G-STAR-BASE (G*BASE)—
A DATA BASE SYSTEM FOR UNDERGROUND INFORMATION AND
POST-PROCESSING FOR TOUGH2

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ABSTRACT

Geothermal reservoir modeling and the prediction of geothermal production behavior using numerical simulation are important steps towards the construction of a geothermal power station. In geothermal reservoir modeling it is necessary to combine surface exploration results and well data obtained from various survey stages from rough to detailed examination in order to form an integrated three-dimensional model of a geothermal reservoir. Since exploration data have been collected by many researchers in the fields of geology, geophysics, chemistry, drilling, logging, reservoir engineering, etc. over a long period of time, specialists in geology and reservoir engineering must make a great effort to find information essential for geothermal reservoir modeling out of a tremendous amount of data presented in various formats. Given this situation, construction of a consistent three-dimensional stereoscopic model is a time-consuming job requiring much skill if it is to be done in a human's head. Also, in forming a numerical model grid for ultimate numerical modeling simulation, a considerable amount of time is required to improve the accuracy of modeling because numerical modeling is also time-consuming and requires much skill. Therefore we developed post-processing system (G*Base) for numerical simulator that includes geothermal data base system (Sato et al., 1998). We would like to present the upgrade of our post-processing system.

DATA BASE

G*Base includes geothermal data base and mapping tools. Data base can store exploration and production data We can query each data and display them using mapping tools. Stored data is compared with results of simulation by TOUGH2. Recently, G*Base is applied for nuclear waste study field in Japan.

G*Base works on Windows95/98 /Me/NT/2000/XP. The database is based on ORACLE that is major relational database engine in the world. The database has a simple structure, and it is possible to redefine and enter all types of data which can be fitted in the structure into the database. We can use it for either system on stand-alone or on client-server system.

For data base system, we can store several kind of data like as Table 1. The retrieval and mapping function of the database allows a two-dimensional or three-dimensional representation of data to be obtained by using single data sets or superimposing various data sets, e.g., geological column diagrams, logging data, surface survey data, production/injection data, results of reservoir simulation (Figure 1).

Table 1. Database structure of G*Base

Data Structure	Data Type
Well Log Table (depth)	Logging, geology, L/C, casing, etc.
2D irregular (X,Y)	Plane view of elevation, geophysical/geochemical data
3D irregular (X,Y,Z)	Geophysical exploration, reservoir simulation results, etc.
Time series	Production/injection, geochemical, etc.
Polygon	Road, river, structure, geology, fracture trace, etc.
Image	SPOT image, geological map, seismic and other scan images
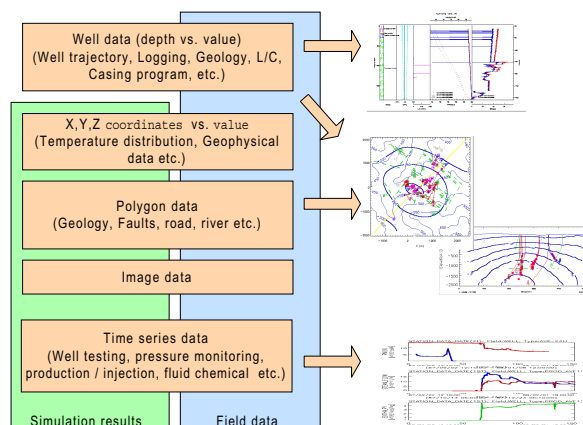
Figure 1.   Data mapping using G*Base

POST-PROCESSING

Figure 2 shows post-processing of TOUGH2 using G*Base. First, we construct a numerical model using GeoCAD (White et al., 2003). GeoCAD generates TOUGH2 input and coordinate files.
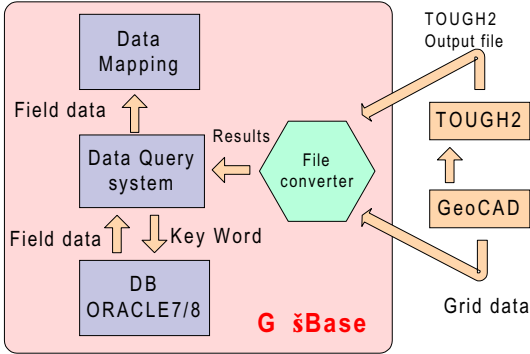

