



ASSESSING BACKGROUND VALUES OF METALS AND METALLOIDS IN SOILS OF THE VENETO REGION

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*7th European Congress on REgional GEOscientific
Cartography and Information Systems
Bologna, 12-15 June 2012*

Summary

- 1) Natural content of metals in soil
- 2) What is background level
- 3) Investigation strategy
- 4) Depositional Units
- 5) Results: background values for Veneto Region



Starting point

Sustainable land management needs to be based on reliable data including ones related to soil contamination

In order to assess soil contamination by metals it is necessary to know natural content due to the composition of the minerals in parent material



SOURCE OF METALS IN SOILS



| Metal | Granite | Serpentine | Basalt | Shale | Sandstone | Limestone | Limits lt. Law |
|-------|---------|------------|--------|-------|-----------|-----------|-------------------|
| As | 2 | 1 | 2,2 | 13 | 1 | 1 | 20 |
| Cd | 0,13 | 0,12 | 0,21 | 0,3 | 0,05 | 0,3 | 2 |
| Co | 4 | 110 | 47 | 20 | 0,3 | 0,1 | 20 |
| Cr | 10 | 2980 | 185 | 100 | 35 | 11 | 150 |
| Cu | 20 | 42 | 94 | 50 | 30 | 4 | 120 |
| Hg | 0,03 | 0,004 | 0,09 | 0,4 | 0,29 | 0,04 | 1 |
| Ni | 10 | 2000 | 145 | 60 | 9 | 20 | 120 |
| Pb | 17 | 14 | 7 | 20 | 10 | 9 | 100 |
| Sb | 0,22 | 0,1 | 0,6 | 1,5 | 0,05 | 0,2 | 10 |
| Se | 0,05 | 0,13 | 0,05 | 0,6 | 0,01 | 0,08 | 3 |
| Sn | 3 | 0,5 | 1,5 | 6 | 0,5 | 0,5 | 1 |
| V | 50 | 40 | 225 | 140 | 20 | 20 | 90 |
| Zn | 50 | 58 | 118 | 85 | 30 | 20 | 150 |



