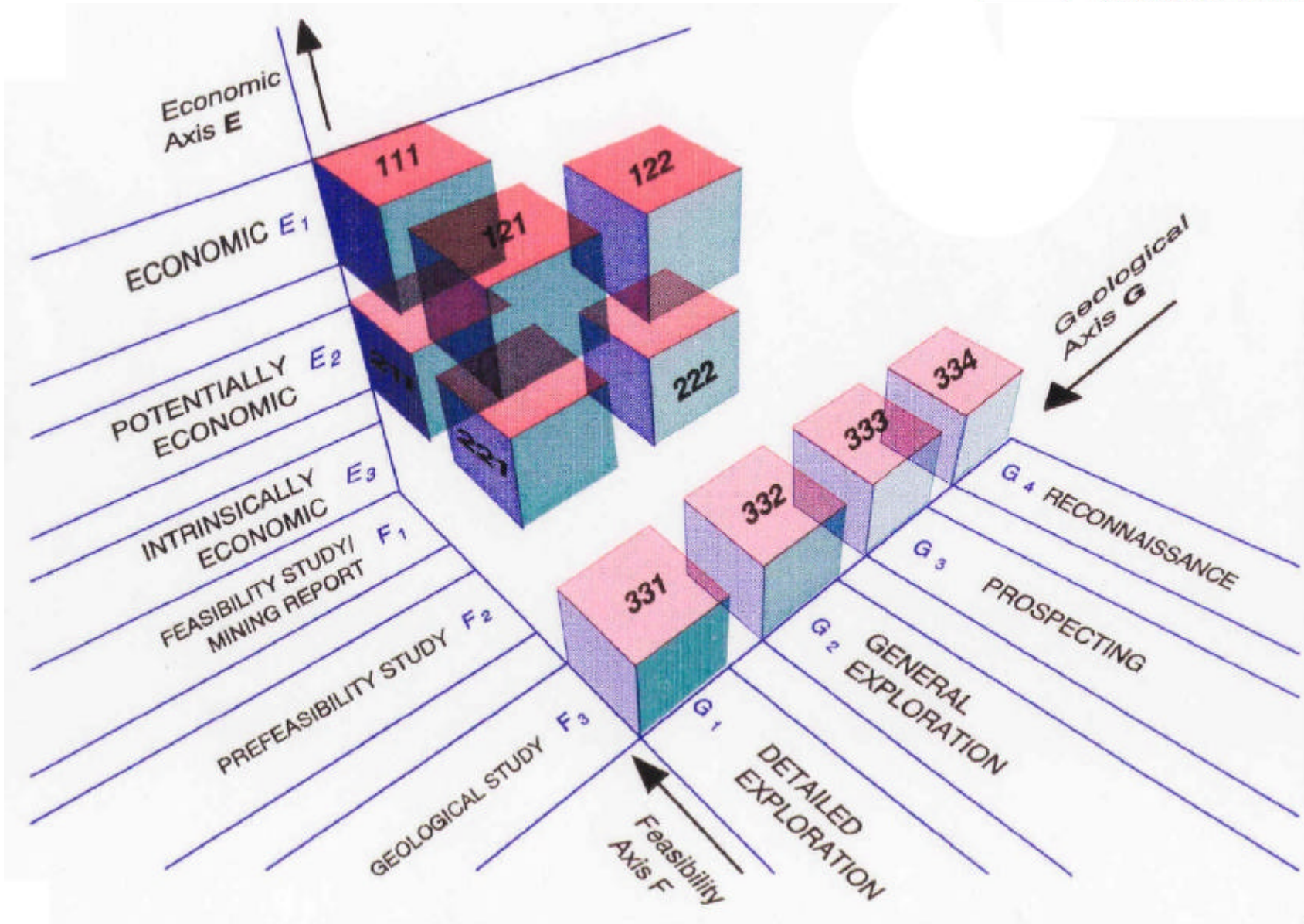


**FRAMEWORK
CLASSIFICATION
FOR
WORLD ENERGY RESOURCES
(OIL & GAS, COAL, URANIUM)**

UN- Task Force on Reserves/Resources

Design Principles
of
**UN FRAMEWORK
CLASSIFICATION**
FOR
RESERVES/RESOURCES

Andrej Šubelj

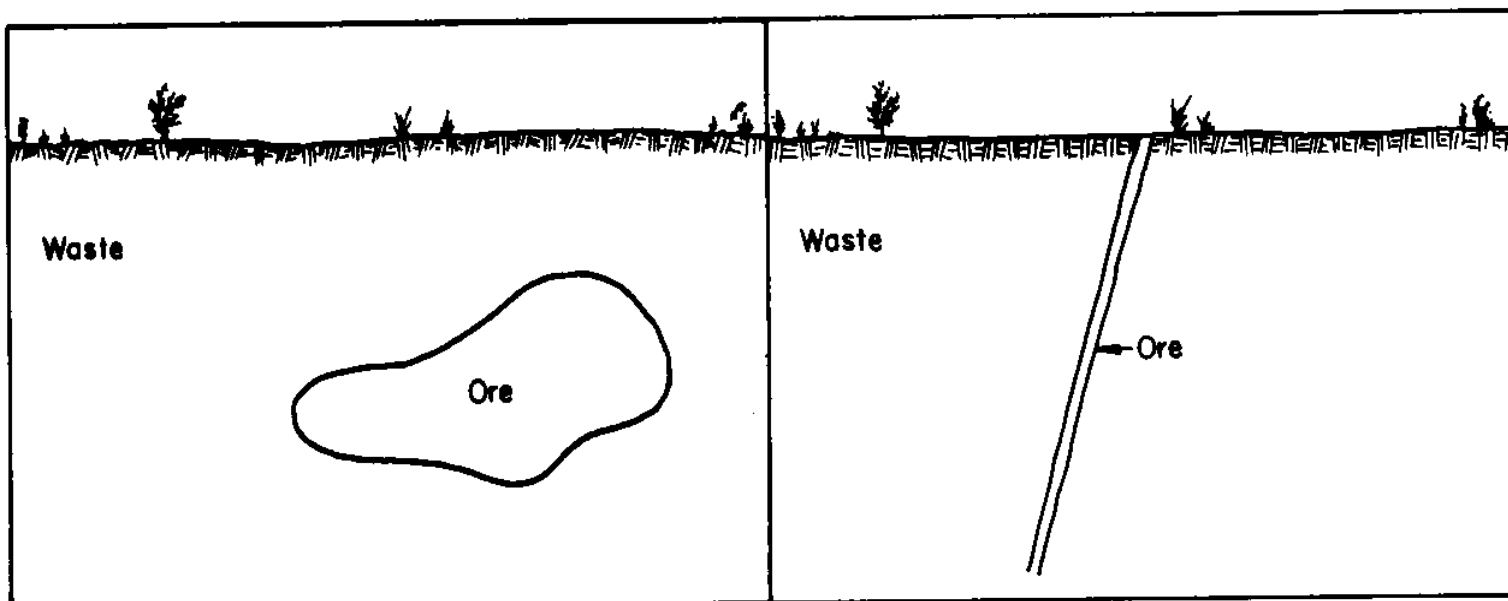


UN International Framework		Detailed Exploration	General Exploration	Prospecting	Reconnaissance
	National System				
Feasibility Study and/or Mining Report		1 (111)		usually not relevant	
		2 (211)			
Prefeasibility Study		1 (121)	+ (122)		
		2 (221)	+ (122)		
Geological Study		1-2 (331)	1-2 (332)	1-2 (333)	? (334)

Economic Viability Categories: 1 = economic . 2 = potentially economic. 1-2 = economic to potentially economic (intrinsically economic). ? = undetermined
 Classification Code: (111). = (E.F.G). where E = degree of Economic Viability, F = stage of Feasibility Assessment, and G = stage of Geological Assessment.

