Influence of land use in small karst catchments on the chemical status of peloid sediments on the eastern Adriatic coast

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General context

Peloids are defined as mud which is applied topically as therapeutic agents (Carretero, 2002) .
In the past 15 years, research of peliods/healing mud on the Adriatic coast has become important because of the needs for the development of high quality tourism.

Most of the catchments areas supplying water and mineral mater to the Adriatic bays with peloids are affected by various degrees of human impact, i.e. activity that is introducing various types of pollutants to environment.

Mostly these are agricultural activities linked with vine and olive production (various types of agrochemicals; Bordeaux mixture and other types of herbicides) but in some areas there are industrial impacts and municipal waste impacts.

General context

During pelotherapy several kilograms of matured mud are rubbed into the body. The peloid acquire chemical elements from the maturation environment both as soluble ions and complexes, and leave them (part of them) to the human skin (cit. F. Tateo).

The therapeutic effects of the treatment are based on mechanisms that are unknown in details, but the triggers of benefits seems to be the heat, the thermophysical properties (malleability, adhesion and warmth that brings immediate relief to the muscles) and the transfer of chemical compounds to the organisms(cit. F. Tateo).

Objectives

➔Classify critical points (contamination sources on the catchment area) according to risks on sediment quality

➔Impact on the chemical status of sediments Criteria for peloids to be used for therapy = baseline "slight impact values", trigger values or element enrichment factors, mobile fractions from sequential analysis)

➔Other alternatives : recommending search for less impacted sediments/peloids

➔Change of land use practices (remediation of contaminated land)

➔Determine guideline/trigger values for healing mud/peloids.

Methods

➔Geochemistry, mineralogy, palinology, geomorphology

Geochemistry

➔ sampling of soils, sediments (stream and marine) and ash

➔Measure the total metal content of the soils.

➔Normalization data on conservative elements

$$EF = ([M]/[Sc])_{recent\ sediment} / ([M]/[Sc])_{preanth.\ sediment}$$

➔Measure bioaccessible metals of the soils, sediments and ash by sequential extraction methods (3 step BCR)

