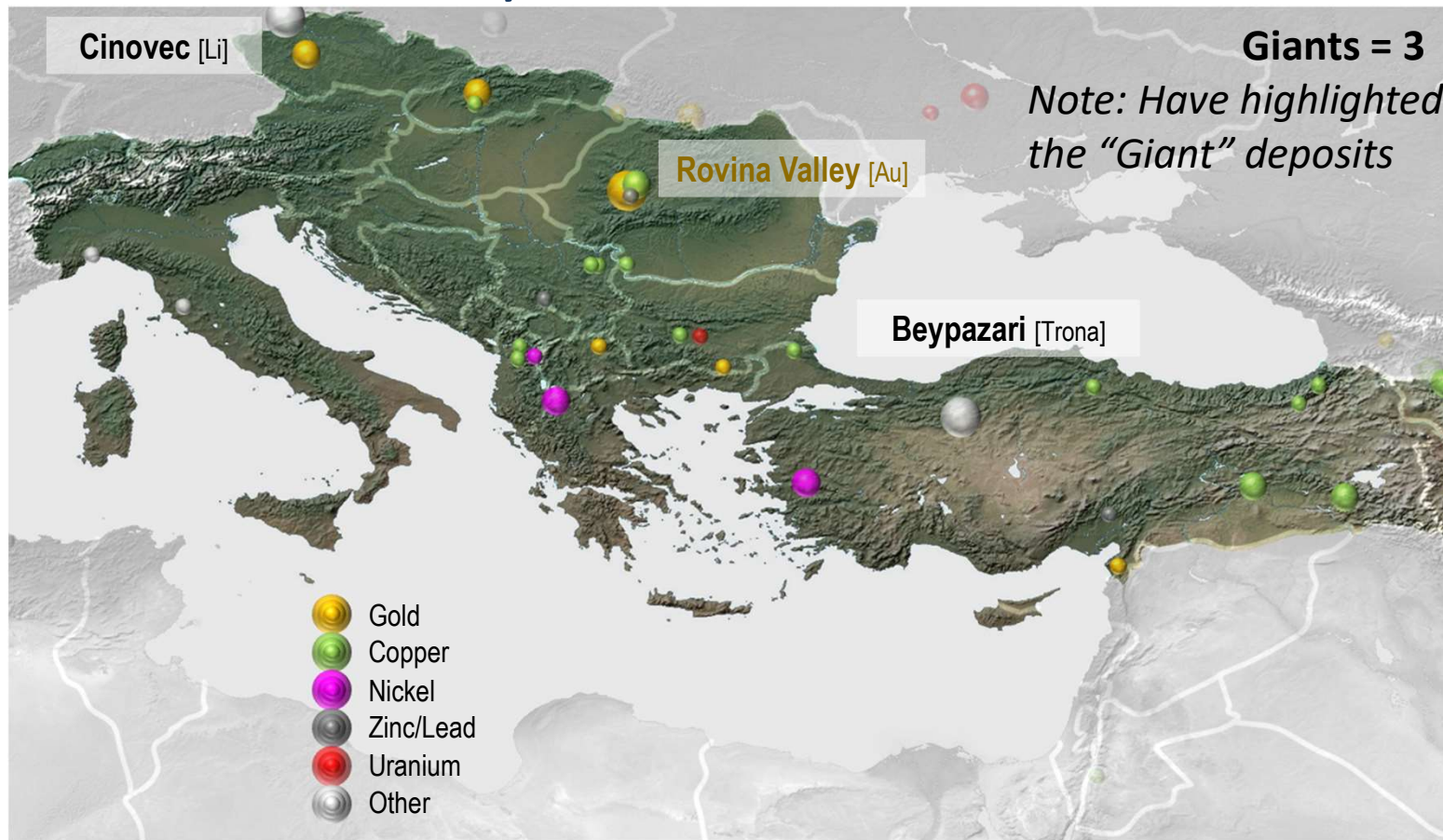
(c): The analysis is based on >=Moderate-size deposits only. Including other (smaller) deposits may result in a non-zero figure for the region

Source: MinEx Consulting © March 2021

Over the last 50 years, 131 significant deposits were found in the Western Tethyan Belt, including 22 in the last decade

