

ANNUAL REPORT ON GEOTRACES ACTIVITIES IN SLOVENIA
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New results

Nitrogen concentrations and isotopic composition were used to investigate whether they have any notable influence on the Gulf of Trieste. The combined use of salinity, nutrient concentrations, and nitrate, particulate nitrogen and carbon isotopic compositions revealed that the seawater surface was influenced by mixing with different sources including seawater, rivers and sewage effluent. The site influenced by sewage effluent is relatively spatially isolated, which suggests that NO_3^- is not widely distributed by this point source. In addition, our results are consistent with the occurrence of nitrification in the water column in autumn and winter. The nitrification activity was higher in autumn, while in winter it occurred in parallel to phytoplankton uptake.

The coastal northern Adriatic Sea receives pulsed inputs of riverine nutrients, causing phytoplankton blooms and seasonally sustained dissolved organic carbon (DOC) accumulation—hypothesized to cause episodes of massive mucilage. The underlying mechanisms regulating P and C cycles and their coupling are unclear. Results provide novel insights on post-bloom C and P dynamics and mechanisms. 1) Post-bloom DOC accumulation to 186 μM remained elevated despite high bacterial carbon demand. Presumably, a large part of DOC accumulated due to the bacterial ectohydrolytic processing of primary productivity that adventitiously generated slow-to-degrade DOC; 2) bacteria heavily colonized post-bloom diatom aggregates, rendering them microscale hotspots of P regeneration due to locally intense bacterial ectohydrolase activities; 3) Pi turnover was rapid thus suggesting high P flux through the DOP pool (dissolved organic phosphorus) turnover; 4) Alpha- and Gamma-proteobacteria dominated the bacterial communities despite great differences of C and P pools and fluxes in both mesocosms. However, minor taxa showed dramatic changes in community compositions. Major OTUs were presumably generalists adapted to diverse productivity regimes. We suggest that variation in bacterial ectohydrolase activities on aggregates, regulating the rates of POM \rightarrow DOM transition as well as dissolved polymer hydrolysis, could become a bottleneck in P regeneration. This could be another regulatory step, in addition to APase, in the microbial regulation of P cycle and the coupling between C and P cycles.

Our comprehensive 2 year time - series study showed that despite the shallowness of this area there was a significant difference between the surface and the bottom bacterial community structure. The bottom bacterial community was more diverse than the surface one and influenced by sediment re-suspension. The surface seawater temperature had a profound effect on bacterial productivity, while the bacterial community structure was more affected by freshwater - borne nutrients and phytoplankton blooms. Our results propose the importance of the water mass movements as drivers of freshwater - borne nutrients and of allochthonous microbial taxa.

Polonium-210 (Po-210 , $t_{1/2} = 138.4$ days) is a naturally occurring radionuclide originating from Uranium-238 decay chain as the daughter of Lead-210 (Pb-210 , $t_{1/2} = 22$ years). The alpha decay of Po-210 accounts for most of the radioactive dose to marine organisms. In some cases it can represent a serious risk to human health, particularly due to its biomagnification along marine (benthic and pelagic) food webs. We studied the total activity of Po-210 determined by alpha-spectrometry in various samples (matrices) collected in the Gulf of

