חקר ימים ואגמים לישראל
Israel Oceanographic & Limnological Research

המכון הגיאולוגי
GEOLOGICAL SURVEY OF ISRAEL
ESTABLISHED 1949

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רקע והעשרה אנתרופוגנית של מזהמים אורגניים ואנאורגאניים בקרקעית הים

כנס בנושא אסדות הגז: קהילה, בריאות וסביבה

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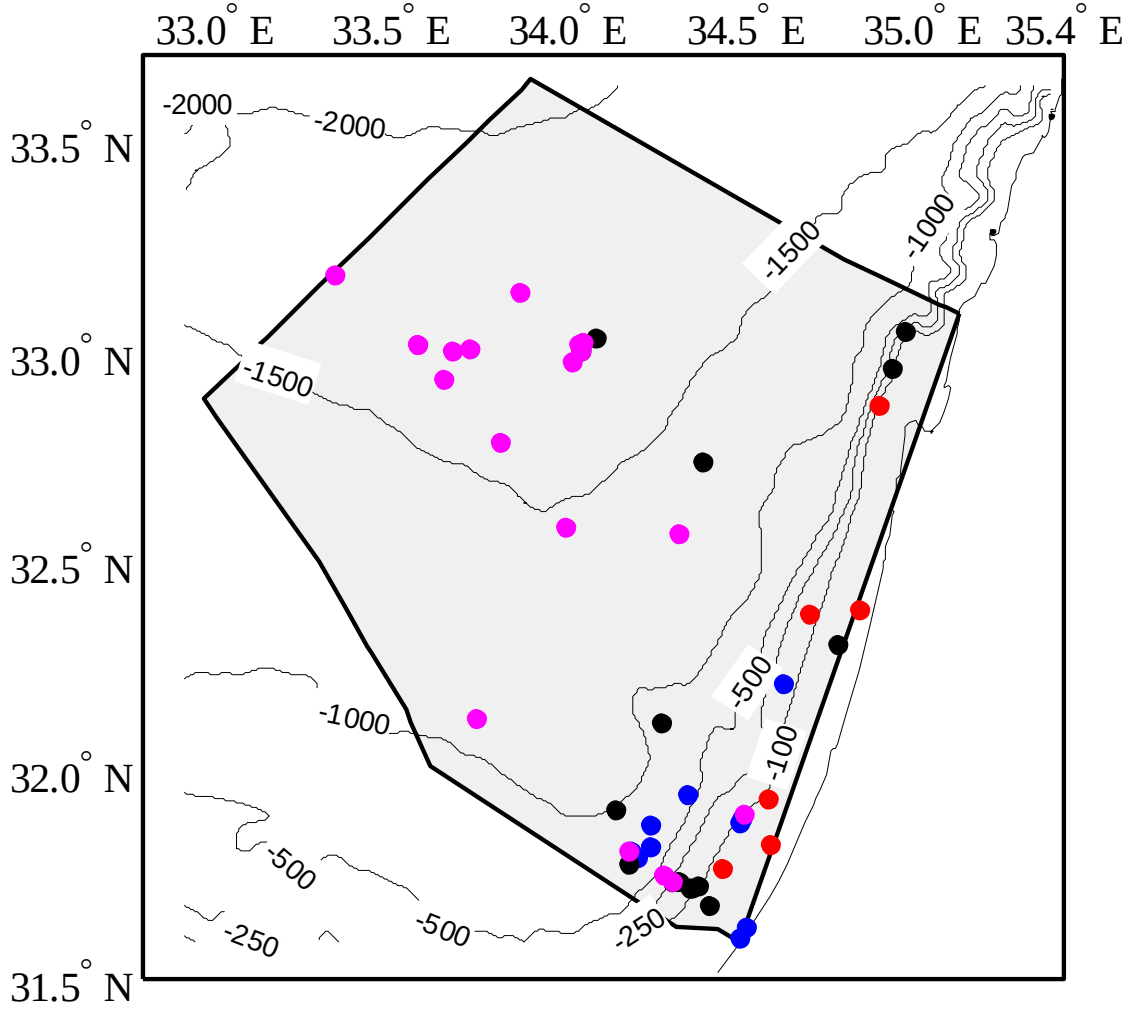
Development of deep water drilling in the Israeli EEZ since 1970

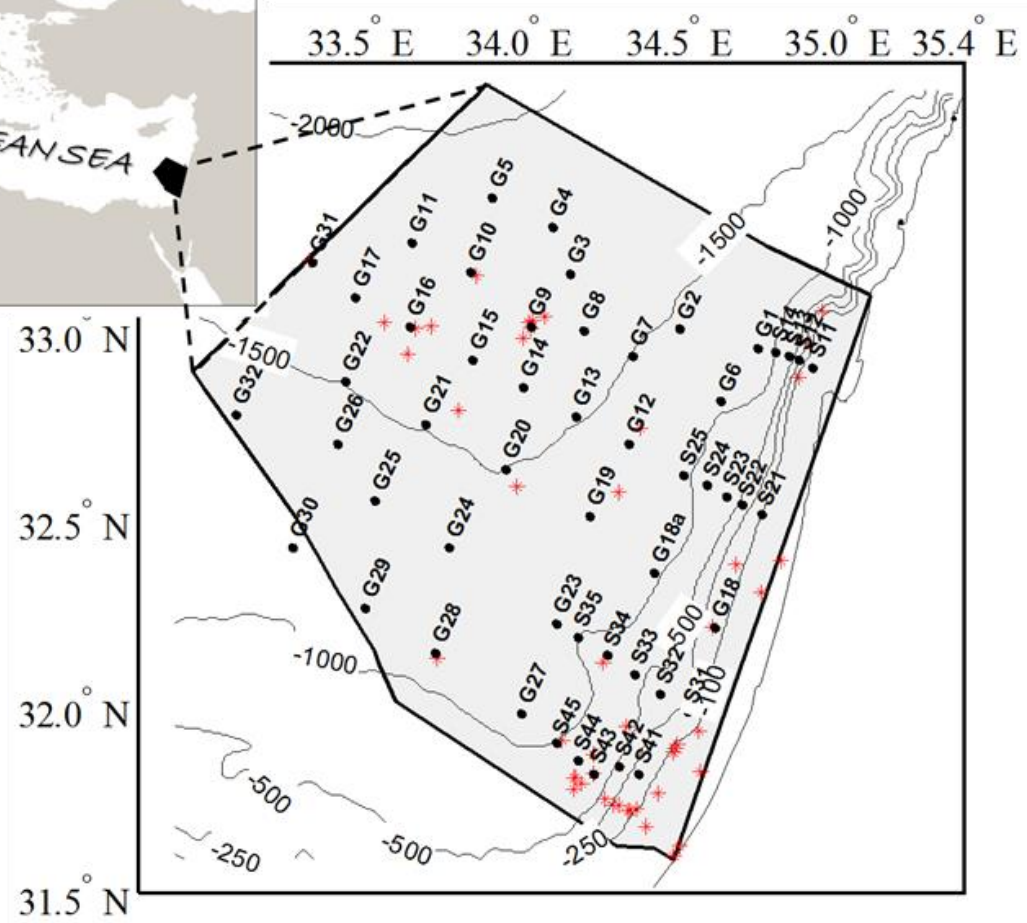


Natural Gas distribution pipelines

Objectives of the deep water survey

- To map the biological and geochemical characteristics of the Israeli EEZ deep water (>100m) sediments and water column. **Identify spatial trends and anomalous behaviors**.
- To assess together with past measurements the potential for harmful impacts to the deep sea habitat resulting from current and future resource development and exploitation.
- To provide a regional baseline for assessing the observations of local monitoring programs at the drilling sites.
- To provide a database for environmental impact risk assessment of future infrastructure development projects (e.g. artificial islands, gas facilities, drilling platforms, gas and oil pipelines).
- To provide a database for the development of environmental catastrophe contingency plans (e.g. oil spills, damage to infrastructure.

During June-July 2013 bottom sediments were sampled at 52 stations in the Israeli EEZ



– Israeli EEZ border

● Sediment sampling station

* Well drilling site

Box core was lowered to the bottom at every station 4 time

Position of the box core relative to the ship was monitored with a USBL system

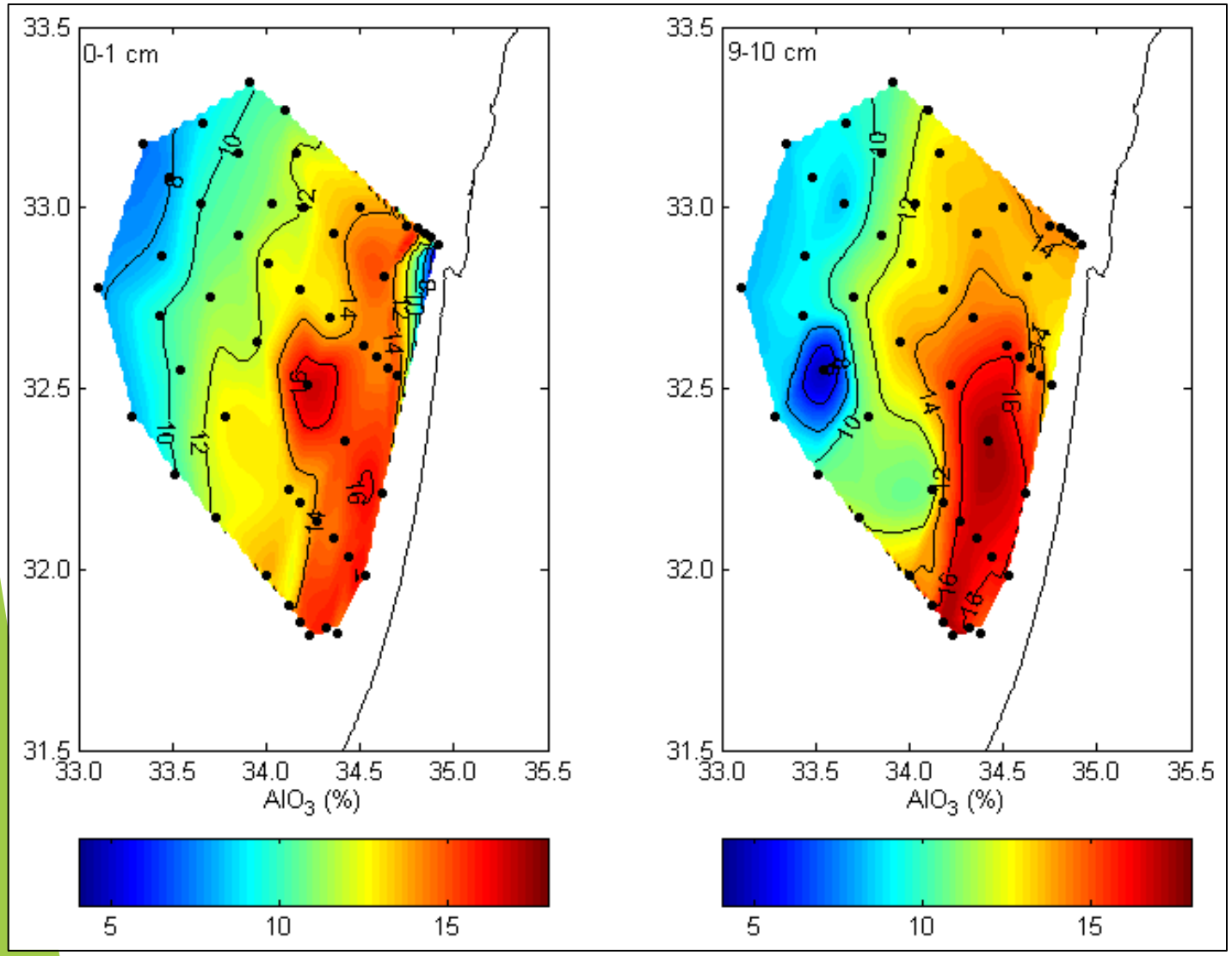
Perspex tubes were used to subsample each box core

