Nationwide Collection, Recording and Provision of Geo-scientific Data: Examples from Ghana, Namibia, Germany and Kosovo – An Experience Report

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Key words: Database, GIS, data collection, data management, minerals

SUMMARY

Over hundreds of years, geo-scientific data were collected and fixed on paper. Handmade descriptions, bore hole logs, maps, exploration reports etc. have filled up public and non-public archives with materials of inestimable value. The systematic capture, storage and distribution of this information is an extremely important and expensive activity.

State managed geological surveys and similar organisations, as well as large private companies, make a broad use of modern data storage systems, such as text files, spreadsheets, databases, CAD and GIS, and electronic images (scans). Many systems grew independently from each other even in one organisation. The result is a jungle of information, many redundancies, problems with coding, networking and distribution of information.

Traditionally, geo-scientific spatial information was collected on maps. Maps were the most important final product of any geo-scientific work. This methodology was used even after the introduction of GIS into the normal geo-scientific working process. Now, we are on the threshold of a fundamental alteration of the management and distribution of geo-scientific and spatial information. More and more, the attention is being directed to the creation of flexible and redundancy-free information systems, which allow the production of many different user-defined final products including access to selected spatial information and maps for investors or a broader public over the internet.

The principles of data storage will be illustrated by case studies of large Information Management Systems for geo-scientific Authorities in Ghana, South Africa, Namibia, Germany and Kosovo in recent years. The presentation will focus on the following systems:

- Non-metallic Minerals of Saxony (Germany): Access 97, ArcView 3.2 (1998)
- Earth Data Namibia: ORACLE, ArcView 3, VB 6, Map Objects (2001 – 2004)
- Geo-Database Kosova: SQL-Server, ArcGIS 8.3, VB.Net, Map Objects (2003 – 2005)
- Information Management System for the Mining Sector of Ghana (2005 – 2006).

ZUSAMMENFASSUNG (German)

Geowissenschaftliche Daten wurden über Jahrhunderte auf Papier gesammelt und verwaltet. Handskizzen und –beschreibungen, Bohrlochverzeichnisse, Karten, Explorationsberichte etc. haben öffentliche und nichtöffentliche Archive mit Material von unschätzbarem Wert gefüllt. Die systematische Erfassung, Speicherung und Verbreitung dieser Informationen ist von großer Bedeutung und eine kostenintensive Aufgabe.
Staatliche geologische Dienste und vergleichbare Organisationen sowie große privatwirtschaftliche Unternehmen haben einen großen Nutzen von modernen Datenverwaltungssystemen wie Textverarbeitung, Tabellenkalkulation, Datenbanken, CAD, GIS und digitalen Bildern (Scans).
Viele Systeme wurden unabhängig voneinander aufgebaut, teilweise selbst innerhalb einer einzelnen Behörde. Im Ergebnis stehen oftmals unübersichtliche Datenbestände mit großer Redundanz, Probleme mit Codierung, Vernetzung und dem Informationsfluss.
Raumbezogene Daten wurden traditionell in Karten gesammelt und stellten das bedeutendste Endprodukt geowissenschaftlicher Arbeit dar – oftmals selbst nach der Einführung von GIS-Technologie in den geowissenschaftlichen Arbeitsfluss.
Derzeit stehen wir an der Schwelle eines fundamentalen Wandels der Verwaltung und Bereitstellung raumbezogener und geowissenschaftlicher Informationen. Der Aufbau flexibler und redundanzfreier Informationssysteme rückt zunehmend in den Vordergrund. Das Ziel ist die Herstellung vielfältiger nutzerspezifischer Endprodukte, einschließlich Zugang zu ausgewählten raumbezogenen Daten und Karten für Investoren und eine breitere Öffentlichkeit über das Internet.
Die Prinzipien der Datenhaltung werden an Hand von Fallbeispielen illustriert, darunter umfassende Informationssysteme für geowissenschaftliche Organisationen in Ghana, Südafrika, Namibia, Deutschland und Kosovo in den letzten Jahren mit dem Schwerpunkt auf:

- Non-metallic Minerals of Saxony (Germany): Access 97, ArcView 3.2 (1998)
- Earth Data Namibia: ORACLE, ArcView 3, VB 6, Map Objects (2001 – 2004)
- Geo-Database Kosova: SQL-Server, ArcGIS 8.3, VB.Net, Map Objects (2003 – 2005)
- Information Management System for the Mining Sector of Ghana (2005 – 2006).