SAMPLE COLLECTION

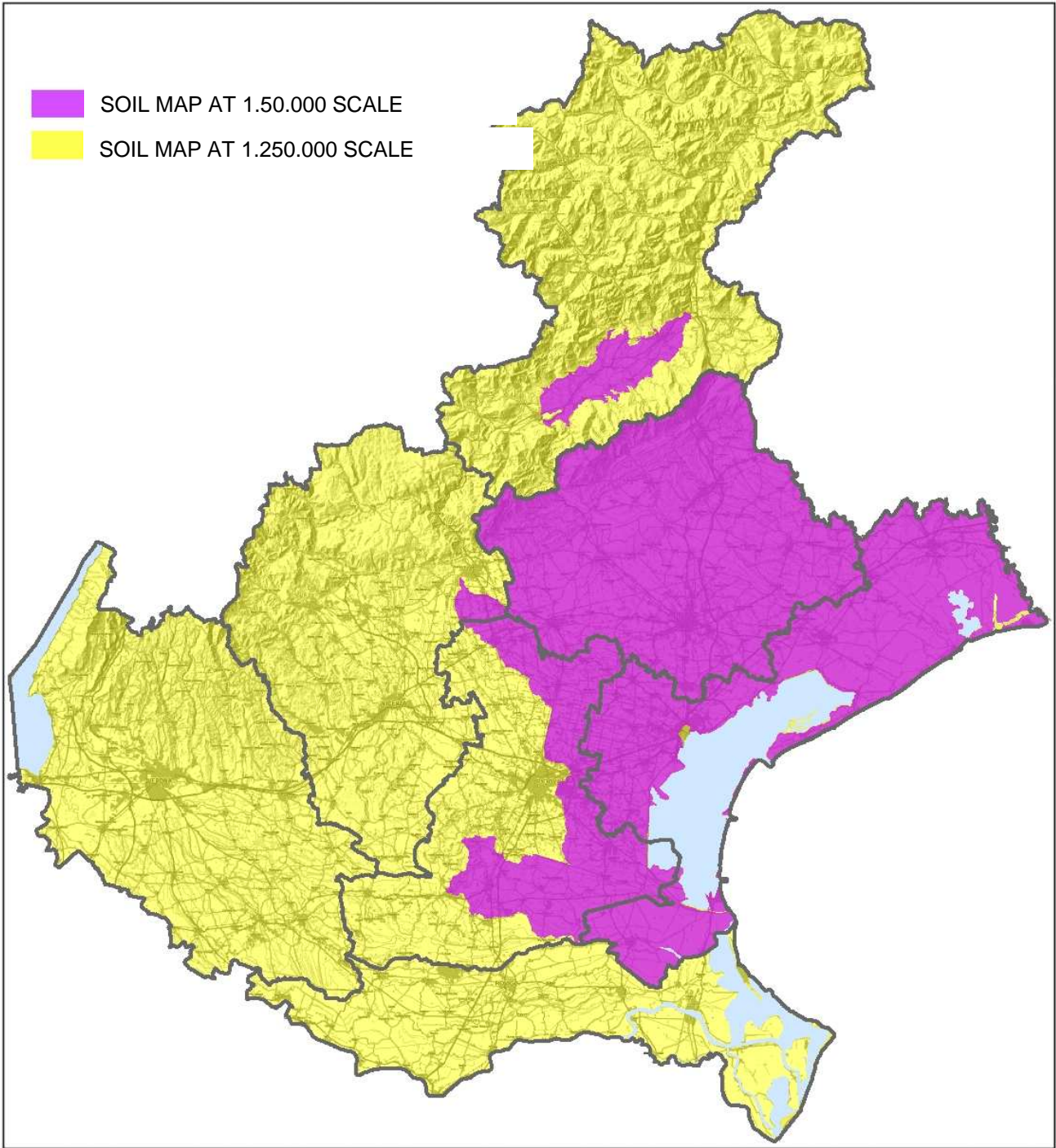


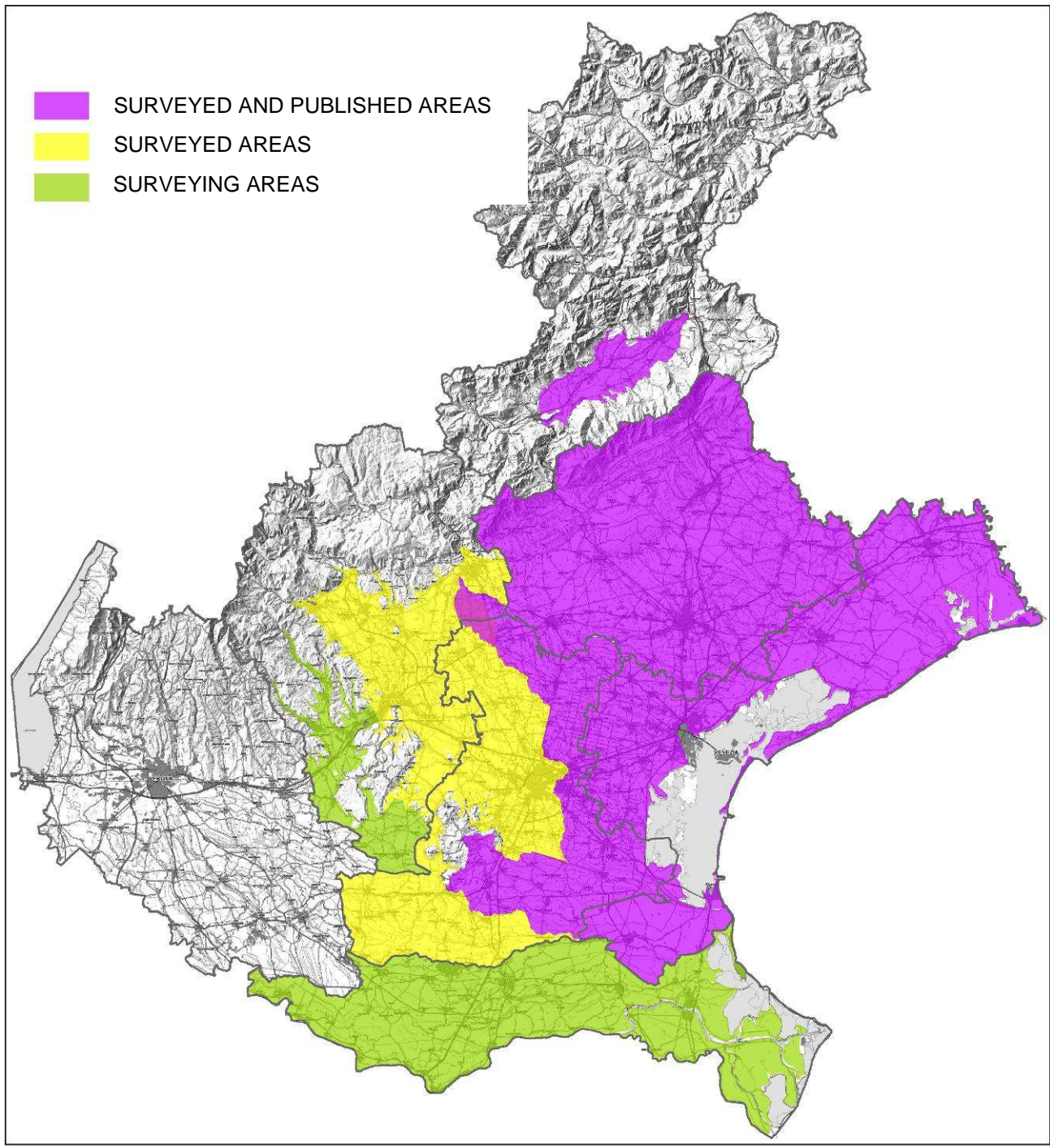
Since 1995 during soil survey sample were collected for analysis of metals:

