Reducing uncertainty in sediment contact testing by considering natural variability and harmonizing control sediments

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Introduction: Sediment contact tests (SCT) aim to assess the toxicity of anthropogenic contaminants in whole sediments introduced into water bodies. However, environmental samples do not only differ in their quantity and quality of contamination, but also in terms of their geochemical properties, such as grain size distribution or content of organic matter. These sediment properties might also affect the test organisms and thus impede the interpretation of toxicity data, e.g. by producing false-positive results (Fig. 1). This has already been shown for various benthic organisms in freshwater sediments (e.g. [1,2]).
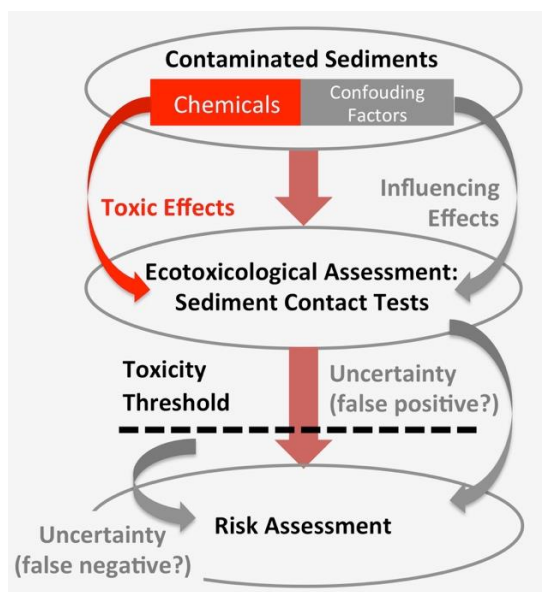
Fig. 1: The dilemma of uncertainty in SCTs.

Attempts to account for the variability of test results of SCTs in form of thresholds or corridors for tolerable inhibitory effects (e.g. [2]) might lead to false negative results and an underestimation of risk (Fig. 1). Therefore, we want to present a strategy, how to reduce uncertainty in sediment contact testing for a more reliable risk assessment.

Methods: Nine different, SCTs (Tab. 1) with organisms from various trophic and organizational levels will be applied to a selection of min. 30 reference sediments, in order to investigate the species-specific variability due to differences in geo-physico-chemical properties of lowly contaminated freshwater sediments.

Tab. 1: Sediment contact tests

Species	Organization Level	Trophic Level	Endpoint	Test duration	Standard
Arthrobacter globiformis	bacteria	destruent	E	6h	ISO/DIS 10872
Myriophyllum aquaticum	plant	producer	G	10d	ISO 16191
Heterocypris incongruens	invertebrate	consumer	G, M	6d	ISO 14371
Caenorhabditis elegans	invertebrate	consumer	G, R	96h	ISO 10872
Chironomus riparius	invertebrate	consumer	G, Em	7-28d	AFNOR T90-339-1
Hyalella azteca	invertebrate	consumer	G, M	14-28d	ISO 16303
Lumbriculus variegatus	invertebrate	consumer	G, R	28d	OECD 225
Danio rerio	vertebrate	consumer	M	48h	Adapted ISO 15088

* E = enzyme activity; G = growth; M = mortality; R = reproduction; Em = Emergence

The project comprises two work packages: In WP1, a common field-collected sedimnt will be defined as control sediment for all test systems. In WP2, min. 30 lowly contaminated sediments from rivers and lakes will be tested with all sediment contact tests. Sediments will be selected according to following criteria: sites should be in a (very) good ecological and chemical status; chemical contamination is below 2 x TEC for each substance (SQGs according to [3]); sediments show a gradient of texture and organic content. Variability of test results will be analyzed statistically in order to derive reliable and safe toxicity thresholds.

Aimed Results: (1) A common natural control sediment will allow comparison of test results among all SCTs. (2) Revision of endpoint specific toxicity thresholds will ensure environmental safety.

References: [1] Ankley et al. (1994) Environ. Toxicol. Chem. 13: 627–635; [2] Höss et al. (2010) Environ Poll 158: 2999–3010; [3] De Deckere et al. (2011) *J Soil Sed* **11**:504-517