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Site-specific data needed to assess contaminated sediment

New research in harbours has explored the most influential environmental and human factors on the release of contaminants from sediment. The scientists suggest that the rate of release can vary considerably between locations and risk assessments of water pollution could be improved if they account for this.

Many pesticides, industrial materials and pharmaceuticals are chemicals known as Persistent Organic Pollutants (POPs). These tend to accumulate in the environment because they are not degraded by chemical or biological processes. Although legislation under the Water Framework Directive (WFD)[1] has reduced the direct release of POPs into aquatic environments, any that have previously accumulated in the sediment can be released back into the water over time.

Many factors can influence the rate of this release, called the sediment flux, and it is important for risk managers to know which factors are the most important in order to identify control measures. For example, POPs can accumulate attached to solid particles in sediment or can dissolve in the water that fills the spaces between particles, known as 'pore water'. POPs can also accumulate in marine plants and animals for instance if ingested. When organisms die and are buried by layers of silt and sand, some contaminant is stored in dead organic tissue in the sediment.

Scientists explored the impact of 15 human and environmental influences on contaminant flux from sediment to water in 36 different scenarios, combining different contaminants (three common POPs and mercury), different sizes of contaminated area and three classes of harbour type: small craft, major craft (ferries, cruise ships, tow boats) and industrial (cargo and supply ships).

The strength of the different influences varied from scenario to scenario, but five emerged as the most important overall: (1) the flux of dead plant and animal material to the sediment, (2) movement of pore water out of the sediment, which is accelerated by the churning up of material by organisms that live in the sediment ('bioturbation'), (3) the ratio of contaminant in pore water to sediment, (4) the ratio of contaminant in pore water to sediment-dwelling organisms and (5) the extent of sediment disturbance caused by the passage of ships.

These results show that in order to *realistically* predict the rate of sediment flux for a given environment, it is important that scientists use the most appropriate values for each of these five influences. However, the correct values will vary considerably between different locations, which have different combinations of physical and biological conditions.

For example, bioturbation can increase the release of contaminant by a factor of ten, but is dependent on specific characteristics of the sediment-dwelling organisms, such as the species present and their abundance. Also, the extent to which marine traffic disturbs the sediment will be heavily influenced by particle size, particle density and water depth.

The research highlights the need for site-specific investigations in order to better establish the potential risks to human health and ecosystems via exposure to contaminants. This is necessary to support decisions on the implementation of potential control measures based on a broad cost-benefit analysis and is a key theme of the EC risk assessment guidelines on chemical exposure (2003)[2].

1. See: EU Water Framework Directive (WFD)
http://ec.europa.eu/environment/water/water-framework/index_en.html
2. See: EU Risk assessment guidelines
http://ecb.jrc.ec.europa.eu/documents/TECHNICAL_GUIDANCE_DOCUMENT/tgdpart3_2ed.pdf

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