Isotopic Composition and sources of Organic Carbon Pools within the Tana River Basin, (Kenya).

Introduction

- Rivers play an important role in the global carbon cycle, and process ~1.9 Pg C annually (Cole et al., 2007). Rivers do not merely transport carbon from the terrestrial to the oceanic environment, but also bury and process organic matter, typically acting as a source of CO2 to the atmosphere (Cole and Caraco 2001; Mayorga et al., 2005).
- It is critical to understand carbon cycling both on a global and a watershed scale. However, there are few studies which quantify carbon fluxes in tropical rivers, and data for the African continent are particularly scarce.
- In this study, we report the altitudinal and seasonal patterns in carbon pools and their stable isotope compositions in Tana River Basin (Kenya).

Site and Methods

- The Tana River is the longest river system in Kenya (~1300 km), with a catchment area of ~130,000 km² (Kitheka et al., 2005).
- The main perennial source areas of the river are Mount Kenya (up to 5199 m asl), the Abadares ranges in the central highlands of Kenya, and the Nyambene Hills in eastern Kenya.
- The basin in general experiences a bimodal rainfall pattern: long rains between March and May and short rains between October and December.
- Data from field campaigns throughout the river basin are presented from three campaigns in February 2008 (Bouillon et al., 2009; dry-season), September to November 2009 (wet-season) and June-July 2010 (end-of-wet-season).
- Furthermore, monthly sampling was initiated in January 2009 at several locations in cattle reporting data up to March 2010 are presented here for 2 of the downstream sites (Garissa and Tana River Primate Reserve). Extensive flood plains are located between these 2 locations, flooding is irregular due to regulation of river flows by reservoirs upstream.
- The samples for total suspended matter (TSM) were filtered through pre-combusted and pre-weighted 5.0 µm Whatman GF/F filters, dried and re-weighted, while samples for POC and δ13C-POC were filtered on pre-combusted 25 mm Whatman GF/F filters, acidified, dried and packed in Ag cups. Soil and sediments samples were collected from all sampling sites, sub-samples ground, decarbonated and similarly packed in Ag cups. POC, δ13C-POC, soil and sediments were measured with standard techniques (EA-IRMS). DOC and δ13C-DOC samples were measured with a TOC analyzer coupled to a Thermo DeltaPlus IRMS.

Results & Discussion

Total suspended matter and particulate organic Carbon

- A consistent downstream increase in TSM was observed during all three sampling campaigns.
- TSM values were similar for the dry-season and end-of-wet-season datasets (p>0.05), but significantly higher during the wet-season campaign.

Seasonal variation in organic composition

- Figure 11 shows the discharge superimposed with δ13C-POC seasonality for the Tana River system.
- As expected, TSM and POC were highly episodic and highest in periods with high discharge along with TSM and POC maxima predicted peak discharge, particularly at TRPR station as observed previously by Kitheka et al. (2005). This suggests release of relatively mobile sediment during initial peak discharge.
- Seasonal patterns in 13C-POC signatures at both stations coincided closely, with 13C maxima during months in high discharge (23 to 21 ka), and decreasing towards predominantly C3 signatures toward the end of dry periods. This suggests that high sediment mobilization during rains occurs mostly in areas with significant grassland cover (C4).

Conclusions

- δ13C constrained from organic matter show C3 derived organic matter dominate the riverine DOC and POC pools.
- High POC/Chl a ratios suggest negligible contribution from in-stream phytoplankton production.
- TSM and POC delivery is episodic during peak discharge and mostly mobilized at intermediate altitudes.
- In the lower section of the Tana River, POC mainly originates from areas with a significant contribution by C4 plant species during high discharge, while during low discharge POC predominantly derived from C3 plant species.

References


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