6. LOCATION OF DISCOVERIES MADE IN LAST 50 YEARS

Western Tethyan Belt Discoveries: 1970-79



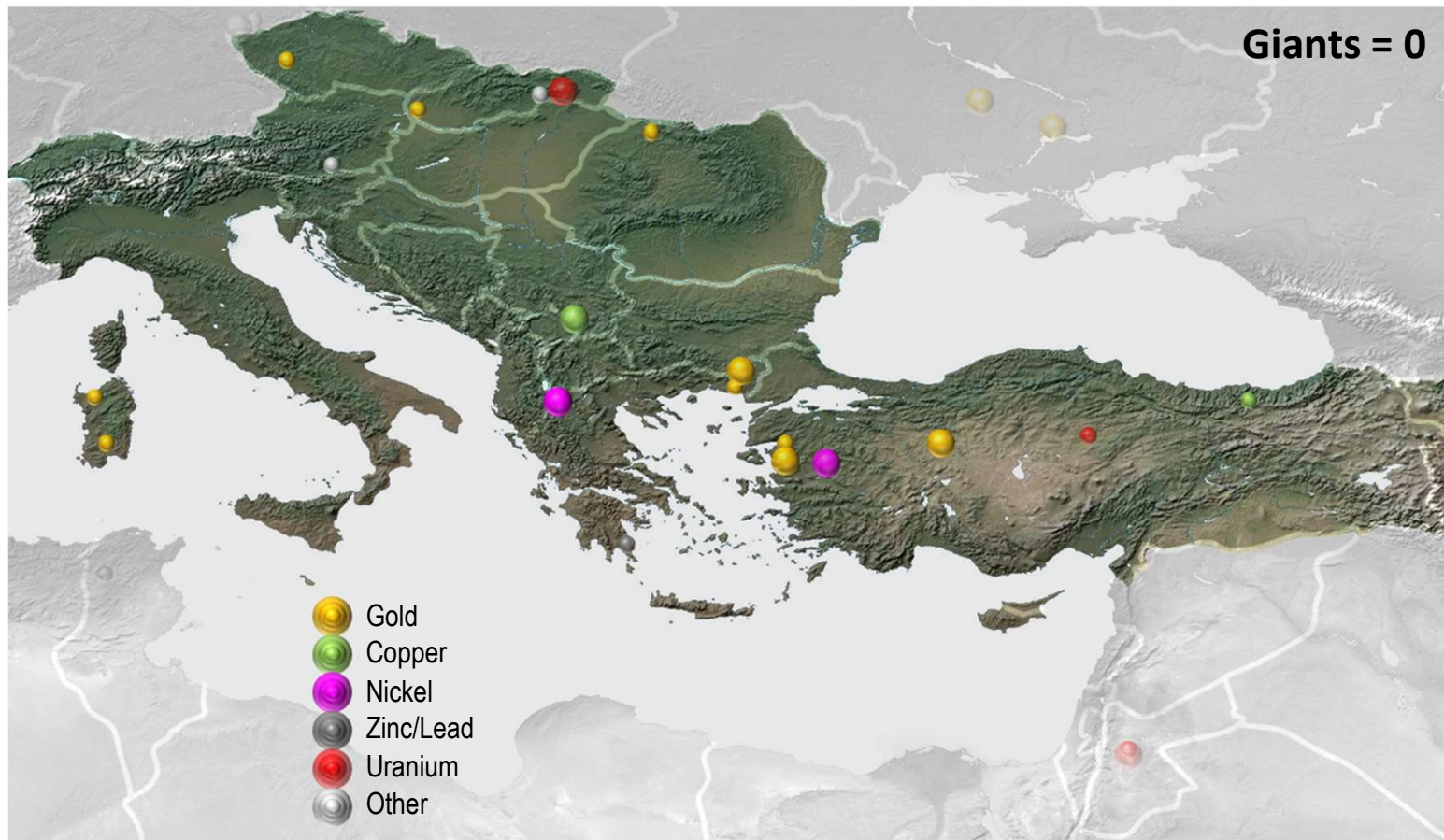
	Au	Cu	Ni	Zn/Pb	U	Other	TOTAL
No.	6	14	3	3	1	4	31
Metal	17.1 Moz	11.5 Mt	1.1 Mt	3.9 Mt	5 Kt U	Garnet, Lithium, Sulphur, Trona	

Western Tethyan Belt

Note: Includes by-product metal

Source: MinEx Consulting © March 2021

Western Tethyan Belt Discoveries: 1980-89



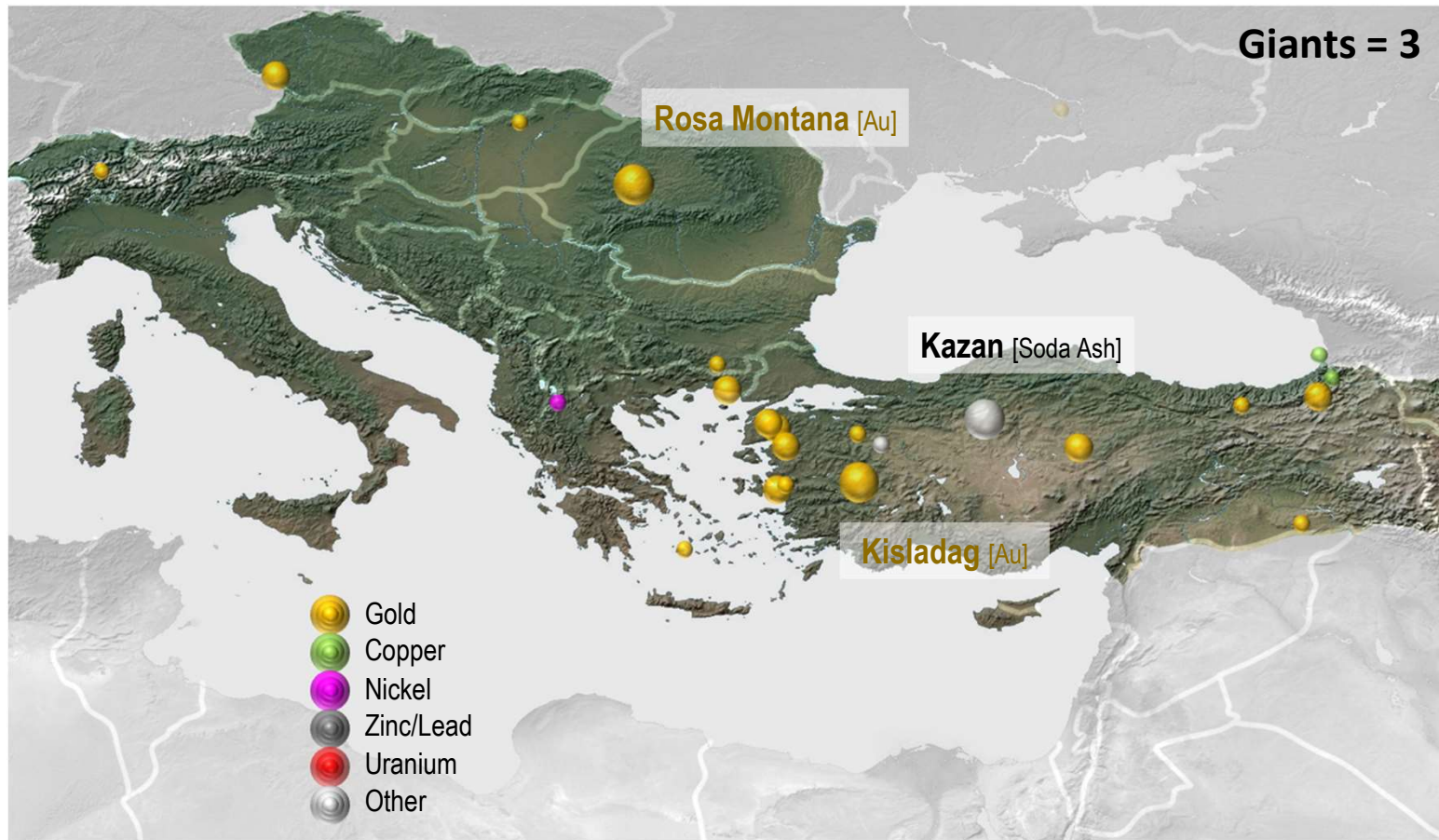
	Au	Cu	Ni	Zn/Pb	U	Other	TOTAL
No.	10	2	4	1	2	2	21
Metal	13.2 Moz	1.9 Mt	1.4 Mt	0.4 Mt	30 kt U	Lithium, Silver	

