THREE DIMENSIONAL SUBSURFACE GEOLOGIC MODEL OF WESTERN OSAKA PLAIN USING BOREHOLE DATA CONSTRUCTED BY MODELING SYSTEM BASED ON WEB-GIS

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ABSTRACT

The three dimensional geologic model in the urban area is very important to use underground space, to protect our life from disaster and so on. Recently, in the world, basic geological data to create three dimensional geologic model is opening actively to public on the Web. Especially in Japan, government and municipal begin to open the boring log and the soil test results to public on the Web. In this paper, three dimensional subsurface geologic model of the western Osaka plain using borehole data has been constructed by the modeling system based on Web-GIS (Masumoto et al., 2009). This system has been designed to provide modeling information of field survey data and geologic model including the stratigraphic correlation and model construction process on the Web. Geological information is able to share widely by modeling with this system.

1. INTRODUCTION

Although some 3D geologic models in Osaka plain have been published (Sakurai *et al.*, 1995, Horikawa *et al*., 2003). Data or modeling process of stratigraphic correlation in the models are not opened to the public.

In this study, 3D geologic modeling system based on Web-GIS (Masumoto *et al.*, 2009), that is designed to provide modeling information of field data and geologic model including the stratigraphic correlation and on the web, was used. The 3D subsurface geologic model of western Osaka plain has been constructed by the modeling system (Masumoto *et al.*, 2009). We checked construction of the Sakuragawa flexure in the western Osaka plain with the model.

2. CONSTRUCT THREE DIMENSIONAL GEOLOGIC MODEL

2.1 Data and target area

The Osaka city borehole data gathered and digitalized for infrastructure improvement were used. They are the 7,357 borehole data for information of the Osaka city standard mesh, ground elevation, lithostratigraphy, thickness, and N values. The depth of borehole data were mainly 20-30m and the deepest data were about 70m.

Figure 1 shows the area for the modeling, the western Osaka plain (4,300m, 6,100m). There are many borehole data (1,100) in this area and part of the Sakuragawa flexure locates in central part of the area. Borehole data were divided into eight layers after Mitamura and Hashimoto (2004).

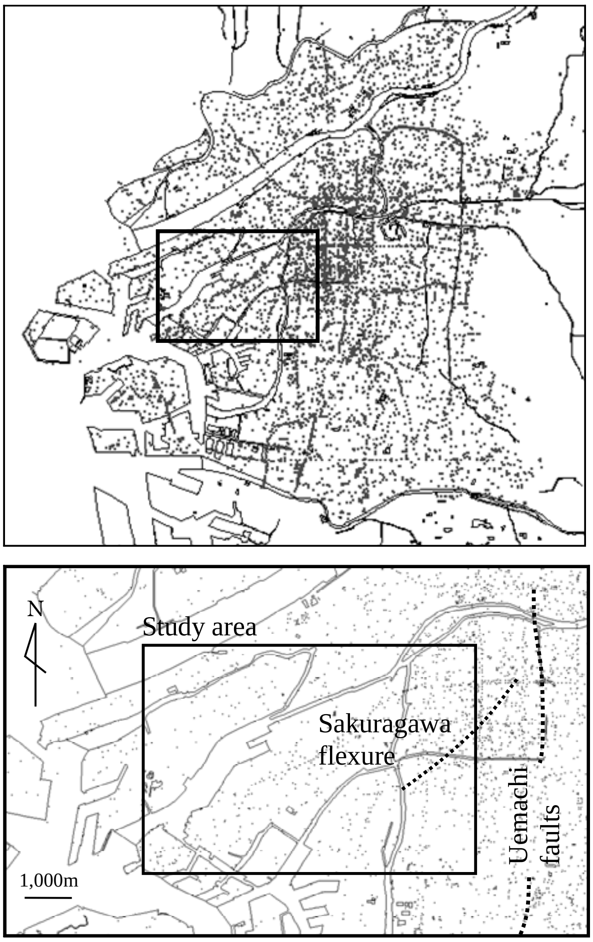

Figure 1. Osaka plain and distribution of whole borehole data (upper), study area and distribution of main geologic structures (lower).

