

A decade of discoveries

A good-news story driven by junior explorers, guided by artisanal workings

Richard Schodde*

Africa has a long history of exploration and development. The Lion Cavern in Swaziland is the oldest known mine in the world. It was first mined in 40,000BC by local artisans who used the iron ore ochre as a cosmetic.

Fast forward to today and you find that artisanal mining continues to play an important role in Africa – directly employing over 8 million people in 2012, principally in the gold, diamond, tantalum, tin and gemstone sectors.

While most of these operations are far too small to be of direct interest to mining companies, their presence is often used by geologists as a leading indicator of mineralisation in the area – and many large deposits have subsequently been found underneath or along strike from old workings.

MinEx Consulting estimates for the period 1975-2014 in gold alone, while artisanal miners accounted for only 7% of all of the significant (>100,000 ounces) gold deposits found in Africa, 30-40% of the gold discoveries made by exploration and mining companies was based on targets identified from local artisanal workings, in conjunction with the normal geochemical and geophysical techniques.

“Over the last decade Africa accounted for a quarter of the world’s mineral discoveries, and has an average discovery rate of 25 significant deposits per year – an enviable record”

A treasure trove

To underpin its strategic studies, MinEx has compiled a comprehensive database of mineral deposits around the world. This includes 1,355 significant mineral deposits in Africa, of which 509 (or 38%) are gold.

A further 161 deposits (12%) have copper, nickel, lead or zinc as their primary metal. The other important commodities in Africa are coal (15%), iron ore (10%), uranium (4%) and diamonds (4%). The remaining 17% (or 235 deposits) are made up of a wide spread of 67 other commodities – ranging from asbestos through to zircon.

In other words, Africa is treasure trove of minerals for the world.

The lion’s share of the deposits are in South



The world-class Kamao copper deposit was found in 2008 under shallow cover in the DRC

Africa – with 433 or 32% of the total. Its nearest rivals are Zimbabwe (7%), the Democratic Republic of the Congo (5%), Ghana (4%), Burkina Faso (4%) and Zambia (4%).

At the other end of the scale, Chad currently only hosts two significant known deposits (0.1%). Hopefully Chad’s standing will improve, given that the BRGM, the French geological survey, is currently undertaking a major study of the country’s mineral resource inventory, to be completed by 2018.

These deposits are spread across the continent (see figure 1), though part due to geology and part due to the need to access transport infrastructure, many of these are near the coast. To date, the heart of Africa remains largely explored.

A quarter of world discoveries

Of Africa’s deposits, 505 have been found since 1975, including at least 201 in the last decade (see figures 2 and 3). This includes 67 known deposits in the last five years (from 2011 to 2015). In practice, the number of recent discoveries is certain to rise, as it takes several years for a deposit to be fully drilled-out and the true size of its resource reported.

For purposes of this article MinEx Consulting defines a ‘significant’ (or ‘moderate-sized’) deposit as one containing a pre-mined resource with an in-situ value greater than 100,000oz of gold (for gems and precious metals) or greater than 100,000t of copper (for base metals and other deposits).

MinEx estimates the final count for the period 2006-2015 will be around 250 deposits for Africa. By comparison, around 1,000 deposits were found in the world over the same time period. In other words, over the last decade, Africa accounted for a quarter of the world’s mineral discoveries, and has an average discovery rate of 25 significant deposits per year – an enviable record.

Even more impressive is the fact that Africa’s discovery rate is nearly three times that achieved in previous decades. Over the

period 1975 to 2004, on average only nine significant deposits were found each year on the continent.

While the recent track record for discovery is extraordinary, it was largely realised through a dramatic increase in exploration expenditures. Figure 3 shows a strong correlation between expenditures and the number of discoveries.

Over the three decades to 2004, industry spent on average US\$700 million per annum (in constant 2015 dollars) on exploration in Africa and found on average nine deposits per year. By comparison the average expenditure in the last decade was 3.6 times higher at nearly \$2.5 billion per annum, but the discovery rate only increased by a factor of 2.8 times.

MinEx estimates that over the past decade 66% of Africa’s discoveries were made by junior exploration companies. The major producers were conspicuous by their absence – accounting for just 4% of all new deposits found. This is less than the 13% found by small-to-moderate producers, 9% by private companies and 5% by artisanal miners. The remaining 3% were found by industrial companies and government agencies.

Only a third are now mines

The wealth creation step in exploration only happens when the discovery is mined. Unfortunately, this takes time and, in any case not all deposits are economic.

