

DATA INTEGRATION AND MACHINE LEARNING ON THE UNCONFORMITY-RELATED URANIUM MINERAL SYSTEM OF ATHABASCA BASIN

First attempt of construction of an integrated 3D geomodel

Marion PARQUER

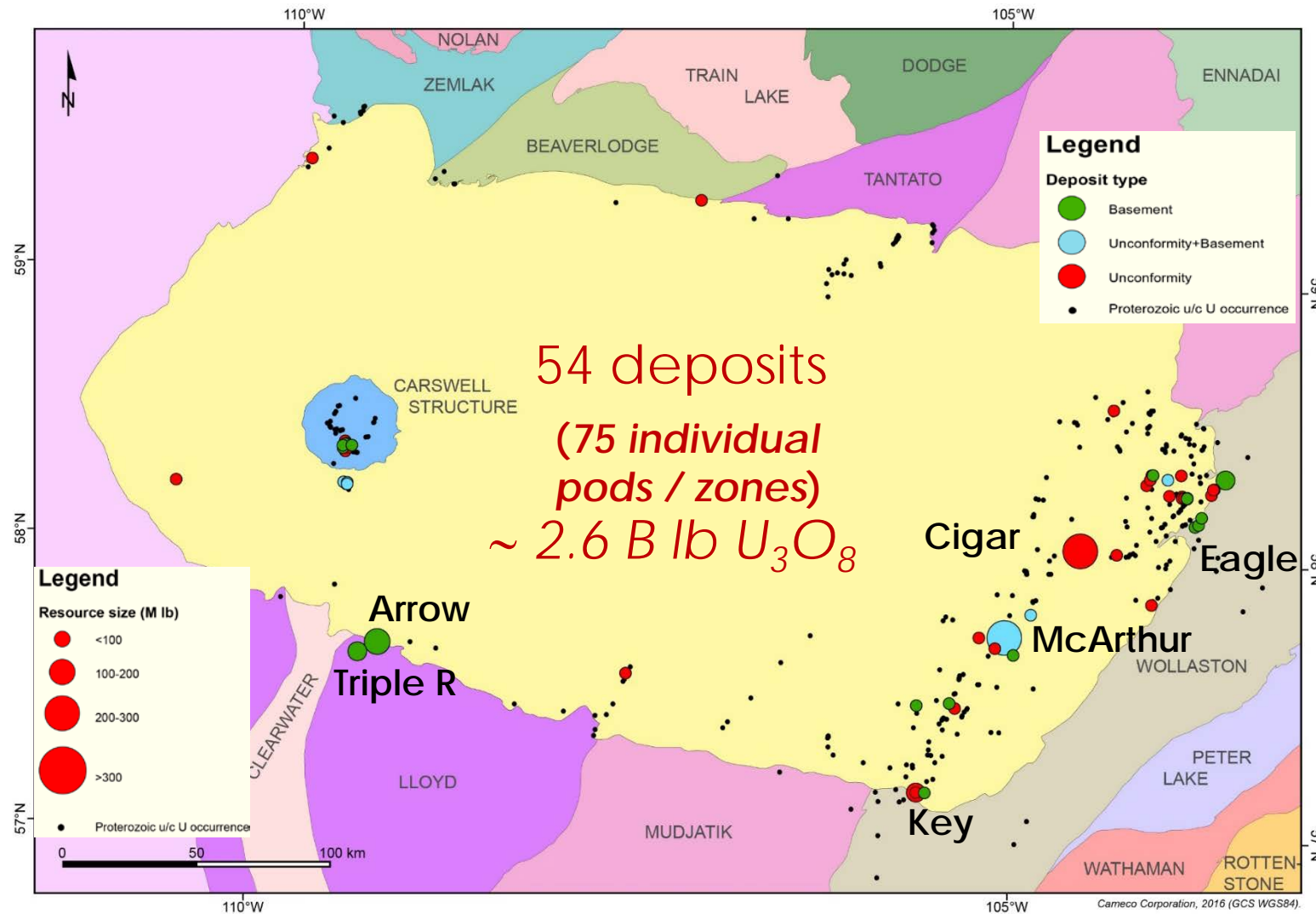
Patrick LEDRU

Anthony LE BEUX

Paul MARCHAL

Introduction

- **Quantity** and **variety** of data collected along the years of exploration and exploitation in the Athabasca Basin
- **Industrial & Academic** datasets
- Need to precise the **location** of the U mineralization
- Need of a **3D model** to visualize the data
- Machine learning to explore the **potential correlation** of analyses with U