The karst

Peloid deposits

Makirina b

Morinje b

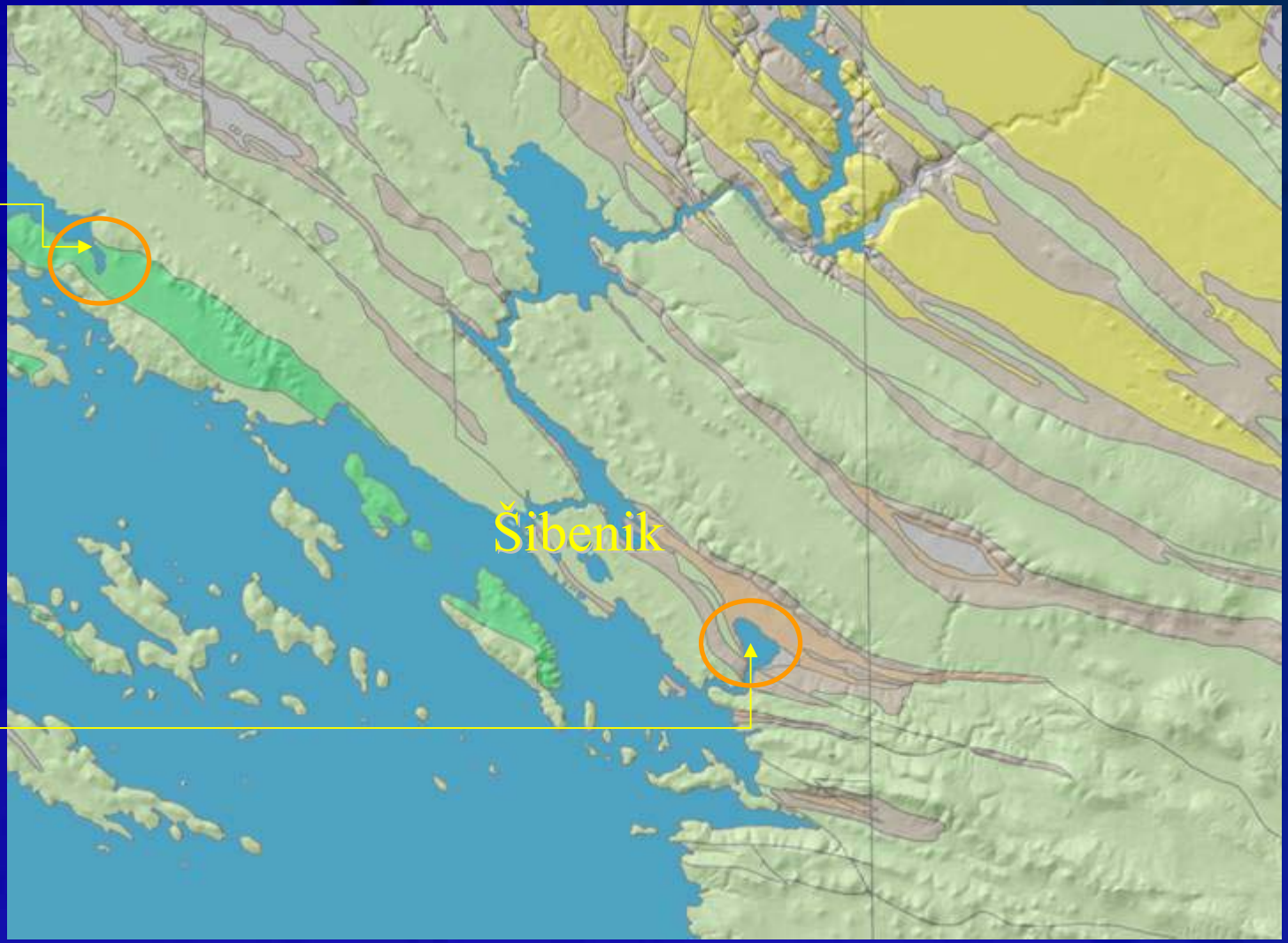
Geology

Makirina bay

Limestone/
dolomite

Marls

Morinje bay



The catchments

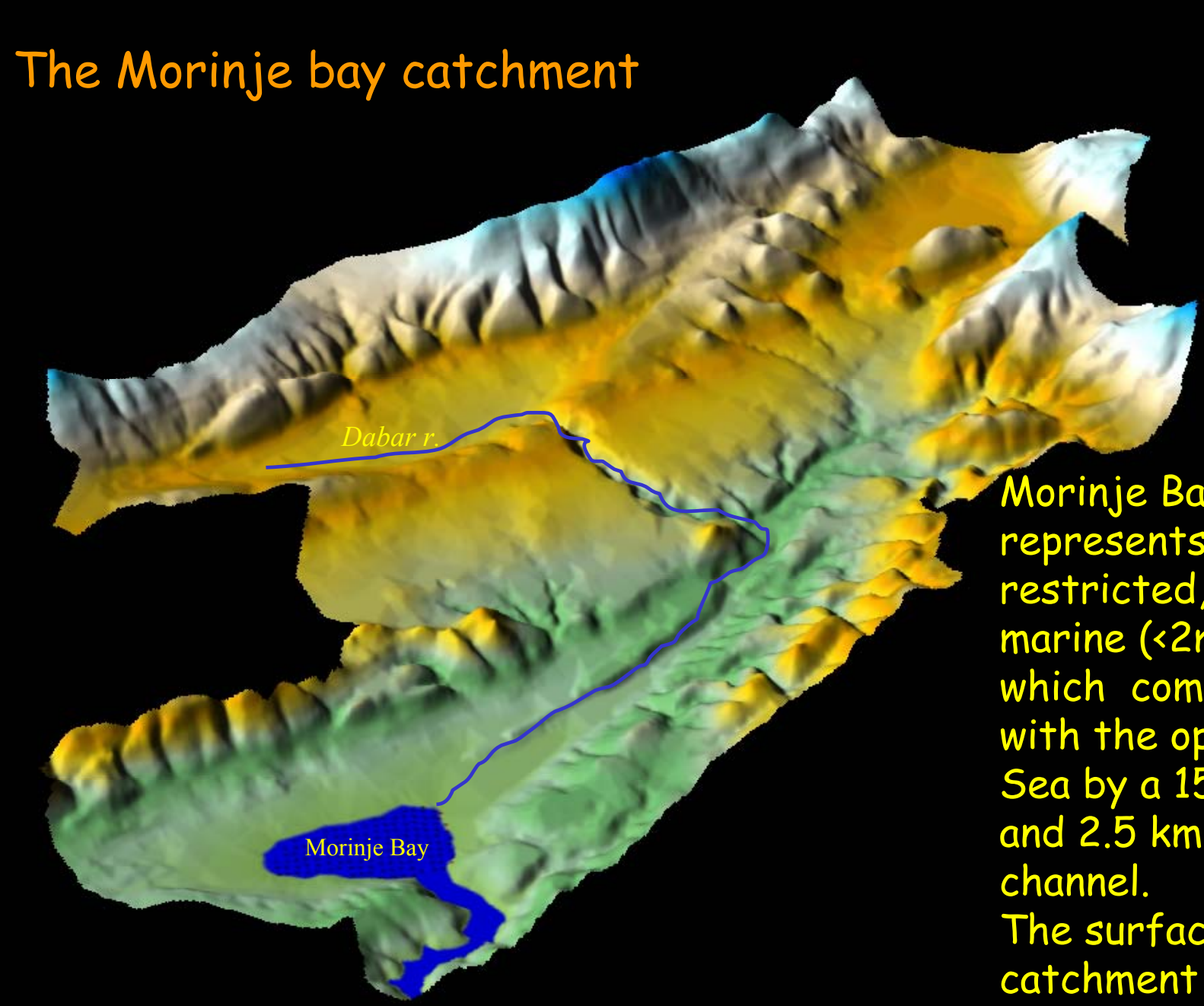
Makirina bay

catchment size
7 km^2
Population 35
Arable land 3 km^2

Morinje bay

catchment size
103 km^2
Population 1850
Arable land 16 km^2

The Morinje bay catchment

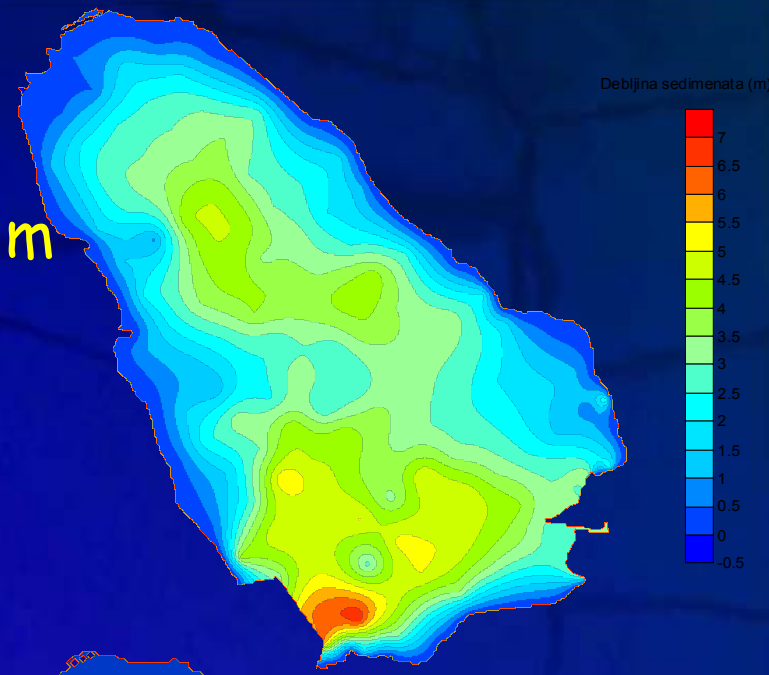


Morinje Bay (3.5 km^2) represents an restricted, shallow marine (<2m) ecosystem which communicates with the open Adriatic Sea by a 150-350 m wide and 2.5 km long Morinje channel.

