Distribution of GDGTs in tropical sediments from Guadeloupe (French West Indies): implications for application of MBT/CBT and TEX_{86} proxies

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Glycerol dialkyl glycerol tetraethers (GDGTs) are lipids of high molecular weight present in membranes of Archaea and some bacteria. Archaeal membranes are composed predominantly of isoprenoid GDGTs, with acyclic or ring-containg biphytanyl chains. The amount of isoprenoid GDGTs with cyclopentyl moieties was shown to increase with water temperature and variations in surface water temperature can be determined via the TEX_{86} proxy. Recently, another type of GDGTs, with branched instead of isoprenoid alkyl chains, has been discovered in peat. Branched GDGTs were suggested to be produced in soils by still unknown bacteria. The degree of methylation of branched GDGTs, expressed in the MBT, was shown to depend on air temperature and to a lesser extent on soil pH, whereas the relative abundance of cyclopentyl rings of branched GDGTs, expressed in the CBT, was related to soil pH. The MBT/CBT proxies are increasingly used as paleoclimate proxies. The aim of this study was to investigate the distribution of GDGTs in tropical sediments from Guadeloupe (French West Indies). Surficial sediment samples were collected in four coastal water ponds: two located in Grande-Terre and two in a smaller island named La Désirade, 10 km east from Grande-Terre. GDGTs either present as core lipids (CLs; presumed of fossil origin) or derived from intact polar lipids (IPLs; markers for living cells) were analysed. Interestingly, the distribution of archaeal and bacterial GDGTs differed between the four sites, as shown by the higher values of the TEX_{86} and MBT in sediments from La Désirade than in those from Grande-Terre. These differences were also reflected in the TEX_{86}- and MBT/CBT-derived temperatures. Temperature estimates derived from GDGTs present in La Désirade sediments were consistent with temperature recorded in the area (annual air temperature 26 °C), whereas temperature estimates derived from Grande-Terre sediments were much lower than expected values. The variability in archaeal GDGT distribution between the four water ponds might be due to different archaeal communities between Grande-Terre and La Désirade. Bacterial GDGTs seem to be essentially derived from surrounding soils in La Désirade. In contrast, in Grande-Terre, a substantial proportion of bacterial GDGTs might be produced in the water pond in addition to being produced in surrounding soils, as revealed by the high relative abundance of bacterial IPLs vs. CLs downcore. Our results suggest that caution should be exercised when interpreting MBT/CBT-derived temperatures in aquatic environments, as they might be largely biased by in situ microbial production.

Weathering of voclanics and the geological carbon cycle

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Weathering and volcanic rocks

Weathering rates in granitic and cratonic terranes have been well studied, yet information on weathering in volcanic terranes remains sparse. Available data suggest that mafic – intermediate volcanic terranes play a disproportionately large role in the carbon cycle. They have high abundances of Ca and Mg silicates, the weathering of which results in much greater CO_2 consumption rates than the weathering of the alkali silicates typical of continental crust, which is an inefficient CO_2 sink. They also have mineralogy and texture that weather much faster than those typical of most cratonic terranes. Additionally, most active volcanic centers are associated with arcs and hotspots that are adjacent to oceans where marine moisture and orographic effects can lead to high runoff and erosion rates, and many of the active island arcs today are located in the wet tropics. All of these features suggest that weathering and CO_2 consumption rates of volcanics should be high. While there are relatively few published data from streams draining active arcs that permit estimation of CO2 consumption rates, there is growing evidence to support the hypothesis that arc weathering is an important CO2 sink [1, 2]

The contribution of arc terranes to global weathering budgets is poorly known in part because rivers in these settings tend to be small and have not been sampled systematically (or in most cases at all) for geochemical purposes. Unlike major continental regions, where a single large river can give information about a large fraction of both the continental surface and total runoff, island arcs are a type of "non-point source" problem. Many smaller streams deliver large loads per unit basin area, and the aggregate flux can be quite large, but no one stream samples a large region.

The srtontium isotope ratios of arc and hot spot weathering is low, reversing the common relationship beteen silicate weathreing and changes in seawater 87Sr/86Sr. Changes in the rates of arc weatheirng can be important drivers of the long term carbon cycle

[1] Rad et al. (2006) *J. Geochem. Exp* **88#**, 308-312. [2] Shopka et al. (2011) *Geochim. Cosmochim. Acta* **75**, 978-1002.