Core Principles and Best Practices for Geological Database

What is a geological database ?

- A structured collection of geological information that is systematically stored and organised and managed for the purpose of supporting resource exploration, modelling, estimation and for making informed decisions. It is for this reason that the database must be authentic.

- When we talk about an authentic geological database we talk about the integrity and validity and consistency of the database

Step	Description
1. Field Observation	Geologists collect raw data in the field (rock samples, measurements, photos, notes).
2. Data Recording	Field data is recorded using notebooks, tablets, or mobile apps with defined lithology codes and locations.
3. Data Validation	Initial review to check for errors, inconsistencies, or missing elements in the field records.
4. Data Entry	Validated data is entered into digital spreadsheets or specialized geological database software.
5. Data Cleaning & Standardization	Data is checked for format consistency (e.g., lithology codes, units) and corrected as needed.
6. Database Integration	Cleaned data is uploaded to the master geological database, ensuring traceability and version control.
7. Quality Assurance	Database managers conduct audits, cross-checks, and backups to maintain data authenticity and reliability.

Core Principles of a geological Database are:

- Accuracy
- Consistency
- Completeness
- Verifiability
- Security
- Scalability
- Intergration
- Compliancy to industrial standards

Core Principles…

- Accuracy
  - Data must reflect true geological conditions
  - Data reflects reality as observed/measured, without alteration.

- Consistency
  - Standardized data entry and formats across all datasets
  - Standardised codes/library
  - Standardised units …ppm, ppb, %, cm, m
  - Lithology names and descriptions
  - Coordinate systems
  - Naming conventions

- Completeness
  - Data should be complete. Inclusion of all critical geological information such as location, sampling, survey results and logs.

Core Principles…

- Verifiability
  - Ability to trace and audit data sources and changes. Includes clear metadata with traceability back to source.
  - Record chain of custody of the data e.g. where was the data collected, how the data was collected and by who on what date.

- Security
  - Protected from unauthorized access or tampering.
  - Should have controlled access
  - Secure backup that is stored off site
  - Secure from viruses and malware

Core Principles…

- Scalability
  - Systems should be able to grow with expanding data needs. Can handle growing datasets from multiple projects/years.
  - For examples use of GIMMS Essentials to later move to a full blown GIMMS database

- Integration
  - Compatibility with other systems and data sources. Able to link or export data to other programs.
  - Should be able to export data into other formats e.g. to csv so that the data can be integrated into a GIS package or other Geological software.

Core Principles…

- Compliancy with industrial standards
  - Adherence to international codes and standards is important.
  - This gives the stakeholders confidence in the data that they are working with.
  - Allows stakeholders to make sound decisions.
  - For most exploration companies this database becomes the most valuable asset.
  - Nonadherence to standards will devalue the project.

  - **Examples of international reporting standards**
  - The Joint Ore Reserves Committee (JORC) Code is an Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves.
    - Sets guidelines for reporting exploration results, mineral resources and ore reserves.
  - NI 43-101 (Canadian National Instrument for Disclosure Standards.
  - SAMREC (South African Code for the Reporting of Exploration Results, Mineral Resources and Mineral Reserves)

What are common database errors/mistakes ?

- Accuracy
  - **Wrong coordinates**
    - due to incorrect GPS setting or
    - using outdated or incompatible coordinate systems
  - **Assay results**
    - Lab QC
    - Standards /CRM insertions, standard selection
    - Poor assay data handling
    - Poor selection of standards / not compatible standards
  - **Downhole Surveys, structural measurements, Recoveries etc.**
    - Poor measuring techniques
    - No core orientation
    - Not recording orientation data correctly (e.g., dip vs dip direction confusion)

What are common database errors/mistakes ?

- Consistency
  - Using inconsistent lithological codes, abbreviations, or descriptions
  - Inconsistent logging by different geologists due to lack of standardized training.
  - Mixing units (ppm, ppb vs %; feet vs meters).
  - Interpreting geology in the field instead of recording what is observed
  - Sampling / Log errors
    - Data capture errors
    - Overlapping intervals
    - Missing intervals
    - Duplicate intervals
    - Biased sampling technique (e.g. high grade/low grade)

What are common database errors/mistakes ?

- Completeness
  - Inadequate or incomplete critical information such as chain of custody information, metadata
  - Missing sample intervals

- Verifiability
  - Field records (photos, notes)
  - Track of data changes – changes made by, for what reason
  - Track all QAQC failures
  - Keep all field data and logistic reports safe for reference and checks
  - Keep core / samples / pulps where possible for verification

What are common database errors/mistakes ?

- Security
    - Unauthorised access or modification of the data which might compromise the integrity of the database
    - Loss of data due to accidental deletion
    - Corrupted files caused by hardware failure or software bugs. Failures in the backup or restoration process causing complete loss of the database
    - Wrong tech for your operating conditions Technological/Software Issues
    - No network security (No protection for viruses and malware)

What are common database errors/mistakes ?

