

# Company Geodata: Growing African National Archives via Transfer of Corporate Geoscience Data

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**Key themes:** Governance and Regulation  
Operational Effectiveness  
**Key countries:** Africa and General Application  
**Completion:** April 2015

**Research aims:**  
This project sought to investigate barriers to corporate data delivery to African national archives from the regulation, technical implementation and compliance perspectives, through:

- face to face interviews and questionnaires
- a review of existing publications
- a country-level case study

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## IM4DC Action Research Report



# Summary of Action Research Activity

## **Company geodata: growing African national archives via transfer of corporate geoscience data**

The African Mining Vision identifies knowledge infrastructure, and resources data in particular, as an imperative for countries to improve their negotiating positions when establishing extractive agreements and also for deals on agricultural terrains, forestry, fisheries and tourism. Precompetitive geoscientific data when made available to mineral exploration companies has been shown to generate inward investment ranging from ratios of 3:1 to 20:1 for a number of international jurisdictions. However, for many African countries, the extent of geodata transferral from industry to government is variable and company geodata is largely missing from the geological infrastructure. When a company ceases activity on a permit, if the datasets they have acquired during exploration are not transferred to the government custodians of geoscientific data, this represents a missed opportunity for growing the national archive.

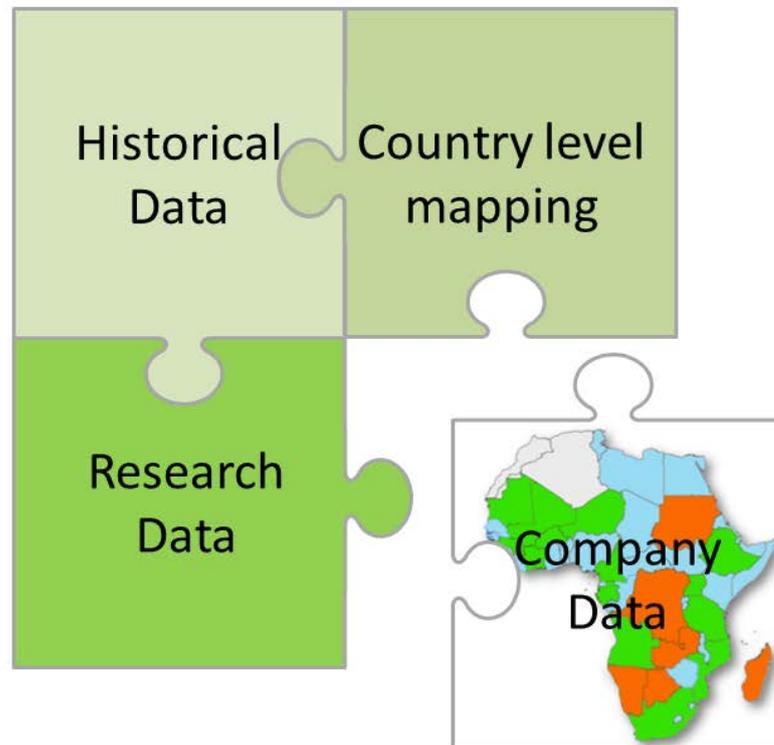
This report is based on an investigation involving face to face interviews with company, geological survey and university personnel supported by a questionnaire completed by 35 respondents from these three groups, existing publications and a combined total of 15 years' experience working in Africa in the minerals sector.

A cumulative approach is proposed to improve the transfer of company geodata to relevant government agencies and to achieve the following objectives:

- Raise the level of trust between companies and government departments
- Demonstrate that these two stakeholders have a shared interest in building national geoscience archives
- Provide a pathway towards a fast-tracked implementation allowing company data to begin to flow to government archives
- Outline a data management and delivery system at a scale that is sustainable for government departments in the initial stages of work-flow establishment and that would receive the maximum level of support from exploration companies, as it addresses their principal needs.

The approach would allow early implementation via transfer of company data from relinquished permits as a first stage towards an extended company geoscientific data management initiative. It would allow transfer, archiving and maintenance systems to be established and proven first, before addressing the need to ensure data confidentiality over active permits, which the survey showed was of real concern to companies in jurisdictions where data management systems are poorly monitored or non-existent.

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April 2015

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## List of Abbreviations

ACP	Secretariat of the African, Caribbean and Pacific Group of States
ADEA	Association for the Development of Education in Africa
AEGOS	African-European Georesources Observation System
AMGI	African Minerals Geoscience Initiative
ASX	Australian Stock Exchange
EGS - OAGS	EuroGeoSurveys - Organisation of African Geologic Surveys
AfDB	African Development Bank
AMDC	African Minerals Development Centre
BUMIGEB	Bureau des Mines et de la Géologie du Burkina Faso
DRC	Democratic Republic of Congo
ICMM	International Council for Mining and Metals
GSO	Geological Survey Organisation
PACE	Plan for Accelerating Exploration (South Australia)
SAEI	South Australian Exploration Initiative
SEAMIC	Southern and Eastern African Minerals Information Centre
UNECA	United Nations Economic Commission for Africa
UNSECO	United Nations Educational, Scientific and Cultural Organization
USGS	United States Geological Survey
WAMEX	Western Australian Mineral Exploration Index

## Acknowledgements

This project was funded by the International Mining for Development Centre.

Survey respondents are gratefully acknowledged:

Damiel Asiedu, University of Ghana,  
Neil Clifford, Aura Energy Ltd, Australia,  
Max de Vietri, EMR Resources Pty Ltd,  
Mababa Diagne, Université Cheikh Anta Diop de Dakar, Senegal,  
Edmond Diah, IFAN Université Cheikh Anta Diop, Senegal ,  
Lamine Diouf, Direction des Mines et de la Géologie, Senegal,  
Mai Ousmane El Hamet, Centre de Recherche Géologique et Minière, Niger,  
Moussa Garba, Ministère des Mines et Développement Industriel, Niger,  
Alain Nicaise Kouamelan, Université Félix Houphouët-Boigny d'Abidjan, Côte d'Ivoire,  
Gbele Ouattara, Ecole Supérieure des Mines et de la Géologie, Yamoussoukro, Côte d'Ivoire,  
Mariette Miningou, Université de Ouagadougou, Burkina Faso,  
Bah Nassirou, Direction Nationale de Géologie, Republic of Guinea,  
Morou François Ouedraogo, Teng Tuuma Geoservices Training Centre, Burkina Faso,  
Damegare Sogle, Direction Générale des Mines et de la Géologie, Togo,  
Abdoulaye Toure, BUMIGEB, Burkina Faso,  
Chris Wijns, First Quantum Minerals Ltd  
together with those respondents who wished to remain anonymous.

Particular thanks to Kwame Boamah and Rosemary Okla (Geological Survey Department of Ghana) and Jerry Ahadjie (Minerals Commission of Ghana) for participating in extended discussions in addition to the survey.

The following people were consulted during the investigation; their comments and insight are sincerely appreciated:

Abdourhamane Abdou, Direction Générale des Mines et de la Géologie, Niger  
Djibo Maïga Abdoul-Wahab, Ministère des Mines et de l'Énergie, Niger  
Margaret Ellis, Geological Survey of Western Australia  
Mesfin Gebremichael, SEAMIC,  
Yok Beth Myambilwa, Geological Survey of Tanzania  
Sid'Ahmed Ould Mohamed Lemine, Aura Energy Ltd, Mauritania  
Louis Théogène Ralantoarison, Aziana Limited, Madagascar  
Noemie Razafindrazaka, Université de Besançon, France  
Margaretha Scott, WH Bryan Mining and Geology Research Centre, Sustainable Minerals Institute, Queensland, Australia  
Wendy Treasure, University of Western Australia  
Abba A. Usman, Nigerian Geological Survey Agency

## Summary

A pilot project was undertaken to investigate barriers to corporate data delivery to African national archives from the regulation, technical implementation and compliance perspectives.

For many African countries, the extent of geodata transferral from industry to government is variable and company geodata is largely missing from the geological infrastructure. When a company ceases activity on a permit, if the datasets they have acquired during exploration are not transferred to the government custodians of geoscientific data, this represents a missed opportunity for growing the national archive.

A cumulative approach is proposed to improve the transfer of company geodata to relevant government agencies and to achieve the following objectives:

- Raise the level of trust between companies and government departments
- Demonstrate that these two stakeholders have a shared interest in building national geoscience archives
- Provide a pathway towards a fast-tracked implementation allowing company data to begin to flow to government archives
- Outline a data management and delivery system at a scale that is sustainable for government departments in the initial stages of work-flow establishment and that would receive the maximum level of support from exploration companies, as it addresses their principal needs.

Geodata from relinquished permits alone would incrementally increase the area of data coverage by significant amounts over a boom and bust cycle of exploration activity. The transfer of these datasets to national archives would represent equivalent data acquisition expenditure of US\$1B across Africa. This figure should not be considered as a dollar amount to be recovered by future sale of the data. A key requirement for generating inward investment is that geodata be made available as precompetitive datasets.

Precompetitive geoscientific data when made available to mineral exploration companies has been shown to generate inward investment ranging from ratios of 3:1 to 20:1 for a number of international jurisdictions.

Contributions to country development resulting from the outcomes of building a robust geoscientific knowledge infrastructure that includes company exploration data are demonstrated to benefit a broad range of stakeholders such as non-minerals government agencies (e.g. environmental ministries) and higher education institutions in addition to industry operators, ministries of mines and geological survey organisations (GSOs).

As a first step towards a full integration of company exploration data into the geoscientific knowledge infrastructure for jurisdictions not currently archiving digital company geodata, this report explores the option of initially requiring that company data transfer to governments be specifically limited to exploration data from relinquished permits. By defining regulations for the transfer of data in this way, the entire work flow could be designed and implemented with much reduced risk to both governments and companies.

Future projects continuing the theme of this investigation include a targeted implementation of a geodatabase system designed to archive, manage and distribute company data for one country or for a region of cooperating countries and a data recovery project to locate and repatriate exploration data from relinquished permits acquired during the last decade.

## 1) Introduction

Africa saw an exponential rise in mineral exploration over the decade 2002 to 2012; however, the individual countries with increased exploration activity and mine development have generally not benefited from the growth in geological infrastructure development that would be expected after such a rise in exploration activity.

Some African mining codes specifically require explorers to submit reports and data based on their fieldwork. In many countries where mining legislation includes the requirement of exploration data accompanying reports, these reports are submitted to mines departments as hard copies and sometimes in pdf format during permit tenure. The associated digital datasets are commonly not provided, even after a company has relinquished a permit. This is a rate-limiting step to additional exploration, as the availability of prior exploration data constitutes a cornerstone for any new exploration project. At present many government departments in Africa are not able to enforce full compliance due to a lack of technical and financial capacity to implement appropriate archiving and digital data management systems.

Current mineral industry trends show that the majority of greenfields exploration is undertaken by junior and mid-size companies. In Canada for example, they currently account for 50% of the exploration budget and 80% of all discoveries<sup>1</sup>. The first technical stage of mineral exploration for such companies involves comprehensive data searches, and explorers will preferentially target reconnaissance zones for which there exists pre-competitive geoscientific data (geodata). For example, common practice for exploration targeting in industry sees ten desk-top studies undertaken before one zone is targeted for reconnaissance work that initiates inward investment.

**“In the mining business, the availability of quality and reliable geologic data is a pre-condition for investment.”<sup>2</sup>**

One of the key challenges identified in the African Mining Vision<sup>3</sup> addresses this issue as part of the theme of building knowledge infrastructure with the aim of improving the ability to negotiate equitable resource exploitation contracts. There are several pan-African and regional initiatives that aim to augment the quantity of pre-competitive geodata available and to facilitate its discovery and dissemination: The European Union SYSMIN Technical Assistance Programs, World Bank Technical Assistance Programs, The World Bank African Minerals Geoscience Initiative (AMGI), The European Commission African-European Georesources Observation System (AEGOS, EGS-OAGS), The West African Exploration Initiative (WAXI) and OneGeology.

<sup>1</sup> Schodde, R., "The rising importance of Junior Explorers .... and the key challenges they face going forward" keynote address to the Quebec Mineral Exploration Association Conference, Quebec City, November 2013

<sup>2</sup> Chindo, M. 2011. An Extensive Analysis of Mining in Nigeria Using a GIS. Journal of Geography and Geology 3, 3-12.

<sup>3</sup> African Union. 2009. Africa Mining Vision

Company data delivery is recognised to be an important part of the geodata puzzle:

*“Procedures need to be developed to systematize and enhance the collection and use of the (company) data contained in the legal reporting requirements mandated under the countries’ mining laws.”<sup>4</sup>*

Less obvious is how this can be achieved in many countries in Africa. This report aims to highlight the inherent value of company exploration data to African geodata infrastructure, and the wide-ranging impacts that successful implementation of corporate data delivery to national archives would produce. We also investigate the major barriers to implementation of such initiatives and provide discussion and recommendations to overcome key obstacles.

