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# Modeling of Halite Deposit with Three Dimensional Digital Modeling Technology

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The great leader Kim Jong Il said:

"The geological prospecting sector must step up its work on modernizaton by introducing the latest technology."

There has been a lot of effort to apply the three dimensional digital modeling technology to modeling of ore deposits [3], but few were successful in the comprehensive use of ArcGIS and GMS.

We have succeeded in modeling a halite ore deposit by using the ArcGIS and GMS system.

## 1. Geology of Ore Depostis

The geological composition of the deposit in our research area is as follows:

On the lower Proterozoic sedimentary metamorphic rocks lie a sedimentary layer of the upper Jurassic series, Sujin formation of the lower Cretaceous series and fluvial deposits of the Holocene of the Quaternary. The Sujin formation containing gypsum and halite ore bodies is divided into Member 1, Member 2 and Member 3 from the bottom up, Member 2 being subdivided into a lower layer, middle layer and upper layer from the bottom.

The sedimentary basin of the research area is faulted sunk basin and is not folded much. It has northeast-southwest second grade fractured structures with their derived faults.

The ore deposit in Sujin formation consists of sediment-originated sulphate ore bodies and chloride ore deposits. The order in which ore bodies lie is as follows in a bottom up way: anhydrite, glauberite, anhydrous glauber's glauberite, halite, anhydrous glauber's salt, anhydrite, gypsum at each successive level.

The total length of the deposit is dozens to 1 000 meters and the width of the ore bodies ranges from one to tens of meters, becoming thicker as it goes towards the core from the earth surface and from north to east. The standard of halite ore is 65 to 98 % and the halite ore layer is not so big in size, its thickness ranging from tens of centimeters to several meters.

## 2. Creating a three dimensional digital model of ore deposits

On the bisis of the geological maps, borehole data, tunnel data and standard data and considering the shape, strike, dip direction and character of the spatial distribution of the ore body, we have created a model of the deposit.

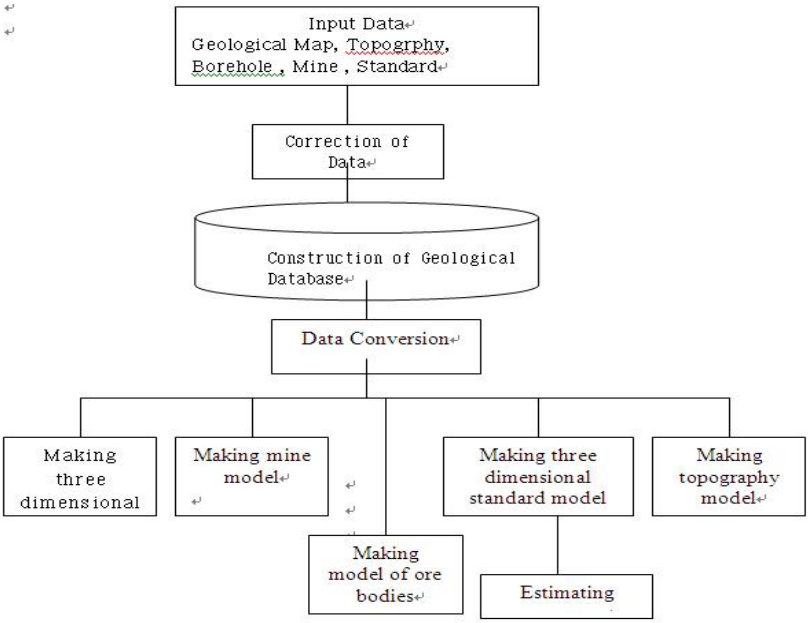


Fig. 1. shows the process of creating a three dimensional model of layers and ore bodies.

**Building of a Geological Database** A geological database means a collection of various types of digitized geological data and files. There are a number of digitizing software available, but we have used ArcMap of ArcGIS, a geographical information system, to digitize the data and built a relation database of property information. The correction of data involves a conversion process to integrate different coordinates of various geological data. The geological mappings and tunnel information are digitized using the ArcMap program and the data concerning its standard is built into a property database together with coordinates.

