Chinese Exploration Standards and Philosophy: Implications for outbound investment

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Outline

- Chinese exploration standards – why care?
- Historical perspective
- Chinese exploration philosophy
- What do the Chinese standards cover?
- How do they compare with international codes like JORC?

Importantly what does this mean for Chinese investment?

or

How you will work with your Chinese JV partner?

Why care?

Outbound investment from China!

走出去“ 战略 (Zouchuqu Zhanlue)

Go abroad strategy! announced in 1998 - Chinese central government officially encourages investment outside of China.

Outbound investment in minerals is key to this and includes:

- Securing a supply of raw materials to provide vertical integration of established manufacturing industries
- Encouraging State owned mining companies to invest abroad
- More recently, privately owned enterprises have begun to invest in mining and exploration projects
- Since 2005, this has equated to $347 billion USD.

Chinese exploration standards

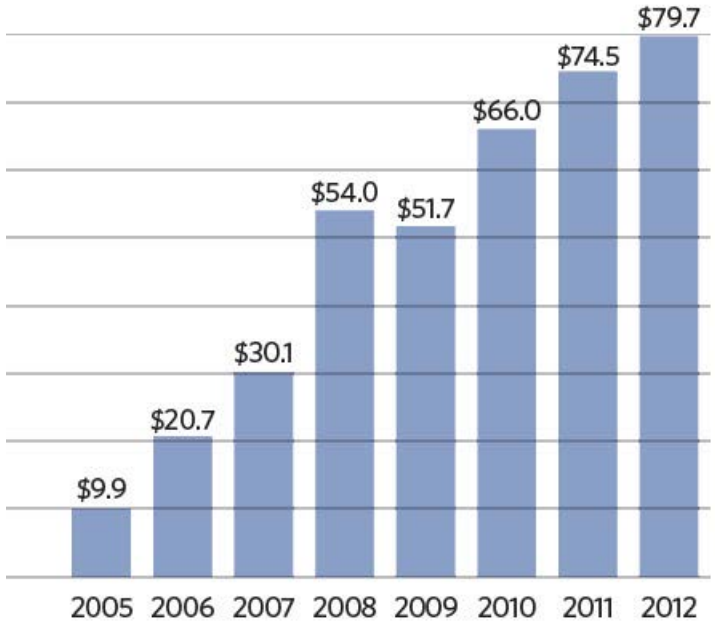
- Chinese investment is taking controlling interests and is active in management decisions!
- Chinese geologists use these standards as a basis for their work and refer to them constantly
- Project will be measured against the standards during initial due diligence or as part of ongoing JV
- Increasingly, Chinese contractors are working outside of China and will apply these standards to their work.