This report is based on an investigation involving face to face interviews with company, geological survey and university personnel supported by a questionnaire completed by 35 respondents from these three groups, existing publications and a combined total of 15 years’ experience working in Africa in the minerals sector.

The scope of the present report is limited to mineral exploration activity on the African continent but the themes and options for data sharing between companies and governments could be applied to other mining jurisdictions. Company geodata refers to digital data acquired through mineral exploration activity and includes outcrop databases, geophysical surveys, geochemical surveys (soil, rock and stream sampling), drill logs and assay data. This report does not address the preservation of drill core and physical rock samples, nor historical data contained in paper or pdf documents.

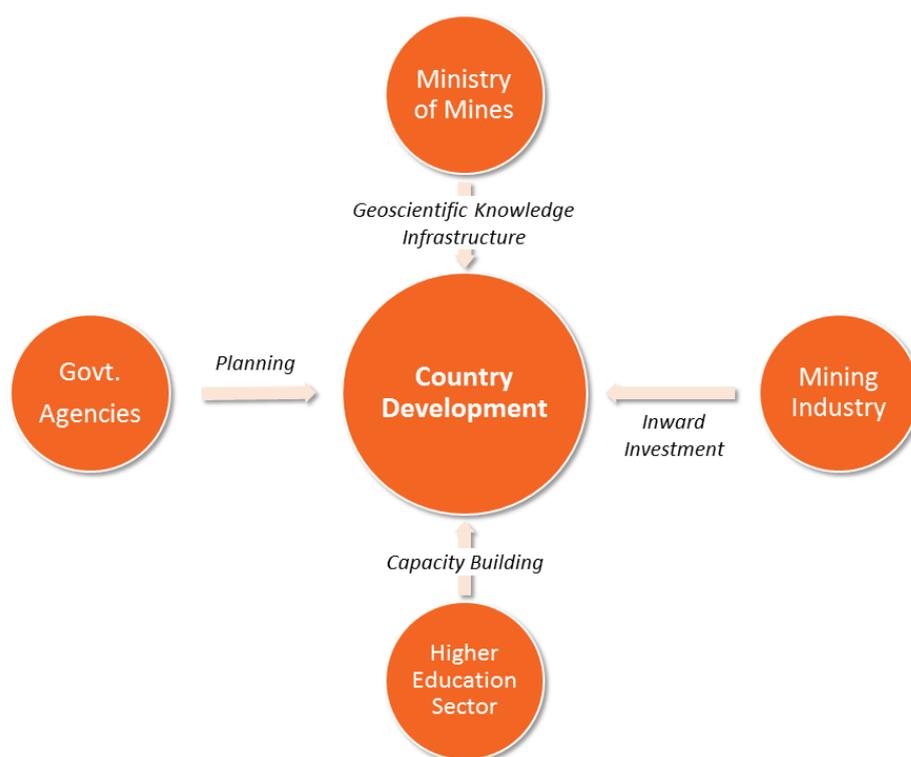
## **2) Stakeholders and benefits**

The African Mining Vision identifies knowledge infrastructure, and resources data in particular, as an imperative for countries to improve their negotiating positions when establishing extractive agreements and also for deals on agricultural terrains, forestry, fisheries and tourism.

This concept of geoscientific data acquired for resource exploration but useful for a wider set of applications is an important idea. For example, exploration drilling data in arid regions that record intersections with the water table is valuable information for hydrogeological and environmental studies. Hence exploration data should be considered to be ‘generic’ in that they have the potential for applications that far exceed their original purpose (Figure 1).

In addition to the applications referred to in the African Mining Vision, Table 1 below gives a non-exhaustive outline of stakeholder benefits from the inclusion of company data in a widely-accessible database in support of building geoscientific knowledge infrastructure.

<sup>4</sup> World Bank. 2014. The African Minerals Geoscience Initiative (AMGI)- The “Billion Dollar Map” Technical Report.



**Figure 1: Illustration of the contributions to country development resulting from the outcomes of building a robust geoscientific knowledge infrastructure that includes company exploration data**

**Table 1: Stakeholder benefits from the transfer of company geoscientific data to national archives**

Stakeholders	Evolution/Development	Stakeholder Benefits
Mining Ministries and GSOs	GSOs become the custodians of the geoscientific infrastructure under the administration of the Mining Ministries	<ul style="list-style-type: none"> <li>Capacity building of government staff</li> <li>Development of robust management systems.</li> <li>Increased knowledge infrastructure improves the position of governments during resource negotiations and strategic planning</li> </ul>
Non-mining government departments	Access to knowledge infrastructure for a broad range of applications in addition to those for which data were originally acquired	The applications of 'generic' data to domains outside the mining sector. The wide availability of the knowledge infrastructure underpins more informed decisions on environmental, agricultural and urban planning
Education	Increased availability of high resolution datasets for teaching and research projects in higher education	Improved training tools for teaching higher education students who will go on to work in government and industry
Mining Industry	Access to previously acquired company data in addition to smaller-scale precompetitive data	Reduced technical risk in successive exploration operations that can build on previous data acquisition campaigns

### 3) The role of company geodata in the geologic knowledge infrastructure

Geoscientific infrastructure is recognised as a cornerstone for minerals industry development.

*“Geoscience data are at the heart of every resource discovery and at the centre of every resource development.”<sup>5</sup>*

An exceptional example of the recognition of the value of geodata exists in the 2014 mining code of Algeria<sup>6</sup> which includes 2 Chapters with 15 Articles concerning the Geological Infrastructure and the conservation of the national geological knowledge heritage. The importance and inherent value of the national geodata legacy has been enshrined into law. Foundations of the geological infrastructure are work programs employing the disciplines of geology, geodesy, geophysics, geochemistry, remote sensing and subsurface sampling (drilling) for the acquisition of knowledge of the soil and subsoil. The references to the acquisition of Geodata for the Geological Infrastructure are primarily concerned with the national GSO. However, also mentioned are other entities having the right to contribute to the national Geodata archive such as universities, independent organisations and companies (including mining companies).

Several initiatives to augment the quantity and quality the geoscientific infrastructure across Africa have been made, and continue to be undertaken, in order to address the lack of geoscientific infrastructure in many countries. Based on published data from 2002<sup>7</sup>, only 14% of the African territory was covered by reasonably detailed geological maps of 1:200,000 scale or better. The major resource geodata development initiatives in Africa, past and present, are summarised in Figure 2.

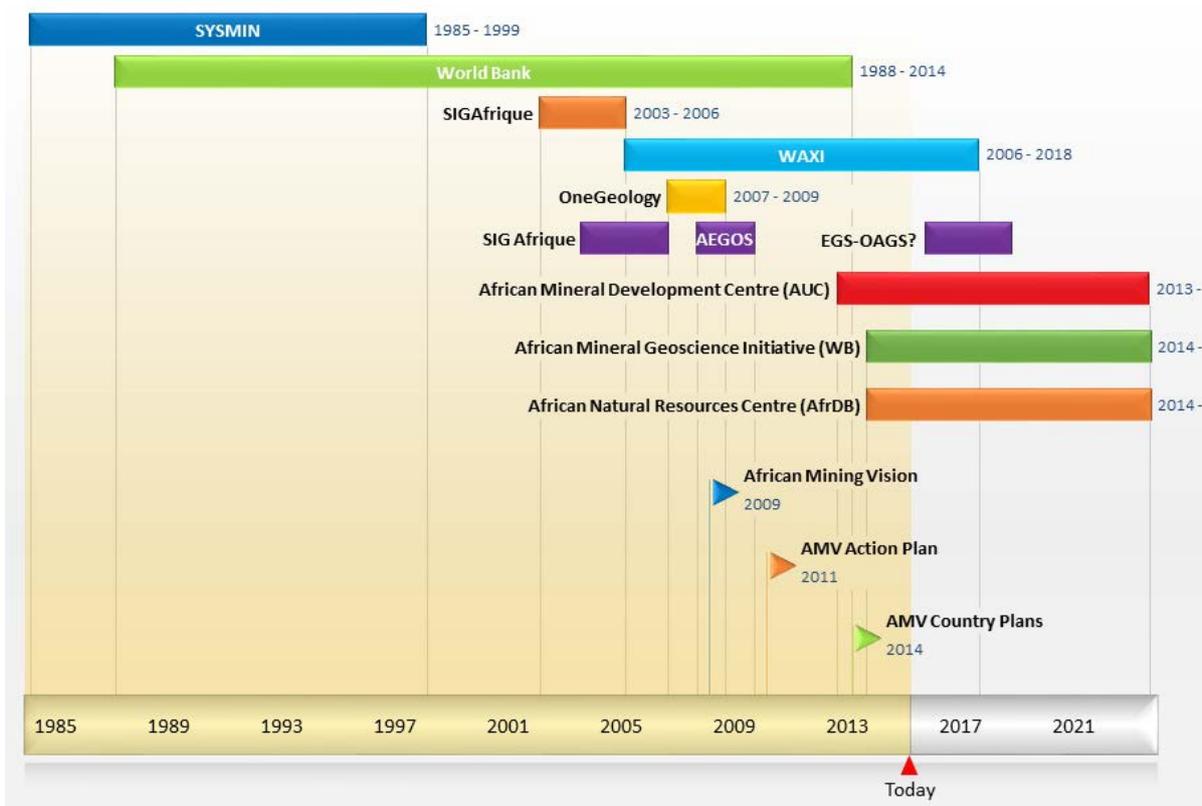
Initiatives such as the EU SYSMIN and World Bank have funded large-area (small-scale) geology mapping and geophysical surveys (Figure 3). These programs have been very successful in providing precompetitive data for industry reconnaissance and early-stage exploration target generation. However, this is only true for those countries where the data has been made easily available.

The current philosophy regarding precompetitive data in Africa, and in major mining countries such as Australia and Canada, is that the onus is clearly on the state to provide good quality regional datasets in order to attract inward investment from mining operators.

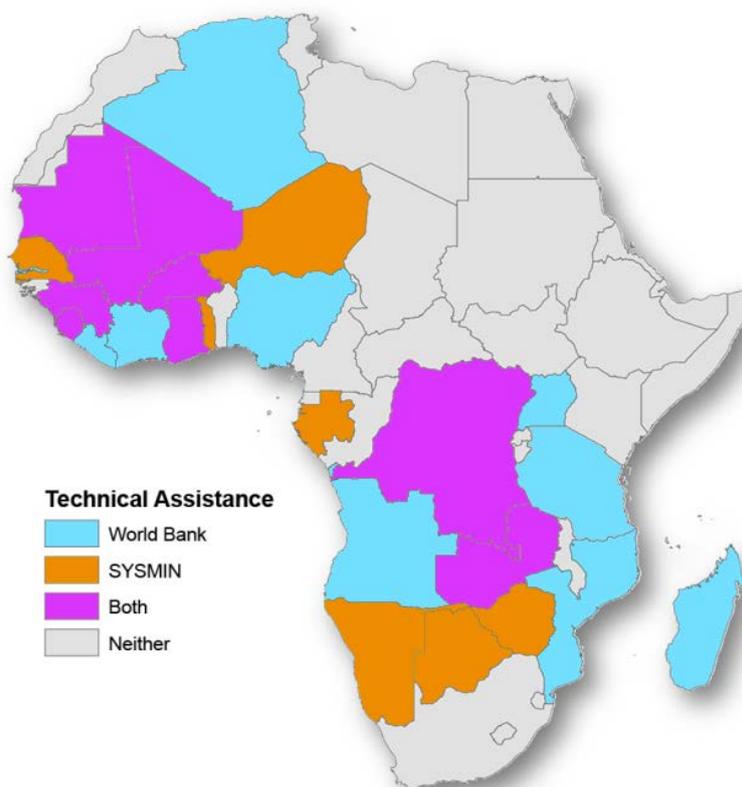
<sup>5</sup> Scott, M., Jones, M., 2014. Management of Public Geoscience Data. IM4DC Action Research Report.

<sup>6</sup> People’s Republic of Algeria. Loi n° 14-05 du 24 Rabie Ethani 1435 correspondant au 24 février 2014 portant loi minière

<sup>7</sup> Secretariat of the African, Caribbean and Pacific Group of States (ACP Group), 2002. Mining Data Bank <http://mines.acp.int/>



**Figure 2: The major resource geodata related development initiatives in Africa**



**Figure 3: Locations of major technical assistance programs supported by EU SYSMIN and World Bank programs (Sources: Walser. G., 2007 and Ralph Spencer Associates. 2000)**

This philosophy has been proven to be robust:

- In Canada it is estimated that for every \$1 spent by the government on data acquisition, \$5 are generated by industry activity in the exploration phase, increasing to \$125 once a mine is in development.<sup>8</sup>
- In Australia, all of the states and the Northern Territory undertake self-funded exploration initiatives aimed at promoting the exploration potential and at attracting inward investment. For example, the state of South Australia has been undertaking a series of drilling, geological and geophysical programs since the early 1990's. One of these, the South Australian Exploration Initiative (SAEI) 1992 to 1996<sup>9</sup> provided the following results for an investment of 23 million Australian dollars:
  1. Metres of drilling activity: Trebled from 201,000 m in 1991 to 634,000 m in 1997.
  2. Private mineral exploration: Trebled from AUS\$17.2 million in 1991 to AUS\$53 million in 1997.
  3. Area of state under mineral licence: Trebled from 14% in 1991 to more than 40% in 1997.
  4. Level of company exploration in SAEI target areas: Rose from 5% in 1993 to 70% in 1997.