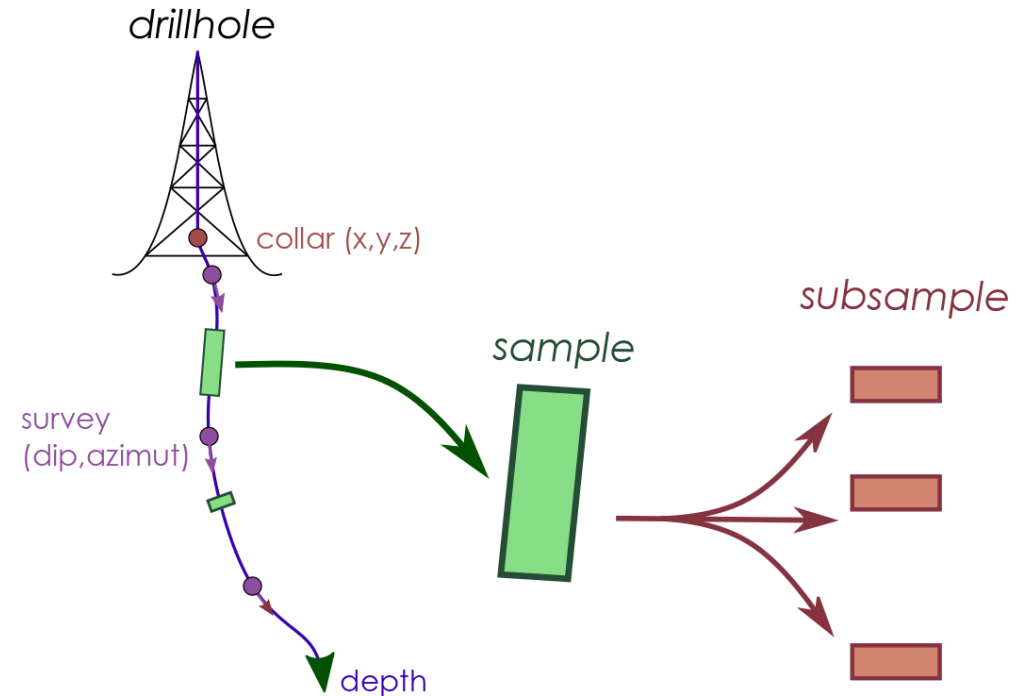


Research data integration & valorisation

➔ Huge amount of academics datasets acquired within joint-projects (Orano/UL) are only available through published papers

Help to integrate joint-project datasets into databases :

1. Good practices **guidelines** : explicit naming, international standards, duplicates minimization : FAIR principles
2. Standardized **data templates** : sampling metadata & analysis data
3. **Data integration tools** : historical data, new datasets, extraction tools



Research data integration & valorisation

1. Controlled input interface development

Help geologists to build a single database-friendly file for each academic project

The screenshot shows a web application interface for project metadata entry. At the top, there are three main navigation tabs: 'HISTORICAL DATASETS INTEGRATION', 'NEW DATASET FILE CREATION' (highlighted in green), and 'JODEL'. Below these are several buttons: 'Create New', 'Open & Modify', 'Save Project', 'Export to CSV', and 'test'. A secondary navigation bar includes 'General Project Metadata' (highlighted in yellow), 'Samples Metadata', 'Storage Metadata', and 'identities data'. To the right of this bar are two 'Browse...' buttons, both showing 'No files selected.'. The main content area is titled 'Project general Metadata' and contains a form with the following fields:

