Abstract n.89

Evaluation of Chromium pollution into an industrial remediation site, and its occurrence in reserve areas of deep aquifers

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Introduction

An important RISE (reserve zone for future human-supply in deep groundwater body - leaky to confined) is proximal to a major contaminated industrial site in Eastern Piedmont, involved into a remediation program (NW-Italy, Alessandria district).

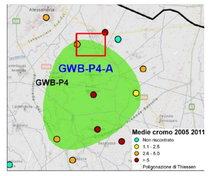
Even though the RISE zone is located up-gradient (with respect to regional groundwater direction flow) with respect to the contaminated site, public authorities and environmental agency take a special care to the drawdown effects caused by a line of several industrial well with high-discharge (values proxi to 1 m^3/s).

One of the most typical contaminants of the industrial site (subjected to a remediation plan including P&T techniques) is Chromium; but also its occurrence of natural origin is well-known in aquifer system, because of peridotites rocks in the regional recharge area (Mt. Beigua ophiolitic massif).

The key questions are therefore:

a) How is the vertical distribution of Cr pollution in groundwater at different depths / levels ?
b) Could the RISE zone be affected by contaminant plumes diffused from industrial wells, settled along the Southern border of the industrial site ?

Background Cr_{tot} in GW 13-19 µg/l



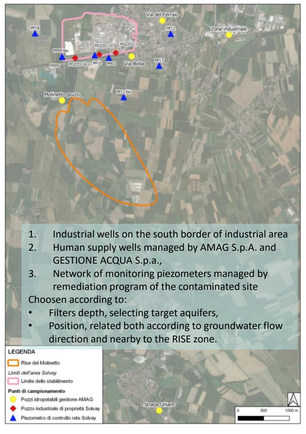
Material and Methods

Conceptual model of groundwater system.

- ✓ Shallow phreatic aquifer (Level "A")
- ✓ Leaky aquifer (Level "B")
- ✓ Confined aquifer (Level "C", "V")

Design of monitoring network and selection of significant wells.

- ✓On-site measuring of physical-chemical parameters and piezometric level
- ✓Dynamic sampling for laboratory measurements
- ✓Basic hydrogeochemical parameters (and Cr/$Cr_{(VI)}$)
- ✓Stable isotopes (^2H,^{18}O)
- ✓ Dating parameters (^3H, ^{14}C)



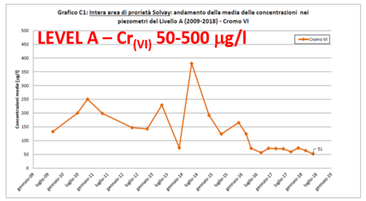
✓GEO-statistical (GIS-based) analysis of Cr concentrations

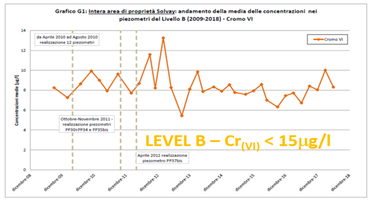
Results

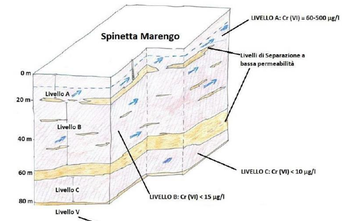
All the hydro-geochemical investigations show an increasing level of confinement of deeper aquifers (level B, C, V: $Cr_{(VI)}$ < 15, 10, 5 µg/l) with respect to the shallow aquifer, that contains very high degree of $Cr_{(VI)}$ contamination (level A: 50-500 µg/l).

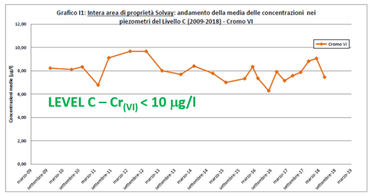
Inside the RISE zone the deepest aquifers (depths between 86-183 below ground level) show artesian flow with pressur up to + 4.5 metri above the ground; positive vertical component of hydraulic gradient.