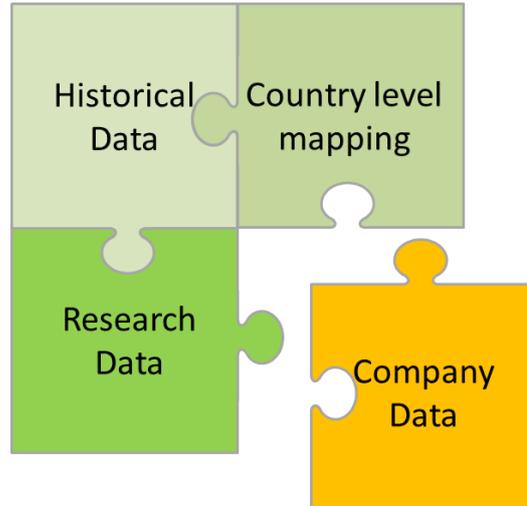
A later South Australian initiative, The Plan for Accelerating Exploration (PACE), conducted between 2005 and 2011, saw an increase in the ratio of government investment to exploration expenditure to 20:1.<sup>10</sup> PACE extension programs are currently underway.

In addition to precompetitive data acquired on behalf of African countries as part of resource development initiatives, there are three other sources of data that contribute pieces to the geoscientific knowledge infrastructure 'puzzle' (Figure 4). These data categories are summarized in Table 2.

<sup>8</sup> Kirkwood, D., 2014. Geoscience knowledge in support of economic development in the North: Geomapping for Energy and Minerals Program, AMGI Workshop, CAG 25, Dar es Salaam

<sup>9</sup> Government of South Australia, Department of State Development, South Australian Exploration Initiative (1992 - 1996) <http://minerals.pir.sa.gov.au/pace/saei>

<sup>10</sup> Economics Consulting Services 2014. The evaluation of the Plan for Accelerating Exploration (PACE): prospectivity, programs, promotion and people, [PACE review 2014], Report for Department for Manufacturing, Innovation, Trade, Resources and Energy, Report Book 2014/00014. Department for Manufacturing, Innovation, Trade, Resources and Energy, South Australia.



**Figure 4: Company data is the missing piece of the puzzle in the geoscientific knowledge infrastructure in most African countries**

**Table 2: Data categories comprising a geoscientific knowledge infrastructure**

Data Category	Description
Country level data	Regional or country scale geological mapping and geophysical surveys and interpretation products
Historical Data	Data acquired that is located predominantly in paper reports located either in national archives or in European GSOs
Research Data	Data that is located in research publications e.g. Scientific journals
Company Data	Acquired by mining companies during exploration activity, sometimes referred to as 'Dark Data' due to its inaccessibility

Regardless of the format of historical and research data, it is theoretically possible for national archives to access and digitise these types of data as appropriate, if they are available. These are valuable components of a national archive and are incorporated into geoscience infrastructures where possible.

Country level mapping from more recent EU SYSMIN and World Bank funded initiatives are available as georeferenced digital datasets, in many cases forming the foundations of geoscientific knowledge in the countries that have benefited from these programs.

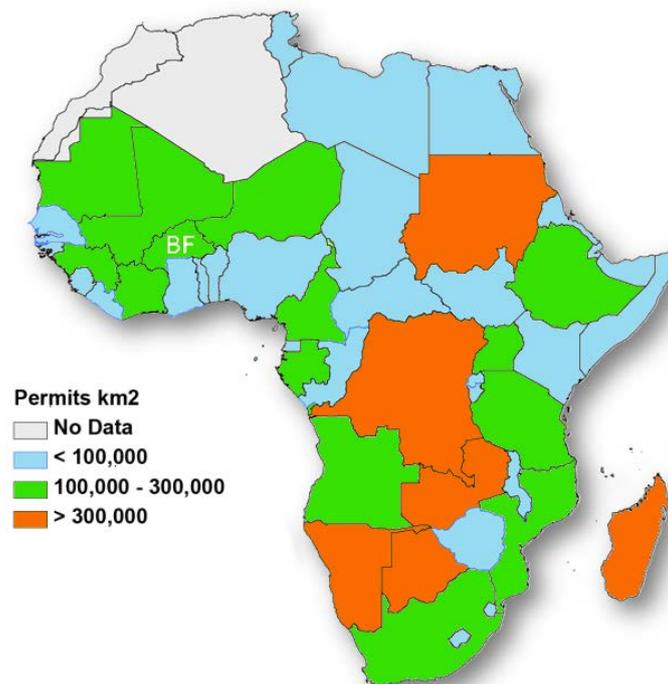
The final piece of the puzzle, company data, also in digital georeferenced formats is for the most part inaccessible in most countries. The best case scenario is that when a company ceases activity, the data they have acquired during exploration activity doesn't leave the country with them.

## 4) The monetary value of company data in Africa

African exploration budgets reported by the SNL Metals Economics Group, and summarised by the USGS, have increased to about \$3.4 billion in 2012 from about \$2.4 billion in 2011. In 2012, the principal mineral targets in Africa were gold, silver, base metals, iron ore, platinum group metals, uranium and diamond<sup>11</sup>. Minex Consulting estimates that the total minerals exploration spend for Africa between 2003 and 2012 was \$16 billion, which led to 20 Tier 1 & 2 discoveries valued at (2012) \$22 billion<sup>12</sup>. Although not all of this cost is directly related to data acquisition costs, it nevertheless represents the replacement cost by another company exploring the same area. When we consider that early-stage exploration projects accounted for approximately 69% of the 2012 mineral resource activity<sup>11</sup>, the majority of which will not proceed to project development, we start to see the value of company data as components of precompetitive data for future exploration and of the geological knowledge infrastructure as a whole.

### Case Study: Burkina Faso

Based on publicly available permit data, data provided by GSOs, and reports on mining activity across Africa, Burkina Faso ranks as a mid-range country in terms of area of permits for 2015, and thus could be considered as representing a typical mining country in the African context (Figure 5).

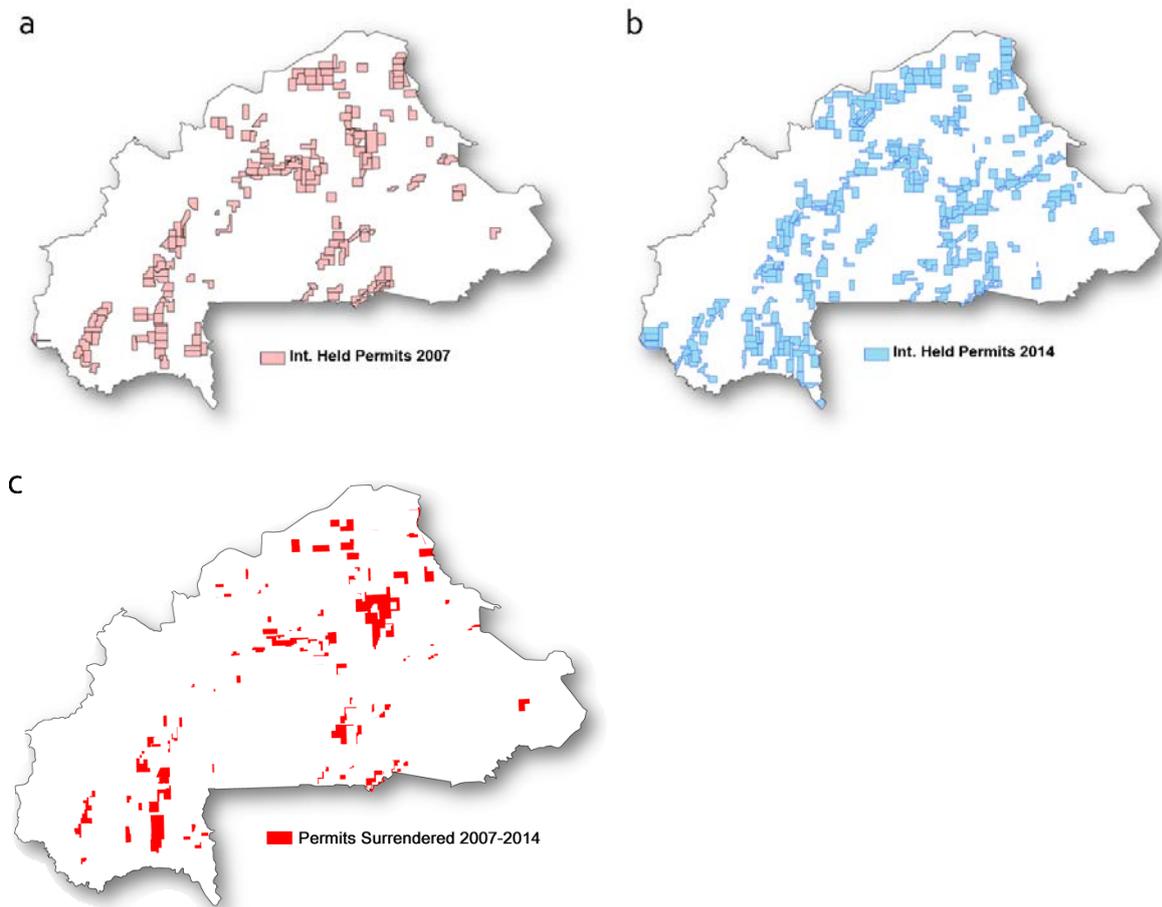


**Figure 5: Total exploration and mining permit areas for selected African countries. Raw data sourced from publicly available mining cadastre data, country-level permit maps provided by Ministries as well as estimates based on reports on company activity. BF shows location of Burkina Faso**

<sup>11</sup> Yager, T.R., Bermúdez-Lugo, O., Mobbs, P.M., Newman, H.R., Taib, M., Wallace, G.J., Wilburn, D.R. 2014. The Mineral Industries of Africa. USGS 2012 Minerals Yearbook. Africa Summary, December 2012

<sup>12</sup> Schodde, R.C., 2014. Challenges and opportunities for under-cover exploration in Australia, Presentation to the UNCOVER Summit 2014, Adelaide, March 2014.

Like much of Africa, Burkina Faso experienced a boom to bust exploration cycle between 2007 and 2014 for which we can analyse the differences between the mining cadastre from these two years to better understand the evolution of permits over this period. Both the number of permits, and their combined surface area, essentially doubled during this period (Figure 6 a & b; Table 3).



**Figure 6: Evolution of exploration and mining permits held by International Companies 2007-2014 for Burkina Faso. a) Permits held by international mining companies in 2007. b) Permits held by international mining companies in 2014. c) Ground that was held by international mining companies in 2007 but was vacant ground in 2014. Source of cadastre maps: Ministry of Mines, Quarries and Energy, Department of Geology and Mining Cadastre, Burkina Faso**

For the purpose of estimating a conservative value of company geodata for relinquished permits, we consider only permits that were held by international companies in 2007 and that were open ground\* in 2014. This represents 13,591 km<sup>2</sup> or 37% of all ground held in 2007 by international companies (Figure 6c). We have excluded Burkina-held companies as the exploration spend is generally small in comparison to international companies and difficult to assess.

\*Which may also be the result of partial relinquishment of a permit, as the Burkina Mining code requires companies to reduce the area of a permit by 25% after 6 years

**Table 3: Evolution of permit holdings in Burkina Faso 2007-2014**

**Source: Ministry of Mines, Quarries and Energy, Department of Geology and Mining Cadastre, Burkina Faso**

Permit Type	Number of Permits	Area km <sup>2</sup>	% of BF (total area 274 200 km <sup>2</sup> )
2007 Internationally-held permits	180	36 573	13%
2007 Locally-held permits	128	25 058	9%
2014 Internationally-held permits	327	53 663	20%
2014 Locally-held permits	363	66 128	24%
Internationally-held permits in 2007 and no longer under licence in 2014	all or parts of 157 permits	13 591	5%

Exploration expenditure in Burkina Faso over the study period varied enormously between companies, and along the life boom to bust cycle. However, we take as examples two companies operating in Burkina Faso whose public announcements provide exploration figures that represent junior and mid-sized explorers in this country. The expenditure for these companies is shown in Table 4.

