Myanmar’s Mining Industry

Realities and Visions for the Future

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Introduction

Assessment of realities and future challenges for the Myanmar mining industry based on:

- More than 14 years experience in Myanmar;
- More than 20 years experience in mainland SE Asia;
- Breadth of experience from project generation through exploration to mining

CSA Global

- International mining industry consultancy with offices in Perth, Brisbane, Jakarta, London, Johannesburg, Vancouver, and Moscow;
- Provides geological and engineering services across the industry spectrum from regional exploration to feasibility and mining;
- Specialist expertise in SE Asia with extensive project experience in all the ASEAN countries.
• First green shoots of the 2000’s mining boom at the largest global mining industry convention
• SE Asia forum – CSA presentation on Myanmar
• Followed apparent liberalisation moves in 2002
• False dawn and the investment door slammed shut again in 2004
WHAT IS DIFFERENT THIS TIME?
DO RECENT CHANGES BRING A REAL OPPORTUNITY FOR DEVELOPMENT OF A MODERN MINING INDUSTRY IN MYANMAR, OR ANOTHER FALSE DAWN?
Myanmar Mining Industry - Historical

- The Golden Land – production of gold, silver, copper, lead, etc. from ancient times
- Rubies and jade – **Mogok** and **Hpakant**
- Important trade routes between India and China
British Colonial Period c. 1824—1948

Lead, Zinc and Silver
- **Bawdwin** Mine and Nam Tu smelter – 1918-38; major producer of Pb, Zn, and Ag
- **Bawsaing** district Pb-Ag and barite

Tin and Tungsten (SE Asia Tin Belt)
- **Tenasserim** – **Heinda**, **Hermingyi**, etc.; extensive (palaeo) alluvial production, limited hard-rock mining
- **Mawchi** W-Sn narrow-vein mine

Gold
- Small scale, alluvial and hard rock
- **Kyaukpazat** district

Oil – Burmah Oil Company
Independence & Nationalisation 1948-1988

- Post-war and post-independence ongoing decline in mine production from colonial levels
- 1963 nationalisation and socialist period; Mining Enterprises established
- 1970’s Colombo plan/UN-aided mapping and exploration
- Monywa – Yugoslavia-Myanmar RTB Bor-ME1 joint venture began operations in 1985
- Kyaukpahto Au deposit discovered c. 1980 and developed with Yugoslav assistance from 1982 to 1993
- Both operations were failures

From Myanmar government website, 2003

- Mid-90’s tender-block rounds.
- Industry enthusiasm amidst the global boom – exploration and mining interest and investment by majors (Newmont), mid-tiers (Ivanhoe) but mostly by juniors.
- **Monywa** – Ivanhoe re-opened the mine in 1998 under a 50:50 JV with ME1 as modern heap-leach SX-EW operation producing 25,000 tpa cathode copper upgraded to 40,000 tpa in 2004
- **Kyaukpahto** – short-lived investment by Newmont.
- First modern exploration in Myanmar, but limited in scope and extent.
- Terminated by 1997-1998 global exploration industry collapse and prolonged subsequent downturn.
- Cyanide ban introduced
Resources “Super-cycle” 2004—2011

- Momentum for political liberalisation in Myanmar reversed in 2004 just as the “super-cycle” gathered pace
- Sanctions and changes in regulations militated against foreign investment – e.g. Commercial Tax and Production Sharing Contracts
- Investment effectively ceased; Ivanhoe pulled out of Monywa in 2007 and lost the Modi Taung Gold project
- Mining Enterprise mines and projects privatised – local companies (e.g. Asia World, Eternal Mining) with or without Asian or Russian JV partners
- Chinese investment focused on known deposits, e.g. Tagaung Taung Ni laterite, Monywa, Bawdwin, Nam Tu slags; also Russian, Thai etc. investors
Current Realities

- Myanmar missed the mining boom(s) and remains almost entirely unexplored
- Requirement for Production Sharing Contracts, high rental rates, short licence terms etc. make risk investment in exploration commercially untenable
- Underdeveloped mining industry relative to potential
  - Production remains at a very low level in terms of quantity and quality
  - Monywa (now Chinese-controlled) is still the only significant modern mining operation in the country; planned Letpadaung development and expansion to 200,000 tpa Cu has not yet occurred
  - Tagaung Taung Ni project also Chinese owned
- Political change and broadly favourable 2012 Foreign Investment Law – renewed mining investment interest but no MIC licences issued for exploration/mining
- 1994 Mining Law still in place and can provide a framework for acceptable “Contract of Work” based exploration title
  - but more changes are needed to attract serious explorers

Gegalaw artisanal gold mining and cyanide leaching, 2009
Future – Realising the Potential?