- 1:50.000 scale (about 60% of plain and hills)
- 1:250.000 scale (the entire territory)

Most samples from profiles







ISO 19258/2005



Pedo-geochemical background content:

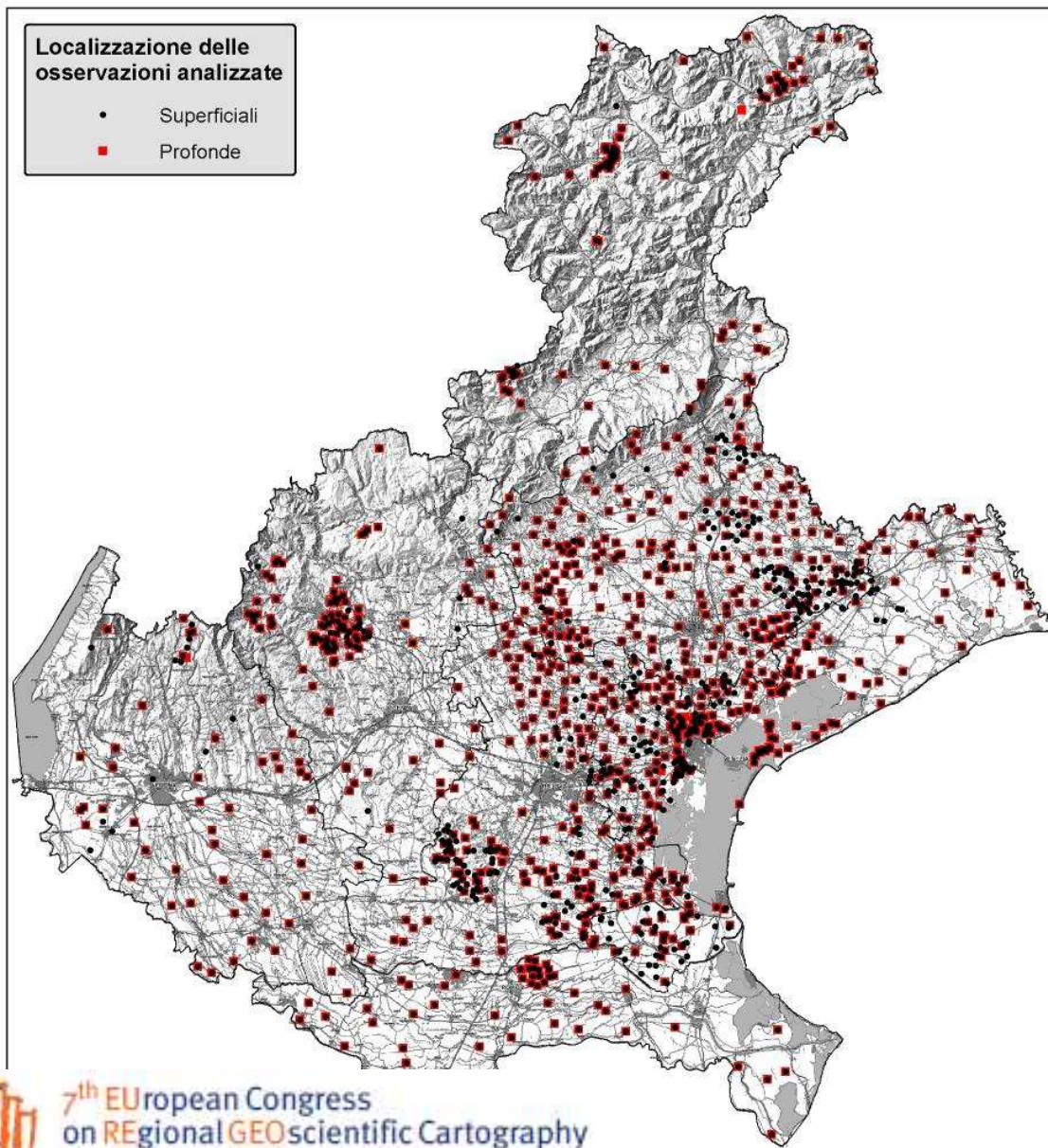
the concentration of elements generated by the characteristic features of pedogenesis, such as the composition and alteration of the rock and any subsequent movements in soil.