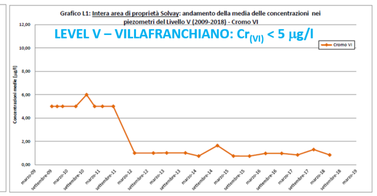
Historical time series analysis of of groundwater quality data (10y) → Background values (from public environmental agency / ARPA and industrial site remediation) → Design of the monitoring network; sampling and analysis reporting → Interpretation of results → Conclusions and evaluation of safety degree of the RISE zone; optimization of the monitoring network

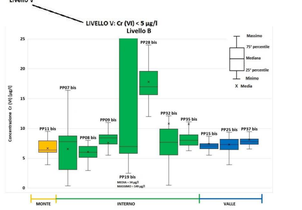


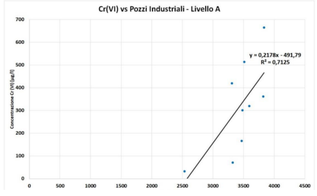


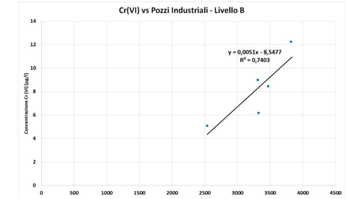


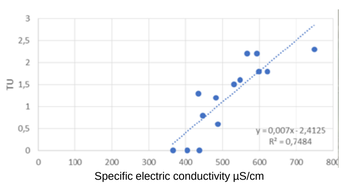


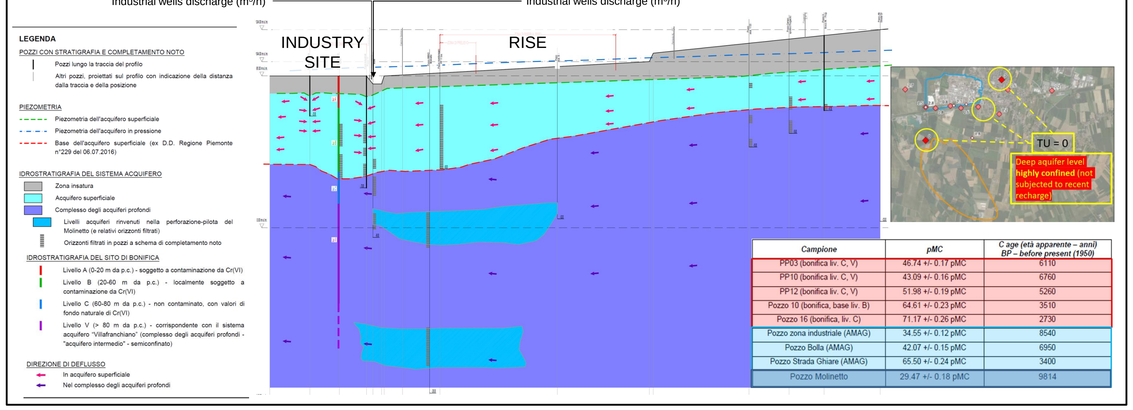












Campione	pMC	C age (età apparente – anni) BP – before present (1950)
PP03 (bonifica liv. C, V)	46.74 +/- 0.17 pMC	6110
PP10 (bonifica liv. C, V)	43.09 +/- 0.16 pMC	6760
PP12 (bonifica liv. C, V)	51.98 +/- 0.19 pMC	5260
Pozzo 10 (bonifica, base liv. B)	64.61 +/- 0.23 pMC	3510
Pozzo 16 (bonifica, liv. C)	71.17 +/- 0.26 pMC	2730
Pozzo zona industriale (AMAG)	34.55 +/- 0.12 pMC	8540
Pozzo Bolla (AMAG)	42.07 +/- 0.15 pMC	6950
Pozzo Strada Ghiare (AMAG)	65.50 +/- 0.24 pMC	3400
Pozzo Molinetto	29.47 +/- 0.18 pMC	9814

Conclusions

The vertical distribution of Cr pollution is strongly differentiated into the groundwater bodies at different depths / levels, with a decrease of 2 orders of magnitude from the phreatic to the deep-confined aquifers.

There is a correlation between industrial wells' abstraction rate (along the Southern border of the industrial site) and Cr concentrations; however, the Cr values in Level «B» remain very low (compared to Level «A») and are close to the background values (controlled by the petrographic composition of the sediments).

The exploitable aquifers in the RISE zone show apparent ages at ^{14}C (> 8,000 years B.P.) several thousand years higher than the wells sampled at the reclamation site, completed in the upper aquifer levels; the exploitable aquifers in the RISE at the indicated depths are characterized as "closed systems" with respect to the infiltration of "modern" waters.

The isotopic composition of the deep drinking water wells and the site control wells / piezometers confirms a likely recharge of this sector for drainage by the deep aquifer, in line with the aforementioned vertical hydraulic gradient in the local aquifer system.

The deepest aquifers into the RISE zone show excelent features of safety in terms of future abstraction by wells for human use

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