THE CONSTRUCTION OF ONTOLOGICAL RETRIEVAL SYSTEM FOR GEOLOGICAL MAP IN KOREA

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Abstract: Geological information is considered as one of the fundamentally national knowledge to be used in various fields such as environmental pollution, ground disaster, natural disasters, exploration of natural resources and so forth. However, it is difficult to find out the interesting data of end users in geology and geological information has been losing as the time past. Also, geological data were produced by different institutes and researchers for a long time. Investigated and published geological maps until a recent date have used different geological boundaries, geological ages, colors, symbols, patterns and acronyms due to different period because of a long period of geological investigation and a number of investigator, and moreover, two adjacent geological maps are included many problems. Major area to solve these problems is data modeling. Present data modeling are disappeared modelers' idea and are distorted by programmers. This also enables data to play a part the level of information but it is impossible to precede with the level of knowledge this problem occurred to be considered data model subsequently which is the most important coupling medium between modelers and programmers. This research prepares as data model, geological symbology and makes out GIS representation for digital geological map unit in Korea. To make out the spatiotemporal information system for geological map in Korea: first, we limited to geologic world to geological map in Korea. Second, we extract to rock units which is spatial object and to geologic time unit which is temporal unit from geological map. Third, we considered the standardization of geological term in Korean and English and make out geological terms for both spatial and temporal object. Fourth, we classify objects of geologic map unit and make a guideline about the specification of spatiotemporal ontology model for digital geological map unit. Finally, we construct the spatiotemporal retrieval system applied geological ontology model.

1 INTRODUCTION

Geological map is an important data source using the development of national territory and natural resources, prevention of geological hazard and environmental pollution, and other educational and research purpose. However its both data modeling and data integration have not yet been tried systematically or comprehensively, thus there is limited to its value and effective usage. Both investigated and published geological map until a recent date have used different geological boundaries, geological ages, colors, symbols, patterns and acronyms due to different period because of a long period of geological investigation and a number of investigators, finally, two adjacent geological maps are included many problems. Therefore it is important to the integration of geological information so that it can be incorporated with other IT and ET resources by, for example, merging with other spatial information, producing thematic map, or extracting additional information the major study area to solve these problems is data modelling.

This research prepares a geo-ontology model and geological symbology and makes out GIS representation for digital geological map unit in Korea. To make out the spatiotemporal information system for geological map in Korea: first, we limited to geologic world to geological map in Korea. Second, we extract to rock units which is spatial object and to geologic time unit which is temporal unit from geological map. Third, we considered the standardization of geological term in Korean and English and make out geological terms for both spatial and temporal object. fourth, we classify

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2 THE SPECIFICATION OF SPATIOTEMPORAL ONTOLOGY MODEL FOR GEOLOGICAL MAPS(DRAFT)

The specification of spatiotemporal ontology model for geological maps limited to the scope of the geological world to digital geological maps in Korea, and extracted geological ages as time units and rock units as spatial units. For the rock unit ontology, we selected English-Korean lithological terms found in digital geological maps and, considering the standardization of terms, we classified rock units, assigned classification identifiers, and defined the concepts of terms.

2.1 Extraction of Spatiotemporal Objects from Geological Maps

The classification of rock units of digital geological maps aims at digitalization in lithologically uniform minimum map unit. The classification of digital geological map in the minimum unit divided space into rock units and time into geological ages, and extracted the objects of rock units and geological ages existing in Korean digital geological maps. First, objects existing in digital geological maps were converted into the minimum units, and 1961 fields of rock layer names were mapped to the specification of rock units ontology made through this research. In addition, for standardizing terms in object extraction, English and Korean terms were sorted out and classified hierarchically. For making the ontology specification, we structured the conceptual definitions of terms, the hierarchical structure of terms related to rocks and geological ages, and the relation of inclusion.

Rock units of digital geological maps were classified first into sedimentary rocks and sediments, metamorphic rocks and igneous rocks, and then subordinate classification was made for applicable scopes. In addition, geological ages in digital geological maps were classified first into the Precambrian Eon and the Cambrian Eon, and then subordinate classification was made for applicable scopes.

In extracting spatiotemporal ontology objects from geological maps, we analyzed Korean digital geological maps in 1961 rock layer units and organized them fittingly to the Korean system at the level of undergraduate senior students, referring to Introduction to Geology, Loren A. Raymond's Petrology, Geologic Map Unit Classification, ver.6.1) of USGS, and GeMPeT (Geoscience, Mineral, Petrology Thesaurus) in Australia.