Background content:

the concentration of an element in a specific type of soil, located in an area or region, resulting from both natural, geological and pedological processes and including diffuse source inputs, such as atmospheric deposition and agricultural practices



TYOLOGICAL APPROACH



**1363 UPPER LAYER
SAMPLES**

1119 PLAIN

244 MOUNTAIN

**1030 LOWER LAYER
SAMPLES**

835 PLAIN

195 MOUNTAIN

DENSITY: 0,075/kmq

PLAIN: 0,093

MOUNTAIN: 0,041



CHOICE OF SAMPLING SITES



HOMOGENEOUS AREAS FOR PARENT MATERIAL

PLAIN: soils were formed by alluvial deposits

- ***Depositional Units:*** Po, Adige, Brenta, Piave, Tagliamento and other smaller fans

MOUNTAIN: soils were formed by alteration of rocks on-site

- ***Physiographic Units:*** Hard Limestones, Basalts, Granites, Marls, Conglomerates, etc.



SAMPLING DEPTH



PLAIN

- ***Background:*** topsoil (10-40 cm)
- ***Pedo-geo background:*** lower layer at C horizon level (80-120 cm)

MOUNTAIN

- ***Background:*** (topsoil: depth depending on soil use)
- ***Pedo-geo background:*** lower layer at C horizon level (under 70 cm if possible)



SOIL ANALYSIS METHODS



Analysis on fraction less than 2 mm (*terra fine*):

D.M. 13/9/1999 "Official methods of chemical analysis of soil", integrated by USEPA ed ISO

General parameters: pH, texture, organic carbon, total carbonates, cation exchange capacity

"Pseudo-total" Metals :

- aqua regia extraction and ICP detection: Be, Cd, Co, Cr, Cu, Mn, Ni, Pb, V, Zn, Fe, Al
- aqua regia extraction, derivatization e ICP hydrides detection: Sb, As, Se, Sn
- elemental analysis (AMA): Hg



LABORATORY



ALL ANALYSIS WERE PERFORMED BY ARPAV LABORATORIES

- Laboratories Service of Treviso,
Chemical Unit
- Until 2009 at Castelfranco Veneto site,
- From 2010 at new ARPAV site in Treviso
- Accredited by SINAL (now Accredia) since 1993
- By 1992 it performs ISE (Int. Soil Exchange)
ring test organized by WEPAL, Wageningen
Universityt (NL)



DATA PROCESSING



Statistical analysis of data was worked out for each depositional unit

Some descriptive statistics were performed for each item, keeping separate values of the topsoil from deeper horizons

For each variable were determined: mean, median, minimum, maximum, some percentiles (5th, 25th, 75th, 90th and 95th), standard deviation, standard error, skewness and kurtosis, normality tests



BACKGRUOND VALUES



ISO 19258/2005: percentiles (25°, 50°, 75°, 90°, 95°) calculation after outliers removal.

