

GEOLOGY AND MINING

CEMENT ENGINEERING (CESA) S.A.

Consulting Engineers

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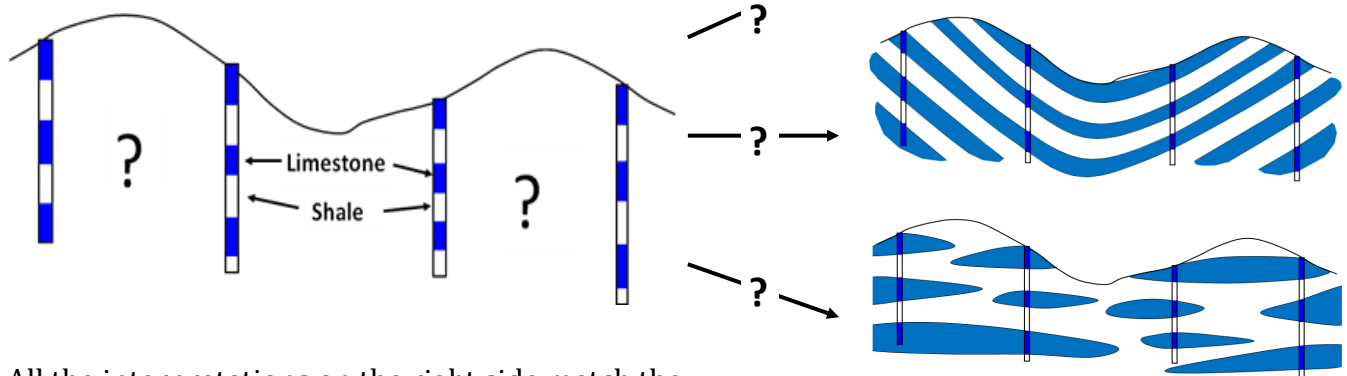
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Geological Mapping

For a cement plant, the raw materials is one of its essential assets. Its extraction has a significant impact on the exploitation costs. In order to optimize the exploitation of the raw materials, a sequence of working stages described herewith has to be implemented.

Surface geological mapping is an unavoidable step as it will provide a general understanding of the deposit. The following example illustrates this point.

Where is the limestone below the surface and how are the different layers linked?



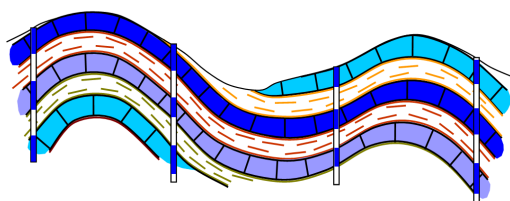
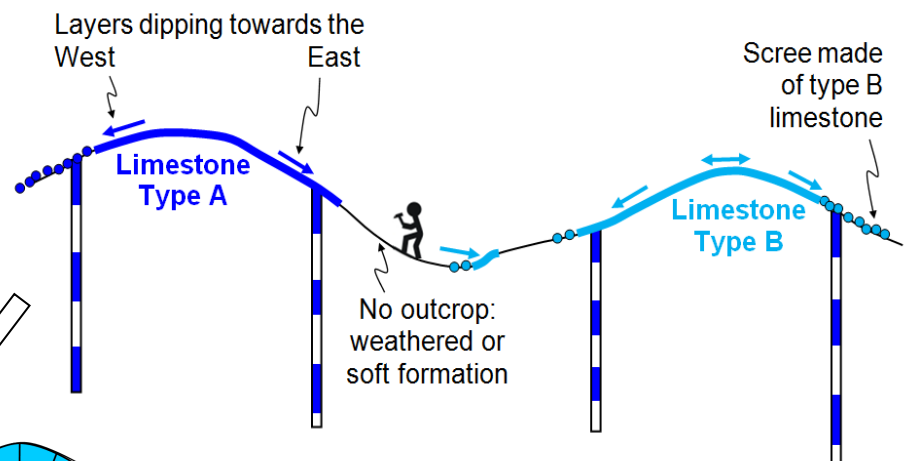
All the interpretations on the right side match the data but are drastically different from each other.

How to solve the problem?

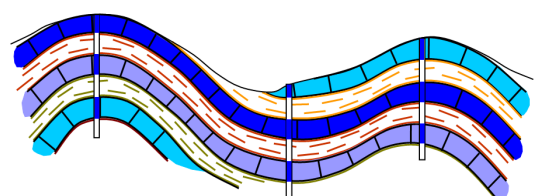
By doing geological mapping by a competent person:

The various limestone qualities (facies) and the large scale structures (folding) were recognised.