Western Tethyan Belt

Note: Includes by-product metal

Source: MinEx Consulting © March 2021

Western Tethyan Belt Discoveries: 1990-99



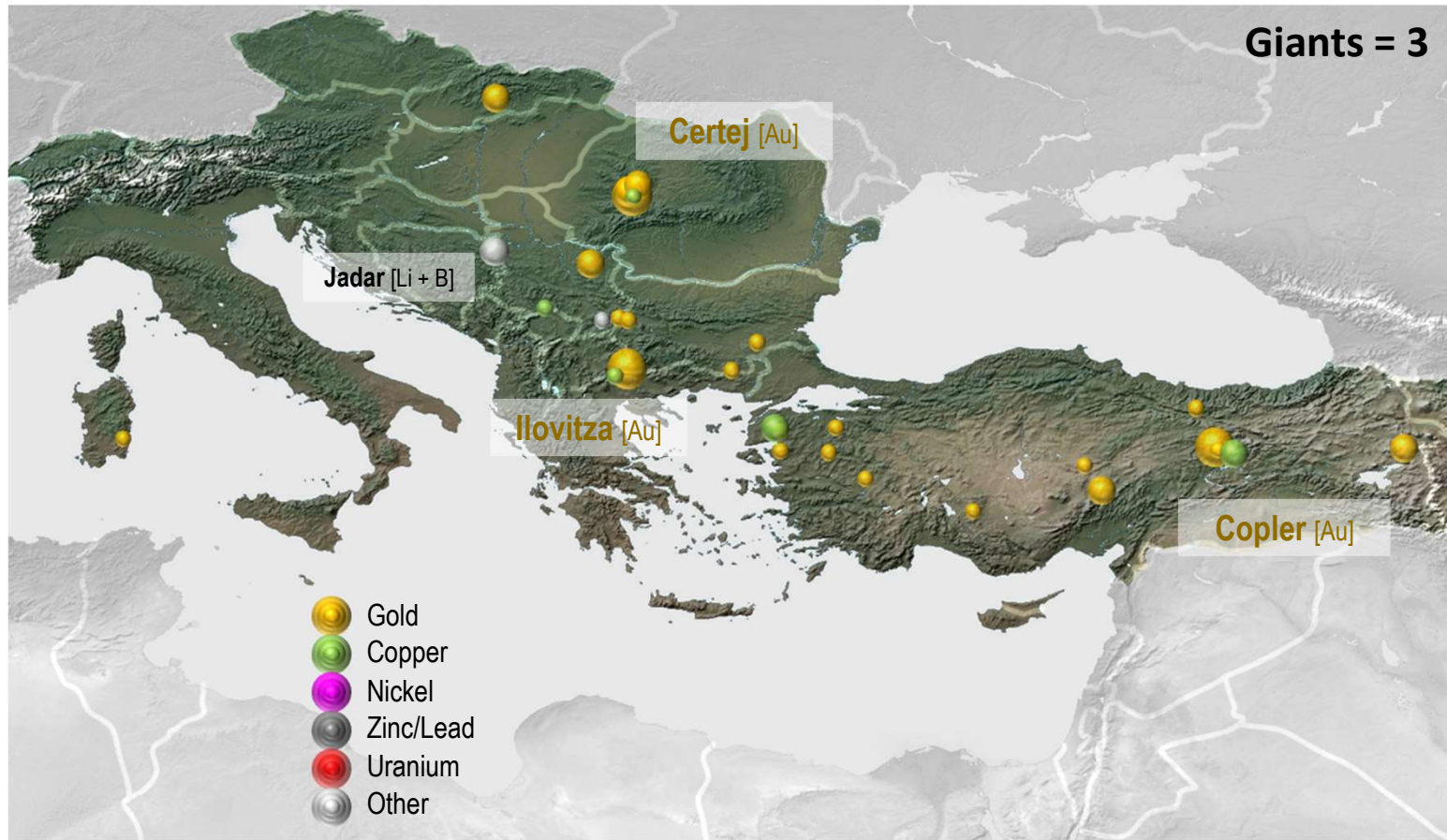
	Au	Cu	Ni	Zn/Pb	U	Other	TOTAL
No.	18	2	1	-	-	2	23
Metal	50.4 Moz	0.4 Mt	0.1 Mt	2.4 Mt	-	Silver, Soda Ash	