Field Name	Value
PROJECT_NAME	test
DATA_DESCRIPTION	test_
KEYWORD	URANIUM@
KEYWORD2	URANIUM_TEST
LANGUAGE	ENGLISH
TITLE	TEST_1
INSTITUTION	TEST&
INSTITUTION2	test_é
SCIENTIFIC_FIELD	GEOLOGY.
SCIENTIFIC_FIELD2	GEOCHEMISTRY
PROJECT_COUNTRY	CANADA
PROJECT_PROVINCE	SASKATCHEWAN

Research data integration & valorisation

2. Semi-automatic testing of historical datasets

Help geologists to compile & format old datasets

MainWindow
Project Files Quality Object Scan

File Tree

- header
 - VAN15000897.CSV
 - CREGU Terraspec Sa...
 - mesures de densit+...
 - mesures de densite ...
 - McDonough and Sun ...
 - 610-1.csv
 - 610-2.csv
 - 610-3.csv
 - 612-1.csv
 - 612-2.csv
 - 612-3.csv
 - 8-1.csv
 - 8-10.csv
 - 8-12.csv
 - 8-13.csv
 - 8-14.csv
 - 8-15.csv
 - 8-16.csv
 - 8-17.csv
 - 8-18.csv
 - 8-2.csv
 - 8-3.csv
 - 8-4.csv
 - 8-5.csv
 - 8-6.csv
 - 8-7.csv
 - 8-8.csv
 - 8-9.csv
 - MSTMSK.csv
 - 18-1.csv
 - 18-2.csv

File View Object Tables Object View

Tests results for each files Test files quality

	open	header	delimiter	samples	extension	group	path
VAN15000897.CSV	True	False	True	True	CSV	header	C:...
CREGU Terraspec Sample Analysis.xls	True	False	nan	True	xls	header	C:...
mesures de densit+®.xlsx	True	False	nan	True	xlsx	header	C:...
mesures de densite wc313.xlsx	True	False	nan	True	xlsx	header	C:...
McDonough and Sun 89.xlsx	True	False	nan	True	xlsx	header	C:...
610-1.csv	True	False	True	True	csv	header	C:...
610-2.csv	True	False	True	True	csv	header	C:...
610-3.csv	True	False	True	True	csv	header	C:...
612-1.csv	True	False	True	True	csv	header	C:...
612-2.csv	True	False	True	True	csv	header	C:...
612-3.csv	True	False	True	True	csv	header	C:...
8-1.csv	True	False	True	True	csv	header	C:...
8-10.csv	True	False	True	True	csv	header	C:...
8-12.csv	True	False	True	True	csv	header	C:...
8-13.csv	True	False	True	True	csv	header	C:...

Object Tree

- 1
 - WC473
 - WC372
 - WC313
 - WC422
 - WC448
 - WC610
 - WC335
 - WC612
 - SF 371-05
 - SF 371-05-445_9
 - SF 732-05
 - SF 732-05-450_4
 - U 382
 - U 382-68
 - U 382-76_6
 - SF 731-05
 - SF 731-05-445_9
 - WC426
 - WC449
 - WC731
 - WC737
 - WC896
 - WC900
 - WC902
 - WC910
 - u382
 - u382-23,8