**Table 4: Exploration expenditure for example mid-size and junior company during the last boom to bust cycle**

**Taken from ASX reports**

	Number of Permits	Total Permit Area km <sup>2</sup>	Published Exploration spend US\$	\$ Expenditure per km <sup>2</sup>
Mid-sized	6	1095	30 000 000	27 397
Junior	3	551	2 600 000	4 719

We have taken two approaches to estimating the value of company data associated with surrendered permits:

1. Based on the specific information available for the two companies shown in Table 4, we can multiply the released area by the two values for per km<sup>2</sup> expenditure which gives us lower and upper brackets of US\$64M and US\$372M for the value of exploration data in Burkina Faso that could have been recovered if a program for recuperating data at permit surrender was in place.
2. To use the value of total exploration expenditure for Burkina Faso between 2007 and 2014 of US\$1.28 billion<sup>13</sup>, which is equivalent to US\$28,370 per km<sup>2</sup>, based on the average area of internationally-held permits between 2007 and 2014. This figure is comparable to the mid-size company expenditure we quote above. We have then used US\$28,370 per km<sup>2</sup> as an upper bound and assumed that exploration budgets were evenly spent on the permits already held in 2007. As 37% of these were relinquished, we then obtain a total of US\$471M for the value of the data acquired over surrendered ground. In reality, given the amount of extra ground taken after 2007, and that it is likely that money was preferentially spent on ground that was retained, we make a conservative estimate of \$50-100M for the value of the data associated with relinquished permits over this time period.

Twenty countries in Africa have similar, or larger, permit holdings than Burkina Faso at the present time (Table 5 and Figure 5). We consider Burkina Faso to be a relatively representative mining country in Africa, and on that basis the total potential return to African nations of a data return policy for relinquished permits would easily exceed US\$1B per boom to bust exploration cycle.

Exploration budgets are currently comparable to 2007 levels after an all-time peak in 2012 and are forecast to increase again during the second half of the decade<sup>14</sup>. Stakeholder benefits of being in a position to access company geodata during that period and beyond will become increasingly significant.

<sup>13</sup> Ministry of Mines, Quarries and Energy data, Burkina Faso, 2015, Indaba Conference, Feb, 2015

<sup>14</sup> Schodde, R.C. 2014. Uncovering exploration trends and the future: Where's exploration going?, presentation at the International Mining and Resources Conference (IMARC), Melbourne, September 2014.  
<http://www.minexconsulting.com/publications.html>

**Table 5: Examples of permit coverage for selected countries in Africa, estimated from publicly available mining cadastre information**

	Approximate Permits km <sup>2</sup>	Country Area km <sup>2</sup>	% of Country under permit
DRC	1 380 000	2 345 209	59%
Kenya	47 000	581 309	8%
Mozambique	196 000	801 590	24%
Tanzania	187 000	947 303	20%
Uganda	109 000	241 038	45%
Zambia	314 000	752 618	42%
Burkina Faso	119 791	274 200	44%

## 5) Best practice management of geoscientific data: examples from Australia and Africa

Just as the value of geoscientific knowledge infrastructure is well-recognised as being of paramount importance to the development of resource industries, the management of geoscientific data is fundamental to achieving that goal.

Global best practices in incorporation of company data into national archives have been defined by Canada and Australia. Canada has a range of policies and procedures of transfer of company data to its administrative organisations in accordance with the mining legislation of each Province.

The IM4DC has prepared a comprehensive report on the Australian company geoscience data policies and management systems, including a full description of the history of the knowledge infrastructure initiatives that have been implemented<sup>15</sup>.

In Australia, a coherent policy has been implemented across all states and territories as a result of the work undertaken by the Government Geoscience Information Committee (GGIC)<sup>16</sup>, a subcommittee of the Australian Government Exploration Investment and Geoscience Working Group (EIGWG). The GGIC includes representatives from Australian and New Zealand GSOs (Australia houses both a federal GSO and seven state and territory level GSOs). Scott and Jones (2014) have summarised the GGIC work program as follows:

<sup>15</sup> Scott and Jones, 2014, International Mining for Development Centre, Mining Development: Guide to Australian Practice – Management of Public Geoscience Data

<sup>16</sup> Government Geoscience Information Committee (GGIC) on instructions of the Chief Government Geologists' Committee. 2012. Australian Requirements for the Submission of Digital Exploration Data.

### GGIC Work Program

- *The development and implementation of national geoscience-related information standards and data models,*
- *Data access and delivery solutions and monitoring new and emerging trends in this domain,*
- *Making recommendations to EIGWG to sponsor projects that will improve data and information exchange, and Managing the National Geoscience Portal as a single entry point to all Australian geoscience jurisdictions (<http://geoscience.gov.au/>)*
- *GGIC makes recommendations such as setting the requirements for digital exploration data supplied by industry to Geological Survey Organisations, specifying that incoming data must:*
  - *Contain comprehensive metadata (e.g. what type of data it is; where it was collected; when; how),*
  - *Conform to commonly used file formats,*
  - *Be supplied in non-proprietary ASCII format where possible (e.g. drilling and geochemistry tabular data), and*
  - *Include exploration reports, which must also meet compliance standards.*

*The Chief Government Geologists, through GGIC, have developed a national standard in regards to mineral and petroleum exploration reporting. Each jurisdiction has its own set of guidelines tailored to its legislation, but these are all based on the national guidelines.*

*Ease of access to high quality data through modern technologies has been a major part of Australia's strategy to fund pre-competitive geoscience.*

*Source: Scott, M., Jones, M., 2014. Management of Public Geoscience Data. IM4DC Action Research Report.*

All of the Australian GSOs have implemented, or are in the process of implementing, online geodata portals that include access to government-acquired precompetitive data and to historical company data for which confidentiality periods have expired.

Western Australia, host to 57% of the country's exploration activity<sup>17</sup>, has an advanced online geospatial information system – currently provided as a series of online databases covering geology, geochemistry, geochronology, mineral occurrences, and company reports. In particular it supports the GeoVIEW.WA interactive (GIS-based) mapping system and the Western Australian Mineral Exploration Index (WAMEX)<sup>18</sup>. WAMEX is a searchable database of open file mineral exploration reports.

In Africa, Namibia's Minerals Act of 1992<sup>19</sup> states that reporting is to be carried out by permit holders "in such form as may be determined in writing by the Commissioner" thus providing a mechanism that allows the government to update reporting requirements without modification to the act itself.

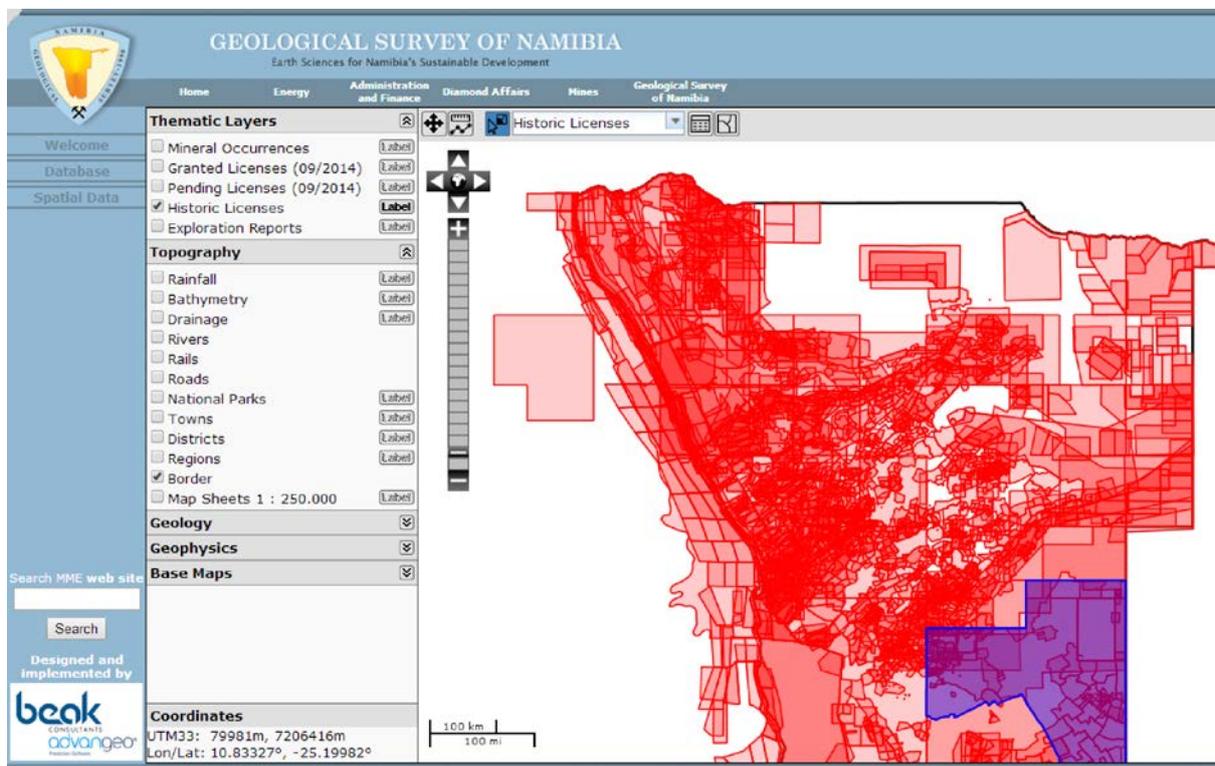
<sup>17</sup> Government of Western Australia Department of Mines and Petroleum. Resources Statistics. <http://www.dmp.wa.gov.au/7846.aspx>

<sup>18</sup> Government of Western Australia Department of Mines and Petroleum. Western Australian Mineral Exploration Index. <http://www.dmp.wa.gov.au/5136.aspx>

<sup>19</sup> Republic of Namibia, Minerals Act of 1992, <http://www.mme.gov.na/>

Namibia is one of a small number of countries that builds upon this legislative mechanism with an active policy of company data transfer to the national archive, and where compliance is consistently enforced. Both current and historical permit data can be accessed remotely via their Earth Data Namibia server<sup>20</sup>. The Earth Data Namibia system allows explorers to view summary geophysical, geological, topographic and permit data. Permit data is separated into Granted, Pending and Historic Licences, as well as Company Exploration Reports (Figure 7). For each permit, a concise metadata table is provided online (Figure 8), and delivery can be organised via email. For reference, this system was developed entirely using open source software with a custom JavaScript browser client built by Beak Consultants<sup>21</sup>:

- OpenSUSE Linux
- Apache HTTP Server
- Apache Tomcat
- PHP
- PostgreSQL with PostGIS Extension
- GeoServer
- OpenLayers
- Proj4js
- The Dojo Toolkit
- Quantum GIS
- GDAL - Geospatial Data Abstraction Library



**Figure 7: Earth Data Namibia Server showing historical permit layer**

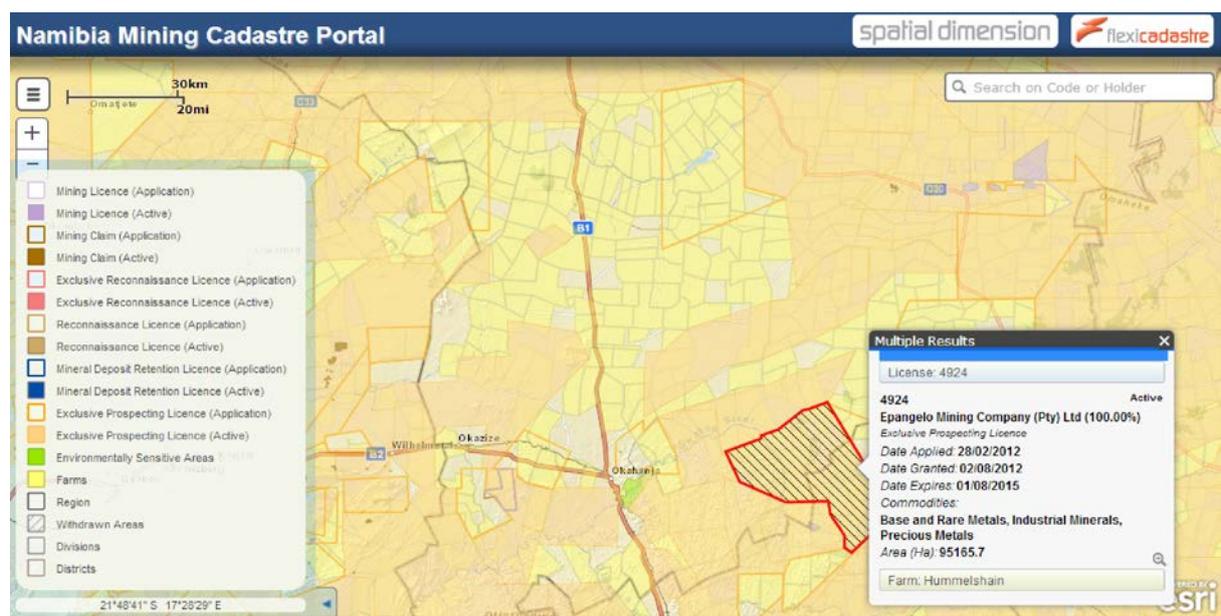
<sup>20</sup> Earth Data Namibia Server: <http://94.100.75.105/>

<sup>21</sup> Barth, A., Eckardt, J., Petzel, V., Schreiber, U., 2004. Report : Earth Data Namibia - a milestone in information management at the Geological Survey of Namibia : background, data base design, features, further planning, *Communs geol. Surv. Namibia*, 13, 93–96.

