Neo-Science of Natural History: An Interdisciplinary Program for the 21st Century Center of Excellence at Hokkaido University, Japan

Noriyuki Suzuki[1], Shunsuke F. Mawatari[2] and Hisatake Okada[1]

[1] *Division of Earth and Planetary Sciences, Graduate School of Science, Hokkaido University, Sapporo 060-0810, Japan*
[2] *Division of Biological Sciences, Graduate School of Science, Hokkaido University, Sapporo 060-0810, Japan*

ABSTRACT

The 21st Century Center of Excellence (COE) Program for the "Neo-Science of Natural History" was launched in 2003 as a 5-year-long, grant-in-aid program awarded by the Japanese Ministry of Education, Culture, Science, and Technology (MEXT). The 21st Century COE Program is an initiative by MEXT to further strengthen education and research activities at Japanese universities. The acceptance of applications for proposed COE programs by MEXT started in 2002 and has continued for 3 consecutive years. Of the 611 applications submitted in FY2003, when we applied, a total of 133 applications were approved together with this COE Program entitled as the "Neo-Science of Natural History - Origin and Evolution of Natural Diversity". Our program is one of 25 programs selected in the research field of "Interdisciplinary, Combined Fields, and New Disciplines".

INTRODUCTION

Various research fields in the sciences originated from the science of natural history, and subsequently became differentiated from one another (Fig. 1). The most significant differentiation took place in the 19th and 20th centuries. Recently, there has been a growing realization that the basic sciences of natural diversity and Earth systems require increasing collaboration between geoscientists and biologists. However, despite an urgent need for integration across geoscience and bioscience, progress in this direction is still limited by traditional institutional structures. The present COE program on the "Neo-Science of Natural History - Origin and Evolution of Natural Diversity" stems from a realization of the necessity to establish an intellectual home for the newly emerging research field of natural history that integrates subfields of the Earth and Life sciences at Hokkaido University.

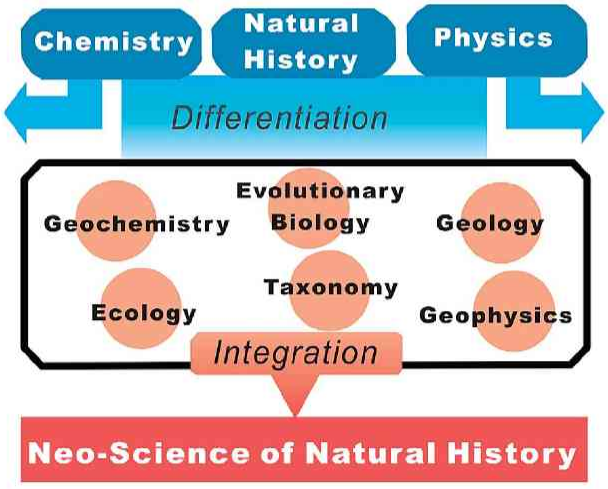

Fig. 1 Conceptual diagram depicting the integration of various subfields of natural science into the Neo-Science of Natural History.

Mawatari, S. F. & Okada, H. (eds.), *Neo-Science of Natural History: Integration of Geoscience and Biodiversity Studies,* Proceedings of International Symposium on "Dawn of a New Natural History - Integration of Geoscience and Biodiversity Studies", March 5–6, 2004, Sapporo, pp. 3–6.

OBJECTIVES, RESEARCH PLAN AND HUMAN RESOURCES

The primary objective of this COE program is to create a modern scientific and academic discipline of the "Neo-Science of Natural History" through the integration (Fig. 1) of various subfields of the Earth sciences (e.g., geochemistry, geophysics, biostratigraphy) and the Life sciences (e.g., biodiversity studies, taxonomy, evolutionary biology), with the goal of gaining a thorough understanding of the origin and evolution of terrestrial matter and the diversity of life. Attaining this objective will require comprehensive research on the diverse phenomena occurring in the life-sustaining outer envelope of the Earth, encompassing the lithosphere, the hydrosphere, the atmosphere, and the biosphere.

This COE Program will establish a research and education center dedicated to modern approaches to exploring nature by studying the long- and short-term interactions between the Earth and life, as well as material cycles on the Earth and phenomena of climate change (Fig. 2). We will investigate various long-term phenomena, such as the appearance and fluctuations of the Asian monsoon, which is directly related to the enhancement of the diversity of the flora and fauna in the vast region of Asia. Such processes occur at time scales of tens of millions to several million years and are influenced by complex interactions between the Earth and living organisms. Changes in sea level, land-sea configurations, and regional geography from glacial to interglacial epochs, etc., governed by interplay between the Earth and life operating at time scales of hundreds of thousands to several years will be considered under research on short-term Earth and life interactions.

