BENOÎT CRÉPIN • *Lille 1 University, France* • *2013*

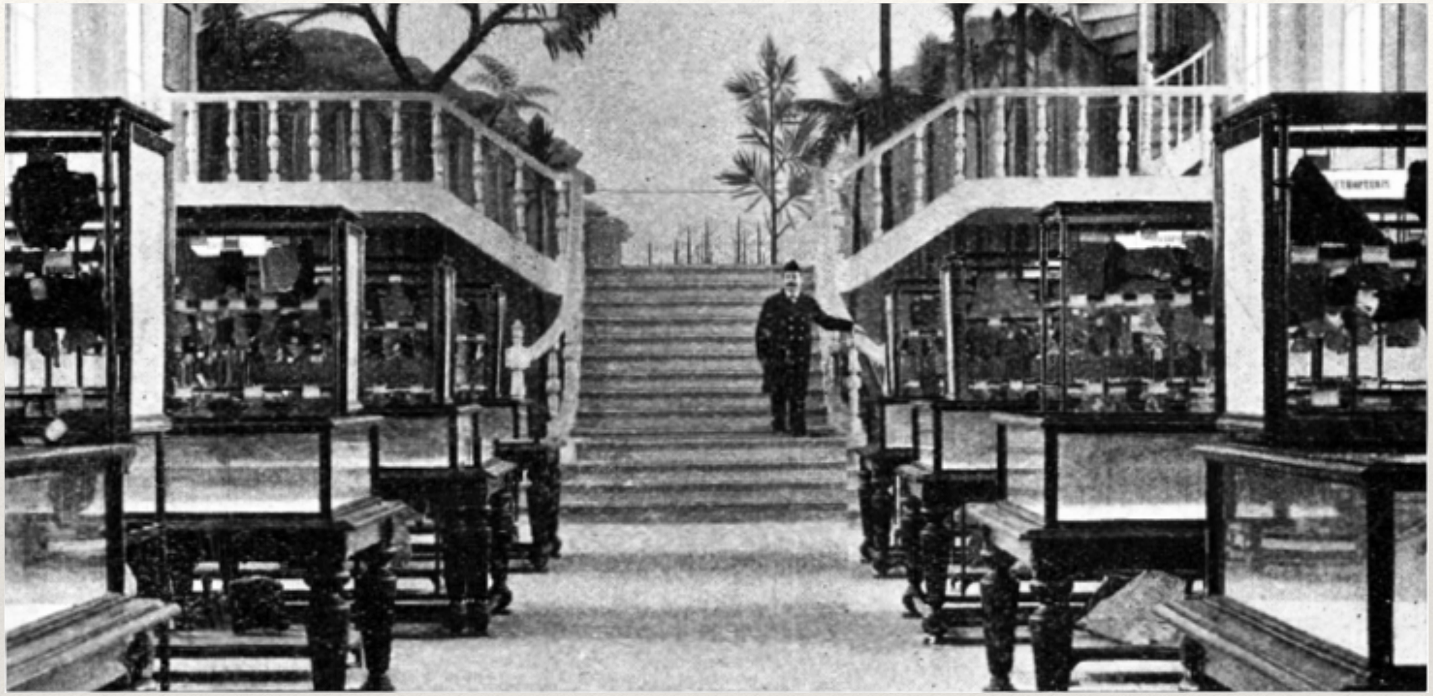
From a "Glass Table" to a 3D model of the coal basin

3D Modelling In the coal basin of Nord-Pas-de-Calais, France

Based on historical data from Lille Natural History Museum : The ***"Glass Tables"***

Student Structure Prize 2013

*At the turn of the twentieth century, in Lille, northern France, a new museum, called the **coal museum of Lille University**, was inaugurated.*



The Coal Museum in 1909 – General View
From "Lille et la région du Nord en 1909" printed by L.Danel

*The most important objects, then, were eight **"Glass Tables"** designed and built to show a model of the regional coal basin .*

*They were made up of several **vertical glass panels**, evenly spaced, on which North-South **cross-sections** of the coal basin of Nord-Pas-de-Calais had been drawn. An **horizontal glass map** was laid on top of them.*

The eighth Glass Table
Still exhibited today in Lille Natural History Museum

Only one remains exhibited at the museum nowadays, but four of them are stored dismantled in the collections.