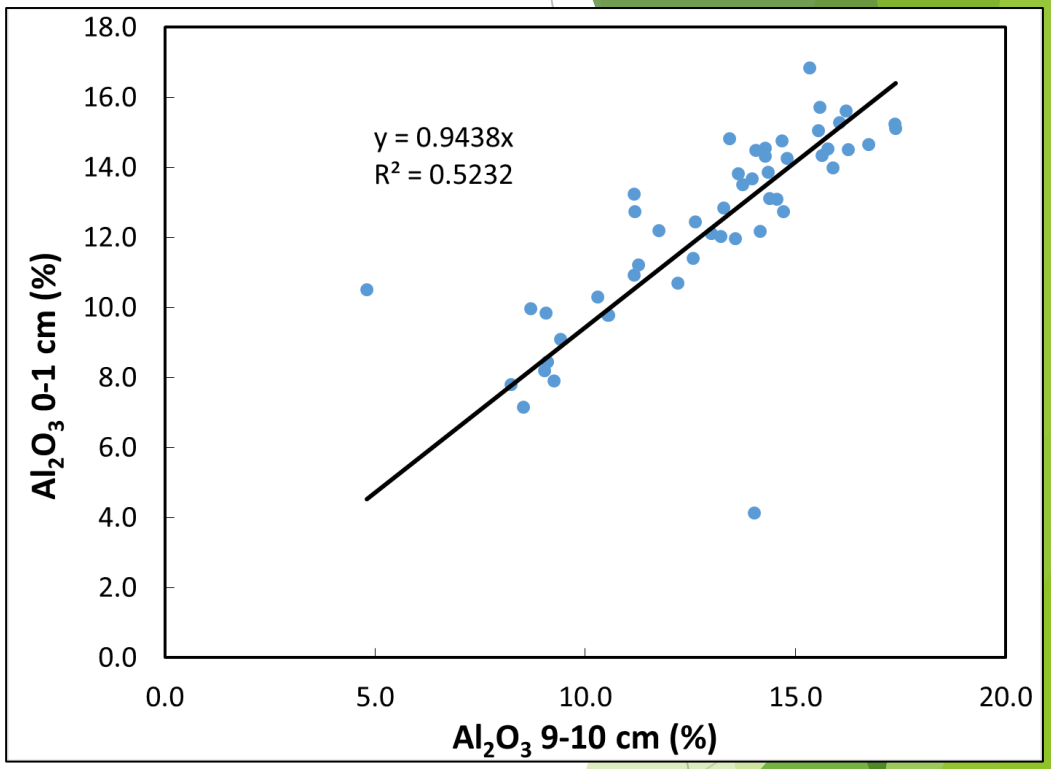
The 0-1cm and 9-10cm depth layers in each subsample was sliced and collected in one container for each layer.

Lab analysis

- Samples were freeze dried and sieved (250µm).
- Grain size distribution by Laser diffraction.
- Heavy metals (As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, U, V, Zn).
- Major Ions (Fe_2O_3, CaO, MgO, Al_2O_3, SiO_2, TiO_2).
- Organic pollutants (TPH, PAHs (16), PCBs (28,52, 101, 118, 138, 153, 180)).
- Total organic carbon (TOC).

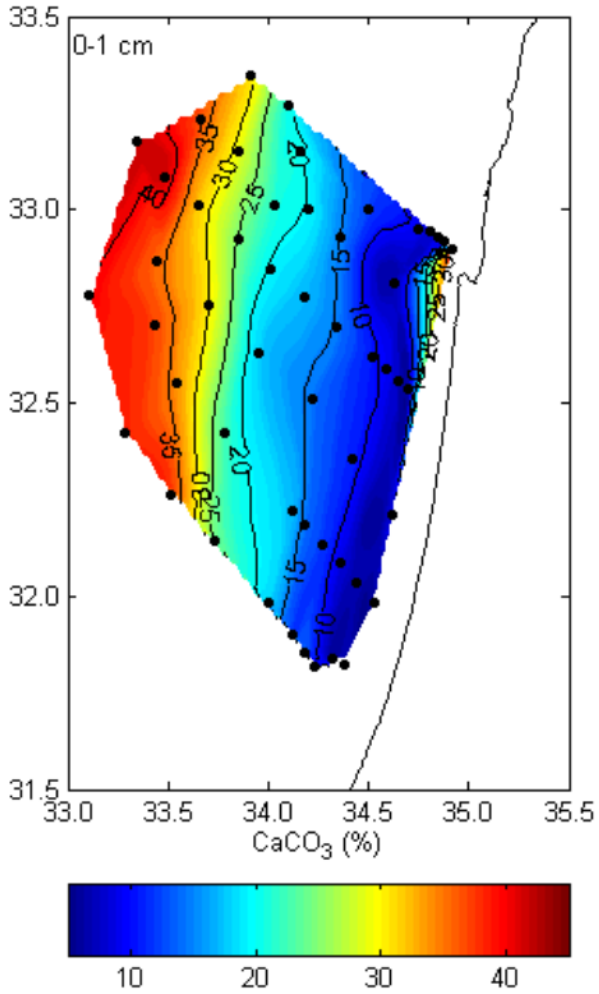
Spatial distribution of a conservative HM - Aluminum

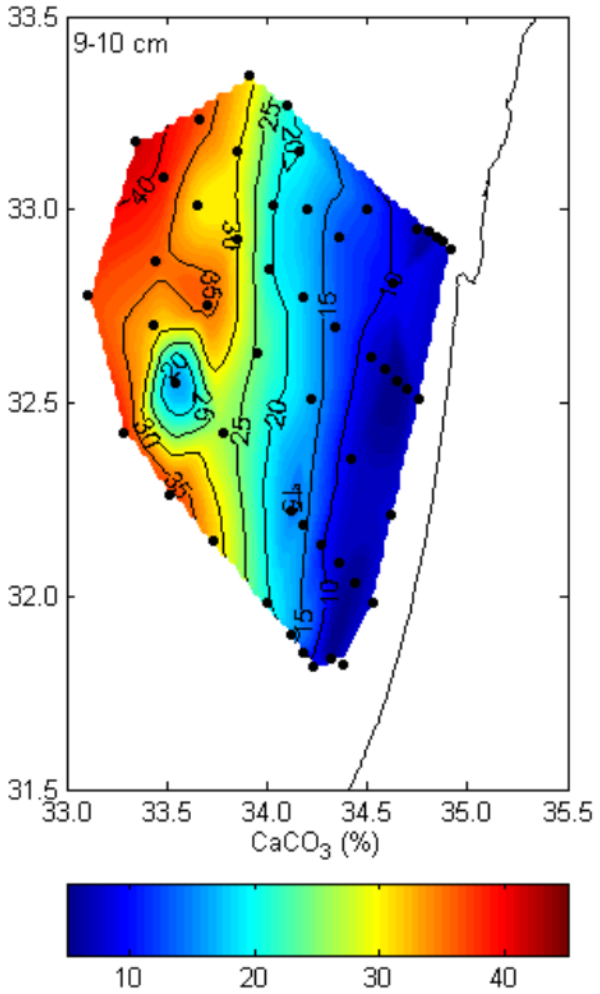


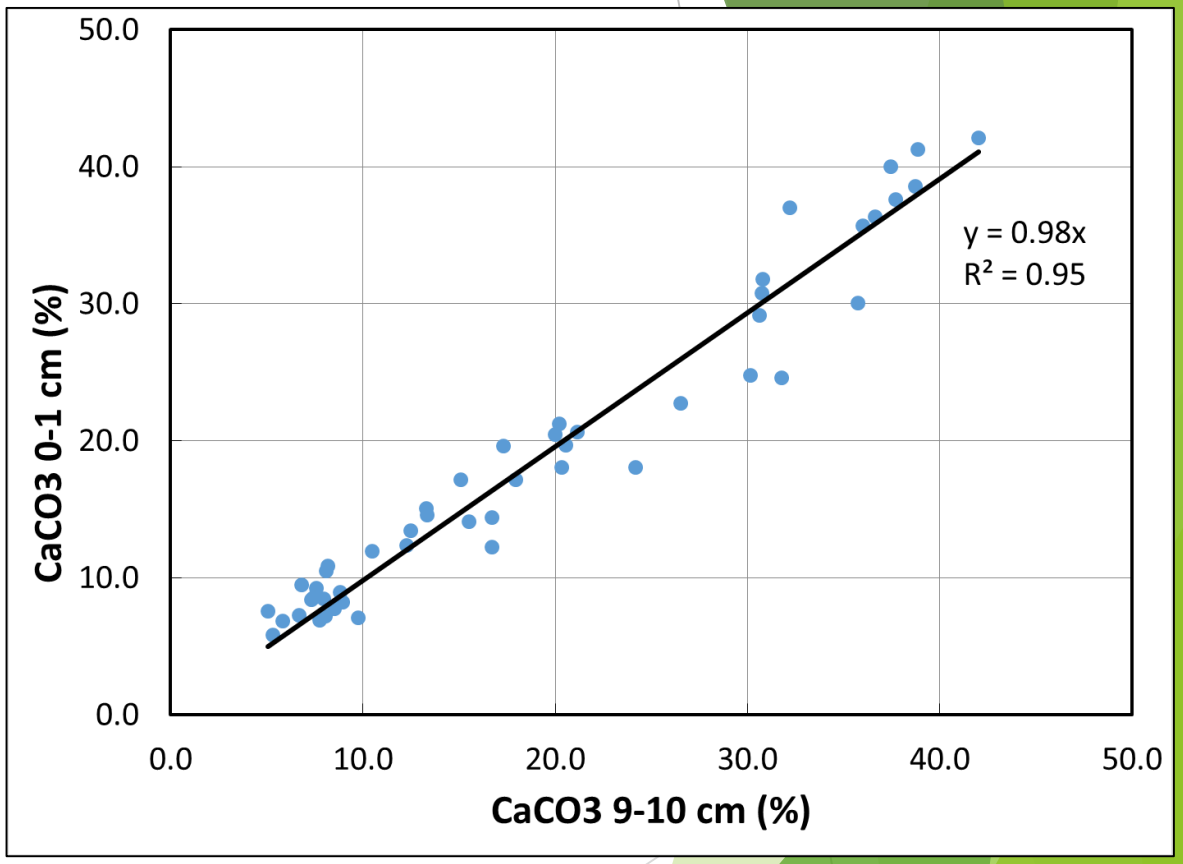


- The mean level in the 0-1cm layer is 5% lower than 9-10 cm layer.
- Level at H2 in the 0-1cm layer is 70% lower than in the 9-10cm layer.

