Stratigraphic Modeling Tools in MineSight Part 1

MineSight has great triangulation and block model creation and manipulation tools, and they get a lot of coverage at seminars and in Mintec's monthly newsletter. Often overlooked though are MineSight's excellent stratigraphic modeling tools. Many assume that they are for coal mining only, and not much use elsewhere. Yet MineSight's stratigraphic modeling tools have many applications beyond coal mining. In this three-part series we will highlight the main features of stratigraphic modeling, why you might use it, and how.

What is stratigraphic modeling?

Stratigraphic modeling is used to model sub-horizontal surfaces and seams, and is generally employed in sedimentary deposits like coal, diamonds and sands (mineral or oil). Globally, many operations use stratigraphic tools to model chemical deposits, like bauxite and nickel laterites.

Governing the creation of a stratigraphic model is the Law of Superposition, defined by the Danish scientist Nicolas Steno in 1669. This states, "assuming there has been no complex folding, reverse faulting or thrust faulting, then the oldest rocks are at the bottom and the youngest at the top". (Figure 1). This is important because it enables the modeler to make assumptions about the geology of a stratigraphic sequence, and interpolate data over long distances between drillholes. What is required however is a good understanding of an area's geology, which is why geologists working on stratigraphic deposits tend to spend more time logging and mapping than geologists in non-stratigraphic deposits.

Figure 1 The Grand Canyon, a good place to observe stratigraphy in all its glory.

WHERE CAN STRATIGRAPHIC MODELING BE USED?

The main application of the stratigraphic tools is in coal mining to generate a seam model from drillhole data. In the next issue, we will look at how this works in more detail.

But there are also non-coal applications. Many operations use MineSight's stratigraphic tools to generate inclined or undulating mining floors. These are commonly shallow sedimentary or chemical deposits where normal bench mining would not be efficient. Instead, the mining floors are designed to maximize the digging depth, while maintaining optimal floor gradients so that trucks and equipment can maneuver safely.

Surface modeling can also have applications in non-stratigraphic areas, such as pit optimization or topographic surface management. Large Gridded Objects (LGOs) have taken over some of the surface management tasks that were historically done with surface models. However, surface models currently have more interpolation and mathematical manipulation tools than LGOs. In the third edition of this series we will look at this type of application in more detail.

STRATIGRAPHIC MODELING IN MINESIGHT

Surface models are also known as Gridded Surface Files, (GSF) and are 2D models. The XY grid is defined by the Project Control File (PCF) while the file has multiple items that can hold the elevation of a grid node. One of the great advantages of a surface model over an LGO is that you can create any kind of item required. You could have grade or slope information stored to it as well as elevation. Because you can have multiple items on a surface model, an XY node can contain multiple elevations, something that MineSight Economic Planner (MSEP) uses to store multiple pit shells. Surface models can be made and used in a 3D Block Model (3-D) type project or a Gridded Seam Model (GSM) type project, which makes them very flexible and usable beyond what people expect.