In Africa, since 1975, only one-third of deposits have so far have been mined. Of those that do get developed, the average delay between discovery and production is 11.4 years (excluding those discoveries made by artisanal miners). These figures vary by commodity, deposit size and country.

To improve the odds of success, industry and government need to focus on improving the level of infrastructure, and lowering input costs, taxes and political risk.

Looking forward, there is concern about the recent collapse in commodity prices and its associated impact on exploration expenditures and activity. In detail, expenditures have collapsed from a peak of \$4.57 billion in 2012 to \$1.41 billion in 2015 – a drop of 69% in real terms, with the fall being felt most acutely in diamonds and bulk mineral sectors.

Although it is too early to report a precise number, there appears to be similar, if not larger, percentage drop in the number of discoveries over the same period. Given the long delay between discovery and development, any decline in the number and quality of discoveries will have a long-term impact on the overall size of the industry and the associated revenues accruing to governments.

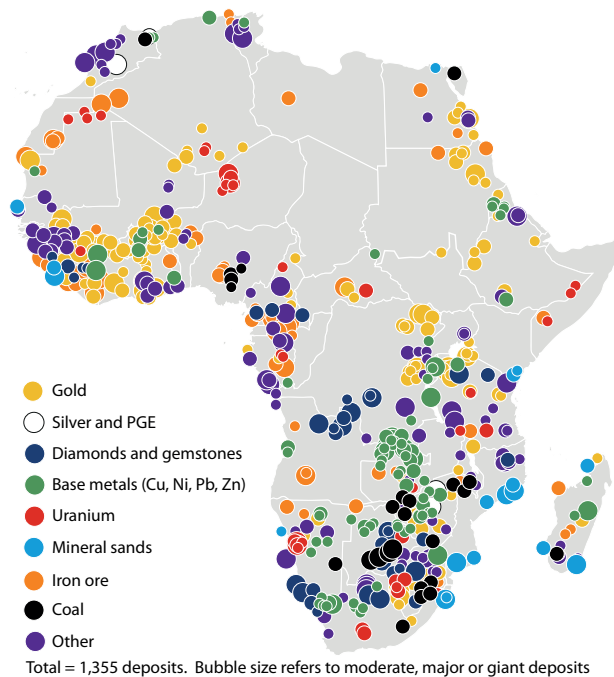


Figure 1: Size and location of significant mineral deposits in Africa (all years)

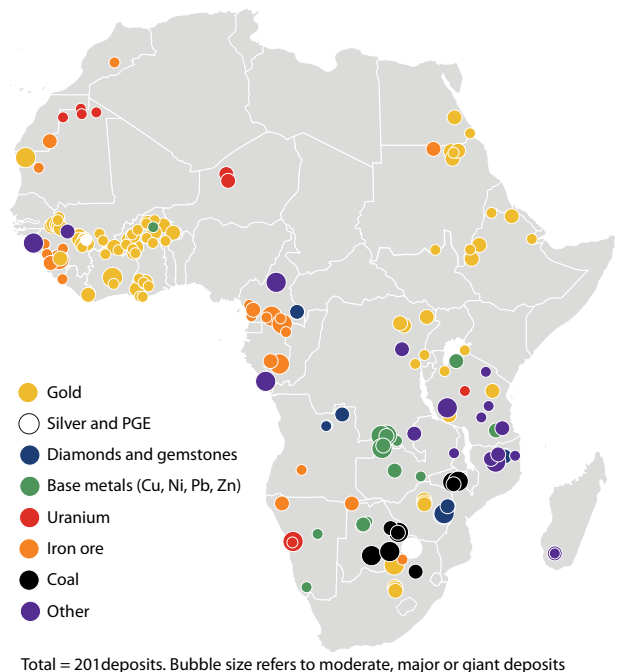


Figure 2: Size and location of significant mineral deposits in Africa (discovered 2006-2015)

Source: MiniEx Consulting, January 2016

Recent important discoveries

Figure 2 shows the commodity type and location of the 201 significant discoveries made in Africa over the past decade.

In summary, the discovery story for Africa for the last decade was dominated by gold – accounting for 96 new deposits (containing 143 million ounces), of which 66 (containing 96Moz) were in West Africa.