Spatial distribution of CaO or $CaCO_3$

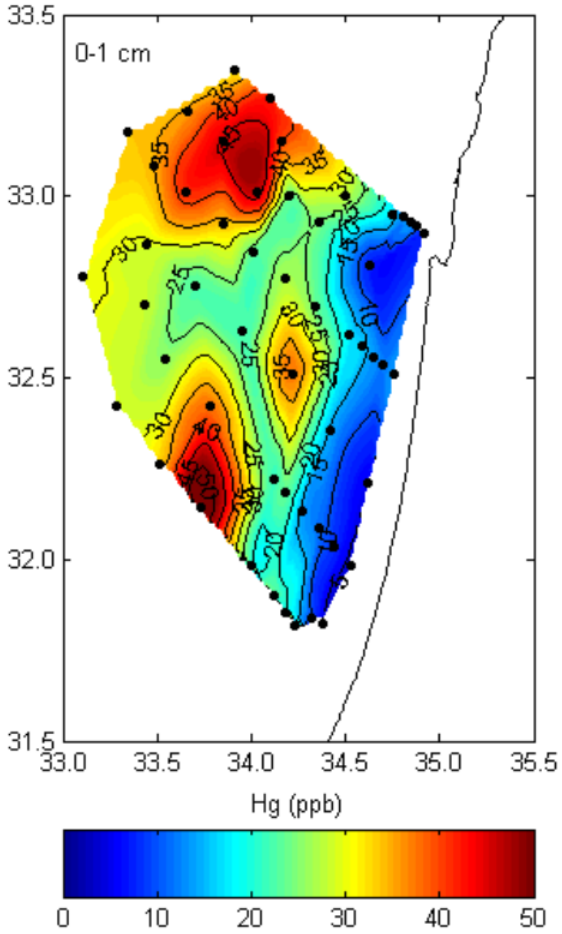


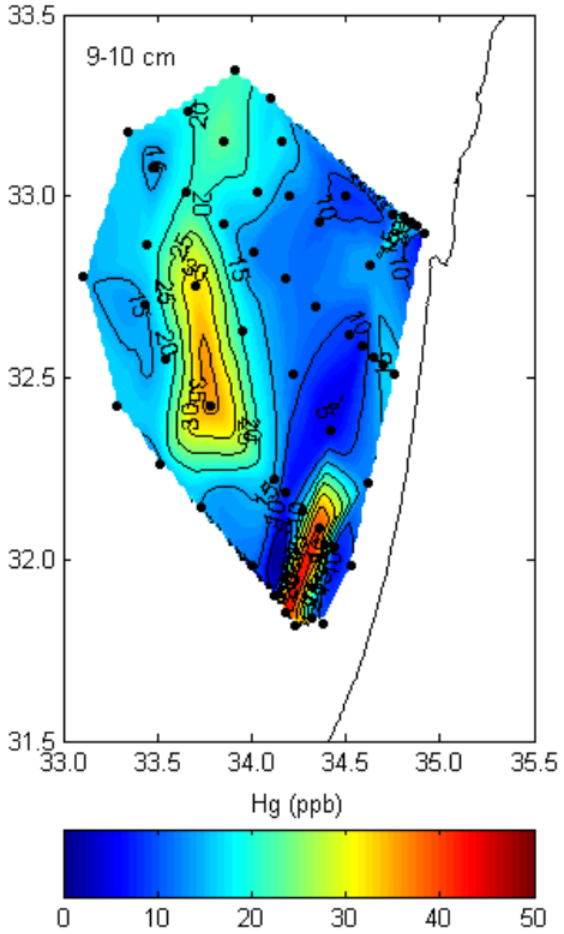


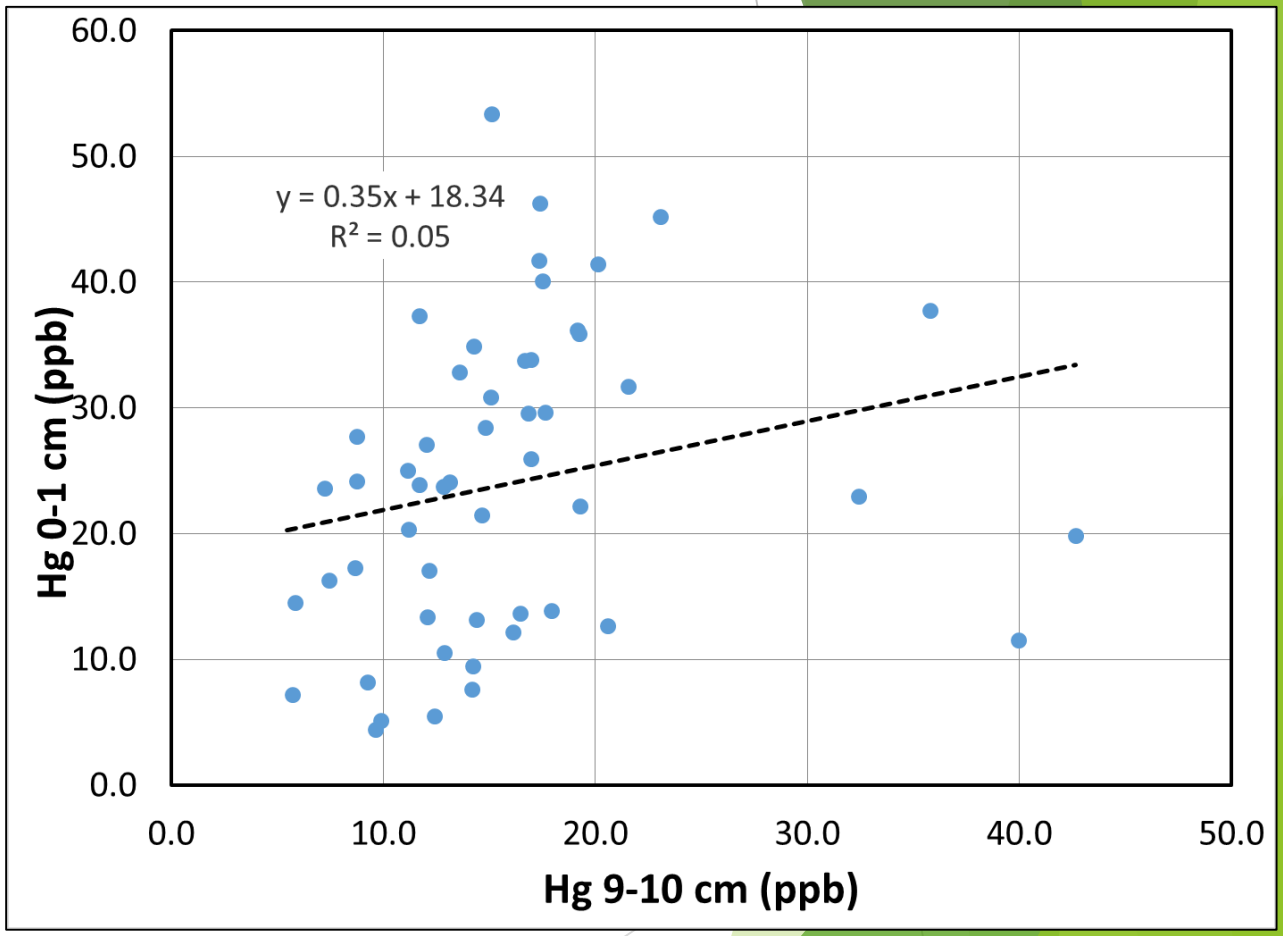


SEM observation indicate that most of the CaO or $CaCO_3$ is biogenic (e.g. foraminifera) (Hayms and Almogi).