Growth of Chinese outbound investment

Sector Breakdown, 2005–2012

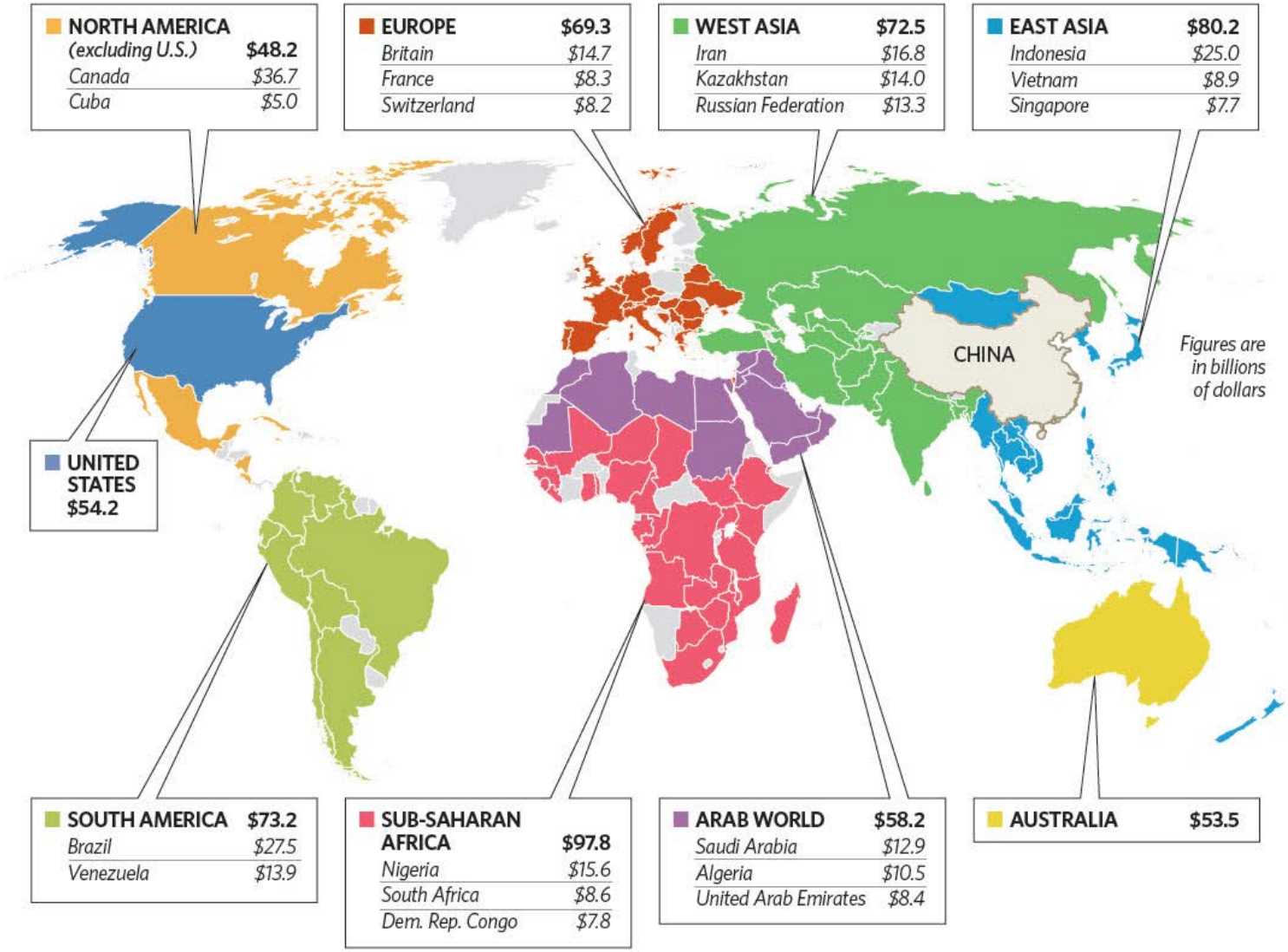
CHINESE BUSINESS ACTIVITY, IN BILLIONS OF DOLLARS

Sector	Investment	Engineering contracts	Troubled
Energy and power	$186.1	$97.2	$75.4
Metals	90.2	8.6	57.7
Finance	37.3	—	29.2
Real estate and construction	21.7	27.6	7.2
Transport	16.6	72.9	15.0
Agriculture	11.8	6.8	9.5
Technology	8.7	4.9	13.3
Chemicals	6.2	2.1	0
Other	8.2	0	0.3
Total	**$386.7**	**$219.9**	**$207.5**



Source: The Heritage Foundation, China Global Investment Tracker dataset, updated January 2013, https://thf_media.s3.amazonaws.com/2013/xls/China-Global-Investment-Tracker2013.xls.

