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Loading and biogeochemical cycling of anthropogenic contaminants in Great Salt Lake, Utah

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Great Salt Lake (GSL), in the western United States, is a terminal lake with a surface area that can exceed 5,100 km2. The open water and adjacent wetlands of the GSL ecosystem support millions of migratory waterfowl and shorebirds from throughout the Western Hemisphere. The GSL ecosystem receives industrial, urban, mining, and agricultural discharge from a 37,500 km2 watershed that includes over 1.7 million people. Beginning in 2000, the United States Geological Survey (USGS) in cooperation with other State and Federal agencies began to evaluate contaminant loading and biogeochemical cycling in the GSL ecosystem. Dissolved ($<$ 0.45 micron) + particulate riverine Se load to GSL during from May 2006 through July 2007 was 1,540 kg. Dissolved Se concentration in water samples collected from four in-lake monitoring sites (May 2006 through June 2007) showed a statistically significant (90 % confidence interval) upward trend in Se concentration. A lake core representing 100-years of sediment deposition collected from the southern part of GSL (site 3510) indicates a two- to three-fold increase in sediment Se concentration beginning in the 1960s and continuing through 2006. Loading of the limiting nutrient (N) from riverine efflux to GSL approaches what is considered dangerous levels (2 g/m2) for freshwater lakes. Consequently, the southern part of GSL is eutrophic (Chlorophyll a $>>$ 15 mg/m3) except during summer when top-down control by Artemia grazing can depress chlorophyll concentration to oligotrophic levels. Over 25 emerging contaminants (ECs) were

detected in riverine efflux to GSL. Many of these compounds were likely derived from treated sewage effluent discharged to GSL and included hormones, food additives, detergents, and pharmaceuticals. Lake bottom sediments collected from GSL contained similar EC compounds and were enriched by over 7,000 times relative to their concentration in riverine efflux. Artemia samples collected from GSL in 2006 were found to bioaccumulate a variety of ECs, including disinfectants, fragrances, and oil/coal combustion products. Methyl Hg concentrations in water from GSL were found to exceed 30 ng/L, triggering human consumption warnings by the State of Utah for three duck species harvested from GSL. A program to monitor and model riverine Hg loadings to the GSL ecosystem was initiated in early 2007 by the Utah Department of Environmental Quality and USGS and is currently (2008) ongoing.