2.2 Development of a Spatio Temporal Ontology Model of Geological Maps

We extracted geological unit objects for rocks and geological ages from geological maps, and defined and classified geological terms for the geological units. In addition, we formulated a rock-time unit ontology model for the geological units. In this study, a spatiotemporal ontology model means a sophisticated model upgraded from data to knowledge. The geological map ontology model can be defined as a set of terms for expressing space objects of rock units and time objects of geological ages as well as the system of contents and structures. In addition, it includes color and pattern symbols mapped one-to-one to spatiotemporal objects.

In rock units classification, S, I and M were assigned as the identifiers of sedimentary rocks and sediments, igneous rocks, and metamorphic rocks, respectively, and sub-class rocks followed the identification information. Based on the basic classification, a hierarchical classification system was prepared. Geological age classification was made, referring to the Korean geological time scale (Geological Society of Korea) and geological dictionaries, by extracting geological age objects of primary, secondary and tertiary classification items, and then quaternary classification was added in consideration of international geological time scale standard in the future (Figure1).

3 ONTOLOGIC DATABASE OF GEOLOGICAL MAPS

The basic data used in the spatiotemporal database of geological maps are digital topographical maps and digital geological maps. (figure 2).

Maps were extracted administrative districts such as counties, towns, villages and provinces in the form of polygons and they were used as data, and from digital geological maps was built a database using the spatiotemporal ontology model. First, we

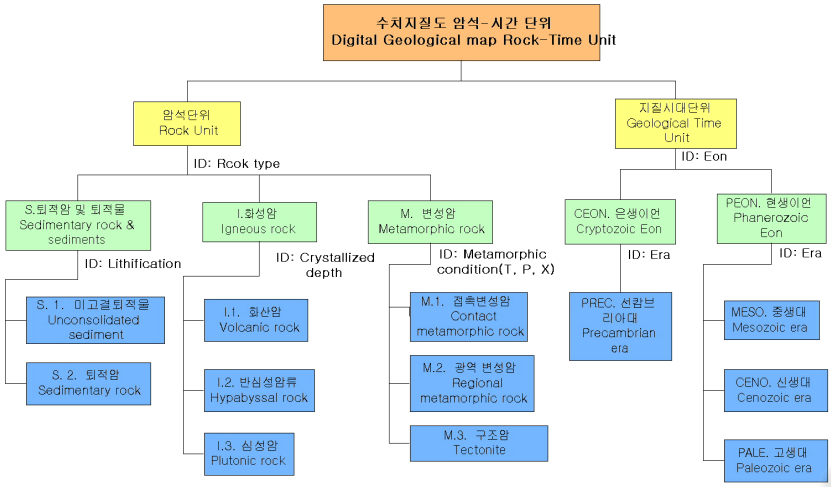


Figure 1: Spatiotemporal ontology model for the geological map in Korea (the basic diagram).

