



TALE OF THREE ESTUARIES: COMPARATIVE EVALUATION OF GEOCHEMICAL AND MINERALOGICAL INTERTIDAL SEDIMENTS IN NORTH CORNWALL, SOUTHWEST ENGLAND

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The north coast of Cornwall, southwest England, is notably indented and dominated by bedrock cliff and shore platforms. However, it also comprises some broad embayments that accommodate estuarine valleys and open coast, typically sandy beaches. The region provides an ideal environment within which to assess broad-scale environmental change and the association between estuarine and open-coast morphodynamics. The Hayle, the Gannel and the Camel estuaries that are located within St Ives, Crantock and Padstow bays of North Cornwall respectively are the study sites. Sedimentary linkage indicators here are explored through the geochemical and mineralogical analyses of sediments sampled from the intertidal zones of these systems. The X-ray fluorescence (XRF) of the inter-tidal sediments is examined to evaluate and compare the broad geochemistry of the sediments in each system (See Figure 1). The total base cation content (Na, Mg and K) of the samples in all of the estuaries is low (5% in total) with the exceptions of Ca which is higher (~>20%). In terms of sub-environment significance, the estuarine and inlet sediments of Hayle exhibit a high content of Ca than the coastal/beach samples with both the Gannel's estuarine and beach samples exhibiting similar percentages of Ca composition. There is high variation in the dimension of Ca in the different sub-environments sampled in Camel estuary. The Al and Fe contents in all of the sites are below 2% except in Camel where Al is around 3.5%. The beach sediments in Hayle have higher content of Si, Al and Fe than estuarine sediments while there is no difference of these elements based on sub-environmental division in Gannel. In Camel, the seaward samples indicate lower Al, Si and Fe compare to the mid-estuarine and inner-estuarine samples. Geochemical and mineralogical composition of sediment indicate contamination by mine waste tailings in the estuaries resulting from major historical mining activities in the region with Sn, Cu, As and Zn as predominant in the Hayle, Pb and Zn in the Gannel and Sn, W, and Zr in the Camel estuaries. The effect of the release of the particulate mine waste are still observed in the sample sediments' mineralogical composition significantly despite the cessation of the mine activities in the 19th or early 20th Century, suggesting that these elements are still bio-available and bio-active for riverine processes to transport in the estuary – coast interaction.



Figure 1. Comparison of major (Na to Fe) and minor/trace (Co to U) element composition across the three sites (H - Hayle; C - Camel; G - Gannel). Elements Na to Fe are measured in %; elements Co to U are measured in µg/g.