Geophysical Research Abstracts, Vol. 8, 02091, 2006
SRef-ID: 1607-7962/gra/EGU06-A-02091

Spatial geo-database of island arc magmatism and volcanic hazards in Sunda Arc, Indonesia

A. Lucas Donny Setijadji (1,2), B. Koichiro Watanabe (1)

(1) Department of Earth Resources Engineering, Graduate School of Engineering, Kyushu University, Fukuoka 812-8581, Japan, (2) Department of Geological Engineering, Faculty of Engineering, Gadjah Mada University, Yogyakarta 55281, Indonesia
(lucas@mine.kyushu-u.ac.jp)

The Sunda Arc, Indonesia consists of numerous Cenozoic and active volcanoes. Largest known eruptions according to their volcanic explosivity index (VEI) are found here, i.e., the Toba (74 ka, VEI 8), Tambora (AD 1815, VEI 7), and Krakatau (AD 1883, VEI 6). In term of casualties, the Tambora 1815 eruption is the worst in the world with 92,000 people killed, followed by 36,000 people killed by a tsunami following the Krakatau 1883 eruption. The Toba eruption was considered affecting the global climate and the evolution of *Homo Sapiens*. Geologic records, either onland or at the sea beds, indicate that other catastrophic volcanic eruptions had also occurred in older geologic ages. In this study we develop a geo-database of island arc magmatism and its volcanic hazards in Sunda Arc since the initiation of Sunda Trench (65 Ma). The aims are to document geologic records and evaluate the evolution of such a long-live subduction zone. For volcanic hazard study, this database is expected to contribute for a better understanding on the scale of impacts and the causes of explosive volcanic eruptions in regard with regional to district-scale tectonic setting, crustal and mantle geology, seismic activities, and geochemistry of magma and volcanic products. In the future development this database is also expected to support a study on the impacts of volcanic eruptions to human evolution of ‘Java Man’ since the Pleistocene period.

We have designed a conceptual data model for volcanic eruption geo-database based on the object-relational modeling technology. Considering the large scale of study area and the expected datasets involved, the fundamental database design is to follow the basic design of other international projects on geoscience data models, such as the ongoing North America Geology Map Data Model (NADM), ESRI Geology

Data Model, and our own Geoscience (Earth Resources) Data Model. Such adaptation allows us to concentrate only on the core data model of volcanic hazards, while using the existing data models for other, more generic geoscience datasets. Fundamental entity definition and relationships among geo-objects involved in a volcanic eruption are logically defined as follows. A volcano is a compound earth material that experiences volcanic eruption event at least once during its lifetime. A caldera is a special type of volcano with a large volcanic depression formed by collapse of the summit or flanks of a volcano evacuated by very large explosive eruption(s). The subduction, arc magmatism processes (e.g., partial melting, fractional crystallization, magma mixing), and volcanism are among the geologic processes that result on the creation of a volcanic eruption. Such processes can be monitored using geophysical methods (e.g., gravity and seismic survey) as well as geochemical investigations. A volcanic eruption is a geologic event that occurs in a specific geologic time, and this age can be measured by relative and/or absolute dating methods. The style and scale of eruptions are parts of geologic properties of a volcanic eruption that can be determined by several classifications, such as VEI and DRE units. Major products of a volcanic eruption are tephras and volcanic rocks; such products are represented as lithological units in a geologic map representation. The spatial distribution of volcanic products from a volcanic center defines a volcanic field. Volcanic products are in turn taken as samples (i.e., rock, gas, or water) and are characterized for their mineralogy, elemental and isotopic compositions using various kinds of analytical instrumentations.

The logical data model is articulated into a universal modeling language (UML) diagram as follows. The top level of data model is the ‘Universe’ that consists of three subclasses: GeologicConcept, Metadata, and GeologicRepresentation. The GeologicConcept compiles all geo-objects and is divided into several group classes. The core of volcanic eruption data model currently consists of interconnected classes of EarthMaterial (Volcano, Caldera and Tephra), GeologicUnit (LithostratigraphyUnit and VolcanicFieldUnit), GeologicProcess (Subduction and Volcanism), GeologicEvent (SubductionEvent and VolcanicEruptionEvent), GeologicSample (RockSample, GasSample, and WaterSample), GeologicProperty (VolcanoType, EruptionType, GeologicAge, VEI, DRE), and GeologicMeasurement (GeophysicalMeasurement, RadiometricDate, ElementalAnalysis, and IsotopicAnalysis). The conceptual UML design of data model has been implemented into a physical relational database that is directly linked with a three-dimensional geographic information system (3D GIS). The GIS utilizes the GeologicRepresentation of data model as the spatial interface between GIS and relational database. The result is a spatially enabling geo-database of volcanic eruptions in Sunda Arc, in which complex contents of the relational database can be visualized, navigated, and interrogated in a 3D spatial environment.