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Dynamics of dissolved major (Na, K, Ca, Mg, and Si) and trace (Al, Fe, Mn, Zn, Cu, and Cr) elements along the lower Orinoco River (Article) (Open Access)

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Abstract

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This study addresses the changes in dissolved major and trace element concentrations along the Orinoco River, including the mixing zone between the Orinoco and Apure Rivers. Water samples from the Apure and Orinoco Rivers were collected monthly in four sectors over a period of 15 months. Auxiliary parameters (pH, dissolved oxygen, conductivity, and temperature), total suspended sediments, dissolved organic carbon (DOC), and major (Na, K, Ca, Mg, and Si) and trace (Al, Fe, Mn, Zn, Cu, and Cr) element concentrations were measured in all sectors. The relative contribution of both rivers after the Apure–Orinoco confluence was determined using Ca as a tracer. Moreover, a mixing model was developed to determine whether dissolved species exhibit a conservative behavior during mixing. The results indicate that DOC is removed from waters during the Apure–Orinoco mixing, probably due to absorption of DOC on mineral phases supplied by the Apure River. Dissolved Na, Ca, and Mg behave conservatively during the mixing processes, and their concentrations are controlled by a dilution process. The anomaly in the temporal pattern of K in the Orinoco is caused by the input of biogenic K originating from the Apure River during the high-water stage. The loss of dissolved Si during the low-water stage can be explained by the uptake of Si by diatoms. Dissolved Mn, Zn, Al, and Fe showed a non-conservative behavior during the Apure–Orinoco mixing. The removal of Mn and Zn from the dissolved phase can be explained by the formation of Mn-oxyhydroxides and the scavenging of Zn onto Mn oxides. Dissolved Fe is controlled by redox processes, although the removals of Fe and Al due to the preferential adsorption of large organometallic complexes by mineral surfaces after the Apure–Orinoco confluence can affect the mobility of both elements during transport. The conservative behavior shown by Cu and Cr can be related to the tendency of both elements to be complexed with small organic colloids, which are not preferentially adsorbed by clays. © 2016 The Authors Hydrological Processes Published by John Wiley & Sons Ltd.

SciVal Topic Prominence

Topic: low flow | river basin | organic carbon

Prominence percentile: 48.429

Reaxys Database Information

View Compounds

Author keywords

major elements | mixing zone | organic matter | Orinoco River | trace elements

Indexed keywords

Engineering controlled terms:

Aluminum | Biochemical oxygen demand | Biological materials | Calcium | Carbon | Dissolution | Iron compounds | Magnesium | Manganese | Mixing | Organic carbon | Organometallics | Process control | Rivers | Silicon | Sodium | Suspended sediments | Trace elements | Water resources | Zinc

Engineering uncontrolled terms

Dissolved organic carbon | Element concentrations | Major and trace elements | Major elements | Mixing zones | Organo-metallic complexes | Preferential adsorption | Total suspended sediments

Engineering main heading:

Dissolved oxygen

GEOBASE Subject Index:

concentration (composition) | confluence | dissolved organic carbon | mixing | redox conditions | river water | trace element | water chemistry

Regional Index:

Apure River | Orinoco River | Venezuela

Species Index:

Bacillariophyta

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