3D Modelling : Objectives

The main aim of this ***MOVE®*** *modelling project was to build a* ***3D model of the structures*** *within the coal basin of Nord-Pas-de-Calais, thanks to the cross-sections and the maps constituting the glass tables.*

The goal was, on the one hand, to ***preserve*** *this heritage, and, on the other hand, to* ***interpret*** *the structures of the represented parts of the basin and* ***compare*** *it with the present knowledge.*

Beyond the geological and scientific aspects, this modelling work involves a ***patrimonial*** *interest by contributing to maintain or to increase the interest for these more than hundred-year old scientific instruments.*

The "Glass Tables" : a brief history

Henri Küss (1852-1914)
Chief engineer of the mines of Douai

Charles Barrois (1851-1939)
Founder of the coal museum of Lille University

In **1905**, **Henry Küss**, chief engineer of the mines of Douai (northern France), designed eight glass tables covering the entire regional coal basin (100 km x 36 km) , at a **scale of 1:10,000**.

Charles Barrois (1851-1939), professor of geology in the university of Lille and member of the Pontifical Academy of Sciences ordered their construction. He wanted them to be the masterpiece of the **coal museum of Lille University** (inaugurated in 1907).

The "Glass Tables" : a brief history

They have been exhibited for the first time at the **world's fair of Liège** (Belgium) in 1905.

3D Modelling Process – Step 1

The first step of the modeling process was to **digitize the glass panels** using a digital camera, mounted on a tripod.

Once acquired, the data, represented by **450 photos**, has been processed, and then, **assembled** (7 shots for each cross-section panel). A **panoramic shot** of 80 Mpx was finally obtained for each of them.