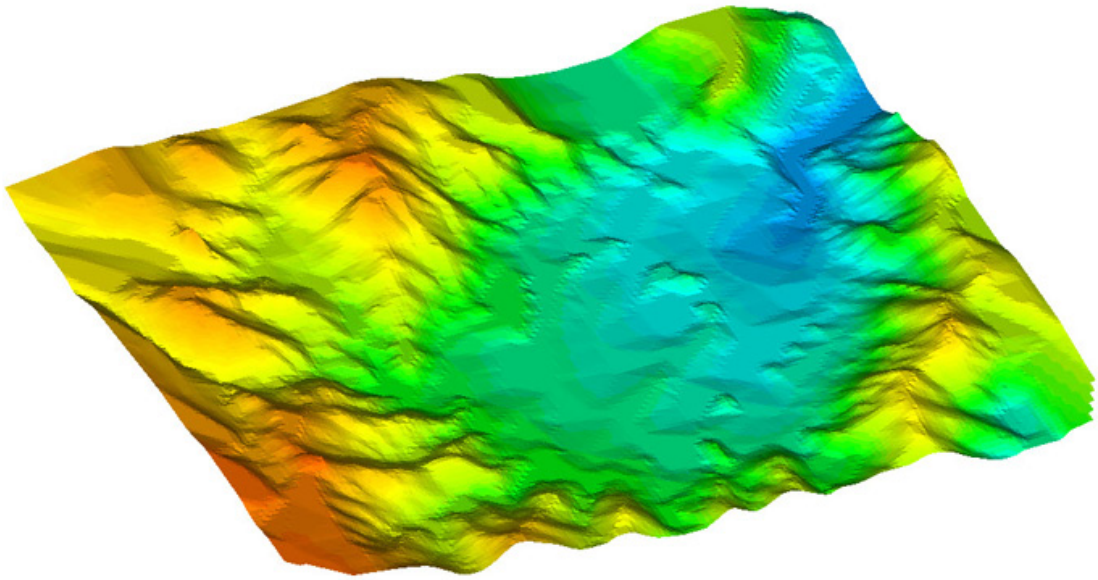

Figure 2. A surface model of topography colored by elevation.

Stratigraphic models are also known as Gridded Seam Models, (GSM) and can only be used in a project of the same type. Stratigraphic models store all the information about each seam, including grade and quality information, as well as thickness and seam top and bottom elevations.

The first step towards utilizing stratigraphic modeling is to initialize a PCF for the project. In MineSight Compass (**File | New | PCF**), define whether it is a 3D or GSM type project (Figure 3). If you choose GSM type then the setup of the PCF is directed to accommodate a number of defined seams instead of block levels.

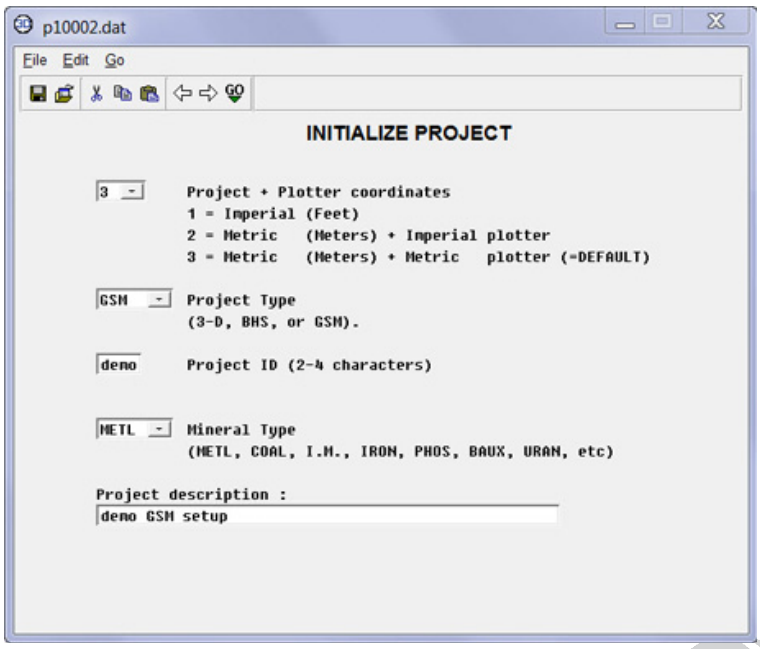

Figure 3. Setting up a new GSM type PCF to use in stratigraphic modeling.

The DH ITEM LABEL chosen usually depends on the type of deposit (Figure 4). ZONE might be used for a bauxite deposit while SEAM is commonly used for coal. It is this item that defines the composite thickness and hence the seam thickness.