project name nb_files nb_folder

0 0 0

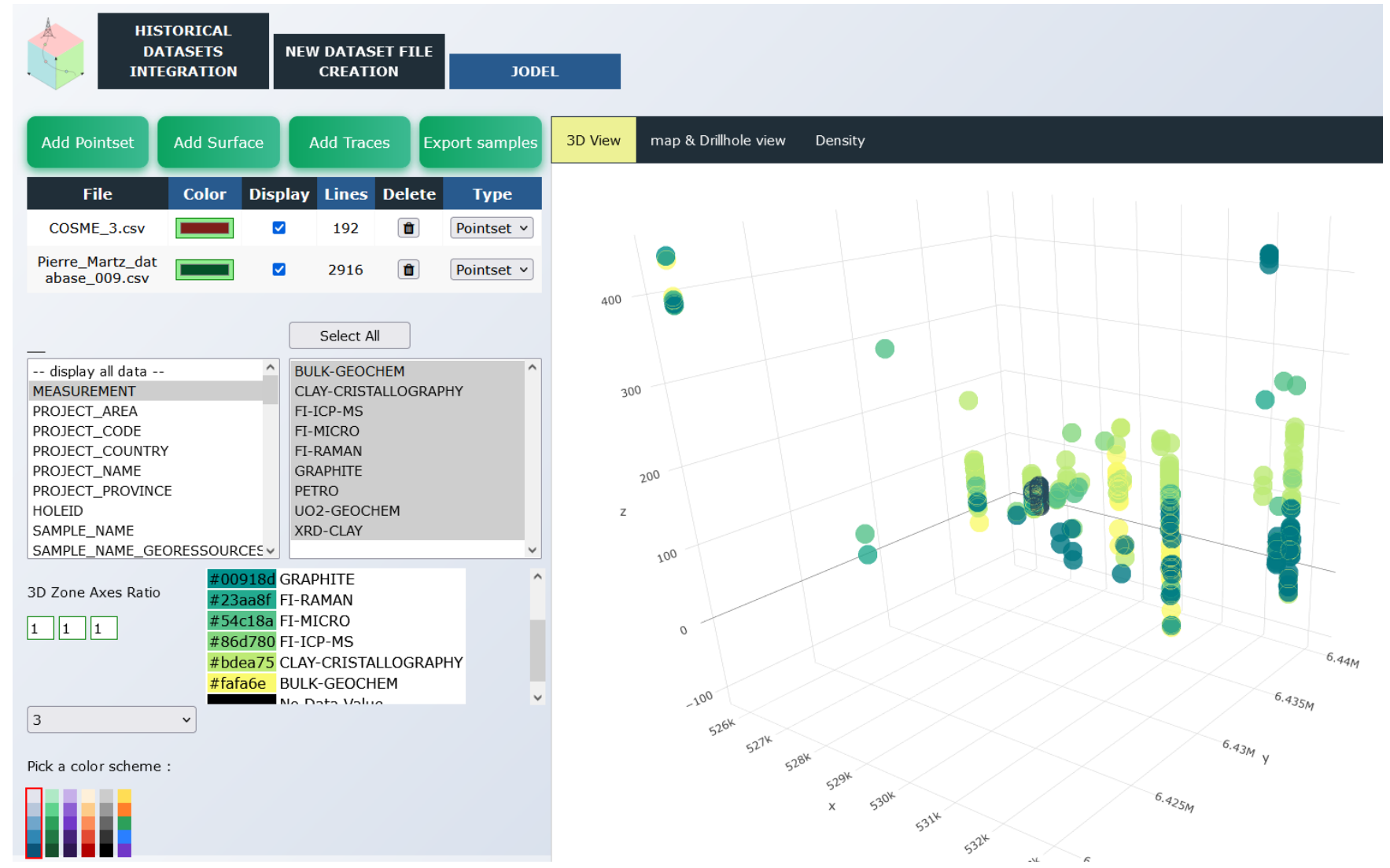
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Research data integration & valorisation

