The river basin-coastal zone continuum: heavy metal contents in stream and marine sediments, NW Aegean Sea (EUROCAT Project)

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North Sea
Baltic
Mediterranean

AFICO project

Provadijska
Axios
Po
Idrija
Vistula
Rhine
Elbe
Humber

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Study area

Axios (Vardar) River 3-D elevation model
Principal industrial hot spots in FYROM investigated by UNEP-2000

- **Ferro-alloy plant at Jegunovce** ('HEK Jugochrom')
  - Nori: Jegenovce
  - Pollutants: Cr

- **Organic chemicals plant, Skopje (OHIS A.D.)**
  - Nori: Skopje
  - Pollutants: HCH isomers, SO₂

- **Lead and zinc smelter, Veles ('MHK Zletovo')**
  - Nori: Veles
  - Pollutants: Pb, Zn, Cd, H₂SO₄

- **Zinc and lead mine, Probistip ('Rudnici Zletovo')**
  - Nori: Probistip
  - Pollutants: Pb, Zn, Cd, cyanides

- **Metal resurfacing factory, Kicevo ('Tane Caleski')**
  - Nori: Kibevo
  - Pollutants: Cr, Zn

- **Thermal power plant, Bitola ('REK Bitola')**
  - Nori: Bitola
  - Pollutants: Heavy metals, SO₂

- **Landfill site, Drisla, near Skopje**
  - Nori: Drisla
  - Pollutants: Organic & inorganic pollutants

- **Fertilizer factory, Veles ('MHK Zletovo')**
  - Nori: Veles
  - Pollutants: P, N

- **Copper mine, Radovis ('Buchim S.C.')**
  - Nori: Radovis
  - Pollutants: Cu, organic pollutants

- **Lojane mine**
  - Nori: Lojane
  - Pollutants: As, Cr, Sb
Zn in stream and marine sediments
Pb in stream and marine sediments
Cr in stream and marine sediments
As in stream and marine sediments
Sediment quality assessment

• The sediment metal contents were compared against the Direct Exposure Soil Action Levels (SALs) Standards for residential use.
• A comparison of the sediment data for Axios River and Thermaikos Gulf with the SALs, reveal that the levels are not exceeded for copper, lead, zinc, cadmium and nickel.
• The SALs are exceeded for arsenic (27% of the data for river sediments and 100% of the marine sediments) and for chromium (42% of the data for river sediments and 100% of the marine sediments), if we assume that all chromium measured is in the oxidized form.
Sediment quality assessment

• **Hexavalent chromium** is a known lung carcinogen and toxic through oral or dermal exposure (i.e. the standards are 100 µg/g for Cr(VI) vs. 3,900 µg/g for Cr(III)). In contrast, trivalent chromium is an essential trace element in human nutrition: Need for speciation!!!

• **Arsenic** concentrations exhibit a definite enrichment indicating a potential human health effect to direct exposure for the marine sediments.
Conclusions 1

- Heavy metals in sediments: Zn, Pb, Cr and As levels appear to be elevated.
- A significant part of these metals originates in ophiolite complexes and other heavy metal-rich formations that are abundant in the Axios R. catchment.
- Smelting industries and mine tailings in FYROM should be considered as primary point sources of heavy metals in the area.
Conclusions 2

• Marine sediments of the Thermaikos Gulf clearly reflect heavy-metal sources, namely the Axios and Aliakmon Rivers, as well as the city and industrial zone of Thessaloniki.

• Sediments quality criteria are exceeded for As and Cr, in both river and marine sediments.

• The need for Cr speciation and regular monitoring is highly recommended.
Sources