- Scalability
  - Selecting a low resource computer that cannot accommodate growth of the database
  - Choosing database management system that has a restricted number of tables, fields or records

- Integration
  - Failure to extract data out of the database in a usable format
  - Failure to load data into a GIS

What are common database errors/mistakes ?

- Compliancy with industrial standards
  - No database audits
  - No QAQC
  - No adherence to compliance standards

Best Practices/ Solutions…

- Establish standard operating procedures (SOPs) for data collection and entry.
- Train field staff in consistent logging and coding standards. Encourage a “record what you see, not what you think” philosophy.
- Create templates with libraries or lookup tables and validation rules to reduce data entry errors.
- Survey all locations or control points
- Downhole survey drill holes
- Regular QAQC checks on assay and geological data.
- Keep track of all QAQC failures and mitigations

Best Practices/ Solutions…

- Choose a suitable database management system for your environment.
- Commitment to core principles ensures database credibility
- Controlled access to the server
- Have a data recovery plan in place in case of loss of data
- Periodic audits of the database against original field notes.
- Periodic database audits by a competent person.

Rock codes / Library – field notes – for consistency

ULTRAMAFIC

U		UNDIFF. ULTRAMAFIC

Igneous Terminology

UD		DUNITE
UP		PERIDOTITE
UX		PYROXENITE
UK		KOMATIITE

Mineralogical Terminology

US		SERPENTINITE
UM		UNDIFF. U/MAFIC SCHIST
UT	UTe	talc rich
	UTr	tremolite rich
	UTh	chlorite rich
	UTc	carbonate rich

MAFIC

Extrusive

MV		UNDIFF. MAFIC VOLC.
MB		BASALT
	MBt	Tholeiitic
	MBk	Komatiitic
	MBa	Alkali
MA		AMPHIBOLITE
MT		MAFIC TUFF
	MTg	Agglomerate
	MTa	Ash Tuff
	MTl	Lapilli Tuff

Intrusive

MI		UNDIFF. MAFIC INTR.
MD		DOLERITE
	MDk	Karoo Dyke
	MDp	ARCH./PROT. DYKE
MG		GABBRO
	MGn	Norite
	MGa	Anorthosite
	MGt	Troctolite
	MGl	Leucogabbro
	MGx	Taxitic gabbro

FELSIC

Extrusive

FV		UNDIFF. FELSIC VOLC.
FT		FELSIC TUFF
	FTg	Agglomerate
	FTa	Ash Tuff
	FTl	Lapilli Tuff

Intrusive

FI		UNDIFF. FELSIC INTR.
FG		GRANITOID
	FGg	Granite
	FGa	Adamelite
	FGt	Tonalite
FP		FELSIC PORPHYRY
	FPq	Quartz
	FPf	Feldspar
	FPqf	Quartz Feldspar
FM		PEGMATITE
FL		APLITE

INTERMEDIATE

Extrusive

IV		UNDIFF. INTERMEDIATE VOLC.
	IVa	Andesite
	IVr	Rhyolite
	IVd	Dacite
IT		INTERMEDIATE TUFF
	ITg	Agglomerate
	ITa	Ash Tuff
	ITl	Lapilli Tuff

Intrusive

II		UNDIFF. INTERMEDIATE INTR.
	IId	Diorite
	IIg	Granodiorite
IP		INTERMEDIATE PORPHYRY

METAMORPHIC/TECTONIC

X		UNDIFFERENTIATED
XS		SCHIST
	XSa	Aluminous
	XSq	Quartz
	XSs	Sedimentary
	XSi	Intermediate
	XSm	Mafic
	XSf	Felsic
XN		GNEISS
XM		MYLONITE
XK		SKARN

SEDIMENTS

S		UNIFF. SEDIMENTS
SR		CHERT
SB		BIF
	SBc	Cherty BIF
	SBf	Oxide BIF
SG		CONGLOMERATE
SS		SANDSTONE
	SSq	Quartz
	SSf	Arkose
ST		SILTSTONE
SH		SHALE
	SHg	Grey
	SHb	Black
SW		WACKE
	SWp	Pebbly
	SWg	Gritty
SA		SLATE
SP		PHYLLITE
	SPq	Quartz phyllite
SQ		QUARTZITE
SL		LIMESTONE
	SLc	Calcitic
	SLd	Dolomitic
	SLm	Marl
SM		MUDSTONE

SOIL COVER/ REGOLITH

O		UNDIFFERENTIATED
OA		ALLUVIAL
OB		BLACK COTTON
OC		CALCRETE
OY		CLAY
OL		COLLUVIAL
OD		DURICRUST
OF		FERRICRETE
OG		GRAVEL
OM		MBUGA
OR		RESIDUAL/SURFICIAL SOILS
OS		SAND
OT		LATERITE
OP		SAPROLITE
	OPu	Upper Saprolite
	OPl	Lower Saprolite
OZ		MOTTLED ZONE
OV		OVERBURDEN
OX		SILCRETE