Example of digitized cross-section

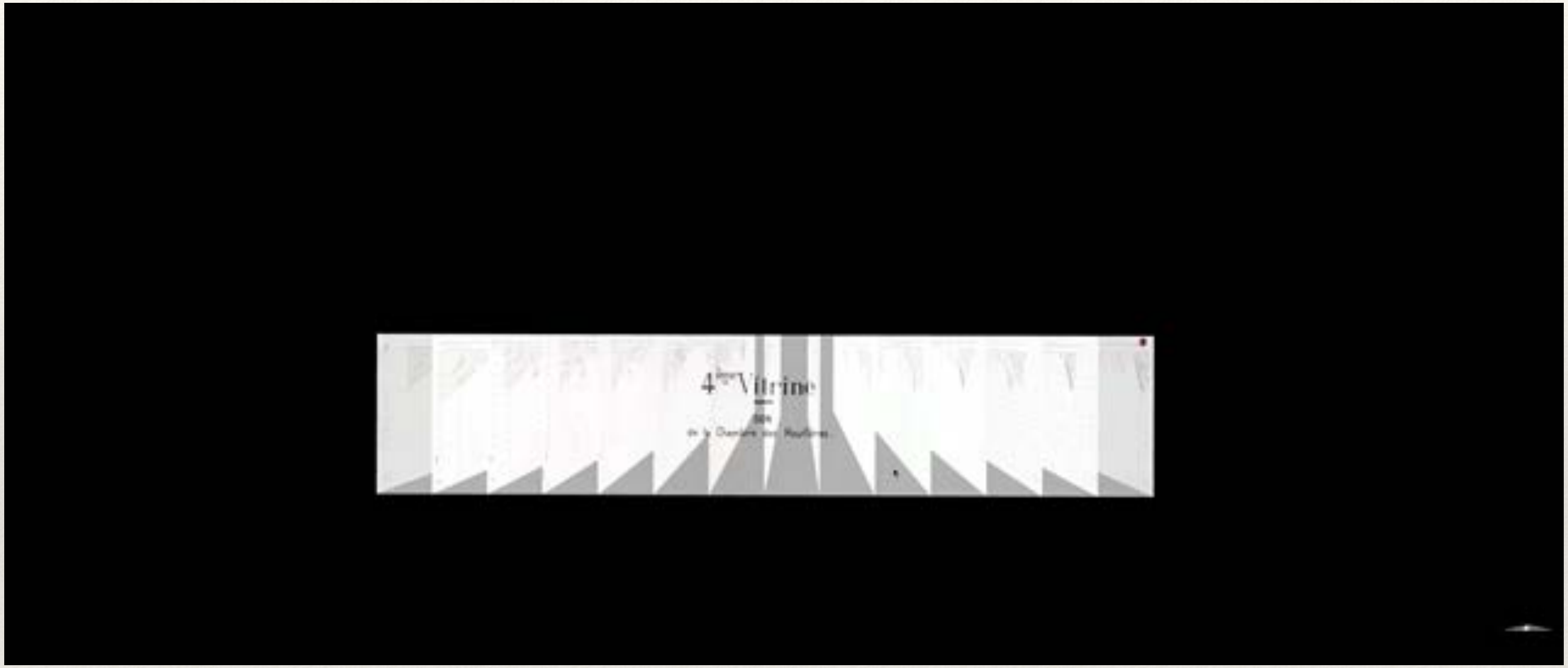
Student Structure Prize 2013

3D Modelling Process – Step 2

The next, and one of the most important step, was to **import the photos into Move®**. After opening the image of the horizontal map, the horizontal cross-sections were located on the map and associated with the corresponding images of the vertical glass panels.

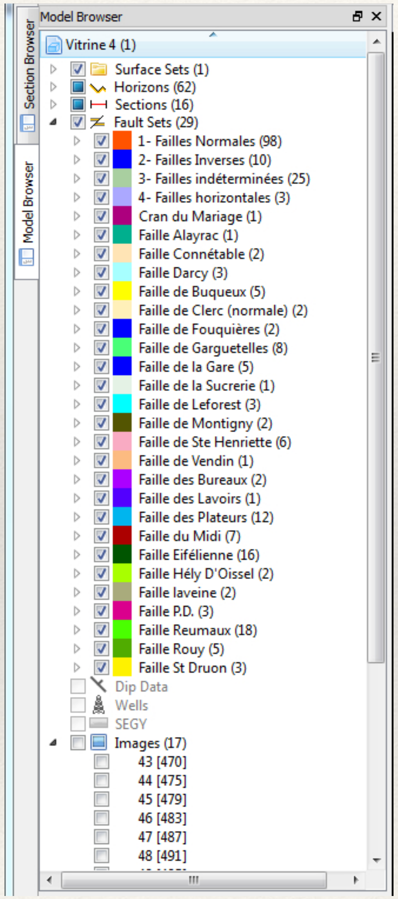
The result of this work is a first 3D model of the actual glass tables, virtually rebuilt thanks to Move®.

3D Modelling Process



This video shows an overview of the **interaction** that can be obtained with Move® after having generated the 3D model. The transparency option let see through the glass panels, as it would be in reality.

