A STUDY OF VIRTUAL MUSEUM TO UNDERSTAND GEOMAGNETIC REVERSE STRAUM

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ABSTRACT

Chibanian, the geomagnetism reversal stratum facing the Yorogawa River in Ichihara City, Chiba Prefecture has been announced as the geological age name of the Cenozoic Pleistocene Pleistocene. Then some ideas of local geopark concept have been discussed for the regional activation, and discussion of political civil engineering construction tends to be preceded. In view of another perspective, virtual museum, which will be suitable for a regional activity as inexpensive volunteer effort may be considered. In this paper, constituent requirements for the virtual museum, and some possible technologies have been discussed.

1. INTRODUCTION

This paper introduces the geomagnetic reversal strata that exist on the cliffs of the riverbank facing the Yoro River in Ichihara City, Chiba Prefecture

For local communities activation, civil engineering development of governmental or NPO based activities come to mind, but businesses that utilize the epoch of the geomagnetic reversal strata is difficult to expect short−term results.

From the opposite perspective, personal learning and human resource development based on a long−term effort should be expected.

One of the activities currently being discussed is the geopark concept. Focussing the geomagnetic reversal stratum, development of a geopark should be natural[1][2].

A museum of the earth will be suitable for the geopark. Volcanic geoparks such as Hakone and Asama have already exhibited the magma activity of the earth. But there seems to be no museum that systematically introduces the earth from a macroscopic perspective, such as the earth's core, earth dynamos, mantle convection, plate tectonics, and continental drift. Furthermore, if we introduce the geological age along with the evolution of living things, boys and girls should be interested in.

2. MUSEUM FOR LOCAL COMMUNITY ACTIVATION

Based on the background mentioned above, we proposed the possibility of constructing a museum with the following items.

(1) Introduction of the Ichihara area

Ichihara City in Chiba Prefecture will be introduced locally, and an overview of the geomagnetic reversal strata in the Tabuchi area should be introduced.

(2) History of the earth

From the story of the strata, we will introduce the geological age of the earth, the history of the evolution of living things, from the birth of life, to the appearance of human beings with the situation that has built today's civilization.

(3) Earth's structure

We will introduce the changes in the internal structure and surface of the earth from the birth of the earth to the present day, and introduce the earth dynamo caused by the electromagnetic fluid in the outer shell and the geomagnetism caused by it with easy−to−understand presentation. We will also introduce mantle convection, continental drift, and volcanic activities.

(4) Celestial bodies and the universe

We will introduce not only the earth but also the magnetic fields of other planets in the solar system, and also explain the formation of the solar system, planetary / satellite exploration, the possibility of extraterrestrial life, and the formation of the universe. The history of the universe, which begins with the Big Bang, has a different scale than the history of the Earth, but recent advances in space models have been remarkable and will be of great interest to curious boys and girls. Furthermore, aerospace science and technology for space exploration and space travel should also be interesting to boys and girls in.

(5) Utilization of computers

Computer simulations are effective in understanding the content of earth dynamos and geomagnetism. From that point of view, we will explain in an easy−to−understand manner how to make computers perform analysis, simulation, graphic display, etc. of physical phenomena such as mechanics, fluid science, heat conduction, and electromagnetism, hold regular workshops, and hold young human resources. Contribute to improving basic science skills.

(6) Establishment of the virtual museum with related learning groups

Groups of people who are interested in geomagnetism, the history of the earth, the geological age, etc., should be expected by means of SNS, local circle activities, club activities in schools as well as museum activities. We also proposed the website content of the exhibition and establish a virtual museum.

3. VIRTUAL MUSEUM ARCHITECTURE

3.1 Overview

Virtual museums should aim to provide systematic knowledge of the subject. Considering this, it should be natural for a creator to determine the directory structure of individual information, store the museum content in the corresponding folder, create the table of contents, and finally set up the entire index corresponding to the directory, so that the information can be searched. This method is something like creating a book on a theme, and is equivalent to gaining knowledge by referring to the text while looking at the table of contents of a book called a virtual museum.