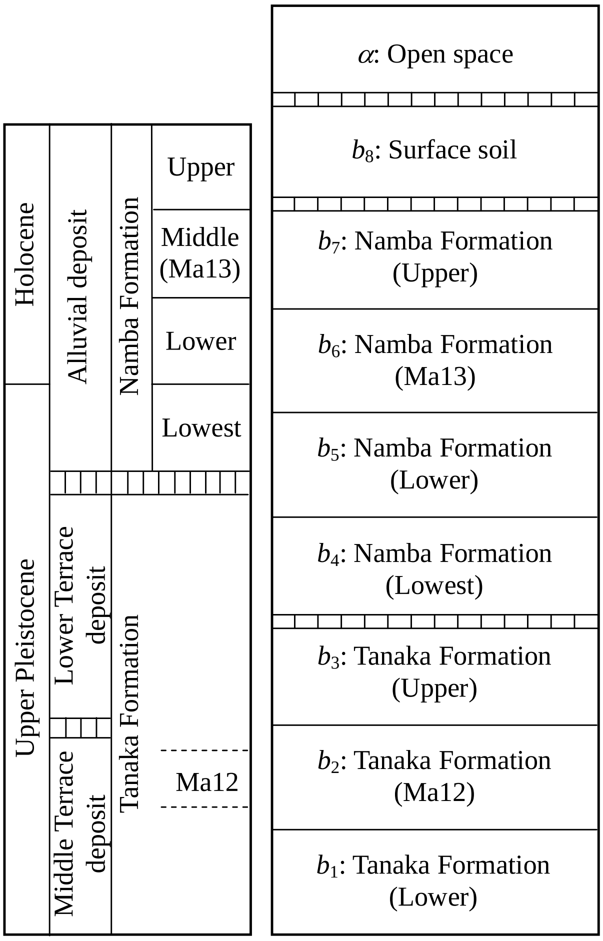

Figure 2. Stratigraphic division using in geologic modeling (right), corresponding to stratigraphic division (Mitamura and Hashimoto, 2004) (left).

2.2 Geologic modeling

The outline of constructing the 3D subsurface geologic model is as follows.

(1) XML data of JACIC (Japan Construction Information Center) format were converted by borehole data of Osaka city. In addition, display data of borehole points were constructed and they were saved in a database using the data acquisition module.

(2) Rule of stratigraphic correlation was set, and borehole data were correlated by the stratigraphic correlation module (Figure 3). Lithofacies and N values were used mainly to correlate the borehole data. Correlation of marine clay bed as key bed helps the correlation. After correlation, we checked horizontal sequentiality. Basic data were output using the correlated results (Sakurai *et al.*, 2008).

(3) The function *F* were output from the basic data using the classify and arrange module. Details of the classify and arrange module and function *F* described in Iwamura *et al.*, (2008).

(4) The event sequence and the logical model of geologic structure were constructed using the stratigraphic division (Figure 4). The logical modeling module using in the modeling system is from Masumoto *et al.*, (2009).

(5) Estimated data of the geologic boundary surfaces were constructed using the positions of the correlated data, the function *F* and the logical model of geologic structure.

(6) Shape of the geologic boundary surfaces (S_i [i = 1, 2, …, 7]) were estimated using the surface estimation module (Figure 5). Estimated parameters were from Nonogaki *et al.*, (2008). Table 1 shows the estimated parameters.

(7) The 3D subsurface geologic model was visualized using the logical model of geologic structure and the grid data of geologic boundary surfaces. NVIZ (3D visualized tool of GRASS-GIS) and Geomodel (Yonezawa *et al*., 2004) were used in this visualization. Figure 6 shows examples of the three dimensional subsurface geologic model.

