Report: A Geoscientific Data Base for Namibia

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Abstract :- Earth Data Namibia (EDN) is the Geological Survey of Namibia's (GSN) multi-disciplinary geoscience data base, incorporating data from mineral and water exploration, geoscientific research and mapping. Since its launch in 2003 it has evolved from a relatively simple mineral exploration data base, designed to store and make freely accessible tens of thousands exploration reports and maps accumulated since the 1950s - thus preserving irreplaceable information - to a complex system with a variety of modules accommodating most of the data held by the Geological Survey. After 20 years of operation and various upgrades, EDN is a powerful software tool, for both GSN staff and the public, who can search its content on site at terminals in the National Earth Science and Energy Information Centre of the Ministry of Mines and Energy or access it online via the Ministry's website.

Keywords :- Data management

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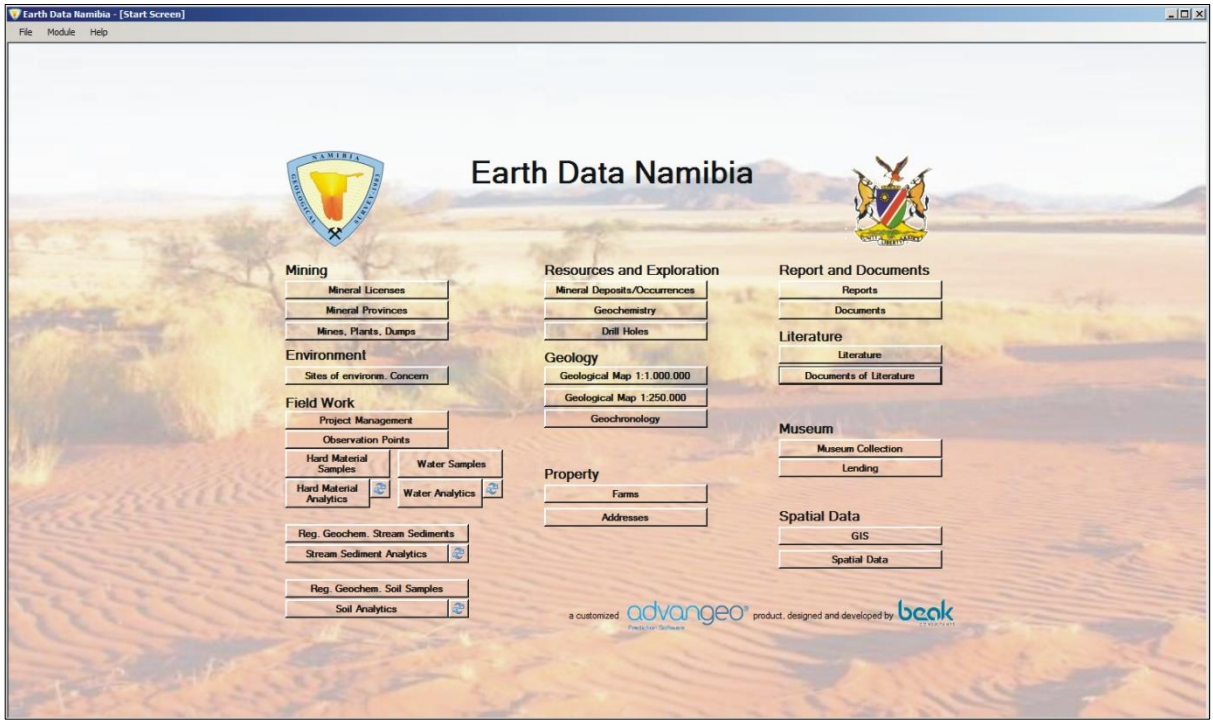

Figure 1. Log-in screen of EDN

History of Earth Data Namibia (EDN)

Up to the end of the 1990s the public was given access to original archival mineral exploration documents - many of them the only copies in existence - at the Ministry of Mines and Energy's National Earth Science and Energy Information Centre. As a result, this valuable data source deteriorated noticeably over the years, through frequent use and occasional misuse. With the widespread introduction of advanced information and computer technology, it was decided to gradually convert all analogue documents into digital format: a project that soon brought about the realisation that the generated profusion of digital files could only be

handled and used effectively by means of a dedicated data base/information system.