All by-product metal

Western Tethyan Belt

Source: MinEx Consulting © March 2021

Western Tethyan Belt Discoveries: 2000-09



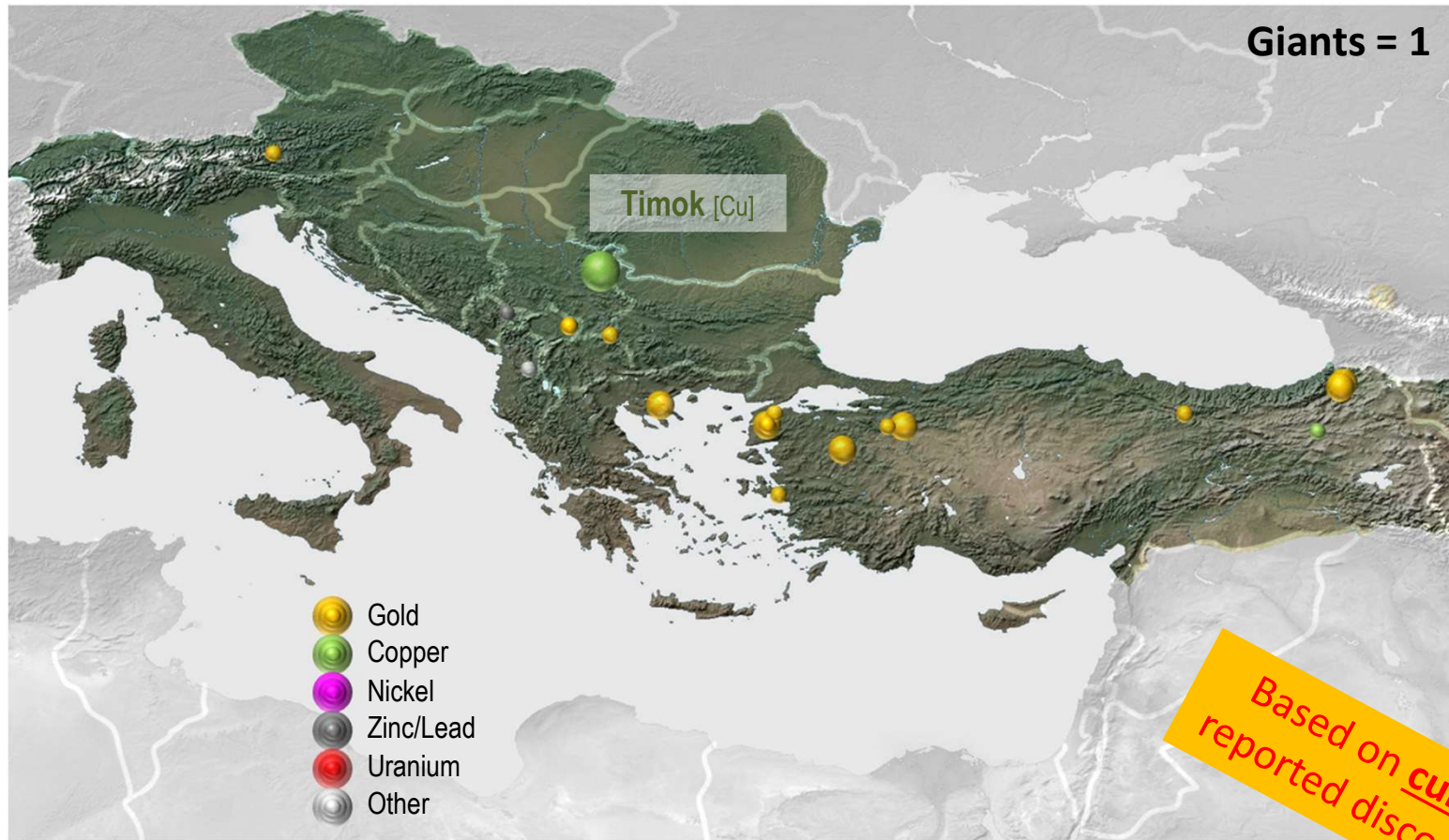
	Au	Cu	Ni	Zn/Pb	U	Other	TOTAL
No.	27	5	-	-	-	2	34
Metal	62.2 Moz	5.7 Mt	- Mt	- Mt	-	Lithium, Molybdenum	

All by-product metal

Western Tethyan Belt

Source: MinEx Consulting © March 2021

Western Tethyan Belt Discoveries: 2010-19



	Au	Cu	Ni	Zn/Pb	U	Other	TOTAL
No.	18	2	-	1	-	1	22
Metal	26.8 Moz	16.5 Mt	- Mt	1.0 Mt	-	Chromium	

