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3D geological model based on the parameters of the lateral continuity of sedimentary bodies using a borehole database

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Three-dimensional geological models of plains in urban areas developed from borehole data are very useful for clarifying shallow-subsurface geological processes. There are several possible techniques for constructing these geological models; these techniques include a 3D boundary correlation procedure for boreholes or 3D grid-node configurations of geological or geotechnical parameters based on borehole logs. The former is considerably more time consuming because the procedure demands researchers to conduct a subjective determination of bed-by-bed correlations, whereas in the latter procedure the grid-node values are automatically estimated by spatial averages or statistical characteristics. The 3D boundary correlation method is effective when borehole data are limited. The recent development of borehole databases with sufficient log data makes the 3D grid-node method increasingly effective. However, some errors relating to the description of the borehole logs can be associated with this procedure. In this study, we considered statistical information such as the lateral continuity of a sedimentary body and its anisotropy, the orientation of the continuity and stratigraphic patterns in the lithological data in borehole database before constructing the 3D geological model.

The lateral continuity of a sedimentary body and its anisotropy can be expressed in terms of an existence probability in a lateral direction based on borehole data as previous studies. This information reveals the geometry of the sedimentary body. Stratigraphic patterns provide information regarding the sedimentary facies or their stacking patterns. Our results suggest that the spatial information that can be obtained from borehole databases is very useful for constructing a grid-based 3D geological model, because the information constrains the estimations of the grid values in the models.

Keywords: Chuseki-so, 3D geological model, discriminant analysis, sedimentary facies, incised-valley fills