BEAK Consultants of Freiberg, Germany, were contracted to develop and maintain the system in accordance with specific user requirements, which initially were only to store and search scanned exploration documents. Additional GIS facility allowed to display spatial reference data, such as mineral licence areas, mineral occurrences, farms and administrative entities, as well as geological data, topographic maps and satellite imagery (Landsat 5). However, before long the obvious advantages of storing data in an organised and searchable environment led to the demand for further modules to host geochemical, drill hole, geochronological, environmental and literature information (Fig. 3). The accommodation of this influx of data required the move from MS Access as the initial data base component to ORACLE and eventually to SQL, while GIS functionality switched from ARCVIEW 3 and a free GIS-viewer to ARCGIS. In addition to these system upgrades, several of the modules have undergone significant modification during the years of operation in response to advanced data and user requirements.

The web presence of EDN made its debut in 2012, enabling the public to search the system not only on site but through the internet, albeit with limited functionality. This service received a "face lift" early in 2023 (Fig. 2) to allow access to a broader spectrum of data stored in EDN and offering improved search, display and download options.

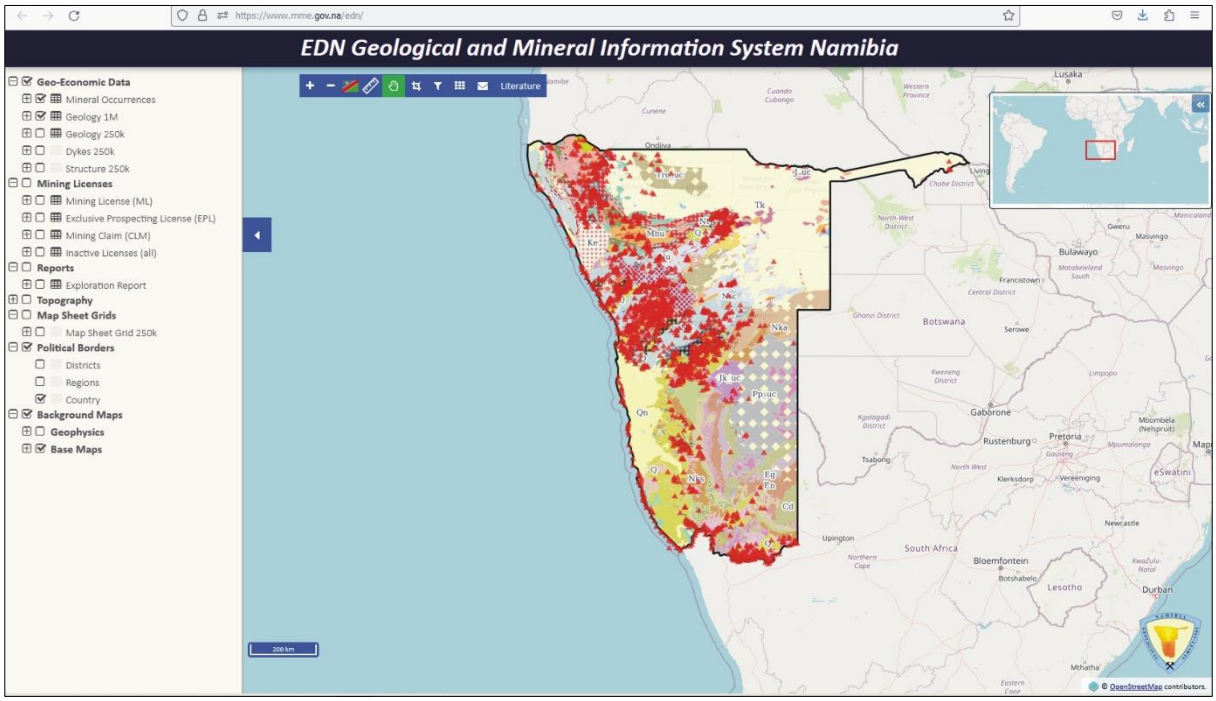

Figure 2. EDN Geological and Mineral Information System (https://www.mme.gov.na\edn)

Challenges

With this powerful tool to hand, it nevertheless became evident that population of the data base, which requires a dedicated full-time work force, was not doing justice to the potential benefits of EDN. A period of stagnation led to a substantial backlog of information, including exploration reports, scientific publications and spatial data (e. g. geochemical/geochronological data, drill holes) from research and exploration. With its usefulness depending on the accuracy of the information contained as well as regular updates, this situation threatened to defeat the purpose of EDN, on whose development and maintenance millions of Namibian dollars had been spent since its inception.

In order to remedy this state of affairs and restore the efficacy of EDN as an up-to-date source of geoscientific information for the exploration industry, researchers and the public in general, at the end of 2020, BGR (Federal Institute for Geosciences and Natural Resources), through the German - Namibian Technical Co-

operation Project «Sustainable Use of Namibia's Mineral Potential», recruited six temporary assistants, mostly graduate students, with the object of furthering the population of the various modules of the data base. Work being done by project staff involves not only the uploading of new and archival data, but also the updating and checking of existing records. After three years of operation and an increase of the temporary work force to eight, significant progress has been made throughout the multi-faceted structure of EDN (Fig. 3). At the same time, however, it has become clear that to keep up the momentum the Geological Survey of Namibia will have to consider the assignment of permanent staff to this task to ensure the maximum benefit from its investment.

