FLUVIAL MORPHOLOGY OF THE OREGON COAST

9950-04180

[Earthquake Recurrence and Quaternary Deformation in the Cascadia Subduction Zone, Coastal Oregon]

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INTRODUCTION

The purpose of this study is first, to determine the feasibility of using river profile and surrounding topographical relationships to identify where geologic controls exist, and second, to expose regions of current uplift on the Oregon Coast. River course and elevation change for 22 rivers and tributaries on the coast of Oregon were digitized from $7\frac{1}{2}'$ and $15'$ topographic quadrangle maps from the U.S. Geological Survey. Lengths varied from under 25 km to over 350 km. Relief varied from 100 m on some of the shorter tributaries, to over 1600 m on the longer rivers. The ratio of relief to length ranged from .2 to 3.6%. The ratio of the area above the river profile within a rectangle defined by relief and length to that below the profile ranged from 1.33 to 13, with a mean of 3.8. Changes in river slope and valley character were compared to geologic information as presented on Peck's 1961 "Geologic Map of Oregon West of the 121^{st} Meridian", U.S. Geologic Survey Map I-325. Peck's map was the most complete reference for geologic information over the entire Oregon coast, and included sufficient detail along river drainages to explain most of the anomalies on the drainages.

BACKGROUND

A river's natural development is from steep slopes in the headlands, where there is little water volume and erosive capability, to flat slopes at the mouth where water volume, and hence erosive capability, have increased. When the river system is in equilibrium, there will be a smooth transition from the steep head to the flat mouth as the river system balances energy (discharge and elevation change) and work (sediment load and degradation). Where the change in slope is irregular, there may be a change in water discharge (an increase in discharge results in a decrease in slope), lithologic change, or tectonic motion. A change in lithology could be expressed in river course change, a change in meander behavior, a change in valley shape, and change in river slope. Downstream of uplift there is downcutting and increased sinuousity if the uplift rate is slow enough, or entrenched meanders if the rate is too fast. The morphology upstream of an uplifted region resembles an area of subsidence, having flooded channels, bank erosion, and generally flattened slope. Since the river system is always eroding toward equilibrium, tectonic effects are not observed for long periods of time, *unless they are an ongoing process.*

DISCUSSION

River elevation and slope versus length profiles were constructed for 22 rivers. The theoretical profile for each river was also generated, theory anticipating a smooth exponential decrease in slope with length. Abrupt decreases in slope, or inflection points, and broad slope convexities were compared to discharge and geologic changes along the rivers' courses. Overall, increased discharge resulted in decreased slope downstream, but there were places where a major tributary joined the main channel and no increase in slope occurred. On several rivers there were increases in slope at tributary junctions, opposite to expectations. Nearly all of the slope irregularities were coincident with geologic contacts and intrusions, such as massive basalts adjacent to estuarine and marine sediments. Generally, inflections occurred as the river bed encountered a resistant formation within a less resistant formation, such as a mafic intrusion into marine sediments. However, not all of the anomalous slope patterns could be explained. For example, a steep section on Siletz River was through a very resistant mafic intrusion, and the river flattened on the more erodable marine sedimentary rocks. Other factors also influence river behavior, one of those being topographical changes, which is in turn generated from tectonic movement. Therefore, although river changes correlate with geologic changes, causality can be ambiguous.

A more significant observation from the river and valley data was that headwaters were very steep and associated valleys wide, there were slope convexities in the middle sections with associated narrow, deep valleys, and many rivers ended with slope *increases*. (See examples in following figure.) Interpretation of the slope increases at the mouths included tectonic movement either in the form of base level lowering at the coast, or uplift further inland. If base level lowering at the coast is accepted, the flat section upriver could only have been eroded during a long period of tectonic stability, an unlikely possibility given the tectonic history of the Oregon coast. If, instead, the slope convexities midriver were caused by uplift 50 to 100 km landward of the coast, both the steepening downstream and flattening upstream were explained. The uplift must be an ongoing process since these river features are a present landform.