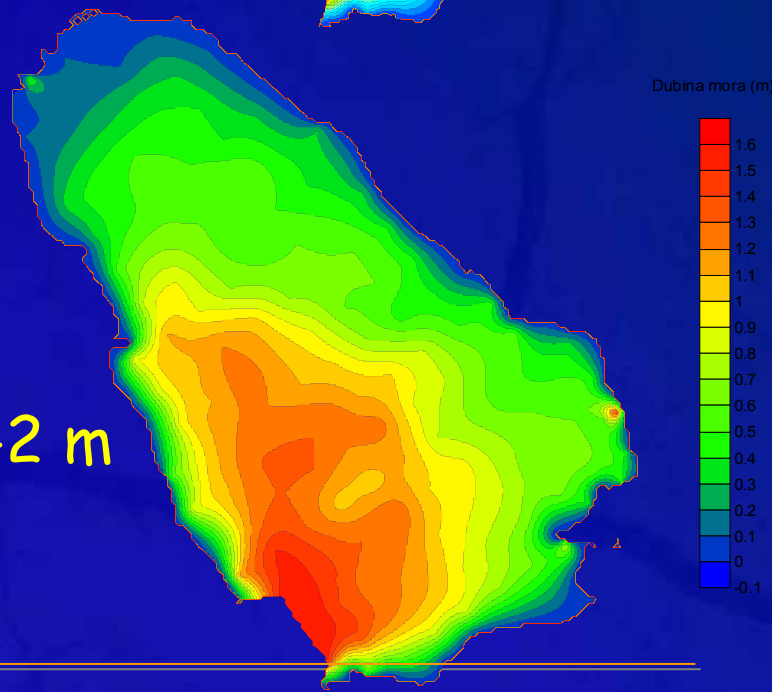
The surface of the catchment is 103 km^2

