Secular Change of the Solid Earth

TSUYOSHI KOMIYA

Dept. Earth & Planet. Sci., Tokyo Inst. Tech., 152-8551, Japan, (tkomiya@geo.titech.ac.jp)

It is twenty years since Allègre (1982) proposed chemical geodynamics as an integrated study of physical structure and evolution of the solid Earth. Complete investigation of geodynamics requires addressing not only the present-day structure, but also the historical evolution of the earth. Especially, understanding the thermal and compositional evolution of the mantle is essential. However, there are two inherent problems; post-magmatic alteration, and tectonic setting. We eliminated elemental movements during alteration by comparison between whole rock and relict igneous cpx compositions. The tectonic setting of mafic magmatism was estimated by an independent method; application of accretionary geology to the Archean greenstone belts.

Our reinvestigation of geology of the Acasta Gneiss Complex indicates that at least four intermediate to acidic magmatism occurred from > 4.1 to 3.5 Ga. The oldest magma was granodioritic to dioritic, and occurrs as many enclaves within well-dated (*ca*. 4.1 Ga) tonalitic to granitic white gneisses at present.

The potential temperature and FeO content of the upper mantle were estimated by comparison of the most primitive MORB from 3.8 to 1.9 Ga with recent melting experiments. The result indicates that the upper mantle had higher FeO content (10 wt %), and that the FeO content was constant until early Proterozoic, and then decreased. Segregation of iron grains from subducted oceanic crust during slab penetration into the lower mantle is plausible to decrease the FeO content in the mantle. If the produced metallic iron sinks and accumulates on the core, the metallic iron layer would be about 57 km thick. The potential mantle temperature of the upper mantle was about 1480 ˚C, and was hotter by *ca.* 150 to 200 ˚C than the modern mantle. The difference of tempearture resulted in thick (*ca*. 15-20 km) oceanic crust, and the temperature also decreased not monotonously, but episodically.

The high temperature of the mantle resulted in high geothermal gradient at the subduction zone, due to subduction of young oceanic plate. Consequently, the thick oceanic crust was partially molten to create many huge TTG batholiths. The slab melting changed the oceanic crust (density=3.07) into a denser Grt-bearing residue (density=3.55), implying that TTG melt extraction provided a potential driving force for Archean plate tectonics. This suggests that Precambrian-type plate tectonics, whose driving force is slab-pull due to densification of the residue of oceanic crust, was already operating in the Early Archean. The transition from Precambrian-type to Phanerozoic-type plate tectonics may be caused by thinning of oceanic crust and thickening of oceanic lithosphere in the late Proterozoic, due to decrease of mantle temperature.

A Multi-element approach to the relative dating of bone fossils

M. KONDO[1], S. MATSU'URA[1], F. AZIZ[2], SUDIJONO[2], E. FUJIMORI[3], H. SAWATARI[4] AND H. HARAGUCHI[3]

[1]Department of Human Biological Studies, Ochanomizu University, Tokyo 112-8610, Japan (megkondo@cc.ocha.ac.jp), (matsu-ur@cc.Ocha.ac.jp)
[2]Geological Research and Development Centre, Bundung 40122, Indonesia (azizf@bdg.centrin.net.id)
[3]Department of Applied Chemistry, Graduate School of Engineering, Nagoya University, Nagoya, 464-0814, Japan (fujimori@apchem.nagoya-u.ac.jp), (haraguch@apchem.nagoya-u.ac.jp)
[4]Research division of Education, Miyagi University of Education, Aoba, Sendai, 980-0845, Japan

Discoveries of hominid fossils are essential for the study of human evolution. Hominid fossil findings are supposed to be examined from various aspects such as morphology, genetics, nutrition and so on; and accurate estimation of the antiquity of these fossils is needed as a basis. Radiometric ages determined on volcanic minerals in the fossil-bearing strata, are usually regarded as substituting for the age of fossils. In case the provenance of the fossil is not precisely grasped, however, it is not feasible to adopt such indirect dating results. For instance, the island of Jawa, Indonesia, which is a treasury of *Homo erectus* fossils, has more than 50 specimens up to now, while most of them are incidentally found on surface ground by inhabitants around. A possible course of events may be like this; a fossil was washed out from an outcrop, falling down and/or rolling down in a stream and so forth, finally found distant from the original bed. Such case makes it difficult to establish the framework of its chronology. We made progress of the fluorine dating method which is well known as a method to solve this provenance problem in Jawa. We have been further trying to discriminate provenances of fossil bones from Jawa by determination of various inorganic elements in fossil bone; and have found that with some new index elements and applying discriminant analysis using these multi-elements as variables, bone stratigraphic sources can be more effectively distinguished than by using the single element of fluorine. Some successful applications to the hominid fossils from Jawa are being obtained.