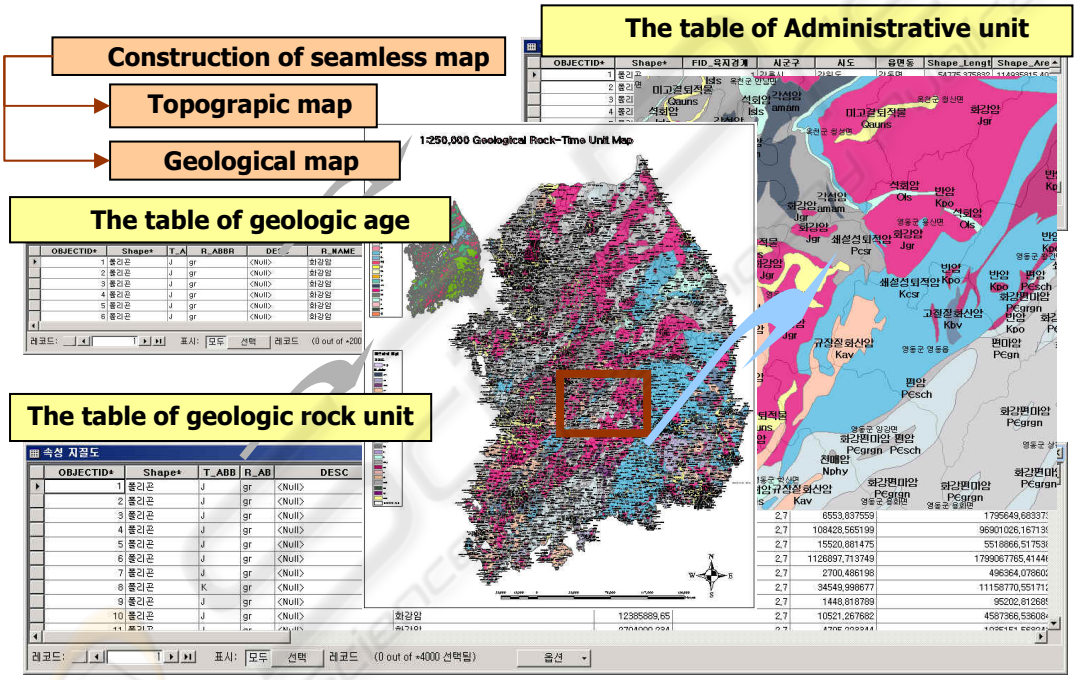


Figure 2: The table and spatial representation of spatiotemporal database for geological map in Korea.

corrected errors in the attribute tables and space data of existing digital geological maps. Second, we redefined the database schema, adding the fields of rock units, geological age units, abbreviations of geological ages, abbreviations of rocks, etc.

In order to build the digital geological map database, first, we examined and revised the attribute tables of map sheets forming digital geological maps. In addition, the index map field was added to identify map sheets, and the table was redefined by adding the fields of rock units, geological age units, abbreviations of geological ages and rocks existing in the developed spatiotemporal ontology model. Second, spatial data forming the Korean territory were converted into a consistent format. Third, Geodatabase was built by integrating the adjacent abutting boundaries of polygon feature classes for each map sheet. Fourth, database was built by inserting the contents of the developed spatiotemporal ontology model into the redefined digital geological map table. Fifth, the patterns and colors of rocks were refined using the symbology unit of the spatiotemporal ontology model, and applied to the geological map schema.

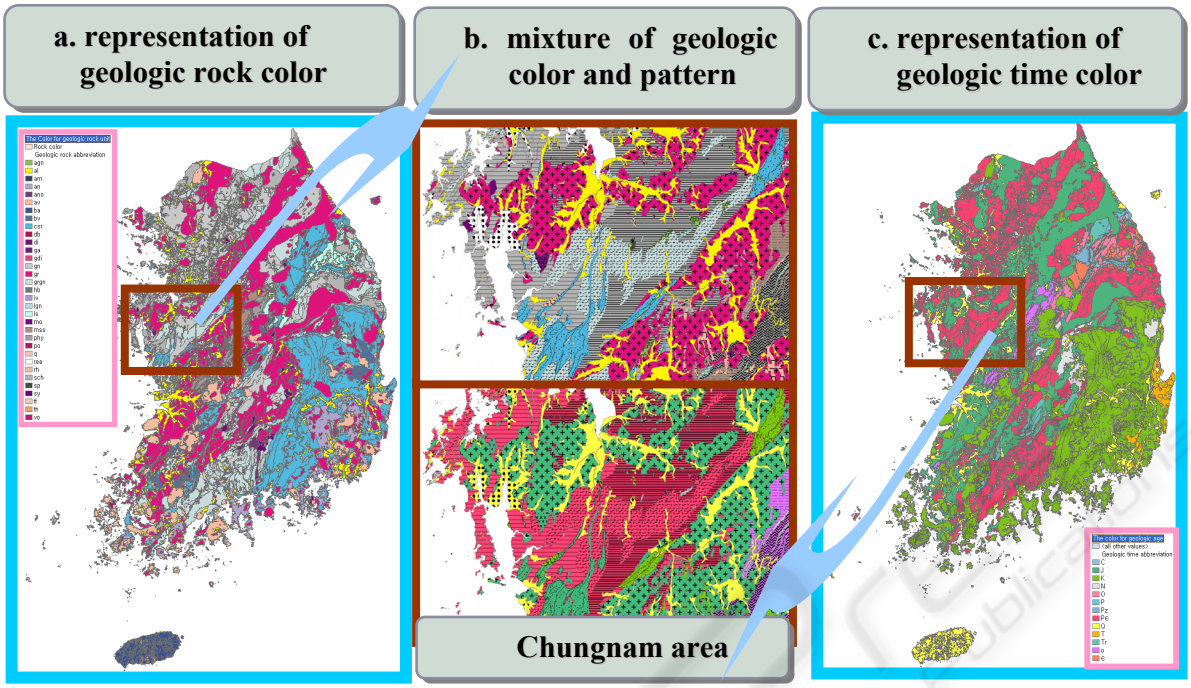


Figure 3: The representation of colors and patterns (a. representation of geologic rock color; b. Mixture of geological color and pattern; c. representation of geologic rock color).)