3.2 Spacial Approach

Next, it will be necessary to consider the specific items of the content in order to organize the folders. For systematic perception, support functions should be needed to enable macroscopic understanding. For that purpose, the spatial axis and the time axis will be basic. Kant, a philosopher of German idealism, points out that human knowledge is based on spatial and chronological grasps, but it is considered to be valid in common sense. From a spatial point of view, a series such as outer space → galaxy system → solar system → earth → world map → map of Japan → Chiba prefecture → Ichihara city can be considered.

3.3 Chronological Approach

From the chronological point of view, it is a hierarchical series of the history of the universe → the history of the solar system → the history of the earth → the geological age. Furthermore, the geological age is divided into Hadean → Archean → Proterozoic → Phanerozoic, and the Phanerozoic is divided into Paleozoic → Mesozoic → Cenozoic. Furthermore, the Paleozoic period is divided into the Cambrian period → Ordobis period → Siruru period → Devon period → Coal period → Belm period. The Mesozoic period is divided into the Triassic period → Jura period → Cretaceous period, and the Neogene period is the Paleozoic third. There is a division of the period → the new third period → the Quaternary, and the fourth period has the division of the Pleistocene → the Complete new age. In the Pleistocene, there are early → middle → late, and the early is divided into Jurasian → Calabrian. There are no divisions in the middle and late stages, and there are no divisions in the Holocene at present. Chibanian is the name for the Middle Pleistocene.

3.4 Users

The users of the virtual museum will be ranged from beginners to experts. Since major targets are local people, especially young generation, it should basically be considered as beginners. If it is positioned as an operational manual, it corresponds to a tutorial manual. Information such as proficient references will rely on academic websites and Google searches.

If it is positioned as a tutorial, the goal is to introduce the above spatial and chronological understanding in an easy−to−understand manner. Introducing the series of space → galaxy → solar system → earth → world map → map of Japan → Chiba prefecture → Ichihara city, then from Hadean → Archean → Proterozoic → Phanerozoic to Paleozoic → Mesozoic → Cenozoic. We think it should be good to introduce the history of time. Regarding geomagnetic reversal, it is necessary to introduce more specialized content than general scientific understanding of space and time. Therefore, since this content is a feature of this virtual museum, it is necessary to make effort suitable for a tutorial to beginners.

4. VIRTUAL MUSEUM COMPONENT

4.1 Geomagnetic reversal mechanism

First of all, it is important to understand the geomagnetic phenomena for the virtual museum of geomagnetic reverse stratum. There is a magnetic field on the earth, but it is known that the magnetic fields of the earth and planets are generated by the magnetic hydro−dynamic action that occurs in the core. In the case of the Earth, the dynamo action occurs in the outer core, which is mainly composed of molten iron.

Figure 1 shows the Earth's internal structure, with the outer core located at a depth of 2900−5100 km[3].

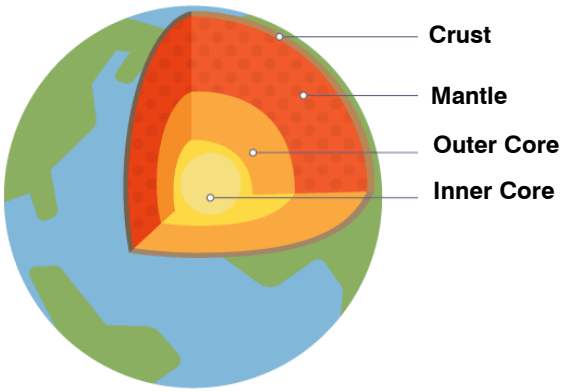


Figure 1. Structure of the Earth

When liquid metal, which is has the conductive fluid, causes convection in a magnetic field, electric current is generated by the principle of electromagnetic induction. A new magnetic field should be generated by the effect of this current, but if the generated magnetic field strengthens the original magnetic field and overcomes the ohm loss, the convection is strengthened in avalanche phenomena, and the convection of the conductive fluid can be sustained. The earth's magnetic field is generated by this principle.

