Mineral Discovery: Awareness Enhances Success

By

Ciceron A. Angeles Jr.
Technical Director, GGG Resources plc / Consultant

09 June 2011
Surigao City
This Presentation contains certain statements that involve known and unknown risks and uncertainties.

The data on Filipino geologists including those involved in mineral discoveries was based on an informal survey of Filipino geologists done in 2006 by C. Angeles, Jr., R. E. Bobis and R.A.L. Flores, both known and unknown to us, mainly through email correspondences. Mineral deposit data were taken as much as possible from public sources (such as company websites) and from knowledgeable people on the deposits, and in the case of documenting mineral discoveries, usually from those who were employees during the time of the discoveries.

There can be no assurances that such information is always accurate and data sourced elsewhere could differ materially from those presented here. Information contained herewith represents the author’s best judgement based on information available in 2006. Consequently, actual results, performance, and/or achievements could differ materially from the expectations expressed in the statements presented herein.

The author do not assume the obligation to prove any of the correctness of the information contained in this presentation. There can be no assurance that future developments affecting the parties mentioned herein would be those anticipated by the author.
When we join the exploration / minerals industry, there is a lot of excitement

- Earn some money...at last
- Travel & see many places
- We were taught how to explore
- Felt confident that finding a mine is a piece of cake
Fast Forward a Few Decades

- We find out we were not so smart after all
- It’s difficult to find even a single mine
Purpose of Mineral Exploration

Mineral Exploration approached as a business

- to manufacture discovery

- Dream of every exploration geologist?
- to be part of a mineral discovery team

- How do you increase your chance of finding a mine?
- (1) hone your technical &/or managerial skills
- (2) be aware of how discoveries are made

“Hunt for Ore Deposits: Recent Findings and Current Trends”, Surigao City, 9 June 2011
CONCLUSIONS - Pinoy Geoscientists in the Minerals Industry

EXPLORATION - MINING STAGES

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EXPLORATION-MINING STAGES (1)

GREENFIELDS EXPLORATION → TARGET GENERATION → TARGET TESTING → MINERAL DISCOVERY! → DELINEATION DRILLING → FEASIBILITY STUDY

DEVELOPMENT 1-4 years → MINING 3 - >10 years → MINE CLOSURE 5 - 10 years

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MINERAL DISCOVERY - DEFINITION

Mineral Discovery: at least 3 drill holes or underground openings intersecting ore over “economic widths”

Characteristics of a Mineral Discovery

- Discovery is a rare event besides being a complex process
- Discoveries are made by teams and not by one person
- Teams can be made up of any combination of geologists, prospectors, engineers, and management people
- The original discovery team seldom sees the property become a mine
- Usually, it takes more than 1 company to explore, make a discovery & turn it into a mine

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Discovery is getting harder as time goes by.

Outcropping vs. Concealed Discovery Sites (1970-95)

- Outcropping Sites: 28%
- Concealed Sites: 72%

Outcropping Discovery Sites:
- Outcrop near Mines: 5%
- Outcrop near Prospects: 56%
- Outcrop in Virgin Areas: 38%

Concealed Discovery Sites:
- Concealed near Mines: 40%
- Concealed Near Prospects: 53%
- Concealed in Virgin Areas: 7%

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Mineral Discovery Takes Time!!!

- **Pre-discovery Exploration**

  - **Average of 19.5 years**
  - **14 years for base metal deposits**
  - **22 years for gold deposits**

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Production Also Takes Time!!!

• Discovery-to-Production

- Usually more than 1 company involved
  - 2 to 10 companies for >70% of the deposits

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INGREDIENTS IN ENHANCING MINERAL DISCOVERY

Exploration Team Level

- Good science (geology)
- People
- Experience
- Intuition
- Perseverance
- Visualization & Creativity

Company Level

- Support of upper management
- Sound exploration strategy (or systems approach)
- Drilling

D. Wood (2010)

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INGREDIENTS IN ENHANCING MINERAL DISCOVERY (con’t)

Field Exploration Team Level

- Good science (geology)
  - Without good science, chance of making a discovery is fairly slim
  - Solid framework in geology, broad experience in mineral resource, some knowledge of mining and what is required for mineralization to become ore
  - Not necessary to be an expert in the deposit type - sometimes following one’s instinct does the trick; To “think out of the box”

- People
  - Key to discovery - although teamwork is important, it is the individual flash of genius that sparks discovery. Discovery is not by consensus, somebody has to lead the way.
  - Geologists should be exposed early in their careers to as much geology and as many orebodies as possible.