3D Modelling Process – Step 3



All digitized faults in the software interface

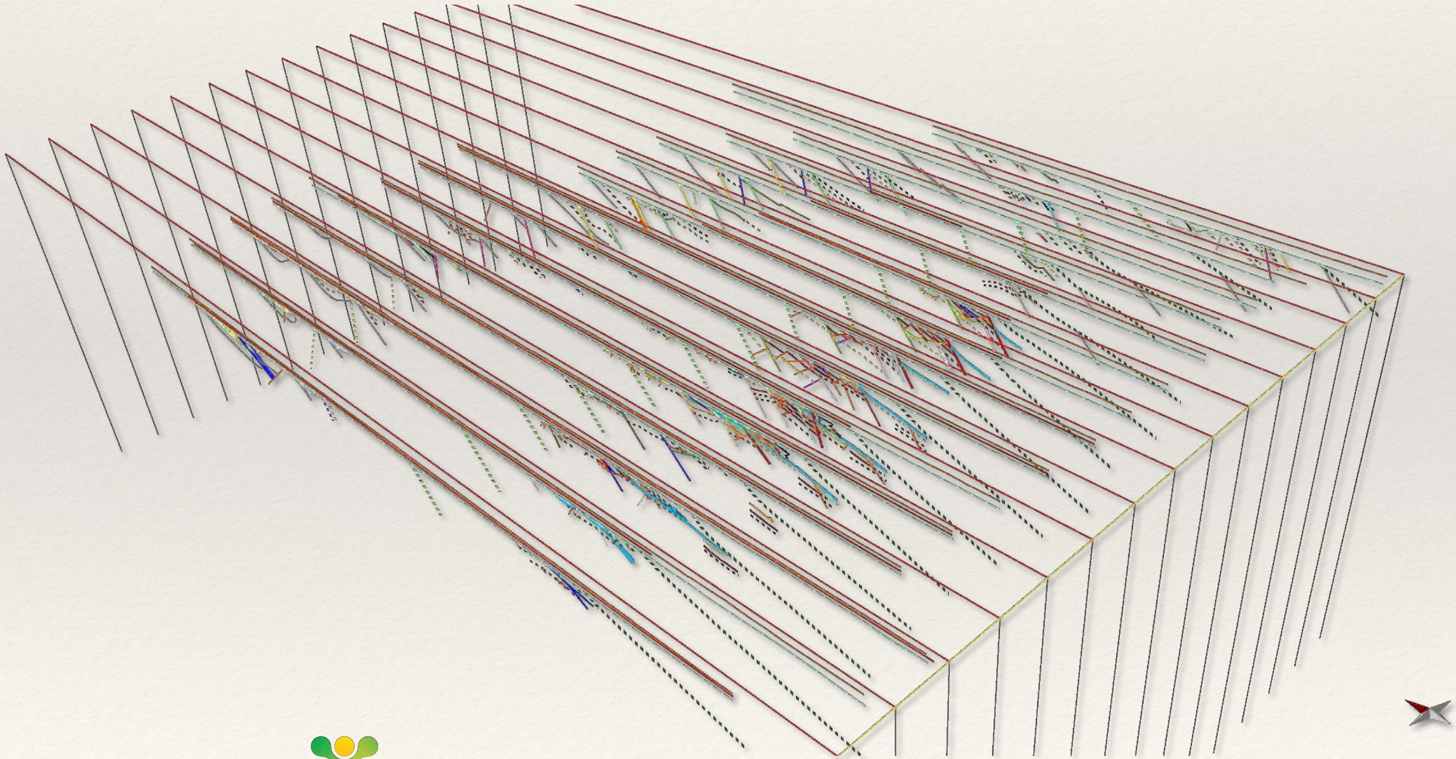
After having generated these simple, but already useful 3D models, **faults have been digitized** on each cross-section shot, indicating their type (normal, reverse…) and sometimes their name, if one had been given by regional geologists.

The real-time update of the 3D view, when adding faults on the 2D images, made it possible to observe the **lateral succession** of the same faults that exists among the cross-sections of a same table.

Used to virtually rebuild the dismantled glass tables, Move® really showed himself to be the tool that gave a "second birth" to these objects.