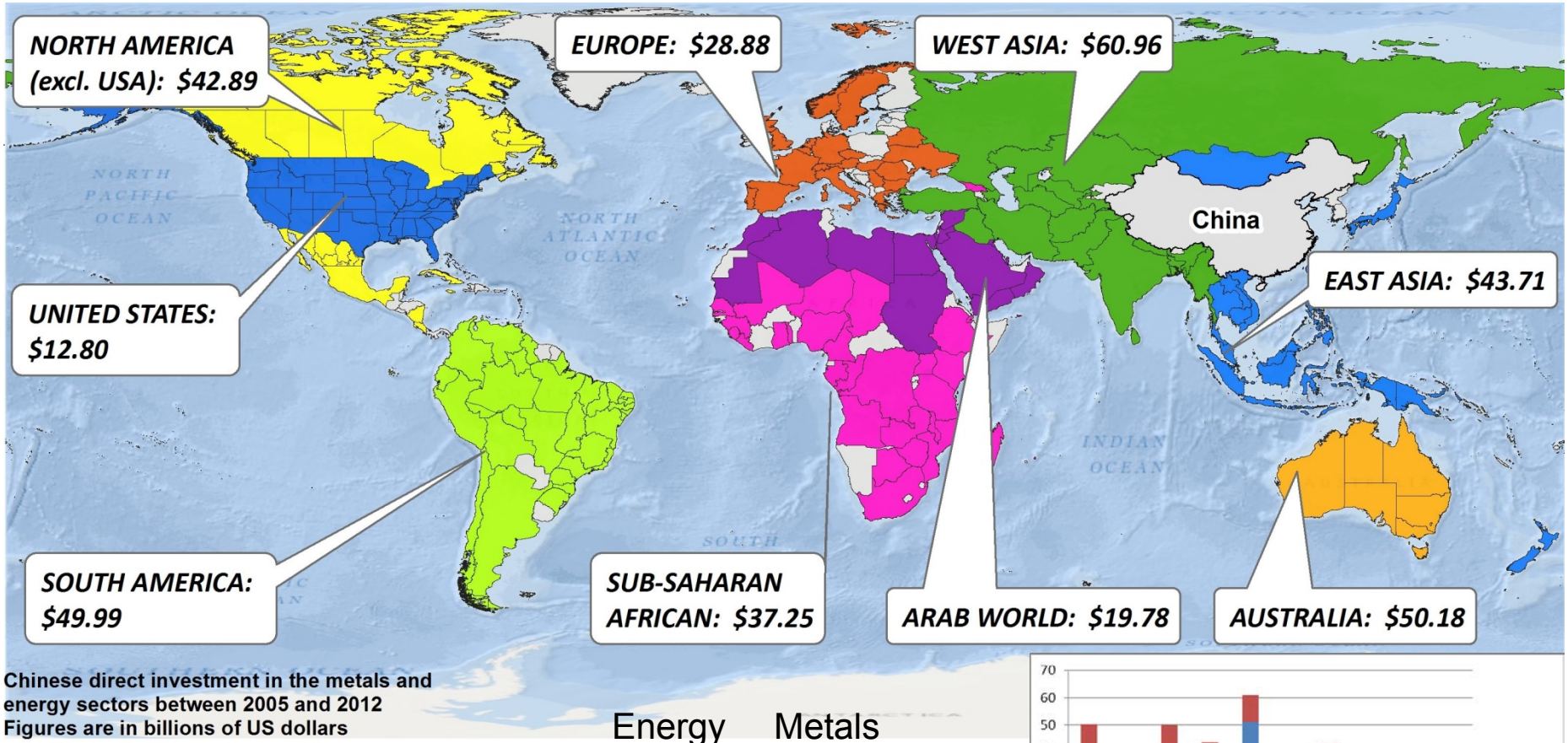
Chinese outbound investment



Total investment (>$100 M) since 2005 in billions of USD

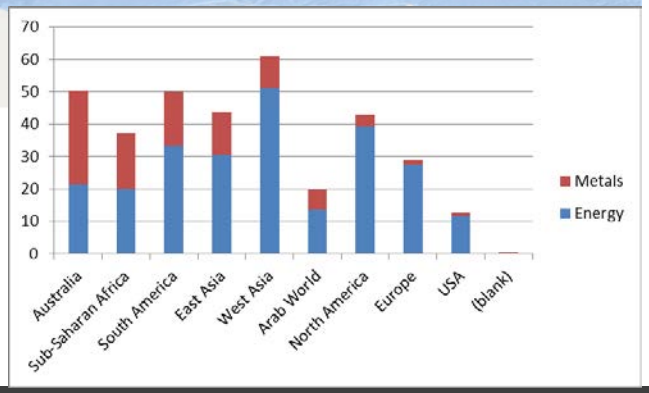
Source: The Heritage Foundation, China Global Investment Tracker dataset, updated January 2013, https://thf_media.s3.amazonaws.com/2013/xls/China-Global-Investment-Tracker2013.xls.

Chinese investment in minerals and energy



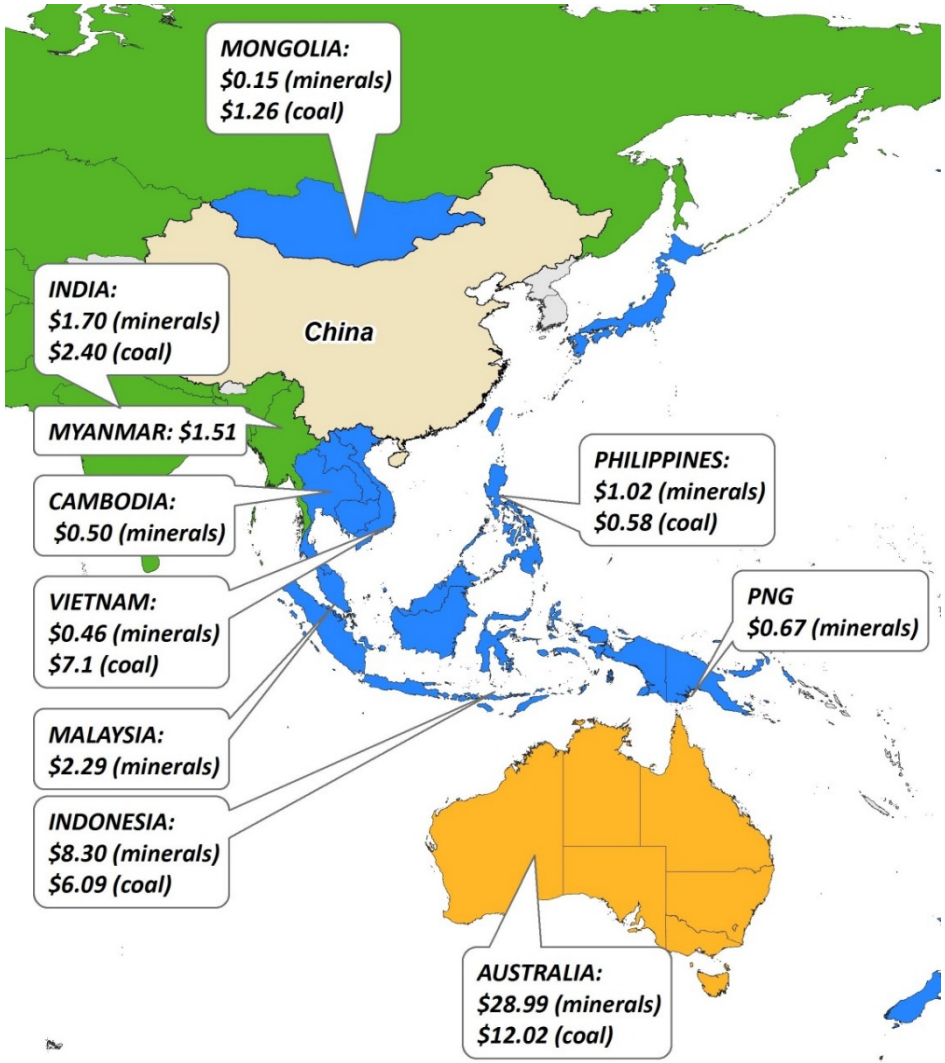
Chinese direct investment in the metals and energy sectors between 2005 and 2012
Figures are in billions of US dollars