Morinje bay

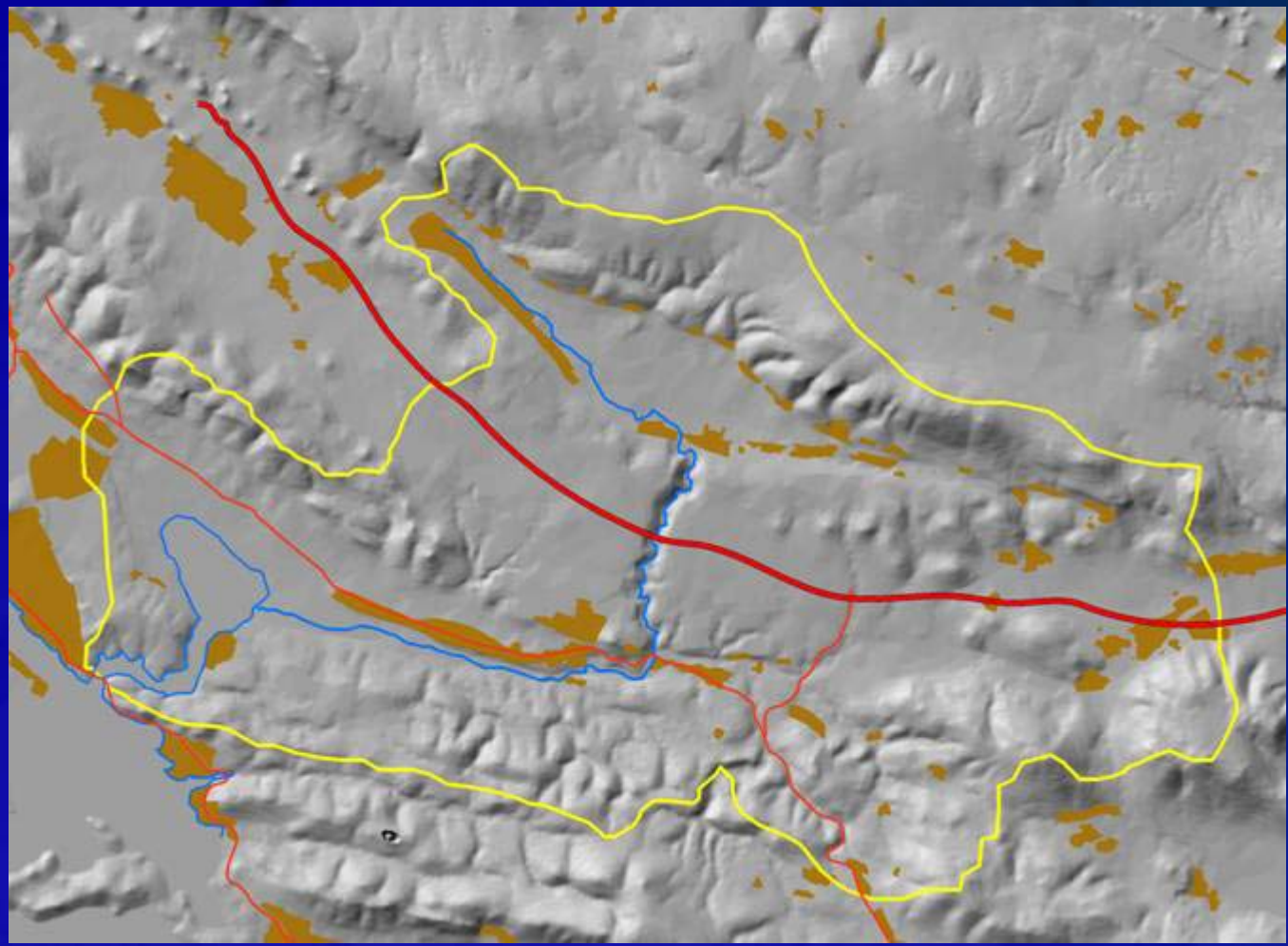
Sediment thickness from 0-7 m



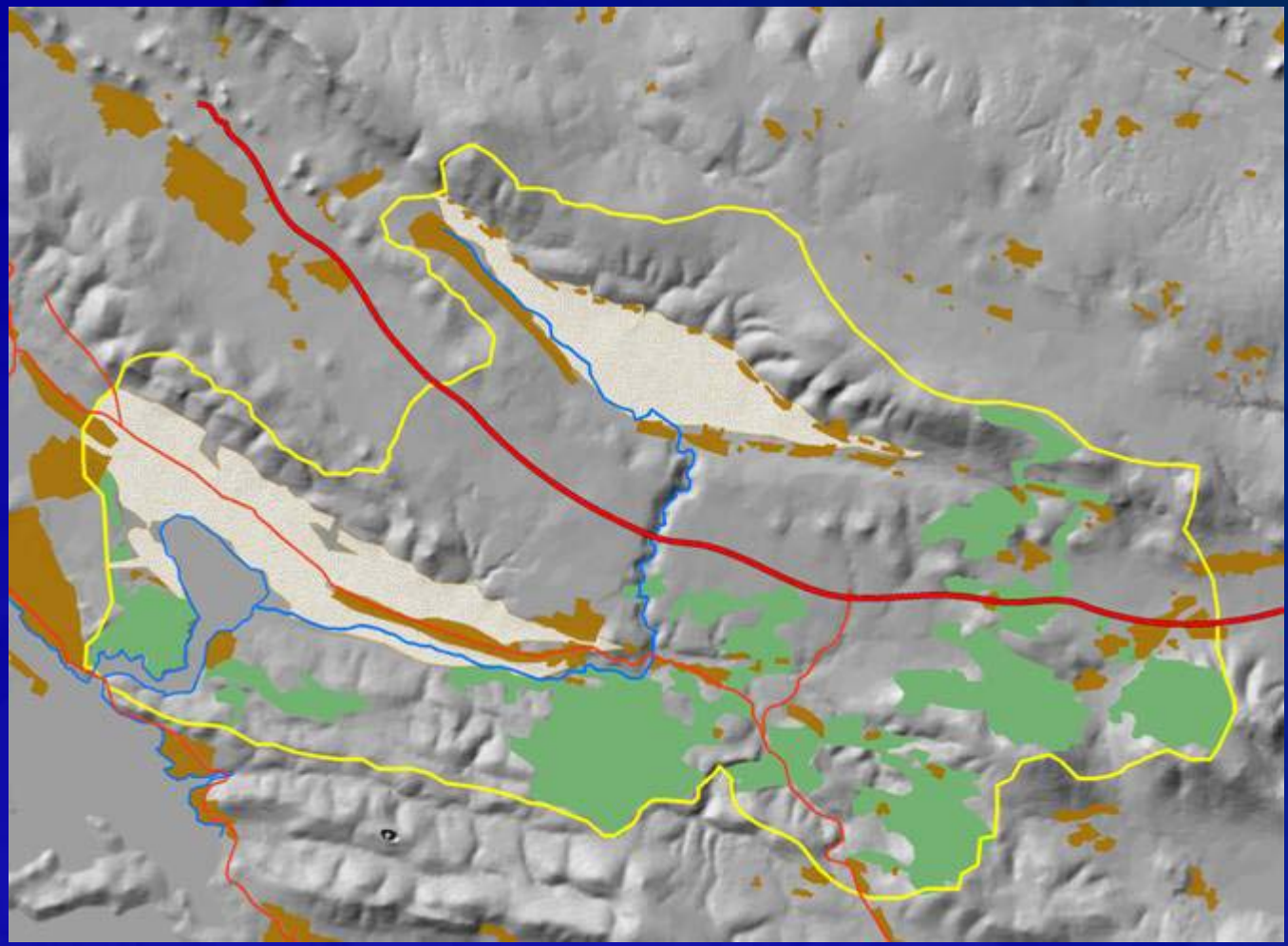
Sea depth from 0-2 m



Morinje bay land use



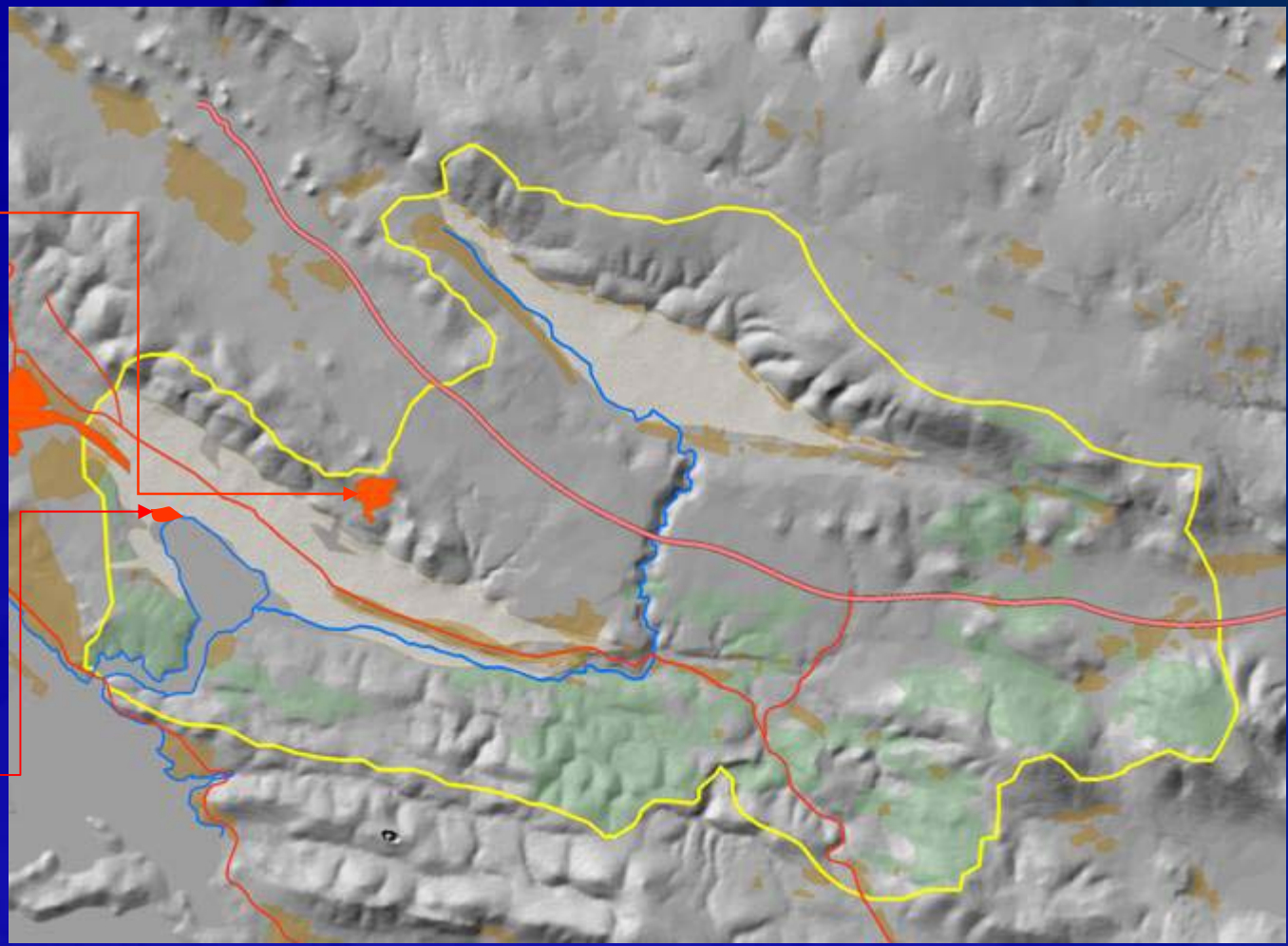
Morinje bay land use