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1. INTRODUCTION

Over hundreds of years, geo-scientific data were collected and fixed on paper. Handmade descriptions, bore hole logs, maps, exploration reports etc. have filled up public and non-public archives with materials of inestimable value. The systematic capture, storage and distribution of this information is an extremely important, long-term and very expensive activity.

State managed geological surveys and similar organisations as well as large private companies make a broad use of modern data storage systems such as text files, spreadsheets, databases, CAD and GIS, and electronic images (scans). Many systems grew independently from each other even in one organisation. The result is a jungle of information, many redundancies, problems with coding, networking and distribution of information.

Traditionally, geo-scientific spatial information was collected on maps. Maps were the most important final product of any geo-scientific work. This principal methodology was continued to use even after the introduction of GIS into the normal geo-scientific working process. Now, we are on a threshold of a principal alteration of the management and distribution of geo-scientific information. More and more, our attention is being directed to the creation of flexible, and redundancy – free information systems, which allow the production of many different user defined final products.

2. PRINCIPLES OF DATA STORAGE

The main components of a database are storage containers for factual data, spatial data and unstructured information such as scanned maps (Figure 1). Although many variants of data storage principles are in use, the core of the systems is always a relational database. The main entities (such as drill holes, sampling points and analyses, legends, mineral occurrences and deposits, mines and licences) are described in systems of tables. These entities are linked with each other by spatial and logical principles (e.g. sampling points related to a certain licence site, licence applicant to a certain licence). The linkages might be created by (link) tables or by application of SQL queries (only when spatial data is stored in the relational database). This linkages are the prerequisite for a comfortable use of the database (inquiries).
The introduction of web-based services for the provision of geographical base data makes sense for a web-based system only.