The borehole data consists of borehole coordinate files, borehole warping files and borehole core files, and the data is input and managed with Excel.

**Data Conversion** The data in the database goes through conversion so that it can be used in various programs at the next stage.

**Creating a three dimensional model of layer and ore bodies** Creation of a three dimensional model of a layer goes, on the basis of borehole information, through two stages. In the first stage, a curved surface is generated for each layer boundary surface by using layer boundary creating modules which have been added to ArcGIS. In the second stage a solid layer is produced with the use of the GMS program.

By using BS-Horizon added to ArcGIS in the form of DLL, a three dimensional model of boundary surface is produced for each layer and layers are produced by GMS.

**Creating a model of a tunnel** A model of a tunnel is created by using digitized (in ArcGIS) tunnel ichnography data and tunnel level values. If tunnel survey data is available, the model is created by combining tunnel ichnography with survey data. This particular ore deposit consists of a 400 level tunnel, a 450 level tunnel, a 650 level tunnel and an inclined

tunnel that connects tunnels of each level. We have created models of tunnels for different levels on the basis of the tunnel ichnography data that has been digitized by ArcGIS system.

**Creating a model of ore bodies** The way a model of ore bodies is made is the same as the way a three dimensional model of layers is made. The ore body is divided into upper plane and lower plane, and their curved surfaces are generated to be combined.

**Creating a topography model** This is done either by creating DEM using measure points directly or by creating DEM after digitizing contours on the contour map. In our research area, there are no rapid accident changes, so we created a topography model based on the surface position of borehole.

**Creating a model of the standard of ore bodies and Estimating reserves** This model is created using a three dimensional spline interfoliation [1] and on the basis of the data about the standard of ore bodies obtained from the tunnels and boreholes. In this area a model of the standard of the ore bodies has been created by combining the standard data that comes from a 650 level tunnel and boreholes on the basis of which the amount of reserve has been calculated.

Fig. 2 and Fig. 3 show the result of three dimensional modeling of these ore deposits using the methods and stages mentioned above.

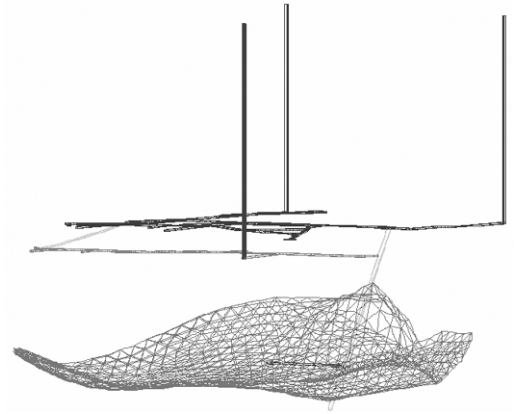

Fig. 2. Halite ore bodies and result of modeling of tunnel

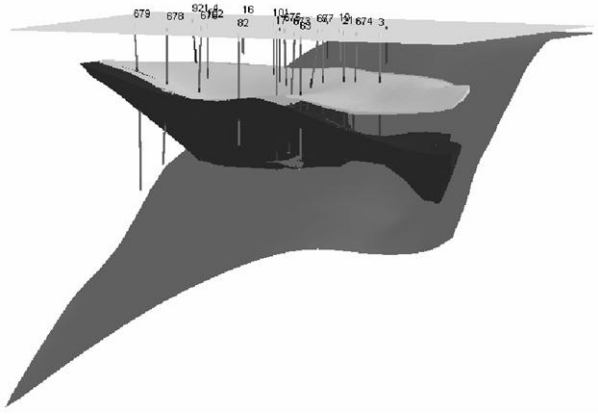

Fig. 3. The result of modeling of ayers and faults

## Conclusion

This paper presents a way of creating three dimensional digital models using ArcGIS and GMS and how it was applied to the modeling of a halite deposit.

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