

Soil water vapor isotopes as a tool for understanding ecohydrological processes

K. SODERBERG^{*1}, S. P. GOOD¹, L. WANG², AND K. K. CAYLOR¹

¹Department of Civil and Environmental Engineering, Princeton University, Princeton, NJ, USA, soderbrg@princeton.edu (* presenting author)

²School of Civil and Environmental Engineering, University of New South Wales, Australia

Abstract

Soil evaporation can represent a significant loss of moisture from an ecosystem. As part of our research into evapotranspiration (ET) dynamics [1], we utilize continuous (1 Hz) measurements of water vapor isotopes to help partition ET into transpiration (T) from plants and evaporation (E) from the soil. This type of measurement is made possible through the recent development of portable, laser-based water vapor isotope analyzers. Defining the necessary isotopic endmembers is relatively straightforward in the case of δ_T using a chamber attached to leaves [2]. The δ_E isotopic signal is more difficult to characterize given that it involves both equilibrium and kinetic isotope fractionation. The liquid soil water isotope composition that gives rise to the δ_E signal can also be very heterogeneous in time and space. We have utilized both a modified Craig-Gordon (CG) modelling approach [3,4] as well as *in situ* measurement of soil water vapor isotopic composition. The CG model was designed to describe the evolution of isotopic composition during evaporation from open water, but is commonly applied to soil evaporation. We propose that soil water potential be used to adjust the normalized humidity parameter in this model, just as the activity of water is used to model evaporating brines. We present results from field measurements at our eddy covariance flux tower in central Kenya, as well as some laboratory data. The effect of this modification is variable, but appears to become significant with soil water potentials drier than around -10 MPa. The *in situ* measurements indicate that even shallow (5-10 cm) soil water vapor appears to be in isotopic equilibrium with adjacent liquid soil water. However, we are currently looking into the effects that soil matrix forces can have on equilibrium isotope fractionation factors.

- [1] Wang et al. (2010) *Geophysical Research Letters*. **37**, L09401
 [2] Wang et al. (2012) *Agricultural and Forest Meteorology*. **154-155**, 127-135.
 [3] Craig and Gordon (1965) *Stable isotopes in oceanographic studies and paleotemperatures*, pp. 9-130.
 [4] Horita (2008) *Isotopes in Environmental and Health Studies*, **44**, 23-49.

Stoichiometry of dissolved bioactive trace metals in the Indian Ocean

HUONG THI DIEU VU¹ AND YOSHIKI SOHRIN^{2*}

¹Institute for Chemical Research, Kyoto University, Uji, Japan, huong@inter3.kuicr.kyoto-u.ac.jp

²Institute for Chemical Research, Kyoto University, Uji, Japan, sohrin@scl.kyoto-u.ac.jp (* presenting author)

Introduction

GEOTRACES JAPAN has conducted a section study in the Indian Ocean during the KH-09-5 cruise of R/V Hakuho Maru from November 2009 to January 2010 (Fig. 1). Here we report the results on dissolved bioactive trace metals (Al, Mn, Fe, Co, Ni, Cu, Zn, Cd and Pb) in seawater. This is the first simultaneous distribution of the nine metals in the Indian Ocean.

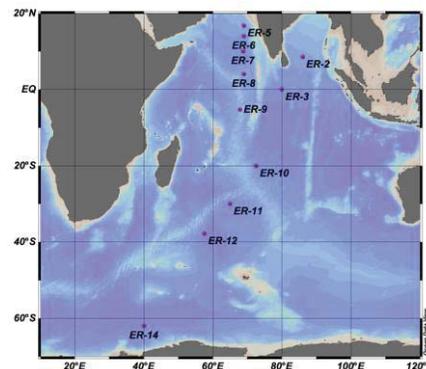


Figure 1: Sampling locations in the Indian Ocean

Methods

Seawater samples were collected using clean technique in accordance with the GEOTRACES protocol. The bioactive trace metals were preconcentrated by solid extraction using the NOBIAS CHELATE-PA1 chelating resin [1] and determined by HR-ICP-MS.

Results and Conclusion

The dissolved bioactive trace metals are divided into 3 groups: (1) scavenged-type for Al, Mn, Co and Pb, (2) nutrient-type for Ni, Cu, Zn and Cd, and (3) recycled and scavenged-type for Fe. The atmospheric dust deposition and horizontal advection cause elevated concentrations of DAl, DMn, DCo, DCu and DPb in the upper water column in the Arabian Sea and the Bay of Bengal. Manganese reduction and iron reduction occur in the Oxygen Minimum Zone resulting the increase of DMn, DCo and DFe. Mid-depth enrichment of DMn and DFe above the Central Indian Ridge is influenced by hydrothermal plumes. The distribution of DN_i, DCu, DZn and DCd is controlled by the biogeochemical cycle. Although DFe does not show a linear correlation with macronutrients and nutrient-type DMs, iron will be a co-limiting factor for phytoplankton production in most of the study area. The stoichiometry of DMs is generally comparable between deep waters in the northern Indian Ocean and the North Pacific Ocean, suggesting consistence of the mechanism controlling the behaviors of DMs between the Indian and Pacific Oceans.

- [1] Sohrin, et al. (2008) *Anal. Chem.* **80**, 6267-6273.