All by-product metal

Western Tethyan Belt

Source: MinEx Consulting © March 2021

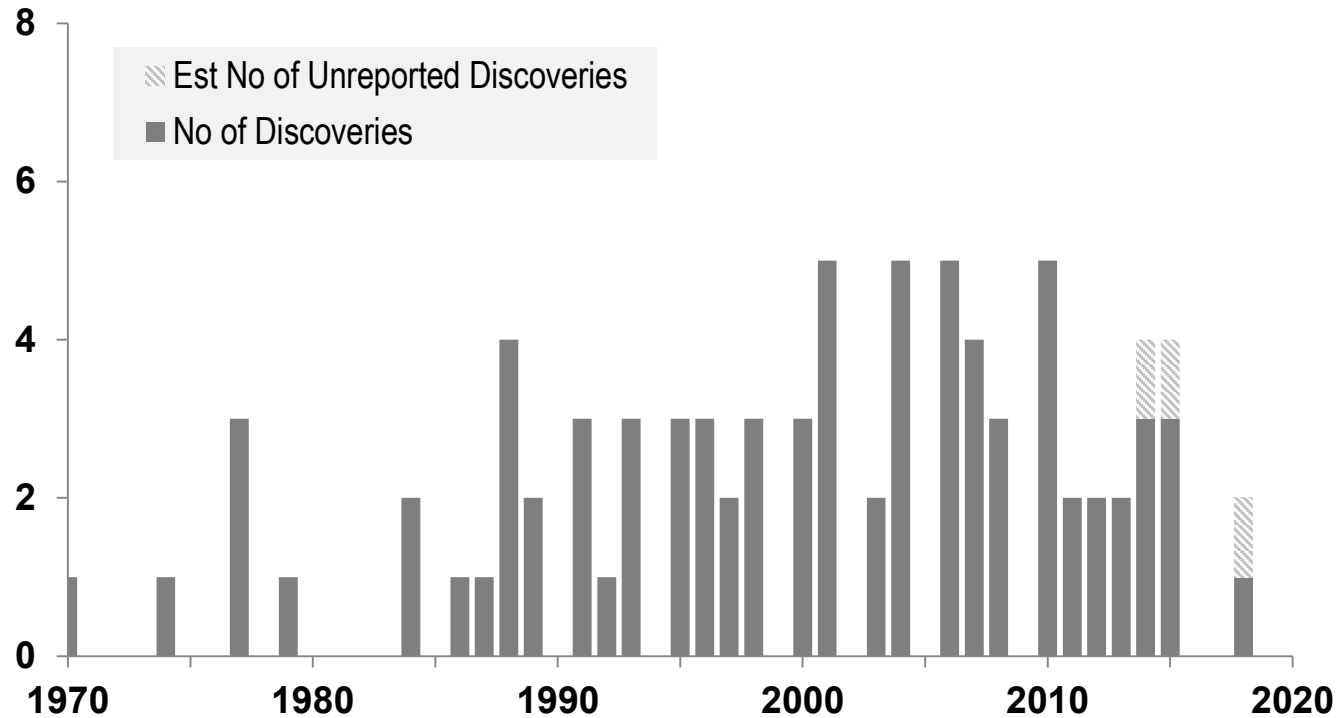
While costs have risen, The Tethyan Belt remains competitive