	Energy	Metals
East Asia	$30.31	$13.39
Australia	$21.19	$28.99

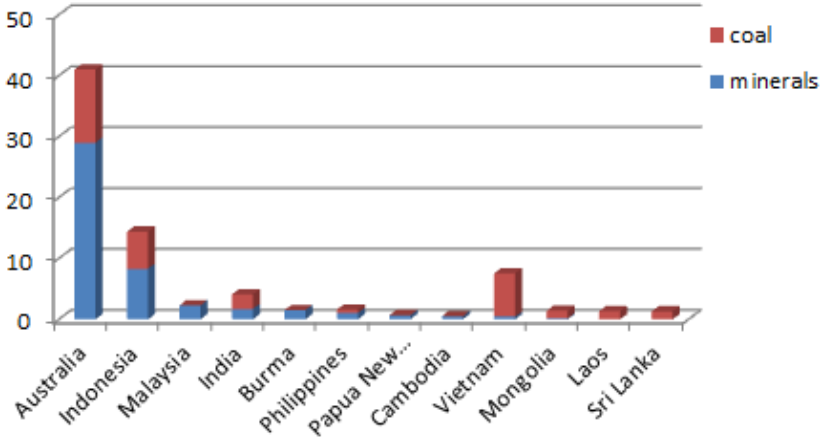


Source: The Heritage Foundation, China Global Investment Tracker dataset, updated January 2013

Significant investment in minerals projects across Asia



Over $ 26.64 billion invested in deals (>$100M) since 2005



Chinese Exploration

Chinese Exploration Philosophy

A centralised view on the planning, implementation and interpretation of mineral exploration:

- Highly prescriptive guidelines
- Rigid – each exploration stage is determined by measures such as sample spacing used in each
- Interpretation based on average values, cut-off grades, what is to considered anomalous and how to interpret them.

There can be a tendency to focus on compliance with the standards – this is sometimes done at the expense of good science!

Historic perspective

- 1950s - China develops exploration and resource standards based on Soviet standards
- 1959 - State Commission of Mineral Reserves (SCMR) defines Chinese standards
- 1983 - SCMR updates standards for mineral resources, exploration and codes

Since the late 1990s, standards have been managed by a variety of groups including the China Geological Survey and overseen by the General Administration of Quality Supervision, Inspection and Quarantine.

Chinese Exploration Standards

Comprehensive set of guidelines covering all aspects relating to mineral exploration:

- Mineral exploration guidelines for fieldwork, data handling, documentation, reporting
- Resource and Reserve classification
- Guidelines are commodity specific
- Provide definitions on exploration/ development stage.

Codes for all aspects of exploration and mining work

- Geological logging
- Exploration data and information
- Survey
- Drilling
- Sampling
- Tunnelling
- Cut-off for grade and thickness of ore deposits
- Geophysical and geochemical surveys
- Code of resource / reserve reporting for mine closure
- Hydrogeology and Engineering Geology of mineral deposit
- Regulations for ore process testing

Commodity specific codes

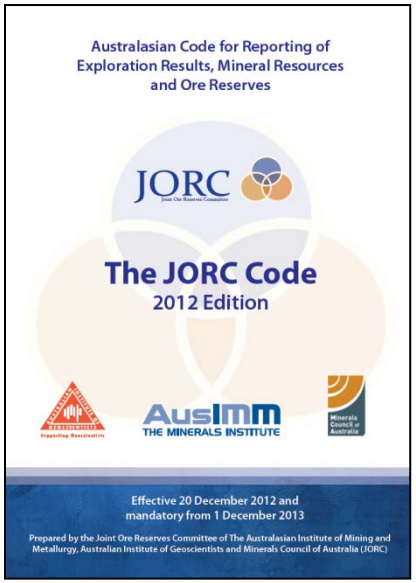
- Coal, peat coal (DZ/T0215-2002)
- Uranium (DZ/T0199-2002)
- Iron, manganese, chromium (DZ/T0200-2002)
- Copper, lead, zinc, silver, nickel, molybdenum (DZ/T0214-2002)
- Tungsten, tin, mercury, antimony (DZ/T0201-2002)
- Gold (DZ/T0205-2002)
- Bauxite (DZ/T0202-2002)
- Pyrite (DZ/T0210-2002)
- Phosphate (DZ/T0209-2002)
- Placer (metal) (DZ/T0208-2002)
- Rare Earth (DZ/T0204-2002)
- Rare Metal (DZ/T0203-2002)
- Barite, fluorspar, boron (DZ/T0211-2002)
- Metallurgical and chemical limestone (DZ/T0213-2002)
- Kaolin, bentonite, refractory clay (DZ/T0206-2002)
- Salts and lake salts (DZ/T0212-2002)
- Silicon material for glass, dimension stone (DZ/T0207-2002)
- Gypsum, chrysotile, wollastonite, talc, graphite(DZ/T0207-2002**)**