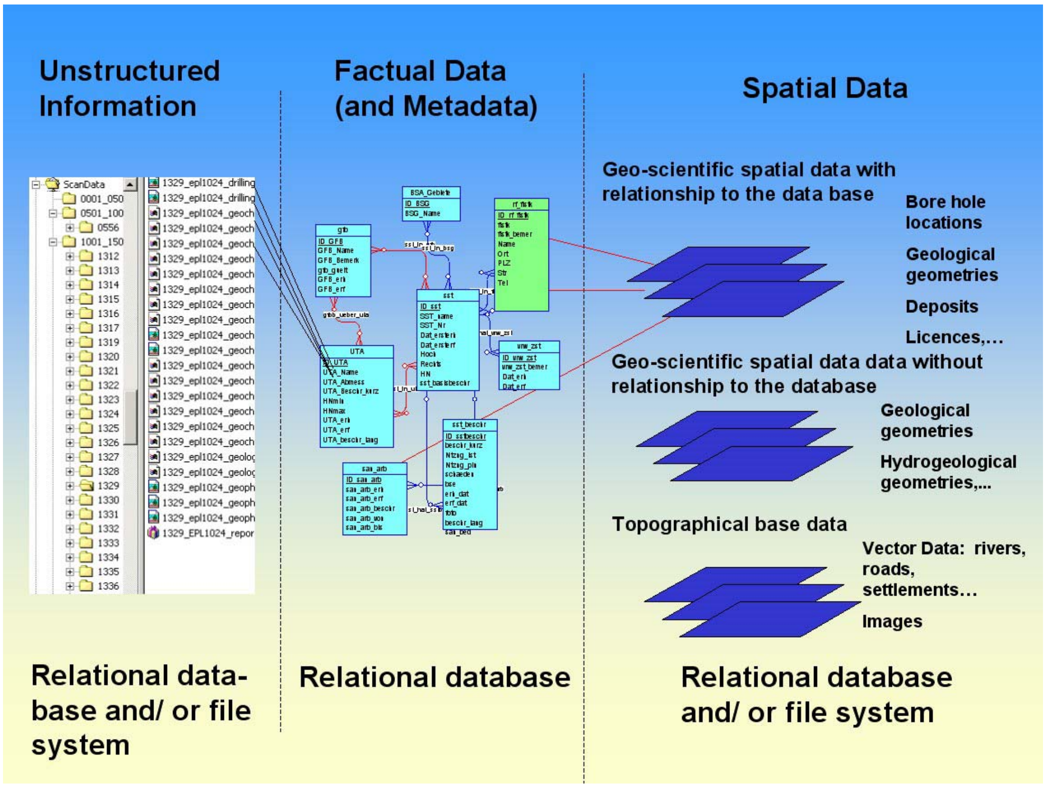

Figure 1: Data structure in principle

3. IMPORTANT FUNCTIONS

Most of the important functions are complex inquiries with spatial and/or logical background (type: show all Copper occurrences of potential economic importance in a certain part of the country; show all sampling points and related Gold values for a certain mineral licence/ for all licences of a certain applicant; show all reports and maps with regard to geochemical sampling done by a certain company, in a certain area; etc.).

The presentation and export of the inquiry results is another important function. It consists of different functions for the automatic creation of user defined maps (content, scale, size) and the generation of text files (tables) for further customised processing (e.g. with other software).

Important administration functions are tools for a customised user management (setting of access rights to different modules of the system) and for data security reasons (backup system and protection against the loss of data and unauthorised data manipulation).

The creation of (fixed) reports is important in some cases only, e.g. the creation of deposit passports, mineral licence documents etc. Principally, the graphical user interface (GUI) can be implemented as a client-server application (Figure 2) or as a web-able application.