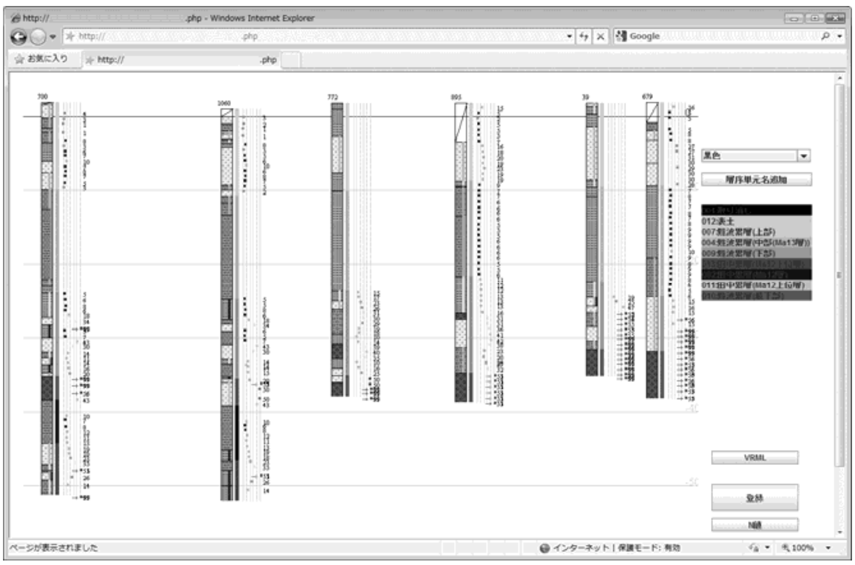

Figure 3. Display example of the stratigraphic correlation module.

$V_8 = (v_1, c, c^*, c, c, c, c^*, c^*)$

	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8
b_1	−		−				−	−
b_2	+	−	−				−	−
b_3	+	+	−				−	−
b_4			+	−			−	−
b_5			+	+	−		−	−
b_6			+	+	+	−	−	−
b_7			+	+	+	+	−	−
b_8							+	−
α								+

Figure 4. Event sequence and logical model of geologic structure.

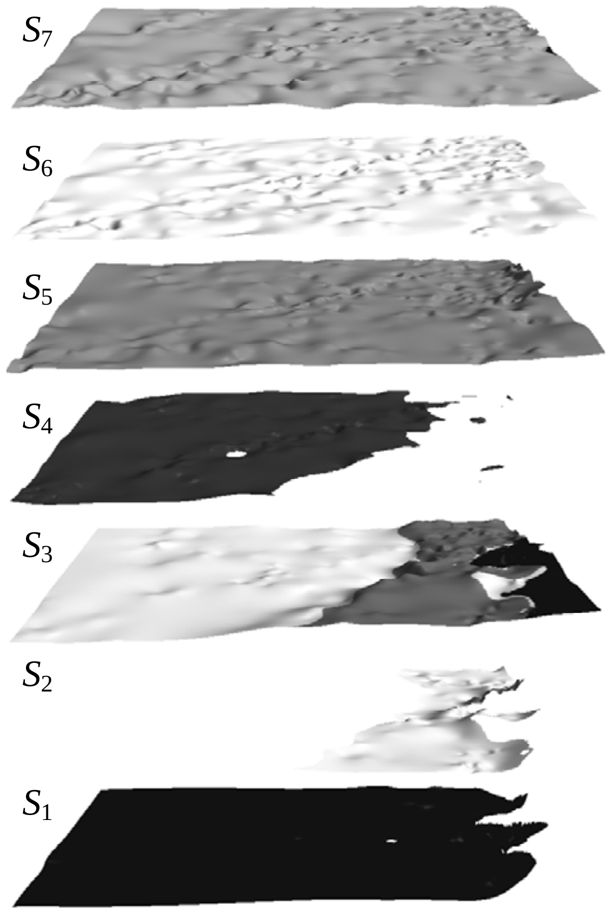

Figure 5. Display example of shape of geologic boundary surfaces (S_i [i = 1, 2, …, 7]) (NVIZ, vertical tenfold highlighted).

Table 1. Estimated parameters.

Pattern	Estimation grid interval (m)	α
A	50	100
B	50	1,000
C	50	10,000
D	100	1,000
E	100	10,000