Comparison with Western standards and work practices

International Reporting standards

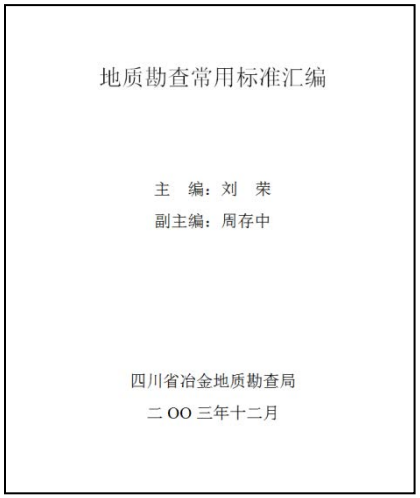
Major reporting standards include:

- JORC (Australia)
- NI 43-101 (Canada)
- AIM (UK)
- HKEx (Hong Kong)
- SAMREC (South Africa)



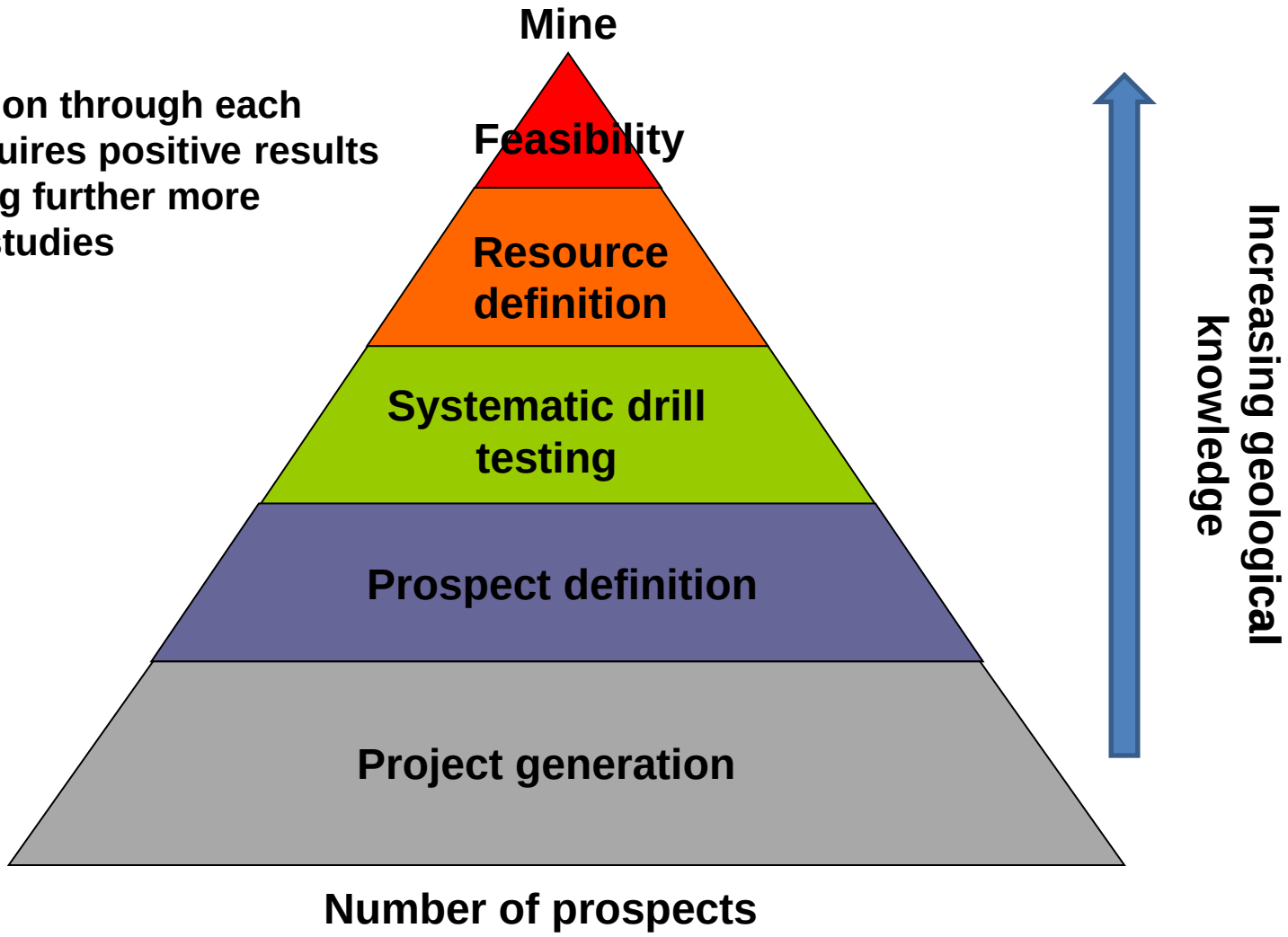
Chinese National Standards

- How do they differ?
- How do they influence the way exploration work is done?