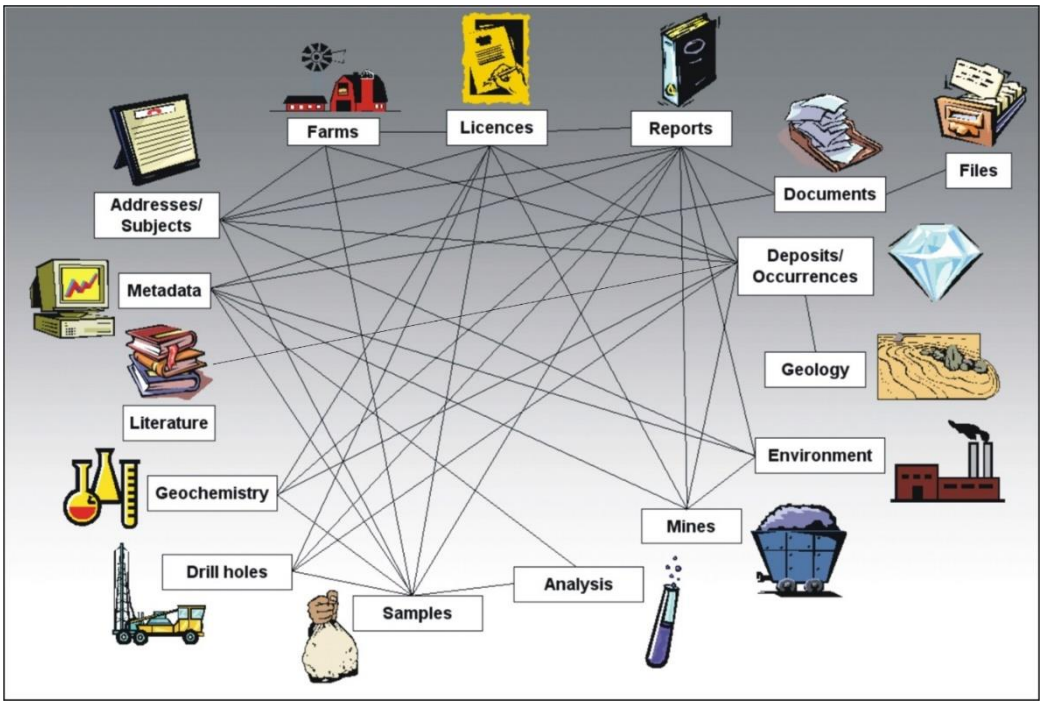

Figure 3. Simplified structure of EDN: All modules are interlinked, resulting in a complex "spider web" with hundreds of data base tables

Current status

The following section gives a brief overview of the content and current status (November 2023) of the main modules of the data base. As the graphs indicate the present initiative has given a significant boost to the image of EDN after years of little activity following the inception phase (note that with the exception of the "Documents" Module, data entered prior to 2011 when EDN moved from ORACLE to SQL are not differentiated).

Mineral licences:

20600 active and inactive licences (incl. those still under application); update is carried out daily by automated import from Namibia's Mining Cadastre Portal.

Metadata include: Name of Applicant (licence holder), mineral group applied for, licence status, validity dates, work carried out and reports available.

Reports:

More than 5200 titles, mostly from mineral exploration, but also other relevant works, such as GSN-reports on mineral deposits, stratigraphy and environmental studies. Reports and related documents pertaining to inactive/historic licences are publicly available under the "Open File" system, while active licence information submitted to the Ministry of Mines & Energy remains confidential ("Closed File") until the licence is relinquished/expired.

Metadata include: Author, report date, number of pages, work done, mineral licence under which the report was generated (where applicable).

Documents:

More than 24000 digital documents, including some 6250 text documents, 11000 maps (geological, geophysical, geochemical, etc.), 4250 bore hole logs and sections, and 2300 data tables mostly from mineral exploration activities, but also from other sources (Fig. 4). Uploaded files include all common Microsoft Office and image formats (e. g. pdf, doc(x), xls(x), ppt(x), jpg, tif), while additional digital material generated by specialised software can be accessed via an external link. The latter information can be viewed/obtained upon request.

Metadata include: Document content, commodity (where applicable), mineral licence.

