

Mercury distribution in bedrock, native copper ore, and soils—Isle Royale National Park, Michigan

W.F. Cannon, U.S. Geological Survey, Reston, Va

L.G. Woodruff, U.S. Geological Survey, St. Paul, MN

In 1998 we began a study of mercury concentration in natural geologic materials on Isle Royale to determine if native copper deposits could be contributing to mercury-impacted lakes. Small native copper deposits on the island were mined sporadically in the 1800's. Those deposits, and mine wastes do contain anomalous amounts of mercury, as much as 14 parts per million (ppm) in the most enriched samples. In contrast, typical bedrock of the island appears to be uniformly very low in mercury. Samples of bedrock we have analyzed all had no detectable mercury at a detection limit of 5 parts per billion (ppb). We analyzed soil and glacial deposits in two test areas. Samples near the Minong mine, the largest native copper mine on the island, were used to determine the extent to which anomalous metal content of the ore affected the trace element content of soils. Samples were taken also within the drainage basins of Sargent Lake and Lake Wagejo, two lakes with elevated mercury in fish. At each site a sample was taken from the A soil horizon, a dark organic mineral soil, 1-6 inches below the surface. A second sample was taken from a depth of about 2 feet, consisting of either reddish sandy glacial till or till slightly modified by soil-forming processes (referred to here as BC horizon). Results show that the copper deposit at Minong mine produces a very distinct trace element anomaly in soil, especially the copper content of the BC horizon. Mercury also is somewhat elevated in samples of the BC horizon closest to the copper deposit. Mean copper content of BC soils in the Minong mine area is 290 ppm and that of mercury is 40 ppb. Highest values are 1160 ppm copper and 220 ppb mercury. The A soil horizon near the Minong mine averages 290 ppm Cu and 70 ppb Hg. In the drainage basins feeding Lake Wagejo and Sargent Lake BC soils average 60 ppm Cu, nearly five times lower than near Minong mine, and 40 ppb Hg, essentially the same as at Minong mine. A-horizon soils in the Sargent-Wagejo drainage average 63 ppm Cu, 130 ppb Hg, and range as high as 370 ppb mercury. We are conducting similar studies in a large region in northern Wisconsin. For comparison, Isle Royale soils are enriched in mercury from two to three times the concentrations that we have observed in Wisconsin. Our results indicate that the very elevated mercury content of soils in the Sargent Lake-Lake Wagejo area is not caused by concealed native copper deposits because there is little or no elevated copper content of those soils comparable to the strong copper anomalies produced by the Minong deposit. Neither is there reason to conclude that local bedrock is the source for mercury, because all tested samples of the chemically very uniform bedrock have very low mercury content. The mercury content of the soils on Isle Royale seems very likely to result largely from airborne deposition. The processes causing the unusually high mean mercury content on the island and the great variability of mercury content of similar appearing soils over short distances remain speculative. Nevertheless, it appears certain that mercury must be very mobile in the soil zone in order to redistribute atmospherically deposited mercury into the highly variable observed concentrations.