- Irreversible political change has occurred
- New discoveries and development requires risk investment
- Minimal past exploration means there is no pipeline of development projects; need to incentivise high-risk investment in high-risk brownfields and greenfields exploration
- Attracting foreign risk investment requires changes to the Mining Law and regulations
  - PSC’s, signature bonus, high rental rates etc. v. terms that encourage exploration dollars in the ground and new discovery
  - Promote high-risk investment and attract quality technically-focused explorers
  - Improve Mines Department capacity to transparently administer licensing system
- Minimal past exploration enhances opportunities for shallow discovery
  - For what commodities? Where?
  - What is the real mineral potential of Myanmar and, with investment, can it underpin a modern mining industry?
Mineral Potential and Tectonic Setting

- SE Asia comprises a collage of tectonic plates separated from Gondwana and accreted to Asia from the Cambrian to the Cenozoic.
- Understanding mineral potential is directly related to:
  - Understanding this tectonic evolution and related metallogeny
  - Understanding deposit preservation potential related to uplift and erosion, especially for epithermal Au and porphyry Cu systems
- Provides the basis for target belt prioritisation
- Knowledge from the surrounding region can be used, especially where limited information in Myanmar
- Significant metallic deposits of Cu, Au, Zn-Pb-Ag, and Sn-W exist within the country or in metallogenic belts that run into the country
Gold Potential

- Permo-Triassic volcanic arc belt, Eastern Shan State
  - Epithermal potential; Mae Chan etc. in Thailand
  - Gold-rich VHMS; Dapingzhang (2g/t Au), Nam Rin (Ba-Au, Thailand), Tasek Chini (Malaysia)
- Triassic Indosinian orogeny in the “Slate Belt”
  - Orogenic gold, e.g. Modi Taung, Shwegyin alluvials, Russell Island etc.; high grade, low tonnage
- Cretaceous collision and deformation in the Central Myanmar Arc
  - Orogenic gold, Kyaukpazat, Legyin etc. – extensive narrow-vein gold systems; high grade, low tonnage
Gold Potential

- Palaeogene volcanic centres along the Central Myanmar Arc
  - Epithermal gold
  - Kachin segment; Setgadone etc.
- Neogene extensional magmatism along the Sagaing Fault zone
  - Epithermal and sediment-hosted gold e.g. Kyaukpahto (>6Mt at 3g/t), Gegalaw
- Neogene transcurrent faulting and magmatism in the Mogok metamorphic belt (Shan scarps)
  - Mesothermal gold, IRG/skarn? – Kwinthonze, Tayetkhone, Kyaikto
  - Epithermal potential – Tengchong-type young volcanic centres?
Copper Potential

- Cambro-Ordovician volcanic centres
  - **Bawdwin** polymetallic VHMS
- Permo-Triassic arc and back-arc volcanism in the Sukothai and Changning-Menglian belts – VHMS; in China
  - **Dapingzhang** (c. 63 Mt at 0.8% Cu)
  - **Yagra** (c. 1 Mt cont. Cu)
- Triassic fore-arc – **Lemyethna Cu-Au**
Copper Potential

- Palaeogene sub-aerial volcanic centres along the Central Myanmar Arc
  - **Monywa** high-sulphidation epithermal copper deposit (early Miocene); c. 1.88 Bt at 0.37% Cu, Letpadaung, Sabelaung, and Kysintaung deposits
  - **Shangalon** Cu-Au porphyry (Oligocene)
- Kachin Arc segment; correlated with Gangdese arc in Tibet
  - **Jiama** (Tibet; 1.17 Bt at 0.41% Cu, 0.04% Mo, 0.1g/t Au)
- Mogok Belt Neogene transcurrent faulting and magmatism
  - Minor skarn copper-polymetallic mineralisation
Zn-Pb-Ag Potential

- Cambro-Ordovician rhyolitic volcanic centres on the western margins of the Shan-Thai block - VHMS
  - **Bawdwin** ("silver pit") polymetallic VHMS(?); 1938 reserve 10.8 Mt at 22.8% Pb, 13.9% Zn, 1.05% Cu and 670 g/t Ag – biggest global producer of Pb and Ag before WW2
  - Large lower-grade ‘halo’ resource reported by Mandalay Mining in 1997
- Potential outside the Bawdwin volcanic centre; unrecognised volcanic centres?
- Vein-hosted deposits in Precambrian and Cambrian clastics
  - **Yadanatheingyi** etc.
Zn-Pb-Ag Potential