- It is easy to recognize mineralization. However, it is difficult to recognize proximity to it.

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Field Exploration Team Level

- **Experience**
  - The art of discovery seems to improve with experience, both on a personal and team level
  - Lengthy apprenticeship - usually 10 years or more

- **Intuition**
  - Once you have the experience, intuitive thinking plays an important role
  - However, it should be accompanied by action to be of real value

- **Perseverance**
  - Plays an important role in discoveries in established mineral districts, e.g. Ridgeway, Lower Fortitude, Post/Betze, etc.
INGREDIENTS IN ENHANCING MINERAL DISCOVERY (con’t)

Field Exploration Team Level

- Visualization & Creativity
  - Capacity to assemble in one’s mind pieces of geology & other info & build an image of what might be
  - Continually ask “What if?”
  - Importance of one’s thought processes rather than relying on technology to provide a creative edge

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INGREDIENTS IN ENHANCING MINERAL DISCOVERY (Con’t)

Company Level

• Support of upper management
  ➢ “Walk the talk” - Must be seen in the field
  ➢ Willing to listen to concerns in the field

➢ Adoption of a discovery culture - this is where many companies fail
  ❏ Employing geologists is not enough
  ❏ Treat exploration as R & D of mining. Remove bureaucratic obstacles
  ❏ Managing exploration is about managing creativity and ideas, not people and resources
  ❏ Free thinking should be encouraged. “Yes” mentality should be downplayed. A few mavericks should be tolerated.
  ❏ Encourage geologists to keep improving their skill sets - provide continuing training, attend conferences/workshops, mine visits etc.
  ❏ Utilize consultants. The more ideas, the better the geologists will be challenged.
INGREDIENTS IN ENHANCING MINERAL DISCOVERY (Con’t)

Company Level

- **Sound exploration strategy** - simple, flexible & responsive
  - Focus clear on mineral commodities, regions/countries
  - How much risk is acceptable? Greenfields vs. brownfields
  - Systems approach - “Forest before trees” - regional to detailed
  - Enhance the quality of the geological team, maximize the contact time between the team & rocks, lots of drilling
  - Encourage “responsible” risk taking - be bold, daring but not reckless

- **Drilling - a key discovery technique**
  - Drilling should be treated as a tool and not the end stage. The sooner that you drill, the better.
  - Allot 40-60% of the exploration budget to drilling - “keep the fire burning on the geologists’ bum”
  - Be daring and drill deep
  - Better to err on over drilling a deposit, than risk nasty surprises
INGREDIENTS IN ENHANCING MINERAL DISCOVERY (Con’t)

Serendipity vs. Luck

- **Serendipity** - “making of happy or unexpected discoveries by accident or when looking for something else”
  
  Eg. some deposits were discovered using initially wrong models, e.g. Batu Hijau (epithermal veins vs. porphyry Cu-Au)

- **Luck** - “the imagined tendency of chance to bring a succession of (favorable or unfavorable) events”

  You can’t depend on luck. But if serendipity happens to smile, you make your luck.

  Chance of serendipity happening may be assisted by simply employing geologists who have made previous discoveries
Are there Filipinos Involved in Mineral Discoveries???