4 REPRESENTATION AND SPATIOTEMPORAL QUERY FOR GEOLOGICAL MAP

This research prepares the specification of spatiotemporal ontology and symbology for geological map and makes out GIS representation for digital geological map unit in South Korea.

We redefined the database schema, adding the fields of rock units, geological age units, abbreviations of geological ages, abbreviations of rocks, etc. and make out the specification of spatiotemporal ontology model for rock unit, time unit and symbology unit and visualize a variety of representation for geological map using this model(figure 3). To make out spatiotemporal DB integration: first, we need to find out the major geological term, symbol, pattern and abbreviation correctly in consideration of internet keyword which is both Korean and English. Second, we classifies geological term in hierarchy with spatiotemporal classification and prepare geological map identifiers(Geologic Map UFID) Finally,

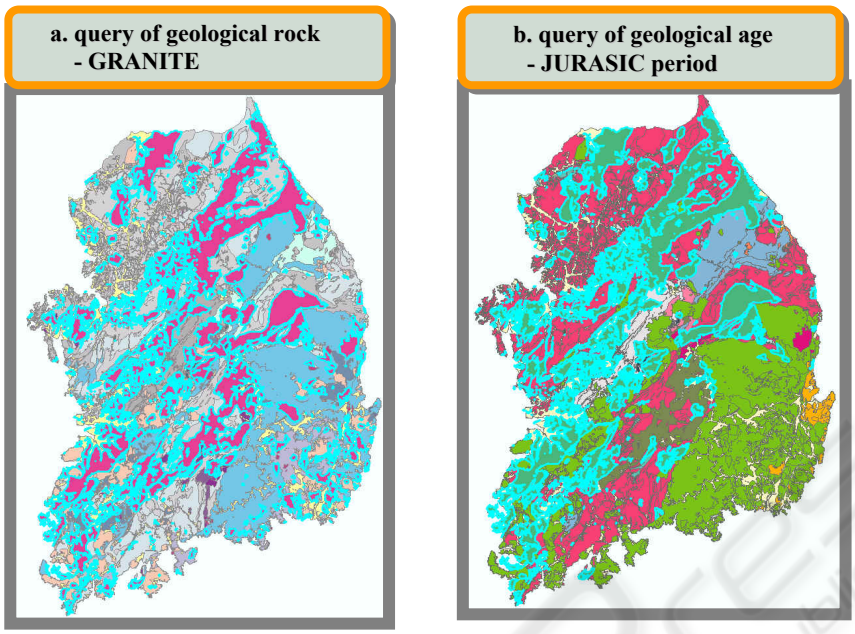
we construct the GIS DB applied geological ontology model and symbology. Therefore, it is possible to query spatiotemporal units on the integrated database of geological maps(figure 4).

5 CONCLUSIONS

This paper carry out the conceptualization and generalization of geological information to construct GIS based Geological information system through the development of spatiotemporal ontology model for geological maps. We have constructed spatiotemporal database using geological object units and thus make it possible to corporate with other spatial information or to distribute and make the best use of geological information.

This research aims to develop knowledge-based geological information system by standardizing the spatiotemporal concept units on the geological map and constructing systematic database. We expect that the use of spatiotemporal ontology model for geological map can avoid computerization costs and spatiotemporal query costs.

This research prepares the specification of spatiotemporal ontology and symbology for geological map and makes out GIS representation for digital geological map unit in South Korea.



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The conclusion and expectation effect of this research is as followings: First, We construct seamless map through the integration of geological map and the construction of database. Second, we make out the specification of spatiotemporal ontology model for rock unit, time unit and symbology unit and visualize a variety of representation for geological map using this model. The third, we extract to rock unit which is spatial objects and to geologic time unit which is temporal objects from geological map. It is possible to query spatiotemporal units on the integrated database of geological maps. Forth, we are spatially mapping for spatiotemporal ontology concepts in the geological map by extracting UFIDs (Unified Feature Identifiers) from the spatiotemporal ontology model for geological map in Korea. These extracted identifiers are used to other ubiquitous systems. Finally, We represents the appearances of geological map using colors, patterns, symbols, abbreviations included the specification of spatiotemporal ontology model for geological map.

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