3. Datasets visualisation tool

Help geologists to compare data available in georeferenced space

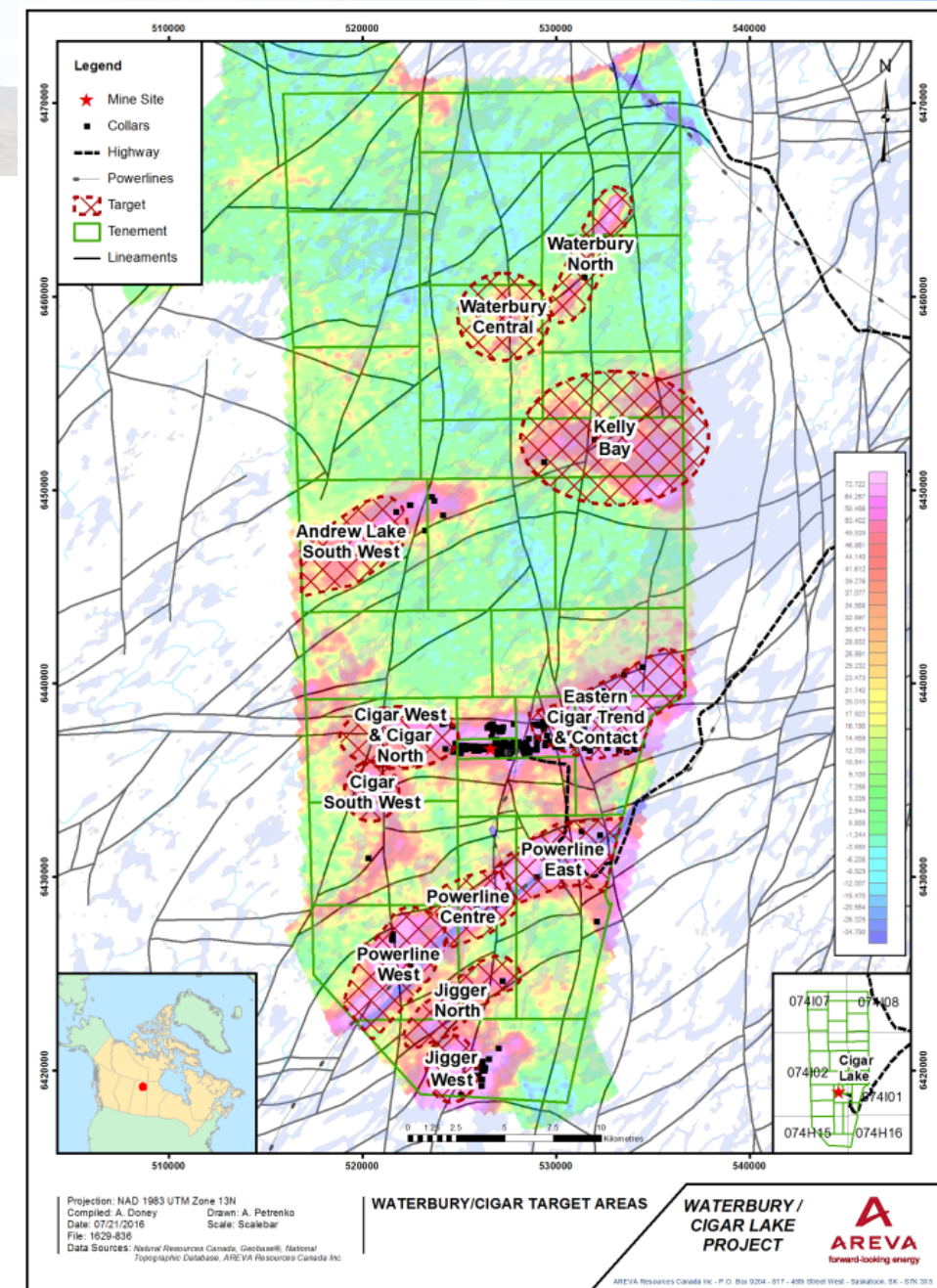
Datasets :
Pierre Martz, 2015
Martin Quessandier, 2021



Database collection

- Waterbury Cigar region
- 975 drillholes with **multiple analysis**: lithology, alteration, orientation of structures, geochemistry, spectral data
- Geophysical surveys
- 3D geological models

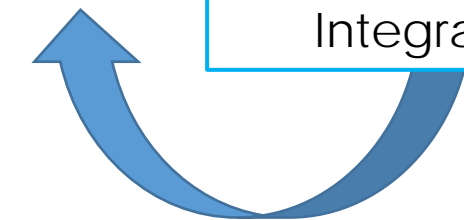
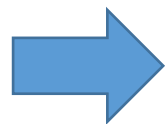
➔ Need of an **integrative tool** permitting to **visualize** and **analyse** several kind of data simultaneously



