

## Silicic acid removal as calcium or magnesium silicate from geothermal water

KOTARO YONEZU<sup>1</sup>, YOHEI KAWABATA<sup>1</sup>,  
KOICHIRO WATANABE<sup>1</sup> AND TAKUSHI YOKOYAMA<sup>2</sup>

<sup>1</sup>744 Motooka, Nishi-ku, Fukuoka 819-0395 Japan,

(yone@mine.kyushu-u.ac.jp)

<sup>2</sup>6-10-1 Hakozaki, Higashi-ku, Fukuoka 812-8581 Japan

Geothermal energy is one of the most probable clean energy in Japan; however the total power supply from geothermal energy has recently plateaued due to short lifetime of reinjection well caused by siliceous deposit from geothermal water. Removal of silicic acid as calcium or magnesium silicate is investigated towards an effective utilization of geothermal energy.

Sample solutions were prepared to be an initial Ca/Si or Mg/Si molar ratio = 1.4 to 4.0 (Si concentration: 400 ppm). The solutions were magnetically stirred and the pH was maintained at 11 or 12 with NaOH solution. At appropriate intervals, an aliquot of the suspensions was filtered using a 0.45 µm membrane filter. At an initial Ca/Si or Mg/Si ratio = 2.1, silicic acid in the solution can be effectively removed within 1 h. The precipitates are identified as calcium silicate or amorphous magnesium silicate by XRD patterns. In addition to removal of silicic acid, simultaneous removal of boron coprecipitated with silicate was investigated (B concentration: 40 ppm). In the case of calcium silicate, around 50 % of boron can be removed. In contrast, almost all boron can be removed from the solution by magnesium silicate. <sup>11</sup>B NMR result showed that boron coprecipitated with magnesium silicate exists as 4-coordinated, suggesting that the coprecipitated boron may be incorporated by substitution of Si with B.

Advantages of this removal method are realization of longer lifetime implement at geothermal power plant and simultaneous removal of hazardous elements. The treatment of enormous amount of silicate removed from geothermal water remains an issue to be solved.

## Christina River Basin Critical Zone Observatory: Carbon-mineral interactions from molecular to basin scales in the Anthropocene

KYUNGSOO YOO<sup>1</sup>, ANTHONY K. AUFDENKAMPE<sup>2</sup>,  
CHUNMEI CHEN<sup>3</sup> AND DONALD L. SPARKS<sup>3</sup>

<sup>1</sup>Dept. of Soil, Water, and Climate, University of Minnesota, St.Paul, MN,USA. (\*correspondence: kyoo@umn.edu)

<sup>2</sup>Stroud Water Research Center, Avondale, PA. USA. (aufdenkampe@stroudcenter.org)

<sup>3</sup>University of Delaware Environmental Institute, DE, USA. (cmchen@udel.edu and dlsparks@udel.edu)

Over the last several decades, biogeochemical studies on terrestrial carbon cycle have converged on a consensus that tight association of organic matter (OM) with minerals through physical occlusion or surface complexation is critical in lengthening the turnover time of carbon (C).

The primary goal of the Christina River Basin Critical Zone Observatory (CRB-CZO) is to scale up C-mineral interactions that occur at molecular and mineral grain scales to soil profiles to hillslopes and finally to basin scales. While small (nano to mineral grain) scale characterizations of C-mineral interactions are being made, physical movement of OM and minerals – such as soil mixing at soil profile scale, physical erosion and deposition in watershed scales, and stream turbulence in streams – is investigated as responsible for their contacts. Chemical weathering of minerals and minerals' interaction with water are considered as processes that generate the surface area and reactivity of minerals where OM could be complexed. Additionally, biological cycling of OM prepares OM's chemical affinity to minerals.

Preliminary analyses suggest that the extents of physical contacts between OM and minerals – which are required for C-mineral complexation – are indeed limited by their physical movements and that these movements are highly sensitive to land use types. Furthermore, eroded minerals from agricultural fields appear to complex C during their fluvial transit. The preliminary data support the core assumptions of our hypothesis that accelerated erosion and deposition in agricultural and constructional watershed may generate greater amount of mineral-complexed C.

In the end, we expect that our intensive field sampling and installation of wireless sensor network and data management toward testing our hypothesis should build our CRB-CZO as an excellent resource for entire scientific community.