- Early Ordovician carbonate-hosted Pb-Zn-Ag-Ba deposits over 1000 km of strike from Kanchanaburi to western Yunnan (Baoshan).
- Broadly “Irish-type” in a back-arc setting?
- Bawsaing district – extensive old barite, lead and zinc mines
- Shan State; Lufang etc.?
- Thailand - Kanchanaburi; Song Toh, Bo Yai global resources >8 Mt at c. 7% Pb, 3% Zn and 100g/t Ag
- Thailand - Li; Phu Mai Tong barite mine, Mae Chong Zn-Pb-Ag-Ba deposit
- Yunnan; Shizishan, Menxing, Dongshan etc.
Zn-Pb-Ag Potential

- Permo-Triassic back-arc volcanism in eastern Shan State; polymetallic VHMS in Sukhothai and Changning-Menglian belts
  - Laocang, Yunnan, c. 20 Mt at 4.3% Zn, 6.6% Pb, 151 g/t Ag and 0.11% Cu
- Indosinian Triassic MVT?
  - Long Keng oxide Zn deposit c. 0.2 Mt at 35% Zn
- Cretaceous MVT in Thailand
  - Padaeng (Mae Sod) oxide Zn deposit c. 1.7 Mt contained Zn
Sn-W Potential

- SE Asian Tin Belt (c. 2800 km) total estimated production c. 9.6 Mt of tin, or 54% of the world's tin production
- Most Sn-W in Myanmar is from Late Cretaceous Western Province granite-related mineralisation in Tanintharyi
- Most Sn production from Mio-Pliocene alluvial and eluvial palaeo-placers, e.g. Heinda and offshore dredging
- Lesser production from modern placers
- Relatively minor primary production from Sn-W greisen and vein deposits, e.g. Hermingyi, Kanbauk
- Tungsten-rich deposits on the eastern side of the belt; e.g. Mawchi, Mae Lama (Thailand)
- Unrealised primary potential – greisen and skarn?
Ni, Cr, PGM Potential

- Extensive ophiolite belts related to Indian collision event; mostly steeply dipping and dismembered ultramafics
  - **Tagaung Taung** lateritic nickel deposit; c. 40 Mt at 2% Ni
  - **Mwetaung** lateritic nickel deposit; c. 36 Mt at 1.5% Ni
  - Relatively small and moderate grade deposits, mainly saprolite; high capital and power costs
- Widespread small chromite deposits and occurrences
- Alluvial PGM’s recorded at Indawgyi, Hukawng valley
- Jadeite at **Hpakant** has provided one of Myanmar’s most valuable mineral exports
Iron-ore
• No significant deposits known
• Potential for skarn magnetite exists in arc belts and associated with tin skarns
• Enigmatic Pang Phet deposit with reported associated Cu and U; basement or Triassic hosted?

Manganese
• Eastern Shan state; volcanic or skarn-related?

Bauxite
• No significant reported occurrences

Coal
• Extensive low-grade sub-bituminous coal in western basin, Kalewa etc.
• Small brown-coal deposits in fault basins on Shan plateau, e.g. Tigyit, Namma
Operating Framework

- Common Law System
- All minerals vested in the state; royalties are not fixed (precious metals 4-5%, base metals and ferrous metals 3-4%, negotiable)
- 1994 Mining Law set the framework for individual contracts which included:
  - DGSE technical support at the exploration stage
  - Principal terms and conditions of production JV with one of the Mining Enterprises – equity participation with cost recovery
  - Prospecting, exploration and production periods (total up to 10 years) with expenditure commitments and progressive relinquishment
- Investment Law sets framework for foreign investment; approval through Myanmar Investment Commission
- Production Sharing Contracts, high level of ‘signature bonus’ and ‘dead rent’ and short licence terms a major disincentive to risk investment in exploration
- Local support or participation essential in states and ethnic areas
- Currently possible to acquire licences through local JV companies; no MIC licences have been issued
- New Mining Law – when and what??
- How will foreign JV’s with non-state companies be accommodated?
Data & Services

• Improved UTM topographic map coverage at 1:50,000 from modern aerial photography
• Geological mapping limited in extent and quality
• Almost no useful exploration data such as geochemical datasets or airborne geophysics
• Limited technical professional experience especially in younger generation
• Low level in-country exploration services, drilling and geophysics; increased foreign involvement in service companies
• Services and equipment can be imported
• Local service scope and availability will quickly improve if foreign investment in exploration picks up
Logistics

- Poor infrastructure, but reversal of long-term decline has begun, and challenges can be overcome
- Unreliable power supply, but substantial energy resources and improving supply
- Difficult communications, but improving rapidly especially mobile coverage and internet access
- Security restrictions are much reduced, but still an issue in some areas
Opportunities and Challenges