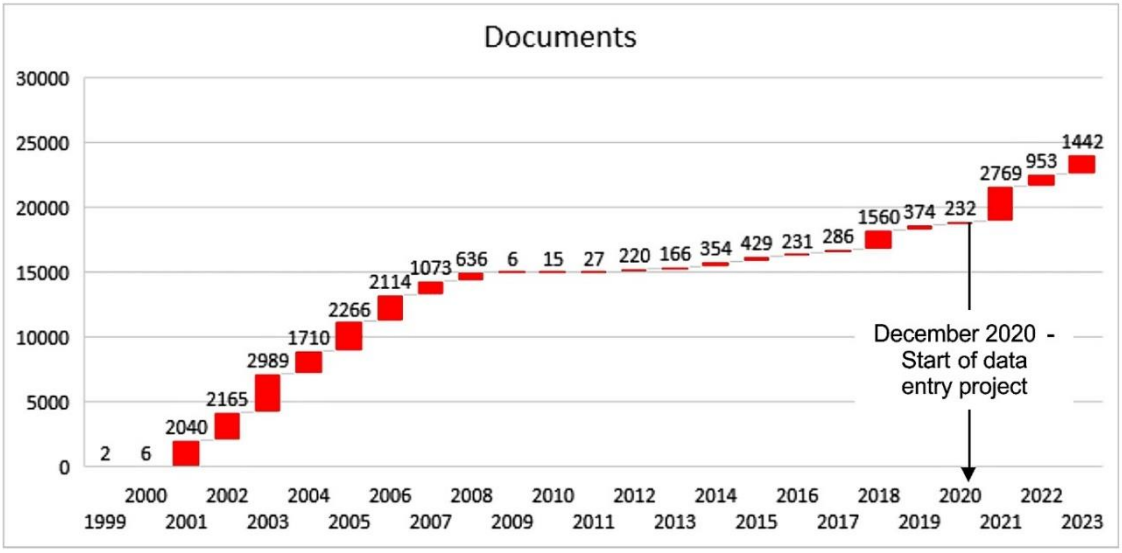

Figure 4. Population history of the "Documents" Module

Mineral occurrences/deposits:

2667 reported occurrences from mineral showings and magnetic / geochemical anomalies to development projects and operating or abandoned mines (Fig. 5); apart from entering new discoveries / anomalies from current exploration activities, major effort is spent on updating and completing existing records with only rudimentary or basic information.

Metadata include: Deposit geology, regional geology, host rock, commodity(ies), ore mineral(s), resources, reserves (if known/applicable), mineralisation type, economic status and spatial reliability of data point.

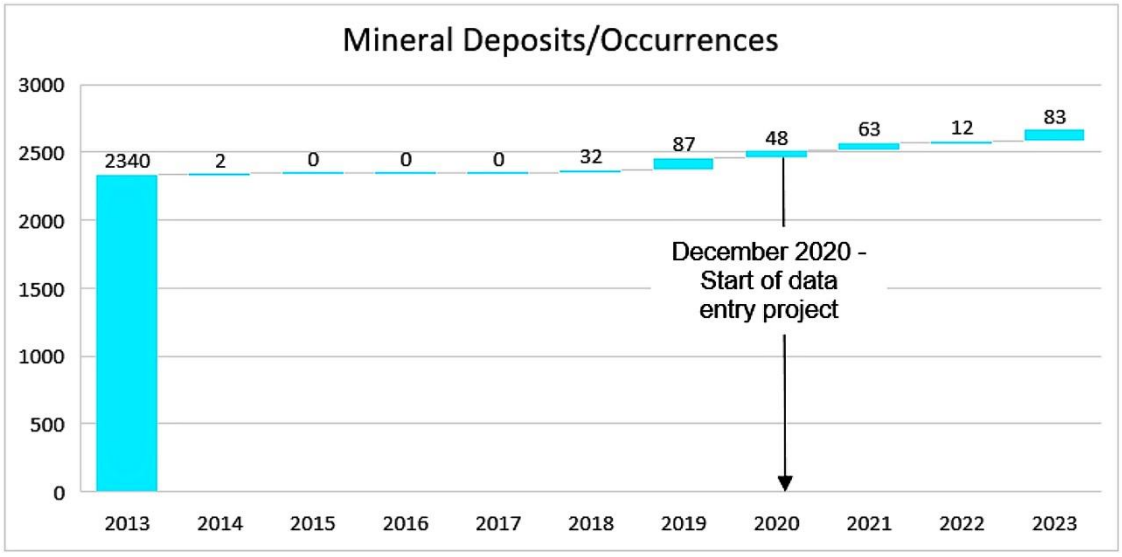

Figure 5. Population history of the "Mineral Deposits/Occurrences" Module

Drill holes:

Water drill holes – 51475 drill holes, many with water analysis, were imported from the Department of Water Affairs' (DWA) GROWAS data base before the launch of EDN; since then 4785 more (some dating back to the early 20th century) have been entered from bore hole completion reports, to bring the current total to 56260 (Fig. 6). Apart from entering bore hole locations and metadata, more than 14 000 bore hole completion reports/logs from GSN and DWA archives were scanned for upload into EDN.