4.2 Object Analysis and Design

For creating static content to systematically understand spatial and chronological phenomena, and for building simulation programs that model Earth's phenomena, including geomagnetic reversal stratum, and dynamic phenomena related to other celestial bodies, object analysis design method is effective.

As a practical method of object analysis design, UML (Unified Modeling Language) has been widely introduced. A popular method for system construction using UML is to create a class diagram with a hierarchical structure from use case diagrams and activity diagrams. In order to create the class diagram for Web content, it is an effective method to organize the content model by XML, because HTML description of Web content can be transformed from XML data through XSLT method. We have developed a system model from UML data model to Web content through XML shown in Fig.2[4].

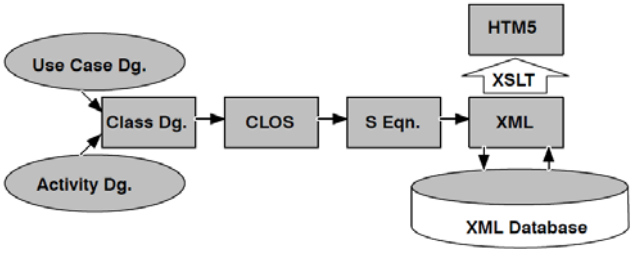


Fig. 2 From UML to HTML5 Content Management Model through CLOS, XML with XML Database Implementation

The content management system mentioned above is suitable for creating and implementing such hierarchically organized models as creating a class diagram from the use case diagram and activity diagram at first. Then the class diagram is defined by CLOS（Common Lisp Object System）and its instance is described in Common Lisp S−equations, which are converted to XML data through Lisp functions. While those XML data, used as a basic data model, are systematically stored in the XML database, XML data are converted to HTML5 by XSLT and displayed as the Web content.

4.3 Example of XML data to HTML5

As mentioned above, the content of the virtual museum are something like electronic books in which the table of contents, index, keywords, and etc., are managed through systematic technology with metadata and/or database. The content will be HTML5 and XML with various types of files. Basic architectural data will be XML with various attributes. Then the mechanism for converting XML to HTML5 should be technically important. XSLT is a tool for that. Typically, the data defined in XML will be frequently displayed on the Web in tabular form. So we should like to introduced an example here. The following is displaying the data of the top layer of the geological age in XML.

```
<?xml version="1.0" ?>
<!-- Geological age -->
<?xml-stylesheet type="text/xsl" href="Geological age.xsl"?>
<Geological age>
  <Geological age group>
    <Name> Hadean </ name>
    <Time> 4.6 billion years ~ </ strong>
    <Features> Birth of the Earth </ Features>
  </ Geological age classification>
  <Geological age group>
    <Name> Archean </ name>
    <Time> 4 billion years ~ </ strong>
    <Features> Birth of life </ Features>
  </ Geological age classification>
  <Geological age group>
    <Name> Proterozoic </ name>
    <Time> 2.5 billion years ~ </ strong>
    <Features> Multicellular organisms </ Features>
  </ Geological age classification>
  <Geological age group>
    <Name> Phanerozoic </ name>
    <Time> 540 million years−present </ time>
    <Features> After the Cambrian explosion </ Features>
  <Geological age / classification>
</ Geological age>
```