*Figure 2. Post-processing of TOUGH2 using G*Base*

To plot TOUGH2 results, the following options are available:

2-D and 3-D Mapping

- Contour map (distribution of temperature, pressure, saturation and concentration of chemical etc.)
- Permeability distribution (x,y,z direction), rock type distribution, rock name distribution, etc.
- Flow vector.
- Grid block layout.

X-Y Graphing

- Temperature, pressure, saturation change.
- Flow rate change etc.

Figure 3 shows a flow chart of the TOUGH2 modeling process including pre-and postprocessing. Figures 4 and 5 show examples of data mapping using G*Base.
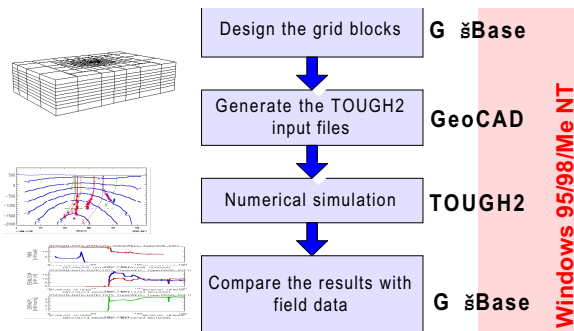

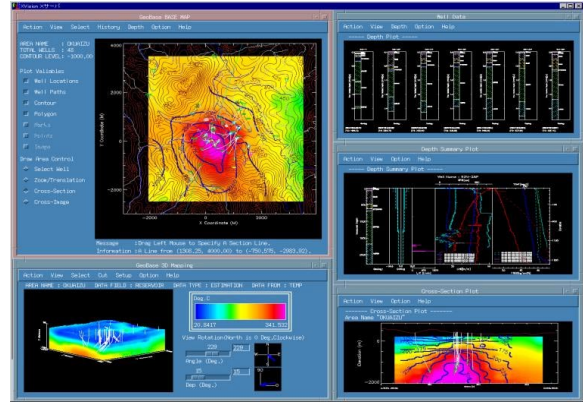*Figure 3. Numerical modeling flow chart*
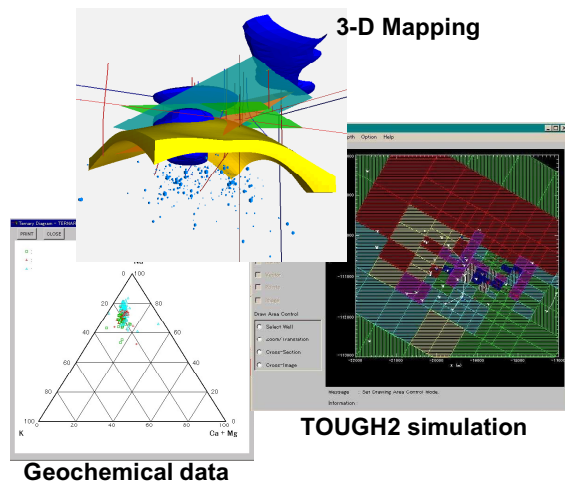

*Figure 4. Example of data mapping using G*Base*

*Figure 5. Example of data mapping using G*Base*

REFERENCES

Sato,T., Ohsato, K.,White, S.P., Burnell, J.G., Yokomoto, S., Development of an Integrated Geothermal Reservoir Modeling System for the Modeling Study using TOUGH2, *Proceedings: TOUGH2 Workshop 1998*, Report LBNL-14995, Lawrence Berkeley National Laboratory, 47–52, 1998.

White,S.P., Burnell, J.G., Ohsato, K., Sato, T., GeoCad, a pre and postprocessor for TOUGH2, *Proceedings: TOUGH Symposium 2003*, Lawrence Berkeley National Laboratory, 2003.