VARIABILITY OF PARTICULATE METAL CONCENTRATIONS IN STREAM FLOW DURING STORM EVENTS IN A SUBTROPICAL WATERSHED

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By

Vincent Laudato Beltran

Thesis Committee:

Eric De Carlo, Chairperson
Yuan-Hui (Telu) Li
Chris Measures

ABSTRACT

Extensive urbanization in Hawai'i, and Honolulu in particular, during the 20th century presents an opportunity to examine effects thereof upon the storm-driven transfer of terrestrial material from the land to the ocean. This study focused on the variability of Pb, Zn, Cu, Ba, Co, As, Ni, V, Cr, Cd, and U concentrations in streams during nine storm events in the Ala Wai Canal Watershed in Honolulu, O'ahu and one storm event in the the Kane'ohe Stream Watershed in Kane'ohe, O'ahu. As expected, a comparison of metal distribution in particulate and dissolved phases revealed the dominance of suspended particulate matter as a means of metal transport through the watershed.

Particulate Pb, Zn, Cu, Ba, and Co displayed enhanced concentrations and elevated loads during storm flow in the lower urbanized sections of both watersheds. Enrichments of these metals likely derive from automotive or industrial-related sources. Agricultural fertilizer use, particularly the association of As with super-phosphate, in conservation areas appears to be responsible for an upper watershed enrichment of particulate As concentrations. Moreover, storm-derived As loads show a dominant source in the upper areas of the Ala Wai Canal Watershed. Although particulate Cd and U also indicated slight enrichment in the upper watersheds, analytical uncertainty for these low concentration metals was significant, particularly for Cd. Concentrations and loads of particulate Ni, V, and Cr during storm events exhibited a relative spatial invariance throughout the Ala Wai Canal watershed, suggesting primarily mineralogical controls on their distributions. However, concentrations of Ni, V, and Cr in the

Kane'ohe Stream Watershed displayed elevated values at the suburban sampling station, implying the presence of a lower watershed source of Ni, V, Cr.

Applied to the particulate metal concentrations for samples collected in both the Ala Wai Canal Watershed and the Kane'ohe Stream Watershed, principal components analysis established eigenvalues accounting for 77% of the total variance and separated variables into 3 distinct factors. Factor 1 elements, including particulate Pb, Zn, Cu, Ba, and Co, were interpreted to represent metals exhibiting anthropogenic enrichment in the urban watershed. The association of particulate Ni, V, and Cr within Factor 2 likely denoted metals whose concentrations derive from erosional processes in the Ala Wai Canal Watershed. However, an apparent anthropogenic source for Ni, V, and Cr may also be present in the lower suburban Kane'ohe Stream Watershed. While As, U, and Cd were grouped in Factor 3, only As and U were positively associated within the factor and may have a common agricultural source. Although Cd displayed an apparent inverse relationship to As and U, low concentrations of particulate Cd likely caused significant analytical uncertainty which may have skewed statistical analysis.