Morinje bay local/point pollution sorces

Municipal waste landfill

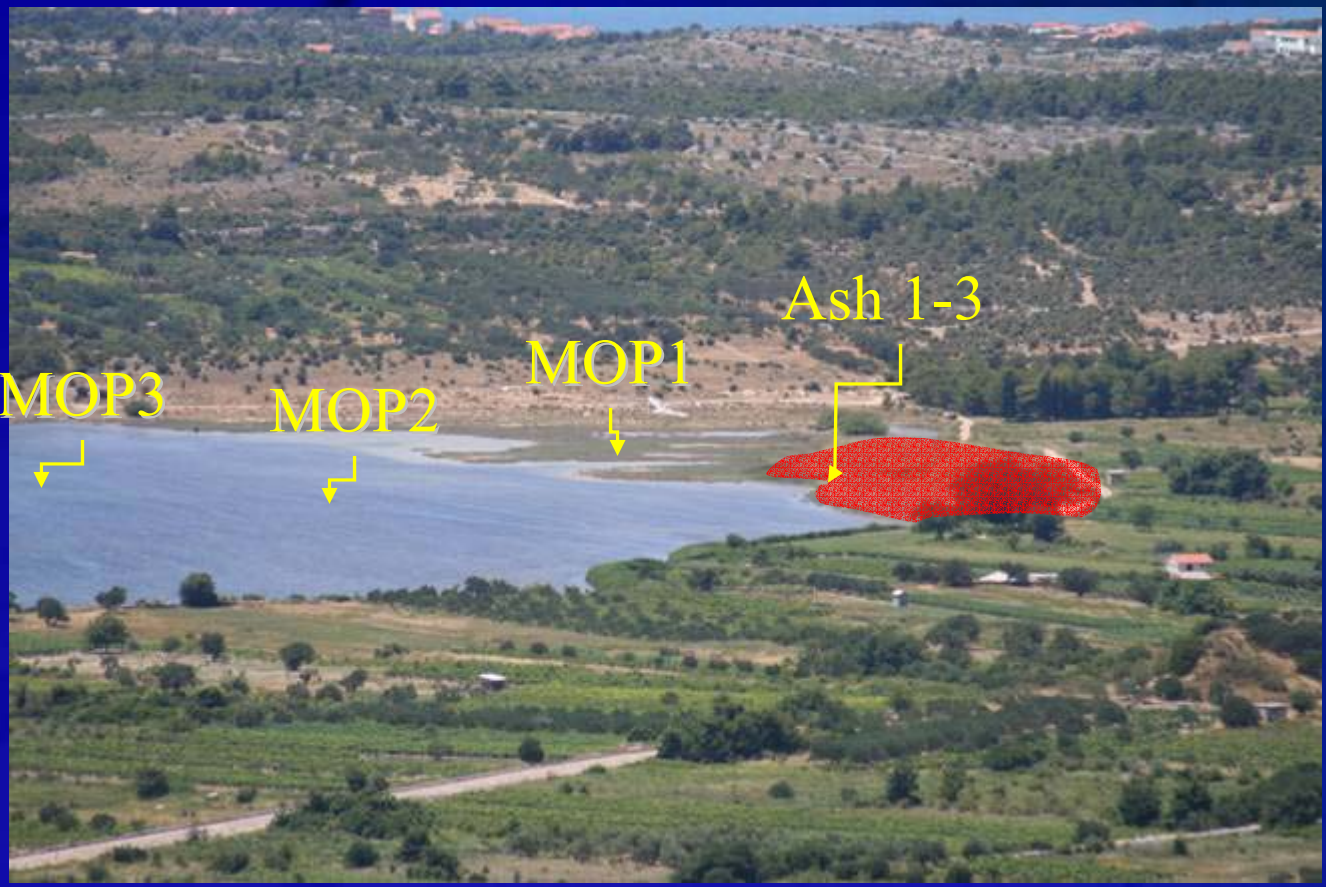
Municipal + medical ash disposal site



Morinje bay pollution sources

Soil sampling

Sediment sampling (cores)



Heavy metals in the ash core (composite samples)

