

2024 年 8 月 11 日

YYYY/MM/DD

独立行政法人日本学術振興会理事長 殿

To: President, Japan Society for the Promotion of Science

研究活動報告書

Research Report

1. 受入研究者/ Host researcher

受入研究機関・部局・職

Name of Host Institution, Department and Title

京都大学・大学院農学研究科・准教授

受入研究者氏名

Host Researcher's Name

渡邊 哲弘

2. 外国人招へい研究者/ Fellow

所属研究機関・部局・職

Name of Institution, Department and Title

University of California, Davis, Department of Land, Air and Water Resources, College of Agricultural and Environmental Sciences, Distinguished Professor, Emeritus

外国人招へい研究者氏名

Fellow's Name

DAHLGREN Randy Alan

3. 採用期間/ Fellowship Period

2024 年 4 月 1 日

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2024 年 6 月 30 日

4. 研究課題/ Research Theme

多様な生態系における岩石中窒素 (Rock-N) からの窒素放出メカニズムの解明

5. 研究活動報告/ Research Report

(1) 研究活動の概要・成果/ Summary of Research Results

The primary research focus of the fellowship was to investigate the occurrence of nitrogen in bedrock from sedimentary origin in Japan. This study builds upon results from a previous study in California demonstrating that geological-derived sources of nitrogen can be ecologically significant. As Japan and California both occur along the Pacific Ring of Fire, their geologic environments are similar in many ways with major accretionary wedges of marine origin comprising many of the coastal mountains. As a proof-of-concept, a total of 116 bedrock samples were collected along a north-south transect from the Sea of Japan to the Pacific Ocean. These rock samples are currently being processed for the determination of total carbon and nitrogen contents. An initial set of samples ($n = 79$) revealed a median total nitrogen concentration in sedimentary rocks of ~ 625 mg/kg, with maximum concentration on the order of 1450 mg/kg. While these values might appear small relative to other rock-forming elements, a 10-cm thickness of rock will contain ~ 1625 kg N/ha that can be slowly released upon chemical weathering. These values are consistent with values found in bedrock samples from California where they have been shown to stimulate the primary productivity of both terrestrials and freshwater aquatic ecosystems.

We further exploring sites/methods to determine whether the nitrogen release from bedrock has an ecological effect on forest productivity and stream/groundwater nitrate concentrations. Based on a country-wide survey of nitrate concentrations in rivers/streams across Japan, a distinct zone of high nitrate concentrations has been observed along the Median Tectonic Line. We have confirmed in Wakayama and Shikoku that high bedrock N occurs in the bedrock surrounding the Median Tectonic Line. Ongoing work and collaborations with hydrologists are underway to pursue this high nitrate anomaly. Given the much higher precipitation values in Japan versus California, the ecological impacts of nitrogen released from bedrock maybe very different. Additionally, Japan receives higher inputs of atmospheric N deposition (~10 kg N/ha/yr) than found in northern California (<2 kg N/ha/yr). Once we have completed our preliminary analyses, we will have a better understanding of how the nitrogen contained in geologic materials is impacting Japanese forests and stream/ground waters.

In addition to the focus on geologic sources of nitrogen from bedrock, significant progress was made on a continental-scale analysis of active Al/Fe (acid oxalate extractable fraction) based on the USDA-NRC soil characterization database for the United States, controls of phosphorus concentrations in volcanic spring waters (Japan versus California comparison) and the stabilization of organic carbon in buried A horizons of Andosols. These additional research objectives have demonstrated very interesting results and provide background to guide future research projects. For example, large volcanic springs (groundwater) in both Japan and California have naturally elevated levels of dissolved PO₄. The dissolved PO₄ concentrations appear to be regulated by equilibrium with hydroxyapatite [Ca₅(PO₄)₃(OH)]. After a second sampling of spring waters on Mt. Aso (Kyushu) this fall, we will have sufficient data to write a paper on this topic.

(2) 主な研究発表(雑誌論文、学会、集会、知的財産権等) / Main Research Publications

Watanabe, T., Lyu, H., Ashida, K., Urayama, S., Hartono, A., Kilasara, M., Mvondo-Ze, A.D., Nakao, A., Sugihara, S., Dahlgren, R.A., Funakawa, S. 2024. Controlling factors for soil organic matter content in surface and subsurface horizons of non-volcanic soils. 9th International Symposium of Interactions of Soil Minerals, October 15-18, Tsukuba.

(3) その他/ Remarks

Traveling Seminars/Visits

Professor Dahlgren also delivered research seminars and/or held discussions with faculty and students at (1) Kyoto Prefectural University, (2) Kyushu University, (3) Tokyo University of Agriculture & Technology, (4) National Agriculture & Food Research Organization (NIAES/NARO) – Tsukuba, (5) Hirosaki University, (6) Akita Prefectural University, and (7) Tohoku University. Several of these discussion have the potential to develop into future collaborative research opportunities between these universities/research groups-Kyoto University-University of California.

Kyoto University Seminar & Teaching Activities

Professor Dahlgren provided 6 seminars at Kyoto University related to soil biogeochemistry. These topics covered a range of soil science topics that provided students with a broad understanding of interactions between the atmosphere, hydrosphere, biosphere and geosphere in the context of soil and ecosystem processes. The six seminar titles follow:

1. From subduction to salmon: Geologic subsidies drive high productivity of volcanic spring-fed rivers
2. Volcanic soils: What makes them so special!
3. Spatial/temporal water quality dynamics in the eutrophic San Joaquin River, California
4. Biogeochemistry in California oak woodland - annual grassland rangelands
5. Wildfire threats to soil and water resources: The California story
6. Finding success in scientific research

Professor Dahlgren also provided a 90 minute lecture for the undergraduate soil science class at Kyoto University. In addition, Professor Dahlgren interacted with several graduate students within the Kyoto University Soil Science Laboratory providing comments and advice on their research topics and reviewing drafts of their manuscripts. These activities are expected to continue via Zoom meetings once Professor Dahlgren returns to the United States.