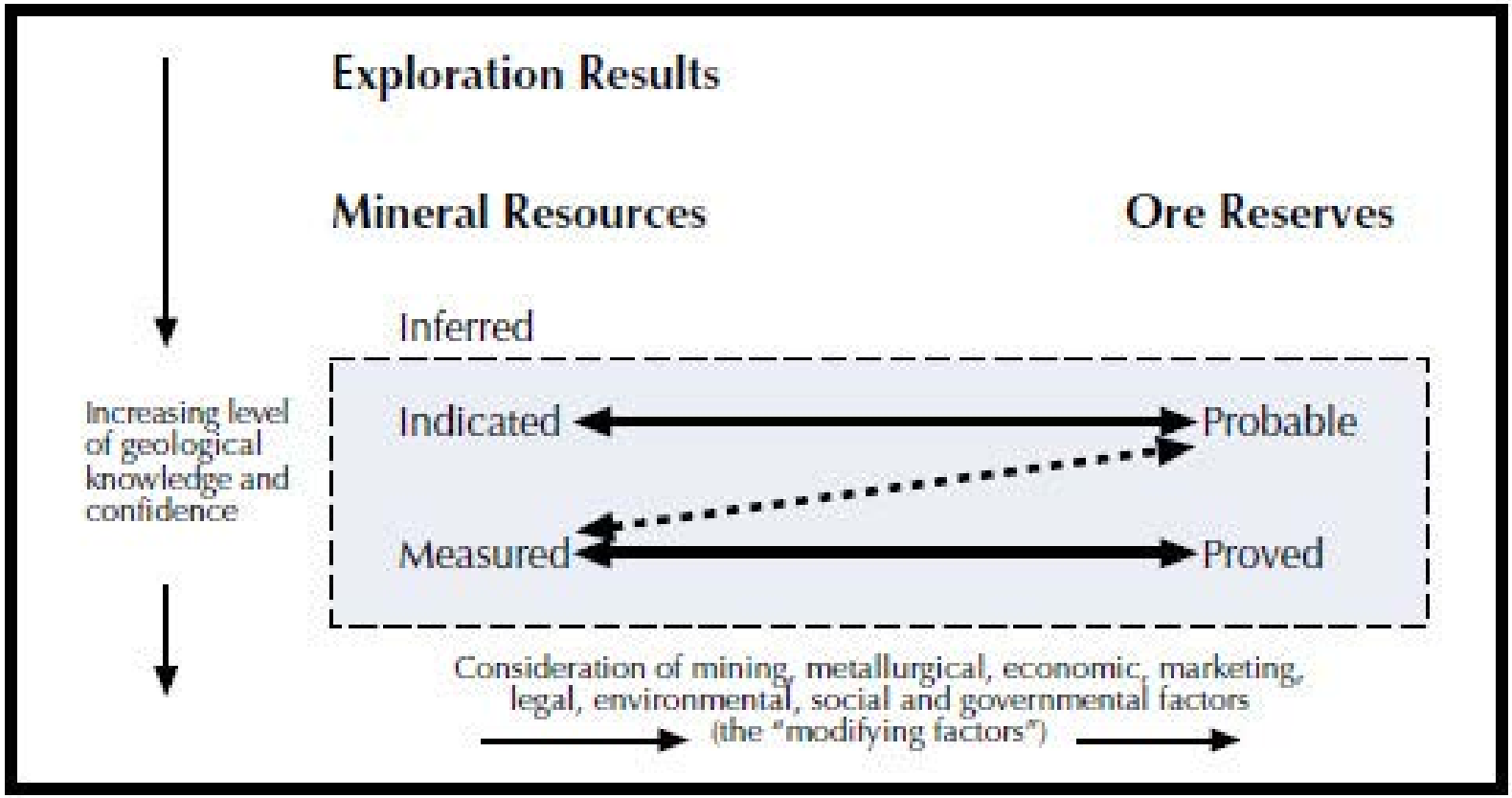
Exploration stages - Western perspective

Progression through each stage requires positive results warranting further more detailed studies



