



The role of soil air composition for noble gas tracer applications in tropical groundwater

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Dissolved noble gases (NGs) in groundwater provide a well-established tool for paleo temperature reconstruction. However, reliable noble gas temperature (NGT) determination needs appropriate assumptions or rather an exact knowledge of soil air composition. Deviations of soil air NG partial pressures from atmospheric values have already been found in mid latitudes during summer time as a consequence of subsurface oxygen depletion. This effect depends on ambient temperature and humidity and is thus expected to be especially strong in humid tropical soils, which was not investigated so far. We therefore studied NGs in soil air and shallow groundwater near Santarém (Pará, Brazil) at the end of the rainy and dry seasons, respectively. Soil air data confirms a correlation between NG partial pressures, the sum value of O_2+CO_2 and soil moisture contents. During the rainy season, we find significant NG enhancements in soil air by up to 7% with respect to the atmosphere. This is twice as much as observed during the dry season. Groundwater samples show neon excess values between 15% and 120%. Nearly all wells show no seasonal variations of excess air, even though the local river level seasonally fluctuates by about 8 m. Assuming atmospheric NG contents in soil air, fitted NGTs underestimate the measured groundwater temperature by about 1-2°C. However, including enhanced soil air NG contents as observed during the rainy season, resulting NGTs are in good agreement with local groundwater temperatures. Our presented data allows for a better understanding of subsurface NG variations. This is essential with regard to NG tracer applications in humid tropical areas, for which reliable paleoclimate data is of major importance for modern climate research.