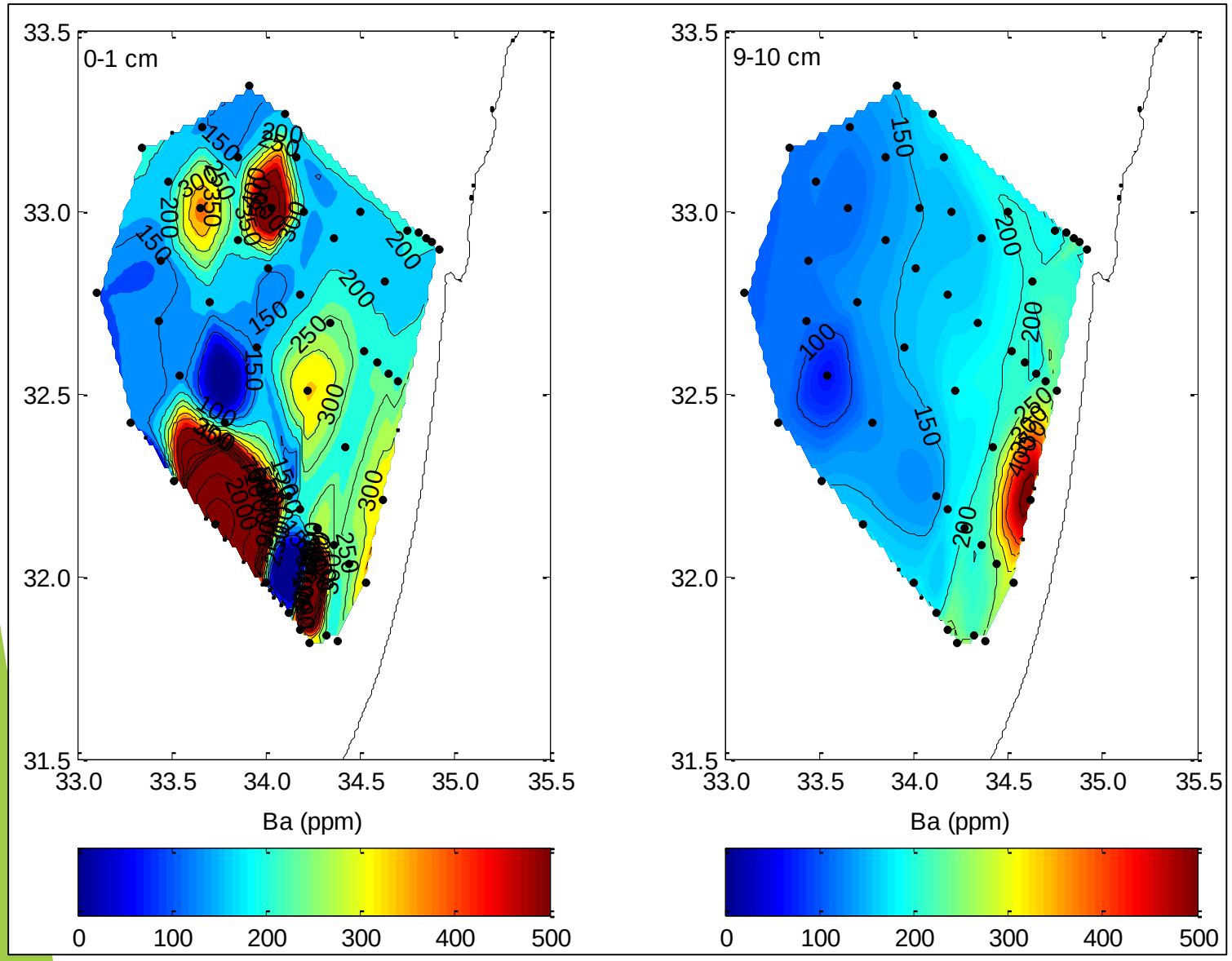
Spatial distribution of Mercury

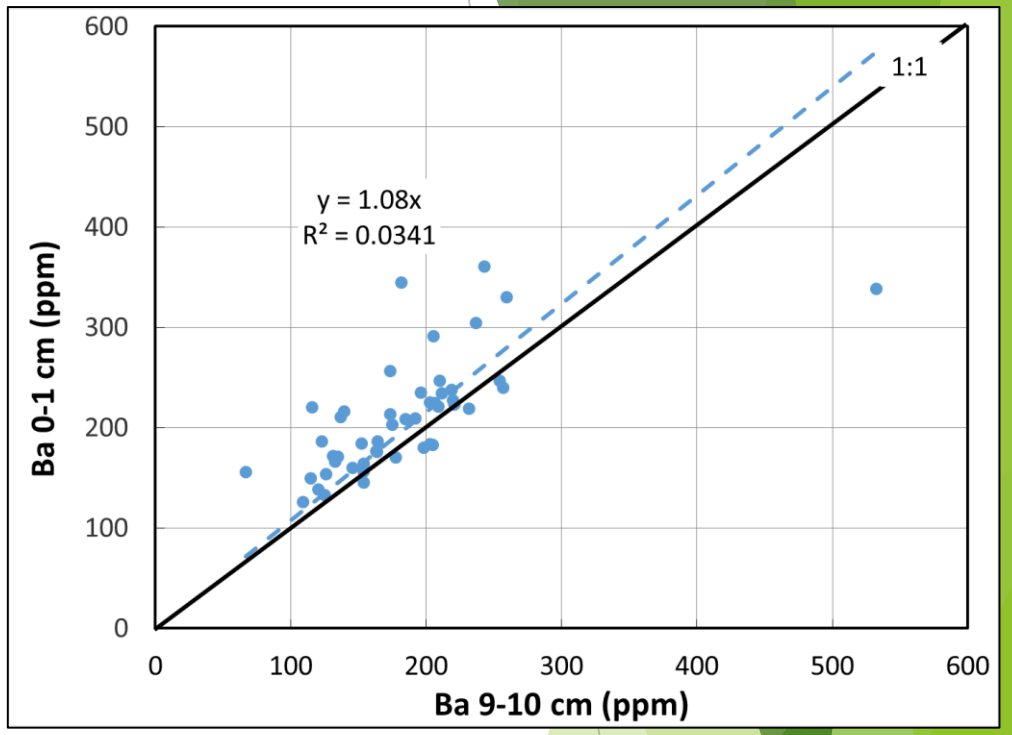






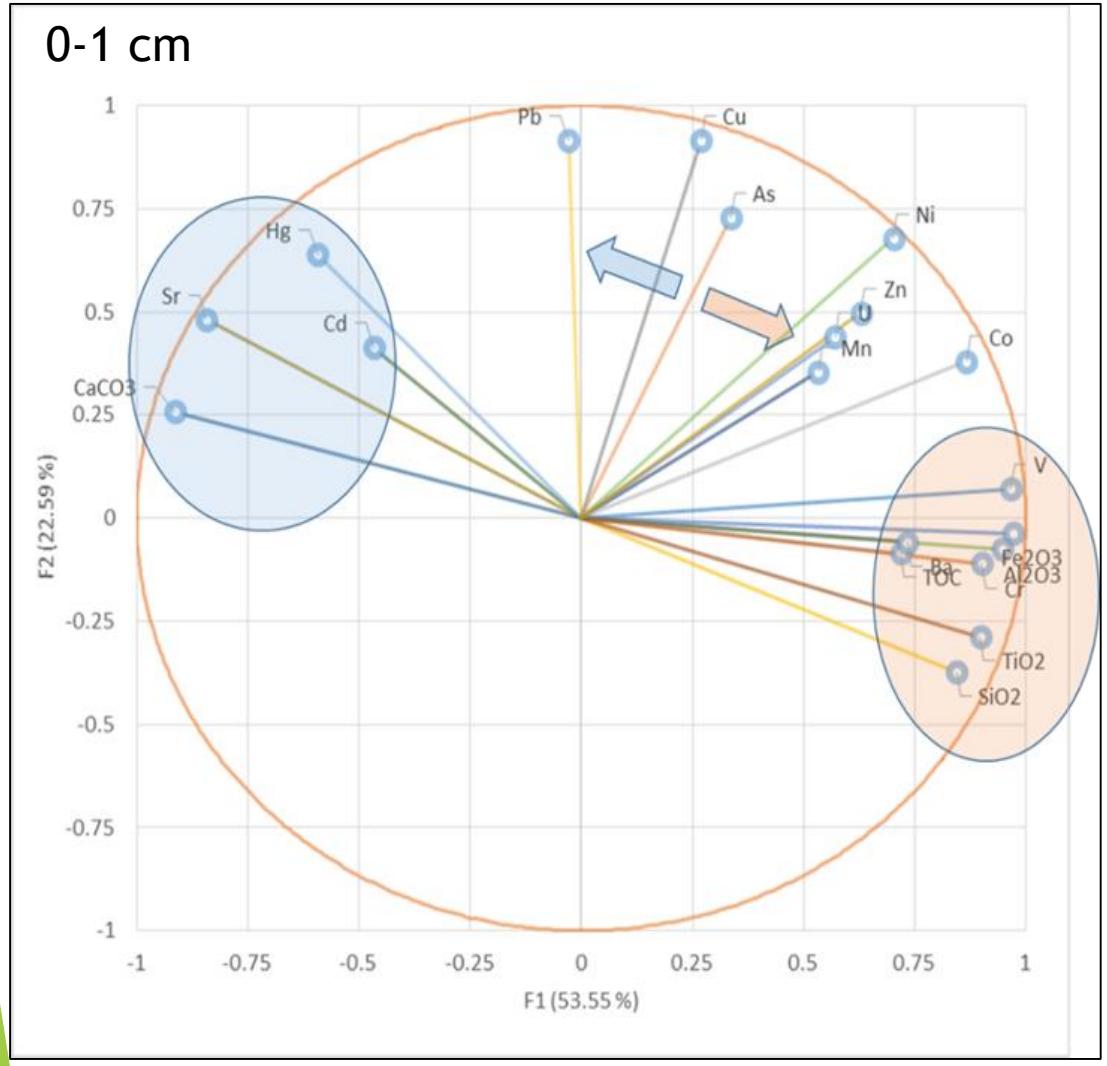
Spatial distribution of Barium

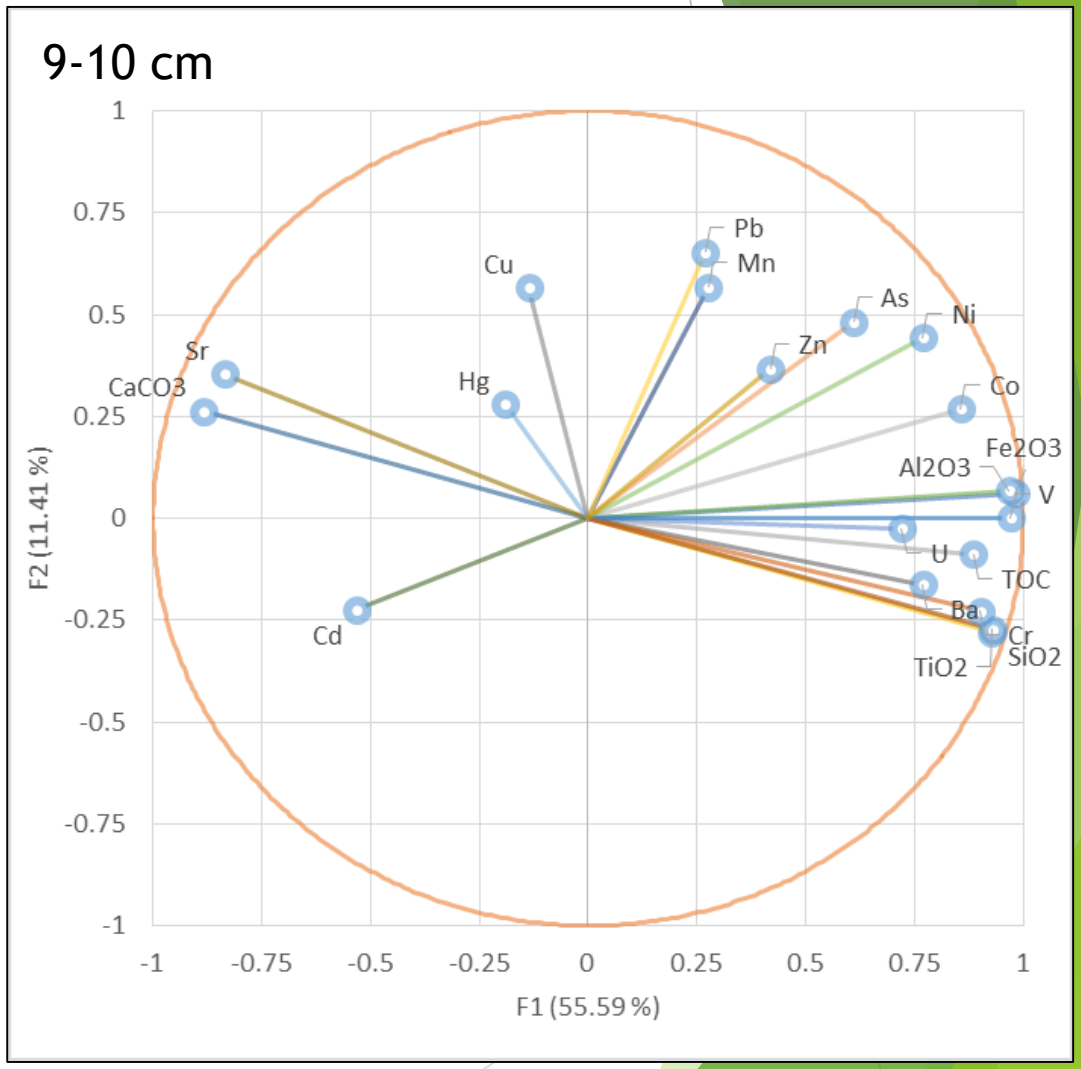




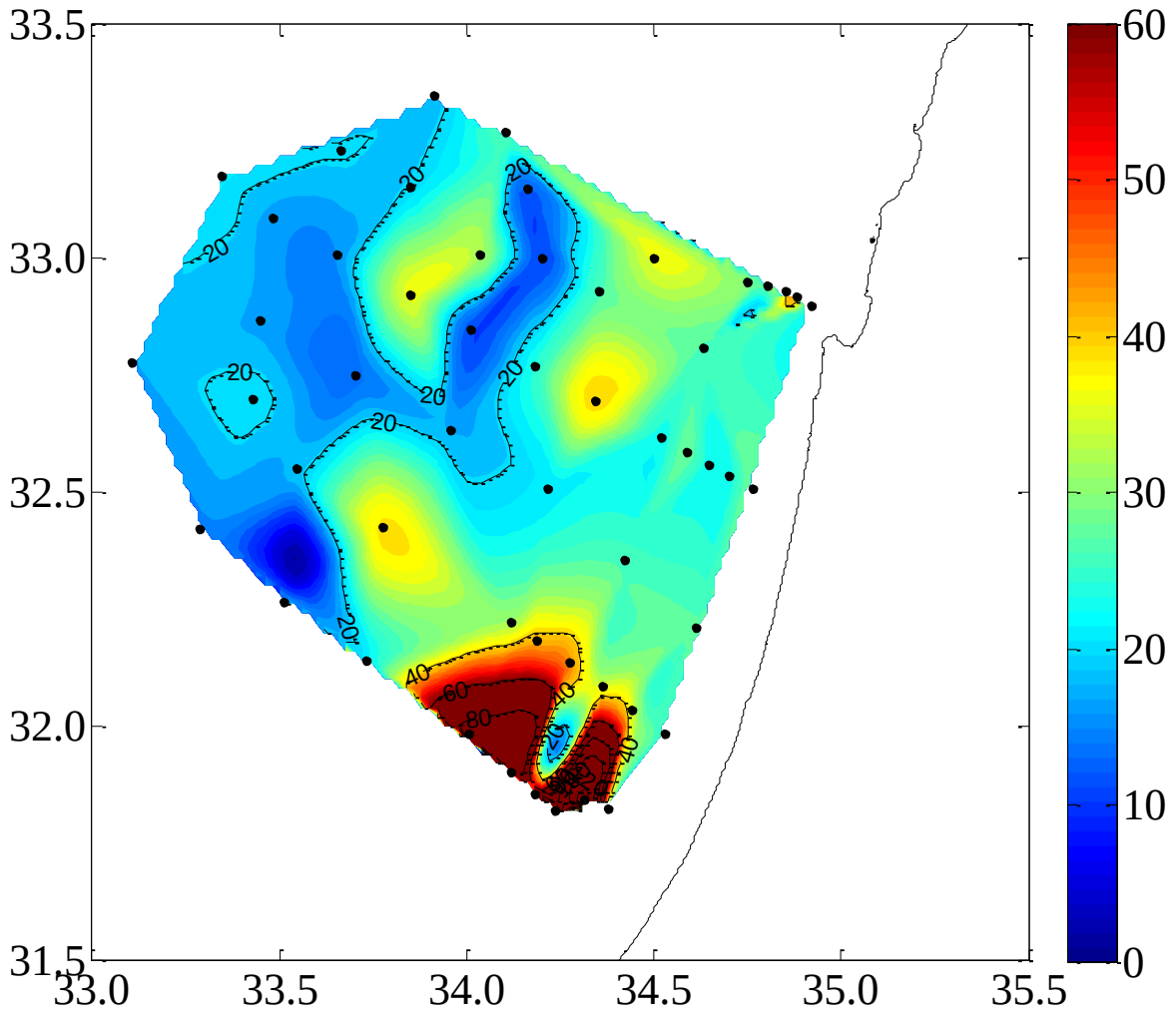
- The mean level in the 0-1cm layer is 60% higher than 9-10 cm layer.
- Extremely high levels (3500 and 664 ppm) were found near well drilling sites.