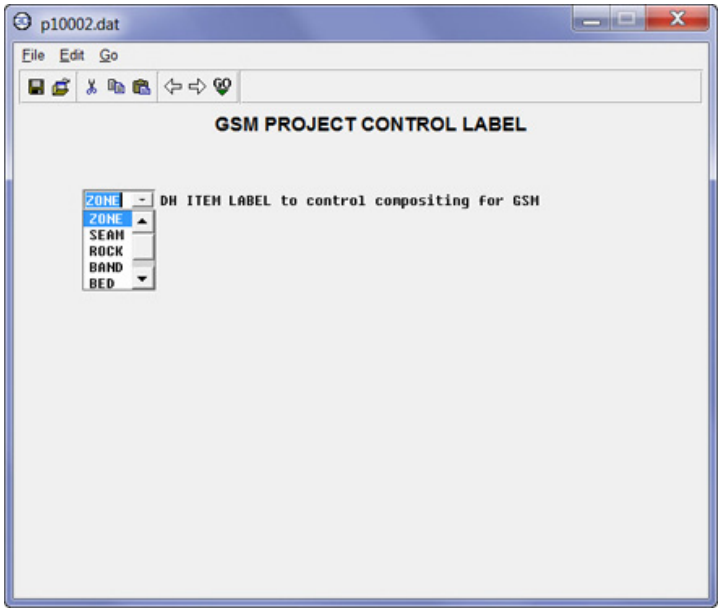

Figure 4. Defining the drillhole item that will control compositing in the GSM.

A major difference between a 3D-type PCF and a GSM type is that the NZ value defines the number of seams in the deposit, as opposed to the DZ you would assign for bench height (Figure 5).

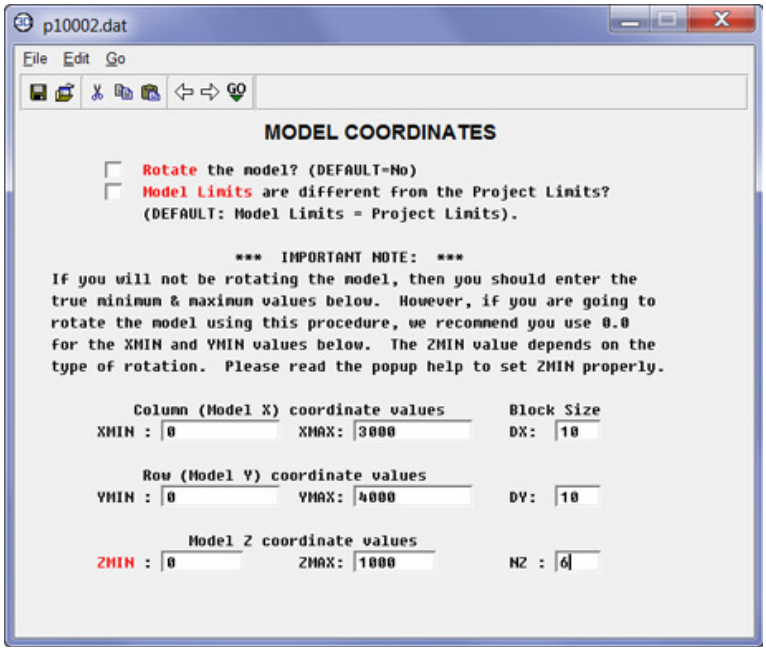

Figure 5. Setting the PCF limits for a GSM project. For the Z coordinate Block Size (NZ), specify the number of seams that will be needed.

The final panel is where you can enter the zone or seam labels and codes (Figure 6). This listing must match the stratigraphic sequence of the deposit, and is directly related to the Law of Superposition defined by local geology.