The stand-out countries were Burkina Faso (with 21 significant discoveries containing 22Moz), Mali (11 discoveries and 14Moz), Guinea (nine discoveries and 15Moz) and Senegal (eight discoveries and 12Moz). Recent noteworthy discoveries in the region include:

- Gounkoto (5.7Moz) by Randgold Resources in 2009;
- Dugbe (4.2Moz) by Hummingbird Resources in 2009;
- Fekola (4.8Moz) by Papillon Resources in 2010;
- Hounde (2.7Moz) by Avion Gold in 2010; and,
- Natougou (1.5 Moz) by Orbis Gold in 2012.

In east Africa the current breaking play for gold is in Sudan – where since 2011 five significant deposits have been found containing more than 8Moz of gold, the best being Galat Sufar South (2.2Moz) by Orca Gold in 2012.

The impetus to explore in Sudan was driven by the recent intense level of artisanal activities there. In spite of the harsh conditions, over 1 million local miners have rushed into the northern part of the country, including 100,000 people into the Jabel Amer district alone. To give a better sense of the scale of the gold rush, production grew from

72,000oz in 2008 to 1.48Moz in 2012 and 2.4Moz in 2014 – of which 2.1Moz came from artisanal sources – a true modern-day gold rush in every sense of the word.

The potential for gold shouldn't really come as a surprise, as the ancient name 'Neb' in the Nubian language means 'gold'. Notwithstanding this, and perhaps mindful of the challenges, to-date only a handful of western companies are active there. Given the size of the prize, this is sure to change. The government has ambitions that Sudan will become the largest gold producer in Africa by 2018.

“In east Africa the current breaking play for gold is in Sudan – where since 2011 five significant deposits have been found containing more than 8Moz of gold”

Continuing with the focus on precious metals, the only significant platinum group element (PGE) discovery made in the last decade was at Waterberg on the Northern Limb of the Bushveld Complex in South Africa.

It was found by Platinum Group Metals in 2011 and (as at July 2015) the resource was 367.3Mt at 0.98g/t Pt, 2.02g/t Pd and 0.24 g/t Au, for a total of 38.4Moz of precious metals. This month, the company announced that it had mobilised 12 drill rigs to drill-out and expand the current resource.

With regard to copper, two noteworthy discoveries are Ivanhoe Mining's Kamao project near Kolwezi in the DRC and Cupric Canyon Capital's Khoemacau project in Botswana. The world-class Kamao copper deposit was found in 2008 under shallow cover and boasts a resource of 966Mt at 2.5% Cu, equal to 24.2Mt of copper metal. Openpit mining is set to start in 2018.

What is special about this massive discovery is that it is in a previously unrecognised western extension of the Central African Copperbelt and was found using good conceptual geology coupled with a high-resolution airborne magnetic survey and an aggressive drilling programme.

The Khoemacau project is made up of a camp of modest-sized but high-grade copper deposits within the Kalahari Copperbelt. While the district has a long history of exploration (with Boseto being found in 1967), Hana Mining found the Zone 5 deposit in 2008.

Under the tutelage of veteran geologist M Steven Enders (ex-Newmont and ex-Phelps Dodge), private US company Cupric Canyon Capital recognised its size potential and ultimately acquired Hana Mining in early-2013.

In 2015 the company had 27 rigs drilling at Zone 5 with every hole intersecting high-grade copper mineralisation. As at July 2015, the resource at Zone 5 had grown to 100.3Mt at 1.95% Cu and 19.9g/t Ag. This is certain to increase when the latest drill results are compiled. It also doesn't include the other deposits within the camp. Relatively-speaking, Khoemacau is modest in size but its high grade and good geometry make it a low-cost mine in a low-risk country. The company

plans to start production from underground operations in 2018.

The two most significant uranium discoveries in the last decade are Husab in Namibia and Adrar Emoles in Niger. The tier-one Husab deposit (583.3Mt at 0.4kg/t U₃O₈ (containing 233,000t U₃O₈) was found by Extract Resources in 2006.

This is the largest uranium deposit found in the world in the last 25 years. The company was subsequently acquired by the Chinese in 2012 for \$2 billion and is set to start production in 2016.

The DASA 1, 2 & 3 deposits were found by Global Atomic Fuels (a private US company) at Adrar Emoles in 2012. In June 2014, the company reported a resource of 28.54Mt at 1.83kg/t U₃O₈, containing 52,000t of U₃O₈. Unfortunately, the recent unrest in the country has slowed down work on the project.

In the last decade there was a flurry of iron ore exploration on and near known old deposits in western and equatorial Africa. Over 20 new iron ore deposits were subsequently found in the region, with best being Zanaga (6.9 billion tonnes at 32% Fe) located 300km from the coast in the Republic of Congo.