A new graduate-level curriculum, the neo-science of natural history, will be introduced that incorporates subfields of Earth science and biodiversity research and includes interdisciplinary topics. This will be accomplished in accordance with the existing research and educational philosophy of Hokkaido University. The COE will also create a new graduate level course on the "Neo-Science of Natural History" suited for international students, and will endeavor to secure a certain number of scholarships from MEXT on a regular basis.

Research programs will take into consideration the goals put forward by international scientific research initiatives such as the Integrated Ocean Drilling Program (IODP), the Global Biodiversity Information Facility (GBIF), and the Global Taxonomy Initiative (GTI). The contribution from Japan to such global science programs, compared to that

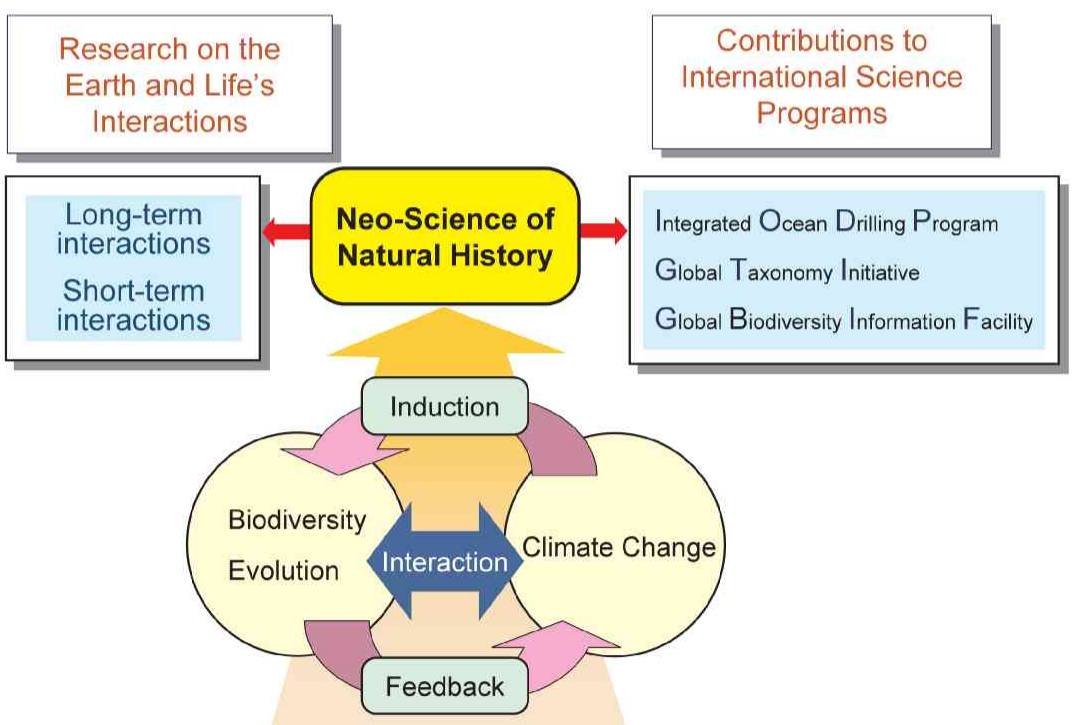

Fig. 2 Summary of research plan of the COE for the Neo-Science of Natural History.

of other developed countries, has so far been inadequate. This is partly due to the small number of Japanese scientists undertaking research on natural diversity. Hence, due importance will be accorded to training people in specialized skills using a novel educational and research system, thereby contributing to international science initiatives on natural diversity. With regard to research on ocean sediments, emphasis will be placed on an integrated approach combining various subfields, such as fossil-based stratigraphy, geochemistry, and geophysics.

Under our COE program, the cultivation, training, and utilization of human resources will be fundamental to progress in taxonomy. The Hokkaido University Museum will function as an interface among various divisions and research centers toward this goal (Fig. 3). Programs involving the university museum will be conducted to re-educate museum curators, train parataxonomists (skilled lay-specialists who function as taxonomists), participate in the creation of electronic databases on natural diversity (both biological and geological), and disseminate our understanding of natural phenomena to ordinary citizens through public seminars. Research will be conducted on the best methods for dissemination to the public of knowledge on the "Neo-science of Natural History", using a computerized database accessible via the Internet.