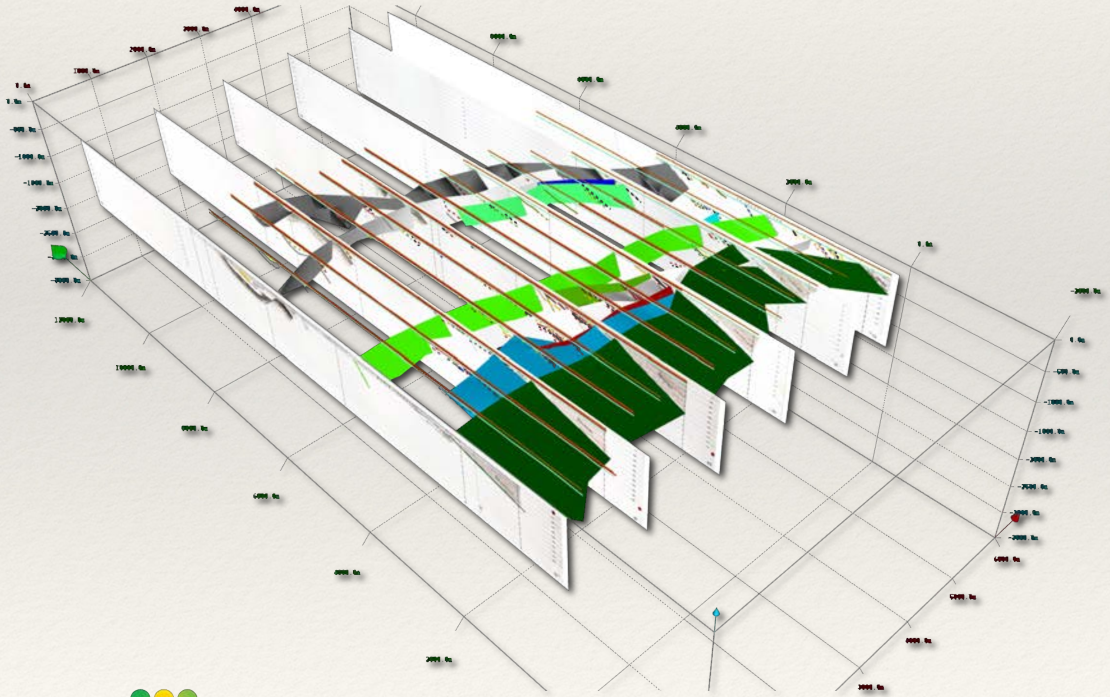
3D Modelling Process – Step 4

As for faults, **coal beds** have been digitized using, this time, the **"Horizon" tool**, combined with a **stratigraphic file** indicating their names and most important features, when available (age, type of associated rock…).