95° percentile is assumed as background values

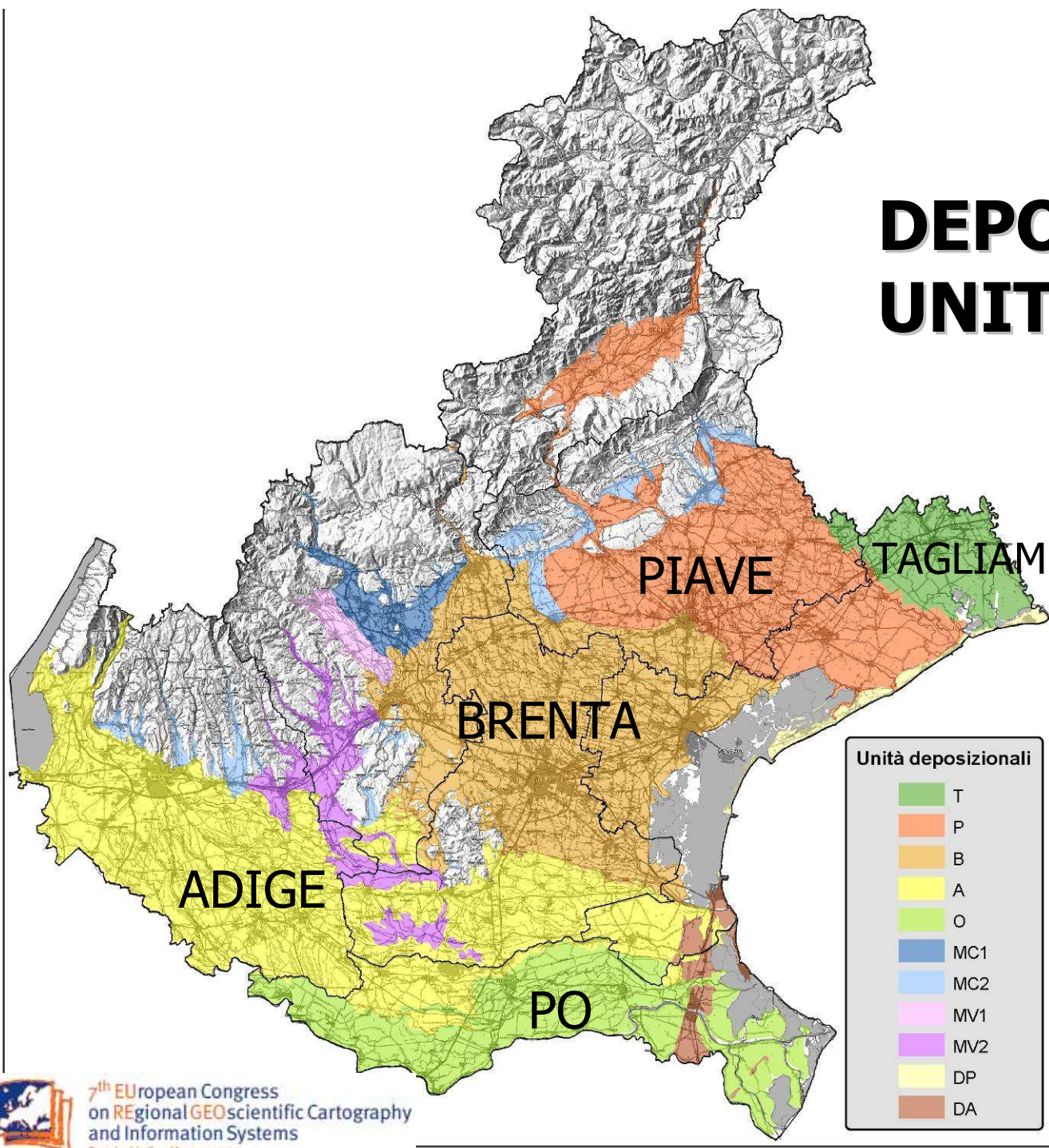
LOWER LAYER → PEDO-GEO BACKGROUND

UPPER LAYER → BACKGROUND

**THE HIGHER OF THESE TWO VALUES
IS ASSUMED AS BACKGROUND LEVEL
ACCORDING TO ITALIAN
ENVIRONMENTAL CODE**



DEPOSITIONAL UNITS



Unità deposizionali

| | |
|--------------|-----|
| Green | T |
| Orange | P |
| Brown | B |
| Yellow | A |
| Light Green | O |
| Dark Blue | MC1 |
| Light Blue | MC2 |
| Pink | MV1 |
| Purple | MV2 |
| Light Yellow | DP |
| Brown | DA |

BACKGROUND VALUES

| Depositional Units | Sb | As | Be | Cd | Co | Cr | Hg | Ni |
|--------------------|-----|-----------|------------|------|-----------|------------|------|------------|
| Tagliamento | nd | 14 | nd | 0,62 | 12 | 67 | 0,09 | 42 |
| Piave | 1,0 | 13 | 1,7 | 0,64 | 15 | 61 | 0,26 | 52 |
| Brenta | 2,4 | 45 | 2,3 | 0,95 | 16 | 64 | 0,67 | 38 |
| Adige | 1,5 | 50 | 1,4 | 1,17 | 20 | 141 | 0,32 | 125 |
| Po | 1,4 | 31 | 1,6 | 0,60 | 20 | 153 | 0,08 | 130 |



