

Investigating OH-GDGTs and GMGTs in lacustrine sediments and potential relationships to environmental conditions

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Abstract:

Numerous temperature and environmental proxies are based on glycerol dialkyl glycerol tetraethers (GDGTs), which are membrane lipids commonly found in the water columns and sediments of lakes. The TEX86 temperature proxy is based on isoprenoid GDGTs, which are produced by members of the archaea, and is used to reconstruct lake surface temperature. Branched GDGTs are lipids produced by bacteria and form the basis of the MBT'5ME temperature proxy. Although many outstanding questions still exist regarding proxies based on isoprenoid and branched GDGTs, both compound classes have been relatively well-studied in lakes. More recently, other types of GDGTs and related compounds are increasingly being reported from lacustrine sediments including hydroxylated GDGTs (OH-GDGTs) and glycerol monoalkyl glycerol tetraethers (GMGTs). In the process of generating lacustrine TEX86 or MBT'5ME temperature records, we noted that OH-GDGTs or GMGTs (or both) are frequently present. The RI-OH, based on OH-GDGTs, recently has been proposed as a temperature proxy in lakes while GMGTs are associated with oxygen-deficient environments. Here we examine distributions of OH-GDGTs and GMGTs in a variety of lakes that also have existing TEX86 or MBT'5ME temperature reconstructions. These lakes range from small to large, shallow to deep, tropical to arctic, differ in oxygenation state, and have sedimentary records covering timespans from the Holocene to multiple glacial-interglacial cycles. Study lakes include El'gygytgyn (arctic Russia), Malawi (tropical southeast Africa), Issyk Kul (Kyrgyzstan), Lake 578 (Greenland), and high elevation lakes in the central Andes (South America). We explore the presence/absence of these compounds in contrasting depositional environments and examine their GDGT distributions in relationship to temperature variability, oxic/anoxic conditions, hydroclimate fluctuations, and other geochemical/environmental parameters.

Plain-Language Summary:

Tetraether membrane lipids of archaea and bacteria are commonly found in lake sediments and are useful for recording past environmental conditions such as temperature changes. Thus far two major groups of tetraether lipids have been studied in lake sediments. This study investigates two related, and more recently identified, groups of tetraether lipids in lake sediments to see if changes in their distributions are related to environmental conditions such as temperature, changes in lake level, or changes in lake water oxygen content.