Trieste (northern Adriatic Sea) affected by fresh water inflows especially from the Isonzo River in the northern part. Observed Po-210 levels were: 1) 1.41-3.35 mBq/L in dissolved phase ($<0.45 \mu\text{m}$) in seawater column (0-20 m) and up to 26.7 mBq/L in the river Isonzo, 2) 0.81-4.59 mBq/L (400-2300 Bq/kg, dw) in the suspended particulate matter (SPM, $0.45\text{-}200 \mu\text{m}$) in the seawater column and up to 10.1 mBq/L in the river Isonzo, 3) 40 (Isonzo River) - 158 Bq/kg in surface sediments (5 sediment cores collected in a N-S transect in the gulf and sectioned in 1 cm slices to the depth of 20 cm), 4) 239 (autumn) – 415 to 1800 (spring) Bq/kg (dw) in meso(zoo)plankton ($>200 \mu\text{m}$) and 5) 300-400 Bq/kg (ww) in mussels (*Mytilus galloprovincialis*) consumed by humans. In seawater, 1/4 to 1/2 of total Po-210 was found in particulate form, while in the Isonzo River the dissolved form dominates (up to 3/4). Plankton fractionation revealed the highest levels in $>200 \mu\text{m}$ fraction - mesoplankton (415-1272 Bq/kg) followed by $55\text{-}200 \mu\text{m}$ (388-997 Bq/kg) and $20\text{-}55 \mu\text{m}$ (318-810 Bq/kg) fractions - microplankton. In sediments, slightly higher levels were encountered in the Isonzo prodelta and in the central (deepest) part of gulf. KD (L/kg) calculated between seawater and SPM, and seawater and sediment amounted to about 5.106 and 6.104, respectively. Obtained data show higher Po-210 levels in all matrices analyzed in the Gulf of Trieste compared to other Adriatic (central Adriatic) and Mediterranean (Ligurian Sea) areas. The Po-210/Pb-210 ratios in water and sediments were mostly below or close to 1 while this ratio greatly increased in trophic levels (up to about 50) reflecting a preferential bioaccumulation of Po-210 over Pb-210. Po-210 accumulation between seawater and SPM and seawater and mesozooplankton amounts to 3.7.104 and 1.1.104. Comparison of the relative importance of pelagic and benthic bioaccumulation pathways suggests greater accumulation in pelagic feeding species except in filter feeder bivalves.

In the framework of the GMOS project further measurements of Hg in air, precipitation, and seawater continued. Research on the analytical approach related to Hg species in seawater was performed. Evasion to the atmosphere of elemental mercury from surface ocean water constitutes an important source of Hg in the environment. Its availability in aqueous samples is affected by a number of factors such as light, temperature, the presence of other ions (Cl^- or Br^-), metals (Fe(III)), organic matter, biological activity, tectonic activity and wind speed. In addition, the presence of oxidized forms of Hg increases the chances of methylation processes where MeHg is formed. For these reasons the importance of DGM and RHg measurements is highly important in understanding and building on existing knowledge of Hg chemistry and in improving the analytical methods used. The overall conclusion stresses the need of on-spot measurements but when this is not possible, analysis of the sample about 24 hours after sampling, without the addition of any preservative agent or filtration, can ensure reliable results. Acidifying the sample or adding a preservative agent such as AgCl_3 and HNO_3 , may lead to unpredictable results, depending on sample matrix.

Publications

Original scientific article

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Invited lecture

- FAGANELI, Jadran, COVELLI, Stefano, OGRINC, Nives, ČERMELJ, Branko. "Zgodovina" recentnega (holocenskega) sedimenta Tržaškega zaliva z uporabo geokemijskih indikatorjev. V: 4. slovenski geološki kongres, Ankaran, 8.-10. oktober 2014. ROŽIČ, Boštjan (ur.), VERBOVŠEK, Timotej (ur.), VRABEC, Mirijam (ur.). Povzetki in ekskurzije = Abstracts and field trips. Ljubljana: Naravoslovnotehniška fakulteta, 2014, 16.

Scientific conference contribution

- KLUN, Katja, ŠKET, Primož, FALNOGA, Ingrid, FAGANELI, Jadran. Determination of seasonal dynamic in size and structure of colloidal organic matter by HP-SEC chromatography and ¹H NMR spectroscopy. V: 2014 Ocean sciences meeting : Honolulu, Hawaii, USA, 23.-28. Febr. 2014. Honolulu: OSM, 2014, 15821. <http://www.sgmeet.com/osm2014/viewabstract.asp?AbstractID=15821>.
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PhD thesis

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