MAIN RESULTS

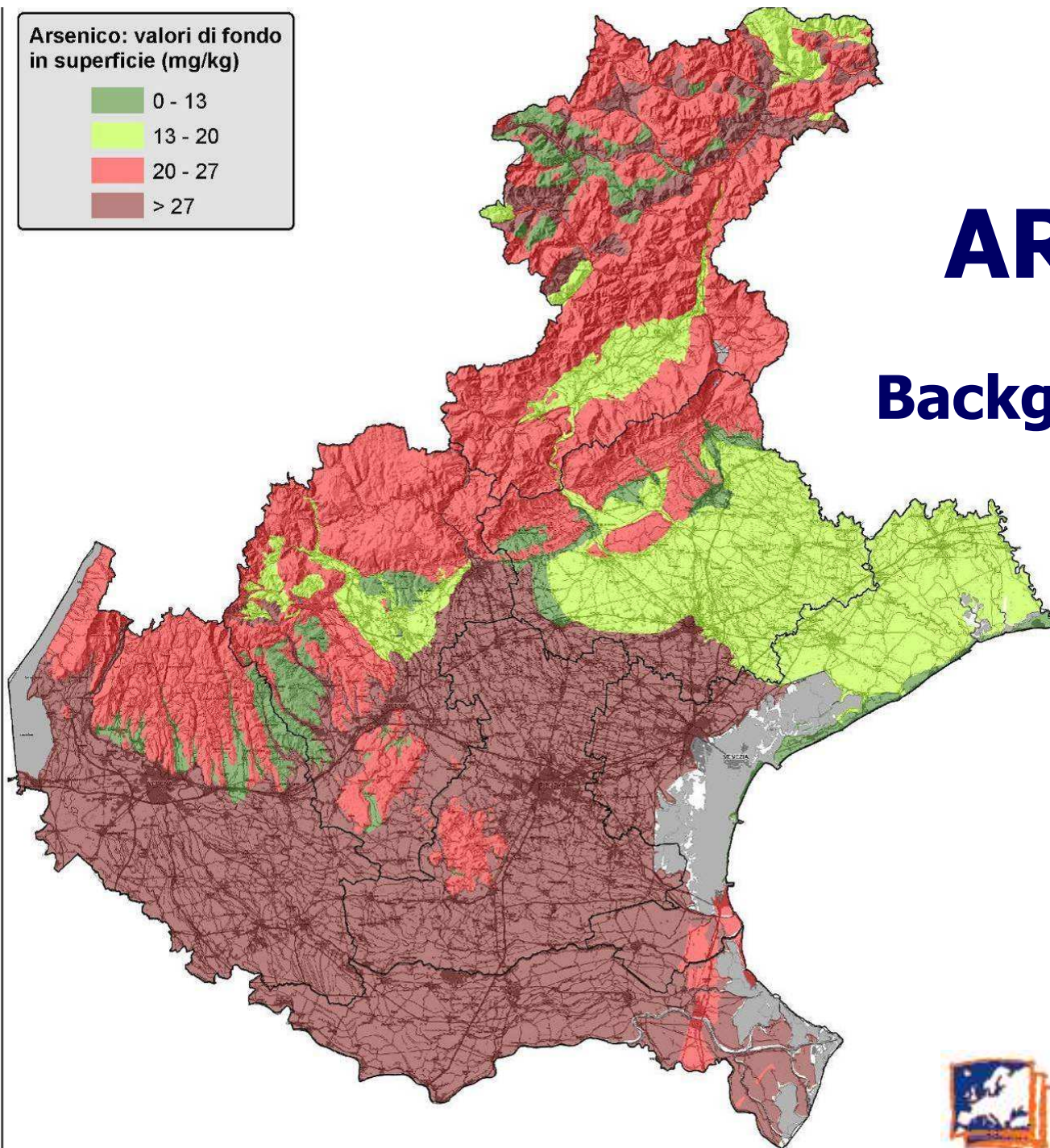


With respect to residential area limits stated by Italian Environmental Code:

- for few elements BV never exceed limits: antimony, cadmium, mercury, lead and selenium
- for some BV have few exceedings : copper (Piave),
- for many BV exceeds limits in many units: arsenic, berillium, cobalt, cromium, nickel, vanadium, zinc
- for one BV exceeds limit in all units: tin

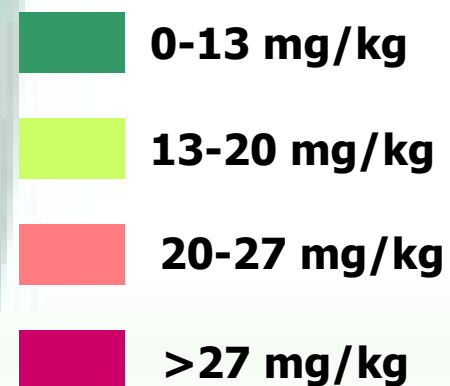


Arsenico: valori di fondo
in superficie (mg/kg)