Metadata include: Depth of hole, depth of water strike, yield, spatial reliability of data point.

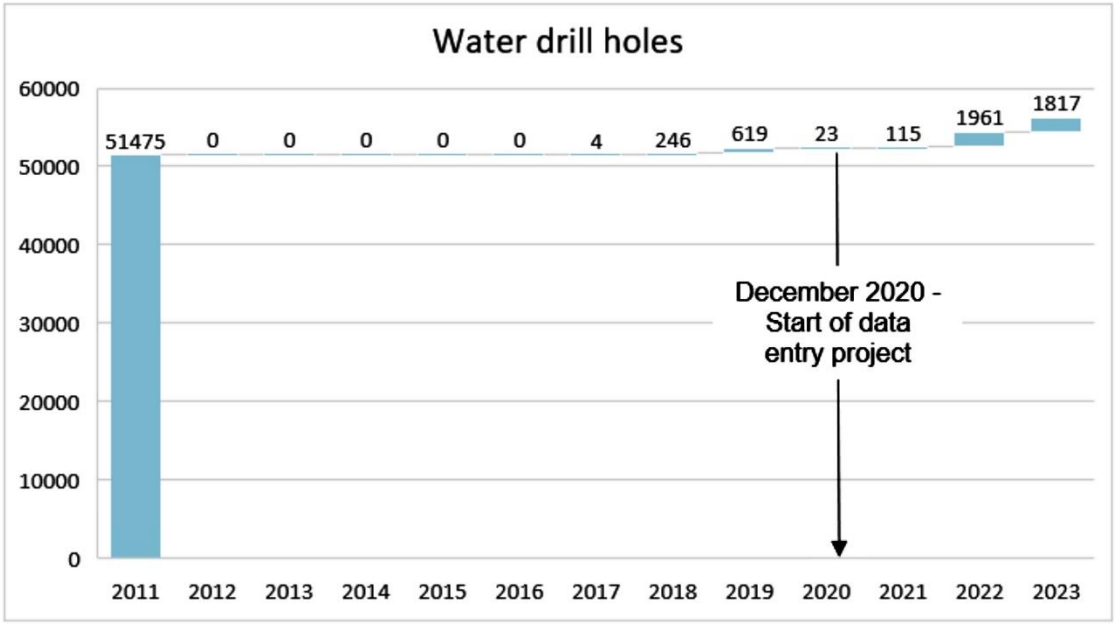

Figure 6. Population history of the "Drill Holes" Module (Sub-module: water drill holes)

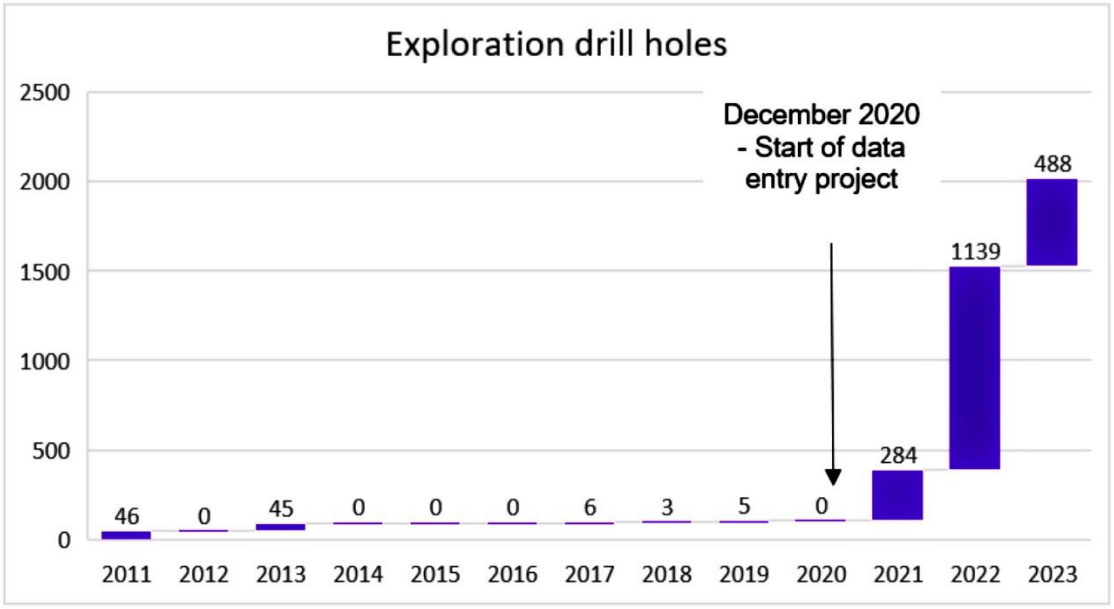

Figure 7. Population history of the "Drill Holes" Module (Sub-module: exploration drill holes)