Workflow

Input data:

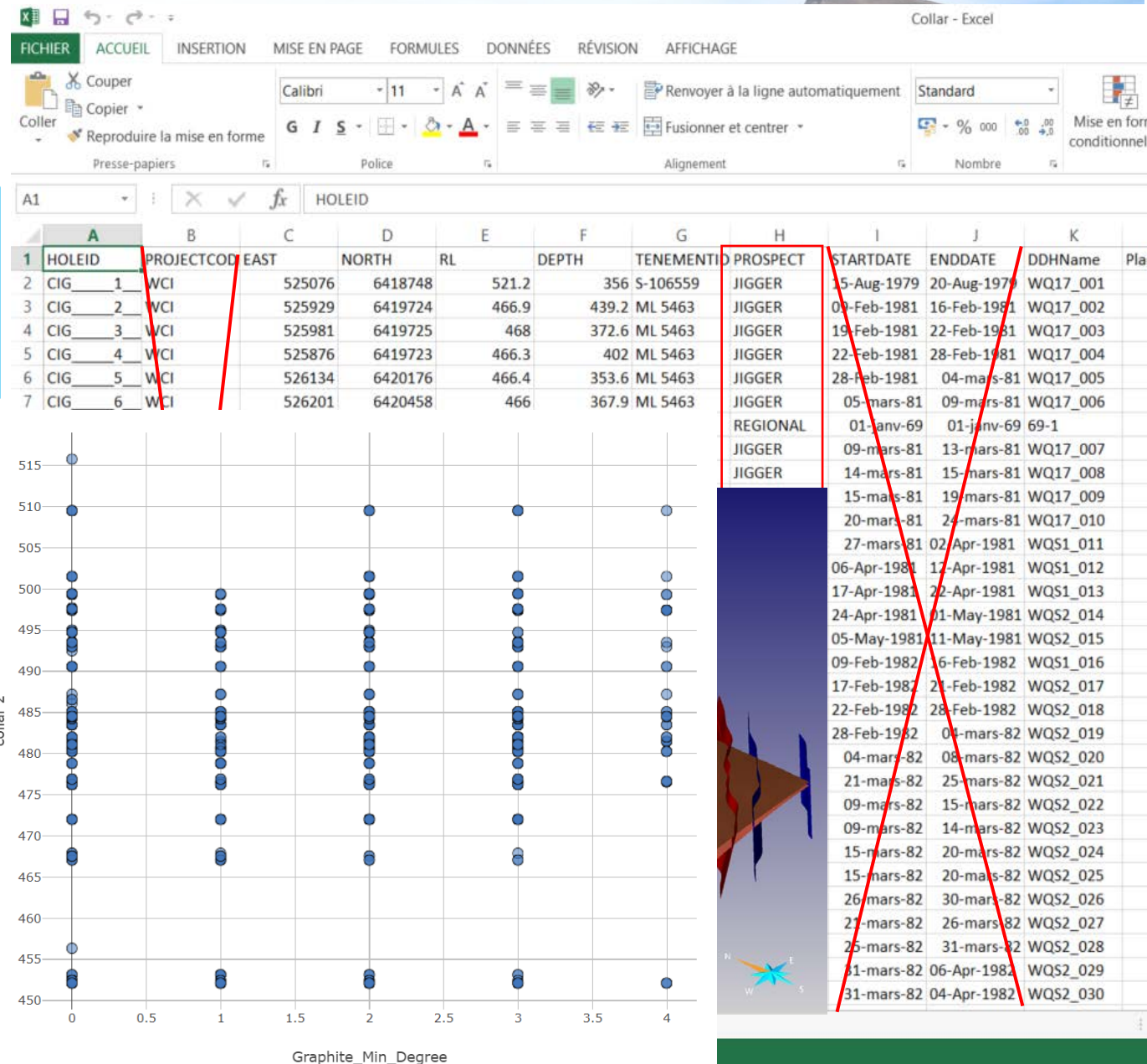
- **Geographic and topographic datasets**
- 3D surface of the **unconformity and geological map**
- **Geophysical data**
- **Drillhole** campaign with locations and attached **geological/geochemical properties**