7. TRENDS IN UNIT DISCOVERY COSTS

Number of discoveries

Western Tethyan: 1970-2019

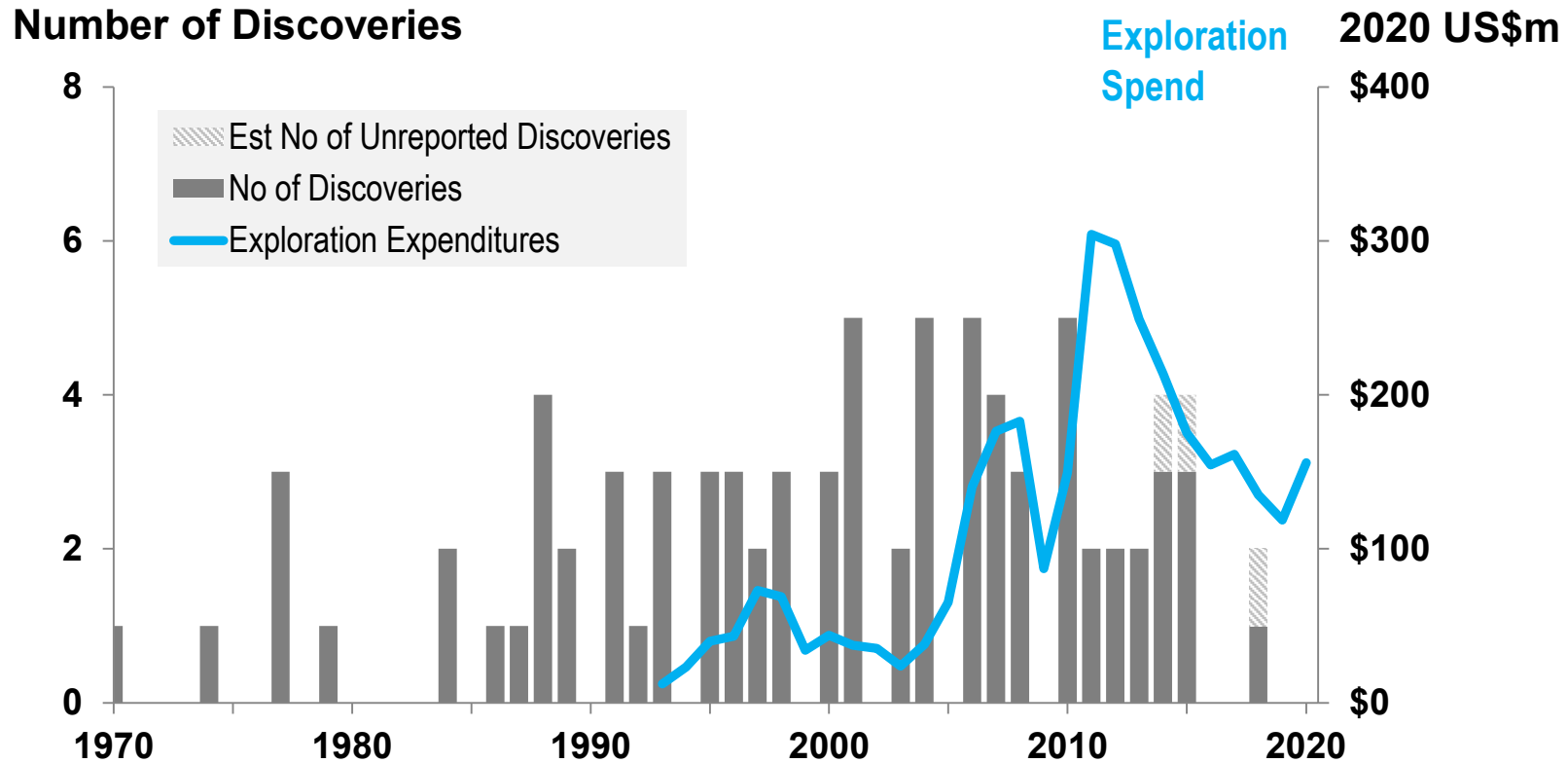
Number of Discoveries



Note: Based on Moderate-, Major- and Giant-sized deposits
 Excludes Bulk Minerals (such as bauxite, coal and iron ore)
 Excludes satellite deposits in existing camps
 Western Tethyan comprises Western Europe + Eastern Europe + Asia Minor TB Regions

Exploration spend and Number of discoveries

Western Tethyan: 1970-2019

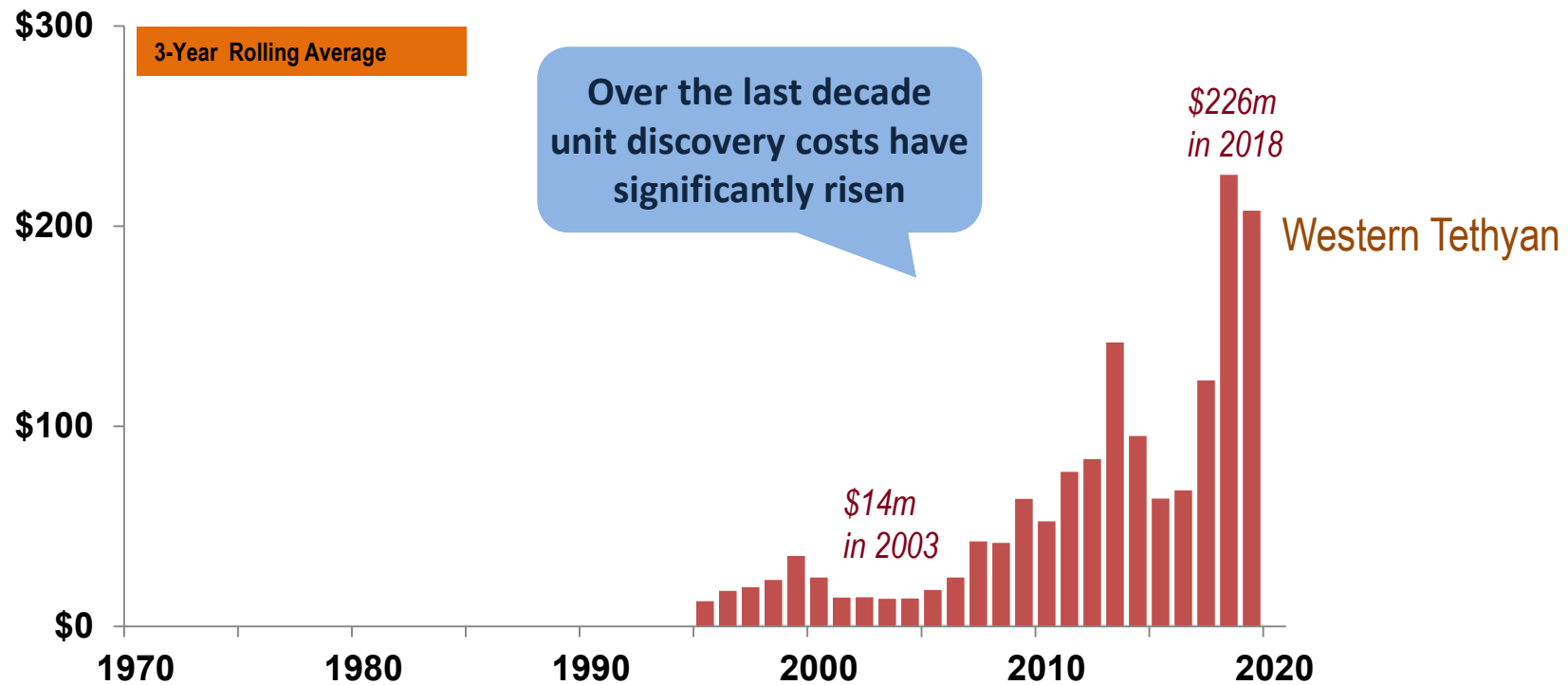


Note: Based on Moderate-, Major- and Giant-sized deposits
 Excludes Bulk Minerals (such as bauxite, coal and iron ore)
 Excludes satellite deposits in existing camps
 Western Tethyan comprises Western Europe + Eastern Europe + Asia Minor TB Regions
 No data on exploration expenditures prior to 1993

Average cost per deposit found

Western Tethyan Belt : 1995-2019

Average cost per Discovery (2020 US\$m)