It was found in 2007 by a private company and ownership was progressively transferred

“In the last decade there was a flurry of iron ore exploration on and near known old deposits in western and equatorial Africa. Over 20 new iron ore deposits were subsequently found in the region”

to Glencore in 2011/2013. A feasibility study was completed in 2014 and permitting for the required rail and port facilities are currently underway.

With regard to precious gemstones, the two most noteworthy discoveries in the last decade were the Marange diamond camp in Zimbabwe and the Montepuez ruby deposits in Mozambique.

Alluvial diamonds were found at Marange in 2006 by the junior company African Consolidated Resources, and the camp is now run by seven private entities in partnership with the Zimbabwe government. In 2012 the camp produced 12 million carats – making it

the biggest diamond operation in the world – and deserving of the title ‘world class’.

High-quality rubies were first found by artisanal miners in alluvial gravels in the Montepuez district in northern Mozambique in 2009. The hard-rock source was identified in the following year.

In 2011, the Montepuez Ruby Mining Company (MRM) was set up – jointly owned by Mwiriti (a local company) and Gemfields (the world’s largest coloured gemstone producer).

MRM has title over the main deposit and bulk testing started in late 2012. To date, 423,000t of ore has been trial-mined producing 16.1Mct at an average cost of \$1.81/ct. The average sales price realised was \$20.65/ct.

With these strong margins, MRM is understandably very keen to go into full scale production. In July 2015, the company published a maiden reserve of 27.5Mt at 15.7ct/t, equal to 432Mct. With further drilling, Montepuez has the potential to become the largest ruby deposit in the world.

Another very profitable discovery made on the back of artisanal miners is the Bisie tin deposit in northern DRC, 180km west of Goma. A large tin-bearing gossan was found in 2002 and soon became the focus of large-scale illegal mining.

Even though tenements were issued over the property in 2006, due to the lawlessness in the area, the company (now called Alpha-min Resources Corp) was not able to drill and discover the main deposit until 2012.

The reported resource (as at December 2015) was 4.78Mt at 4.06% Sn, 0.29% Cu and 0.15% Zn.

While this is relatively modest in size, even with the current depressed commodity prices, the in-situ value of the ore is over \$600/t. This suggests that it will be a very profitable operation.

Finally, one of the truly outstanding success stories for Africa in the last five years has been the discovery of a belt of giant graphite deposits in northern Mozambique/southern Tanzania. The initial discovery was Balama West in Mozambique by the junior explorer Syrah Resources in 2011. In January 2013, a maiden resource of 564Mt at 9.8% Total Graphitic Carbon (TGC) was reported.

As of May 2015, it stood at 1.19 billion tonnes at 10.78% TGC equal to 128.5Mt of flake graphite. The company was originally exploring for uranium but serendipitously found extensive zones of high-grade graphite at surface. The rest, as they say, is history. The company’s market cap quickly soared from \$5 million to over \$700 million.

The excitement generated from Syrah’s success, plus the fact that graphite is an essential element in the manufacture of lithium-ion batteries (a rapidly expanding market) generated a modern-day staking rush. To date, over 16 companies have taken up tene-

MINEX CONSULTING

MinEx Consulting’s mineral deposits database has been used by a number of researchers in academia. This includes staff from International Monetary Fund in collaboration with Oxford University.

Their study (Arezki et al, 2015) involved assessing the local impact of major oil and mineral discoveries on conflict within Africa over the period 1946 to 2008.

They found that resource discoveries appear to improve local income (as measured by the relative amount of nightlights in the local area).

In particular they found “resource discovery significantly reduce the likelihood of conflict onset up to ten years post resource discovery”.

And that there was little or “no [diversity] in the relationship between resource discovery and conflict across resource type, size of discovery, pre- and post- conclusion of cold war, and institutional quality”.

The results remained the same at the local, regional and national levels.

The IMF also used MinEx’s data in its 2015 Report on the World Economic Outlook.

They found that the new frontiers for exploration have shifted from advanced to emerging market and developing economies.

Of more interest is the empirical observation that, at the country-level, the rate of discovery is influenced by business risk – and that “a one standard deviation improvement in the political risk rating (which corresponds to a move from, for example, Mali to south Africa, South Africa to Chile, or Chile to Canada) would lead to 1.2 times as many metal discoveries in those countries”.

The World Bank (2016) has also used MinEx’s database to determine the impact of changes in policy options on the time delay between discovery and development.