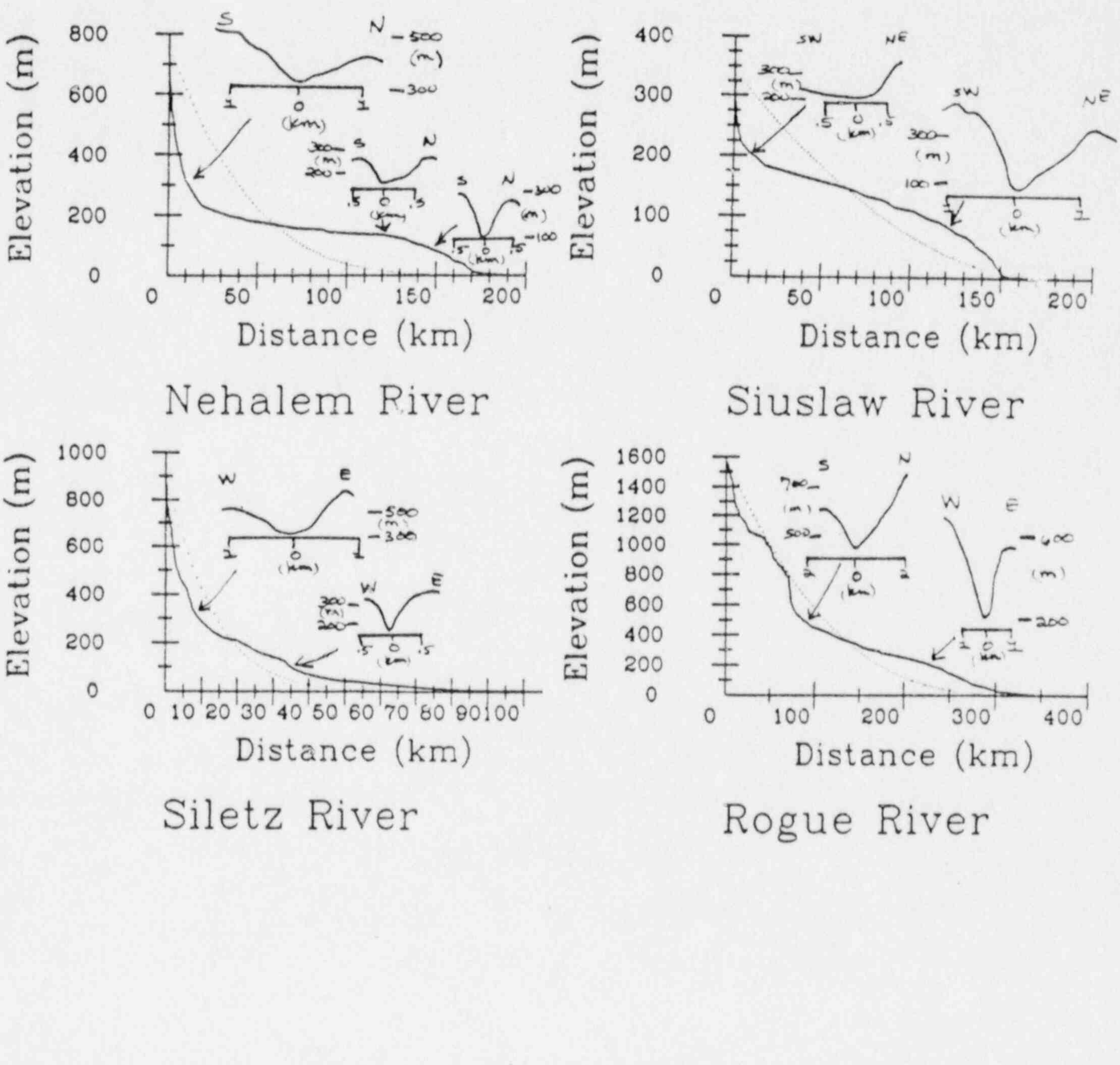

Figure 1. River profiles for four rivers studied on the Oregon Coast. Dotted line represents 'ideal', or theoretical profile. Valley profiles at several places along the river are also included, demonstrating entrenching on downstream flat sections of rivers. Convex profiles toward mouths of rivers suggest ongoing uplift within 50 to 100 km of the coast.