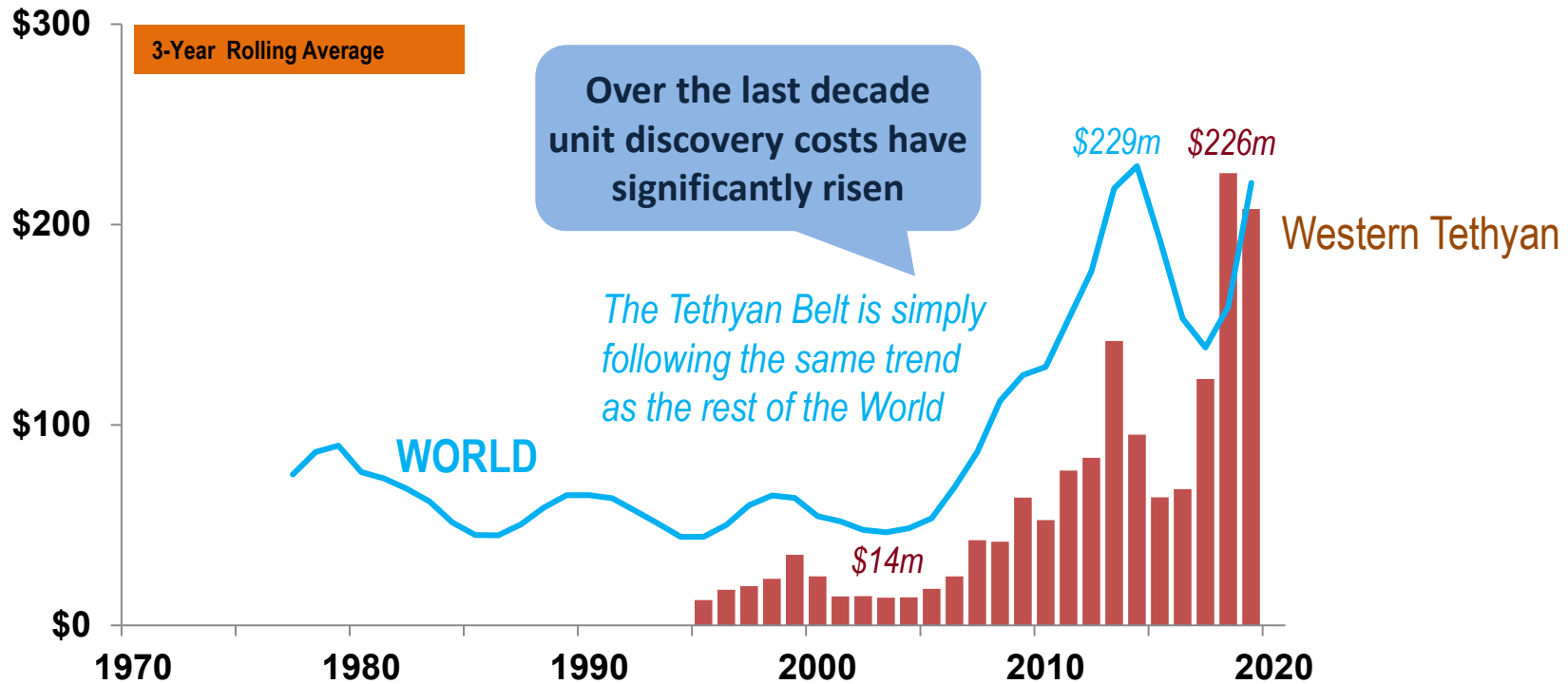


Note: Excludes bulk mineral expenditures and discoveries
Includes an adjustment for estimated unreported discoveries in recent years

Average cost per deposit found

Western Tethyan Belt versus the World: 1995-2019

Average cost per Discovery (2020 US\$m)



Note: Excludes bulk mineral expenditures and discoveries
Includes an adjustment for estimated unreported discoveries in recent years

Not all discoveries turn into mines

8. TIME DELAYS AND CONVERSION RATES FOR DISCOVERIES

Less than half of all discoveries made in the World since 1950 have been put into production

And for those deposits that did get developed, the average delay was 12 years

	Number of Deposits			Average Delay (Years)
	Discovered	Developed	Conversion Rate	
Total	4676	2120	45%	12.4

Note: Based on deposits >100 koz Au, >100kt Cu, >300kt Zn+Pb, >10kt Ni, > 5kt U₃O₈ or other minerals of equivalent size
Excludes Bulk Mineral discoveries and satellite deposits within existing camps

Source: MinEx Consulting © September 2017

The conversion rate and delay period varies by commodity

	<u>Number of Deposits</u>			<u>Contained Metal (Pre-Mined Resource basis)</u>			Average Delay (Years)
	Discovered	Developed	Conversion Rate	Discovered	Developed	Conversion Rate	
Gold	1992	1018	51%	5751	3793	Moz Au 66%	10.2
Copper	950	353	37%	2541	1363	Mt Cu 54%	16.8
Zinc+Lead	313	169	54%	754	447	Mt Zn+Pb 59%	14.1
Nickel (sulphide)	208	82	39%	106	60	Mt Ni 57%	12.8
Nickel (laterite)	150	48	32%	149	64	Mt Ni 43%	19.5
Uranium	347	156	45%	8.5	4.8	Mt U 57%	13.4
Other	716	294	41%	na	na	na	11.9
	-----	-----	-----				-----
Total / Average	4676	2120	45%			~57%	12.4

In terms of the amount of metal found, the conversion rates were higher ... i.e. bigger deposits are more likely to be developed

Source: MinEx Consulting © September 2017

Key Question: Is it getting more difficult to convert a discovery into a mine?

i.e.