MISCELLANEOUS

MIN		MINERALISATION
GO		GOSSAN
Q		QUARTZ
	Qv	Vein
	Qs	Stockwork
	Qt	Stringers
BX		FAULT BRECCIA
SZ		SHEAR ZONE
CB		CARBONATE

QUARTZ VEIN TYPE

Q	UNDIFF. QUARTZ
Qc	Clear Quartz
Qm	Smokey Quartz
Qo	Opaque Quartz
Qg	Sugary Quartz

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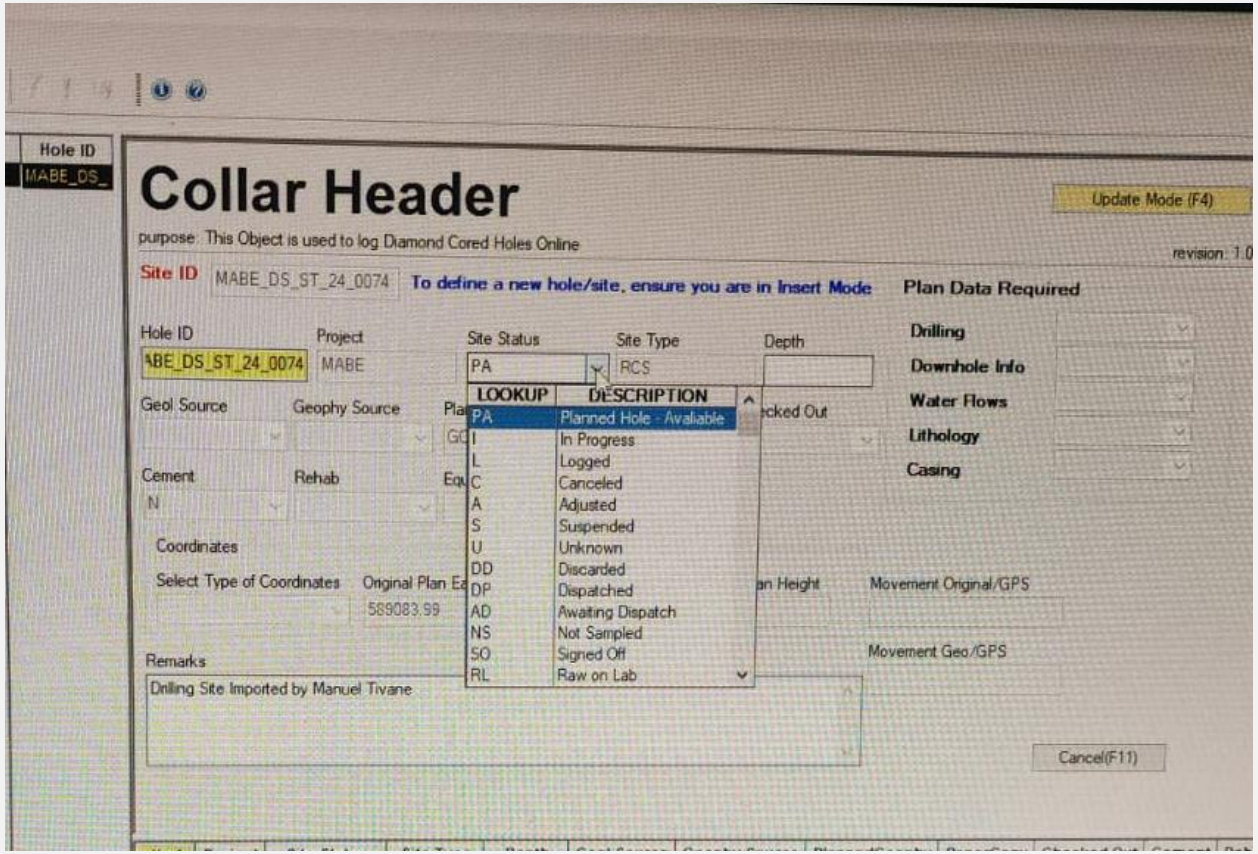
Consistency – look up table



Validations – plot your data as you go along

Outcomes of authentic databases

- Reliable databases enhance the accuracy of geological models. Your model is as good as your data. A good database increase the value/credibility of the resource.
- Facilitates transparent and defensible resource estimates
- Supports regulatory compliance and reporting requirements
- Critical for stakeholders for informed decision making
- Supports easy collaboration and knowledge sharing among stakeholders (geologists, engineers etc.)
- Continuous improvement in data protocols strengthens organizational outcomes.

THANK YOU

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