ARSENIC

Background values

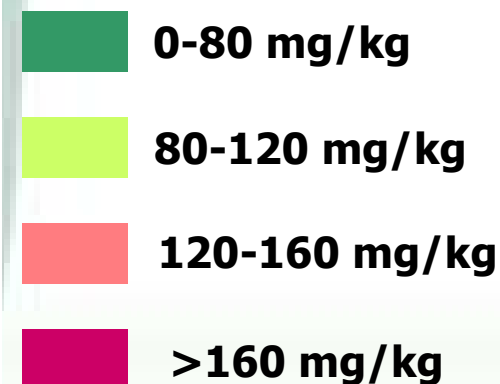
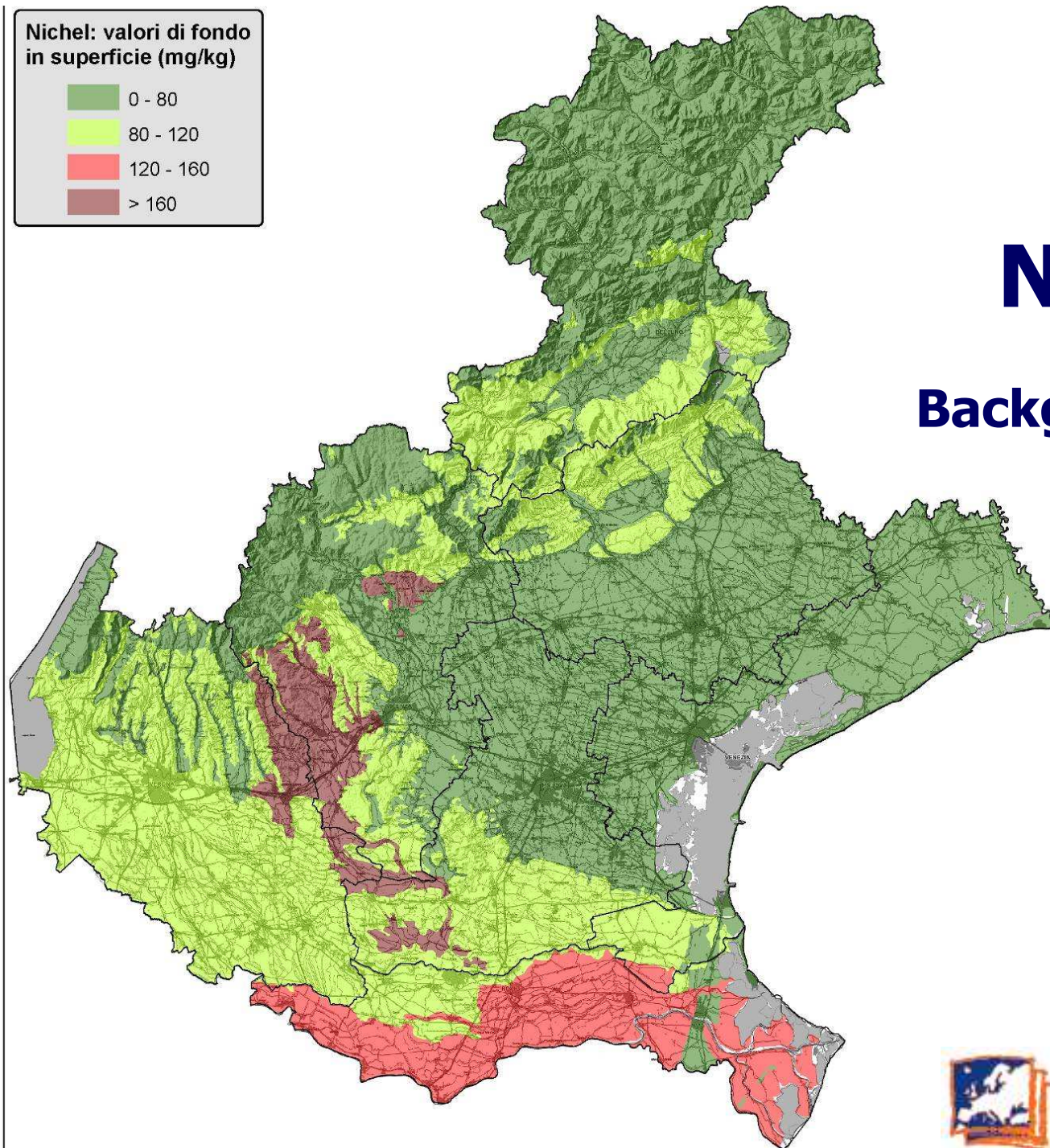


Nichel: valori di fondo
in superficie (mg/kg)