Exploration drill holes – 2016 records from mineral and hydrocarbon exploration, linked to logs and other relevant information (e.g. down hole surveys, core photographs, drill sections, locality maps), where available (Fig. 7).

Metadata include: Length of hole, inclination/ azimuth, drilling target, drilling method, mineral licence, drilling year, project name, drilling/contracting company, core size, core availability (incl. storage facility/place of storage).

Up to the beginning of the present data entry campaign, very little work had been done on this important aspect of mineral exploration. Considering the vast amount of drilling undertaken in Namibia only over the last few decades, the data currently available in EDN only represent a small portion of the information held by the Geological Survey, but - aided by the complete restructuring of the module involving the separation of water and exploration holes, each new sub-module with its own set of specific metadata – considerable progress has been made during the last couple of years.

Spatial data:

1035 georeferenced geological, geophysical and topographic maps from GSN and exploration surveys, 365 orthophotos and scanned aerial photographs as well as 258 satellite images (ASTER & LANDSAT; Fig. 8). High-resolution imagery is stored at linked server locations outside the data base, owing to their great file size and existing system limitations. Current work on this module included updating of existing records as much as entry of new data. In June 2022, it was temporarily shelved in favour of continuing with the population of the Geochemistry module (see next paragraph), but will resume soon.

Metadata include: Data type, author, production year, map scale and/or image resolution.

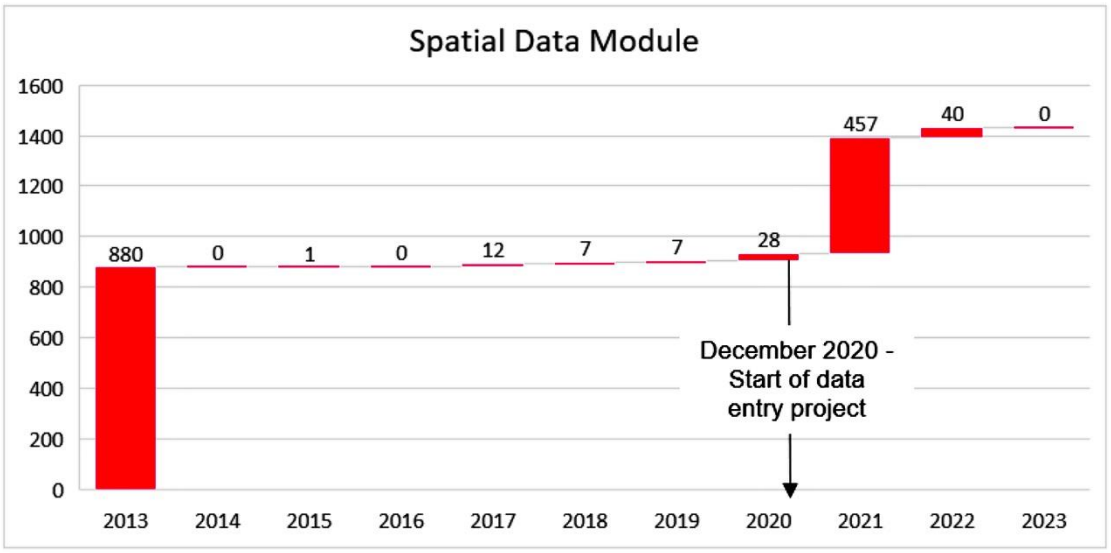

Figure 8. Population history of the "Spatial Data" Module

Geochemistry:

Over 915000 sampling points, predominantly from mineral exploration, but also from regional mapping campaigns, analysed for one to 60 elements (mostly for base metals and/or gold; Fig. 9).

Metadata include: Sample type, fraction analysed, analytical method, sample preparation, laboratory, spatial reliability of data point, sampling year, mineral licence and exploration company (where applicable).

Geochronology:

1651 records from research publications and mapping projects, with concordia diagrams, where available (Fig. 10).

Metadata include: Sample number, age, error, method, material analysed, age interpretation, reference.