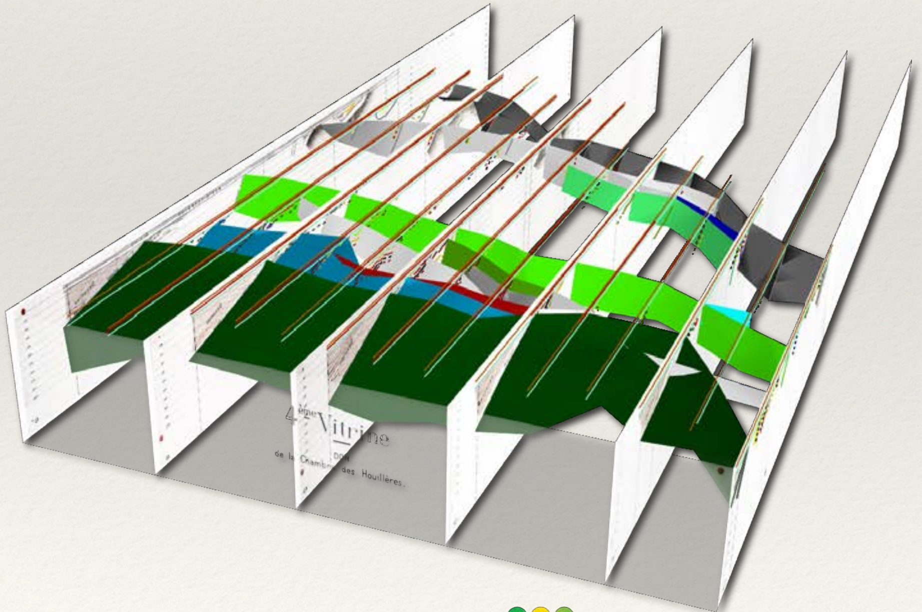
3D Modelling Process – Step 5

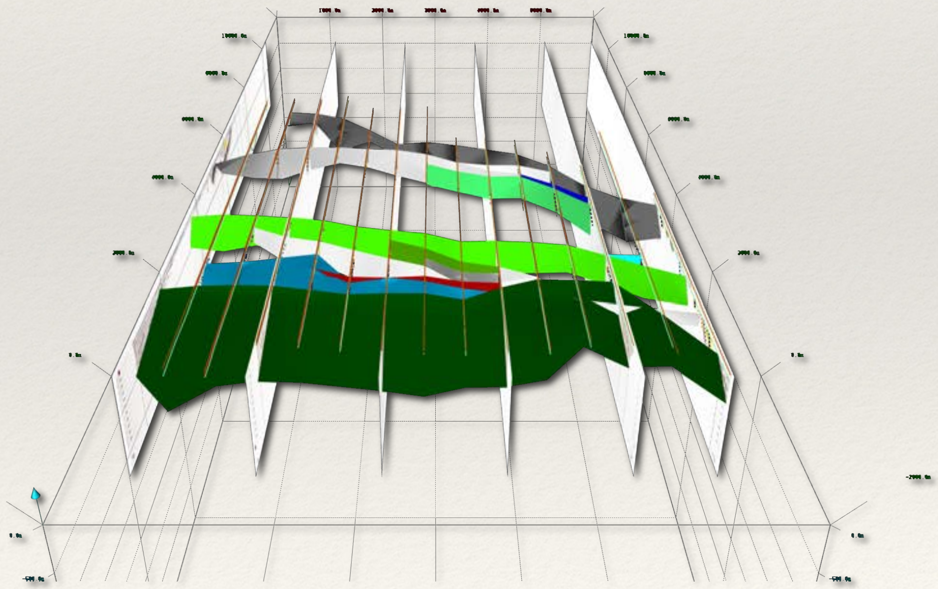
The final step of the 3D modeling process, was to **generate surfaces** for faults and coal seams, using the **"Surface" tool**. The repeated faults or veins were firstly selected and then used to create the surface, thanks to the corresponding functionality of the software.



3D Modelling Process – Step 5

The final 3D models obtained is a combination between a simple 3D model (the assembly of the images of the horizontal glass map of a table and its vertical cross-sections) and a **powerful digital model**, presenting faults and coal veins. It enables the user to display or hide each digitized object and to set up many of its features as opacity, color or representative symbol. It makes it possible to combine the photos composing each glass table with the digital representation of the geological features they represent.





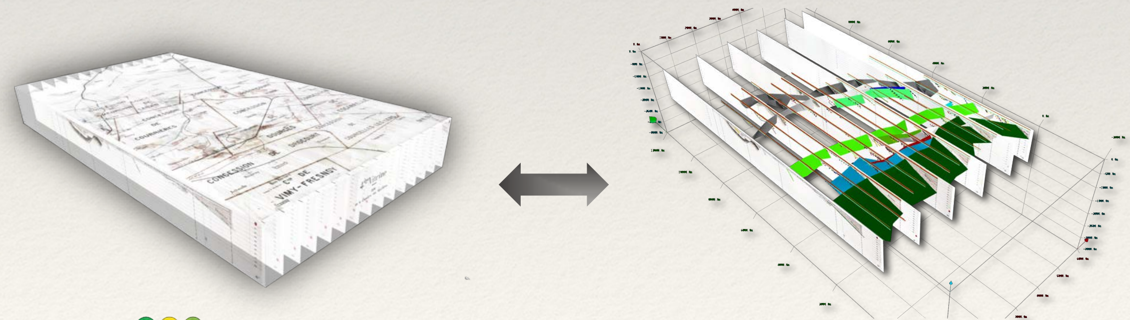
Model interpretation and interests

As mentioned before, the first interest of this 3D modelling process using Move® is to re-build the tables virtually. It helps to **visualize** anew the structures, which were not highlighted anymore, because of the disassembly of the tables. This powerful tool gives us the opportunity to **study** the coal basin of Nord-Pas-de-Calais in a really simpler and more instructive way than conventional cross-sections.

