

## Learning of geological formation for pupils by Geological Museum: Part (3) Explanation of geological formation

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The Geological Museum offered the learning program of geological formation as off-campus education program for elementary schoolchildren in the 2008 fiscal year. As a part of this program, the authors presented the explanation of geological formation in the audiovisual room. The contents of presentation are divided into the following four parts: 1) Topography and outcrops of geological formations around their schools, 2) Relationship between topography and geology (including with geological map reading), 3) Vertical succession and 3D distribution of geological formations, and 4) Investigation about the reason why stones are so hard. These contents are described in detail as follows.

1) Topographic features around their schools are shown by graphics using computer software Kashmir3D and Google Earth. In general, topographic features are roughly divided into three parts: low lands, terraces and mountains. Most pupils have not experienced to observe the outcrops of geological formations because most outcrops are covered with surface soil, vegetation and artificial covers such as cement.

2) Pupils learn how to read the geologic map. Surface soil is denuded from the surface of geological map. The younger formations are painted with the lighter colors, and the older the darker color. The cold colors are used for sedimentary formations, and warm colors for igneous formations. Pupils can understand the relationship between topography and geology as follows. Lowlands and terraces are composed of younger formations, and mountains are of older formations.

3) The authors ask pupils to imagine what kind of the geologic outcrop will appear if they cut and open the school ground by big knife. The photo of big quarry of sand and gravel near Lake Kasumigaura is shown. The geological cross sections are also presented from the geological map of Tsukuba Science City and its surroundings with a scale of 1:25,000. Both figures help them to realize the geological sequences hidden under the ground. The outcrop shows that the formations are underlain in descending order: surface soils, volcanic ash, clay formation, and sand formation. The big fossil, molar of *Elephas naumani* is found from the clay formation. The mold of the fossil is taken with hands and observed by pupils. The pupils are asked what kind of formation will be revealed by 500 m depth drill holes. It is explained by geologic cross sections that granitic rock composed of Mt. Tsukuba distributes widely under the surface.

4) The final question is the reason why stones are so hard. The authors give hints that formations accumulate and migrate into deeper portion, and emerge again on the surface. We call it as the underground trip by stone in order to give them strong impressions.

The authors have already given lectures on geological formations to schools more than 15. Our impressions will be told as follows.

1) Mutual communication is emphasized in order to inspire pupils to the subjects at the classes. Mutual communication ability of pupils seems to be related to daily communication between teachers and pupils at their classes.

2) It is very important for pupils to observe real outcrops of geological formations. The author would like to recommend teachers to organize out-of-school observation trip to geological outcrops besides visiting to our geological museum.

3) It is very important for pupils to take real samples with hands for their deep memories.

4) It is very important to evaluate the abilities of speculation and analogical inference rather than simple learning of technical terms.