



Geogenic arsenic and fluoride in groundwater of the shallow aquifers impacted by volcanic ash in the province of La Pampa, Central Argentina

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The Chaco-Pampean Plain in the Republic of Argentina is characterized by groundwater resources with the occurrence of arsenic (As) and fluoride (F^-) at toxic levels above the limits of WHO drinking water guidelines (10 $\mu\text{g/L}$ for As and 1.5 mg/L for F). Significant parts of the rural population are diagnosed with long term impacts of hydroarsenicism and dental fluorosis and osteo-fluorosis due to prolonged exposure of As and F in the drinking water sources. The source of these contaminants in groundwater is primarily geogenic, resulting from the weathering of volcanic ash (with rhyolitic glass) and the associated Quaternary loess sediments in the alluvial aquifer, originated from the Andean volcanic eruptions. This study was carried out to assess the drinking water quality from the shallow aquifers in the rural areas of the province of La Pampa in Central Argentina and to evaluate the main factors controlling the mobilization of As and associated trace elements from the shallow aquifers.

Groundwater analysis revealed predominantly alkaline character with pH in the range of 7.4 to 9.2), mild oxidizing conditions in the aquifers with redox potential (ca.0.24V), and high EC (456-11,400 $\mu\text{S/cm}$) varying significantly in different wells in the study area. The predominant water types in recharge and discharge areas were of Na-HCO_3 type and Na-Cl-SO_4 type respectively. High degree of mineralization was evidenced by the high EC and TDS. The concentration of NO_3^- and PO_4^{3-} in groundwater was high indicating anthropogenic contamination. Total As concentrations varied between 6 to 535 $\mu\text{g/L}$, with 94% of the wells above the WHO drinking water guideline. Total F concentrations ranged from 0.5 to 14.2 mg/L with 78% of the wells exceeded the WHO guideline value. Generally, As is present in groundwater as oxidized species and show positive correlations with HCO_3^- , pH, F, B and V. Total Fe, Al and Mn concentrations were low under oxidizing conditions in these groundwaters and showed negative correlation with As and F. The mobility and distribution of As and other trace elements seem to be governed by a complex interplay of various factors such as the hydrogeology of the regional aquifer system, climatic influence and geochemistry of the aquifer sediments typical of the semi-arid region.