ABSTRACT

An abstract of the thesis of Diana L. Baker for the Master of Science in Geology presented March 7, 2002

Title: Holocene (2-16 ka) Sedimentation in the Columbia River Estuary

A deep borehole was drilled at Warrenton, Oregon in the ancestral valley of the Columbia River. The borehole cores represent a geologic record that extends from 2,000 years before present (2 ka) to 16 ka. Prior to the Holocene marine transgression at 16 ka, the incised Columbia River valley was cut to 112 m below present sea level. Grain size and heavy mineral analyses indicate the Columbia River tidal basin served initially (16-11 ka) as a sediment-bypassing conduit to the mid-continental shelf, and/or the Astoria Canyon. With the ongoing Holocene marine transgression and decreasing sediment supply, the Columbia River tidal basin became more efficient as a river-sediment trap (sink) between 11 and 9.5 ka. After 9.5 ka, the tidal basin served as a sediment delivery corridor (source) of sand to the high-energy coastline. The Warrenton borehole cores provide detailed down-core information about deposition in the lower Columbia River estuary during the period of marine transgression. Site-specific information about sedimentation rates and sediment provenance has been extended to represent the filling of the lower Columbia River valley based on existing data sets from previous workers. The onset of estuarine circulation occurred at 11 ka as determined by a study of diatoms in the sediments of the borehole cores. The
geochemistry (INAA and X-Ray Diffraction Analysis) and heavy mineral analysis indicate that between 16 and 11 ka the Columbia River tidal basin was dominated by the eastern basin sediment provenance. The tidal basin sediment provenance was in transition from the eastern basin to Cascade Arc provenance between 11 and 9.5 ka. After 9.5 ka, the tidal basin was strongly dominated by a Cascade Arc sediment provenance. The total volume of sediment that has accumulated since the onset of the Holocene transgression in the lower Columbia River valley is 73 km$^3$. The basin volume accumulation rate gradually increases from 0.6 million m$^3$/yr to slightly over 18 million m$^3$/yr between the depths of 112 m – 30 m (16 to 9 ka). After the 30 m depth (corresponding to 9 ka), the rate of basin volume fill dramatically decreases to just over 4 million m$^3$/yr.