PCA of Trace metals distributions

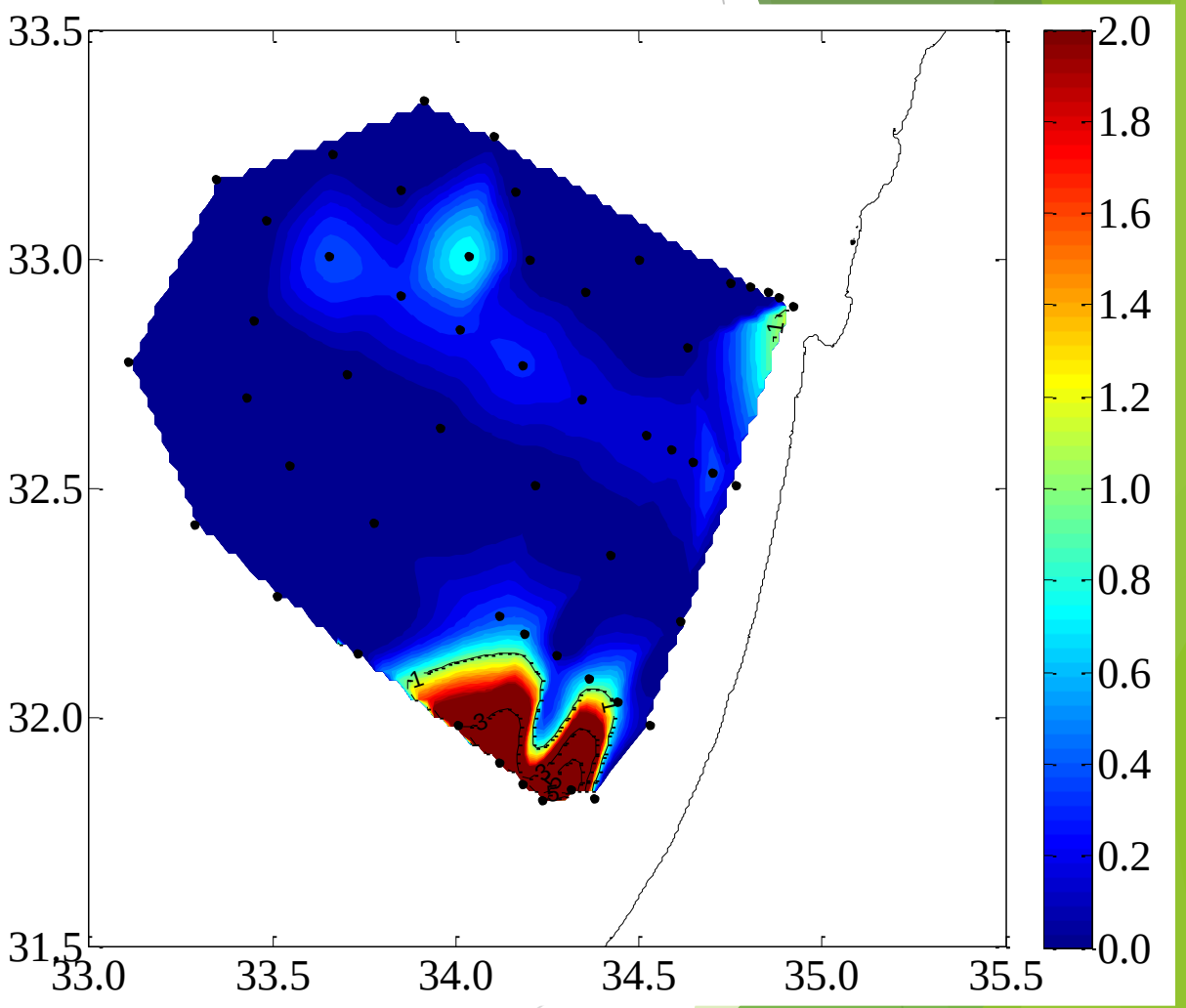




Spatial distribution of organic contaminants 1



ΣPAH16 (ppb); $\Sigma PAH16_{max}$=190ppb

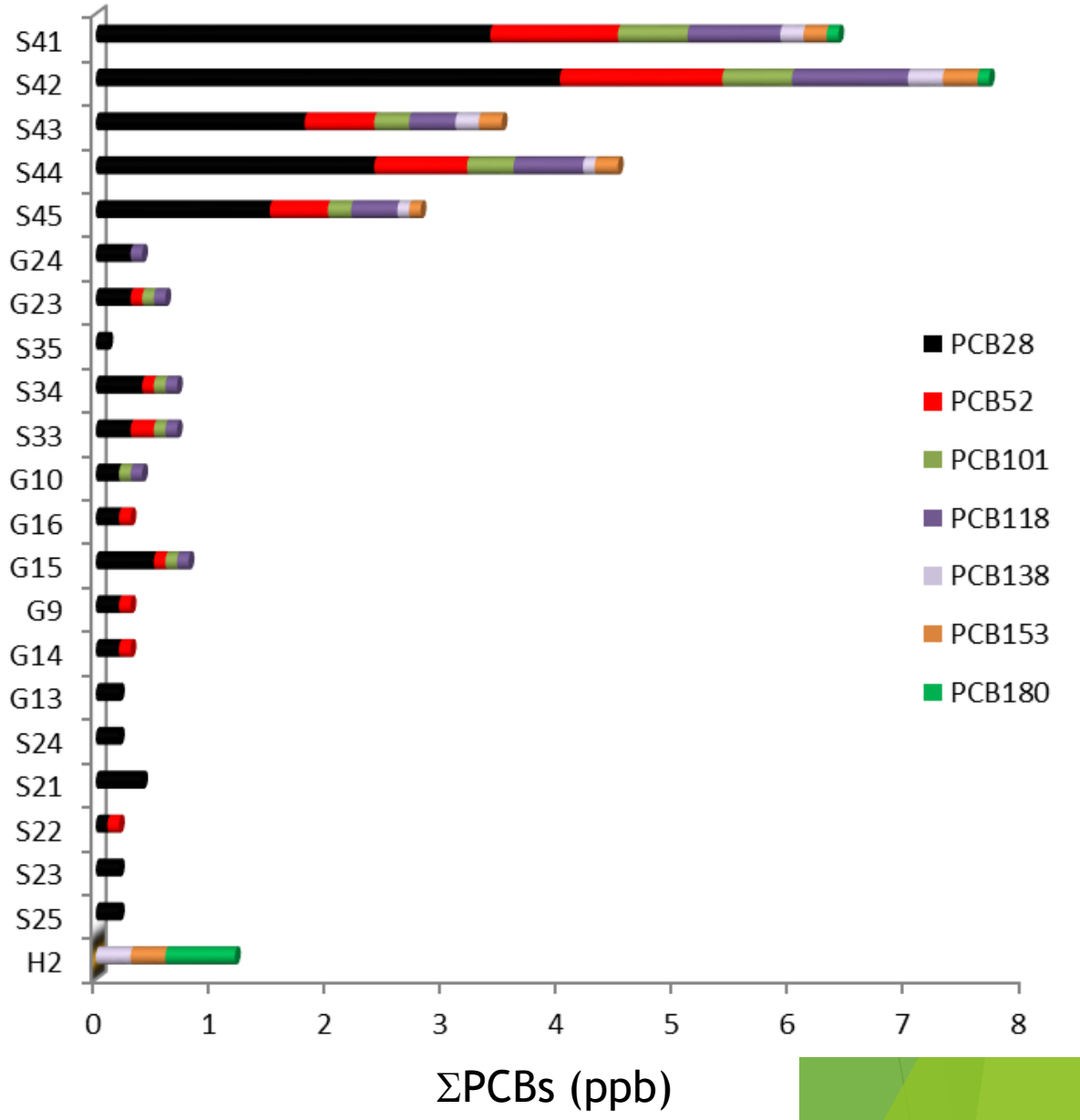


ΣPCBs (ppb); $\Sigma PCBs_{max}$=8ppb

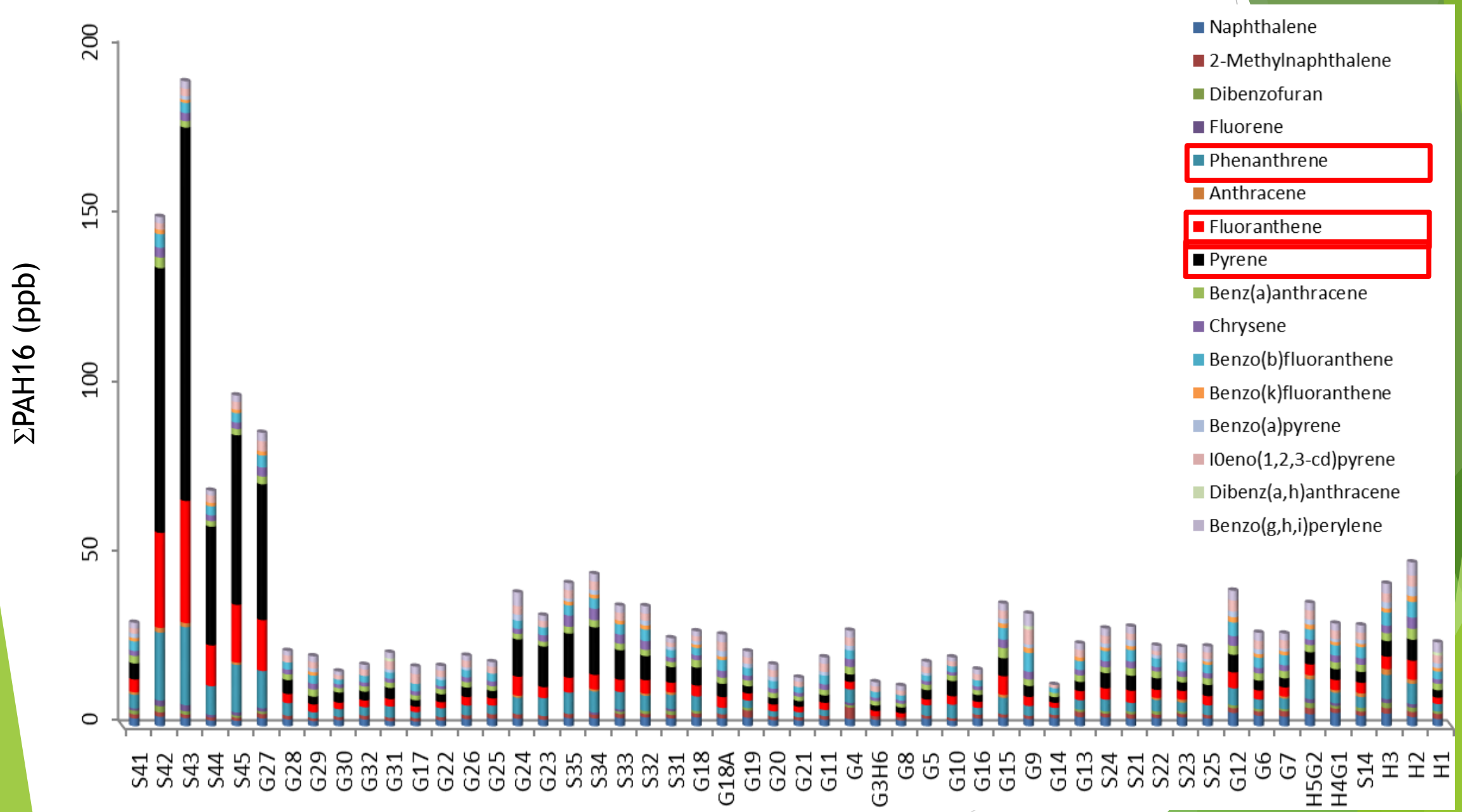
Spatial distribution of organic contaminants 2

PCB Congener distribution

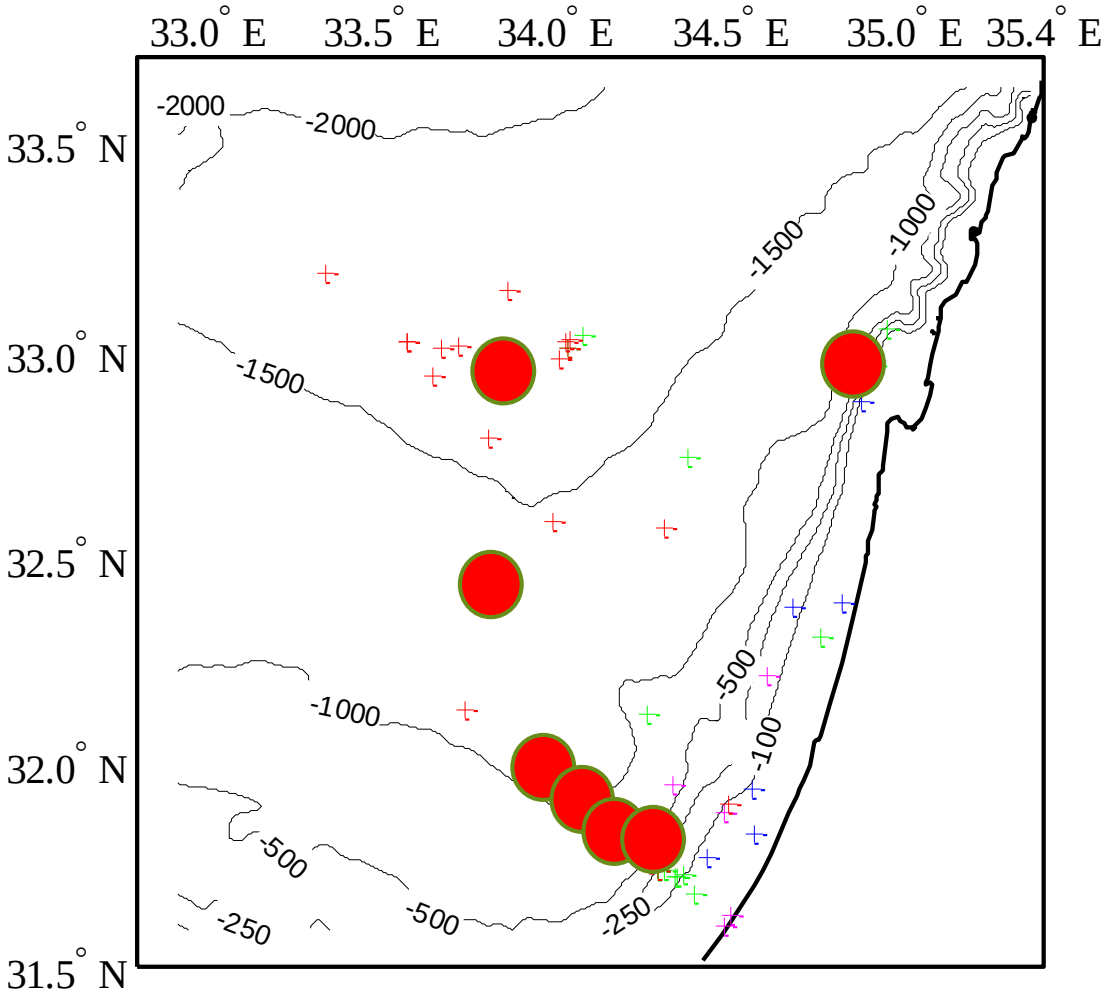
- PCB28 and PCB52 are found at all stations where PCBs were found except station H2.
- At H2 only PCB138, 153 and 180 are found. These congeners are not found at any other station.



