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Database construction and application to spatial modeling of metal contents using the resource survey materials in Japan

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Much metal mines had been operated in Japan, and investigations to estimate metal resources abundance and their concentrations were performed in the metal deposits areas. However, most these results are not utilized at present because they have been paper-based non-digital data without unified data formats. It is important to utilize such information and knowledge accumulated in the past, because these data-set becomes available for analyses of traditional statistics and spatial modeling by arranging and being digitized. From the results of analyses of the data-set, acquisition of novel knowledge about the origin and the generation mechanism of a metal mine is expected. This knowledge can be used for the exploration of metal deposits of other countries. In addition, they are also useful for the inspection and validation of other studies.

Investigation reports by JOGMEC, the regional investigations of 54 districts from Kyushu to Hokkaido, the detailed investigations in 34 districts, the potential assessment investigations of the rare metal resources of 9 districts, and the fundamental geological investigations of gold mine of 3 districts, were used for constructing a database. These investigations had been carried out from 1966 through 2002. The coordinate of each borehole, geologic column, and main metal contents were selected from these reports. The errors of the coordinates of the data described in the reports were corrected by comparing the original data with landmarks and topography using digitalized images.

Basic statistical analyses, a deposit type and metal content, metal type and the correlation with the depth, were carried out using the constructed database. It was revealed that Cu and Sn, Sn and Zn, Pb and Zn, and Ag and Pb were strongly correlated, because of existence of kuroko-type deposits and hydrothermal deposits. Spatial distribution models of the metal contents were constructed by original kriging, co-kriging, and sequential Gaussian simulation for several areas such as the Bantan area (west Kinki) and the Noya area (middle Kyushu). In addition, to clarify the formation and development process of the deposits, 3D geological models were constructed using category data extracted from the geologic columns by the borehole investigation, geological cross-sections, and digitized images of the fault traces. By integrating these spatial models, it was clarified that highly-concentrated zones of Cu were divided into by two faults in the Bantan area. In the Noya area, an andesite layer was found to divide highly-concentrated zones of the Ag and Au into two parts at different depths. Our next step is to construct a more advanced database and combine it with various software for comprehensive GIS and 3D modeling.

Keywords: Borehole investigation data, Geostatistics, Metal deposit, Mineralogy, Statistical analysis, 3D spatial modeling