Geophysical Research Abstracts
Vol. 17, EGU2015-15638, 2015
EGU General Assembly 2015

Mineral weathering experiments to explore the effects of vegetation shifts in high mountain region (Wind River Range, Wyoming, USA)

Christian Mavris (1), Gerhard Furrer (2), Dennis Dahms (3), Suzanne P. Anderson (4), Alex Blum (5), Jens Goetze (6), Aaron Wells (7), and Markus Egli (8)

(1) Department of Earth Sciences, Natural History Museum, Cromwell Road, London SW7 5BD, U.K., (2) Institute of Biogeochemistry and Pollutant Dynamics (IBP), ETH Zurich, CH-8092, Switzerland, (3) Department of Geography, University of Northern Iowa, Cedar Falls, USA, (4) INSTAAR and Dept. of Geography UCB-450, University of Colorado, Boulder, CO 80309, USA, (5) US Geological Survey, 3215 Marine Street, Boulder, CO 80303, USA, (6) Department of Mineralogy, TU Bergakademie Freiberg, D-09596 Freiberg, Germany , (7) ABR, Inc. Environmental Research and Services, Anchorage, AK, 99518 , (8) Department of Geography, University of Zurich, CH-8057, Switzerland

Climate change influences the evolution of soil and landscape. With changing climate, both flora and fauna must adapt to new conditions. It is unknown in many respects to what extent soils will react to warming and vegetation change.

The aim of this study was to identify possible consequences for soils in a dry-alpine region with respect to weathering of primary minerals and leaching of elements under expected warming climate conditions due to shifts in vegetation. To achieve this, a field empirical approach was used in combination with laboratory weathering experiments simulating several scenarios. Study sites located in Sinks Canyon and in Stough Basin of the Wind River Range, Wyoming, USA, encompass ecotones that consist of tundra, forest, or sagebrush (from moist to dry, with increasing temperature, respectively). All soils are developed on granitoid moraines.

The mineralogy of the soils along the altitudinal sequence was analysed using cathodoluminescence and X-ray diffraction, and revealed clear mineral transformations: biotite and plagioclase were both weathered to smectite while plagioclase also weathered to kaolinite. Cooler, wetter, altitude-dependent conditions seemed to promote weathering of these primary minerals.

To test the impact of soil solutions from different ecotones on mineral weathering, aqueous extracts from topsoils (A horizons) were reacted with subsoils (B horizons) in batch experiments. Aqueous extracts of topsoil samples were generated for all three ecotones, and these solutions were characterized. For the batch experiments, the topsoil extracts were reacted for 1800 hours with the subsoil samples of the same ecotone, or with the subsoil samples from higher altitude ecotones. Solutions collected periodically during the experiments were measured using ICP-OES and ion chromatography.

Dissolved Ca, Mg and K were mainly controlled by the chemical weathering of oligoclase, K-feldspar and biotite. With increasing altitude (and consequently cooler and moister climate) the total concentrations of Ca, Mg and K in the aqueous extracts decreased, the relative ionic contribution by K decreased, while the ionic contribution by Ca increased. Thus, a shift in vegetation due to climate change seems to affect the ionic composition - but not the ionic load - of the soil solution. In the case of a shift from forest – to - sagebrush and tundra – to - forest or sagebrush, the relative contribution by K strongly increases at the expense of Ca.

We hypothesize that K should play an important role in future biogeochemical cycles under the assumptions of climate warming and subsequent vegetation shifts to higher altitudes.