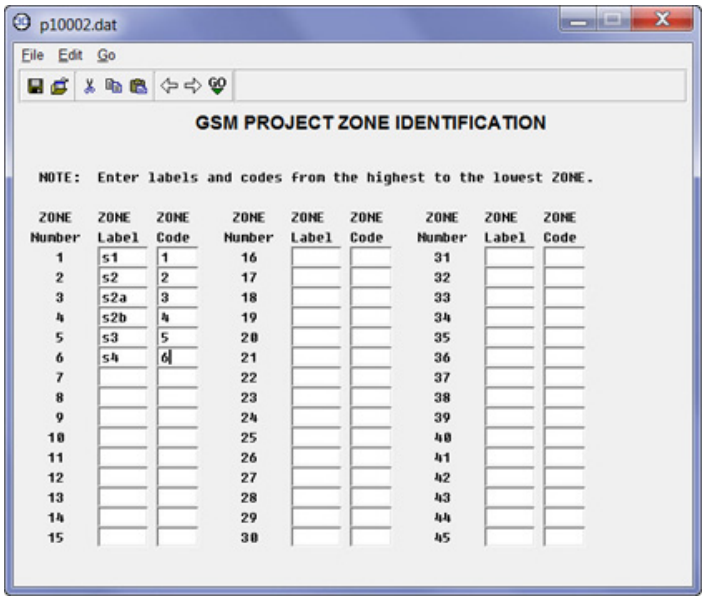

Figure 6. Entering the ZONE label codes.

It is possible to add new zones or seams to the PCF after the initialization, though this may require you to remodel the surfaces and make alterations to any multi-runs you have developed. To add zones or seams to an existing PCF, use the **Project | Edit Project Parameters** utility, and then add the extra zones or seams to the table under **Extent | Levels** (Figure 7).

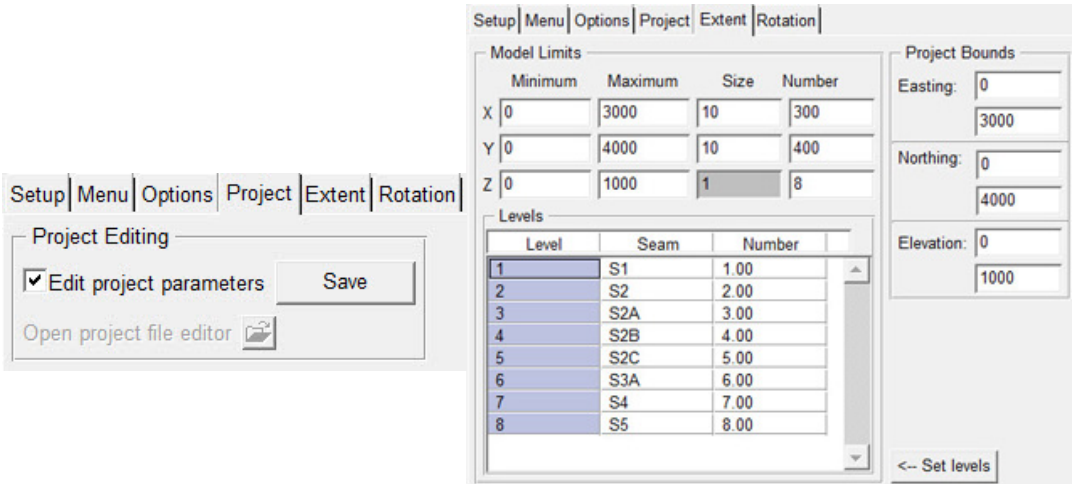

Figure 7. Listing or adding new zones or seams to an existing project.

Initializing a stratigraphic model is exactly the same as creating a 3D block model, but some required items will need to be added (Figure 8). Using **Project | Project File Editor | File | New | 15 – GSM**, define the items in your model.

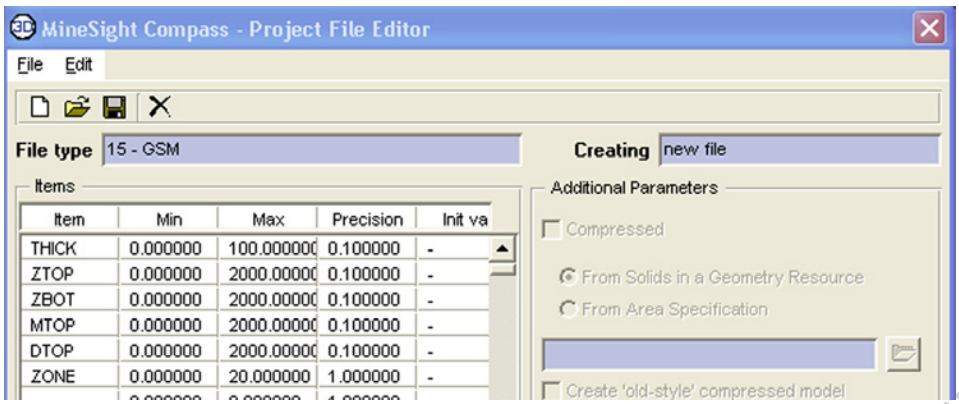

Figure 8. Initializing a GSM stratigraphic model with the required items.