In our system content is described in Japanese as follows.

```
<?xml version="1.0" ?>
<!-- 地質年代 -->
<?xml−stylesheet type="text/xsl" href="地質年代.xsl"?>
<地質年代>
  <地質年代区分>
    <名称>冥王代</名称>
    <時期>46億年～</時期>
    <特徴>地球誕生</特徴>
  </地質年代区分>
  <地質年代区分>
    <名称>始生代</名称>
    <時期>40億年～</時期>
    <特徴>生命誕生</特徴>
  </地質年代区分>
  <地質年代区分>
    <名称>原生代</名称>
    <時期>25億年～</時期>
    <特徴>多細胞生物</特徴>
  </地質年代区分>
  <地質年代区分>
    <名称>顕生代</名称>
    <時期>5.4億年～現在</時期>
    <特徴>カンブリア爆発以後</特徴>
  <地質年代/区分>
</地質年代>
```

The tabulated data is shown in Table 1 as follows.

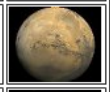
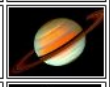
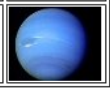
Table 1. Tabulated data from the XML data in Japanese

名称	時期	特徴
冥王代	46億年～	地球誕生
始生代	40億年～	生命誕生
原生代	25億年～	多細胞生物
顕生代	5.4億年～現在	カンブリア爆発以後

Image data as Jpeg can be included in the table, and the taxonomic information can be organized visually and systematically. Table 2 shows an example of classification and display of planets in the solar system.

4.4 Simulation Content

Table 2 Data of Planets in the Soar System

番号	惑星名	太陽までの平均距離	衛星数	画像
0001	水星	0.387 au	0	
0002	金星	0.723 au	0	
0003	地球	1 au	1	
0004	火星	1.523 au	2	
0005	木星	4.952 au	69	
0006	土星	9.554 au	61	
0007	天王星	19.218 au	27	
0008	海王星	30.068 au	14	

What we would like to expect as a virtual museum model is the dynamic simulation. Especially for electromagnetic phenomena such as geomagnetic reversal, we would like to expect a visually appealing model. Such fields have not always been introduced in conventional museums and Web content, but new development is expected due to the strong computer power and the development of simulation tools in the future.

The handling of spatial information using the finite element method comes to generalized, and fluid simulation tools combined with the finite element method have also been established. In the field of Computational Fluid Dynamics (CFD), it is the aerodynamic design of moving objects such as aircraft, ships, automobiles, and railroad vehicles, the analysis of airflow and sea currents in map systems, and the wind to buildings and steel towers. It is widely used for the influence of the above, indoor airflow in ventilation and air conditioning, etc.

The application of the Earth's outer shell to electromagnetic fluids for the "Chibanian Virtual Museum" seems to be an issue for the future, but it is expected to be realized. Such simulation methods are also an interesting application field that expands the possibilities of virtual museums in the future, but the key is to develop tools that are easy to understand and use.

5. DISCUSSION

This proposal is merely a starting point, but in order to activate the region, it will be necessary to propose such a rough plan and to organize discussion through various practical dialogues.

In Chapter 2, we introduced the overview and outline of the virtual museum. Chapter 3 introduced the architecture of spatial and chronological development approach and also architecture for users. Chapter 4 explained the geomagnetic reversal mechanism, object analysis and design method, XML to HTML5 conversion, and simulation method related to content.

Explanation of the geomagnetic reversal phenomenon and the easy−to−understand introduction should be especially important. This should be the essential issue for the future study.

Currently, Chibanian Visitor Center has been opened locally and operated as a real museum. The virtual museum should be expected to support the role of the visitor center.

6. CONCLUSION

Chibanian, the geomagnetism reversal stratum facing the Yorogawa River in Ichihara City, Chiba Prefecture has been named as the geological age name of the Cenozoic Pleistocene Pleistocene. Architecture and component of the virtual museum concerning to Chibanian has been planned and studied. A systematic content management model based on UML for virtual museums has been proposed. Development of content which explains the geomagnetic reversal phenomenon and the easy−to−understand introduction should be especially important and expected in future. Personal learning and human resource development based on a long−term effort should also be expected.

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