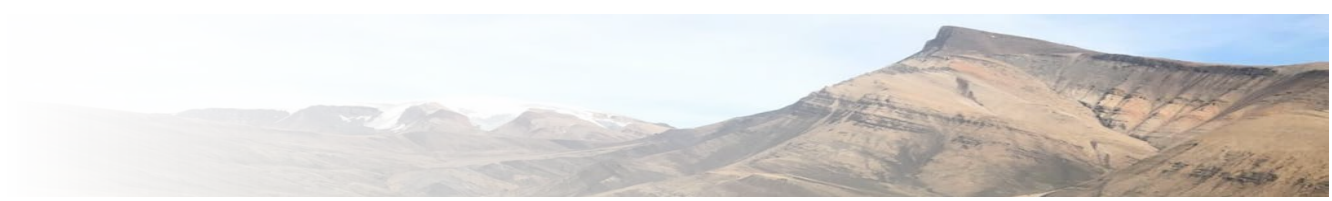
Integration into one platform
Geoscience Integrator

QA / QC

- Remove unnecessary columns
- Creation of classifications
- Management of missing data
- Uniformization of units



Data integration



- Data import into private server of **Geoscience Integrator**
- AcQuire database

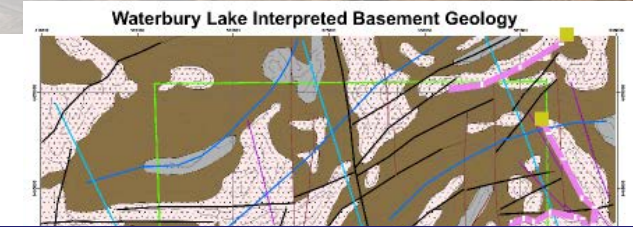


The screenshot shows the Geoscience Integrator web interface. At the top, it displays 'Project: Universite de Lorraine' and 'Theme: Drillholes & wells'. The user 'Marion Parquer' is logged in. A left sidebar contains navigation options: Data set explorer, Data set search, Data fusion, Reporting, Forms, Import, Tags, File manager, Document library, Maps/plans/sections, and Project settings. The main content area is titled 'Data sets (tables)' and shows a grid of data set summaries for 'drillholes':

