



Copper Reserves and Resources



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USGS Reserves/Resource Definitions

- **Resource:** a concentration of naturally occurring solid, liquid or gaseous material in/on the Earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible.
- **Reserves:** That part of the demonstrated resources (measured and indicated) which could be economically extracted or produced at the time of determination. The term need not signify that extraction facilities are in place.



Based on U.S. Geological Survey Circular 831, 1980

USGS Resource Classification—I

| Cumulative Production | IDENTIFIED RESOURCES | | | UNDISCOVERED RESOURCES | |
|-----------------------|--|-----------|--------------------------------|-----------------------------|-------------|
| | Demonstrated | | Inferred | Probability Range | |
| | Measured | Indicated | | Hypothetical ^(q) | Speculative |
| ECONOMIC | Reserves | | Inferred Reserves | + | |
| MARGINALLY ECONOMIC | Marginal Reserves | | Inferred Marginal Reserves | | |
| SUBECONOMIC | Demonstrated Subeconomic Resources | | Inferred Subeconomic Resources | | |
| Other Occurrences | Includes nonconventional and low-grade materials | | | | |



Based on U.S. Geological Survey Circular 831, 1980

USGS Resource Classification—II

| Cumulative Production | IDENTIFIED RESOURCES | | | UNDISCOVERED RESOURCES | |
|-----------------------|--|-----------|------------------|-----------------------------|-------------|
| | Demonstrated | | Inferred | Probability Range | |
| | Measured | Indicated | | Hypothetical ^(q) | Speculative |
| ECONOMIC | Reserve | | Inferred Reserve | + | |
| MARGINALLY ECONOMIC | Base | | Base | | |
| SUBECONOMIC | Base | | Base | | |
| Other Occurrences | Includes nonconventional and low-grade materials | | | | |



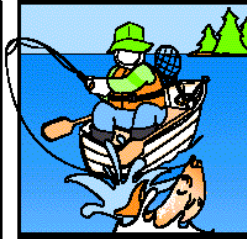
Based on U.S. Geological Survey Circular 831, 1980

FISHING, NI 43-101 STYLE!

Inferred



Indicated



Measured



Inféré

Indiqué

Mesuré

LA PÊCHE, STYLE NI 43-101 !

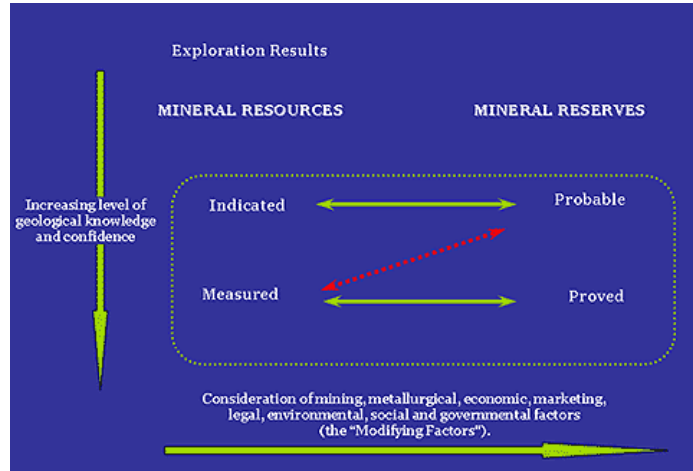


Committee for Mineral Reserves International Reporting Standards (CRIRSCO)

- 1994—Formed under auspices of the Council of Mining and Metallurgical Institutes
- Group of representative organizations responsible for developing mineral reporting codes/guidelines in Australia, Canada, Chile, South Africa, United Kingdom, United States, and Western Europe
- 1997—Participants reached agreement for definitions of reserves and resources
- 1999—Agreement to incorporate CRIRSCO definitions into the United Nations International Framework Classification for Mineral Reserves and Resources (UNFC)
- 2007—Formed affiliation with International Council on Mining and Metals (ICMM)



CRIRSCO International Minerals Reporting Code template



Joint Ore Reserves Committee (JORC) Resource Definition

“A ‘Mineral Resource’ is a concentration or occurrence of material of intrinsic economic interest in or on the Earth’s crust in such form, quality and quantity that there are reasonable prospects for eventual economic extraction. The location, quantity, grade, geological characteristics and continuity of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge. Mineral resources are sub-divided, in order of increasing geological confidence, into Inferred, Indicated and Measured categories.”