Twenty-one core members, represented by academics and research scientists of Hokkaido University, are participating in the COE program. They are affiliated primarily with the Graduate School of Science (Division of Earth and Planetary Sciences and Division of Biological Sciences), but also with other graduate schools and research centers (Division of Environmental Resources of the Graduate School of Agriculture, Center for Advanced Science and Technology, Division of Marine Environment and

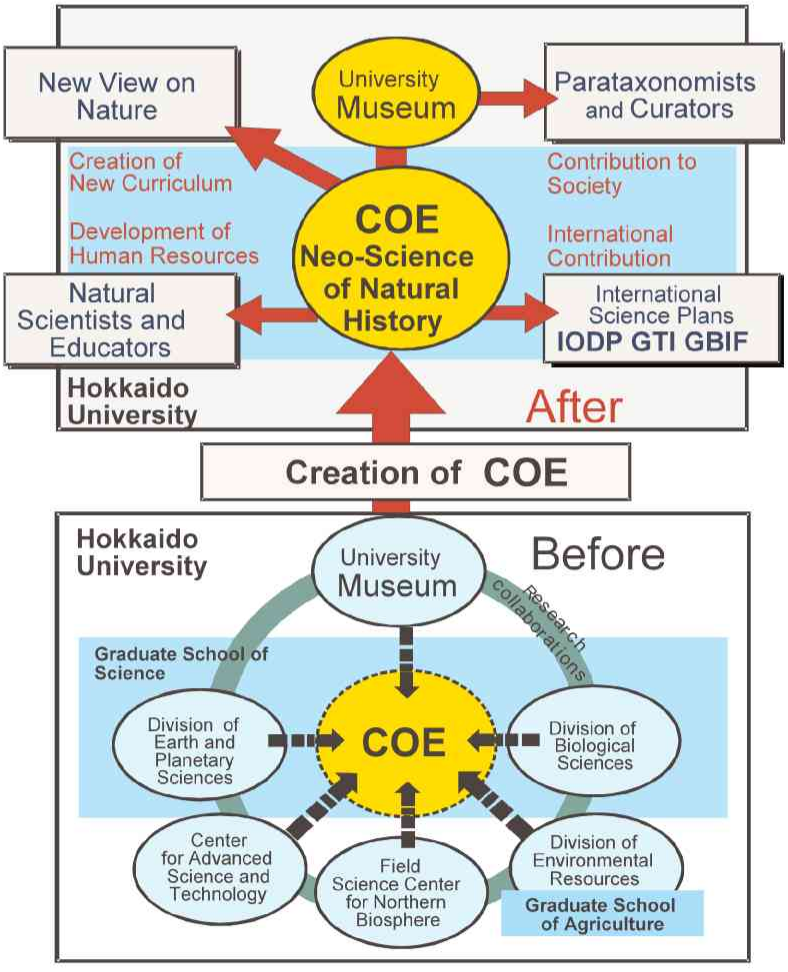

Fig. 3 Participation of various graduate schools, research institutions, and the University Museum in creating the COE for the Neo-Science of Natural History, and the institutional position of the newly created COE.

Resources of the Graduate School of Fisheries Sciences, Field Science Center for the Northern Biosphere, and Information Initiative Center).

The fields of expertise of the core members encompass the Earth sciences (primarily paleoceanogeography, inorganic geochemistry, biogeochemistry, isotope geochemistry, mineralogy, economic geology, sedimentology, tectonics, hydrology, and climate systems), biodiversity studies (primarily systematics (phylogenetics/taxonomy), evolutionary biology, biogeography, and ecology), and information science (computer networks). In order to execute the multidisciplinary research programs smoothly, the COE has been employing postdoctoral researchers (PDs), one per core member. In addition, the program supports the involvement of a number of young researchers, represented by doctoral course students, as research assistants (RAs), for constructive participation in the COE research activities. Both the PDs and RAs conduct collaborative or independent research on topics related to the themes put forward and advanced by their respective COE core members. Emphasis is given to collective research efforts that contribute to the overall objectives of the COE program.

CONCLUDING REMARKS

The 21st Century Center of Excellence (COE) Program for the "Neo-Science of Natural History" is a platform that combines intellectual and experimental efforts by both geoscientists and biologists. We aim to understand the Earth system and its evolution in broad terms, on both spatial and temporal scales. Being in its initial stages, the COE program must still optimize its programs to make them more effective and fruitful. In order to develop a common vision and to revise working guidelines of the COE program, input from workshops and seminars (such as the first COE international symposium, "Dawn of a New Natural History - Integration of Geoscience and Biodiversity Studies", held 5–6 March 2004) is of utmost importance. The opinions expressed by the invited speakers from home and abroad, and active discussions between them and core members regarding the overall COE program objectives, their importance, and ways to effectively execute the research plans, will be considered in the days to come. Further information on current programs is available from the COE Webpage at the following URL: http://nature.sci.hokudai.ac.jp/index_e.html.