From the correlation with the drill hole data, the limestone and marl layers are located at their likely



position.

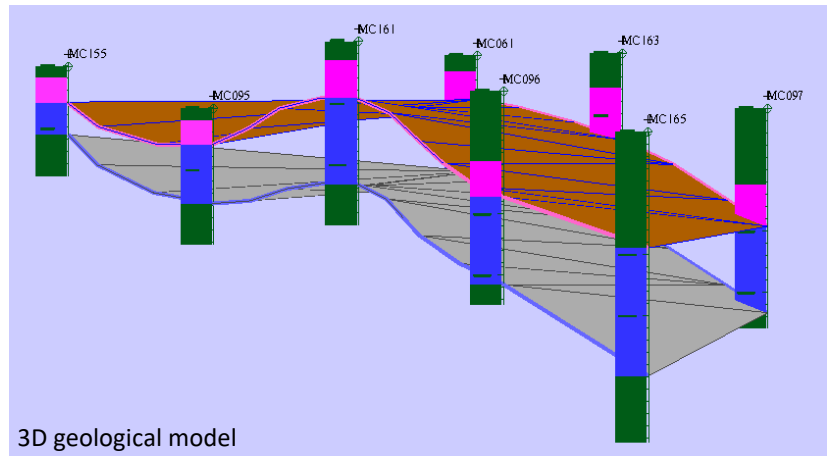


Knowing the geological structure allows saving holes

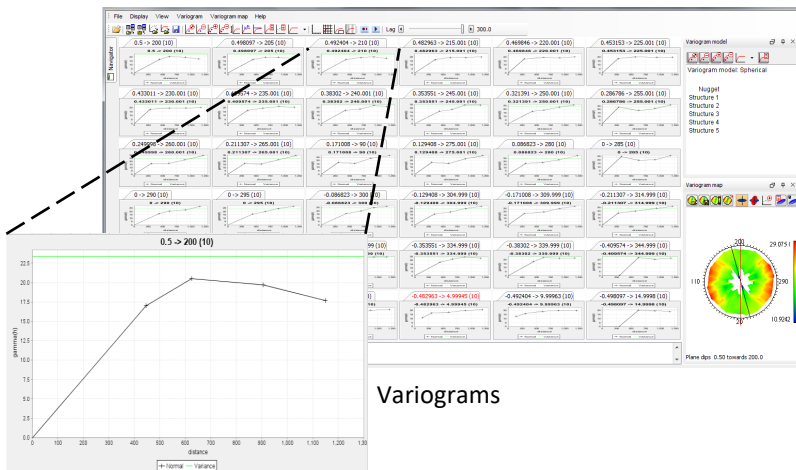
Geostatistical tests and Block Modelling:

Chemical analyses and physical tests are performed on the cores obtained from the drilling campaign. The results of all these analyses are stored in a database with their x,y, and z coordinates.

With all these data (geology, chemistry, etc.) a 3D geological model of the deposit is built.



3D geological model

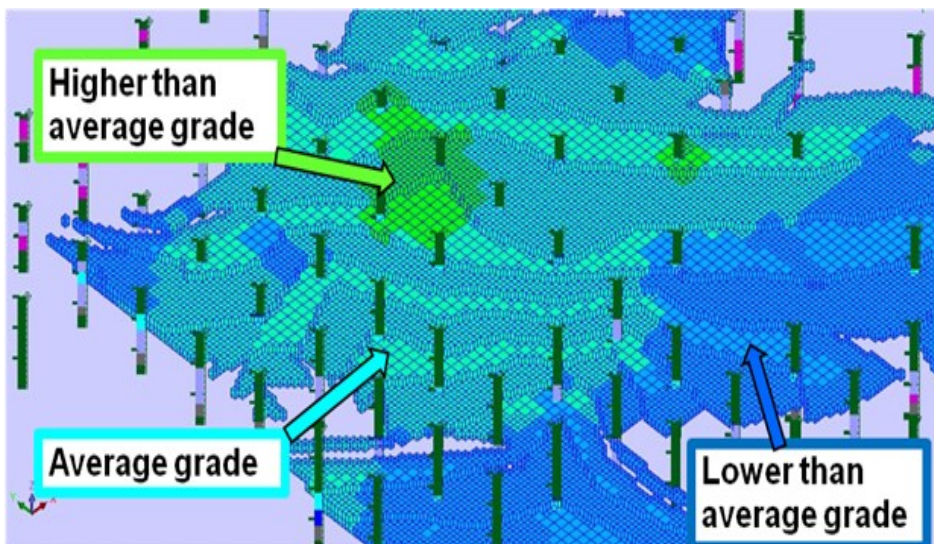


Variograms

The geological model enables the grouping of materials of similar quality. A series of geostatistical tests are performed in order to define the parameter for the construction of a representative block model.