Model interpretation and interests

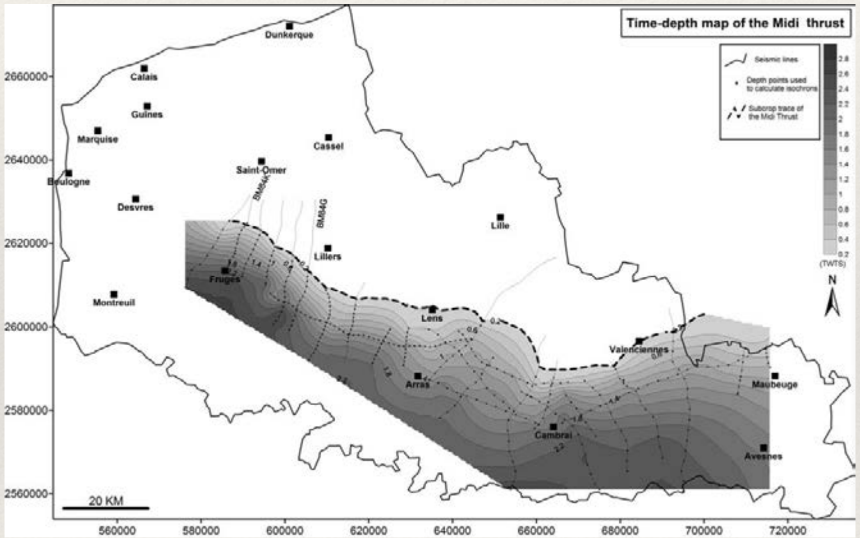
Furthermore, the ability to digitize the structures implies **multiple interests**. The first one is the possibility to order the faults and veins structures. These important elements of the model appear sometimes with different names or colors on the historical cross-sections. So this 3D modeling process is an opportunity to understand the **link** that may exist between some of them and that was not obvious on independent cross-sections.

Then, the model generated with Move® lets us **compare** the historical data from 1905 with the recent knowledges about the regional coal basin. One century ago, the technical means were so different from today, that we could expect major differences or mistakes between the former interpretations of the structures and the reality of the geology of the coal basin, discovered more recently.



Model interpretation and interests

The **divergences** are actually minimal, only **one major issue** has been discovered. The fault, called in french **"Grande faille du Midi"**, (southern limit of the coal basin, linked with an overlapping event) has been interpreted as a **normal** fault, whereas it is in fact well known, nowadays, as an huge **inverse** fault.



Time-depth map of the main Variscan frontal thrust (Midi fault)
(after Minguely, University Lille 1, 2007)

*The reason why this mistake has been made, is **still not clear**. The name given to the fault that appear on the cross-section may not be the good one, or maybe the veins, appearing on both sides of the fault and leading to an interpretation of a normal tectonic structure, are in fact independent.*