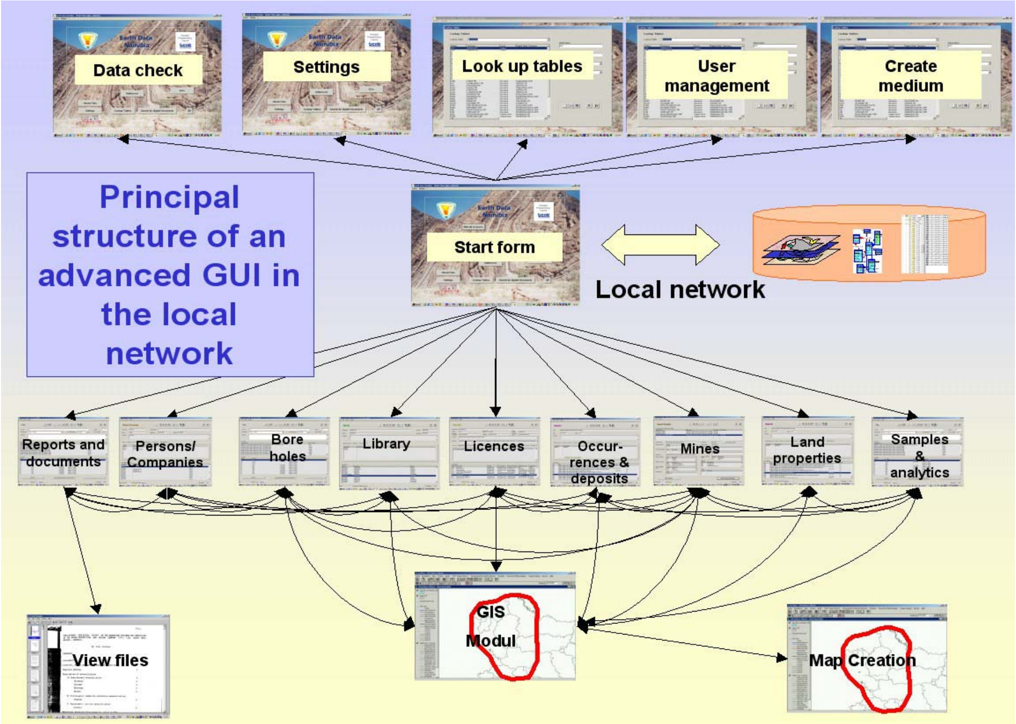

Figure 2: Principal structure of an advanced GUI in the local network

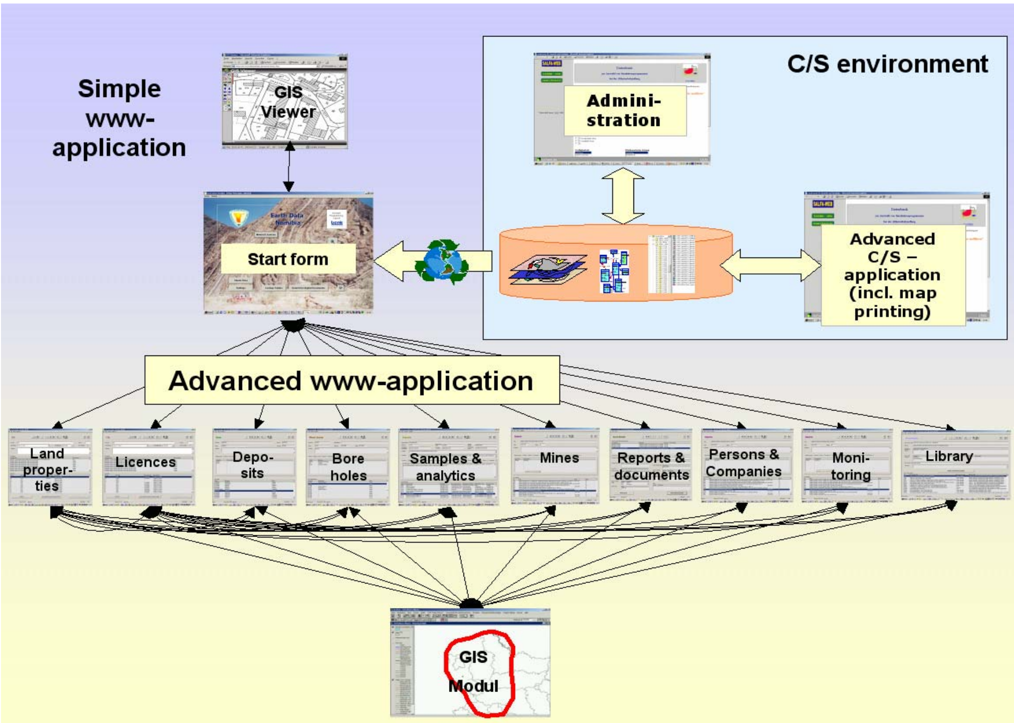

Figure 3: WWW- based application

Internet technologies open a wide range of information distribution to the public and (or) to remote (restricted) users. For the time being, a web-client can not (yet) replace the functionality (especially map printing) of a full scale client-server application (Figure 3).

4. DATA CAPTURE PROCESS

The value of a complex geo-scientific information system does not only consists of its easy-to-use and fast GUI, but also of the correctness and completeness of its data. Therefore, the organisation of the data capturing process and its quality management are of high importance (Figure 4). The quality insurance process consists of different constituents: e.g. the storage of primary paper documents for further checks, plausibility checks during the data entry process, data check by third persons, recording of the date and the person of any data modification.
Good experience was made both with a continuous data capturing process (data is entered as it arrives), and with a project-like organised process. The latter one is important for the capture of old information from different sources, such as mineral occurrences and deposits, bore holes, reports and documents.