<b>Report Title:</b>	FINAL EXPLORATION REPORT EPL3066 
<b>Authors:</b>	GUNZEL A
<b>Creation Date:</b>	7/1/2006
<b>No. of Pages:</b>	
<b>Licenses:</b>	EPL3066 - HIEBIS
<b>Commodities:</b>	Cu - Copper Ni - Nickel Pb - Lead Zn - Zinc
<b>Mineral Groups:</b>	base metals rare metals
<b>Regional Mapping:</b>	
<b>Work Done:</b>	
<b>Scanned Documents:</b>	FINAL EXPLORATION REPORT EPL3066
<b>Comment:</b>	JULY 2006 ONGOPOLO MINING LIMITED TERMINTAION OF EPL3066

**Figure 8: Earth Data Namibia Server metadata for a selected exploration report, the full page provides a link to main Survey website where this report can be requested by email**

In addition Namibia uses a commercial Flexicadastre portal<sup>22</sup> to serve additional information about the current permit holdings, together with a layer showing the farms for the whole country (Figure 9).



**Figure 9: Commercial Flexicadastre portal for current permits and farm information**

<sup>22</sup> Namibia Mining Cadastre Portal: <http://portals.flexicadastre.com/Namibia/>

## 6) Barriers to implementation in the African context

The African Mining Vision has identified a number of challenges that African countries currently face that impede their ability to collect and centrally store geological information.

### Barriers Identified by Country Mining Vision

- *Poorly resourced geological and mining institutions (financial, technological and human resources). Lack of coordination among institutions involved in and affected by the mineral sector. In most countries data is collected and stored by multiple agencies without any coordination, and with poor collaboration.*
- *Lack of enforceable arrangements for mining companies to deposit geological data with government. Currently some countries have provisions for mining companies to deposit geological data and information with the government, but the provisions remain ineffective or not enforced. This is because of lack of binding mechanisms to compel the companies to deposit such information.*
- *Lack of capacity for storage and handling of geological data and information. Most African geological surveys lack the financial means to upgrade their physical infrastructure and human capacities in order to have a modern geological and mineral database. Thus, even where a mechanism exists for compelling mining companies to deposit information, the lack of capacity remains constraining.*
- *Lack of access to geological data and information. In many African countries there is no guaranteed access by mining companies and other interested agencies to geological data held in government databases. Data which is available in the database should be accessible openly or at a fee.*

*Source: A Country Mining Vision Guidebook*

These challenges to implementation of the transfer of corporate geoscience data fall into four categories when we consider barriers to implementing database management systems in support of national geoscience knowledge infrastructure which are: legislation, compliance, technical capacity and financial resources.

As part of this project a survey was conducted to provide insight into the range of current practices in government, industry and education with respect to data management and company data transfer. The responses to the surveys provide information on the levels of compliance to regulations, technical capacity and training for geoscientific data management. The questionnaires and summary results are included in Appendix A. Observations, results and comments from the surveys are included in this chapter where relevant.

To provide a legal context for the observations, this section first looks at existing legislative support for data transfer from companies to governments in Africa, based on our analysis of 20 mining codes and regulatory frameworks across Africa.

Financial resources barriers are not explored in this section; however, they are referred to in the discussion.

## Legislation

Mining acts in African countries pertaining to knowledge-sharing refer in the majority of cases to regular reporting (annual and/or semester or quarterly). In reports to the national mines administrative bodies (mines inspectorates, ministry of mines, cadastres or minerals commissions) emphasis is usually placed on activity expenditures, human resources and summaries of exploration results. There are a small number of jurisdictions that specifically require raw digital data to be submitted in support of company reporting. Most mining acts require a final report as part of the permit surrender process, but digital data submission is not specifically requested in that case.

Naturally, mining codes across Africa are varied in their requirements for company reporting and data sharing. The range of variation is summarised as follows:

- A. Legislation specifically requires raw company exploration data with reports and refers to a schedule or guidelines that list data submission protocols
- B. Legislation specifically requires raw company exploration data with reports, but does not refer to a schedule or guidelines that list data submission protocols
- C. Legislation only requires company reporting in accordance with a schedule or guidelines that currently do not specify raw data submission
- D. Legislation only requires company reporting with no raw data specified and does not refer to a schedule or guidelines

In addition, of the 10 Government agencies who participated in the survey for this project, half of the respondents stated that those agencies require company report submissions in hard copy format only.

In many cases, legislation and/or regulations are ambiguous in that there are often requirements to transfer 'geological knowledge', 'information' or 'records' to government agencies. These terms leave room for interpretation of the requirements to be limited to abridged results e.g., selected highlights of results and schematic representations of results included in company reports in lieu of raw data. While these types of information are appropriate for inclusion in reports, they do not contribute to the geoscientific infrastructure on their own as they are not 'generic' datasets and are not readily incorporated into a digital archive.

## Compliance

There are a small number of 'Category A' African countries (as defined in the preceding section) that have an effective legislative mechanism, and that enforce company compliance, resulting in regular data transfers to their designated geo-data custodians such as occurs in Namibia and Botswana. However, the majority of countries that have the legislative mechanism and appropriate guidelines for data transfer are not presently enforcing compliance.

*“There is an unwritten agreement between government agencies and companies that raw exploration data is neither demanded nor supplied because the governments cannot guarantee appropriate data management and companies do not trust governments to manage the data and keep them confidential”<sup>23</sup>*

A major cause of this impasse is related to a lack of technical capacity within the government agencies to effectively and securely manage company data. This issue is addressed in the following section.

One of the objectives of the questionnaire directed to industry representatives during the course of this study was to highlight the industry perspective on the issue of compliance to data transfer regulations.

Many of the companies with exploration activity in Africa have experience of operating in jurisdictions requiring regular data transfer to national archives. It is considered to be standard procedure, particularly for the over 350 Australian and Canadian companies exploring in Africa, where both parties (government and industry) benefit from a readily-accessible geoscientific database in their home countries.

The industry survey revealed that companies operating in Africa are reluctant to submit raw data to accompany their activity reports due a lack of confidence in the capacity of government agencies to:

- Maintain the confidentiality of data acquired over currently valid permits
- Prevent the loss of data by reliably archiving and ensuring retrieval for future users
- Transparently implement data transfer policies in a consistent and fair manner for all operators

14 out of 15 industry respondents cited confidentiality risk as the primary barrier to data sharing. For current exploration projects where significant budgets are allocated towards high-risk exploration activity, the risk of losing the competitive advantage is simply too great.

However, because of the high-risk nature of exploration, it follows that a significant portion of exploration permits are relinquished during a typical boom and bust activity cycle, as demonstrated in Chapter 4.

All 15 respondents to the industry survey stated that they would support a data sharing initiative for relinquished permits. A small number of respondents (2) said that they would only do so if it was required by law, this may be due to budget constraints impacting on the resources required for data

<sup>23</sup> Personal communication – Senior African geodatabase specialist

sharing at the end of life for a permit. The survey suggests that for permits where companies no longer require the competitive advantage, there is far less reluctance to data sharing by the companies.

In addition, all the respondents were in favour of having access to data from an archive that provides geodata for relinquished permits as part of a country's precompetitive datasets. Selected comments provided by company employees were:

*"This should fast track exploration work in new areas or on new projects by reducing the reproduction of work due to ignorance about what others had done before"*

*"If all previous data on an area is available, our exploration could then build on the work done by others. At present, in the African countries in which I have been involved, previous exploration is usually unavailable through the government, and if it is it is usually in poor condition and format, and incomplete."*

*"Accessing data in other countries is a huge challenge so this initiative would be very beneficial, since it is a barrier to entry in many countries"*

## Technical capacity

### Information Technology Infrastructure

Discussions with representatives from African government minerals and geoscience departments have highlighted the following technical barriers to implementation of effective Geodata management systems:

- Paper reports, pdf versions and geodata are often housed across several departments (e.g. Ministry of Mines, Minerals Commission and Geological Survey) on multiple servers which are not interconnected
- Hardware updates are piecemeal so that new data are archived on new servers but older data remains on the older servers
- Software such as GIS packages are updated reasonably regularly, but newer computers with updated software cannot access older data servers.
- Lack of financial resources to ensure sustainability of commercial data management solutions for geoscientific infrastructure initiatives.

Nevertheless, the respondents to our Geological Survey/Ministry questionnaire also indicated that, for most organisations, it would be possible to implement a fast-tracked company geodata system using minimal requirements:

- 9 currently employ a database platform such as Microsoft SQL, Access or Oracle
- 6 currently use geographical information software for georeferenced mapping and visualisation of geoscientific data (ArcGIS in all cases)
- 8 currently have 2 or more database administrators employed within the service

The option of implementing a fast-tracked solution using minimum requirements is explored in the following chapter.

## Human Resources and Training

Multiple gaps analysis studies regarding technical capacity for geodata management in Africa have cited a lack of human resources and training as one of the barriers to implementation of an effective geological knowledge infrastructure.<sup>24 25</sup>

There have been several significant initiatives for training of government minerals administration and geoscience professionals over the last 30 years, including geospatial data manipulation, mapping and management. A high proportion of EU SYSMIN and World Bank technical assistance programs included training for employees of Ministries of Mines and GSOs, as have WAXI, SEAMIC, IM4DC, Australia Africa Awards and many of the European GSOs.

These important programs have resulted in a modernisation of data management systems in participant countries; however, tertiary education institutions were not generally supported in the development of courses that would ensure a technically capable workforce able to maintain established systems.

In the last ten years, the African Mining Vision, the World Bank and the African Development Bank have recognised the need for renewed support of the higher education to support the growing African population, which is predicted to have the world's largest labour force by the year 2040.<sup>26</sup>

The university survey conducted for this report showed that Earth Science departments in tertiary education institutions facilitate training in GIS platforms as part of courses applied to geological mapping, geophysical data processing and interpretation, and remote sensing processing and interpretation. Geological and geophysical modelling are also taught in a limited number of institutes. Students taking these courses are introduced to the basics of database management and data handling as part of these courses. A detailed understanding of the databases needed to support a data management system is not provided within a typical geoscience degree, so establishing links with IT faculties is essential to ensure that trained undergraduates and graduates are available to meet the GSO's and Ministries' demands.

<sup>24</sup> AEGOS. 2010. African-European Georesources Observation System Delivery D6.3 Definition of curricula, qualifications and outline of capacity building modules. Date: 2010-02-24

<sup>25</sup> Scott, M., 2013. Developing Effective Mineral Resource Policy for Sustainable Livelihoods through Geoscience Summary of Action Research Activity. IM4DC Action Research Report.

<sup>26</sup> African Development Bank. 2014. African Development Fund. The Bank's Human Capital Strategy for Africa (2014-2018).

## 7) Company data from relinquished exploration permits: A Two-Stage Implementation

As a first step towards a full integration of company exploration data into the geoscientific knowledge infrastructure, this report explores the option of designing a two-stage approach. The first stage stipulates that the company data required by governments be specifically limited to exploration data acquired from relinquished permits. By defining regulations for the transfer of data in this way, the entire work flow could be designed and implemented with much reduced risk to both governments and companies.

The advantages for countries implementing a staged implementation plan are:

- Lower data volumes to process during the early stages of database design and management implementation
- No requirement to partition data access into public and confidential categories in the first stages of implementation
- No risk of confidential company data being released to third parties
- Higher probability of compliance resulting from higher confidence in data management system
- Fast-tracked incremental growth of geoscience knowledge infrastructure
- The first stage of implementation would provide valuable experience from the deployment of locally appropriate management and data handling systems

A second stage extended implementation could be designed once experience has been gained from working with data from relinquished permits during the first stage. An analogous rationale for incremental approaches to mineral resources management is found in the Natural Resource Charter Second Edition:

*“As part of this assessment, the government should consider the structure and capacity of the institutions and sectors that are expected to manage the processes along the decision chain, and may conclude that a country’s economy or governance system is not yet ready to effectively manage large windfalls. Staggering the timing of exploration and extraction may be one option in this case; it allows the staff of government institutions to learn from experience while managing their workload.”<sup>27</sup>*

<sup>27</sup> Natural Resource Governance Institute. 2009. Natural resource charter. Second Edition

## 8) Options for implementation

A number of options are explored in this chapter to address the major barriers to the transfer of company data to national archives. The proposed options are intended for jurisdictions yet to implement an effective data sharing system, with the aim of providing a pathway towards the establishment of a fast-tracked data exchange between exploration companies and governments.

### Legislation

Mining legislations that currently refer to reporting requirements in a separate document, such as a schedule or set of regulations, would not need further amendment to enable the transfer of raw geodata from companies to the national archive. In the case where mining legislation only requires company reports on activity, a project for amendment to the legislation that enables a set of regulations as in the above case could be slated for the next mining code review.

Associated schedules, regulations or guidelines that are enabled by a mining act could be amended to require companies to hand all data acquired during exploration activity to the government as part of the permit relinquishment process.

