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Chemical groundwater outputs from small drainage basins: two tropical examples

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Numerous chemical weathering studies in small drainage basins assume that most of dissolved elements are exported through surface runoff. While measuring only surface water at the outlet, it is implicitly assumed that export through groundwater is negligible.

Because hydrogeological limits of groundwater catchment do not coincide systematically with hydrological limits of surface watershed in small basins, groundwater ows can occur through the watershed limits. The general high elemental content of groundwater induces therefore that elements uxes exported can be hardly neglected. This point is illustrated on two case studies.

Two forested tropical basins with distinct hydrogeological setting are studied: the Nsimi watershed (Cameroon) with a shallow water table in a swamp accompanying the stream and the Moole Hole watershed (India) with a disconnected deep water table. Climatic, hydrological and chemical monitoring have been carried out for several years (since 1994 and 2003 respectively) on both basins.

Chloride Mass Balance technique is used for the assessment of direct recharge using the chemical data series acquired on rainfall, stream water and groundwater. Preliminary results indicate that recharge to groundwater is about 350 mm/yr on the hillslope of Nsimi watershed from an annual rainfall of 1770 mm/yr. The hydrodynamic study

shows that one part of this water (about 50 mm/yr) ows out the watershed through the swamp aquifer and 300 mm/yr through the stream. At Moole Hole, for an annual rainfall of 1140 mm/yr, the total groundwater recharge is about 50 mm/yr which entirely ows out the watershed through the aquifer in gneissic fractured rocks. The total dissolved sediments (Ca, Na, K, Mg and Si) exported are 11 kg/ha/yr through the swamp aquifer and 38 kg/ha/yr through the stream at Nsimi. At Moole Hole, the exported TDS are 17 kg/ha/yr through the stream and 75 kg/ha/yr through the fractured aquifer. While at Nsimi the elements ux exported by groundwater ows is of the same order of magnitude than ones exported by surface water, at Moole Hole more than 80% of elements are exported by groundwater. These results show that groundwater uxes are comparable to surface uxes and cannot be neglected for chemical weathering assessment in small head drainage basins. Integrated approaches coupling hydrogeological study to geochemical monitoring are therefore necessary.