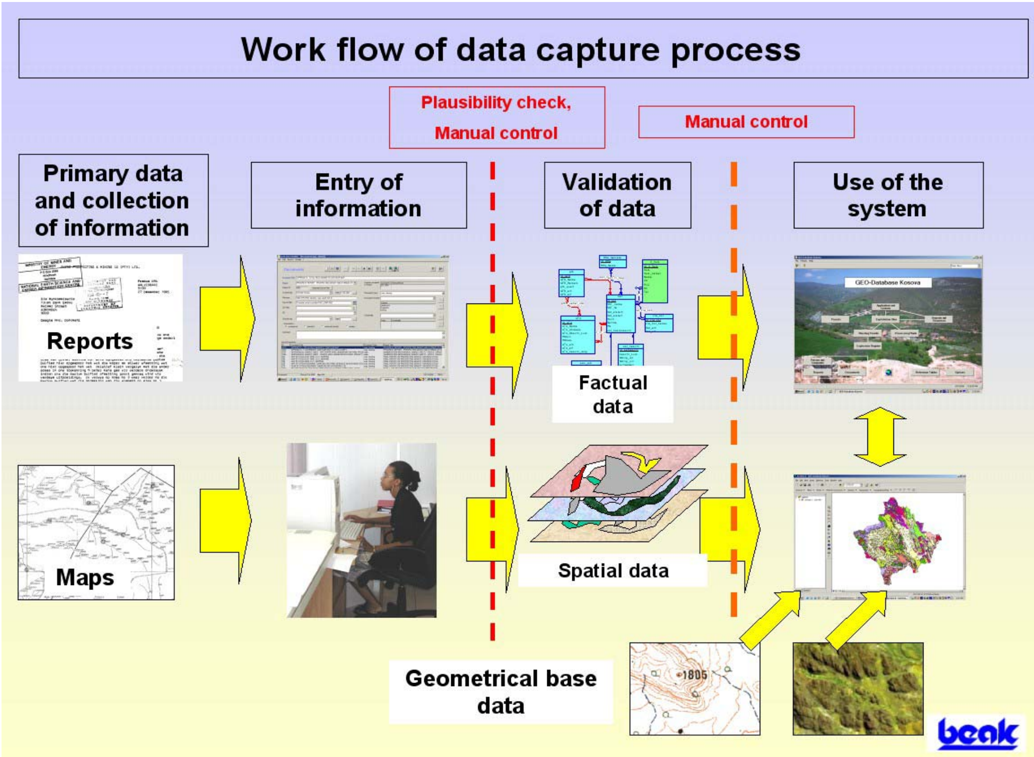

Figure 4: The data capture process

5. SOFTWARE

Although the general structure of the systems is equal everywhere, the creation of customer designed tailor-made software is recommended. Due to local requirements (e.g. laws, regulations, responsibilities) and different pre-requisites (hardware, software, information systems, coding systems), a multiple use of exactly the same database structure and front end software in most cases is impossible. Moreover, the fast development of hardware and software demands the adjustment of the special system to new conditions.

We have made the best experience with high-end products from **Microsoft, Oracle** and **ESRI**. These products are not cheap, but they guarantee investment security, good support and a comparably long period of use of the systems.

6. EXPERIENCE AND CONCLUSIONS

Our experience shows that Information Systems for an organisation like a Geological Survey or a large company should be planned strategically. The best “basement” of a future-oriented system is a modular, network-like, and redundancy-free organised data model.
The creation of seamless datasets demands the strict use of general legends (organised flexibly and open for new entries) and look-up tables. A restricted access to the look-up table management including the legends is essential for a long-term useable database.
The data capture process is very expensive, but saving up measures will press on the quality of the data. As experience shows, the retrieval of wrong data and its correction is much more expensive than the entry of correct data.
An easy to use and self explaining GUI will contribute a lot to the acceptance of the system.

7. PRESENTATION

The presentation includes the following systems:

- Non-metallic Minerals of Saxony (Germany): Access 97, ArcView 3.2 (1998)
- Mining damages of Saxony (Germany):
- Earth Data Namibia: ORACLE, ArcView 3, VB 6, Map Objects (2001 – 2004),
- Information Management System (IMS) for the Mining Sector of Ghana (2005 – 2006), SQL-server 2005, VB.Net, ArcGIS 9.x

As an example, the structure of the IMS Earth Data Namibia will be illustrated on the following pages.

For a detailed description of the IMS Ghana, see the paper “Planning and Implementation of the Information Management System of the Mining Sector of Ghana” (Afenu et al.) in this volume.