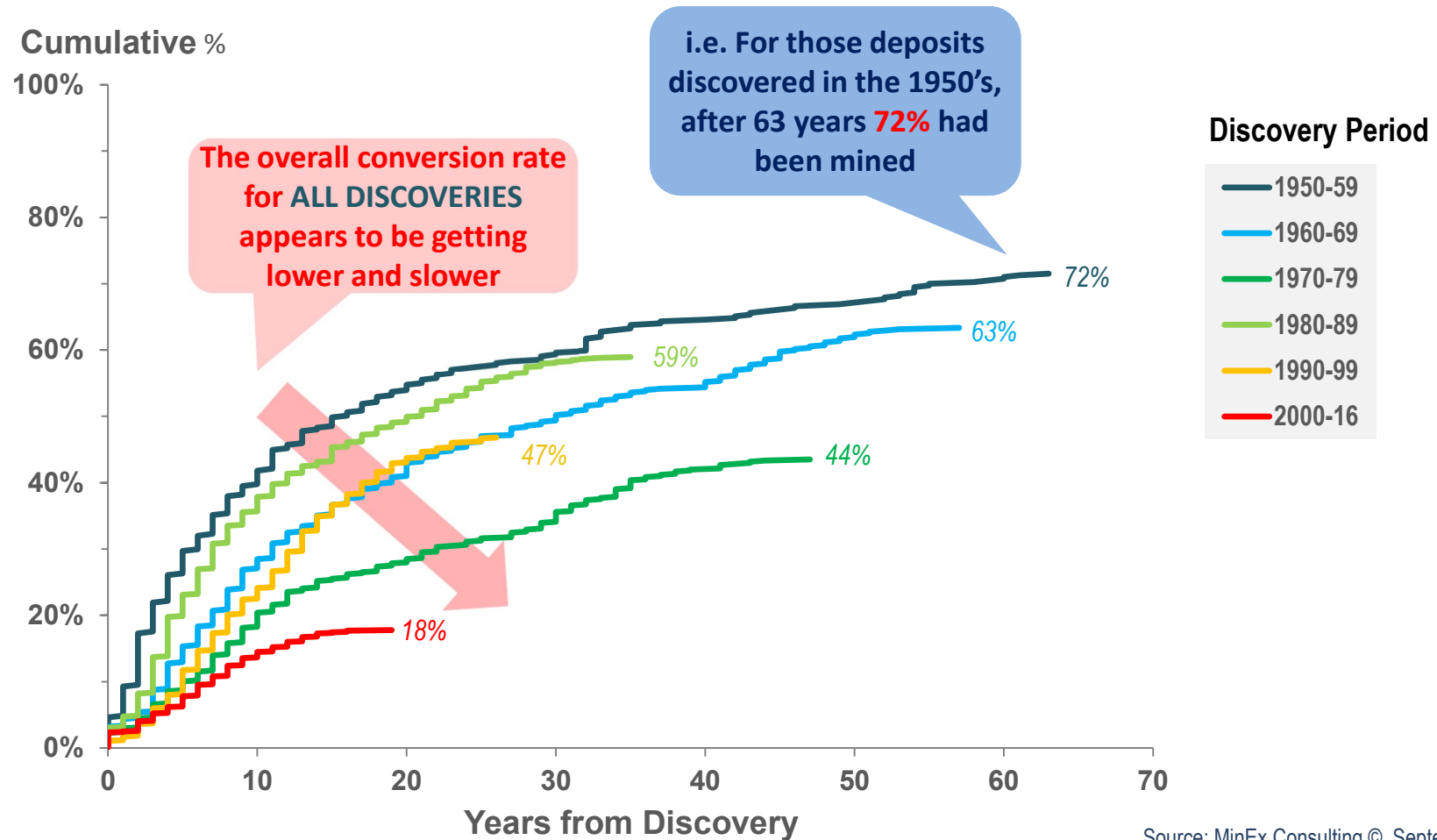
- Is the overall conversion rate getting better/worse?

And for those discoveries that do turn into mines ...

- Is the delay between discovery and development getting shorter/longer?

Cumulative Number of Discoveries that become mines: **ALL**

All Discoveries in the World \geq Moderate in size



The Tethyan place is a fertile and profitable place to explore.
Some regions within the Belt are better than others

The best opportunities are in Eastern Europe

9. CONCLUSIONS

Conclusions: [1/3]

1. Countries covered in the analysis

- The Tethyan Belt covers 7% of the earth's surface and spans 33 countries
- Have broken up the Belt into 6 Regions
 - Western Europe, Eastern Europe, Asia Minor, Central Asia & Middle East, Himalayas and South East Asia

Collectively called the Western TB

1.6% of the World's land mass

2. Trends in exploration spend

- Expenditures have grown substantially since the early 2000s
- Over the last decade, the Western-end of the Belt accounted for 1.4% of global exploration expenditures on non-bulk minerals
- The two main targets are gold and copper

3. Number of discoveries made in Western Tethyan Belt

- Over the last 50 years, 131 significant deposits have been found and industry continues to find ~3-4 new deposits each year
- In the last decade 20 out of the 22 discoveries were gold or copper

Conclusions: [2/3]

5. Mineral Endowment

- After adjusting for differences in land area, the size-frequency of the Belt's current mineral endowment for gold and copper is comparable to the World average
- The two most fertile regions are East Europe and Asia Minor

6. Trends in unit discovery costs

- The average cost per significant discovery has risen from \$14m (in 2003) to over \$200m in 2019
 - The rise in costs echoes that seen elsewhere in the World. Costs in the Tethyan Belt are comparable to the Global average

7. It is becoming progressively more difficult to convert a discovery into a mine

- Based on long term trends (at best) less than half of all discoveries are developed, and over those that do get mined the average delay can easily exceed 20 years.
 - Note: These rates vary by commodity, location and project size/quality

Conclusions: [3/3]

In conclusion, the Tethyan Belt is fertile for gold and base metals. To date, much of it is under-explored and is ripe for significant major new discoveries.

All it needs is a brave/smart geologist with the right tools to unlock the treasure



Contact details

Richard Schodde
Managing Director
MinEx Consulting
Melbourne, Australia

Email: Richard@MinExConsulting.com

Website: MinExConsulting.com

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