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Predicting the Impact of Mining on Watersheds: a Case Study from the Ocoña Watershed in Arequipa, Peru

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With increasing resource development comes associated responsibility to prevent environmental contamination. A variety of ore deposits are mined in the state of Arequipa in Peru, where artisanal and small-scale mining serve as a major source of livelihood to the local community. Additionally, both local and international companies are conducting brownfields and greenfields exploration throughout this region. However, mining in Arequipa also serves as a point of contention among citizens due to concerns of contamination of local freshwater sources. These concerns have been particularly documented in the Ocoña watershed, where mining co-exists with agriculture and fishing along the river valley.

The aim of this study is to better understand the impact of mining activity, the buffering capacity of the local geology and water rock interaction on water quality. Principle component analysis of Ocoña river water data suggests a contribution of Cu, Mn, Al and Fe in areas where mining is the dominant anthropogenic activity. Water discharge-concentration relationships are indicative of greater contribution of such metals at higher river discharge levels. Despite flushing of Cu-Mn-Al-Fe at higher discharge, the neutral to basic water pH conditions (median pH = 8.09) maintains concentrations of such metals at lower levels, compared to the neighboring Tambo and Chili watersheds. Local geologic characteristics in mining areas that are capable of neutralizing acidic solutions include vein carbonate and propylitic-altered rocks.

The environmental impacts of resource development are a critical consideration in early stages of mineral exploration and ultimately mining. Understanding the relationships of mining, geology and the Cu-Mn-Al-Fe hydrogeochemical signature can be used to predict risks of contamination of local watersheds prior to any exploration activities. Ultimately, knowledge about the interplay of human activity, the local geology and its natural acidity buffering capacity can help minimize adverse water quality impacts and inform remediation efforts.