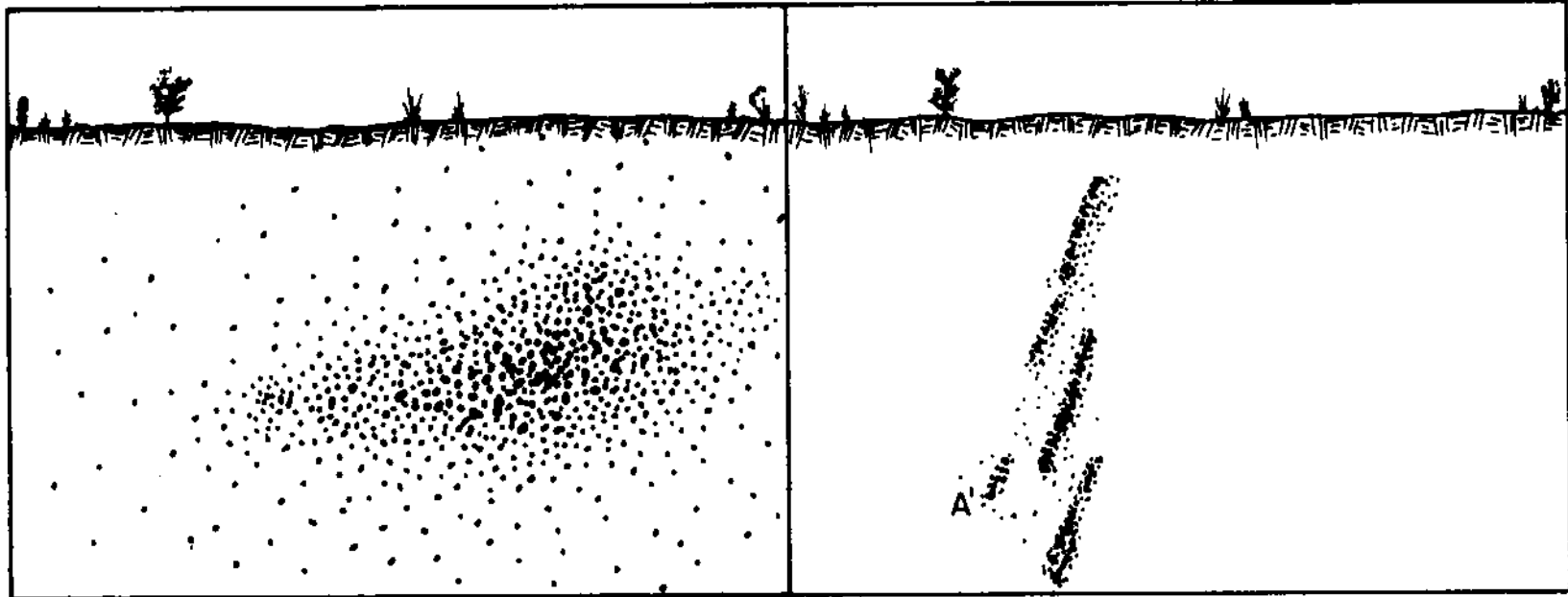
Mineral resource

**is used to denote all solid,
liquid, or gaseous geologic
materials exploitable for use**



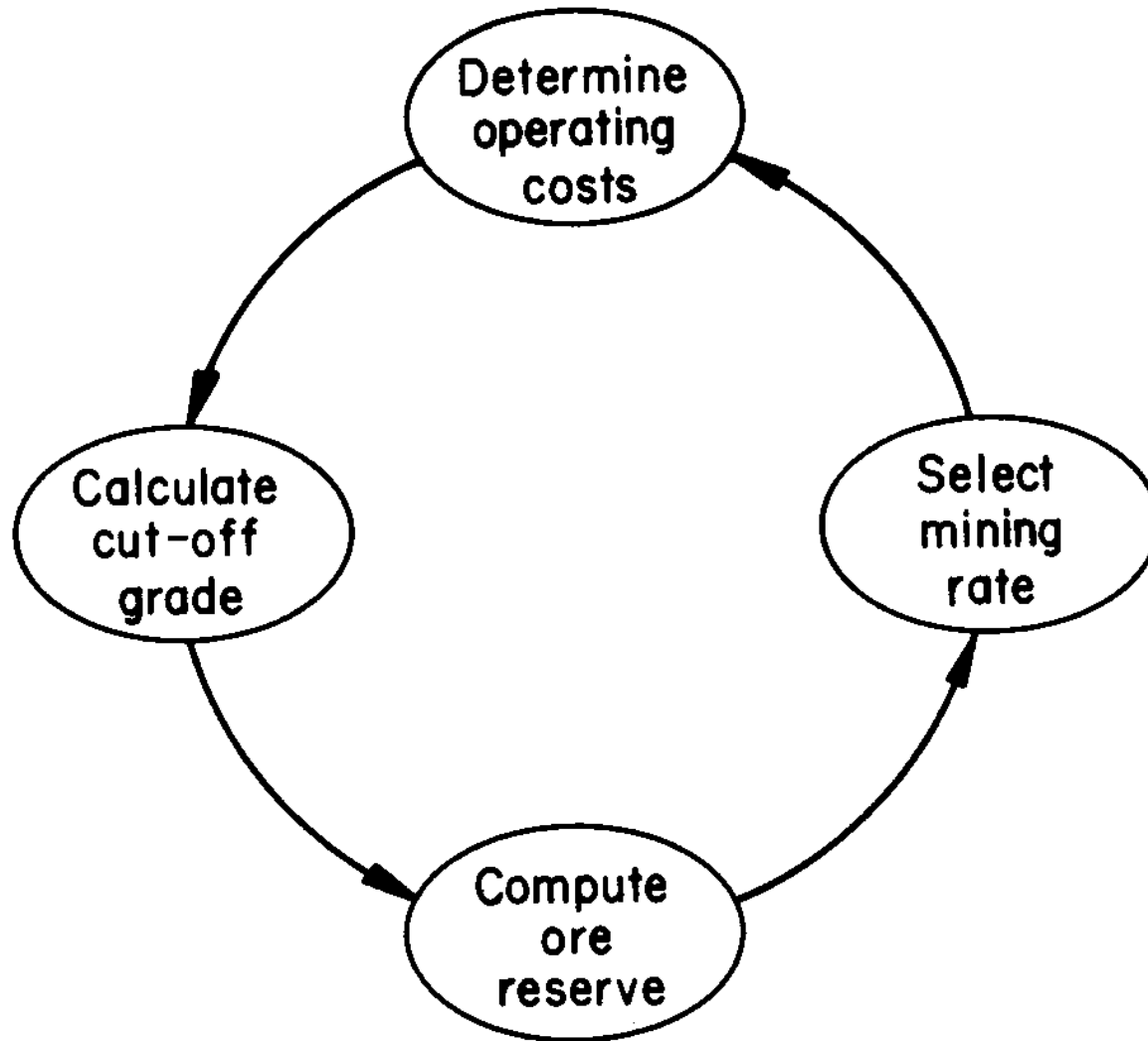
(a) Massive deposit

(b) Vein deposit



(a.) Massive deposit

(b.) Vein deposit



Mineral reserves

are measured quantities of minerals and metals which can be exploited profitably with currently available technology in present economic conditions

Requirements for good classification system

- **covers all aspects**
- **covers all needs**
- **translation interface**
- **as simple as possible**

Need for unification

two initiatives

- Joint Ore Reserves Committee

CMMI

- Countries in transition

UN ECE

UN TASK FORCE

D. Kelter, FR Germany

G. Fettweis, Austria

HU KUI, PR China

V. Tverdohlebov, Russian F.

A. Šubelj, Slovenia

G. Riddler, UK

H. Gluskoter, USA

Who needs Classification

- **governments (inventory, SEC)**
- **financial institutions**
- **companies**
- **international organizations
(WEC, IAEA, OPEC, IASB, CESR)**

Classification systems

- **states**
- **international organisations**
- **companies**

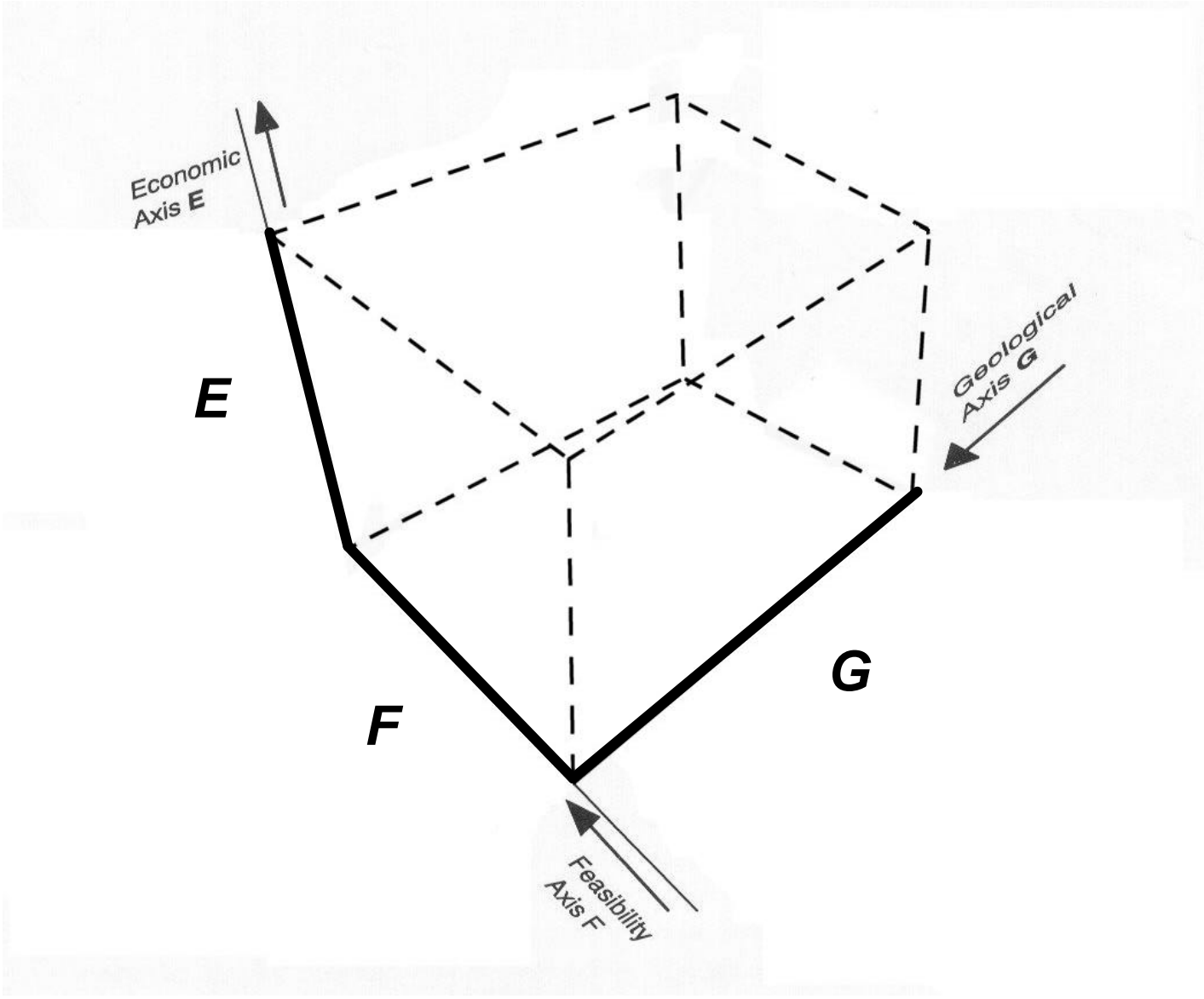
History of Classification systems

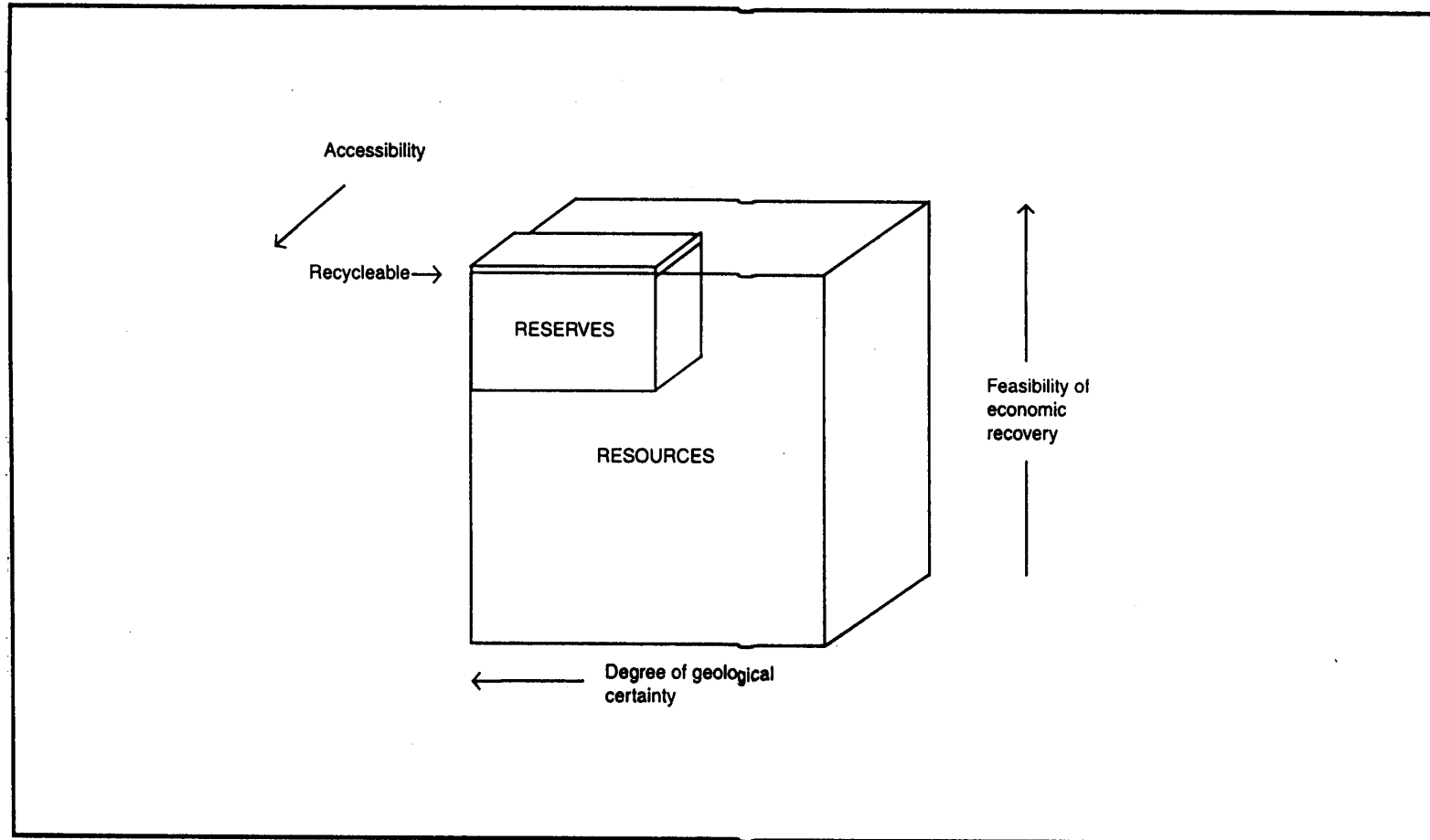
- **1915 Witwatersrand Basin**
- **1920 Shinkolobwe Congo**
- **1928 Soviet Union**
- **1943 USA**
- **1950 Eastern Systems**
- **1960 decline in military use of U**
- **1973,86 McKelvey, 1981 Canada,
1978/79 UN, 1981 Fettweis**
- **1996 UNFC**
- **1999 JORC**
- **2001 harmonisation of solid minerals,
oil, gas and uranium classifications**

Eksploitability

$\text{Ekspl} = f(\text{geol,tech,leg,env,....,mpr})$

$\text{Ekspl} = f(\text{G,F,E})$





Source: Based on Peter Cook, 'The Role of The Earth Sciences in Sustaining our Life Support System'.
British Geological Survey, Technical Report WQ/91/1