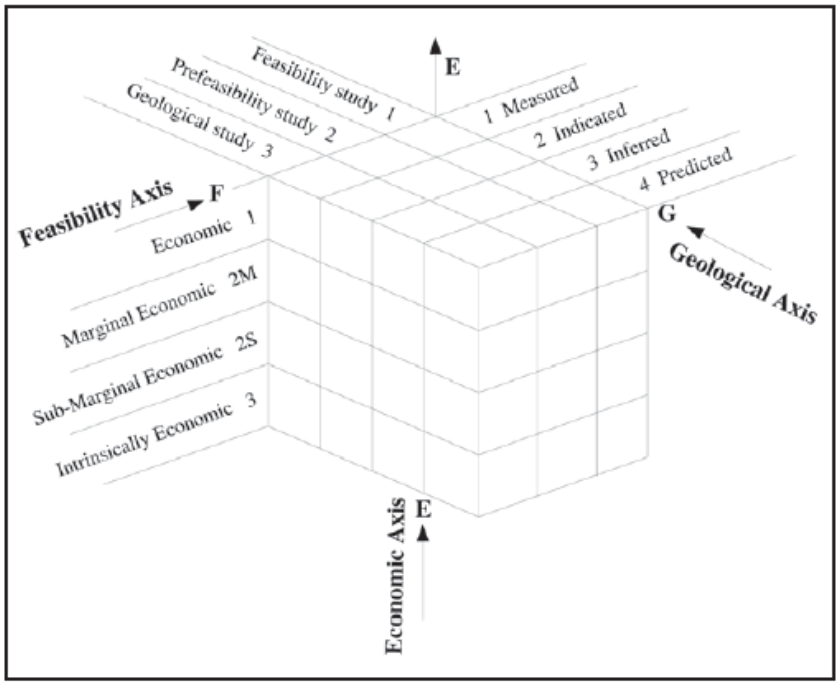
The JORC Code

General relationship between Exploration Results, Mineral Resources and Ore Reserves



Chinese Exploration stages

1. Reconnaissance (334)
2. Prospecting (333)
3. General Exploration (331)
4. Detailed Exploration (331)



Chinese Exploration stages

	Reconnaissance	Prospecting	General Exploration	Detailed Exploration
Description	Exploration targets based on geophysics, geochemistry, geology and/or mineral occurrences	Identified mineralisation with basic understanding of controls on mineralisation	Broad understanding of controls on mineralisation	Detailed understanding of controls on mineralisation
Sample spacing	Very few	Limited, but identified potential mineralisation	Systematic sampling and drilling	Detailed sampling
Geological knowledge	Limited	Inferred	Basic	Confirmed
Confidence	Predicted Resource (334)	Inferred Resource (333)	Indicated Resource (331)	Measured Resource (331)
Metallurgical testing	None	Initial testwork	Benchtop testing	More detailed up-scaled testing
Feasibility study	None	Preliminary	Pre-feasibility	Feasibility

Feasibility studies

There are three levels of feasibility studies corresponding to the exploration stages:

- Preliminary study: basic economic studies based on geographic location, commodity, deposit style and other factors
- Pre-feasibility and feasibility studies carried out by mine design institutions.

Resource evaluation

Old Classification		A & B		C			D	E & F
New Classification								
"E" Economic Evaluation (100)	**Designed mining loss accounted**	Recoverable Reserve (111)	Probable Recoverable Reserve (121)		Probable Recoverable Reserve (122)			
	Designed mining loss not accounted (b)	Basic Reserve (111b)	Basic Reserve (121b)		Basic Reserve (122b)			
Marginal Economic (2M00)		Basic Reserve (2M11)	Basic Reserve (2M21)		Basic Reserve (2M22)			
Sub-Economic (2S00)		Resource (2S11)	Resource (2S21)		Resource (2S22)			
Intrinsically Economic (300)		-	-	Resource (331)		Resource (332)	Resource (333)	Resource (334)
"F" Feasibility Evaluation		**Feasibility (010)**	**Pre-Feasibility (020)**	**Scoping (030)**	**Pre-Feasibility (020)**	**Scoping (030)**	**Scoping (030)**	**Scoping (030)**
"G" Geological Evaluation		**Measured (001)**			**Indicated (002)**		**Inferred (003)**	**Predicted (004)**
JORC							***Unclassified or Exploration Potential***	
					Inferred			
			Probable Reserve OR Indicated Resource					
		Proved / Probable Reserve OR Measured Resource						

Bucci *et al*., 2006

Reporting - often not very transparent!

- Refers appropriate standard in the Chinese system without adequately explaining work done
- Do not report intersections or grade – even at early stage exploration, will classify zones of mineralisation into “ore bodies” using average grades within polygonal wireframes
- Very simplistic assessment of geology and structure to provide continuity.

Sampling and analysis

- Sample handling
- Storage
- Security
- QA/QC
- Analytical quality

Sample crushing equipment, poorly maintained and not cleaned

Drilling and sampling

- Sample or drillhole spacing usually based on what is prescribed in standards
- In practice, drilling is mostly vertical, even on steeply dipping ore bodies
- Poor drilling recoveries (85% is considered acceptable)
- Downhole surveys (uncommon, but when done, they are typically single-shot type)
- QAQC - sampling protocols, blanks and standards not commonly used.

Drilling

Summary of differences between Chinese and Western systems

	Chinese	Western
Technical Studies	"Development Plan", PFS, FS	Chinese PFS is likely equivalent to Scoping Study; FS is likely equivalent to PFS
Ore Declaration	Proven to be economic through a Chinese PFS or FS	At least a PFS
Drill Spacing	Prescribed in the Chinese exploration standards	Competent Person's decisions (based on geological continuity and geostatistical properties)
QA/QC	"internal checks" (pulp duplicates) and "external checks" (inter-lab checks) only	Blank, standards, duplicates, inter-lab checks
Resource Estimation	Sectional polygonal, 2D	Geostatistics, 3D
Cut-offs	Prescribed in the Chinese exploration standards. Only Resources under one single cut-off are presented.	Competent Person's decisions. Resources under a number of different cut-offs are commonly presented.

