DMMP/SMS CLARIFICATION PAPER

REPORTING OF SEDIMENT-BOUND CONTAMINANTS: STANDARDIZATION OF SIEVING AND ANALYTICAL PROCEDURES

Prepared by David Sternberg (WA State Department of Ecology) for the Dredged Material Management Program (DMMP) agencies and Ecology's Sediment Management Standards (SMS) Program.

INTRODUCTION

Evaluation of contaminated sediments using defensible methods is critical to the assessment of ecological and potential human health risks associated with COPCs. Proper evaluation of certain physical and chemical properties of sediment is critical for determining the potential for them to harbor chemicals of potential concern (COPCs).

The mass and concentration of COPCs found in sediment deposits depend on certain physical and chemical properties of the sediment. It is generally accepted that the majority of contaminants in fluvial systems end up in depositional areas associated with the fine-grained fraction of the bed sediment. Studies performed on contaminated sediments normally focus on the sand, clay and silt fractions because of their prevalence in depositional areas and they are known to contain the majority of the anthropogenic contaminants. For marine and estuarine systems, most sediment tends to be of a finer- grain size as well. Many reservoirs created by dams may also be dominated by finer-grained sediments, but this is not the case for all aquatic ecosystems. In higher energy fluvial systems common to the western U.S., for example, sorting of sediments may be poor, e.g., finer-grained material can readily mix with coarser-grained clasts of the gravel to boulder size. This is precisely the case in the Spokane River, for example, which is the site subject of significant ongoing investigation and cleanup work.

PROBLEM IDENTIFICATION

The purpose of this paper is to clarify existing guidance for sieving sediment samples, prior to sample preparation and chemical analysis, and for reporting all analytical results for COPCs in a manner is representative and consistent.

Although total organic carbon (TOC) concentrations are typically higher in the silt/clay portion of sediment relative to fine sand (250µm), elevated carbon concentrations and associated toxicants may also occur in coarse sand due to the presence of organic debris (Ghosh et al., 2000). Organic debris in the very coarse-sand size range (1- 2 mm) may contain high levels of contaminants and is of particular interest in higher energy carbon-starved river systems. Contaminants typically associated with organic carbon in sediments may bind to organic debris in carbon starved systems. The increase in organic particles and the contaminants bound to them is quantifiable and accurate, provided that the sediment is analyzed on a dry-weight basis and diligent sample collection and sieving procedures are followed. In some cases, provided care is

taken to collect and analyze all the sediment particles, TOC concentrations in the coarser sand-sized grains approach those seen in the silt/clay fraction of sediments (Anderson et al 1981). This organic debris frequently contains contaminants at similar concentrations to those found in the silt/clay constituents of sediment (Ghosh et al., 2001). The manner in which organic matter may disperse among all the coarser fraction of fine-grained sediments (<2mm) and the important role that organic carbon may play in sequestering environmental toxicants in silt/clay portions of sediments necessitates inclusion of both the fines (silt/clay) and sand fractions in studies designed to characterize contaminated sediments. ***Inclusion of gravel or larger and more inert clasts (> 2mm) in sediment samples designated for chemical analysis leads to results with an inappropriately low bias.***

Regulatory authorities continue to revise standard operating procedures (SOPs) for evaluating sediment quality based on the consensus scientific opinion that recognizes COPCs are generally associated with smaller grained particles (<2 mm). Federal and state agencies charged with managing contaminated sediment sites use chemistry data reported on a dry-weight or organic carbon-normalized basis to make regulatory decisions, e.g., cleanup and restoration. ***Although there is general agreement that sediment fines behave as sinks and/or sources of contaminants, further guidance is required to ensure appropriate sample preparation procedures are followed in order to make certain that consistent and comparable grain-sizes are used in the evaluation and reporting of COPCs relative to the total sample (e.g., a bulk sample).***