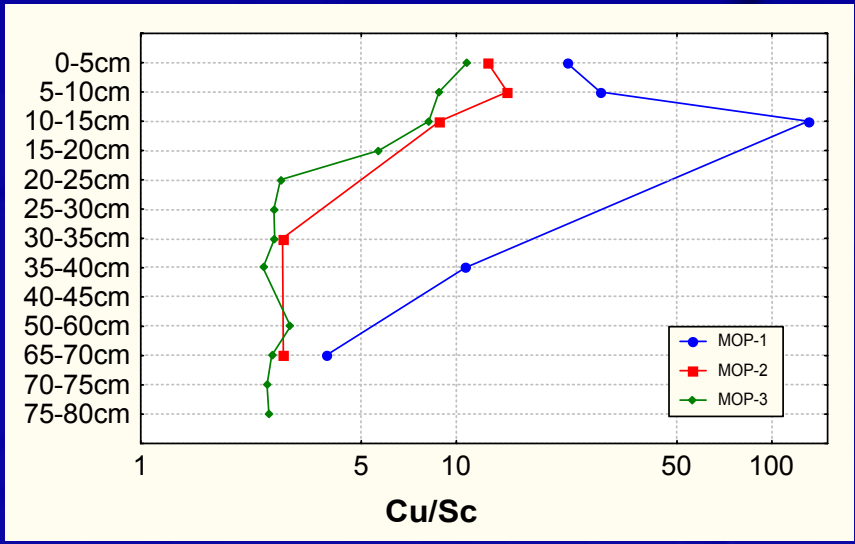
ELEMENT	Mo	Cu	Pb	Zn	Ni	Co	Mn
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Ash 0-1.5 m	25.8	572	1169	5033	142	17	1825
Ash 1.5-2,5m	18	557	1196	5607	96	20	2120
Ash 2.5-3.5m	15	717	1031	6610	137	21	1460

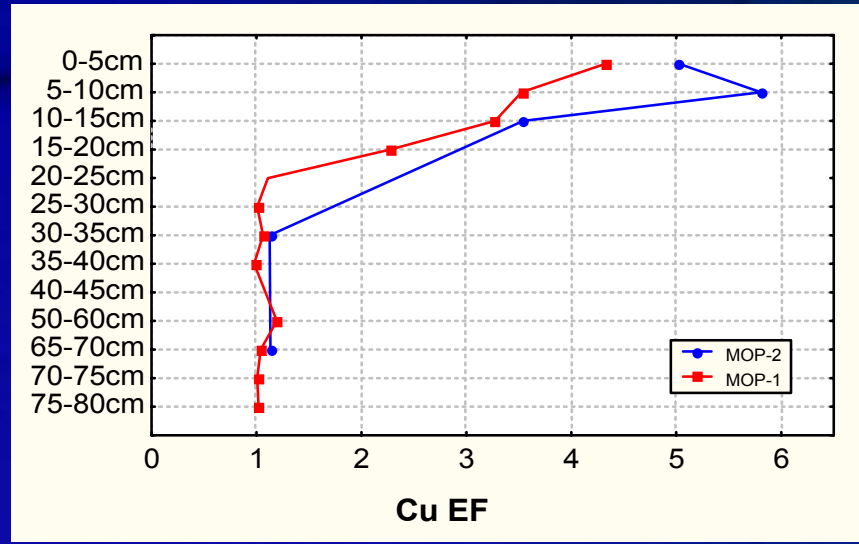
ELEMENT	Cd	Ca	Cr	W	Sn	Ag	Au
	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Ash 0-1.5 m	8.4	18	352	4	149	6.3	0.06
Ash 1.5-2,5m	18.3	15.7	1048	7	113	2.2	0.37
Ash 2.5-3.5m	6.1	15.4	264	1.7	234	2.2	0.09