Source: The Joint Ore Reserves Committee of The Australasian Institute of Mining and Metallurgy, Australian Institute of Geoscientists and Minerals Council of Australia



JORC Reserves

“An ‘Ore Reserve’ is the economically mineable part of a measured and/or Indicated Mineral Resource. It includes diluting materials and allowances for losses, which may occur when the material is mined. Appropriate assessments and studies have been carried out, and include consideration of and modification by realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate at the time of reporting that extraction could reasonably be justified. Ore Reserves are sub-divided in order of increasing confidence into Probable Ore Reserves and Proved Ore Reserves.”



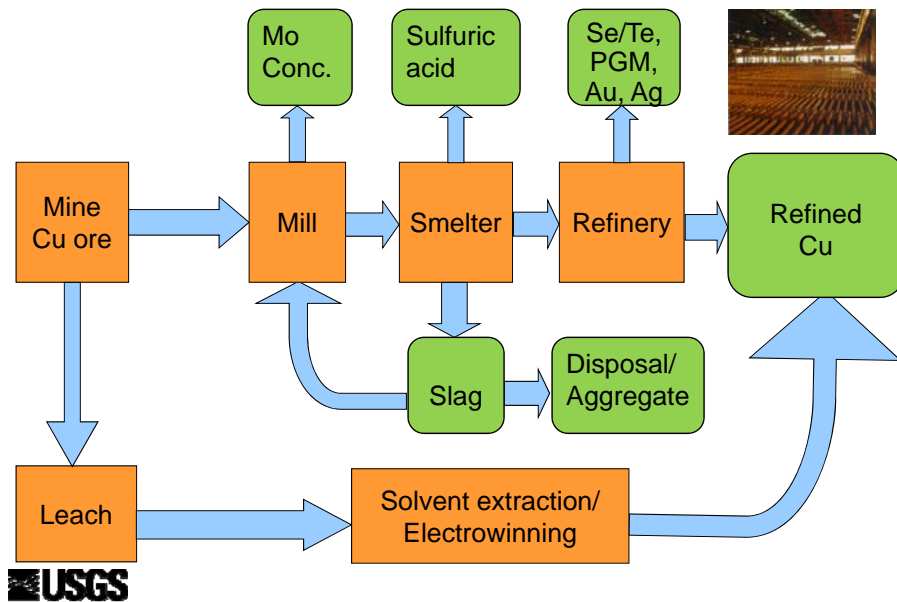
Geoscience Australia

- **Introduced a new term specific to Australia’s resources—Economic Demonstrated Resources (EDR)**
- **In essence, EDR = JORC proved and probable reserves + measured and indicated resources**
- **Present s a long-term perspective of what is likely to be economic to mine**
- **2010 copper EDR = 80 Mt (about 95 times the current annual production rate)**
- **JORC reserves = 23 MT**



Source: Australia’s Identified Mineral Resources, 2010

Mined Copper Flow

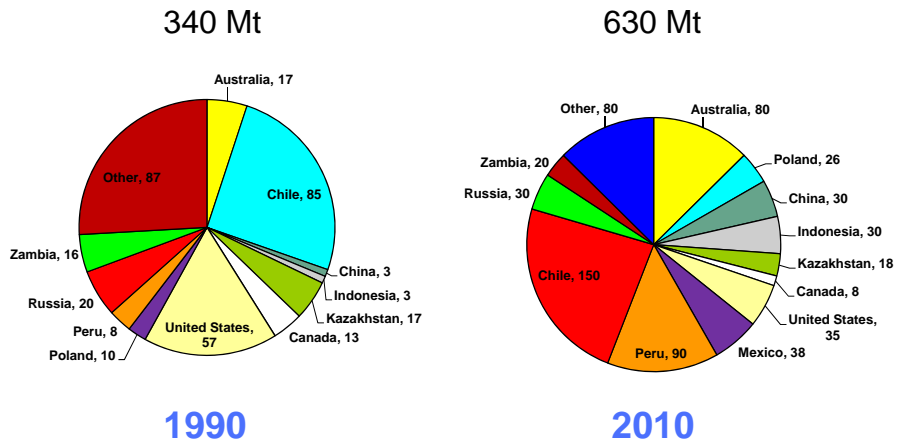


USGS Reserves Data Sources

- National resource assessments by governments or country-specific bodies
- Compilation of published company reports or other periodic literature on a property-by-property basis
- International minerals availability studies conducted by the U.S. Bureau of Mines prior to 1996 and adjusted for new developments and reduced by historic production

World Copper Reserves, 1990 and 2010

[Million metric tons (Mt)]

