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Retoxification by heavy metals at land-sea interface in coastal aquifers

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Although during the last decades a significant number of countermeasures have been put in place with respect to the release of pollutants into the environment, and emissions of many of these are in fact ceased, the signs of a generalized pollution are found with increasing frequency. The appearance of new signals may surprise, given that common sense leads us to believe that in a period of reduced emissions the environment should be in an improved state rather than in a worse one: however, the environmental effects of previous pollution are clearly appearing after a build-up of pollutants in the environment over the past decades, with a lag with respect to the activities that generated it.In particular, soils are the final receptor (sink) of pollutants as heavy metals, pesticides and fertilizers: the common belief that the heavy metals remain forever locked may, however, give a false sense of security: today it is no longer possible to ignore the fact that the soils involve potential long-term impacts.With this in mind we can open a window on some aspects of the nonlinear behavior of soils and detrital aquifers. Researches on the former are more frequent and help extending some results to the latter. As matter of fact, in response to variations in environmental conditions, sudden releases of pollutants accumulated in soils occur with a considerable delay compared to the input.
The attention of the study is on coastal aquifers. The coastal areas in general are dynamic non-linear systems at the land-sea interface in perpetual chemical-physical disequilibrium: these areas are complex with regard to the constituent elements and subject to a set of variable boundary conditions (oscillating borderswith periodic and aperiodic frequency), to cyclic and non-cyclic variations of climatic conditions and anthropogenic forcing (permanent or transient), whose behavior is not easily predictable, and that act on different temporal and spatial scales.The question is: can the changes of environmental factors control the chemical form of contaminants in such a way as to convert the "sink" into sources of contamination, thus changing the coastal areas in areas of potential environmental retoxification?
The study shows that in coastal aquifers, in response to the groundwater dynamics,triggered, among other factors, by the tidal oscillations, the retoxification phenomena become visible due to the gradual or abrupt changes in groundwater salinity. In particular, heavy metal concentrations in ground waters vary when aquifer sediments are concerned by brackish water. Apart from natural environments, contaminated coastal sites (which in the last 60-70 years have been the location of uncontrolled release of industrial wastes) and land reclamation areas, are other places of potential retoxification by heavy metals. It is reasonable that the remediation of contaminated sites located coastal areas might severely alter the physical, chemical and biological properties of sediments and groundwater, if in communication with the sea, and determine the re-mobilization of heavy metals.