Presentation of the EarthDataNamibia (EDN) –
the information system of the Geological Survey of Namibia

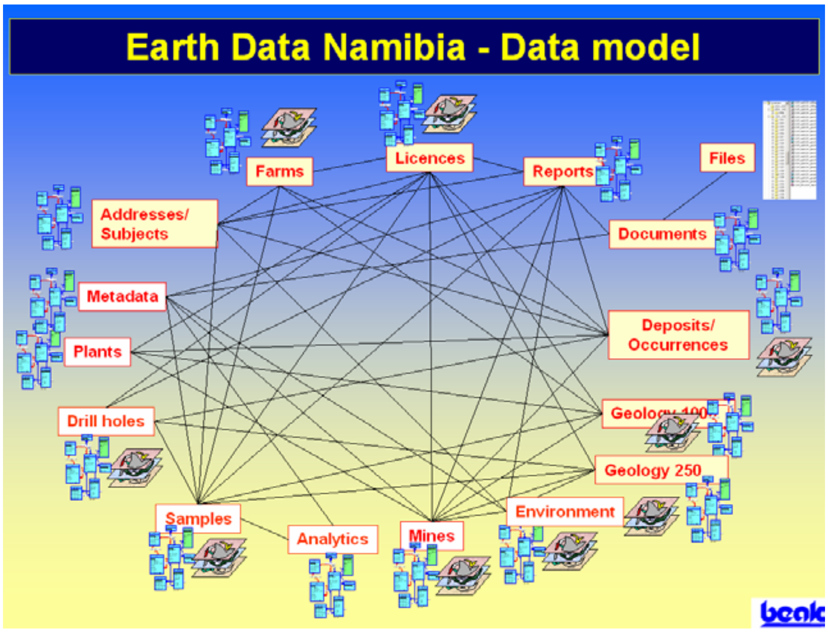

Figure 5: Data model of EDN

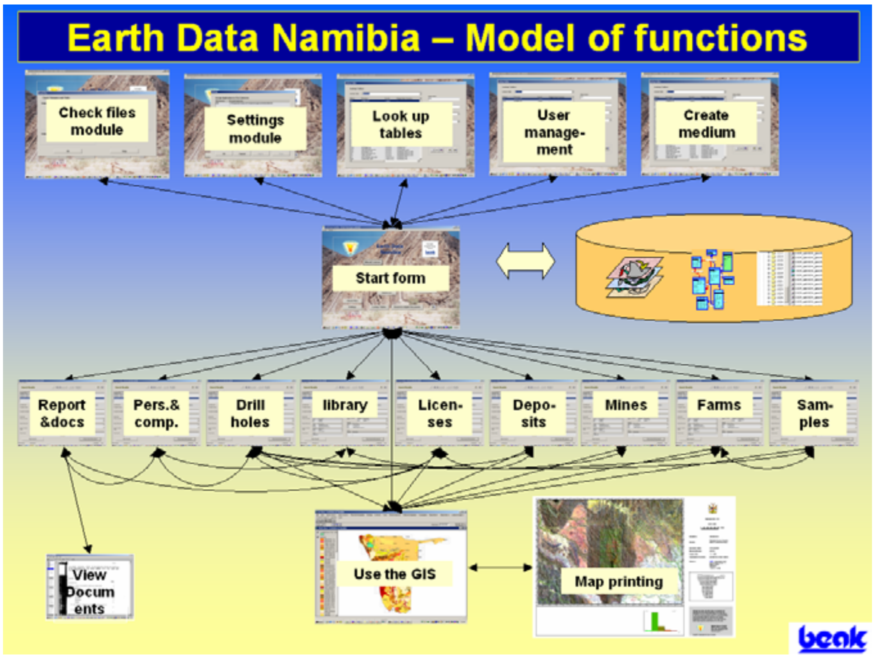

Figure 6: Model of functions of EDN

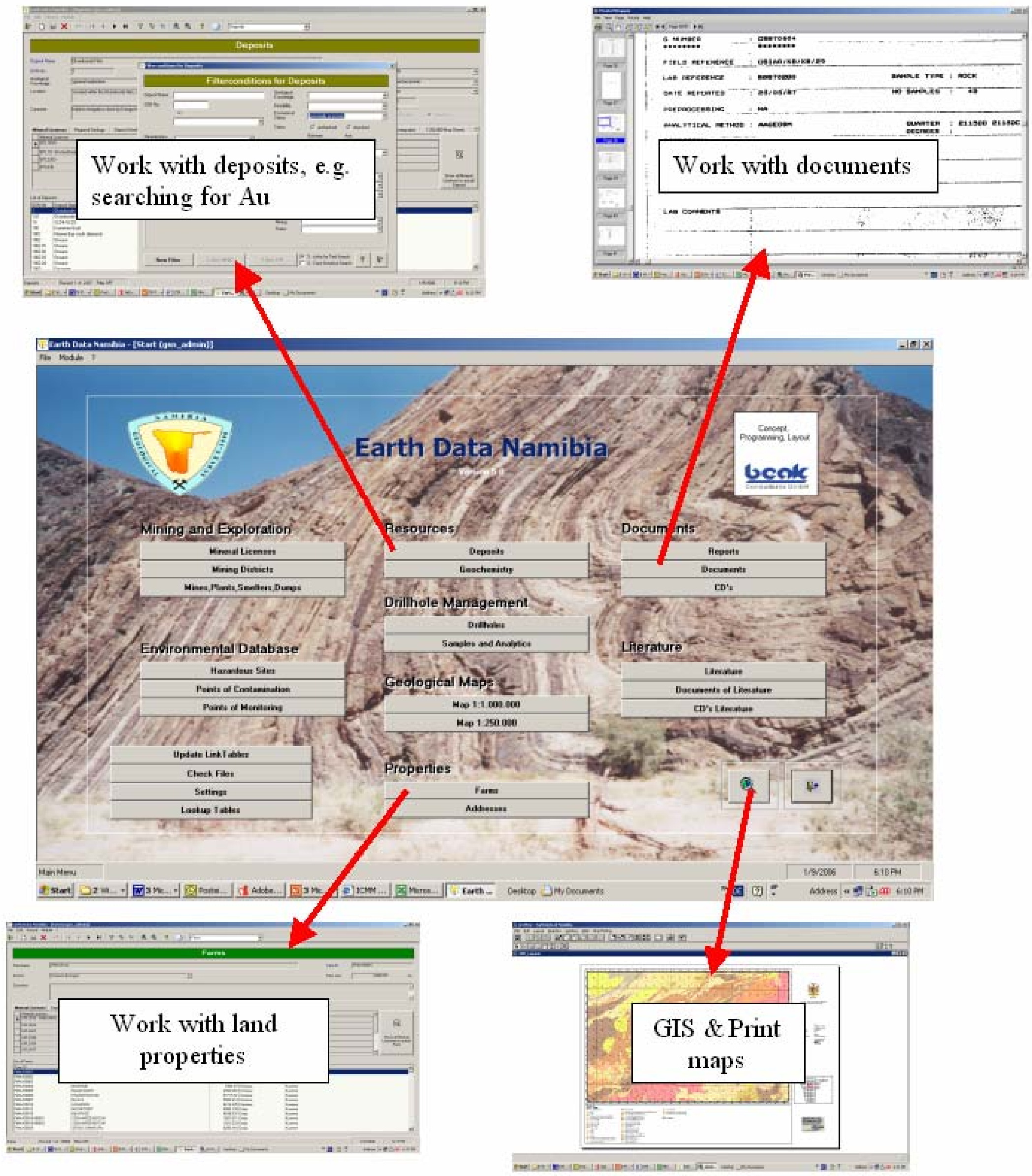

Figure 7: Interfaces of Earth Data Namibia Application

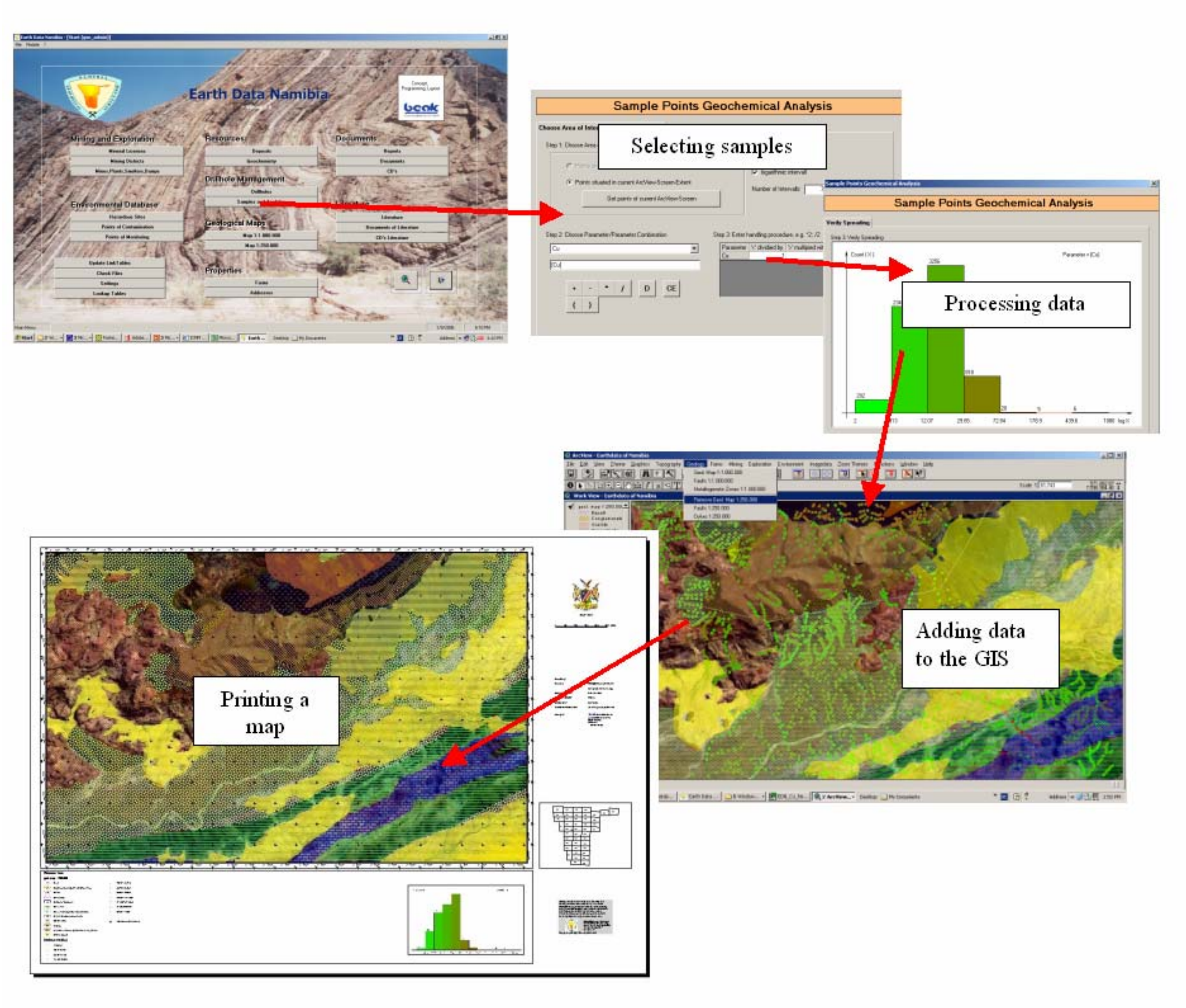

Figure 8: Workflow of geochemical data processing, Earth Data Namibia

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BIOGRAPHICAL NOTES

Dr Andreas Barth, born in the German Democratic Republic, studied Geochemistry at the Moscow State University (Lomonosov-University) in the former Soviet Union 1974 – 79. Dr Barth reached a PhD in Geology at the Freiberg Mining Academy (Germany) in 1983.
From 1979 – 1990, he worked mainly in geological exploration in Yemen and Mongolia.
Since 1994, Dr Barth is Managing Director of Beak Consultants GmbH, Germany, and conducted projects in the area of geosciences, environment and development of information systems in Germany, Kosovo, Ghana, South Africa, Namibia, Jordan, Albania, Kyrgistan, Bolivia and other countries.

Selected Publications :

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