MULTIDISCIPLINARY APPROACH TO ASSESS THE SEASONAL EFFECT ON REDOX PROCESSES OCCURRING IN A TROPICAL ALLUVIAL AQUIFER

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The detection of high concentrations on Mn and Fe in groundwater are usually related with the occurrence of redox processes, which are clearly due to organic matter oxidation (Palmucci et al., 2016). In hydrogeological contexts, where multilayer alluvial aquifers are in direct connection with surface-water heavily impacted by eutrophication (Lewandowski et al., 2015), the organic matter load in groundwater could change seasonally, due to the dilution effect related both to the river discharge variations and to the piezometric level fluctuation (i.e. wet season recharge), especially in tropical areas.
To assess this phenomenon, the San Pedro Sula alluvial aquifer, located in the north-west Honduras, was selected as study area. This is a tectonic basin filled by continental deposits whose thickness ranges from a few meters up to 250 m. For this multilayer alluvial aquifer, well known surface-water/groundwater interactions were identified (Di Curzio et al., 2016).
The datasets used for this research refer to two monitoring rounds performed in 2002, both in the wet (February) and in the dry season (May), each one consisting of 94 groundwater samplings, 32 surface-water samplings, 56 hydraulic head measurements and 9 river discharge measurements. For the assessment of the seasonal variation of redox processes extent, a multidisciplinary approach was chosen, integrating a Principal Component Analysis (Palmucci et al., 2016) on several chemico-physical parameters and a Mn and Fe speciation, using the modeling tool Phreeqc (Appelo & Postma, 2005), both for the wet and the dry season.
The first statistical, chemical and numerical results highlight a strong correlation of Mn concentration with redox processes, both in the wet and in the dry season. This is likely related to the organic matter transfer from heavy polluted surface-water to the aquifer and to the trigger of redox processes that solubilize Mn. For Fe, the correlation with redox processes has also been detected, enhancing the solubility of Fe in groundwater. In some cases, when the samples present high turbidity, the high concentration of Fe can be related to a fine colloidal phase that is formed when different groundwaters mix up in the wells, which are screened in different aquifers. As unusually expected, the colloidal phase formation increases during the dry season, when discharge of main streams and the precipitation are more abundant. In this condition, surface-water transfers more organic matter to the aquifer and the redox processes play the foremost role on Fe mobilization.

References

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