It is an accepted practice for field and laboratory personnel to remove larger clasts and debris from sediment samples, as long as they provide a record of their activities. The flexibility of field personnel to make these decisions, based on their best professional judgment, needs to be maintained. However, regulatory decisions should be made on samples processed in a consistent manner and inter-laboratory differences, due to variations in sample handling methods, should be minimized whenever possible. ***Establishing SOPs for the removal of larger-grained gravels/objects prior to chemical analysis and defining the fraction of finer sediments analyzed for COPCs will ensure spatial and temporal consistency in sediment chemistry values.***

PROPOSED ACTION/MODIFICATION

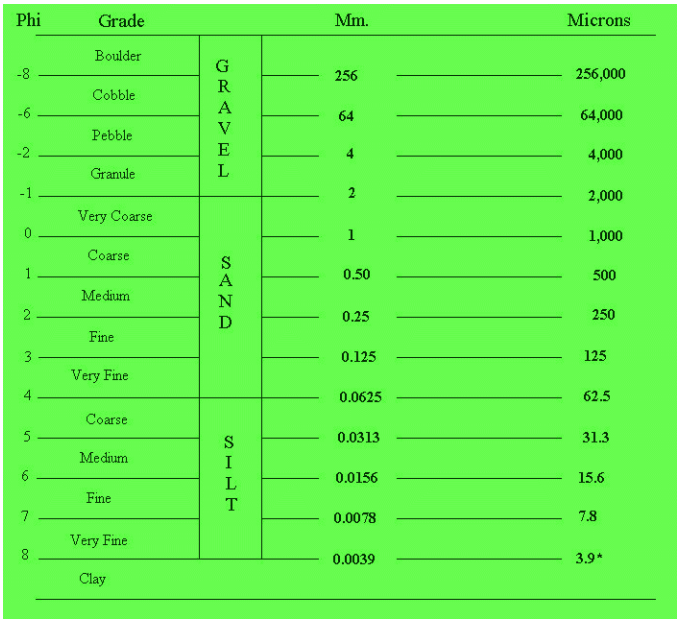
Based on the aforementioned characteristics of sediments, DMMP and Ecology staff propose clarifying sampling and data reporting guidelines to better standardize sediment chemistry analysis relative to specific grain size fractions of sediment samples. This is of particular concern in the higher energy fluvial systems where well sorted, fine-grained deposits often are not the norm. Adherence to a common framework/guideline will enable Ecology and other agencies to compare data within and between sites on a statewide and regional basis. Creation of comparable data will also increase our understanding of the relationship between sediment grain size, contaminant concentrations, and toxicity. The agencies are also coordinating with the Regional Sediment Evaluation Team (RSET) to advance this initiative on a more expansive regional basis.

Specific recommendations include:

1. Continue supporting field personnel and their decisions to remove large debris from sediment samples, provided that such sorting and removal is well documented.

2. Require final sieving of samples be performed under laboratory conditions in order to ensure that lighter density organic debris is included in subsequent chemical analyses.

3. Continue requiring that sediment grain size be routinely reported for at least four size classes or fractions: gravel/cobble (> 2 mm), sand (0.63 µm - 2 mm), silt (4 µm - 63 µm) and clay (< 4 µm).



4. Standardize protocols for sieving and removal gravel and debris larger then 2 mm prior to chemical analyses.

5. Measure and report, at a minimum*, sediment chemical concentrations for the all sand and smaller size fractions of the bulk sample (i.e., < 2 mm).

6. Continue requiring sediment chemistry data to be reported on a dry-weight basis, with data for non-polar organic compounds also organic carbon-normalized to facilitate comparison to SMS criteria.

** Ideally chemical analysis of the "fines only" fraction (> 63 µm) sediment fractions should also be performed. Although costly, analyzing the sand and silt/clay fractions of the sediment samples is consistent with current protocols used throughout the United States by the National*

Water Quality Assessment Program of the U.S. Geological Survey (NAWQA-USGS) (Shelton and Capel, 1994).
Adoption of these recommendations and the continued refinement of SOPs for sediments will enable all agencies involved in the RSET to have greater confidence in data when comparing sediment from various watersheds throughout the region. In fact, this clarification paper attempts to formalize practices that are already commonly used in sediment laboratories. These recommendations are technically defensible and account for physical/chemical factors that affect the concentration, bioavailability, and ecological effects of COPCs in sediments.

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