Case studies – Chinese project listing on HKEx

HKEx Chapter 18 only accepts JORC, NI 43-101 and SAMREC

- Project with Chinese classified resources
- Drill spacing too wide, QA/QC data lacking and resource based on 2D polygonal techniques.

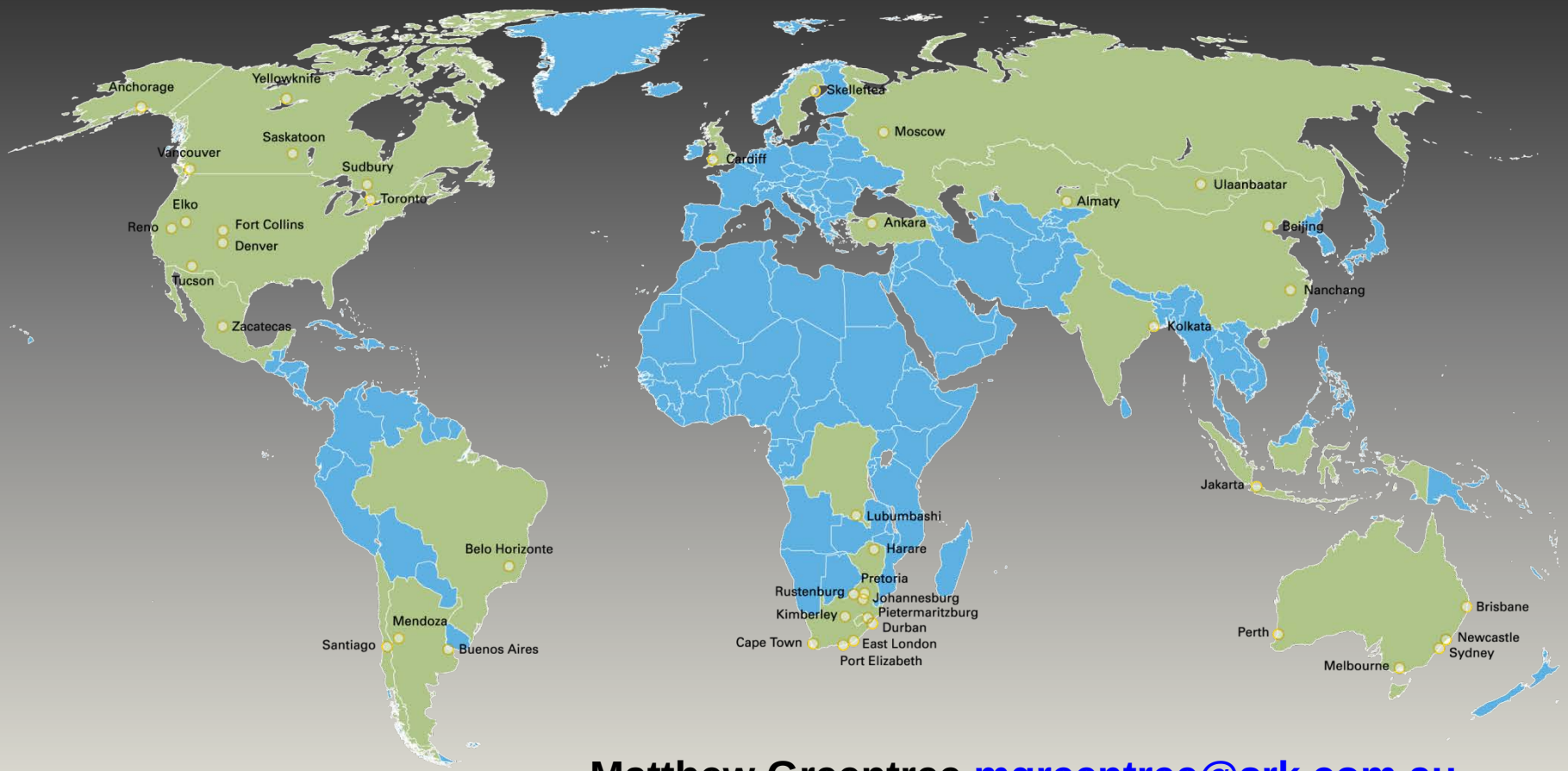
Project requires holes to be twinned (~10% of drilling), cores partly re-sampled (QA/QC) and in-fill drilling

- Re-estimate and classify in accordance with the JORC Code

Summary

- China has invested over $347 billion USD globally in resource projects since 2005
- Chinese standards are highly prescriptive; this centralises planning and interpretation
- The standards differ in philosophy; they are prescriptive and do not rely on a competent person
- Chinese resource companies will continue to use these standards as they work outside of China; it will influence the way they work and work with other companies.

Thank you



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