The chemical composition of each block is estimated with respect of the variability of the data (variograms).

A **block model** is nothing else than an inventory of the deposit. It shows the location of the specific qualities in the deposit. Every possible parameter can be estimated like :



- Chemistry
- Physical parameters
- Extraction costs
- Etc.

Thanks to this inventory and knowledge of the deposit, the following operations can be optimized:

- Raw mix design
- Deposit extraction scheduling
- Etc.

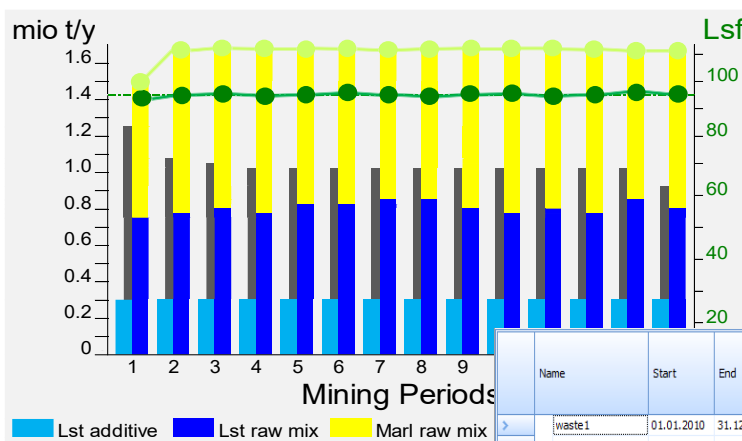
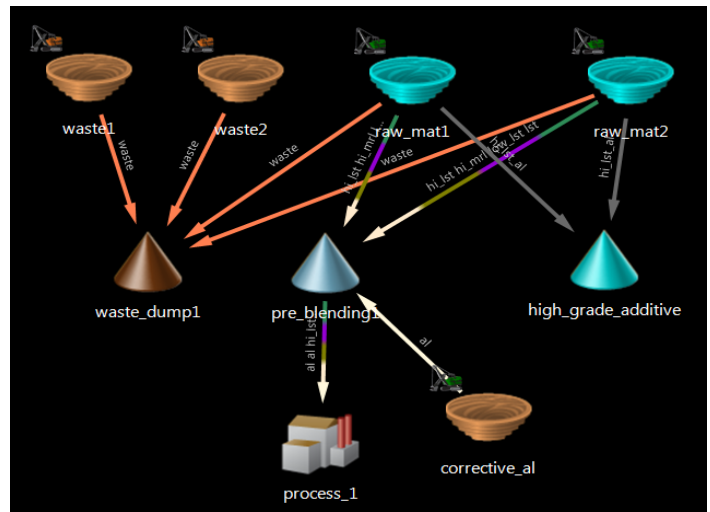
Quarry Planning

Scheduling:

Based on the “inventory” (block model) it can be determined which parts of the deposit have to be exploited and blended at each time to produce the desired raw mix.

Several deposits can be managed simultaneously and correctives can be taken into account.

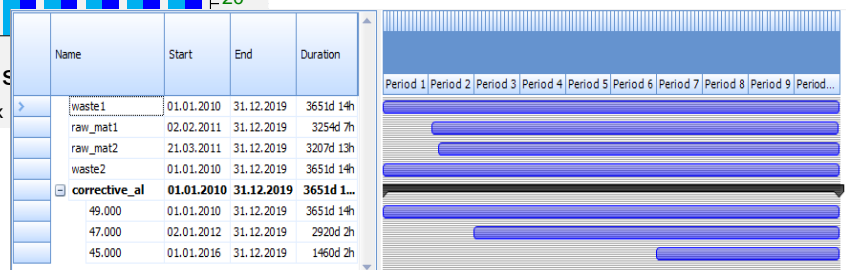
There is no limit to the complexity of the chart as shown on the right. A rule of the thumb being to keep it as simple as possible but as complex as necessary!



The results of the scheduling can be displayed in any desired format:

- Graphs
- Gantt Chart
- Tables

or any tailor made output.



Benefits:

- Increase the life of mine of the deposit by proper blending of the various qualities
- Assure steady output in terms of quality and quantity
- Simplify quarry operation by improved organisation of the exploitation

Furthermore

- Improved and simplified quarry operation results in less fuel consumption and lower maintenance costs per ton of raw material
- Steady raw mix composition allows optimising the clinker manufacturing process, resulting in lower energy consumption and stable clinker quality
- Better clinker quality allows blending more additives