All stratigraphic models need items that define the seam or zone top and bottom elevations. ZTOP and ZBOT are common items used, but you may wish to store multiple elevations, such as when the seam relates to a mining floor as opposed to geology. So you could have a DTOP and a MTOP for the design and mined surfaces of an inclined or non-flat mining bench.

Most stratigraphic models also have a thickness item (THICK) to store the difference between the seam top and bottom. Thickness is essential to many stratigraphic operations, including grade interpolations.

Beyond these required items it is possible to add as many grade or quality items needed by the project. An extra item that may be useful is SEAM or ZONE. The seam ID is inherent in the PCF, but cannot be displayed as a label or used to color a model view, so writing the seam code back to an item can be useful.

All of the stratigraphic modeling tools can be accessed through MSCompass, and can operate on either a surface model or a stratigraphic model. And the modeling process can be easily automated in a multi-run.

Two standard menu groups in MSCompass contain all of the required procedures for stratigraphic modeling (Figure 9)

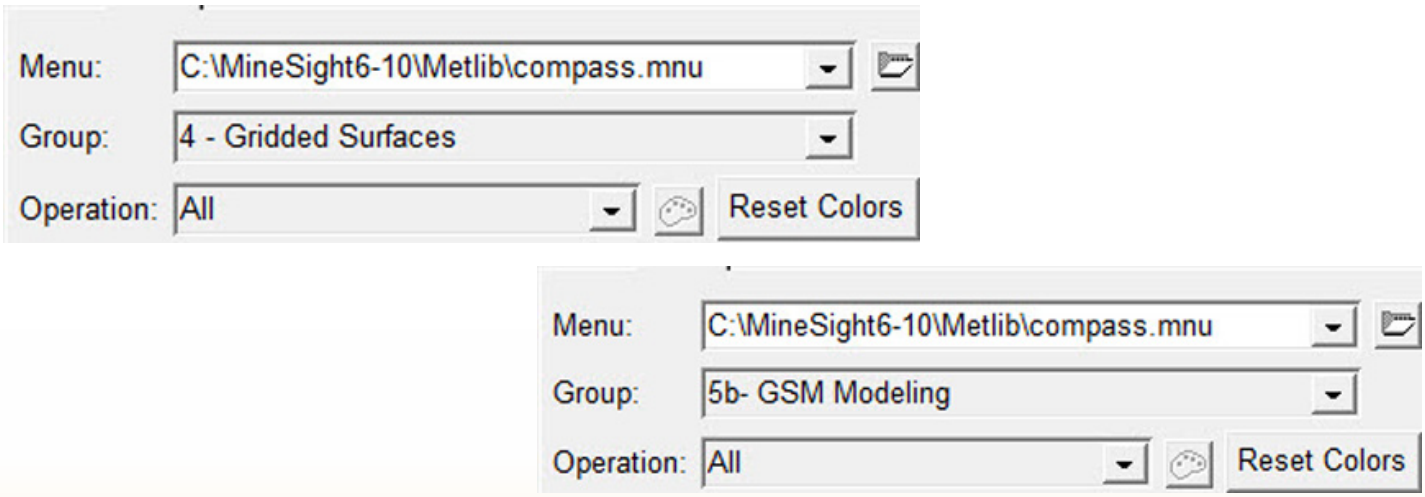

Figure 9. The MineSight Compass stratigraphic modeling related menu groups.

Parts 2 and 3 of this series will examine some of the more commonly used procedures in detail.

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