

Suggestion for the Earth Science in the educational systems in Japan from a Geochemical point of view

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We will make recommendations concerning the geochemical contents in the Earth Science in the educational systems. We are members of the Geochemical Society of Japan. However, this presentation does not reflect the official opinion of this society.

1) Recent studies of geochemists in Japan

We have analyzed recent studies of geochemists in Japan based on their presentations at the annual autumn meeting in 2004. Objects of the studies are the Atmosphere, Oceans, River and Ground water, Lakes, Rocks and Minerals, Meteorites, Earth, etc. In these studies, they measure major elements, minor elements, rare earth elements, hydrogen, oxygen, radioactive elements, etc. Contents of the studies are environment problems, movement of chemical elements, dating, etc. Many types of instruments, such as TIMS, ICP-MS, are used for measurements of elements, ions and isotopes.

2) Geochemical contents in current Earth Science curriculum in Japan

a) Junior high school: The structure of the atom, ions, isotopes and radioisotopes are not mentioned in segments related to 'atoms and molecules' or 'chemical formulas'. Carbonic Calcium and SiO₂ are included in 'stratification'. In 'Volcanoes', there are descriptions of relationships between igneous rocks and SiO₂, but no detailed discussion of the contents of volcanic gases. Fossil age, not radiometric age, is the only measurement for the geological time scale. There is no explanation of many popular words such as meteorite, supernova, big bang and solar wind. There is no geochemical explanation of recent environmental problems.

b) Senior high school: {General Science A}; There are explanations of elemental symbols, isotopes and radioisotopes in 'Structure of the atom' and 'Atomic energy'. However, there is no detailed explanation for ion. Metal elements of land and sea floor and contents of seawater are described in 'Resources.' We can find discussions of popular elements in living, but not in nature. In 'Air Pollution', we can also find the formulas for chemical reactions concerning acid nitrogen. {General Science B}; There is much interesting content about the Sun, the Planets, the Earth, History of the Earth, Circulation of matter, and Environmental pollution. There are simply written explanations using chemistry without chemical symbols and formulas for such topics as primordial atmosphere, ozone, acid rain and the greenhouse effect. There is no discussion of the words ion, isotope or radioisotope. {Earth Science IB}; We can find the words ion and radioisotope in the discussion of thermal flow, radiometric age, minerals, sedimentary rock and seawater. We can also find chemical matters in volcanoes, volcanic rocks, deposits, the history of the earth, environmental problem, structure of the atmosphere and the Sun. Students who did not study chemistry in 'General Science A' or 'Chemistry' in senior high school must understand these matters only from the poor chemical knowledge gained in junior high school. There is no discussion of isotope as is currently used by geochemists. {Earth Science II}; Creation of elements in space is described in this course.

3) Suggestions from geochemical viewpoint

*Students must learn about chemical matters connected with nature and life not as only elements. *Students who do not need science in the future must learn basic chemical knowledge concerned with environment problems, disaster and life. For this purpose, they need knowledge of ions and isotopes. *This knowledge must be required on the university entrance examination. *We wish to include the following contents in the Earth Science at the senior high school: Ancient environment, movement/circulation of elements concerned with environmental problems and evolution of the earth, isotopes (Sr, He, etc.) in plate tectonics, geochemistry for earthquakes, volcanic eruptions and meteorites, new instruments for measuring chemical matters, etc.