FUNDING PROGRAM FOR NEXT GENERATION WORLD-LEADING RESEARCHERS

Project Title: Soil carbon stabilization in micro and submicron-scale aggregate	
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1. Background of research

Soil carbon (C) has received growing attentions recent years due to anticipated global warming. Soil contains two to three times more C as soil organic matter (SOM) compared to the amounts present in atmosphere as CO_2. SOM plays vital role for plant growth by holding nutrients and water. Main reason for the stabilization of SOM against microbial degradation in most soils is its interactions with micro and nano-sized mineral particles and subsequent formation of 3-dimentional structure called soil aggregate. Acceleration of SOM decomposition (thus CO_2 production) upon increasing temperature may further accelerate global warming. Yet the mechanisms of SOM stabilization or decomposition remain poorly understood. As a result, current global C models have large uncertainty when predicting the response of soil C pool to future warming.

2. Research objectives

The goal of this study is to elucidate SOM stabilization mechanisms. I will examine volcanic-ash soils (world leading soil type for C sequestration potential) as well as major soil types of the world by isolating micro- and nano-sized soil aggregates and characterizing each size-class aggregate using spectroscopic, isotopic, and selective dissolution methods. I will also conduct laboratory “aggregation” experiments using model organic and mineral materials.

3. Research characteristics (incl. originality and creativity)

SOM has traditionally been studied by dissolving organic components of soil via alkali extraction. By taking advantage of rapidly-advancing spectroscopic methods, I will examine the chemical forms of C as well as mineral particles in each aggregate without destroying sample structures. I will also assess inter-aggregate bonding mechanisms and geometric aspects of aggregates using dispersion experiments, gas sorption, and electron microscopy. These analyses together with the information on the age and origin of C gained from isotope analyses would advance our understanding on SOM stabilization.

4. Anticipated effects and future applications of research

Interaction of organic matter with mineral particles is a fundamental process in soil and sediment. Better understanding of this process therefore could contribute to (i) the improvement in C simulation models and (ii) the development of green technology that enhances the stability of C and aggregates themselves against land degradation and desertification.