- High geological potential for a number of commodities/deposit types, notably
  - Epithermal and porphyry Cu-Au in arc belts
  - Volcanic- and sediment-hosted Zn-Pb-Ag massive sulphide
  - Sn-W greisen and skarn
- Potential, especially for gold and copper, can be misunderstood, e.g. should not be compared directly with Indonesia
- Improved geological and metallogenic understanding can be applied to support effective targeting models in ground selection and exploration
- Paucity of detailed geology, maps or research, and limited understanding of several significant deposits and districts
- Lack of past exploration implies opportunity for rapid discovery of outcropping orebodies using well-targeted basic techniques such as stream-sediment geochemistry and airborne geophysics
- No data from past exploration to follow up or guide effective approaches
- No regional-scale government geochemical or geophysical data
- Artisanal gold operations provide a key targeting criterion in unexplored areas
Opportunities and Challenges

• Improving political and investment environment
• Limited understanding of the mining industry and incentivisation of exploration risk in bureaucracy and government
• Bureaucracy supportive of mineral exploration investment
• Mines Department is understaffed, under-resourced, and lacks experience in managing and regulating an active exploration and mining industry
• 1994 Mining Law has provided the framework for exploration and development contracts providing a pathway to development with reasonable terms
• Subsequent regulations are very unfavourable for exploration risk investment, e.g. PSC’s, high dead-rent, signature bonus, etc.
• No ‘one-stop-shop’ – multiple departmental approvals required, central and regional and local government
• New Investment Law favourable for foreign investment
• TERMS OF THE NEW MINING LAW REMAIN UNCERTAIN BUT WILL BE CRITICAL IN DETERMINING THE FUTURE FOR MYANMAR’S MINING INDUSTRY
• Role of states is a crucial uncertainty linked to substantive political issues
• Environmental and community framework also remains poorly defined
• EITI application is a positive indication of government intentions
• Improved security situation and access in most peripheral regions
• Problems and tensions remain in some areas
Opportunities and Challenges

- Profusion of local businesses investing in mineral exploration as potential partners for foreign investors
- Limited understanding of the exploration and mining business and a business environment and practices distorted by years of a military-controlled economy
- Multiple stakeholders wanting a slice of the pie, especially in the ethnic regions
- Unrealistic perceptions of value
- Improving infrastructure and communications
- Access in large parts of the country is slow and difficult
- Unreliable power supply, but substantial energy resources and improving supply
- Improved UTM topographic map coverage at 1:50,000 from modern aerial photography and availability of high resolution satellite imagery
- Availability of geologists and workforce with a strong work ethic enthusiastic to learn and grasp opportunities; widespread use of English
- Limited pool of commercially-focused technical experience, especially in mining
- Service companies in country can provide support in geology and exploration, including limited geophysics and drilling
- Service industry still at a low level, but ability to grow quickly
WHAT HAS CHANGED TEN YEARS LATER?

MYANMAR

SHOULD I GO?

- Geology and ground availability – yes / YES
- Political stability – a qualified yes / YES
- Logistics and exploration costs – maybe / YES
- Mining Law, Investment Regulations, Business Environment – with requisite understanding of the system, if the geological potential warrants the costs/THE JURY IS STILL OUT
- Political correctness - ?? / YES
WHAT HAS CHANGED TEN YEARS LATER?

**MYANMAR**
WHERE TO FOR THE GOLDEN LAND?

- Uncompetitive Mining Law/Regulations
- Limited understanding of the value of nurturing a mining industry and, especially, how to achieve this
- The White Elephant syndrome – elusive economic reality in formerly centrally-planned economies

**But**

- Excellent geological potential
- Difficulties can create opportunities for those who can work the system
- Likely future political change
- Not for everyone, but can do business

.... the rare albino elephant was sacred, and each new one born belonged to the king....

....It was a gift to be dreaded as recipients could neither use the elephant nor get rid of it....
Opportunity for Myanmar – Closing Remarks

• Myanmar has the geological potential to develop a significant mining industry
• HIGH-RISK INVESTMENT IN EXPLORATION IS NEEDED IF MINING IS TO SERIOUSLY CONTRIBUTE TO THE SOCIO-ECONOMIC DEVELOPMENT OF MYANMAR; THIS REQUIRES AN INVESTMENT REGIME THAT REWARDS RISK
• An investment regime that encourages risk investment in exploration combined with effective social/environmental regulations will attract serious exploration and mining companies
• Serious players may include large, mid-tier and well-managed technically-competent junior companies
• Reputable companies will follow industry-standard best practice and understand the need to have a ‘social licence to operate’; this will deliver the best outcome in terms of economic return, social and environmental impact
• JVs with local companies and use of local Myanmar service companies will help build a local responsible mining industry
• Undiscovered and undeveloped mineral deposits are unrealised assets until they are developed and contribute to the economic and social development of the country
• MINES WILL NOT BE DEVELOPED IF ECONOMICALLY UNREALISTIC PROCESSING AND REFINING REQUIREMENTS ARE DEMANDED