### Compliance

Where legislative mechanisms are already in place requiring companies to transfer exploration data to the government as part of the permit surrender process, the following options for enforcing compliance are already in place in some jurisdictions:

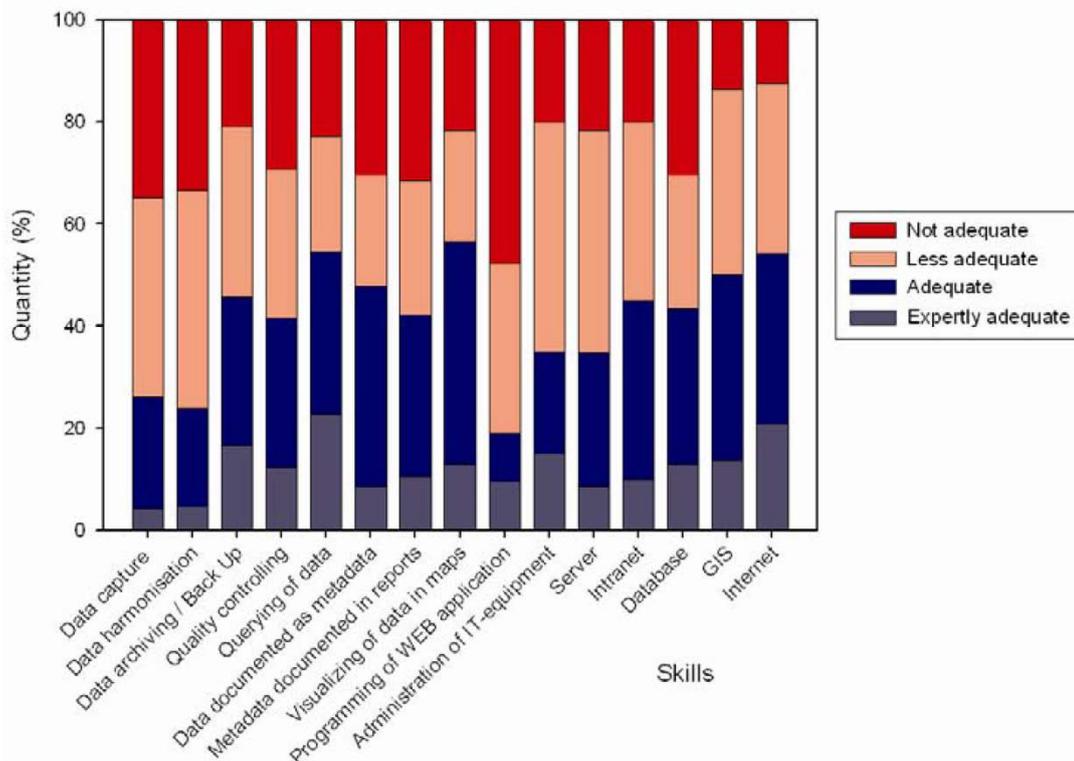
- Transfer of company data upon permit surrender\* as a priority criterion for the future granting or renewal of exploration or mining titles to the relevant company. This is the condition linked to the transfer of all company data for a permit, regardless of permit status, in Australia;
- Transfer of company data for a permit linked to a performance bond that may also include minimum work programs and expenditures. In 2009, Mauritania introduced performance bonds to ensure that the minimum requirements for work undertaken on exploration permits are met. This could be amended to include the requirement for the transfer of relevant company data at the time of permit surrender\* in conjunction with their relinquishment report.

\* This could be further amended at a later time to include all exploration data on a yearly or quarterly basis, as currently occurs in countries such as Namibia and Australia, once secure and reliable data management systems are established.

### Technical Capacity

Geoscientific databases are not static systems. International experience has shown that it takes teams of people, from a range of disciplines, working over several years to design, implement, monitor and improve geodatabases. Even well-established data archiving and delivery systems, such as those in Australia, still have dedicated groups of specialists who are charged with updating the database design as new data types are added and as end-user requirements evolve. These groups of specialists require sufficient expertise to both maintain and advance the spatial data infrastructure for the country.

A 2009 AEGOS survey<sup>28</sup> of 27 African government ministries and GSOs showed that 35 to 55% of the respondents had “adequate” to “expertly adequate” levels in the skill domains that we suggest are necessary for a company geodatabase for relinquished data, namely Data Archiving, Querying, Metadata, Data Visualisation, IT Administration, Server, Intranet, Database and GIS capacities.



**Figure 10: Adequacy of skills available at geoscientific institutions<sup>28</sup>**

The AEGOS survey results suggest that a fast track solution is feasible and would meet the essential needs of end users without placing undue strain on existing human and technical resources. Such a system could simply consist of:

- 1) Mining legislation that refers to regulations/guidelines detailing the permit surrender process and including specific reference to raw digital data from exploration activity, the data types to be submitted data standard formats where possible
- 2) A GIS meta-database for all past, pending and current permits with only past permits providing metadata on associated company data. International standards for metadata can be adapted for use here.
- 3) A Structured flat file storage of digital company data
- 4) A GIS template for companies to use when relinquishing permits that provides georeferenced metadata for each digital dataset
- 5) Online or email delivery to end users of a single GIS layer containing permits and associated metadata
- 6) Online or offline delivery of digital company data on request using cost recovery when necessary

<sup>28</sup> AEGOS 2010. D6.3 Definition of curricula, qualifications and outline of capacity building modules

## 9) Discussion

A set of options for the implementation of corporate data delivery to national archives has been examined taking into account the significance of company exploration data to African geodata infrastructures, the impacts that successful implementation would produce, and the potential barriers to implementation of this type of initiative.

When we consider the monetary value of company data we demonstrate significant value (US\$50-100M in the case study for Burkina Faso) from relinquished permit geodata. The distinction should be noted that monetary value does not mean that the data are assets of specific value to a country in and of themselves. However, the money spent on acquiring data can be compared to other forms of data acquisition allowing estimation for the return to the country as inward investment (as estimated by the Canadian and Australian GSOs).

Even if the area of relinquished permits is a small percentage of the total area of a country (or of a country's total explored area), the value of the data that could be transferred to the government is considerable. In the case study for Burkina Faso we calculated that 5% of the total area of the country was released from exploration permits during the years 2007 to 2014. A consistently enforced policy of incremental geodata additions to the national archive from surrendered ground would significantly enhance the growth of geoscientific knowledge infrastructures.

The adoption of a policy requiring company geodata transfer to government organisations uniquely for data acquired over relinquished permits in a first stage implementation of a company geoscientific data management would allow transfer, archiving and maintenance systems to be established and proven before the need to ensure data confidentiality is implemented as is the case for jurisdictions where company data transfer for all exploration permits is currently practised.

The volume of data to be dealt with in the early stage of implementation would also be less compared to an extended data policy. This would mean that the technical capacity of the organisation charged with custodianship of the database could evolve at a pace in line with technical and human resource capacities.

The current downturn in the minerals industry provides an opportunity, and the time, to put in place a new system. Importantly this would mean companies that take up ground during the next upturn will already know what is expected of them, and Government organisations will have the time to develop effective strategies without the overwhelming demands that are placed on them during a boom.

### Regional Implementation and Data Ownership

Grouping initiatives where appropriate into regional implementation projects would benefit from economies of scale. However, data sovereignty is a major issue which would require collaborative approaches to data housing and dissemination. This is a challenge also faced by larger geodata initiatives such as AMGI. The principle of data sharing for cost recovery rather than profit would contribute to alleviating the concerns regarding data sovereignty but in itself presents challenges pertaining to financial resource barriers to implementation of data management systems.

## Financial Resources

Much has been written on the need to increase funding of government agencies in support of knowledge infrastructure development.

In many countries worldwide, due to lack of financial resources in minerals resource administration, geoscientific data have been regarded as assets for income generation in and of themselves rather than tools providing pathways to greater inward investment. In countries where data are provided to companies as precompetitive tools, we have seen the rewards of those investments, such as the examples mentioned in Chapter 5.

### *Acquisition and storage of geological data and information*

*Mechanisms should be established to obligate all private exploration companies to lodge all geo-information, data and samples/cores (not consumed in analyses) with the national geo-survey entity. This will substantially reduce future exploration costs over the same property, but will require the allocation of substantial resources to the geo-survey entity for establishing the infrastructure to hold such data and samples (storage warehouses, computer storage, etc.).*

*Source: A Country Mining Vision Guidebook*

However, at least for the Stage 1 implementation described above, relatively modest financial resources may be all that are required to establish infrastructure to house the geodata archive, in support the creation of a robust geoscience data custodianship with adequate financing to ensure sustainability of service and to ensure long-lasting access to and growth of the knowledge infrastructure.

## Data Standards

An ongoing issue concerns data standards for long lasting access. Software for data interrogation and processing evolves over time, but the rates of turnover can be slow (decades), so that the longevity of data accessibility is not always foreseeable at the time of archiving. Both the AEGOS project and the AMGI intend to put considerable resources into ensuring that appropriate standards are agreed upon, and the case of company data is essentially a sub-set of this larger issue.

The current best practice is to maintain data in its simplest form e.g. delimited ASCII text format for tabular data. There are several widely-used image formats which are non-proprietary and therefore likely to be easily supported into the future. However, many of the more complex data-types currently being acquired are archived by companies in the proprietary formats that their chosen software packages support. For example GIS vector map products that include polygons with attributes are created and archived in proprietary commercial formats. At present there are two major formats in use with their respective software packages, ArcGIS and Mapinfo (the open-source QGIS supports both of these formats).

An example of standard data formats from the Western Australian guidelines to companies submitting digital exploration data is included in Appendix B.

There remain some data types for which there are no widely-agreed standards such as 3D geological models.

### Corporate Social Responsibility

At a time when mining host countries are increasingly looking towards companies to operate with shared-value principles, the concept of shared knowledge is fundamental. Exploration budget allocations for permits flagged for relinquishment are extremely tight and companies will naturally divert exploration dollars to ongoing project areas. However, international best practice requires companies to undertake permit surrender procedures including site rehabilitation, reporting, and geodata transfer.

Conversely, the industry survey results highlight that companies have real concerns about risks associated with the transfer of confidential exploration data in some jurisdictions where data management systems are poorly monitored or non-existent.

In addition to promoting an avenue for more socially responsible conduct on the part of both governments and companies, the option to implement a fast-tracked company geodata management system proposed in Chapter 8 would contribute to the building of greater trust between these two stakeholders.

Questionnaires returned from the surveys conducted as part of this investigation illustrate the perspectives of government and industry representatives:

*“In our country, most mineral deposits if not all have been discovered by the Geological Survey. Mining companies have taken advantage of our data and this normal because this is our role. In return it is mandatory that the details which they have uncovered revert to the Geological Survey that is responsible for the management of the geological heritage of our country.” (African Geological Survey respondent)*

*Data handover for relinquished permits is “rarely done as it is not a requirement to do so and this can be time consuming to arrange and often seems futile. The government geological surveys lack systems to store data and they give little back in return, with the exception of where there have been outside assistance, such as with the SYSMIN surveys. Ideally, data from relinquished projects would be available to the next explorer to prevent needless repeat activities.” (Minerals exploration company respondent)*

The proposed early stage implementation, limiting company data transfer to geodata for permits or parts of permits where exploration has ceased, would greatly reduce the risks to stakeholders as there is no requirement to partition data access into public and confidential categories. This kind of initiative has the potential to contribute to the building of trust between these two stakeholders in operating environments where the sentiments expressed in the preceding comments are prevalent and would be an important application of the shared-value principle underpinning corporate social responsibility.

## 10) Future work

A continuation of this pilot study is proposed as an implementation phase of Stage 1 company data management, with the following components:

- Targeted implementation in one country, or in a region of cooperating countries, of a geodatabase system designed to archive, manage and distribute company data. This could be linked to an existing cadastre system and/or designed for integration with future pan-African data delivery initiatives as appropriate (OneGeology, AMGI, EGS-OAGS)
- Linkages with African and partner universities (IT and Earth Science departments) to create postgraduate research projects to further develop data management capacities in the higher education sector

Petroleum industry data reporting practises could form part of a later stage extension of this project theme.

A separate large-scale project requiring support from a significant financial source could be developed to attempt to locate and obtain exploration datasets from as many operators as possible. This would be designed to locate and recover lost data from the past decade of exploration in Africa, to convert it to acceptable database formats and to restore the data to respective national archives. Global exploration activity reached an unprecedented level of US\$30B in 2012, and exploration in Africa counted for 15% of that activity<sup>29</sup>. As detailed earlier, we estimate that at least a billion dollars' worth of exploration data was acquired during that time for permits that are no longer held.

<sup>29</sup> Schodde, R., 2013. Overview : The Rising Importance of Junior Explorers ...and the key challenges they face going forward. Quebec Mineral Exploration Association Conference 12th – 14th November 2013, Quebec City, Canada.

## 11) Conclusions

A robust geological knowledge infrastructure underpins effective development and management of mineral resources and contributes to a wider range of applications including strategic planning and education.

We propose a fast-tracked approach allowing early implementation via transfer of company data from relinquished permits as a first stage towards an extended company geoscientific data management initiative. This staged approach would allow transfer, archiving and maintenance systems to be established and proven before the need to ensure data confidentiality.