Yes!!!
A 2006 Informal Survey of Pinoy Geoscientists in the Minerals Industry
(Angeles, Bobis & Flores, 2007)

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COMMODITIES - Pinoy Geoscientists in the Minerals Industry in 2006

- Cu-Au: 217, 82%
- Ni-Cr: 23, 9%
- Fe: 20, 8%
- Others/Mixed: 4, 2%

Total: 270, 100%
GOING GLOBAL - Pinoy Geoscientists in the Minerals Industry in 2006

Pinoy Geos Operating in 18 Countries

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GOING GLOBAL - Pinoy Geoscientists in the Minerals Industry in 2006

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WORKPLACE - 2006 Pinoy Geoscientists in the Minerals Industry

194 Pinoy Geos in the Philippine Minerals Industry

1980-2006, 40 copper-gold discoveries: in-situ total value of US$469 BILLION

Note: 67 Filipino geologists were involved in 40 Mineral Discoveries delineating 69 million tonnes of Cu metal & 3,447 tonnes of Au for an in-situ value of US$ 469 BILLION at metal prices of $6000/tonne Cu and $500/oz Au.
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**Indonesia-** US$91.58 B  
Batu Hijau: R. Aquino  
Batusupangah-Kopra: N. Silvio  
Cibaliung: C. Angeles  
Kucing Liar: A. Ona  
Meratus: V. Baratang, R. Obial, H. Salvador  
Menteu: C. Bautista, R. Bobis, T. Malihan, R. Tan  
Mesel: R. Aquino  
Mt Muro: G. Alapan  
North Lanut: C. Bautista, J. Garcia  
Rawasa: C. Rena  
Talawaan: A. Latorre  
Wetar: C. Rena  
**Saudi Arabia -** US$ 7.65 B  
Ad Duwayah: J. Protacio  
Ar Rjum: H. Salvador  
Bulghah North: J. Protacio  
Mansoura-Masarra-Jabal  
Gadarah: J. Salamat, H. Salvador, N. Silvio  
Sukhyabarar: J. Protacio  
**Korea-** US$ 0.12 B  
Eunsan: P. Rovillos  
Gasado: L. Morales, P. Rovillos

**Philippines-** US$118.88 B  
Boyongan: J. Briones, A. Cabrera, G. Comia, M. Estaris, R. Gonzales, H. Ruelo, B. Sy  
Bulawan: G. Gloria, E. Hidalgo, W. Hofilena, R. Jacinto, A. Sevillano  
Co-O: B. Domingo, A. Fernandez, J. Salamat  
Dinkidi: A. Arrojo, R. Rodulfo, J. Briones  
Dizon Ext: L. Albarracin, O. Esguerra, G. Imperial III, T. Malihan, A. Olarte  
Far Southeast: H. Agupitan, R. Concepcion, A. Disini, D. Flores, D. Malicdem, J. Pascual, B. Sab-it  
Siana Ext: R. Alonso, B. Somintac, D. Wawey, A. Panol  
Sibutad: J. Deloso, R. Hidalgo, R. Jacinto, A. Sevillano  
Tampakan: A. Buenavista, D. Marcos, J. Protacio  
Teresa: F. Guadana, D. Tandoc  
Victoria: A. Disini, A. L. Cuisin, J. Garcia, B. Sab-it, A. Tandoc

**Malaysia-** US$0.28 B  
Bau: R. de Lara, V. Mercado, L. Morales, M. Papio, P. Rovillos, R. Valentín  
**Chile-** US$235.12 B  
Escondida: A. Ona  
**Laos-** US$13.35 B  
Sepon: J. Aquino, W. Bondame, N. Ruelo  
**Mongolia-** NRY  
Khok Adar: J. Garcia, R. Paloma  
Khongor: L. Sosa  
**Australia-** US$0.18 B  
St Patrick: A. Latorre  
**China-** US$0.42 B  
Nibao: R. Bobis, C. Medina  
**Guyana-** US$1.00 B  
Rory’s Knoll: A. Flores IV  
**Myanmar-** NRY  
Modi Taung: L. Ausa, L. Daiparine

*“Hunt for Ore Deposits: Recent Findings and Current Trends”, Surigao City, 9 June 2011*
SUMMARY

• It is difficult to predict when discoveries will happen

• Steps can be made by both the company and the geologists in increasing the chances of mineral discovery
  - (1) continually hone technical &/or managerial skills
  - (2) be aware of how discoveries are made

• Pinoy geologists are contributing to mineral discoveries worldwide
Pinoy Geologists – may you continue to thrive !!!!