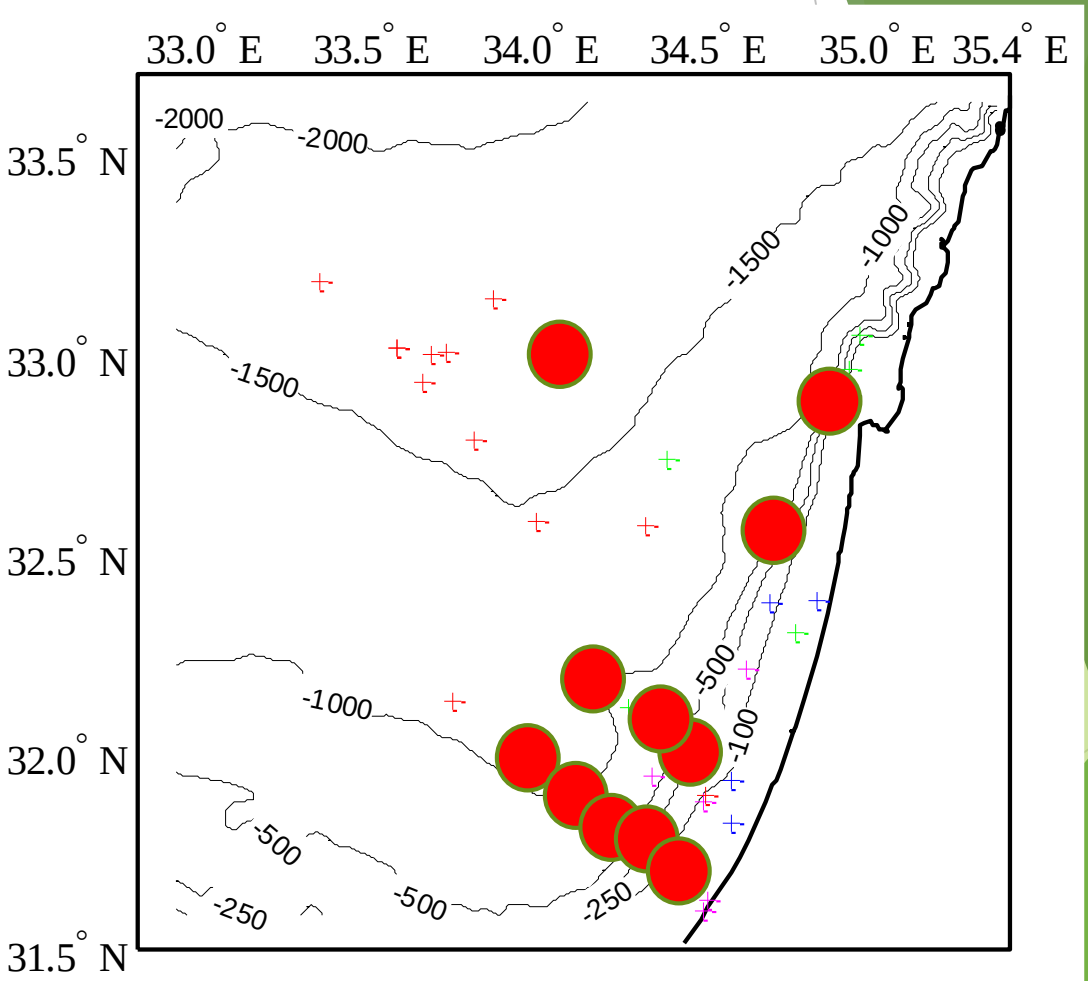
Spatial distribution of organic contaminants 3