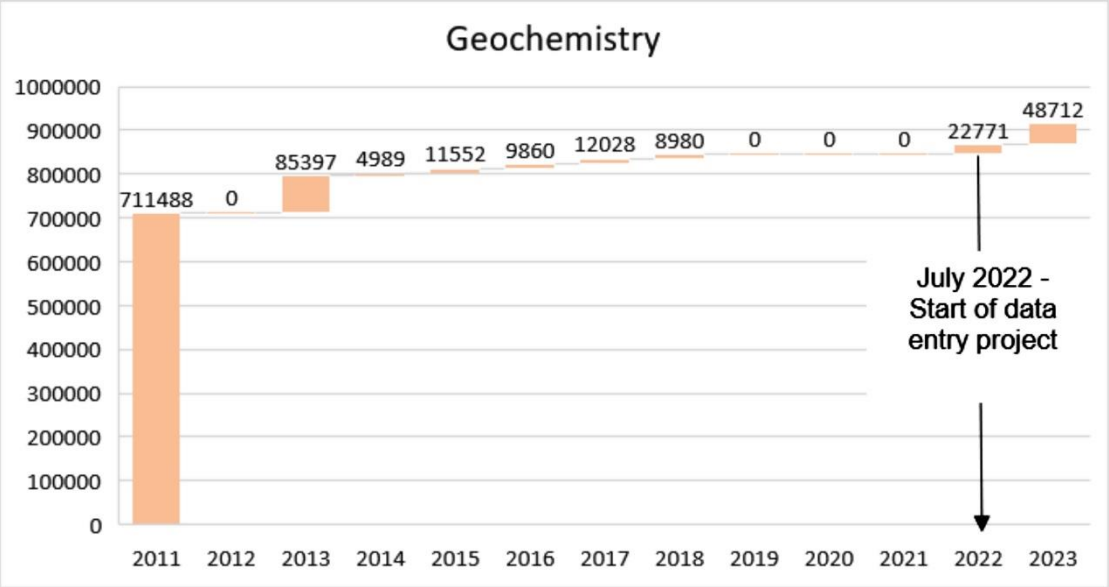

Figure 9. Population history of the "Geochemistry" Module

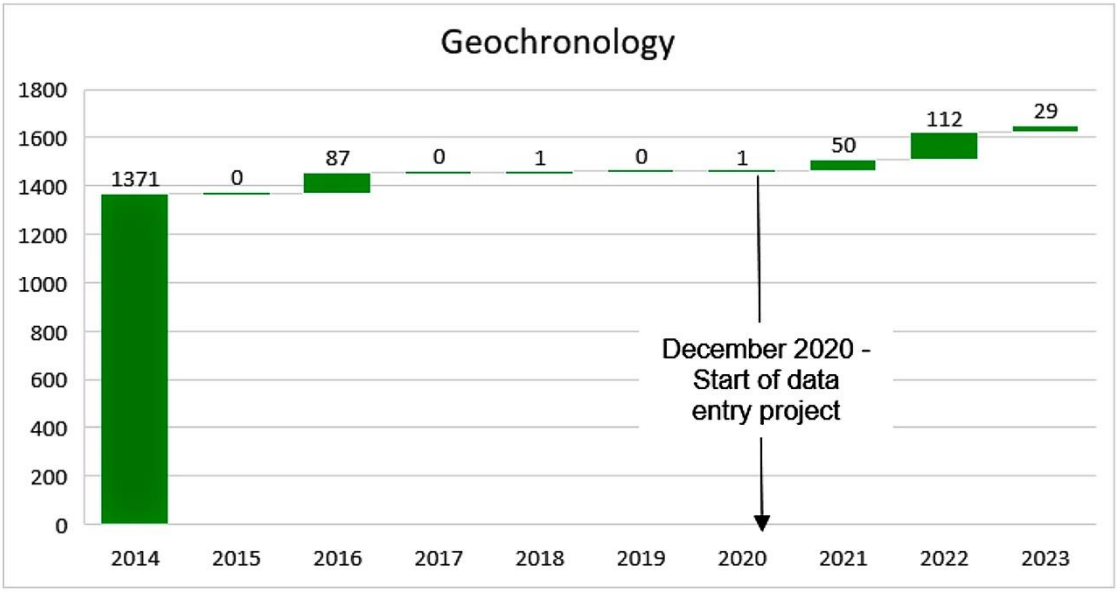

Figure 10. Population history of the "Geochronology" Module

Literature/Documents of Literature:

Nearly 10000 research and review papers, theses, conference abstracts, posters and news articles, with some 4000 linked digital files (Documents of Literature, Fig. 11), predominantly on Namibian geology and related fields, but also on topics of regional/global interest (e. g. geological correlation, mineral economics) and methodology (e. g. GIS technology, geostatistical techniques for the presentation of survey data).

