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Evidence and Implications of Movement of the Deep Brine Layer in the South Arm of Great Salt Lake, Utah

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Trace elements are found in elevated concentrations in lake bed sediments of Great Salt Lake and their periodic resuspension and dissolution into the water column may affect water quality and the biota and needs to be better understood. Lake circulation is restricted by a railroad causeway completed in 1959 and typically the South Arm of the lake is stratified with a lower dense deep brine layer (DBL) that originates in the North Arm. The DBL flows to the bottom of the South Arm of the lake where it accumulates decaying organic matter from the overlying water column and becomes anoxic. Periodic interruption of stratification in the water column has been observed at two fixed stations on the lake by monitoring vertical water temperature profiles and 3-D velocity profiles (Figure 1) using a SonTek® Argonaut™-XR Acoustic Doppler Current Profiler. Displacement of stratification is characterized by an abrupt change of the DBL temperature to the temperature of the upper brine layer (UBL) during periods where the DBL is warmer than the UBL (September–March) and where the DBL is colder than the UBL (April-August). Abrupt changes in horizontal velocity and direction precede the temperature equilibration between the layers. Events occur over periods of 12 to 24 hours and are associated with strong sustained wind events and development of a surface seiche on the lake. The surface seiche may set up an internal seiche along the UBL/DBL interface which would place oxic UBL in contact with anoxic sediment previously overlain by DBL. Mixing or displacement of the DBL may involve trace element movement within the water column due to changes in pH and redox potentials. For example, methylmercury concentration from unfiltered whole water samples in the DBL are high (12-42 ng/l) compared to the UBL (0.4-1.6 ng/l). Laboratory experiments simulating UBL contact with anoxic lake bed sediment were conducted over 24 hours to investigate trace element desorption and (or) dissolution for selected trace elements. Results from the laboratory experiments indicate that a small percentage of selenium (1%) and arsenic (2%) associated with anoxic bottom sediments is periodically recycled into the UBL where it can potentially be incorporated into the biota utilizing the oxic, UBL of GSL.

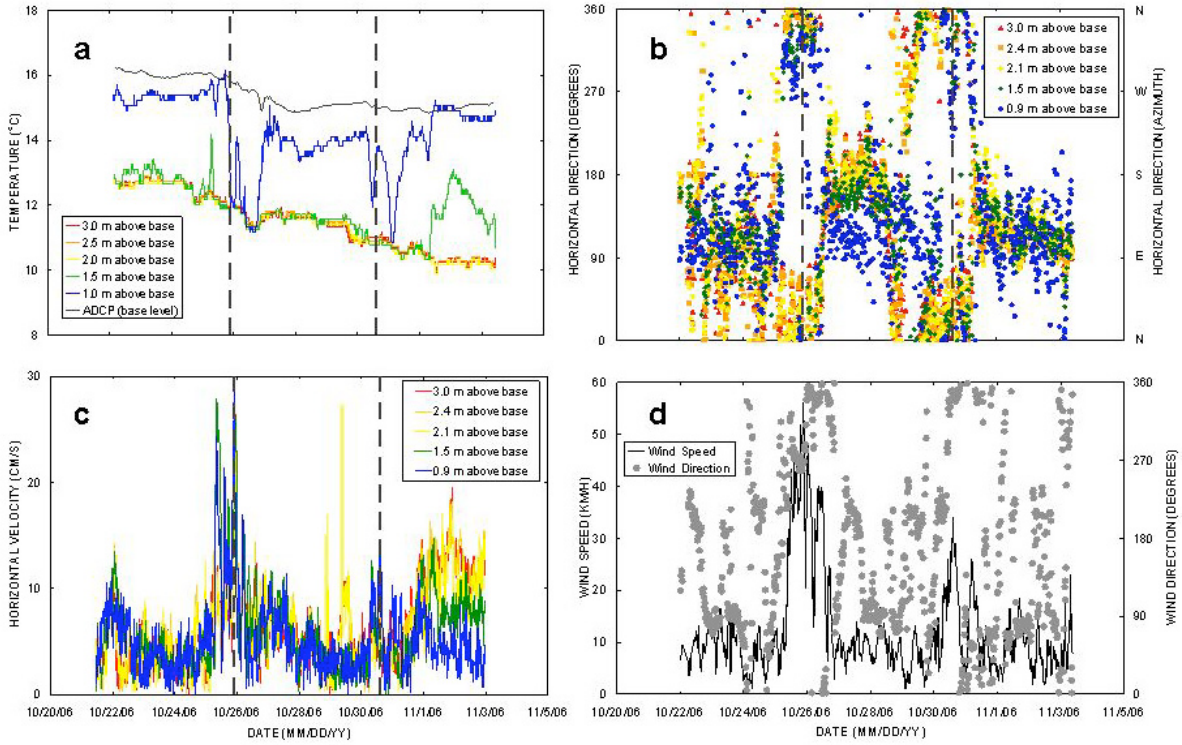

Figure 1–Variations in parameters during a strong wind event, Great Salt Lake, Utah: (a) temperature equilibration event at site 3510 associated with (b) a fluctuation in horizontal velocity from ADCP, (c) fluctuation in horizontal direction from ADCP, and (d) deviations in wind velocity and direction at Hat Island (MesoWest). Dashed lines correspond to peak wind speeds.