Two general groups of classification systems

- “eastern”
- “western” - CMMI

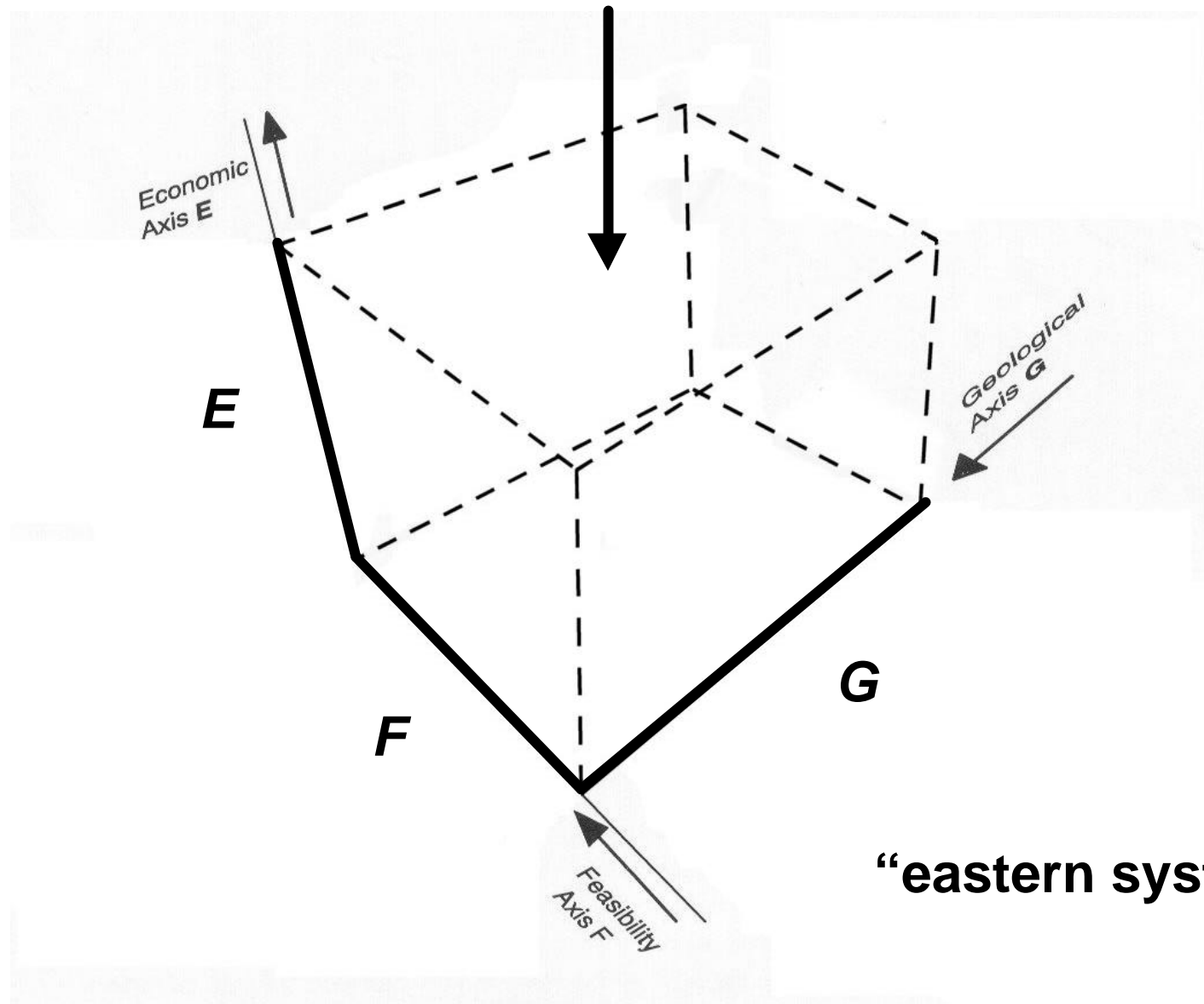
G

F

“eastern” systems

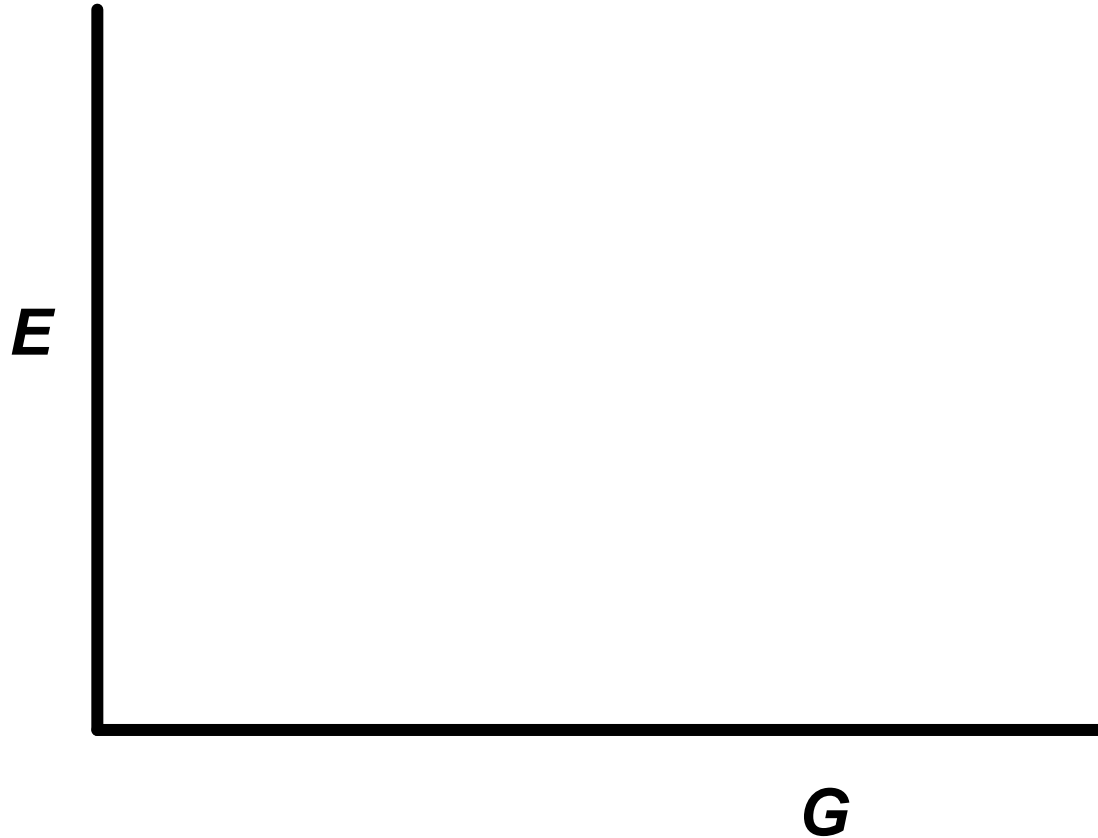
Soviet Union

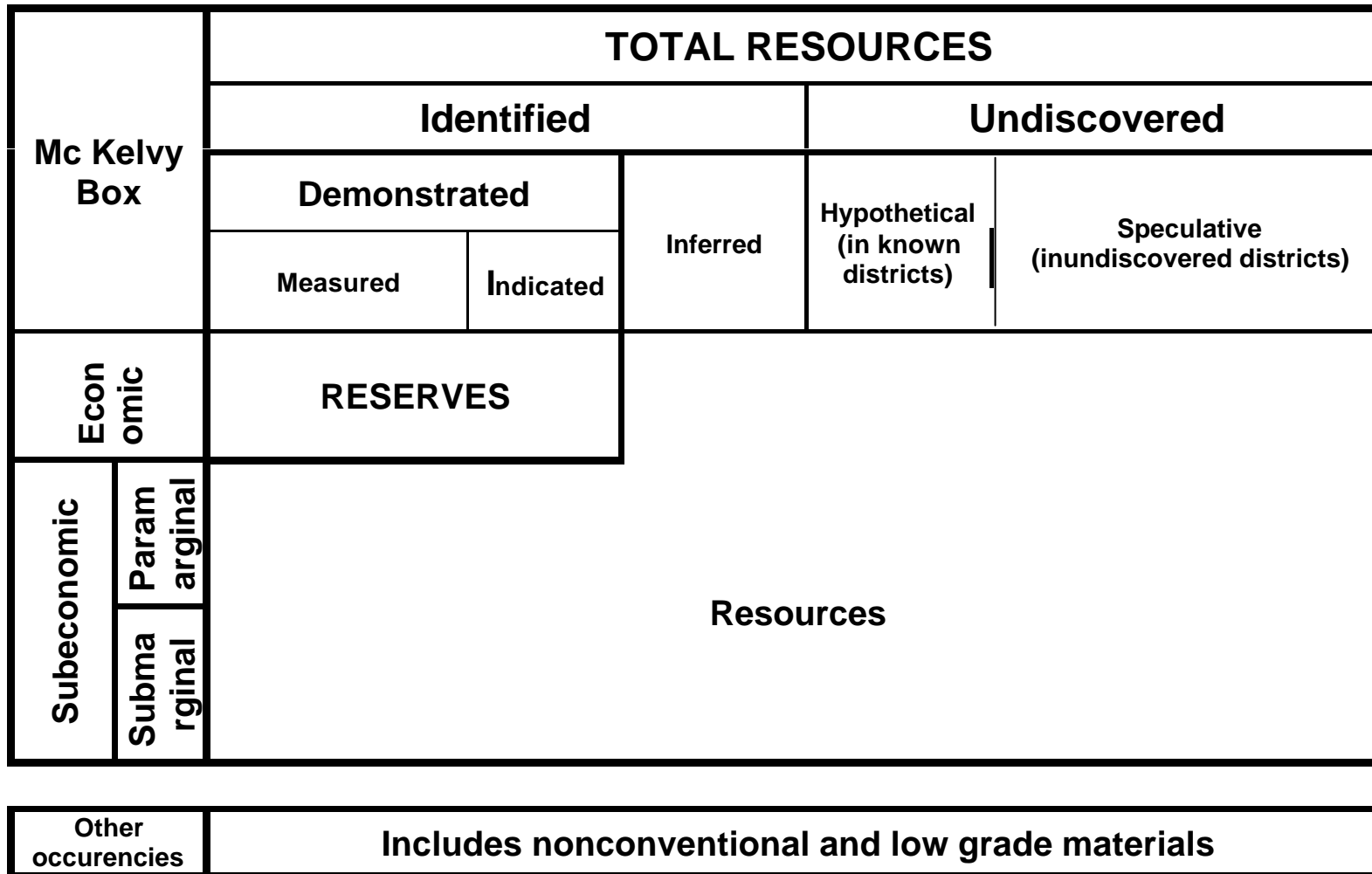
		TOTAL RESOURCES					
		Degree of knowledge (certainty) and categories					
NATIONAL ECONOMIC CATEGORIES	RESERVES				PROGNOSTIC RESOURCES		
	Exploration		Preliminary estimation		P₁	P₂	P₃
Balance reserves	A	B	C₁	C₁	Resources in explored areas, exploration areas and found by prospecting	Resources in areas with known deposits	Resources in areas with no known deposits
Out of balance reserves	a	b	C₁	C₂			



“eastern systems”