Geodata from relinquished permits alone would incrementally increase the area of data coverage by significant amounts over a boom and bust cycle of exploration activity. The transfer of these datasets to national archives represents equivalent data acquisition expenditure of US\$1B across Africa if made available to stakeholders as publicly available data. Host countries would also see monetary benefits that are many multiples of this in the form of inward investment by industry operators benefiting from knowledge of previous work undertaken by preceding title-holders.

The effective integration of company geodata into geodatabase systems, where the data are made available to all stakeholders, would lead to a significant growth of the national archive over time with benefits from the improved accessibility of these datasets flowing to the wider community.

## Bibliography

(Cited references in bold)

- ADEA. 2015. Diversify and Differentiate African Higher Education Systems! ADEA Policy Brief.
- ADEA. 2015. Stimulating Science, Technology and Innovation (STI) Development in Africa : An Urgent Post-2015 Agenda.
- ADEA. 2013. 1st African Ministerial Forum on ICT integration in Education and Training Report of the Forum.
- ADEA-WGHE-AAU-IIEP. 2009. Private sector as a partner in higher education development in Africa.
- AEGOS. 2010. African-European Georesources Observation System.** <http://www.aegos-project.org/>
- AEGOS. 2010. African-European Georesources Observation System Delivery D6.3 Definition of curricula, qualifications and outline of capacity building modules. Date: 2010-02-24**
- African Development Bank, NORAD, World Bank. 2009. Governance of the Extractive Industries in Africa : Survey of donor-funded assistance.
- African Development Bank. 2014. African Development Fund. The Bank's Human Capital Strategy for Africa (2014-2018).**
- Afeti, G., Adubra, A.L., 2012. Skilling Africa: The Paradigm Shift to Technical and Vocational Skills Development.
- African Union Commission, African Development Bank, United Nations Economic Commission for Africa, 2011. Building a sustainable future for Africa's extractive industry: From vision to action.
- African Union, UNECA, AfDB, 2012. The African Minerals Development Centre Business Plan.
- African Union. 2009. Africa Mining Vision.
- African Union. 2011. Addis Ababa Declaration on Building a Sustainable Future for Mineral Resources Development.
- African Union. 2011. African Development for Africa Draft Action Plan for Implementing the AMV.
- African Union. 2011. Minerals and Africa's Development.
- African Union. 2012. AU Outlook on Education Report.
- African Union. 2013. Agenda 2063 E-mail du futur de la Présidente de la Commission.
- African Union. 2014. AU Outlook on Education Report Economic Community of West African States AU Outlook on Education Report.
- African Union. 2014. Common Africa Position (CAP) on the Post- 2015 Development Agenda. 22nd Ordinary Sess. Assem. Union 31 January 2014.
- African Union. 2014. Common Africa Position (CAP) on the the Post 2015 Development Agenda.
- African Union. 2015. Position Commune Africaine sur le Programme de Développement pour l'après-2015.
- AMDC. 2014. Country Mining Vision, Domesticating the Africa Mining Vision.**
- The Australian Geoscience Information Association <http://agia.org.au/>
- Bangu, A., 2012. Total Approach to Financing Higher Education Students Loans. The 4th Higher Education Forum, 2012, Arusha.
- Barth, A., Eckardt, J., Petzel, V., Schreiber, U., 2004. Report : Earth Data Namibia - a milestone in information management at the Geological Survey of Namibia : background, data base design, features , further planning, Communs geol. Surv. Namibia, 13, 93–96.
- BGS International, 2012. Geodata for Development - a Practical Approach.
- Burkina Faso Ministry of Mines, Quarries and Energy, Department of Geology and Mining Cadastre. 2007. Cadastre Minier shapefile**
- Burkina Faso Ministry of Mines, Quarries and Energy, Department of Geology and Mining Cadastre. 2014. Cadastre Minier shapefile**
- Campbell, B., 2012. Corporate Social Responsibility and development in Africa: Redefining the roles and responsibilities of public and private actors in the mining sector. Resour. Policy 37, 138–143. doi:10.1016/j.resourpol.2011.05.002
- Cervantes, M., Green, K.P., Wilson, A., 2014. Survey of Mining Companies: 2013/2014 data. Fraser Institute.
- Chindo, M. 2011. An Extensive Analysis of Mining in Nigeria Using a GIS. Journal of Geography and Geology 3, 3-12.**
- Christensen, B.V., 2010. China in Africa, A Macroeconomic Perspective Working Paper 230 November 2010.
- Cloete, N., Bailey, T., Pillay, P., 2011. Universities and Economic Development in Africa CASE STUDY : Tanzania and University of Dar es Salaam 136.

- Coats, J.S., Jones, R.R., Davies, B.J., 1998. An affordable exploration and mining license administration system for developing countries. BGS Technical Report WC/98/62
- Coyle, M., Dumont, R., Keating, P., Kiss, F., Miles, W., 2014. Geological Survey of Canada aeromagnetic surveys: design, quality assurance, and data dissemination. doi:10.4095/295088
- Département de l'Énergie et des Mines, Royaume du Maroc. 2013. Guide des Procédures Administratives Relatives au Département de L'Énergie et des Mines.
- Dixey, F., 1962. Geology, Applied Geology (Mineral Resources) and Geophysics in Africa. UNESCO Report UNESCO/NS/NR/2
- Economics Consulting Services 2014. The evaluation of the Plan for Accelerating Exploration (PACE): prospectivity, programs, promotion and people, [PACE review 2014], Report for Department for Manufacturing, Innovation, Trade, Resources and Energy, Report Book 2014/00014. Department for Manufacturing, Innovation, Trade, Resources and Energy, South Australia.**
- Fabian, J.P., 1987. Establishment of a Mineral Resource Centre. UNDP Report UNDP/GHA/82/029
- Feast, B., Davids, J., Mills, T., 2006. Mining Cadastre in Africa – Lessons Learnt. Promoting Land Administration and Good Governance 5th FIG Regional Conference Accra, Ghana, March 8-11, 2006.
- Geological Society of Africa. 2006. Maputo Declaration on the Development of Geosciences in Africa.
- Geological Survey of Western Australia. 2014. GeoVIEW.WA User Guide.
- Government Geoscience Information Committee (GGIC) on instructions of the Chief Government Geologists' Committee. 2012. Australian Requirements for the Submission of Digital Exploration Data.**
- Government of South Australia, Department of State Development. South Australian Exploration Initiative (1992 - 1996).** <http://minerals.pir.sa.gov.au/pace/saei>
- Government of Western Australia, Department of Mines and Petroleum. Guidelines for mineral exploration reports on mining tenements. Gazetted December 2006**
- Government of Western Australia Department of Mines and Petroleum. Resources Statistics.** <http://www.dmp.wa.gov.au/7846.aspx>
- Government of Western Australia Department of Mines and Petroleum. Western Australian Mineral Exploration Index.** <http://www.dmp.wa.gov.au/5136.aspx>
- Guj, B. Pietro, Bocoum, B., Limerick, J., Meaton, M., Maybee, B., 2013. How To Improve Mining Tax Administration And Collection Frameworks A Sourcebook. World Bank.
- Hetherington, R. 1997. Exploration and Mining Titles in Africa : an Introductory Review. AIG-SMEDG Symposium on Exploration and Mining in Africa, 18 August 1997.
- ICMM, 2012. The role of mining in national economies.
- Jessell, M.W., Baratoux, D., Siebenaller, L., Hein, K.A.A., Maduekwe, A., Ouedraogo, F.M., Baratoux, L., Cucuzza, J., Seymon, A. 2015. New Models for Higher Education in Geosciences in West Africa, Case study submitted to the African Higher Education Summit, 10-12 March, Dakar, Senegal.
- Kadiresan, K., 2012. The Challenge of Mineral Resource Exploitation and its Contribution to Development in the Region. 7th Regional Meeting (Southern Africa) of the ACP-EU Joint Parliamentary Assembly. World Bank.
- Kay, P., Hoatson, D., Huleatt, M., Lewis, B., 2012. Assessment of mineral potential, geoscience survey capacity, risk, and geological aid in Africa, Asia, Latin America, and the Pacific. Record 2012/64.
- Kirkwood, D., 2014. Geoscience knowledge in support of economic development in the North: Geomapping for Energy and Minerals Program, AMGI Workshop, CAG 25, Dar Es Salaam.**
- KPMG. 2008. Democratic Republic of Congo Mining Guide.
- KPMG. 2009. Mining in Africa.
- KPMG. 2014. A case study of how understanding impacts of mine community development can help maximise value for stakeholders.
- KPMG. 2014. A New Vision of Value.
- KPMG. 2014. Botswana - Country Brief.
- KPMG. 2014. Cameroon Country mining guide
- KPMG. 2014. Ghana Country Mining Guide.
- KPMG. 2014. Guinea Country mining guide, 2014.
- KPMG. 2014. Mozambique Country mining guide.
- KPMG. 2014. Zambia Country mining guide.
- Maennig, W., 1990. SYSMIN : An Evaluation. Intereconomics, January/February, 35–38.
- McMahon, G., Moiera, S. 2014. The Contribution of the Mining Sector to Socioeconomic and Human Development. Extractive Industries for Development Series #30 April 2014. World Bank.

- Mekgwe, P., Made, P. Ramtohol, R. 2010. Trends, Themes, Challenges and Opportunities for Transforming Higher Education in Africa. A Pan-African Agenda Setting Dialogue, University of Botswana, September 27–28, 2010.
- Ministère de l'Énergie et des Mines, Algérie. 2010. Bilan des Activités Minéral Resources Map of Algeria.
- Ministère des Mines, du Pétrole et de l'Énergie, Mauritanie. 2013. Guide de l'investisseur minier.
- Mogessie, A., 2011. The need for a geoscience education roadmap for Africa, *Episodes*, 35, 489–492.
- Mouton, J., Gaillard, J., 2014. Science Granting Councils in Sub-Saharan Africa. CREST, Stellenbosch.
- Natural Resource Governance Institute. 2009. Natural resource charter.**
- Oliver, K., Boyers, M., Paramon, M., Davies, H. 2012. Mining and prospecting in South Africa : creating maps as tools for more effective decision making. Why did we do it ? Endangered Wildlife Trust.
- Onana, C.A., Teferra, Oyewole, O.B., Beneitone, P., González, J., Wagenaar, R., 2014. Tuning and Harmonisation of Higher Education: The African Experience. 391p. University of Bilbao.
- OneGeology. 2014. <http://www.onegeology.org/>
- Ortega-Girones, E., Pugachevsky, A., Gotthard Walsler, 2009. Mineral Rights Cadastre. Extractive Industries for Development Series #4 June 2009. World Bank.
- Ovadia, D., McCourt, B., O'Connor, E. 2012. Geodata for development a practical approach. *El SourceBook*
- Pedro, A.M., 2006. Mainstreaming Mineral Wealth in Growth and Poverty Reduction Strategies. *Miner. Energy - Raw Mater. Rep.* 21, 2–16. doi:10.1080/14041040500504319
- People's Democratic Republic of Algeria. 2014. Loi n° 14-05 du 24 Rabie Ethani 1435 correspondant au 24 février 2014 portant loi minière.**
- Ralph Spencer Associates. 2000. Evaluation Synthesis – Cooperation in the Mining Sector and SYSMIN**
- Republic of Namibia. 1992. Minerals (Prospecting and Mining) Act, 1992 (Act 33 1 of 1992), of the National Assembly**
- Republic of Senegal. 2014. Plan Senegal: Plan d'actions Prioritaires 2014-2018.
- Schodde, R., 2013. Overview : The Rising Importance of Junior Explorers ...and the key challenges they face going forward. Quebec Mineral Exploration Association Conference 12th – 14th November 2013, Quebec City, Canada.**
- Schodde, R.C. 2015. Canada's Discovery Performance and Outlook. PDAC, March 2015. <http://www.minexconsulting.com/publications.html>
- Schodde, R.C. 2012. Economic Development and Infrastructure Inquiry into greenfields mineral exploration and project development in Victoria Parliament of Victoria Economic Development and Infrastructure Committee. <http://www.minexconsulting.com/publications.html>
- Schodde, R.C., 2014. Challenges and opportunities for under-cover exploration in Australia, Presentation to the UNCOVER Summit 2014, Adelaide, March 2014.**
- Schodde, R.C. 2014. Uncovering exploration trends and the future: Where's exploration going?," presentation at the International Mining and Resources Conference (IMARC), Melbourne, September 2014.** <http://www.minexconsulting.com/publications.html>
- Scott, M., 2013. Developing Effective Mineral Resource Policy for Sustainable Livelihoods through Geoscience Summary of Action Research Activity. IM4DC Action Research Report.**
- Scott, M., Jones, M., 2014. Management of Public Geoscience Data. IM4DC Action Research Report.**
- SEAMIC. 2008. Mineral potential of SEAMIC member countries.
- Secretariat of the African, Caribbean and Pacific Group of States (ACP Group), 2002. Mining Data Bank <http://mines.acp.int/>
- Service Géologique du Maroc, 2013. Catalogue des produits du Service Géologique du Maroc.
- Strange, A., Parks, B., Tierney, M.J., Fuchs, A., Dreher, A., Ramachandran, V., 2013. China's Development Finance to Africa: A Media-Based Approach to Data Collection. Centre for Global Development Working Paper 323.
- Trust Africa. 2015. Revitalizing Higher Education for Africa's Future. Trust Africa-Higher Education in Africa Summit, March 10-12 2015, Dakar, Senegal
- UNECA, African Union. 2011. Minerals and Africa's Development - The International Study Group Report on Africa's Mineral Regimes 210p.
- UNECA, SADC. 2004. Harmonization of Mining Policies, Standards, Legislative and Regulatory Frameworks in Southern Africa. UNECA ECA/SA/TPub/Mining/2004/03
- UNECA. 1962. Research and Training Institutes in Africa. UNECA E/CN.14/INR/11
- UNECA. 1967. The mining industry in West Africa. Report E/CM.14/3HE/128
- UNECA. 2007. Determination Fundamental Datasets for Africa. UNECA ECA/ISTD/GEO/2007/02E