Spatial distribution of organic contaminants 4

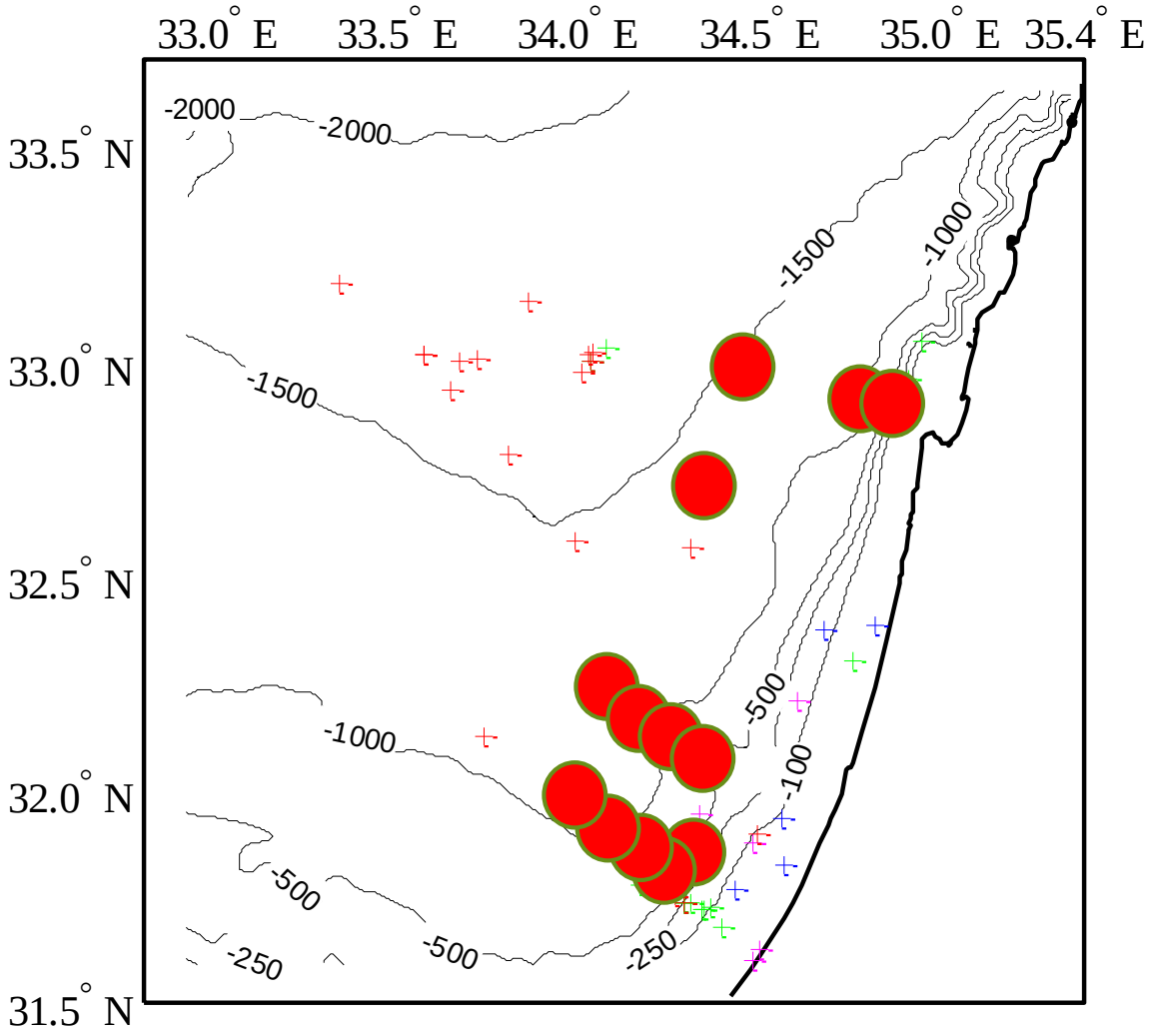


Fluoroanthene above LOQ

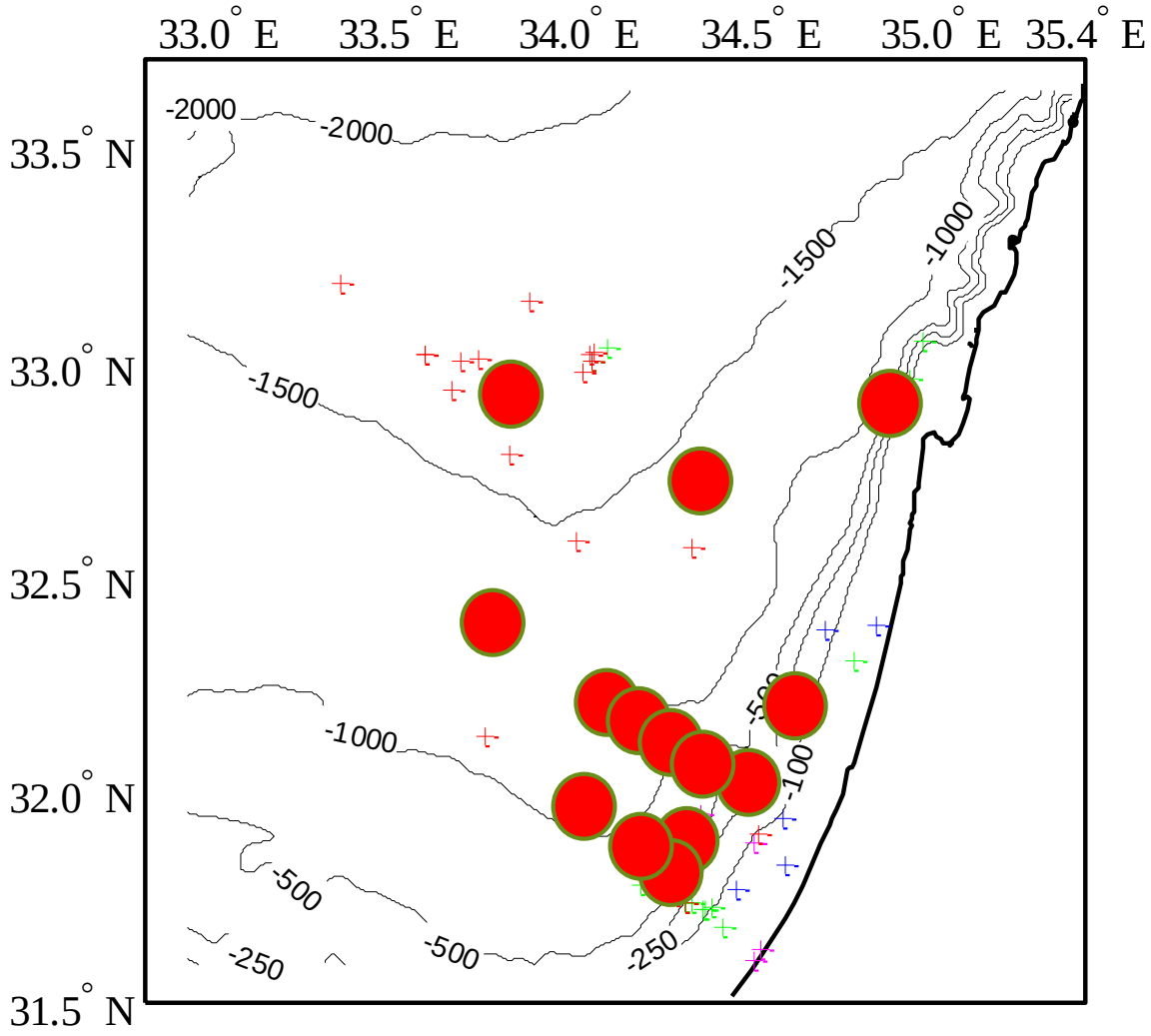


PCBs above LOQ

Spatial distribution of organic contaminants 5

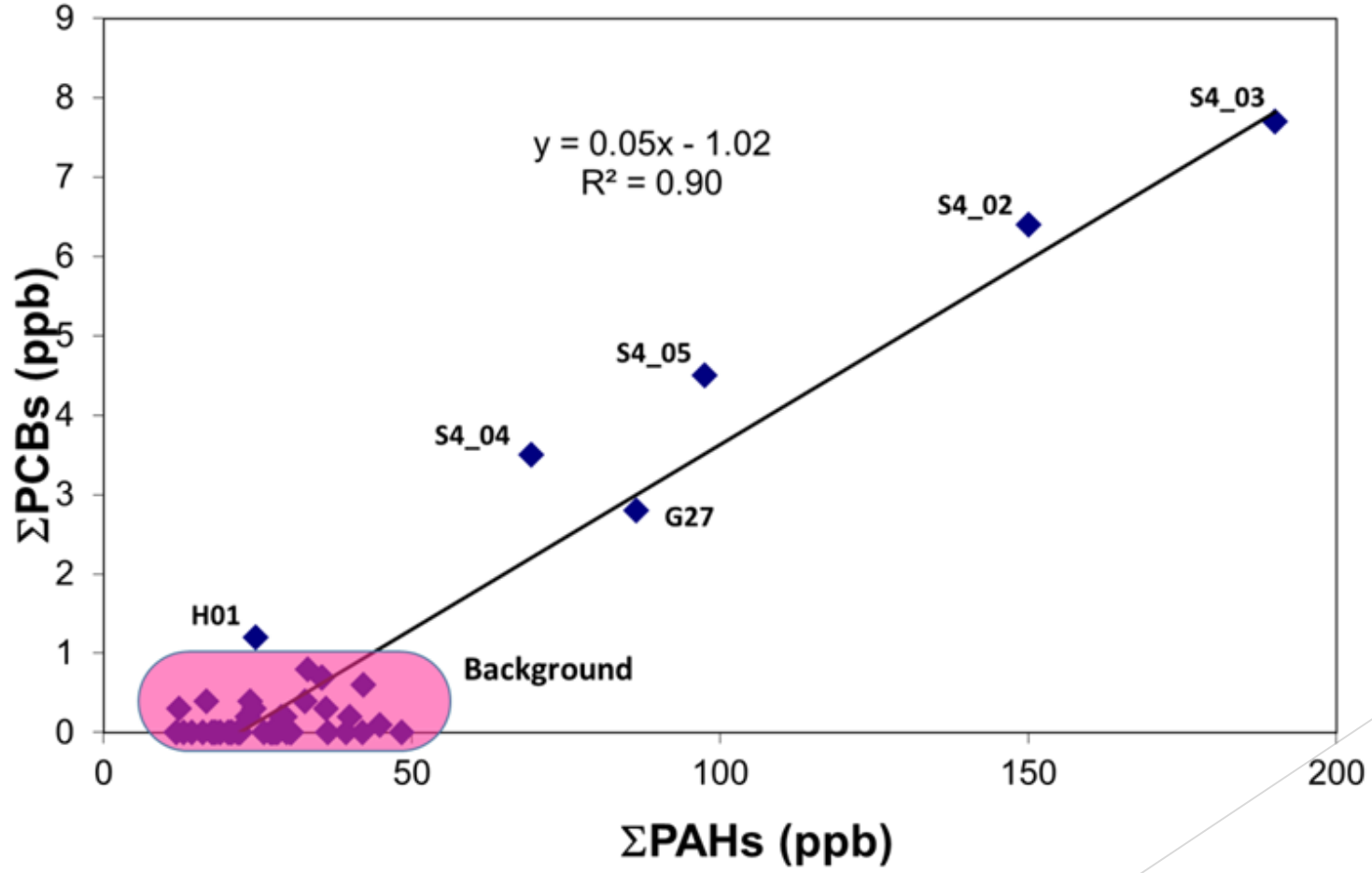


Phenanthrene above LOQ



Pyrene above LOQ

Assuming that enriched PAHs and PCBs are from the same source



PAHs in the EEZ originate mostly petrogenic with a very small component of atmospheric deposition

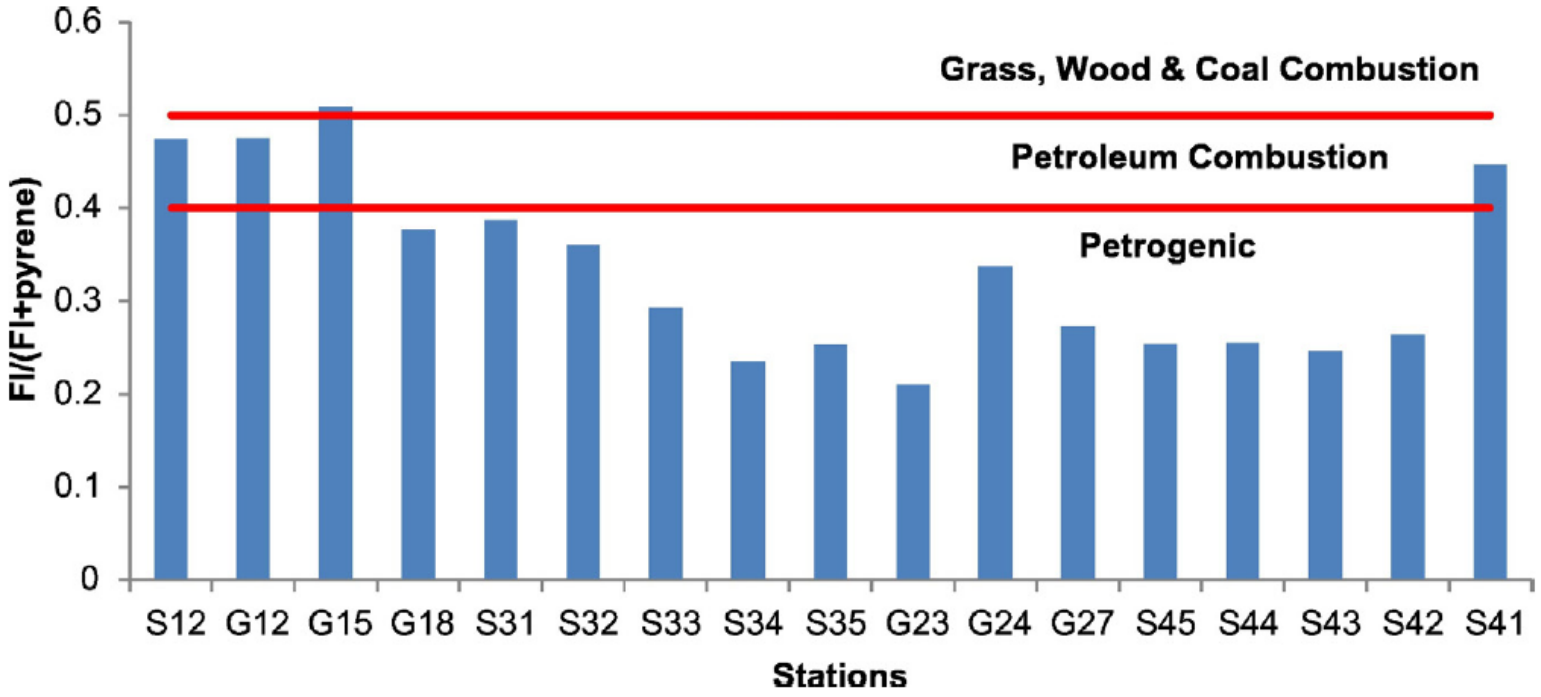


Fig. 9. Analysis of pyrogenic versus petrogenic sources of PAHs in the deep water sediments of the SE Levantine basin according to the Fl / (Fl + Py) ratio (only values above LOQ were used for this analysis).

PCBs and PAHs on the southernmost continental slope transect are well correlated indicating a common source

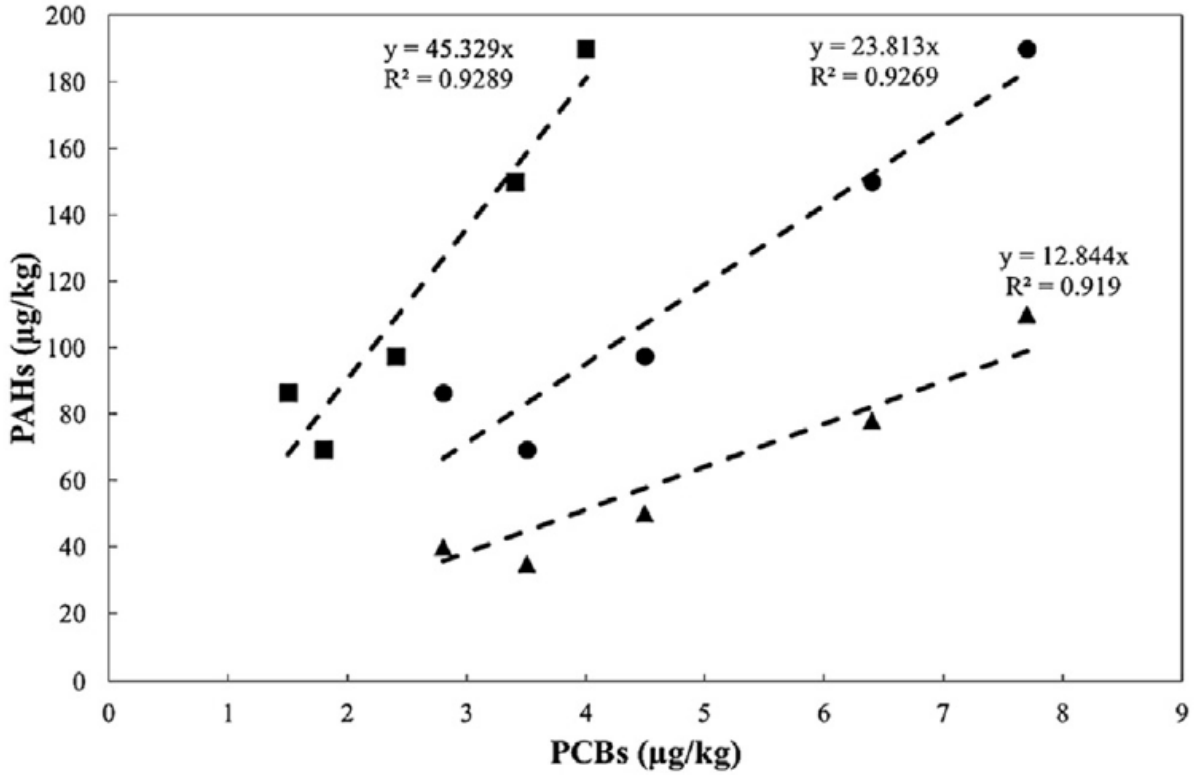


Fig. 7. Correlation plots of ΣPAHs vs. ΣPCBs (circles), ΣPAHs vs. PCB-28 (squares) and Pyrene vs. ΣPCBs (triangles) measured in continental slope stations along the southernmost east-west transect in the study area, SE Levantine basin (Fig. 1).

Conclusions 1

- Heavy metal and organic pollutant levels in the EEZ sediments are substantially lower than ERL with the exception of Ni and Cr, which were higher even than ERM at some stations. While the Ni and Cr levels are exceptionally high they appear to be natural levels.
- The exceptionally high levels of Ba are strongly associated with drilling sites in the EEZ over the past 40 years.
- Aluminum depletion in the surface layer relative to the 9-10cm layer is consistent with the decreased supply of fine sediments from the Nile Delta since the erection of the Aswan dam.
- Enriched levels of TPHs, PAHs and PCBs appear to be associated with the locations of well drilling sites and MARI-B gas refinery rig in the EEZ.

Conclusions 2

- PCB congeners in the southern EEZ (PCB28, PCB52) do not correspond to prevalent PCBs found in the moderately to heavily polluted coastal sediments off Egypt that are more highly chlorinated (PCB101, PCB153, PCB180)(Astrahan et al., 2016). This rules out the possibility that PCB pollution in the southern EEZ originates in Egyptian waters.

Thank you for your attention!

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