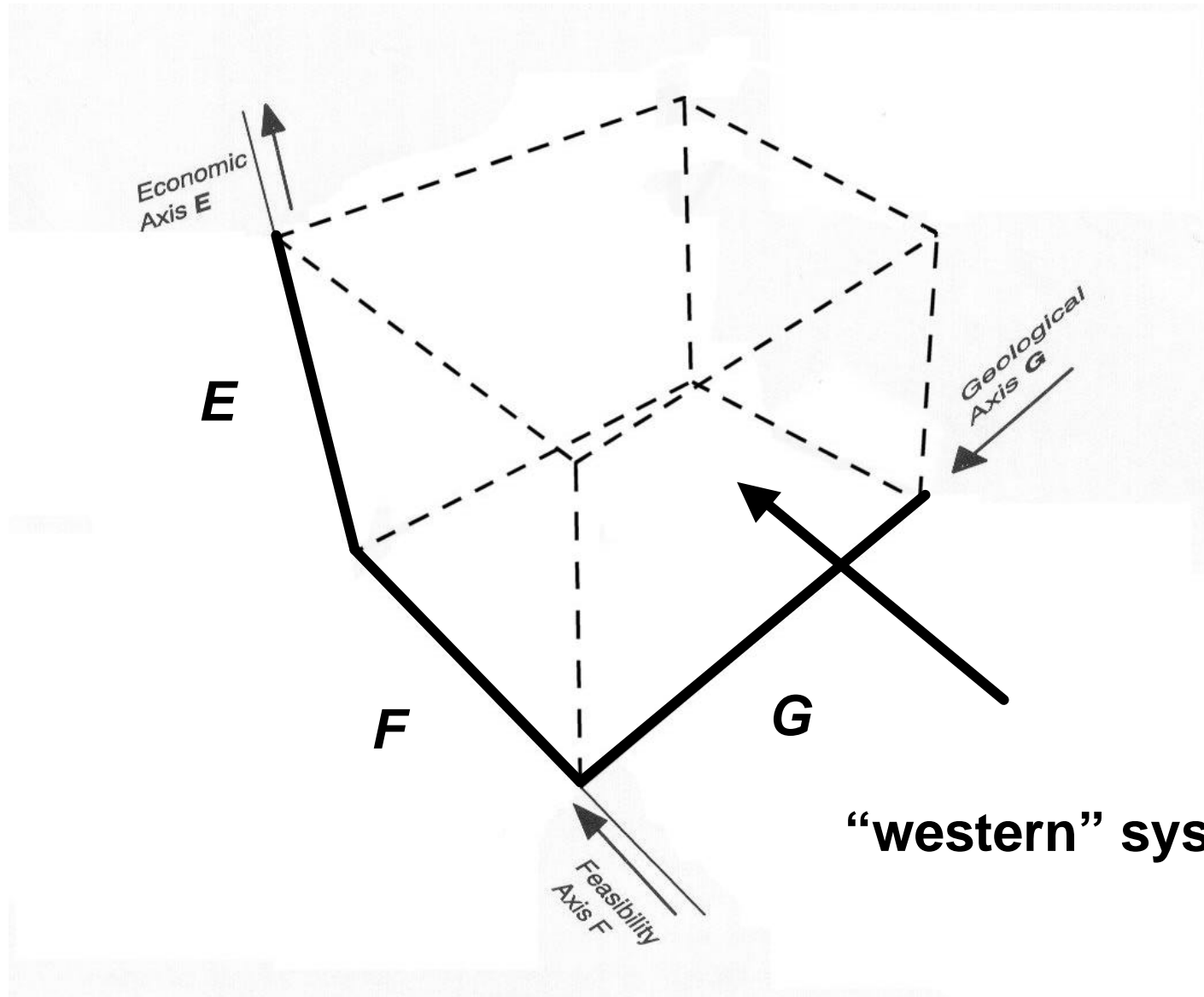
“western” systems



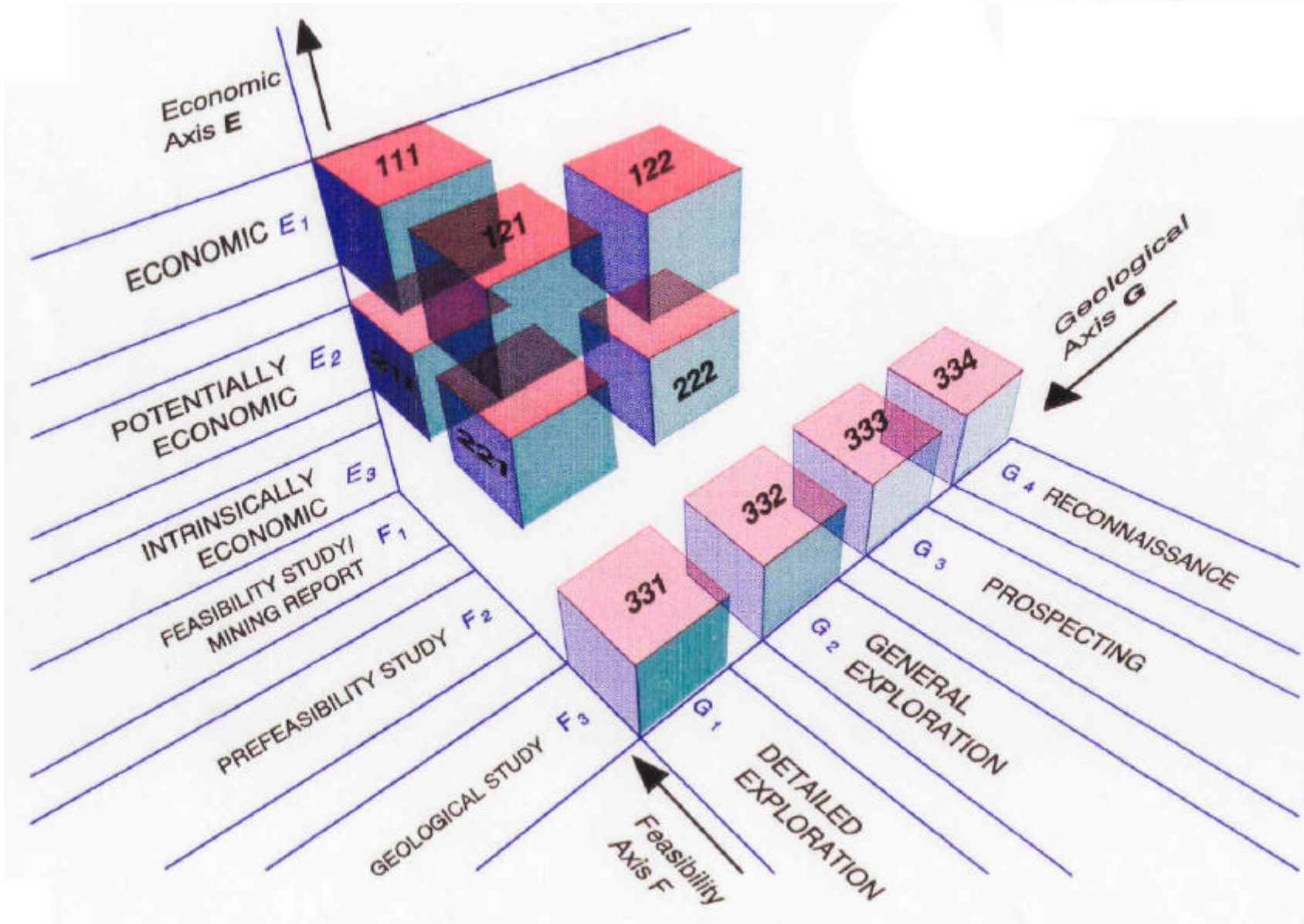


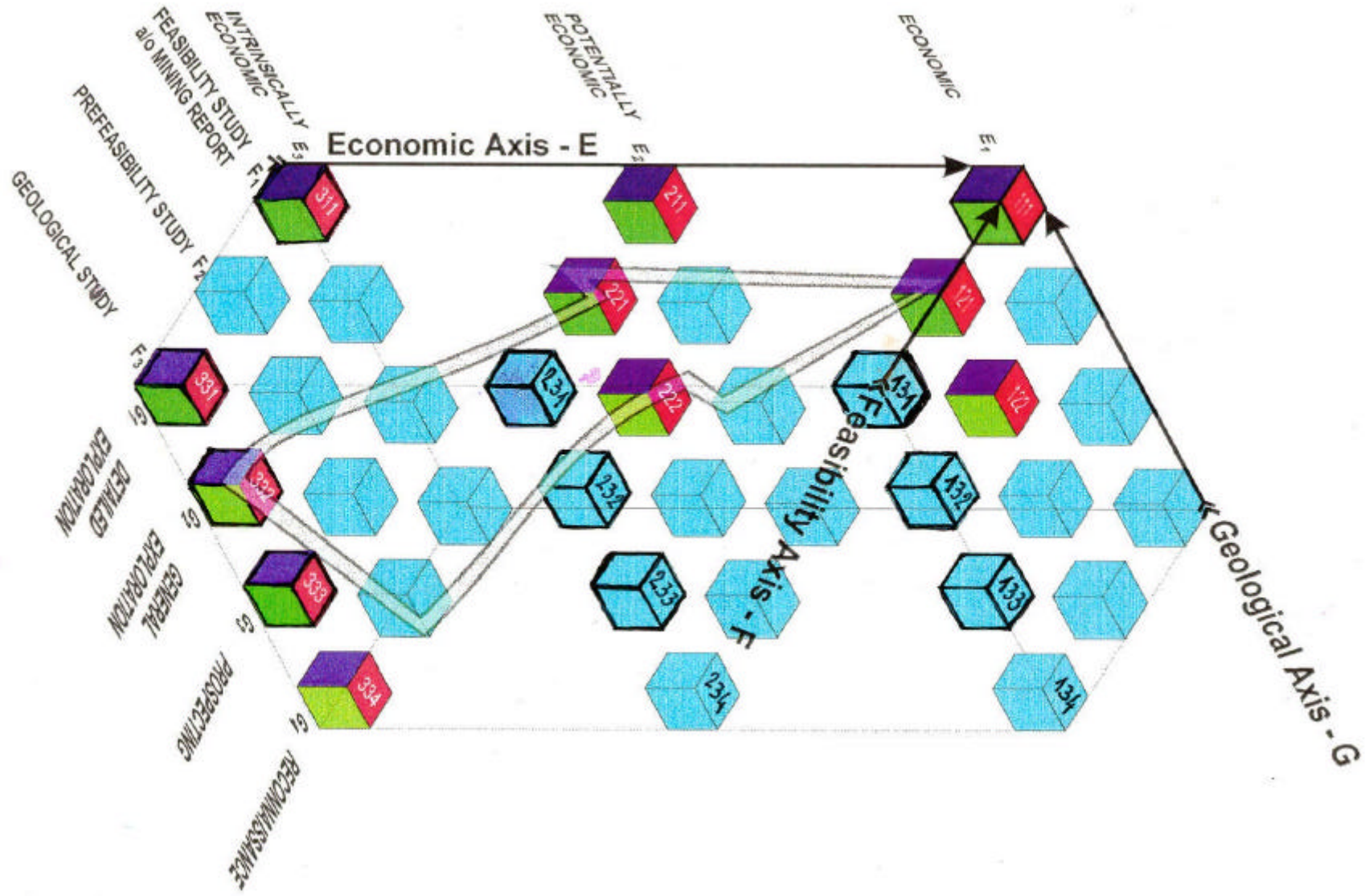
Economic feasibility of recovery ↑

← Increasing degree of geological assurance



“western” systems

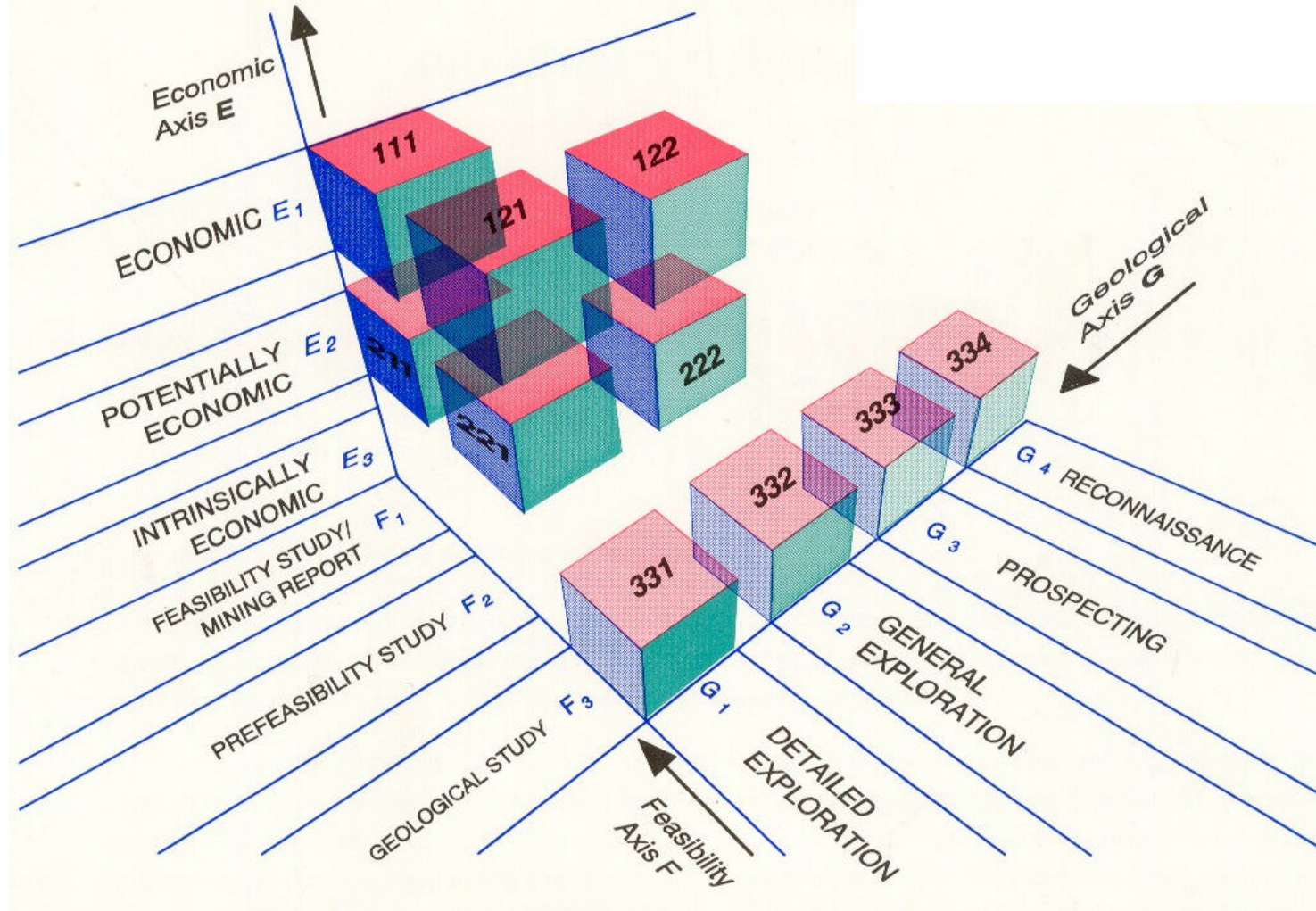




Why numeric code

- **semantic problems**
- **every nation has the right to use its own language**
- **“soft” globalization**
- **easy transformation from one to another system**
- **everybody uses what he needs**

Three digit Numerical Code



By courtesy of UN ECE

Question of Potentially Economic Category

UNITED NATIONS INTERNATIONAL FRAMEWORK CLASSIFICATION FOR RESERVES/RESOURCES - Solid Fuels and Mineral Commodities -

UN International Framework	National System	Detailed Exploration	General Exploration	Prospecting	Reconnaissance
↓	↓				
Feasibility Study and/or Mining Report		1 (111) 2 (211)		usually not relevant	
Prefeasibility Study		1 (121) 2 (221)	+ (122) + (122)		
Geological Study		1-2 (331)	1-2 (332)	1-2 (333)	? (334)

Economic Viability Categories: 1 = economic, 2 = potentially economic, 1-2 = economic to potentially economic (intrinsically economic), ? = undetermined
 Classification Code: (111). = (E.F.G), where E = degree of Economic Viability, F = stage of Feasibility Assessment, and G = stage of Geological Assessment.