They found that adopting best practice could shave 2-3 years off the development time line for a major copper project.

References:

- Arezki, R., Bhattacharyya, S. and Mamo, N., June 2015, “Resource Discovery and Conflict in Africa: What does the Data Show?” OxCarre Research Paper No.159, Oxford Centre for the Analysis of Resource Rich Economies, University of Oxford. A copy can be downloaded from: <http://www.oxcarre.ox.ac.uk/images/stories/papers/ResearchPapers/oxcarrerp2015159.pdf>.
- IMF, October 2015, “World Economic Outlook – Adjusting to Lower Commodity Prices Special Feature”, published by the International Monetary Fund. Pages 47-50. A copy can be downloaded from: <http://www.imf.org/external/pubs/ft/weo/2015/02/>.
- The World Bank, January 2016, “Global Economic Prospects. Special Focus: From Commodity Discovery to Production: Vulnerabilities and Policies in LICs”. A copy can be downloaded from <http://www.worldbank.org/reference/>.

ments in the region and 11 significant discoveries have been reported with many more waiting in the wings.

The title of the biggest graphite discovery is currently held by Triton Minerals, with their also-named Balama deposit. The Balama (Triton) deposit was found in 2014 and boasts a Resource (as at October 2015) of 1546Mt at 10.74% TGC equal to 166Mt of flake graphite.

Adding together the published and estimated resources of the known discoveries in Mozambique and Tanzania generates a total of 330 million tonnes of flake graphite. To put this into perspective, in 2012 the USGS reported that the world's total "economic reserves" (or more correctly resources) of graphite were 70Mt. In other words, the recent discoveries in east Africa have increased the World's supply of graphite by 470%.

Outlook for Africa

To summarise, Africa's track record in exploration has been surprisingly robust and has resulted in over 250 significant discoveries over the last decade across a wide range of commodities.

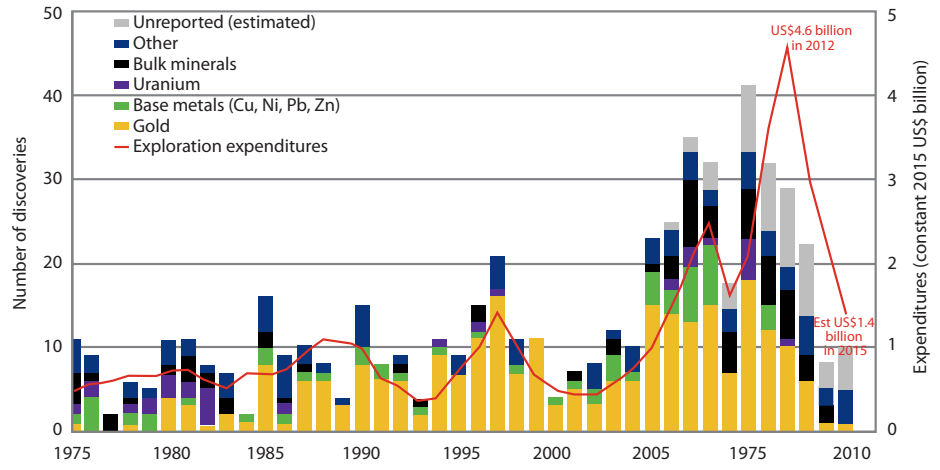


Figure 3: Exploration expenditures and number of significant mineral discoveries in Africa: 1975-2015

It is interesting to note that a one-third of these discoveries are derived from evidence generated from the prior workings of local artisanal miners.

They have been, and continue to be, the vanguard of the industry. It is equally significant to note that two-thirds of all discoveries were made by junior explorers – who are in

severe financial difficulties due to the challenges associated with raising fresh capital.

However, Africa still faces the perennial challenge of converting these discoveries into mines. This requires industry and government working together to improve the level of infrastructure, and lower the level of input costs, taxes and political risk.

*Richard Schodde is the managing director of MinEx Consulting, a consultancy group that specialises in providing strategic and economic advice to resource companies. In December 2015, Mining Journal nominated Schodde as one of the top 20 power people in world mining, due to his strategic insights and influence on policy in the exploration sector

Minjng Journal Supplements

Unique solutions for the global mining industry

Tailor-made publications created by the world's top mining media team. Customers include governments, resource companies, agencies and institutions.



For more information, contact **Christine Gill**
 on: +44 (0)20 7216 6088 or
 by e-mail at: christine.gill@aspermontmedia.com

www.mining-journal.com/focus/supplements

