

Sea water intrusion and correlated pollution: the case of mercury contamination of coastal aquifers in southern Tuscany (central Italy).

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EXTENDED ABSTRACT

Southern Tuscany contains a large variety of mineral deposits such as pyrite, barite, Fe, Cu-Pb-Zn (Ag), Sb, Sn and Hg which were exploited until only a few decades ago. In southern Tuscany Hg occurs along mineralization, mainly represented by cinnabar, and within alluvial deposits as clastic material eroded from primary mineralizations and/or country rock.

Until the mid-90's no significant presence of Hg had ever been observed in water delivered by wells and springs. Cinnabar is practically insoluble in fresh water, having a solubility product close to -51 . However, since 1995 increasing Hg concentrations above the admissible limit for drinkable water ($1 \mu\text{g/l}$) started to be detected in the water delivered by wells of five areas located along the southern coast of the Tuscan region (Fig.1). The contaminated wells tap both carbonate and clastic aquifers and all have experienced a huge increase in groundwater exploitation over the last few decades.

A monitoring study based on repeated sampling and analyses of the well waters in the different areas was conducted between June and October 1998. The study has highlighted that:

- 1) sea water intrusion processes affect all the areas, though to different degrees;
- 2) Cl content, which varies from less than 300 (Monte Argentario) to more than 20000 (Ansedonia) mg/l, is in fact governed by sea water contamination, as clearly revealed by $\delta^{18}\text{O}$ data (see the example in Fig.2)
- 3) strict relations between Cl and Hg concentrations in the well water characterize each area. Fig.3 shows the example of Follonica area

We, therefore, hypothesized that Cl, by interacting with the Hg minerals naturally present in the aquifers, could produce mobile Hg-Cl complexes and thereby the Hg pollution of the well waters. This hypothesis was verified by means of the Phreeqc computer code by modelling possible interactions between mixtures containing variable percentages of sea water and Hg solid phases. The role played by sea water intrusion in mercury mobilization is clearly evident in Fig. 4, which summarizes the modelling results at the observed pH and pE conditions.

Sea water intrusion therefore seems to be the major responsible factor for the rather recent Hg contamination of the well waters of the coastal aquifers of southern Tuscany.

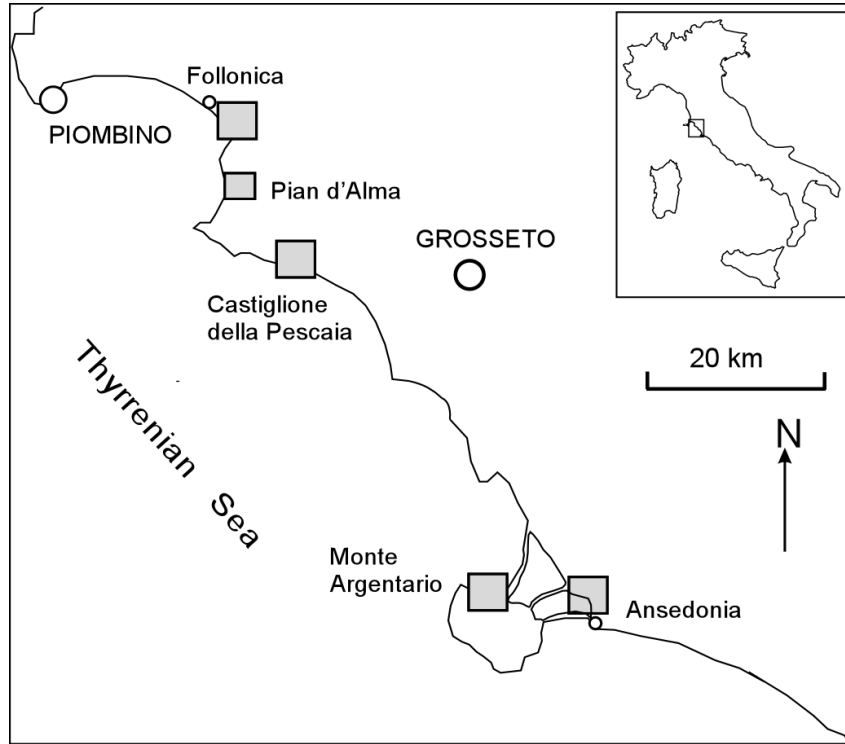


Figure 1: Location of Hg contaminated areas

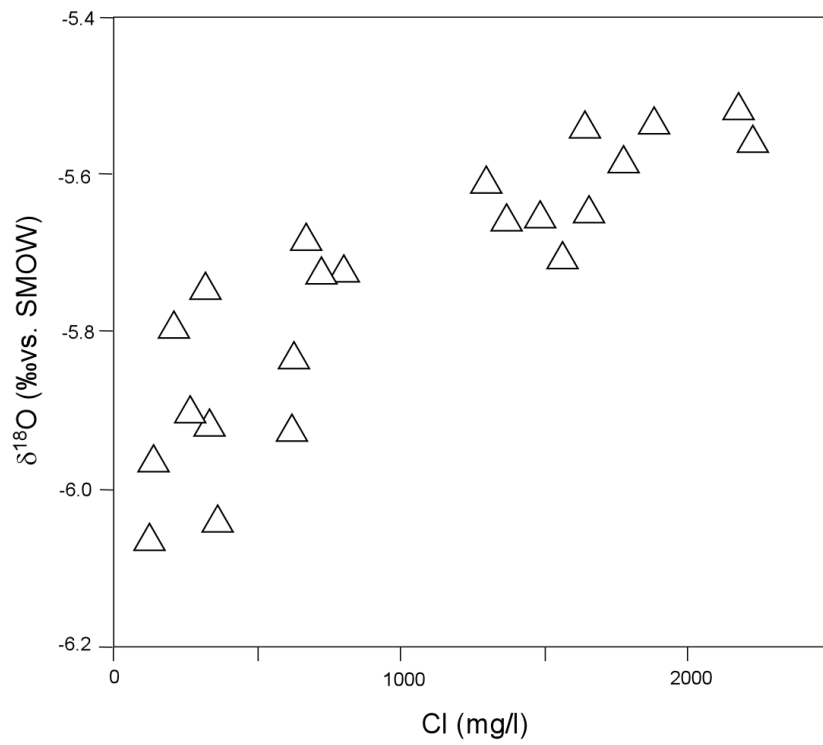


Figure 2: $\delta^{18}\text{O}$ vs. Cl for Follonica area

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