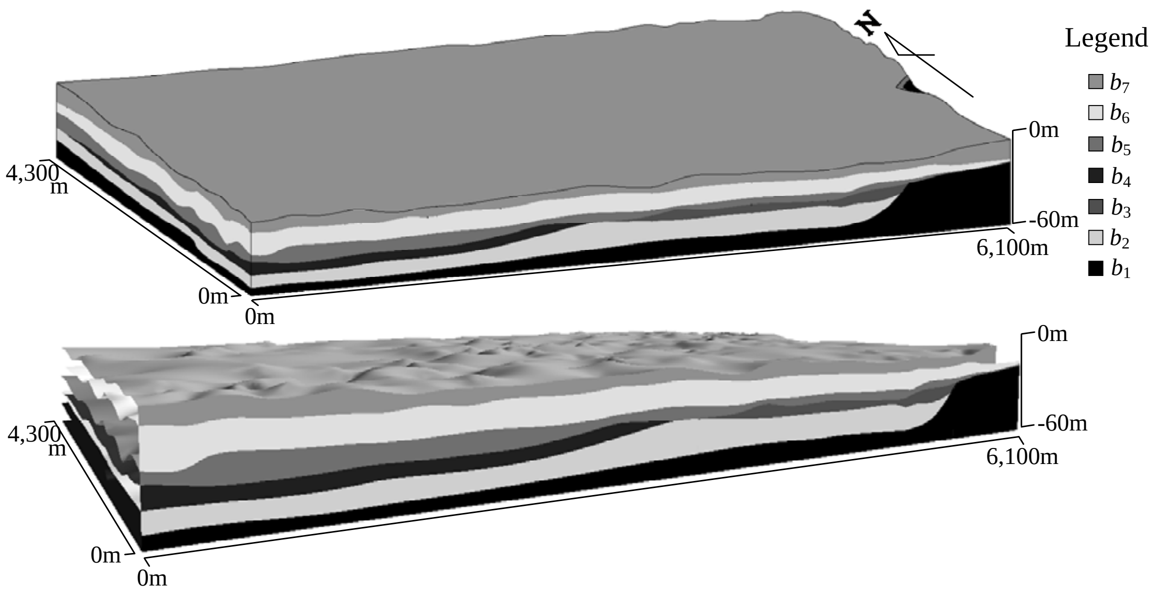

Figure 6. Visualized example of three dimensional geologic model (Geomodel [upper], NVIZ [lower], vertical tenfold highlighted).

2.3 Model assessment

In this study Pattern B was used, because it has a few errors and it can check geological structure easily. To check internal structure, geologic sections were constructed on 14 lines, which were shown in Figure 7 using Geomodel (Figures 8 and 9).

The 3D subsurface geologic model shows basically flattened structure except the part of Sakuragawa flexure. Cross-sections along the lines in Figure 7 (C-C', D-D', E-E', J-J', K-K', L-L', M-M', N-N') ran on the Sakuragawa flexure (Figure 8). The Sakuragawa flexure is recognized in the Tanaka formation but not in the Namba formation (see Figures 2). The Sakuragawa flexure is located on the slightly west than the position of that show in Geographical Survey Institute (1994).

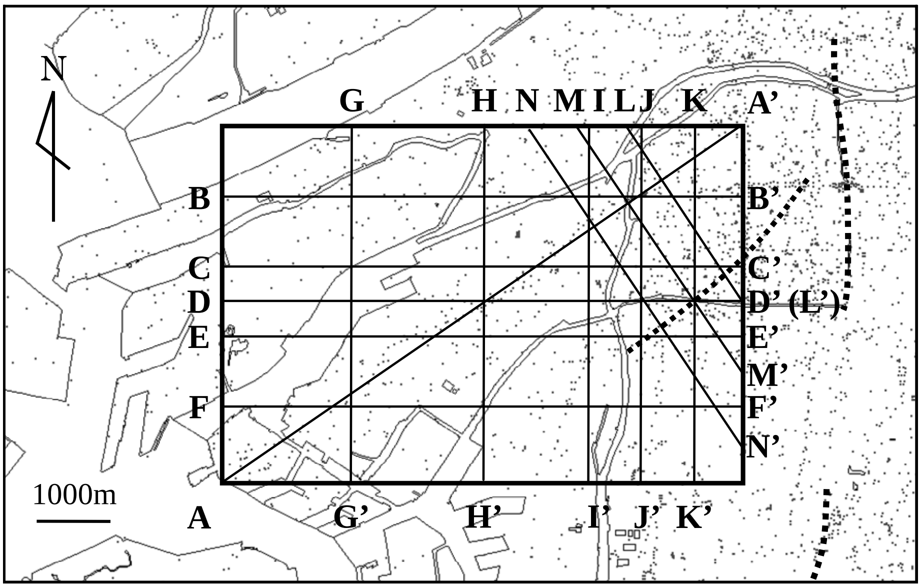

Figure 7. Study area and position of geologic sections.

