Transportation of sediment and heavy metal resuspended by a giant tsunami based on three dimensional, tsunami, ocean, and particle tracking coupled simulations

*Satoshi Nakada[1], Mitsuru Hayashi[2], Shunichi Koshimura[3]

1. Graduate School of Maritime Sciences, Kobe University, 2. Research Centre for Inland Seas, Kobe University, 3. International Research Institute of Disaster Science, Tohoku University

The Japanese government has reported that a Nankai Trough Earthquake will occur with approximately 70 % probability within 30 years and cause a giant tsunami. Giant tsunamis can disturb marine sediment and form muddy seawater in nearshore areas. Marine sediment can be resuspended and transported by not only the tsunami current but also by the tidal, wind-forced, and density currents in the coastal ocean. Because the marine sediment in the coastal oceans around megacities contains heavy metals and cysts of harmful algae, the resuspension of marine sediments can induce multiple forms of marine pollution, such as harmful red tides and heavy metal contamination in extensive areas. This study evaluated the transportation of resuspended sediment and zinc flux from the seabed in the urban semi-enclosed sea, Osaka Bay as a pilot ocean in terms of heavy-metal pollution based on the greatest tsunamigenic earthquake scenario along the Nankai Trough occurring in the near future. The high-resolution, three-dimension tsunami-ocean coupled simulation was conducted to simulate particle tracking assuming the sediment resuspension forced by tsunami. These simulations demonstrated that the marked resuspension areas of zinc “hot spots” were locally formed in the nearshore region around landfills, and the particles from seabed from those areas vertically advected to the upper layer in the nearshore region and transported offshore owing to the estuarine circulation. After the tsunami, the zinc was transported by the tidal and wind current and widely redeposited in the bay, and gradually migrated to the southern offshore region facing Pacific through the Kitan and Kii Straight. As a result, the benthic environment and ecosystem can be improved only in areas around the “hot spots” where the zinc concentration decreases.

Keywords: Giant tsunami, Heavy metal, Particle tracking simulation, Mega-earthquake along Nankai trough , Osaka Bay