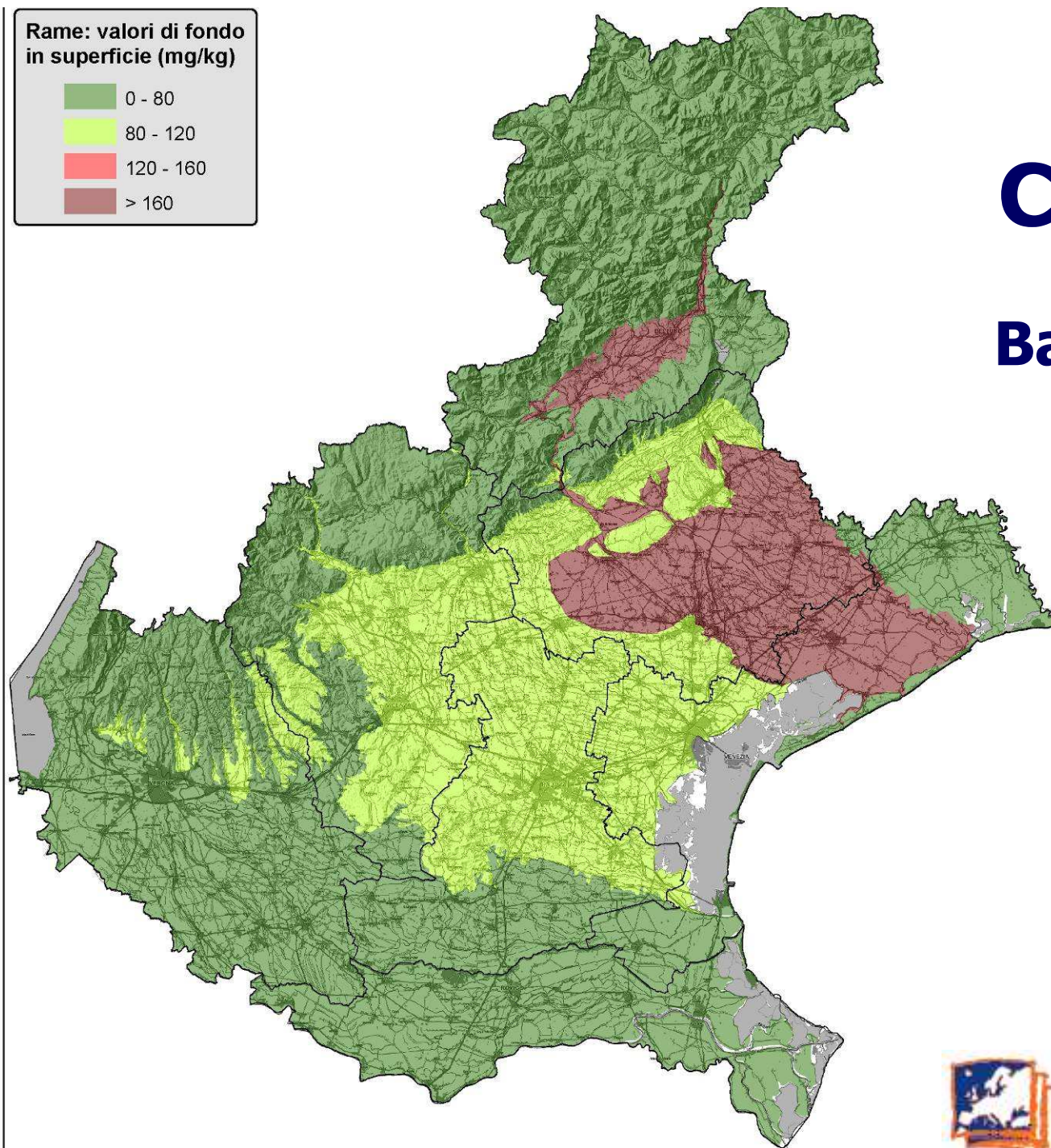
NICKEL

Background values



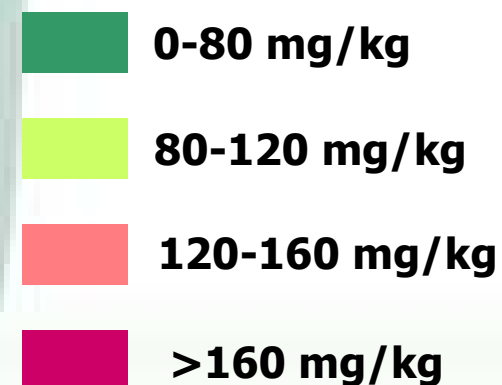
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Rame: valori di fondo
in superficie (mg/kg)



COPPER

Background values





**Thank you
for your attention**