Сопоставление основных принципов

проекта международной

Классификации запасов (ресурсов)

угля и проектов российских

Классификаций. .
Декабрь 1994г.

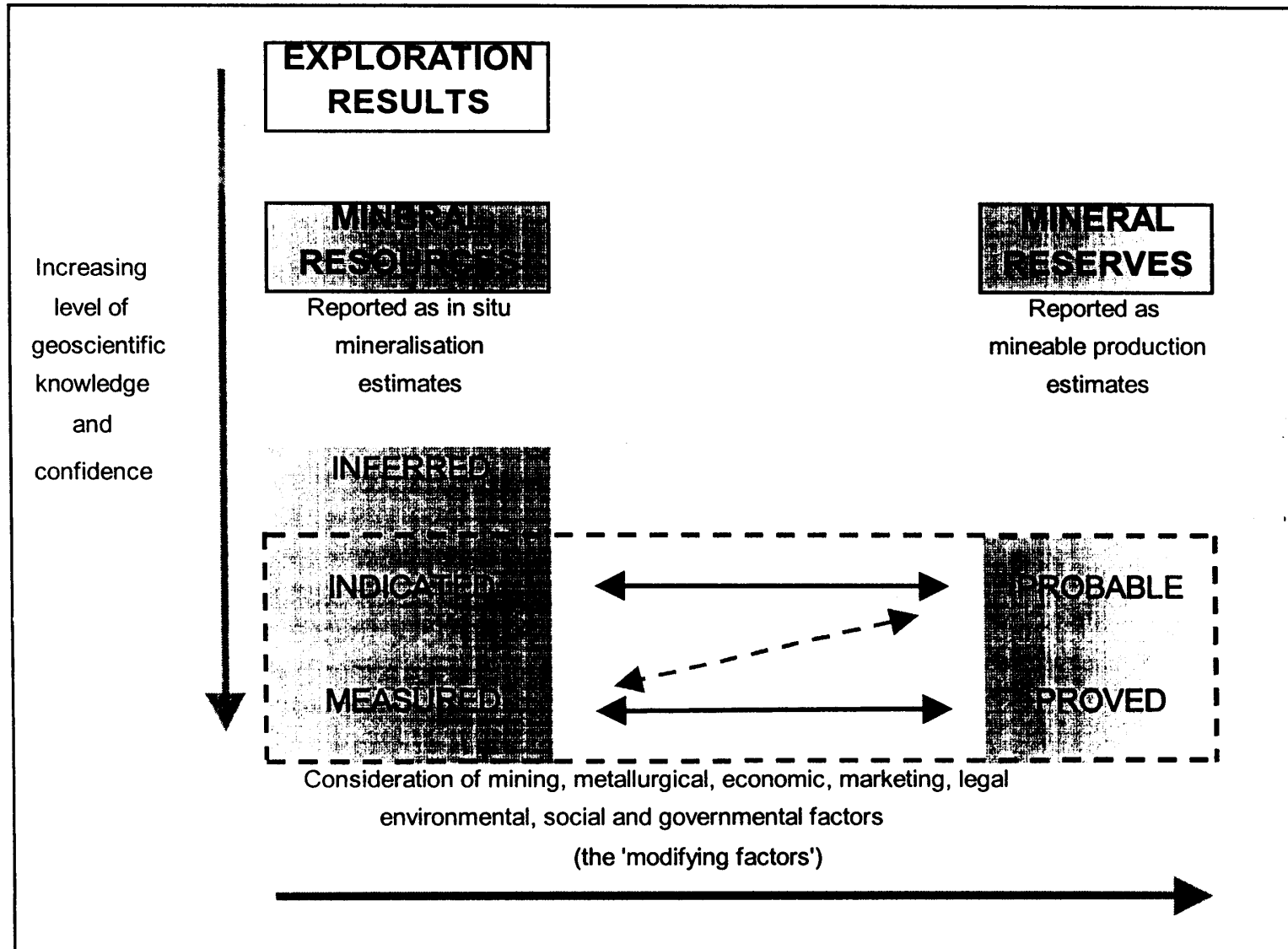
← Геологическая изученность запасов месторождений

		A	B	C ₁	C ₂	P ₁ P ₂ P ₃	ГКЗ
		Detailed Exploration	General Exploration		Prospecting	Reconnaissance	
		Детальная разведка	Предварительная разведка		Поиски	Разведочная	ООН
		Детально изученные	Предварительно изученные		Первоначально изученные	Прогнозные	ВТК
		A	B		C	D	
I. Feasibility study Детальная оценка (ТЭО, проект строительства)	1. Economic Эффективные (рентабельные)						
	2. Marginally economic Малозэффективные (малорентабельные)						
	3. Subeconomic Неэффективные (нерентабельные)				usually not		обычно не
II. Prefeasibility study Предварительная оценка (ТЭД, ТЭР)	1.....						
	2.....						
	3.....				relevant		делается
III. Opportunity study Начальная оценка (на основе геол. параметров)	1.....						
	2.....						
	3.....						
ООН.							ВТК

Балансовые запасы

Примечания.

1. ВТК- проект временного творческого коллектива при Российской угольной компании "Росуголь"
2. ГКЗ - совместный проект Роскомнедра и ГКЗ Минприроды РФ(1994)
3. Затемнена площадь несовпадения оценок по проектам ООН и ВТК: по проекту ООН на этой площади технологические и экономические оценки не делаются



1. $TMW^* = \text{resource}^{1)}$

2. $TMW^* = \text{reserve} + \text{resource}^{2)}$

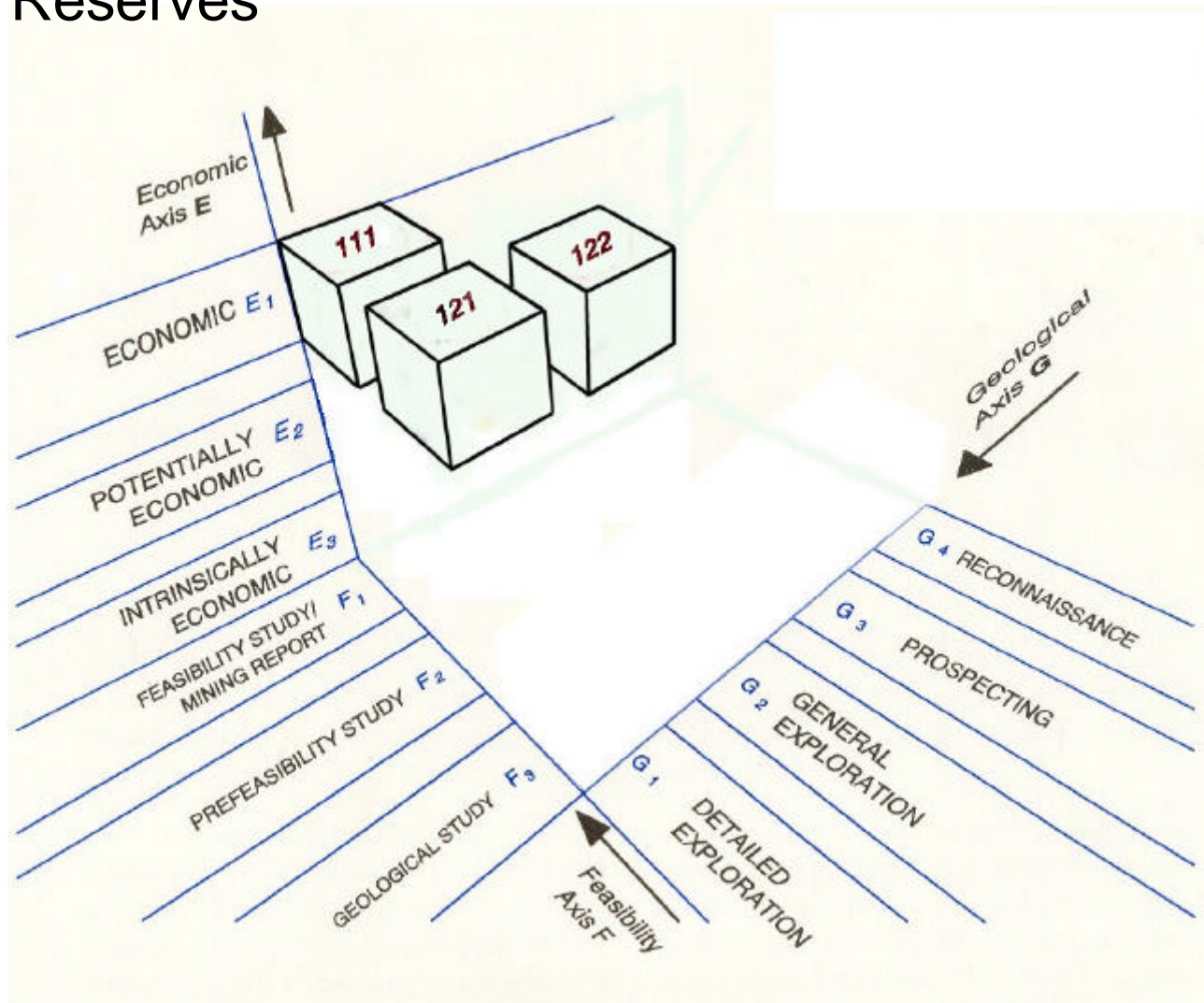
3. $\text{resource} = \text{reserve} + \text{resource}$
(equation only true for reserve = 0)

