Watershed 1 Calcium Addition

The objective of the Watershed 1 (W1) manipulation at the Hubbard Brook Experimental Forest (HBEF) is to evaluate the role of Ca supply in regulating the structure and function of base-poor forest and aquatic ecosystems. To this end an experimental manipulation of W1, a 11.8 ha gauged watershed, is being conducted to increase the base status of soil and investigate the response of major ecosystem processes, including stream chemistry, soil and soil water chemistry, forest floor mass and chemistry, composition and structure of the forest, phytosociology and nutrient status of the herbaceous layer, aquatic ecology, foliar chemistry, soil microbial activity and ultimately tree growth and vigor.

The Ca content of soil was increased through the application of wollastonite ($CaSiO_3$). The application rate of 1.2 metric tonnes Ca/ha was intended to increase the current base saturation of the soil from 10% to 19%. This latter value is thought to have been the base saturation of soil at the HBEF 50 years ago, before the advent of acidic deposition. To accomplish this manipulation, 56 tons of VANSIL-10, a commercial form of wollastonite, was purchased from R.T. Vanderbilt Inc. The VANSIL-10 is mined and crushed in Gouverneur, NY, and has a median particle diameter of 9.6 µm, an $^{87}Sr/^{86}Sr$ of 0.70548, and a Ca/Sr (g/g) of 1196. These characteristics will result in the rapid dissolution of the material and will allow us, through isotopic and standard chemical analysis, to trace the fate of the added Ca as it is cycled through the ecosystem. Following excavation and processing, the VANSIL-10 was shipped in one ton "super sacks" to ASC Minerals Inc. in Allerton, IL for pelletizing. The wollastonite was pelletized into 1.5 to 4 mm diameter pellets with a lignin sulfonate binder (approximately 2% wet weight). The pelletized wollastonite was repacked in the one ton super sacks and shipped to the staging area on U.S. Route 3 in Woodstock, NH, just north of the HBEF. Fifty-six super sacks of pelletized wollastonite were off-loaded from three trucks at the staging area on 18 October 1999. The total weight of wollastonite received at the pelletization facility was 109,665 lbs. The total weight of the pelletized material that left the facility was 112,992 lbs. The added weight represents the binder plus increased moisture content. The weight of the pelletized material that was applied to W1 was 110,992 lbs less minor spillage at the helicopter staging area.

In addition to W1, a destructive plot adjacent to W1 was designated for treatment and eventual study. The destructive plot area is a 50-m wide strip along the western watershed boundary between grid plots 51 and 153 (see plot map). The purpose of the destructive plot area (2.4 ha) is to provide an area for destructive sampling without disturbing W1. Prior to treatment, the perimeter of W1 and the destructive plot area was delineated with large strips of blue tarp placed on the ground and blue, helium-filled Mylar balloons. Lysimeters and microbial plots were covered with tarps prior to the treatment. Aliquots of the pelletized wollastonite were obtained from each super sack and composited. This bulked material was applied by hand to the lysimeter and microbial plots following the helicopter application and will be used to characterize the material applied to the watershed and destructive plot. Composited material was also given to A. Bailey for archiving in the HBEF sample archive building. One of the one-ton super sacks was delivered to the barn at Hubbard Brook for application to the NUPERT plots.

The wollastonite treatment began on 19 October 1999. The wollastonite pellets were added to W1 by helicopter, piloted by Mr. Ray Newcomb of JBI Helicopter Services. Prior to the treatment, Mr. Newcomb delineated the watershed boundary with a navigational global poonline-book/introductionsitioning system (GPS), with the assistance of C. Johnson. The computer-controlled hopper was calibrated to provide the 1.2 metric tonne Ca/ha application rate. A backhoe with a forklift attachment was used to lift individual super sacks to the hopper. Once in position, the sack was cut and the pelletized wollastonite fell into the hopper, which had a nominal capacity of 1 ton. Applications were made in a north-south direction, approximately perpendicular to the contours of the watershed. The pilot flew to positions above the watershed canopy specified by the GPS system. He released the hopper and then flew along a path designated by the GPS to ensure uniform coverage. This procedure was used so that the application was "shingled" along a north-south direction. On 19 October, 46 tons of wollastonite was applied to W1. There were some delays in the application due to an occasional malfunction of the release mechanism on the hopper. The treatment was delayed on 20 October due to low cloud cover and rain. The treatment resumed on 21 October, with the remaining 9 tons applied to the very northeast portion of the watershed.

A total of 110 collectors (each 1.2 ft^2 in area) were systematically positioned throughout W1 prior to the treatment in order to assess the spatial variability of the application. The collectors were placed every 25 m along 12 east-west transects across W1 and extending 50 m outside the watershed boundary. In sum, 74 collectors were positioned within the watershed, 7 collectors were located in the destructive plot area and 29 collectors were positioned outside the treatment area. Of the 110 collectors deployed, 67 appeared to function well, 23 failed largely due to tipping from helicopter turbulence, and 20 were flagged because they moved from their initial placement but collected wollastonite. These collectors are being analyzed for dry mass deposited.

Preliminary observations suggest that the application was quite even across the watershed and did not significantly exceed the watershed boundaries. The high quality of the pelletization resulted in very little release of fine particulate material during the application. The prevailing wind was from the west, further restricting any contamination of Watershed 6. Atmospheric samplers were deployed by D. Buso outside of W1 during the application.