Originally a "stand-alone" module, the latest version of EDN also allows links between mineral occurrences, drill holes and geochronological data points and relevant publications in the "Literature" module.

Metadata include: Author, publication type, title, keywords, publication year, publisher, editor, ISBN/ISSN number and web link (where applicable).

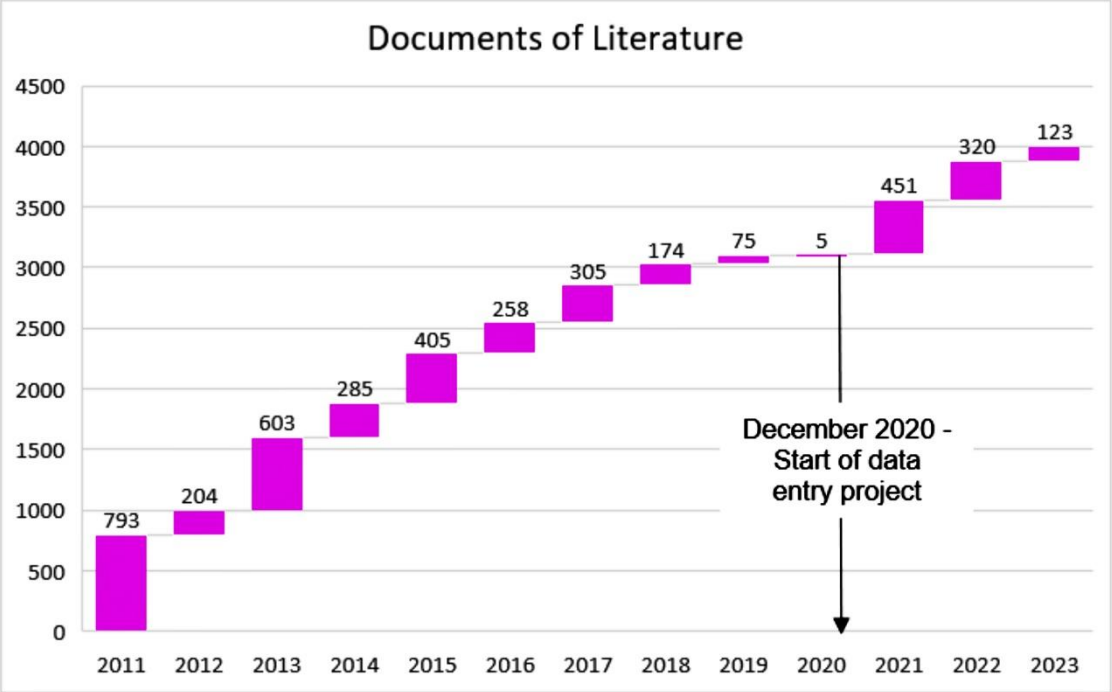

Figure 11. Population history of the "Documents of Literature" Module

Additional features:

Apart from the modules described above, EDN also contains geological vector data at 1:250 000 and 1:1 000 000 scale, a "Field Work" module for internal use to store field data collected by the various divisions and a "Museum" Module to catalogue mineral and fossil specimens held by the National Earth Science Museum and administer inter-institutional lending. Record modification tabs and a "User Administration" module keep track of data entry and quality control, and regulate data access.

Towards the Future

As EDN is increasingly used, both by GSN staff and the public, expectations with regard to software performance and capability also grows. Constant interaction with the developers results in two to three upgrades per year to allow EDN to keep pace with the demands made of it. The latest major modification, i. e. the reprogramming of the so far dormant "Environmental Sites of Concern" module, was implemented in October 2023, and is now in the testing phase; some "fine-tuning" may be necessary as data entry commences to iron out initial shortcomings. The restructured module is designed to contain information on abandoned mines, current mining operations, and any other sites presenting potential or actual geohazards, with links to the "Mineral Deposits / Occurrences", "Documents" and "Documents of Literature" modules.

On an operational level, the GIS component of EDN will move from ESRI ARCGIS to open source Quantum GIS, primarily to provide independence from new ESRI releases and the resultant necessity for recurring system upgrades and adaptations. Initial developing costs for this conversion are expected to be soon equalised by a drop in licence fees for proprietary software, as well as in EDN maintenance expenses.

Although the information contained in EDN is as yet by no means complete and much remains to be done - both in the way of capturing archival information and coping with the steady influx of new data – the current effort has contributed considerably towards establishing EDN as Namibia's number one all-round geoscience data base.