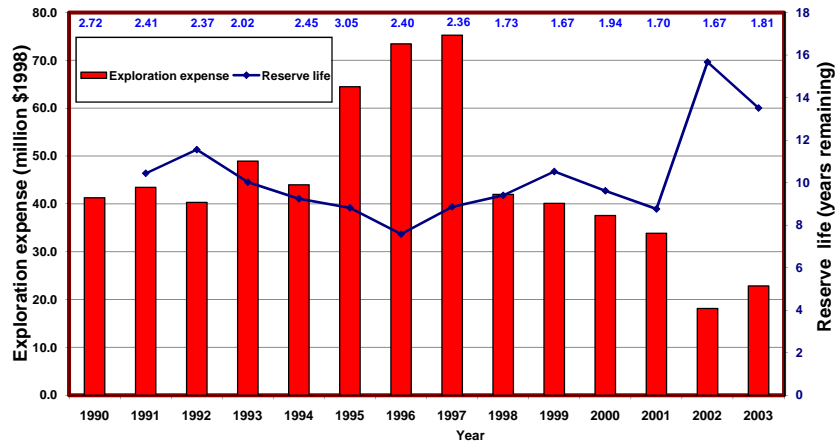


Reserves are not stagnant—they adjust with depletion, increased deposit knowledge, and changing economics

- **1990: copper reserves = 340 Mt**
- **2010: copper reserves = 630 Mt**
- **1990 - 2010: Ore containing 300 Mt copper processed**
- **1990 - 2010: About 600 Mt of copper reserves added, nearly double 1990 reserves estimate**

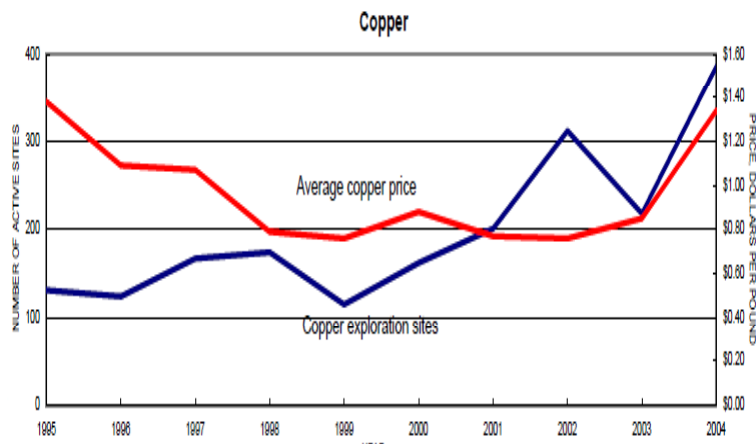


Phelps Dodge Corp. Reserves and Exploration Budget



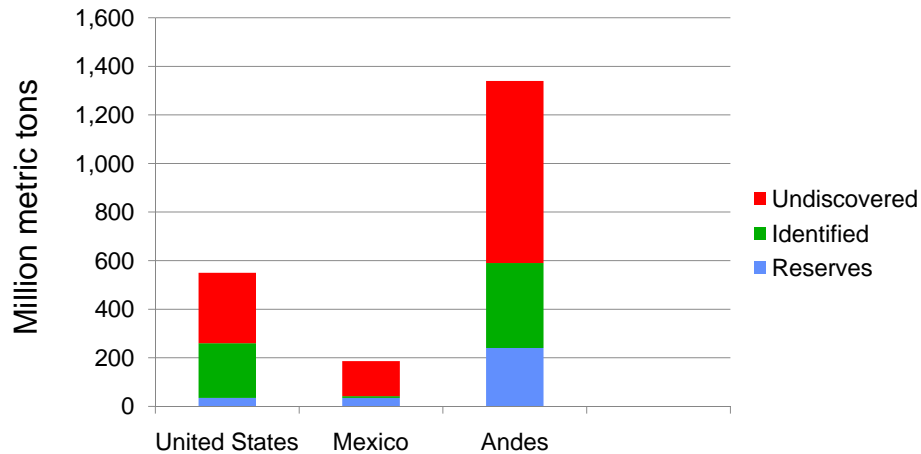
Source: T. Goonan, USGS (unpublished)

Principal Copper Exploration Sites and Price



Source: D. Wilburn, USGS Data Series 139

Reserves and Remaining Resources (Identified and Undiscovered)



Source: USGS

Conclusions

- Reserves are a function of geology, exploration and development expenditure, and current market conditions.
- On an individual deposit/mine basis, reserves may be an indication of mine life subject to geologic constraints and mining methods.
- On a country, regional, or global basis, reserves are not necessarily a good indicator of resource depletion.
- Reserves are a near- to medium-term estimate of developed (evaluated) economic resources.

