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Project Title: Morphology and Sedimentation of Kigoma Bay and Vicinity

Introduction

Lake sedimentation is affected by four variables: (1) lake water chemistry, (2) fluctuations of shoreline, (3) relative abundance of river-derived clastics, and (4) autochthonous sediments. Lake Tanganyika, the world's second largest (volumetrically), deepest, and oldest lake, is known for its organic-rich deposits and for its rift lake characteristics. Lake Tanganyika occupies the deepest part of the north-west-southeast trending extensional system. Tectonic structures correlated with this location along the western branch of the East African Rift include a series of steeply sided half grabens and associated border fault system. The dominant sediments found along the border fault (Nondwa Point) are characterized by coarse-grained clastic material. Lateral deltaic sediments extend on the ramping side of the half grabens. Fine grained hemipelagic muds interbedded with fine clays comprise the deep-water sediments. The purpose of my study includes examining the bathymetry of Kigoma Bay and using samples to supplement evidence for structural control of the Kigoma area. In addition, I hope to examine samples for sedimentary transport processes from the Luiche Delta north of Nondwa Point.

Materials and Methods

Part I of my project consisted of creating a high resolution bathymetric map of Kigoma Bay from Bangwe Point north to Nondwa Point. Depth was recorded using a Raytheon 8100 Echosounder sonar system and transducer. The transducer was mounted onto a small Styrofoam float and towed behind a zodiac. Coordinates were recorded with a Garmin 45XL GPS. Tracklines were made using waypoints with spacing of approximately 0.25km apart. Data was analyzed using Surfer6 and various maps were produced. Ponar grab samples were collected along margins of topographic change.

Part II consisted of investigating three specific sites (Figure 1): Luiche Delta (1), Kigoma Bay (2), and shoreline beaches (3). The Luiche Delta represents an area of high sedimentation with an exposed and regular shoreline. The Kigoma Bay represents a semi-protected and irregular shoreline area. More than seventy grab samples were made of the surface sediment using a Ponar Grab Sampler and coordinates were recorded with a Garmin 45XL GPS. Samples were taken at 0, 2, 5, 10, 20, 30, 50, 100, 150m intervals. Where Ponar grab samples were not available, dive samples were taken. Sediments were analyzed for grain size using dry sieving and wet sieving methods with even sizes rang-

ing from -2 to 4Φ . Complete descriptions will be made of the sediments, including variability of graphical mean grain size and degree of sorting, comparisons of detrital carbonate vs. lithics vs. biogenic grains, and Total Organic Carbon (TOC) and Total Carbon (TC) will be measured using loss on ignition procedures. These results will be related back to provenance and lacustrine sedimentary processes.

Preliminary Results

A series of tracklines were made with the echo sounder to record the changing bathymetry of the lake bottom from Nondwa Point south to Bangwe Point (Figure 2). These data points were used to create a contour map of Kigoma Bay (Figure 3). Multiple lineaments can be viewed from this map and are emphasized with dark lines (Figure 4). A 3-D perspective view of Kigoma Bay was also produced from this data set (Figure 5). I will examine these maps in conjunction with aerial photographs and topographic maps to match up exposed land with the bathymetry of the region. In addition, I will use my results from sediment analysis to supplement my interpretations of structural control.

Twenty-two samples have been described and analyzed for mean grain size and sorting. More samples must be examined before complete interpretations can be made. My preliminary work suggests four major points: (1) the greatest degree of sorting is found along exposed beaches, (2) fine clays and silts are found both onshore and offshore, (3) coarse gravels and pebbles dominate beach zones, and (4) grain size decreases with increasing depth.

Samples taken in less than five meters depth from the Luiche Delta north of Nondwa Point are highly variable in both grain size and their degree of sorting. Figures 6 and 7 show that the coarsest grained material is concentrated along the shoreline with fines restricted to deeper, offshore water. The general trend of sorting decreases with increasing depth and distance from shore (Figure 7). The highest energy of lake systems tends to be concentrated along beaches where frequent wave activity reworks the sediments to remove fines from coarser grained material. Along the northern margin of Ujiji and the Luiche Delta, the greatest degree of reworking was found. The beach exposures in this area are significantly different from the protected coves of Kigoma Bay. Here, broad gently sloping beaches extend twenty-five meters out into the lake with a water depth no greater than two meters. Marsh vegetation is patchy along this area and onshore topography consists of relatively flat, low lying terraces. The sediments are extremely fine grained with 3.4Φ size and are homogeneous. The concentration of lithic fragments is greater near the delta than any other area of study.

Two kilometers north of the Luiche Delta, in the vicinity of Kitwe Point, coarse gravels and pebbles dominate the beach zone and range in size from large cobbles and boulders to

coarse gravels. The clasts are composed largely of light minerals including an abundance of quartz and feldspars with some heavier minerals including iron oxides and amphiboles. Adjacent the beaches are twenty-meter high cliffs of meta-conglomerates. As erosion from the waves undercuts the bedrock, cobbles are weathered out and deposited along the beach shore and nearly all the fines are removed.

Carbonate cemented beach rock extends north of Kitwe Point and south of Bangwe Point. There is a noticeable increase in abundance of detrital carbonate and a sharp decrease in lithic fragments. In one small protected cove, pebble-conglomerate beaches give way to medium grained sands. Coated grains composed of calcium carbonate make up nearly the entire content of the beach sediments on the north beach and are absent from the south beach.

The sediments of Kigoma Bay are widely variable and possibly reflect provenance and sedimentary transport processes. I need to complete further analysis before I can describe this region with confidence. Grain size from -1Φ (coarse sand) to 4Φ (coarse silt) and sorting is also highly variable. There is an observable change in sediment composition from our initial grab sample work. On average, below the depth of 60 meters fine clays and muds were collected. At approximately 50 meters and 30 meters there was a significant decrease in successful Ponar grab samples that were taken, possibly resulting from a blanket of coarse grained carbonate shells and sands. From 30 meters up to 10 meters patchy areas of sand alternating with shells dominate. Ripple marks characterize beaches from ten meters up to the shoreline.

I anticipate interesting results that may aid in offering some details to the structural control and sedimentary transport systems of Kigoma Bay and vicinity.