Impact of Unburnt Hard Coal Particles in River and Marine Sediments: Boon or Bane for Sediment Management?

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Introduction: Unburnt coal is one of the oldest and most widespread anthropogenic contaminants in river and marine sediments. Emission sources such as mining [1], loading [2], spill accidents [3] and naturally outcropping seams near water bodies [4] can lead to significant amounts of hard coal particles in sediments (Fig. 1). Timescales of significant emissions vary from predominantly former times e.g. in many European countries up to the present e.g. in Vietnam [5].

It is known that hard coal particles act as a sink for hydrophobic organic compounds (HOCs) in the environment which is explained by strong sorption with high capacity compared to other organic matter [6, 7]. However, it is less known, that large amounts of native HOCs, such as polycyclic aromatic hydrocarbons (PAHs) can be present in hard coals up to hundreds (in some cases up to thousands) of mg/kg [8, 9], which can impact sediments. Whereas much is known about physical effects of coal particles on organisms, there are surprisingly few studies focusing on chemical effects from HOC-rich coals on organisms [10].

The aims of this study are to elucidate whether (1) increased native PAH concentrations are present in hard coal samples from large mining areas worldwide, (2) PAH amounts and patterns correspond to hard coal rank, (3) characteristic PAH patterns exist in hard coals and (4) if they are bioavailable.

Methods: For the analysis of PAHs in hard coal samples from some large mining areas (i.e. China, US, Australia, Indonesia, Poland, Germany, Ukraine, Kazakhstan), we apply accelerated solvent extraction using dichloromethane and toluene followed by fractionation by liquid chromatography. Subsequently, fractions containing PAHs (~50 PAHs) are analyzed by GC-MS. Additional methods for coal characterization will be applied. Several methods to investigate bioavailability of PAHs from hard coals are available [Ehlers & Loibner, 2006] and a selection of two to three will be applied.

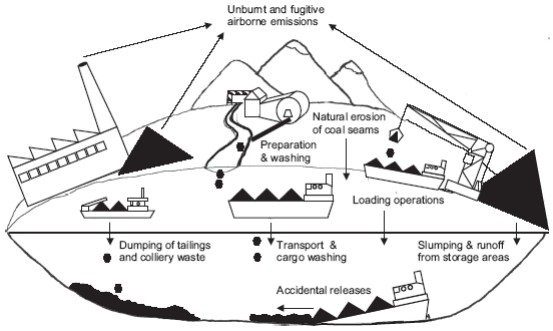

Fig. 1: Emission sources of coal into the aquatic environment [10].

Results: First results show that EPA-PAH concentrations of coals from Australia, South Africa, Poland, U.S., Indonesia and Germany range from tens to few hundreds of mg/kg and total PAH concentrations vary from ten and one thousand of mg/kg. For the first time, Dibenzopyrenes are detected in coals and concentrations up to 25 mg/kg occur. PAHs of hard coals only correlate to according rank, if the coals are characterized by a common origin. Results of the current study will be presented.

References: [1] Pies, C., Yang, Y. and Hofmann, T. (2007) *J Soils Sediments* **7**: 216-222; [2] Johnson, R. and Bustin, R.M. (2006) *Int. J. Coal Geol.* **68**: 57-69; [3] Chapman, P. M., Downie, J., Maynard, A. and Taylors, L. A. (1996) *Environ. Toxicol. Chem.* **15** (5): 638-642; [4] Short, J. W., Kvenvolden, K. A., Carlson, P. R., Hostettler, F. D., Rosenbauer, R. J. and Wright, B. A. (1999) *Environ. Sci. Technol*., **33**, 34-42; [5] Wagner, I. (2007): Weltnaturerbe im Kohlerevier. Deutschlandfunk, 19.01.2007, http://www.dradio.de; [6] Kleineidam, S., Schüth C. and Grathwohl, P. (2002) *Environ. Sci. Technol*. **36**: 4689-4697; [7] Wang, G., Kleineidam, S. and Grathwohl, P. (2007) *Environ. Sci. Technol*. **41**: 1186-1193; [8] Willsch, H. and Radke, M. (1995), *Polycycl. Arom. Comp*. **7**, 231-251; [9] Van Kooten, G. K., Short, J. W. and Kolak, J. J. (2002): *Environ. Forensics* **3**: 227-241; [10] Ahrens, M. J., Morrisey, D.J. (2005) *Oceanogr.Mar. Biol. – an annual Review*, **43**: 69-122.