**total resource = reserve +
remaining/additional resource**

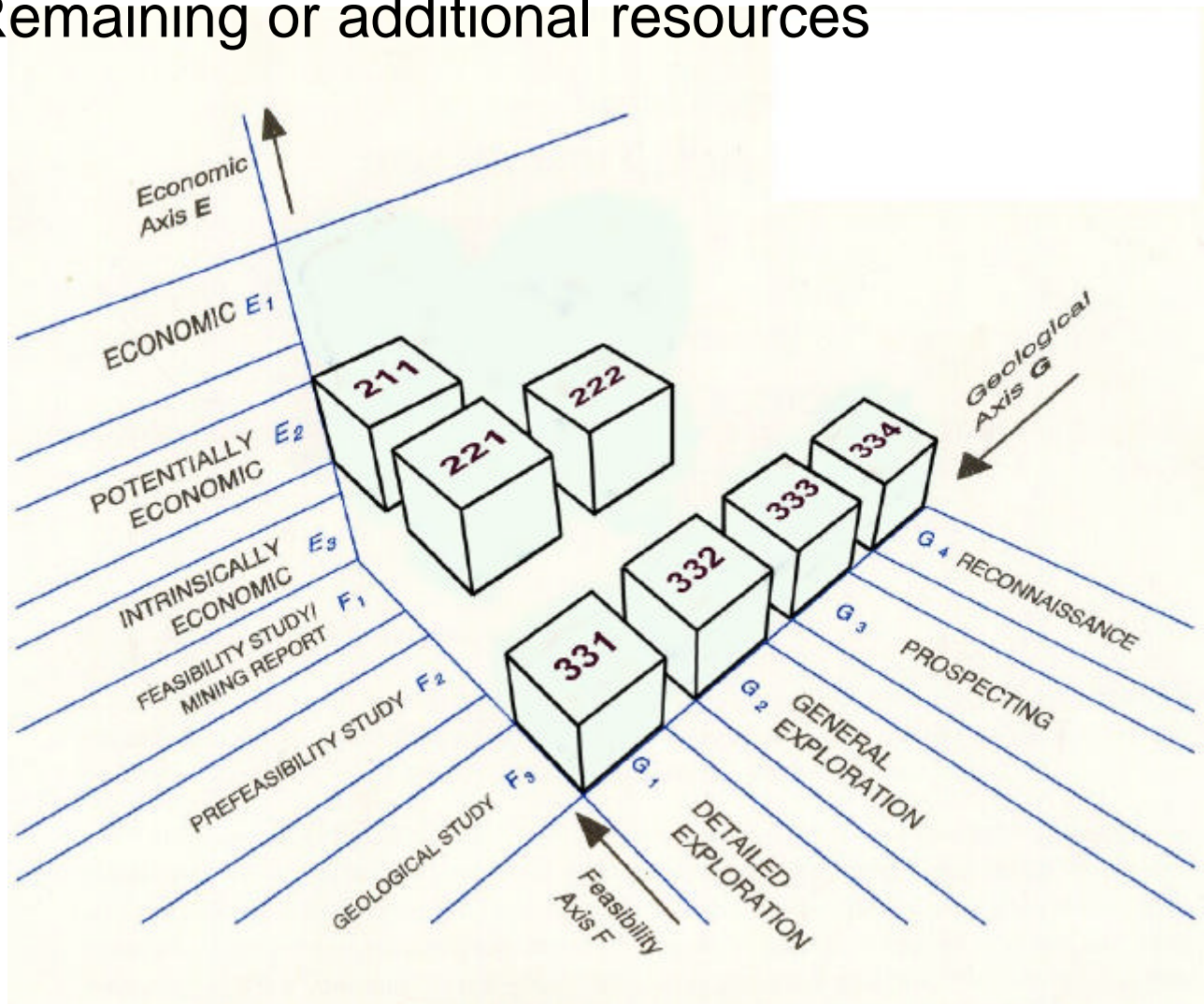
***TMW = total mineral wealth**

1) usual perception, 2) professional expression

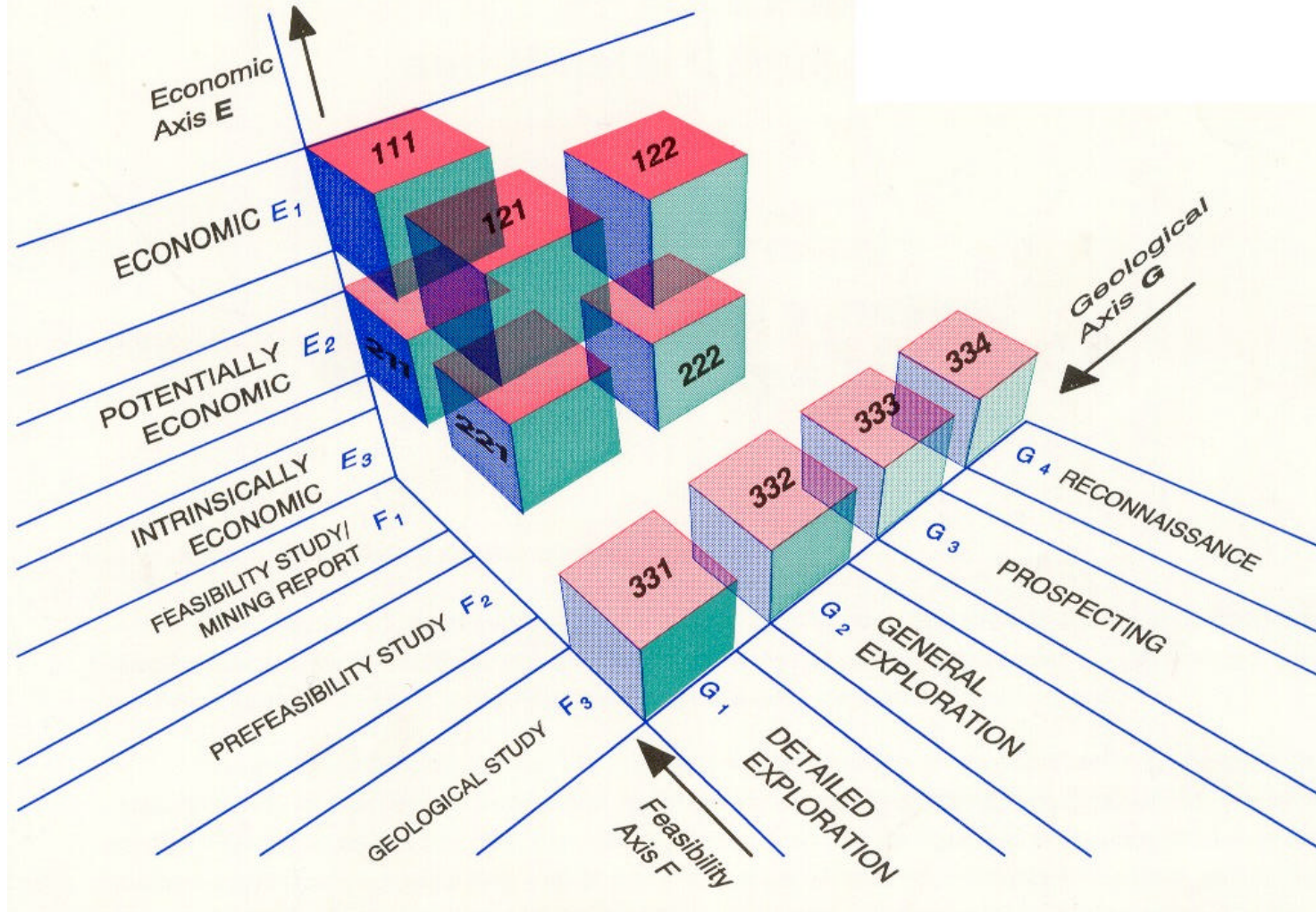
Reserves



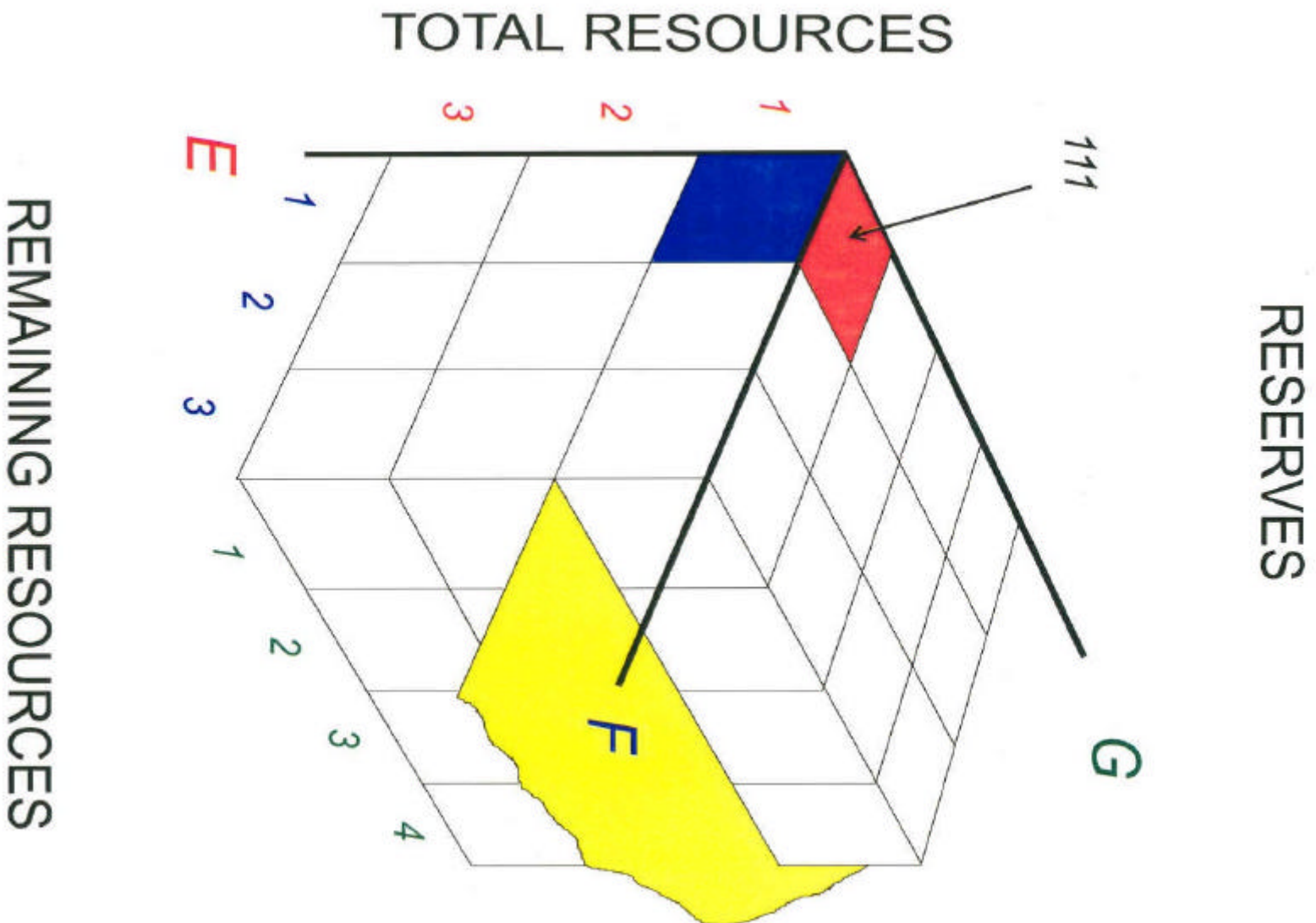
Remaining or additional resources



Total resources



By courtesy of UN ECE



UN International Framework →		Detailed Exploration	General Exploration	Prospecting	Reconnaissance
↓	National System →				
	Feasibility Study and/or Mining Report	1	(111)		usually not relevant
2		(211)			
Prefeasibility Study	1	(121)	+ (122)		
	2	(221)	+ (122)		
Geological Study	1-2	(331)	1-2 (332)	1-2 (333)	? (334)

Economic Viability Categories: 1 = economic . 2 = potentially economic. 1-2 = economic to potentially economic (intrinsically economic). ? = undetermined
 Classification Code: (111), =(E,F,G), where E = degree of Economic Viability, F = stage of Feasibility Assessment, and G = stage of Geological Assessment.

**UNFC System is universal,
very flexible and covers all
different needs - close to
“global system”**

UNFC System is very flexible

it can be adapted to specific needs:

- low capital commodities**
- proposal for oil and gas**

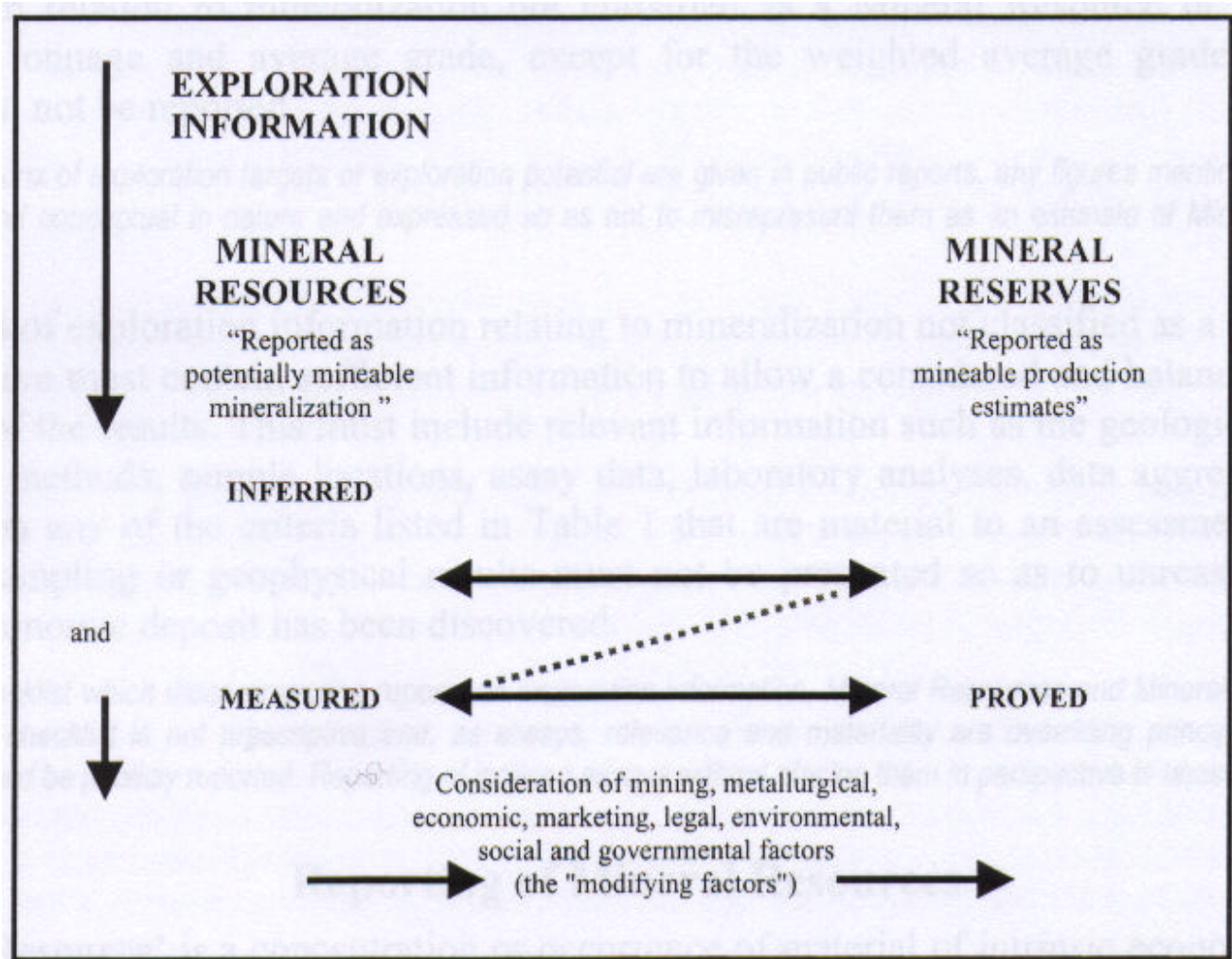
Countries	Prefeasibility Study, Feasibility Study and / or Mining Report		Geological Study	
	Economic	Potentially Economic	Detailed & General Exploration	Prospecting & Reconnaissance
	(111) (121) (122)	(211) (221) (222)	(331) (332)	(333) (334)
Total World				