- UNESCO. 1961. Conference of African States on the Development of Education in Africa - Final Report. UNESCO/ ED/ 181
- UNESCO. 1963. A review of the natural resources of the African continent. 429p.
- Yager, T.R., Bermúdez-Lugo, O., Mobbs, P.M., Newman, H.R., Taib, M., Wallace, G.J., Wilburn, D.R. 2014. The Mineral Industries of Africa. USGS 2012 Minerals Yearbook. Africa Summary, December 2012**
- Walser, G. 2007. World Bank Mining Activities in Africa Policy Framework and Country Experience, presentation at AfDB-WBG Experience-Sharing Meeting Tunis February 12-13, 2007**
- WAXI. 2015. The West African Exploration Initiative. <http://www.waxi2.org>
- World Bank, Elsevier. 2014. A Decade of Development in Sub-Saharan African Science, Technology,
- World Bank. 2010. Financing Higher Education in Africa. World Bank ISBN-13: 978-0-8213-8334-6
- World Bank. 2014. Human Capital for the Oil, Gas and Minerals Industries.
- World Bank. 2014. The African Minerals Geoscience Initiative (AMGI)- The “Billion Dollar Map” Technical Report.**

## Appendix A – Project Surveys

A survey of extractive industry members, African government organisations and universities was conducted in order to aid in the identification of barriers to implementation of corporate data delivery to national archives and to illuminate issues to be addressed in follow-up initiatives.

A total of 36 surveys were completed with the following breakdown:

Survey Group	Number of respondents
Industry	15
Government Organisation	10
University	11
Total	36

Most respondents preferred to remain anonymous so the names and organisations have been omitted from the results. Respondents who wished to be named in the study are gratefully acknowledged at the beginning of the report. Raw data from the questionnaires are collated in the tables below.

**Table 6: Government organisation survey results**

Ministry of Mines or Geological Survey	Reporting formats	End of permit report	Rate of compliance	Digital archive	Number of archives	Number of data administrators (personnel)	Data Formats
1	paper, pdf	yes	5	yes	3	2	shp, tif, others
2	paper, digital	yes	5	yes	several	15	digital
3	paper, digital	yes	2	yes	1	7	shp, digital, paper, database
4	DNR	yes	5	yes	1	12	digital
5	paper and digital	yes	3	yes	2	9	shp, jpg, tif, gdb
6	paper	yes	4	yes	1	2	shp, xls, dbf
7	paper	yes	DNR	yes	Several (moving to house all data on 1 server)	2	shp, gdb, others
8	paper	DNR	DNR	DNR	DNR	DNR	DNR
9	paper	no	DNR	yes	DNR	3	shp, jpg, dbf
10	paper	yes	DNR	yes	several	DNR	DNR

**Table 7: Minerals industry survey results**

Company	Submit regular reports	Reporting formats	Supportive of company geodata transfer for a current permit	Supportive of company geodata transfer for a relinquished permit
1	Yes	DNR	no	yes
2	Yes	pdf, in some cases digital data	no	yes
3	Yes	paper, pdf	no	yes
4	Yes	Paper and in some cases digital data	yes	yes
5	Yes	paper	no	yes
6	Yes	paper	no	yes
7	Yes	Paper, pdf and sometimes digital data	no	yes
8	Yes	paper, pdf and digital	maybe	yes
9	Yes	paper, pdf	no	yes
10	Yes	paper, pdf and digital	no	yes
11	Yes	paper	no	yes
12	Yes	paper	no	yes
13	Yes	paper, pdf	no	yes
14	Yes	paper, pdf	no	yes
15	Yes	paper	no	yes

**Table 8: Higher education institute survey results**

Higher Education Institute	Courses include data processing	Courses include GIS	Software (GIS and others where cited)	Geophysics Courses	Geophysics Software
1	No	No	N/A	No	N/A
2	No	Yes	Mapinfo, Surpac	Yes	Geosoft
3	Yes	Yes	ArcGIS, Surfer	Yes	ModelVision, QuickMag, Geosoft
4	No	No	N/A	Yes	None
5	Yes	Yes	ArcGis, Mapinfo	No	N/A
6	Yes	Yes	Open Source	No	N/A
7	Yes	Yes	DNR	Yes	DNR
8	yes	Yes	ArcGIS, Mapinfo	Yes	Geosoft
9	DNR	Yes	ArcGIS, Mapinfo	Yes	DNR
10	Yes	Yes	ArcGIS, Mapinfo, ILWIS	Yes	Geosoft
11	Yes	Yes	ArcGIS, Mapinfo	No	N/A

## International Mining for Development Centre

### Research Activity

#### Growing National Archives via Transfer of Corporate Geodata at Permit Relinquishment

##### *Geological Survey / Ministry Questionnaire*

This questionnaire is part of an IM4DC-funded pilot project to investigate current best practise for corporate data delivery to national geological surveys from the regulation, technical implementation and compliance perspectives.

The purpose of this questionnaire is to obtain information about the current state of geo-data access and archiving within African government organisations with a view to developing a pathway towards the transfer of corporate geoscientific data to incrementally build upon the national archive.

Please answer as many questions as possible.

##### Contact information

1. Name
2. Position
3. Organisation
4. Country
5. Email address

##### Reporting procedures

6. What is the most recent version of the mining code in your country?
7. At present do exploration companies provide regular activity reports?
8. Are reporting guidelines provided to companies?
9. How often do they have to report?
10. What formats (paper, pdf, and digital databases/GIS data) do exploration companies provide for reporting?
11. Are companies required to submit relinquishment reports on permit surrender?
12. If so, rate the average level of compliance:  
1 = No compliance  
5 = Full compliance  
1      2      3      4      5

### **Data archiving infrastructure**

13. What are the main data types currently available in the national archive?
14. What GIS system is used at the survey/cadastre/other?
15. Is there one archive or are there several e.g. Geological Survey, Mines department, Minerals commission?
16. Who maintains the data archive/s (what organisation)?
17. How many people maintain it and what training have they had?
18. What are the data formats in the geodatabases? Is there a standardised format system?
19. If a company does give you any of their data (drilling, surface assays, geophysics, metallurgy, physical samples) what do you do with it at present?
20. What do you think are the limitations to the implementation of a company data archive and retrieval system? -(compliance, software, hardware, training)

### **General comments**

21. What benefits would the addition of company data bring to your country?
22. Do you have any other comments on this issue?

### **Permission to publish results of the survey**

23. Do you wish to be named in the report as a respondent to the questionnaire or to remain anonymous?
24. Do you agree to the use of this survey in a report specifically related to the transfer of company data to national archives to be published by the IM4DC?

## International Mining for Development Centre

### Research Activity

#### Growing National Archives via Transfer of Corporate Geodata at Permit Relinquishment

##### *University Questionnaire*

**This questionnaire is part of an IM4DC-funded pilot project to investigate current best practise for corporate data delivery to national geological surveys from the regulation, technical implementation and compliance perspectives.**

**The purpose of this questionnaire is to obtain information about the current state of geo-data access and archiving within African government organisations with a view to developing a pathway towards the transfer of corporate geoscientific data to incrementally build upon the national archive.**

1. Name
2. Position
3. University
4. Email address
5. Phone number
6. Does your university teach database management and/or data processing? If so, what are the course names?
7. Does your university provide GIS training courses? If so, what are the course names?
8. What GIS software is taught ArcGIS, Mapinfo, other?
9. Does your university have geophysical processing courses at undergraduate or graduate level? If so, what are the course names?
10. What geophysical software is taught (Intrepid, Geosoft, other?)

#### **Permission to publish results of the survey**

11. Do you wish to be named in the report as a respondent to the questionnaire or to remain anonymous?
12. Do you agree to the use of this survey in a report specifically related to the transfer of company data to national archives to be published by the IM4DC?

## International Mining for Development Centre

### Research Activity

#### Growing National Archives via Transfer of Corporate Geodata at Permit Relinquishment

##### *Company Questionnaire*

This questionnaire is part of an IM4DC-funded pilot project to investigate current best practise for corporate data delivery to national geological surveys from the regulation, technical implementation and compliance perspectives.

The purpose of this questionnaire is to obtain information about the current state of geo-data access and archiving within African government organisations with a view to developing a pathway towards the transfer of corporate geoscientific data to incrementally build upon the national archive.

1. Name
2. Position
3. Company
4. Email address
5. Phone number
6. List the African countries where you currently have projects
7. In Africa do you provide regular reports?
8. In what formats (paper, pdf, and digital databases/GIS data)?
9. Would you support an initiative to grow national archives through the addition of corporate data?
10. Under which circumstances would you comply?
11. What are barriers to compliance?
12. Would you wish to hand over data for a current permit?
13. Why/why not?
14. Would you wish to hand over data for an expired permit?
15. Why/why not?
16. Please describe how your company could benefit from such an initiative?

##### **Permission to publish results of the survey**

17. Do you wish to be named in the report as a respondent to the questionnaire or to remain anonymous?
18. Do you wish for your company to be named in this report?

## Appendix B – Types of Geodata and data standards

**Table 9: Acceptable formats for digital data as prescribed by the Western Australian guidelines for mineral exploration reports on mining tenements**

Data Type	Description	Format	Suffix (UPPERCASE for data; lowercase for visualisations)
Tabular data	Point locations, geochemistry, heavy mineral, diamond indicator and drilling data	Delimited ASCII	txt
Report text	Documents, figures etc. previously provided only in hardcopy	Adobe Acrobat	pdf
Maps, plans, figures and photographs not embodied in report text	Files of maps, plans, figures, core photographs, aerial photographs etc.	Adobe Acrobat GEOTIFF/TIFF (colour) JPEG GIF PNG	pdf TIF jpg gif png
GIS data	Data in GIS format	Each State & Territory to determine which format(s) they will accept	e.g. SHP, TAB, MIF
Video clips	Fly-throughs etc	Each State & Territory to determine which format(s) they will accept	
3D mine models	3D mine model data	Each State & Territory to determine which format(s) they will accept	
3D modelling	3D models	As appropriate to fulfil requirements in Sect 2.4.6 below ASCII .dxf files	DXF TXT
Geophysics (other than seismic)	Raw and processed located data and gridded data. For example, magnetics, radiometrics, EM, DTM and gravity data	ASEG GDF2 ASEG ER Mapper XML (including schema)	GXF grid GDF GXF GRD, XML, XSD ERS

Geophysical and other remotely sensed images	Images derived from geophysical / remote sensing surveys, e.g. TMI, Bouguer, radiometrics, Landsat 5 or 7	GEOTIFF/TIFF (colour) TIFF (greyscale) Compressed ER Mapper JPEG GIF PDF PNG	tif TIF ecw jpg gif pdf png
Geophysical Inversion and Numerical Modelling	Models	Points (DXF or ASCII) Images Surfaces 3D grids (UBC Grid or GoCAD Voxet)	DXF TXT pdf TIF jpg gif png DXF
Seismic data	Raw and processed data	SEG Y, preferably Rev. 1 SEG D	SGY SGD
	Navigation data	UKOOA P1/90	UKA
	Processed sections (refer to Petroleum data submission guidelines for further information, www.ga.gov.au)	CGM+ format with metadata (line number, shotpoint number) Geophysical image formats as above	cgm TIF, jpg, gif, pdf, png
Petrophysical and geophysical log data	Raw and processed wireline and MWD data (refer to Petroleum data submission guidelines for further information, www.ga.gov.au)	DLIS LIS LAS Delimited ASCII (format must be explained) WELLOGML (POSC standard)	LIS LIS LAS asc
	Log plots	Adobe Acrobat TIFF (colour) TIFF (greyscale) JPEG GIF PNG	pdf tif tif jpg gif png
	Processed downhole velocity data	SEG Y, preferably Rev. 1	SGY

Source: Government of Western Australia. Department of Industry and Resources. Guidelines for mineral exploration reports on mining tenements. Gazetted December 2006