LABORATORY 3:
STREAM TABLE EXPERIMENT

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1 Purpose and Objectives

This is a partially controlled experiment where erosional processes, depositional processes, and the geomorphic responses of a river system will be simulated based on the change of slope conditions using stream tables. The objectives of this experiment are to evaluate the effects that a change in slope has on a river system and the different characteristics associated with each slope.

2 Materials and Methods

The stream tables that were used for the experiment were large wooden tables filled with semi-saturated packed sand in which an initial river path was carved. At the top of the slope was a basin to hold water that would flow down the carved path and into the outflow lake where it was drained into a bucket. Also at the top of the slope, there are rocks placed to prevent washout at the head of the river.

Once the table is set up in the general form as depicted in Figure 1, the experiment is ready to take place. The slope associated with the stream table forces the water at the top basin/lake to flow down the pre-made channel to the bottom. When increasing the capacity of the basin at the top, be sure to not fill it too quickly or turbulently as it will change the results of the flow patterns on the river.

As the water flows, pictures and notes should be taken in regards to the effects the water has on the existing channel. Ensure that the outflow from the river has a receptacle so that the overflow from the lake at the bottom can spill over. After notes have been taken and the water has been run for approximately 10 minutes, stop the input water and let the river drain into the outflow lake to get a final result from the flow's effects on the river.

Figure SEQ Figure * ARABIC 1 - Layout and Stream Table Setup

3 Results and Discussion

Two stream tables were set up for this experiment. Each stream table had a different slope and therefore had different river flow characteristics that could be examined.

The first stream table had a wavelength of 67cm and amplitude of 16cm (both as show in Figure 2). The rise at the highest point of the table was 15cm and the length of the table base was 213cm. The angle of the slope was approximately 4 degrees.

The slope calculation is

X = arctan(15/213), then X = 4.0283deg

The second stream table had a wavelength of 68cm and amplitude of 17cm (both as show in Figure 3). The rise at the highest point of the table was 21cm and the length of the table base was 213cm. The angle of the slope was approximately 5.6 degrees.

The slope calculation is

X = arctan(21/213), then X = 5.6307deg

Figure SEQ Figure * ARABIC 2 – Stream Table 1 Initial Layout

Figure 3 - Stream Table 2 Initial Layout

For the first stream table, I would expect to see erosion around the outsides of each bend in the river and deposition on the insides of the bends prior to the curve. At the end of the river, I expect it to fan out and form a delta shape.

For the second stream table, I would expect to see a lot more erosion than the first table as there is more potential energy behind the river's flow. Because of the increase in potential energy, I can see the possibility of the river creating a new path as it forces its way over a bank on one of the river's curves. As like the first stream table, I also expect it to form some kind of delta or flare at the mouth of the river.

Figure SEQ Figure * ARABIC 4 - Stream 1 (low slope) Final

Figure 5 - Stream 2 (high slope) Final

From our observations on the first stream, the expectations for erosion and deposition were somewhat correct as there was a lot of cut bank erosion along the outsides of each river bend and point bar deposition on the insides of the bend as seen in Figure 4. The erosion started happening immediately but mostly on the lower bank and edges. The mouth of the river started to expand immediately to accommodate the flow and eventually turned into a delta. On the second curve, the cut bank suffered heavy erosion and the water started to flow over and make a floodplain that eventually turned into a meander to link up with the initial river flow. The delta continued to widen until it reached the edge of the box and was halted by the wooden frame.

While observing the second stream (of high slope), the expectations pertaining to a more drastic change due to the increase in potential energy (compared to the low slope stream) were true. Immediately the first curve started to get a cut bank from the force of the river and the meander started not long after. This is obvious due to the low amount of erosion and deposition that occurred on the second curve. The little water that managed to make it through the initial river flow prior to the creation of the meander managed to make a small delta at the mouth to the outflow lake. Once the meander had taken over the river's flow, it made a cut across the original river's 3rd bend point bar deposition and made a deep cut progressing further to the right. The meander also made a couple more branches which proceeded to further widen the delta and create a few islands. There was a very high amount of deposition placed in the outflow lake due to the higher speed and force behind the river's flow.

From the experimental observations, it is obvious to deduce that the slope of a river's flow is a huge part of its formation and changes that happen in its lifetime. The differences between the two different slope simulations were relatively the same, but the higher slope exhibited much faster and stronger results. We did see a meander form in the lower slope, but the higher slope simulation's meander formed almost immediately. The other features that emerged and evolved in the broader floodplain of the channel were an oxbow lake in the high slope simulation, and there was an area of high soil saturation that occurred near the meander in the low slope simulation. It seems that if the low slope simulation had been given more time to continue, it may have formed an ox bow lake from its meander. The morphology of the outlet delta changed from a low width and a high depth to a high width and a low depth as the position of the velocity of river flow changed from the curves in the initial flow. The delta got progressively wider but not all of it had full flow coverage and it started to leave some saturated soil behind. The width from the delta would likely regain flow if the river ever had an increased flow volume.

4 Summary and Conclusion

The results obtained from this experiment were to be expected. The only surprising outcome from the experiment was how such drastic of a change 1.6 degrees can make for the flow patterns of a river system. The river flow patterns were well simulated on such a small scale and the morphology which was observed was well represented considering the given limitations.

The effect of slope on river forms and processes allows us to predict what may actually happen to a river. By predicting the outcomes of the rivers, we can more accurately place infrastructure where we know it will be safe from future changes in the rivers flow. The stream table was limited by its width, length, and material characteristics. The fact that the river's banks and surrounding landscape was all made of sand without any bedrock, vegetation, dirt, or urbanization, the experiment was not 100% controlled. Despite the experiment being a decent simulation to illustrate a river's morphological processes, it was not a sufficient way to model a real-world scenario. If the experiment had a larger simulation area with more accurate materials, it would likely be improved.