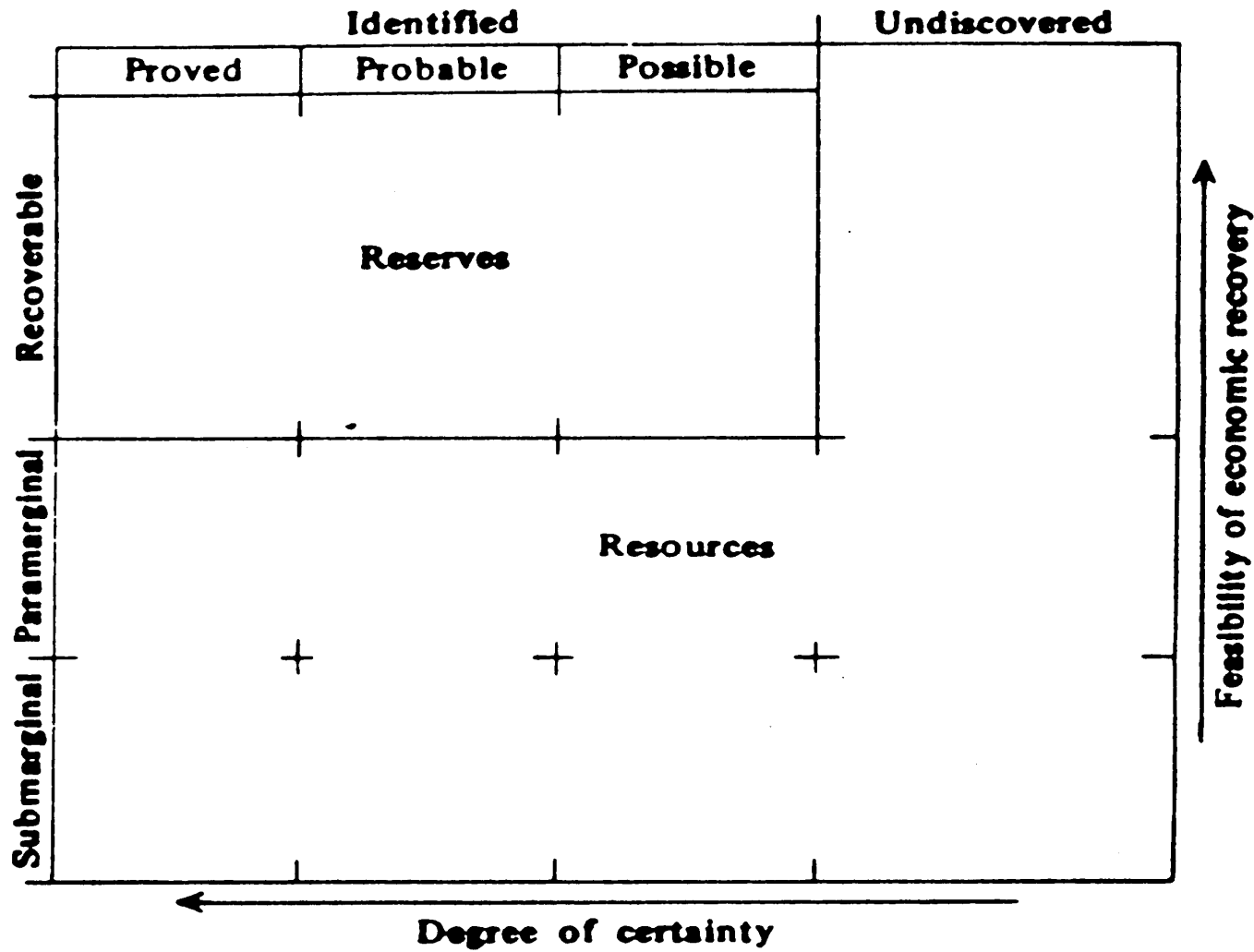
 = International System

Date :

Code: (123)

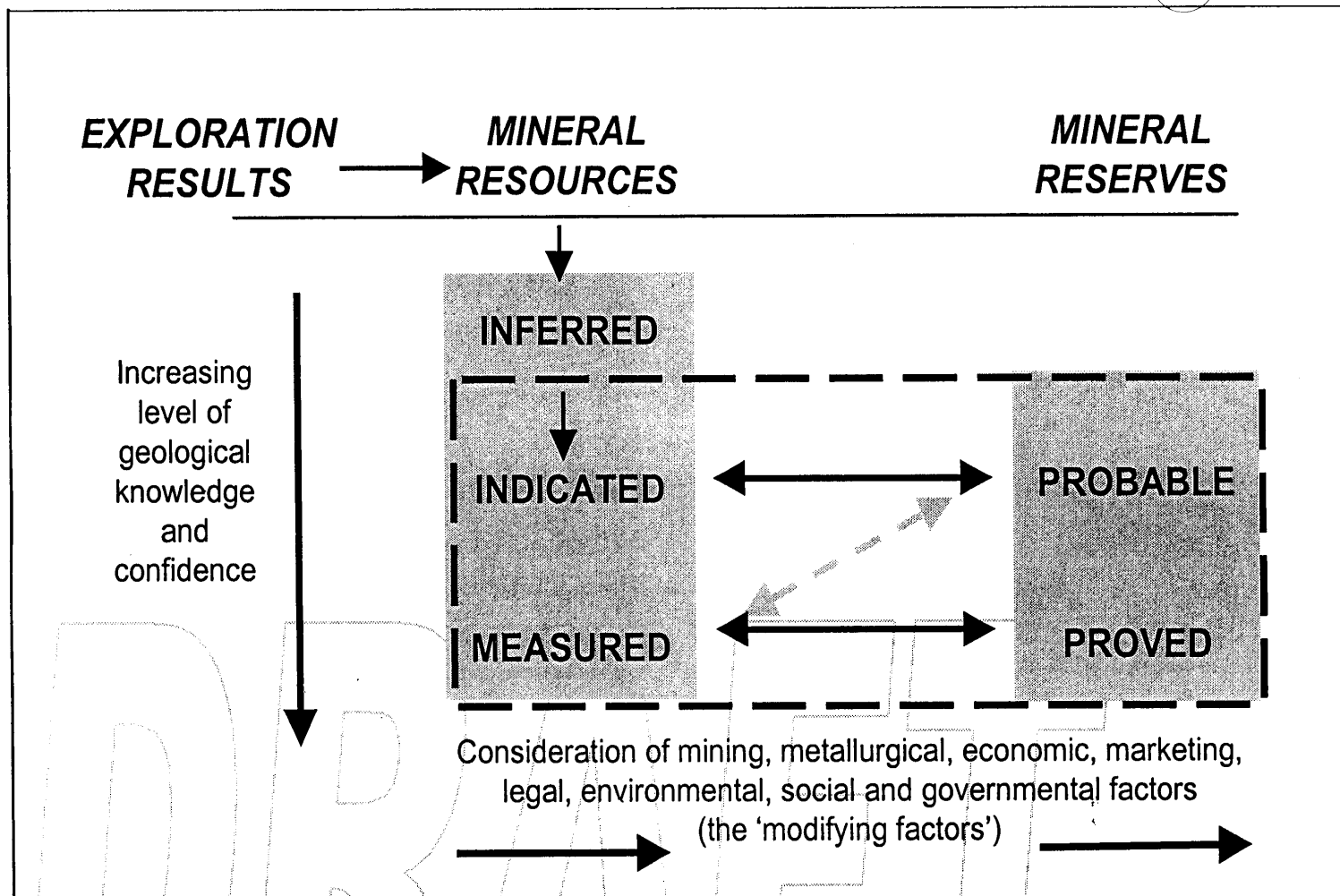
SME - CMMI type system





Yugoslavia Slovenia		GEOLOGICAL RESERVES					
		PROVEN RESERVES			POTENTIAL RESERVES - RESOURCES		
		A	B	C ₁	prospective C ₂	prognostic D ₁	assumed D ₂
BALANCE RESERVES	EXTRACTED						
	EXCAVATED						
	TOTAL						
CONDITIONAL BALANCE RESERVES							
OUT OF BALANCE RESERVES							

Figure 1 Relationship between Mineral Resources and Mineral Reserves



UK

MINERAL RESOURCES

MINERAL RESERVES

INDICATED

PROBABLE

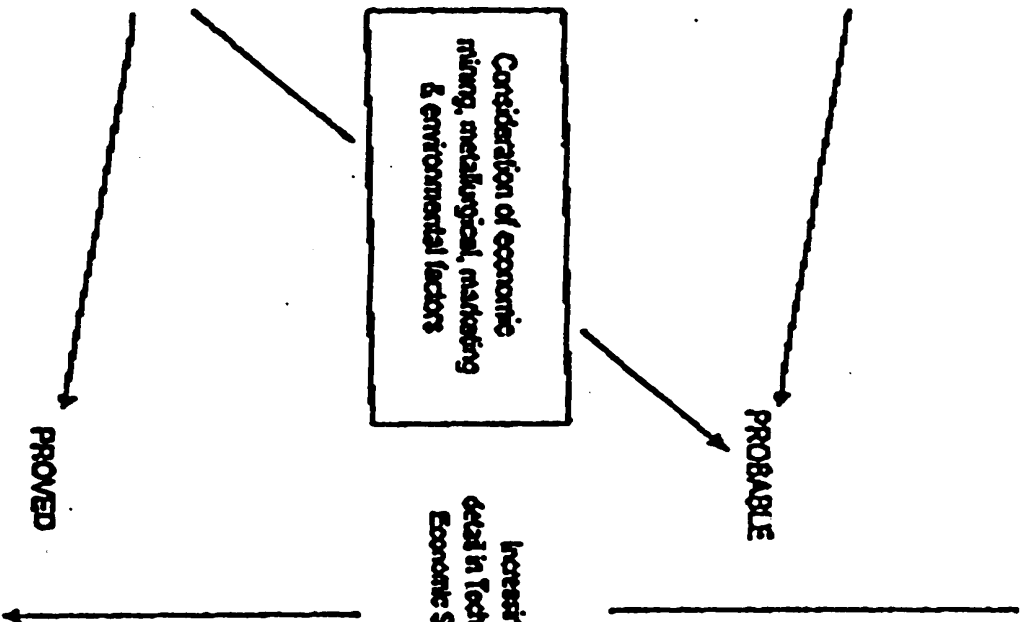
Consideration of economic
mining, metallurgical, marketing
& environmental factors

Increasing
detail in Technical &
Economic Studies

Increasing level of
geological knowledge
and confidence

MEASURED

PROVED



Lagerstätteninhalt
Volume of the deposit

Voreinteilung:
First classification:

I. Bergbauliche Vorräte
Mineable resources

II. Potentielle Vorräte
Potential resources

Geologische Beurteilung,
Vorhandensein:
Geological
assessment,
existence:

A
sicher
proved

B
wahrscheinlich
probable

C ₁ angedeutet indicated	C ₂ vermutet inferred
---	--

möglich
possible

Grenzwerte der bergbaulichen Vorräte
Limits of the mineable resources

a
sicher
proved

b
wahrscheinlich
probable

C ₁ angedeutet indicated	C ₂ vermutet inferred
---	--

d
prognostisch
prognostic

Grenzwerte der potentiellen Vorräte
Limits of the potential resources

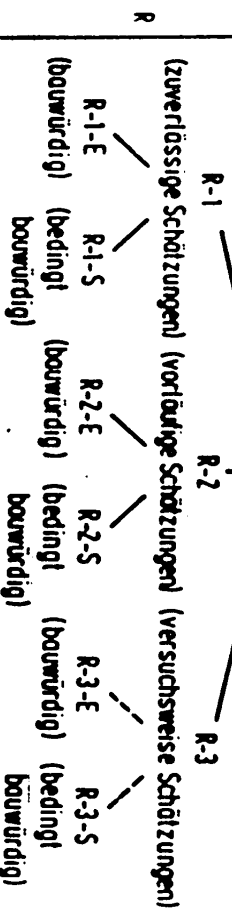
Cumulative production	IDENTIFIED RESOURCES		UNDISCOVERED RESOURCES		
	Demonstrated		Inferred	Probability range	
	Measured	Indicated		Hypothetical	(or) Speculative
ECONOMIC	Reserves		Inferred reserves		
MARGINALLY ECONOMIC	Marginal reserves		Inferred marginal reserves	+	
SUB-ECONOMIC	Demonstrated subeconomic resources		Inferred subeconomic resources	+	
Other occurrences	Includes nonconventional and low-grade materials				

