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Impact of the Maximum Turbidity Zone (MTZ) on trace element (Cd, As) behavior in the freshwater reaches of a macrotidal estuary (Gironde estuary, France)

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The Gironde Estuary is a macrotidal estuary with a permanent maximum turbidity zone (MTZ) that moves upstream and downstream depending on hydrologic conditions. The MTZ is located in the upstream reaches of the estuary (fluvial zone) when river discharge is low and can be expulsed to the coastal zone during floods. The MTZ is characterized by very high suspended particulate matter (SPM) concentrations ($>$1g/l at the surface) showing strong turbidity gradients towards both the marine and the fluvial end. In 2004, monthly sampling has been realized in the freshwater reaches of the Gironde Estuary (from the limit of the tidal zone in the Garonne River to the beginning of the salinity gradient). We present particulate and dissolved (0.2 μm and 0.02 μm) concentrations and C18 extracted metal-organic complex fractions for Cd and As, during contrasted hydrologic situations. During the first situation, at the end of a flood (Garonne River discharge: 827 m3/s), no MTZ was observed in the study zone and SPM concentrations were low (60-110 mg/l). In this situation, Cd and As concentrations were less variable than during low discharge, when a strong MTZ was observed in the fluvial zone (SPM concentrations up to 2,300 mg/l). In the MTZ, dissolved and particulate Cd and As showed very contrasted behavior. For example, particulate Cd concentrations decreased by 50% and particulate As concentrations increased by 30% in the upstream part of the MTZ, where SPM concentrations increased from 5 mg l-1 to 2,300 mg/l within only 20 km. The Cd decrease was attributed to dilution of new fluvial SPM by older MTZ particles with lower Cd concentrations due to estuarine processes (e.g. organic matter degradation, desorption by the beginning salinity gradient). In contrast, the increase of particulate As concentrations may be

due to exchanges between the dissolved and particulate phases, e.g. adsorption onto particulate transport phases. Exchanges between the particulate, the colloidal and the dissolved phase deduced from different filtrations (0.2 μm, 0.02 μm) suggest that colloidal phases play an important role in this zone. Despite important colloidal Cd and As fractions downstream from the MTZ, the C18-extracted metal-organic fraction always represented less than 5% of the total dissolved Cd and As concentrations.