Model interpretation and interests

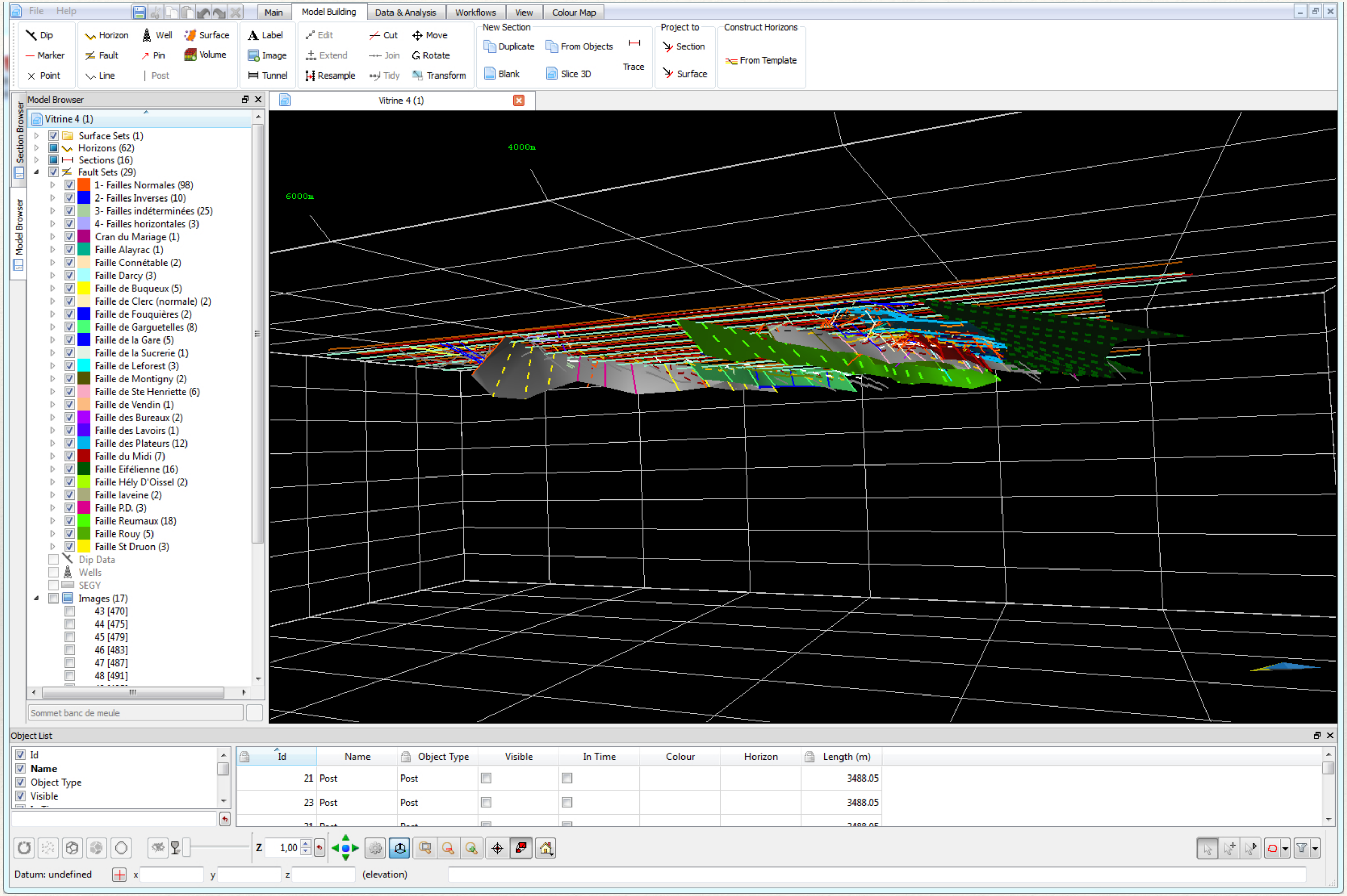
Thirdly, beyond these scientific and geological aspects, the 3D model building has an **historical interest**, linked with a legacy aspect. Indeed, the photographing process of the glass cross-sections and then the building of a digital 3D model of these historical tables, is a way to back up the data they represent, which may be lost, one day, because of their fragility and age.

Furthermore, the glass tables were in a way **forgotten** and unknown from many people nowadays, so this modelling project appears to be an excellent mean to give a **new interest** for these unique historical scientific tools.

Conclusion

Move®*, thanks to its powerful features, gave us the opportunity to build an* ***accurate 3D model*** *of the structures of the coal basin of Nord-Pas-de-Calais as they appeared to scientists a century ago. It is a great help to* ***understand the tectonic processes*** *that led to the formation of this important coalfield, exploited for nearly 300 years and that has consequences, still today, on the economy and cultural distinctive features of our region.*

But beyond these scientific aspects, the main unexpected interest of Move®, is to let draw attention on ***scientific heritage*** *by giving us the possibility to* ***back up*** *and even improve historical data, that may have been lost if this digitalization had not been possible thanks to Move®.*



Student Structure Prize 2013

Contacts

Student :

Benoît Crépin

Student, Lille 1 University of Science and Technology, France

benoit.crepin@etudiant.univ-lille1.fr

http://www.univ-lille1.fr/Accueil/contacts/

Université Lille1 Sciences et Technologies

Academic Supervisors :

Fabien Graveleau

Associate Professor, Lille 1 University, Géosystèmes Laboratory

fabien.graveleau@univ-lille1.fr

http://tecmodweb.free.fr/TecMOD_France/Geosysteme_Lille.html

SGN

Thierry Oudoire

Head of the geologic collections, Lille Natural History Museum

toudoire@mairie-lille.fr

http://www.lille.fr/cms/accueil/culture-lille/Musees-et-expositions/Musees/musee-histoire-naturelle

Musée d'Histoire Naturelle de Lille