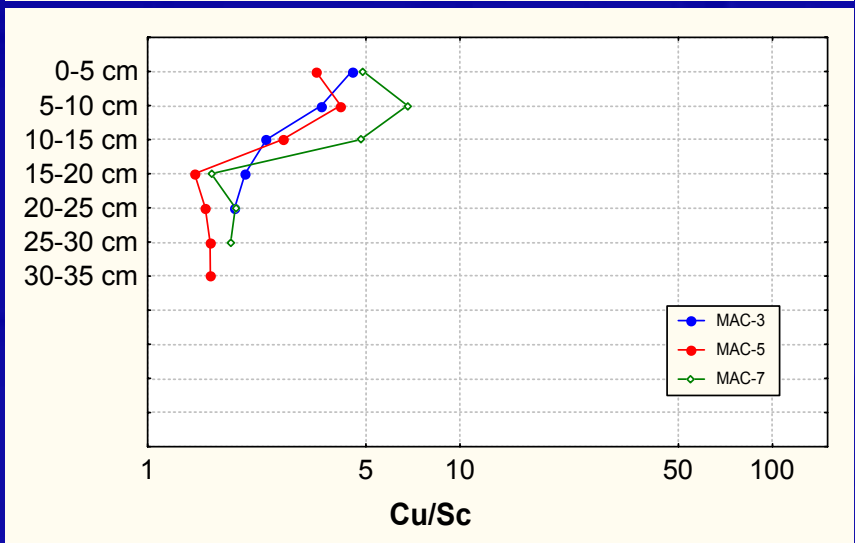
Heavy metals in soils and sediments

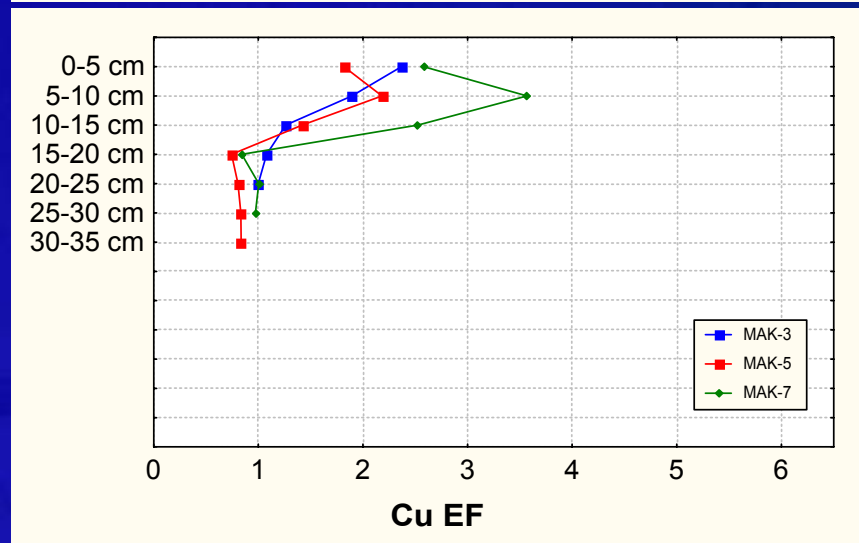
	Mo mg/kg	Cu mg/kg	Pb mg/kg	Zn mg/kg	Ni mg/kg	Co mg/kg
Soils on limestone	2,5	38,7	55	127,7	70,6	19,1
Sediment (0-15cm) (previous study by Dolenec et al.)	10,5	26,6	20	63,2	58,1	7,9
Soils vineyards	0,6	242,6	23	94,6	69,3	13,0
Stream sediments (Dabar r.)	0,5	36,6	22	62,0	54,0	13,0
Soil with BM	0,6	4028,8	15	89,0	57,5	9,0
Sediments fom cores	10,8	71,4	37	121,8	68,4	11,6
Ash core	19,6	615,3	1132	5750,0	124,7	19,3