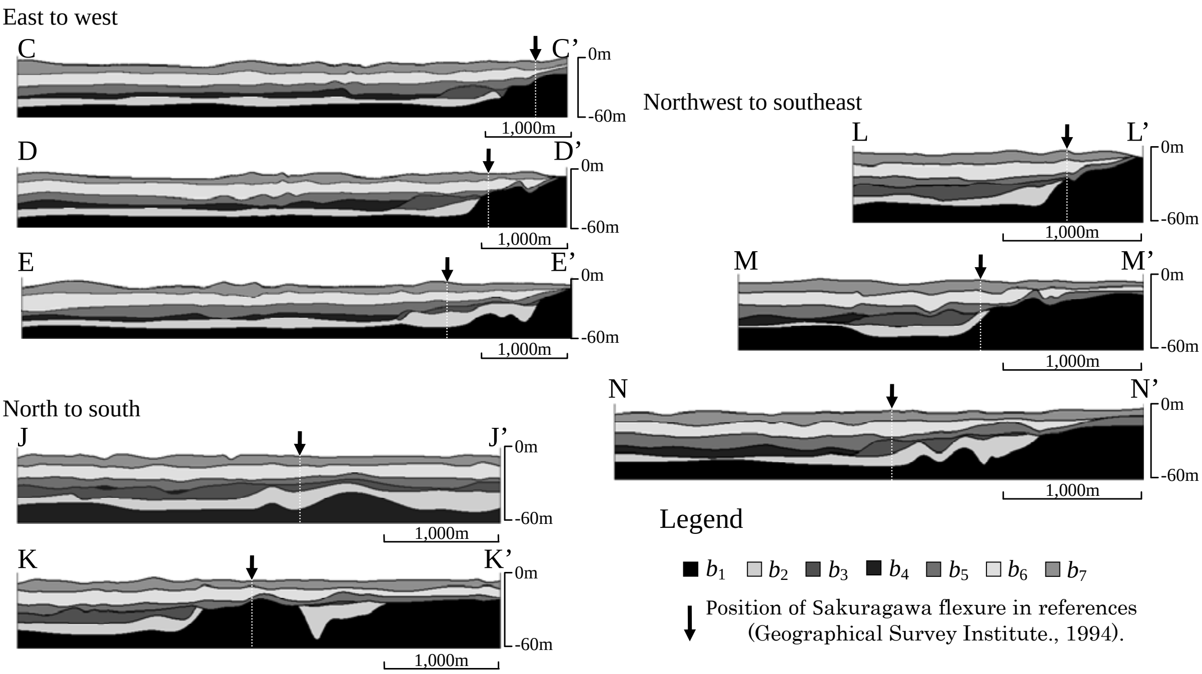

Figure 8. Geologic sections of study area (including Sakuragawa flexure, vertical tenfold highlighted).

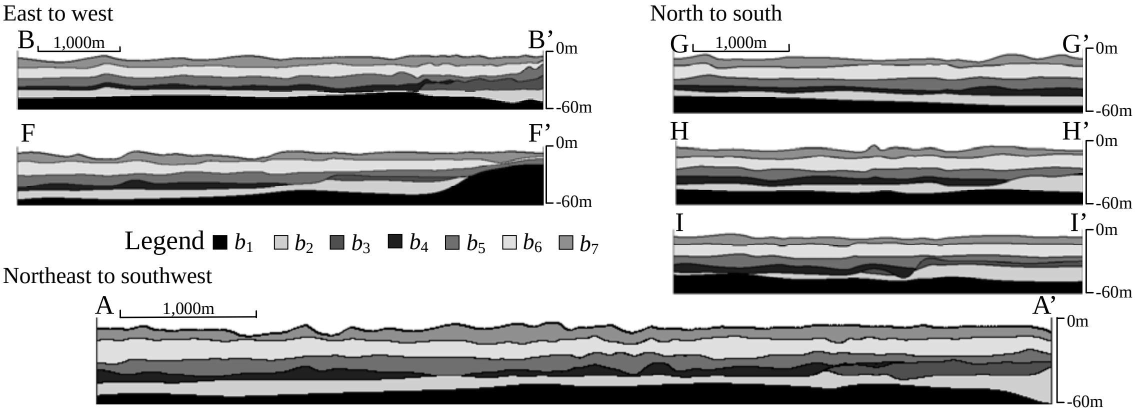

Figure 9. Geologic sections of study area (not including Sakuragawa flexure, vertical tenfold highlighted).

3. CONCLUSION

The 3D subsurface geologic model of the Tanaka formation to surface soil in the western Osaka plain was constructed. The result is consistent with original field data. We need more borehole data to make modeling and inspect the difference from Geographical Survey Institute (1994). In addition, we are planning to create the model in whole of the Osaka city.

4. ACKNOWLEDGEMENT

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