THE IMPACT Project 2000
Observations and Modeling of Lake Hydrology and Meteorology

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A hydrological and meteorological field program was conducted this summer at Lake El'gygytgyn to understand the modern processes that may be important to both paleoclimate and modern-climate change analysis in the Arctic. Lake El'gygytgyn is located inside of an impact crater created 3.6 million years ago in northeastern Siberia and lies in a region of the Arctic that is currently experiencing an anomalous 30-year cooling trend. A short sediment core obtained from this lake in 1998 shows strong teleconnections with the GISP core and dates back approximately 400,000 years; a full 3.6 million year core is planned.

The crater hydrology is fairly simple. All of the water entering the lake (roughly 12km in diameter) is derived from within the crater rim (roughly 18km diameter) and the outlet channel quickly braids into a broad outwash plain while draining southwest to the Anadyr River and the Bering Sea. Approximately 50 streams drain into the lake; most of these were trickle at this time, and the dominant hydrological event is likely snowmelt. The channel network and watershed area of each stream was measured by computer analysis from a 1:50,000 scale DEM, and ranked by size and discharge. A dominant, active geomorphological process affecting the hydrology is long shore drift, which acts to impound the inlet streams, creating lagoons, and constricting the outlet stream. These lagoons act as temporary settling ponds for the finer grain materials produced within the watersheds.

The lake level and temperature were measured over a three-week period, and instrumentation was left in place to continuously measure water temperature at 6 depths and lake level for a 3-year period. There is no significant thermocline, with nearly uniform water temperatures throughout 170m depth, starting early August at 2.9C and increasing to 3.4C after 3 weeks. The lake level dropped by approximately 10cm over this period, indicating that watershed inputs were less than outflow (beginning at 20 and falling to 12m3/s over 3 weeks) and evapotranspiration. Storm and ice shoves berms surrounding the lake and previous research indicate that lake level may fluctuate by a meter or more throughout the summer. A stage/discharge relationship was produced for the outlet stream for late summer flows such that the varying storage capacity of the lake could be assessed and used as a validation for modeling of the inlet stream hydrology, in combination with the local weather data.

Three meteorological stations were established this summer. One is a complete micro-met station located near the outlet stream at lake level, including air-temperature and relative humidity at 1m and 3m, wind direction and speed at 4m, net solar radiation, barometric pressure, precipitation, and soil moisture and soil temperature at 8 depths in

two pits. The second is located on the crater rim near the outlet and approximately 230m above lake level, measuring air and soil temperature, as well as precipitation. The third station is similar to the second and located at lake level on the opposite side of the lake. We are using these data in several ways. First is to assess spatial differences in weather across the lake. Second is for use as input to a hydrological model, used for both modern process studies and, in combination with SAR remote sensing, regional soil moisture studies. Third is for use in determining if the weather at Lake El'gygytgyn is representative of regional scale synoptic weather patterns and long-term trends. And fourth is to provide local weather data for use in planning a major drilling project for recovery of the 3.6 million year core, tentatively proposed for winter 2003, once several years of data has been obtained.