Copper in cores from Morinje and Makirina bays

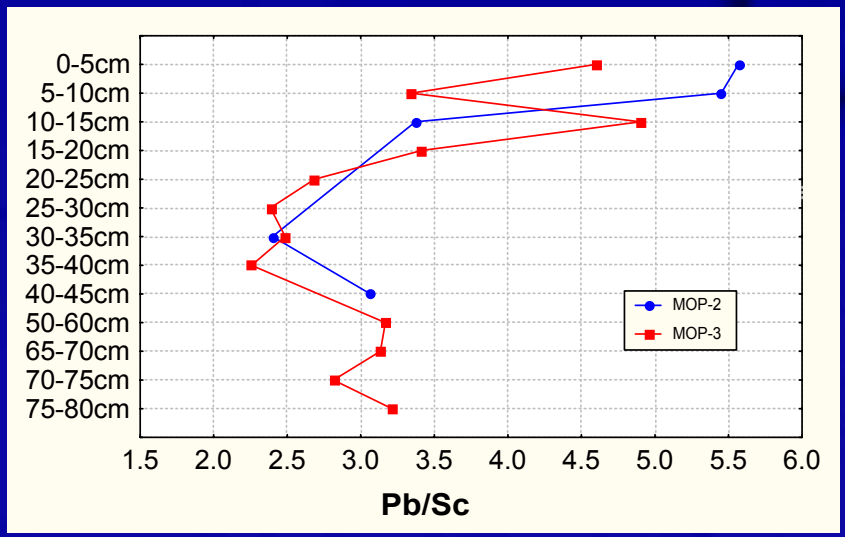


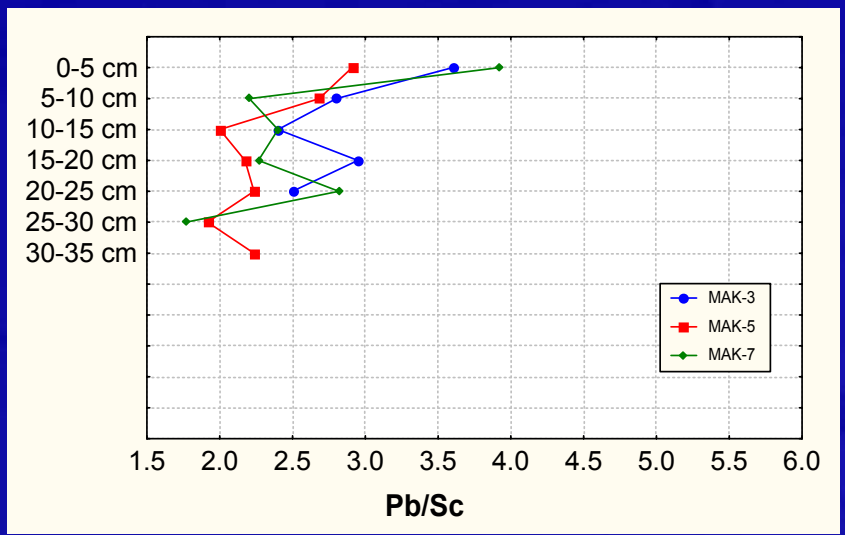


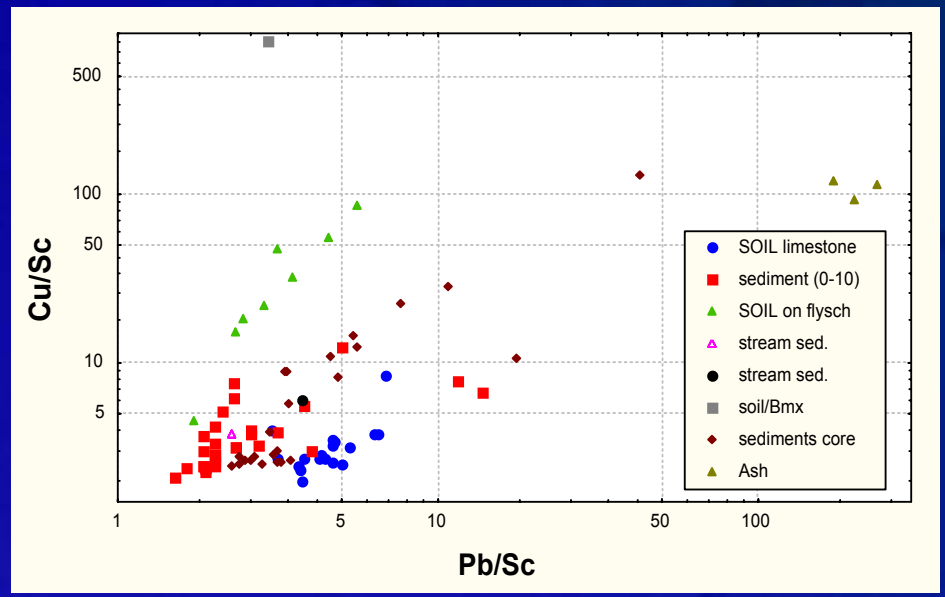




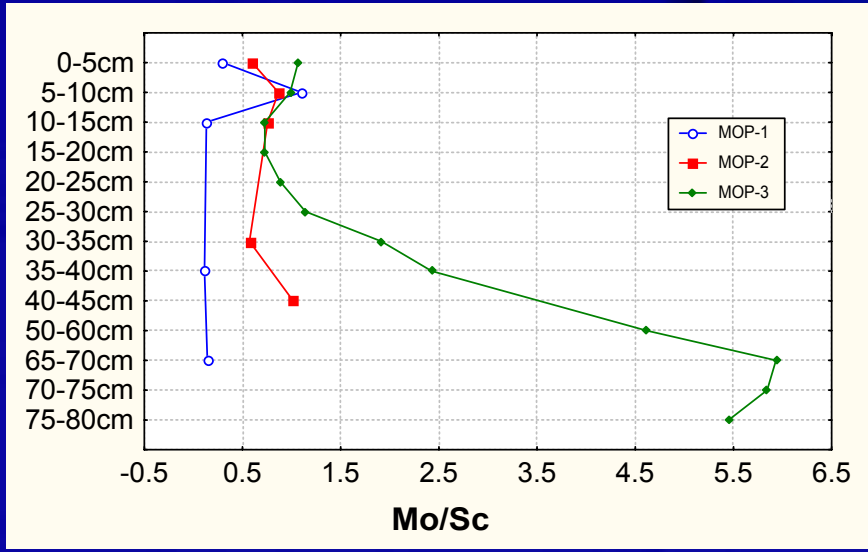
Lead in cores from Morinje and Makirina bays

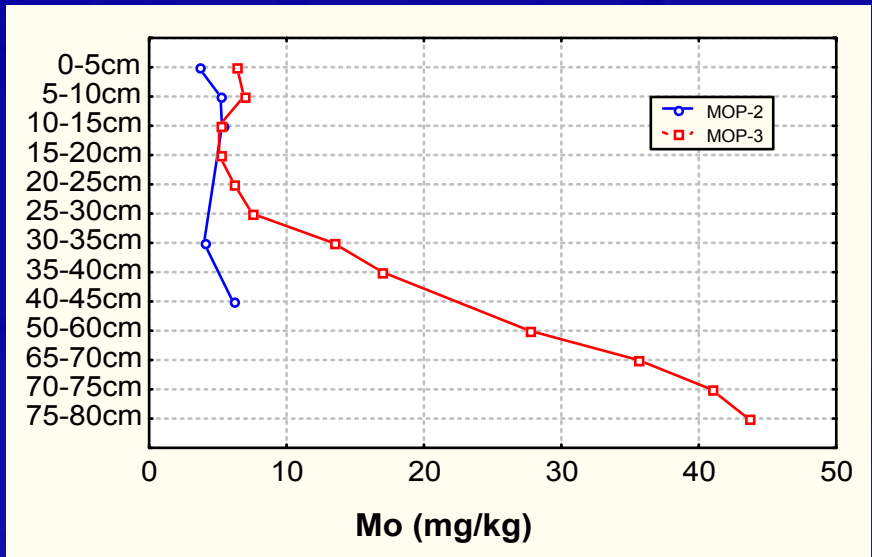


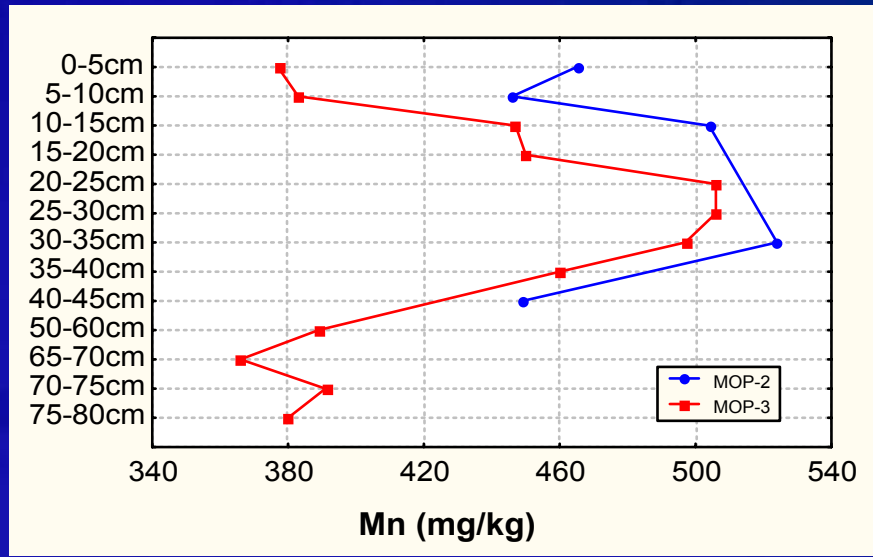




Molybdenum in cores from Morinje bay







Conclusions

The variation of mineralogy, geochemistry and organic matter within the peloids is dependent on numerous factors which include geology, soil, hydrogeology, of the watershed supplying freshwater to the bay.

Since their features are a result of a fragile balance of all these factors anthropogenic influences on these environments can greatly impact the sediments and alter their balneotherapic properties.

Further studies on the mechanisms of transfer of chemical compounds to the organisms via skin from sediments is required in order to develop trigger values which may differ considerable from present threshold vales for contaminated sediments

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Thank you!

Acknowledgements

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