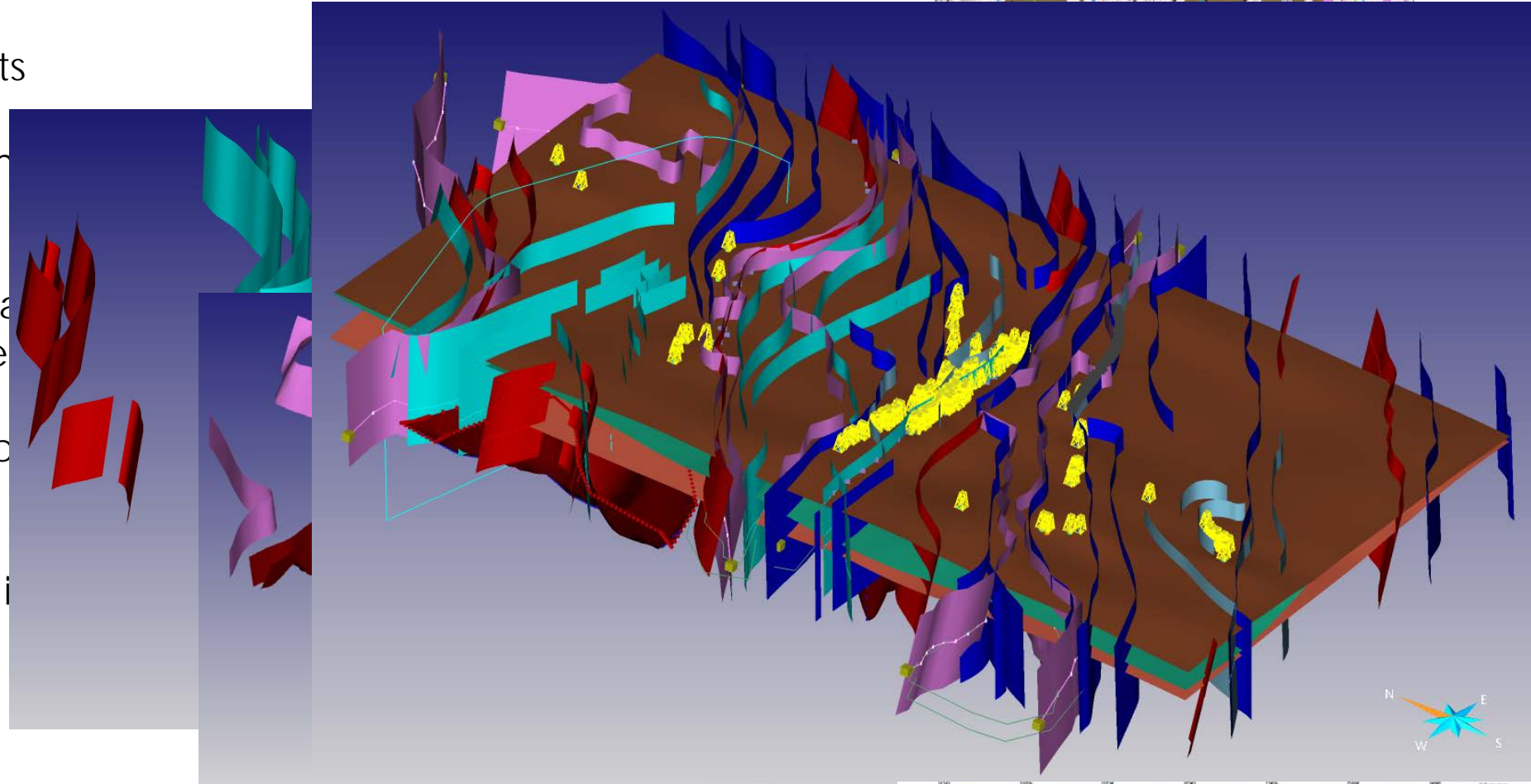
- Neighbourhoods (0)**: none
- Tags (0)**: none
- Files/maps/documents (0)**: none
- Properties (315)**:
 - Mandatory fields**: drillhole ID, x (m), y (m), z (m), length (m)
 - Path fields**: drillhole ID, distance (m)
- Data set range**: x: 520307 to 535690, y: 6418748 to 6463094, z: 449 to 522
- Drillholes & wells (737)**: Showing first 100 only. List includes CIG_100, CIG_101_A, CIG_101, CIG_102, CIG_103, CIG_104, CIG_105, CIG_106, CIG_107, CIG_108.

Construction of an integrated 3D geomodel (in progress)

AIM: provide a general spatial framework inside which studying spatial heterogeneity of various properties thanks to IA methods



- 1) Modelling the main faults
- 2) Modelling the unconformity and drillhole info
- 3) Extracting the outcrops and unconformity (interpreted)
- 4) Simulation of facies propagation from the unconformity
- 5) IA methods application in the model



Conclusions and perspectives



- **Academic datasets** : tests on new projects
- **Geosciences integrator**, a useful tool to collect, visualize and integrate data
- A **first 3D model** is in construction using drillholes and interpreted maps at the unconformity
- Need to integrate **geophysical** and **geochemistry** data
- A comparison of integrated data with Footprints data on **MacArthur Millennium** lineament is planned

Thanks for your attention