Vorräte

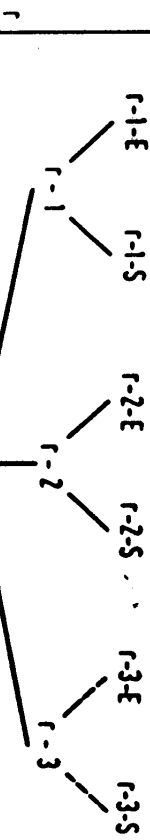
- Mengen, die für die nächsten Jahrzehnte von wirtschaftlichem Interesse sind

Vorkommen

R=Anstehende Mengen



r=Ausdringbare Mengen



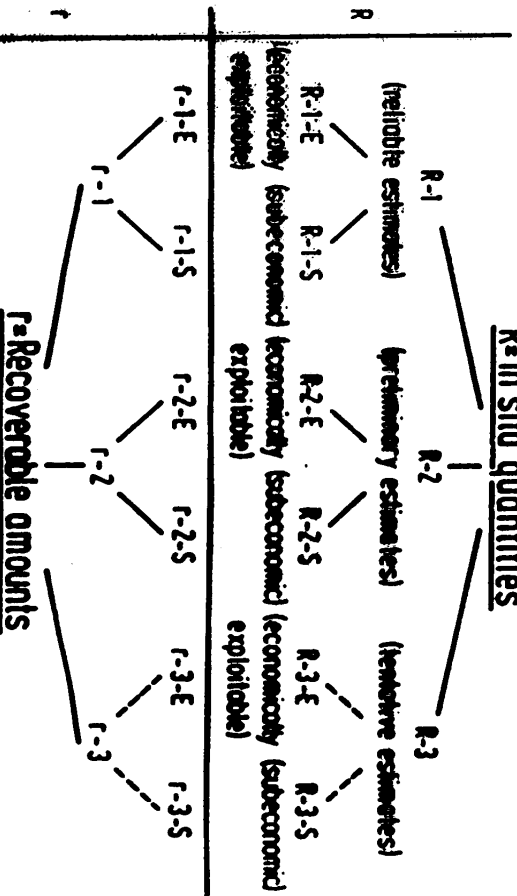
- R-1 entspricht ~: A, B, C; demonstrierbar; ressource sichergestellt
- R-2 entspricht ~: C; inferred; estimated additional;
- R-3 entspricht ~: D; prognostisch; undiscovered (hypothetical and speculative)

Resources

- quantities of economic interest for the next few decades

Occurrences

R=in situ quantities

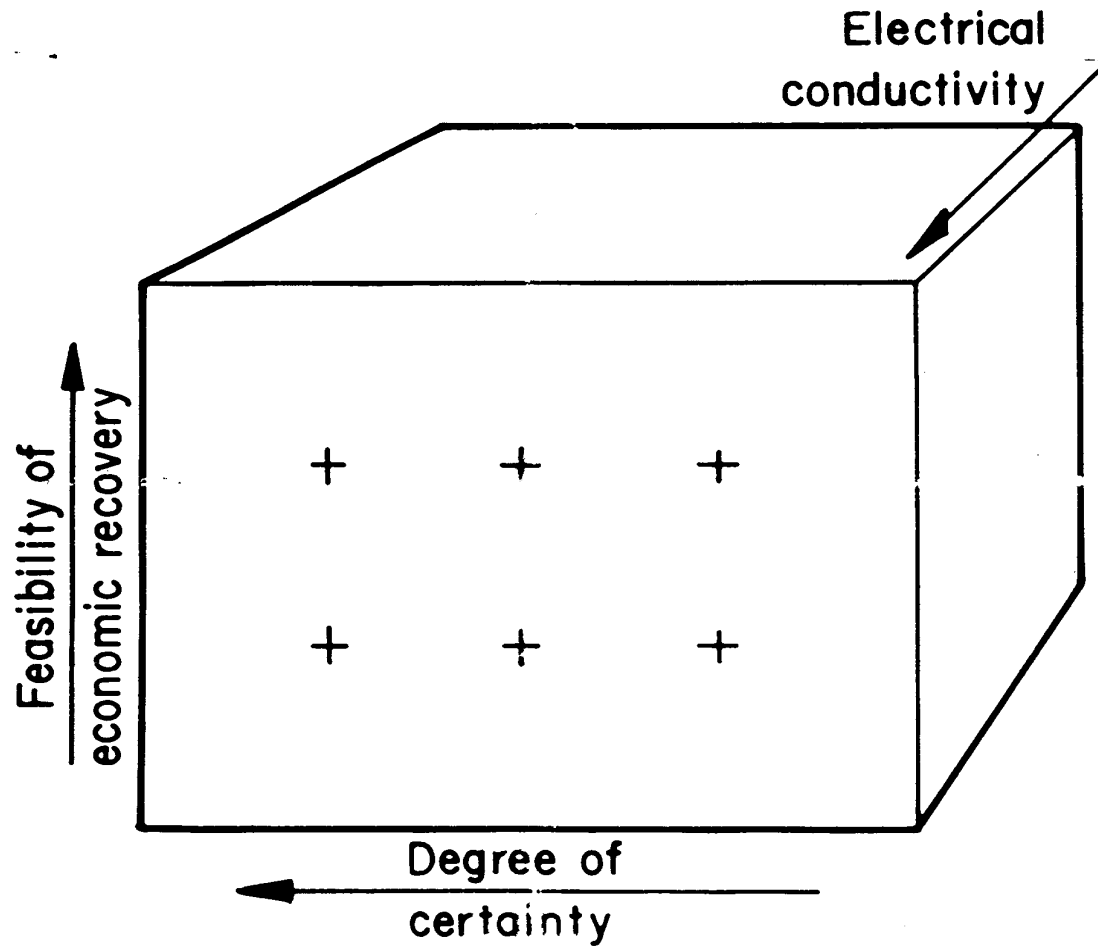


r=Recoverable amounts

RECOVERABLE AT COSTS	\$ 130 to \$ 200 / kg U	REASONABLY ASSURED RESOURCES	ESTIMATED ADDITIONAL RESOURCES I	ESTIMATED ADDITIONAL RESOURCES II	SPECULATIVE RESOURCES
	\$ 80 - \$ 130 / kg U	REASONABLY ASSURED RESOURCES	ESTIMATED ADDITIONAL RESOURCES I	ESTIMATED ADDITIONAL RESOURCES II	SPECULATIVE RESOURCES
	up to \$ 80 / kg U	REASONABLY ASSURED RESOURCES	ESTIMATED ADDITIONAL RESOURCES I	ESTIMATED ADDITIONAL RESOURCES II	SPECULATIVE RESOURCES

DECREASING CONFIDENCE IN ESTIMATES





Implementation:

- over 60 countries
directly (Indonesia, Malaysia,
Ukraine, India)
indirectly (Russia, China,
Turkey, Germany, Austria, ...)
partly (US, South Africa, ...)**
- education very important**

Cooperating institutions:

UN Task Force

CMMI with national associations

SPE/WPC/AAPG

NEA/IAEA

STATOIL, OPEC

WEC

EFG

National Govt. & Nongovt. Agen.

Current Documentation:

UNECE

- UNECE Information Unit**

E-mail: info.ece@unece.org

<http://www.unece.org>

- Sustainable Energy Division**

E-mail: info.energy@unece.org

<http://www.unece.org>

Ad hoc Group of Experts on Energy Reserves/Resources Terminology

- Chairman: **S. Heiberg, N**
Vicechairmen: T. Ahlbrandt, USA; A. Šubelj, SI;
O. Zaborin, RF
- Subgroup Coal:
Chairman: A. Šubelj, SI
- Subgroup Petroleum:
Chairman: P. Blystad, N
- Subgroup Uranium:
Chairman: J.R. Blaise, IAEA

Oil and Gas (SPE/WPC/AAPG, Statoil)

TOTAL PETROLEUM-INITIALLY-IN-PLACE		DISCOVERED PETROLEUM-INITIALLY-IN-PLACE		PROJECT STATUS CATEGORY	
		UNDISCOVERED PETROLEUM-INITIALLY-IN-PLACE	DISCOVERED PETROLEUM-INITIALLY-IN-PLACE		
			SUB-COMMERCIAL		COMMERCIAL
UNRECOVERABLE		UNRECOVERABLE	UNRECOVERABLE	0	Sold and delivered
				RESOURCES	
PROSPECTIVE RESOURCES		UNRECOVERABLE	UNRECOVERABLE	2A/F	Approved Development Plan
				3A/F	Decided recovery
				4A/F	In planning
				5A/F	Unclassified
UNRECOVERABLE		UNRECOVERABLE	UNRECOVERABLE	6	Not very likely
				7A/F	Not evaluated
				8	Prospect
UNRECOVERABLE		UNRECOVERABLE	UNRECOVERABLE	9	Lead

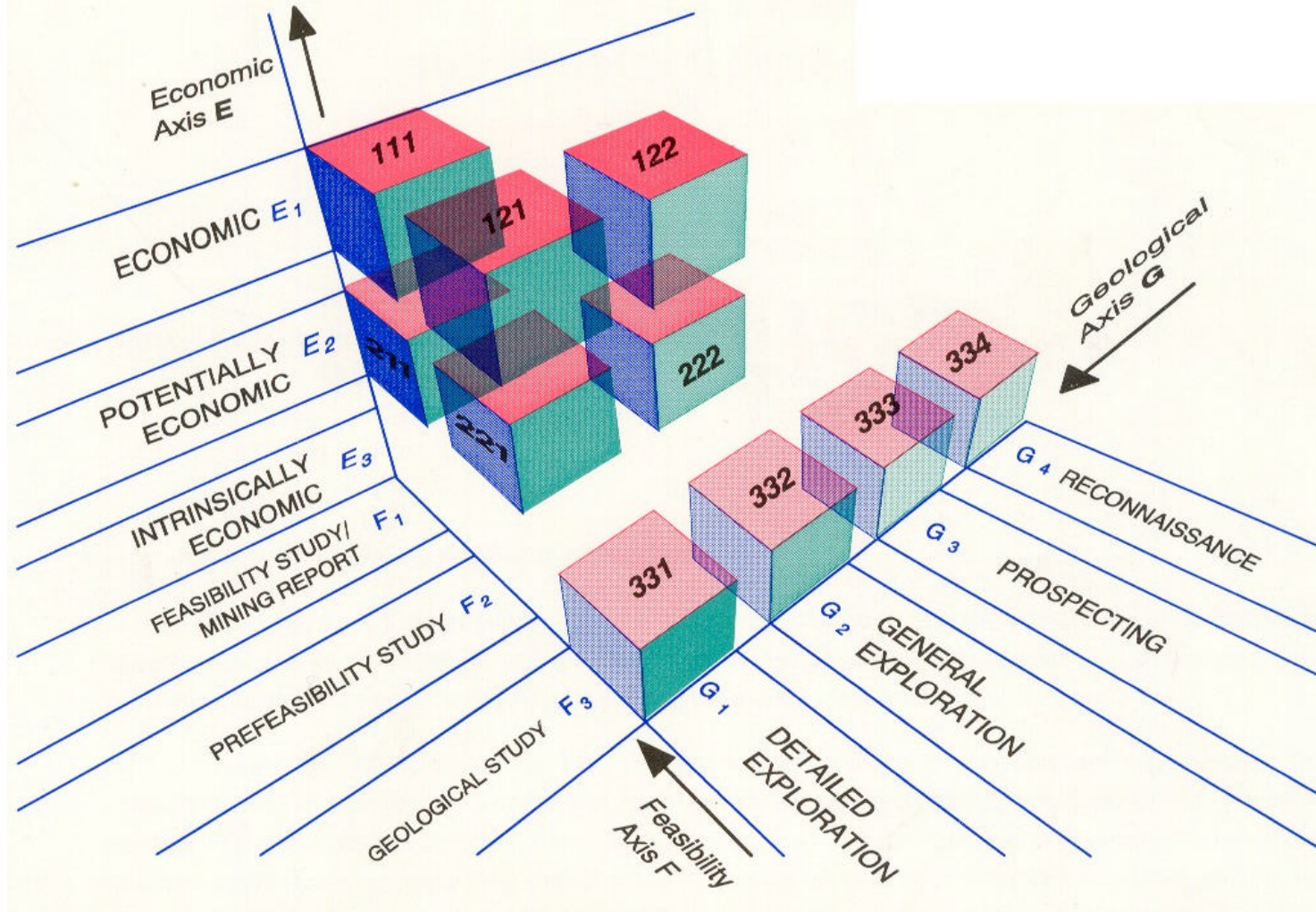
← RANGE OF UNCERTAINTY →
← PROJECT MATURITY →

HIGHER RISK
LOWER RISK

Uranium (NEA/IAEA)

NEA/IAEA	RAR	EAR-1	EAR-2	Speculative
	UNFC			
< 40 \$/kg _U	111	121,122	Usually not relevant	
40-80 \$/kg _U	211	221,222		
80-130 \$/kg _U	311	321,322		
> 130 \$/kg _U	331	332	333	334

International UNFC system



By courtesy of UN ECE