# Unraveling the microbialite web: Formation and diagenesis of laminated and massive carbonate sediments in saline lakes of North America and Australia

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Organo-sedimentary structures in saline lakes are an excellent archive of changes in environmental conditions of the basin and catchment. By examining variations in mineralogy and composition, important inferences can be made about brine composition, climatic conditions in the drainage basin, and the nature of sedimentary processes. Shallow water microbialites in saline lakes can take a variety of forms and occur in response to many different physical, chemical and biological processes. There has been much debate about the fundamental mechanisms by which the carbonate structures are forming and even whether or not there is biogenic mediation involved. Most microbialite research has been carried out in marine and marginal marine settings. Despite noteworthy occurrences in both modern and ancient lake settings, surprisingly little microbialite research has been carried out in continental lacustrine environments.

Modern and Holocene microbialites occur in a variety of lakes in North America and Australia. The lakes in this study have been selected to represent a spectrum of hydrologic, climatic and geolimnological characteristics under which microbialites are forming. The structures in these lakes show variations in internal and external morphology, as well as mineralogy. The range of conditions permits a detailed evaluation of the processes of carbonate microbialite formation. Petrography and geochemistry of the microbialites have potential to reveal a complex interaction of both primary and bio-induced precipitation of minerals. Furthermore, examination of the laminated structures allows for the development of a proxy for changes in the local environmental conditions over time. For example, Manito Lake, a large permanent, hypersaline lake located in the northern Great Plains of western Canada, contains microbialites of varying composition and morphology. Detailed isotopic and mineralogical analyses of these structures reveal a complex history of hydrologic and environmental change over the past 2000 years.

# Simulating regional climatic effects of atmospheric aerosols

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Atmospheric aerosols can affect climate through direct radiative forcing of solar and infrared radiation (direct effects) and through their effeects on cloud microphysics and the thermal structure of the atmosphere (indirect effects). Because of the particles' relatively short atmospheric residence time, the distribution of tropospehric aerosols of both natural and anthropogenic origin varies substantially at the regional scale. This implies that their climatic effects are also particularly important at regional to local scales. For this reason, regional climate models (RCMs) can be particularly useful tools to study the regional climatic impacts of tropospheric aerosols. During the last several years a simplified but comprehensive aerosol module has been interactively coupled to the ICTP regional climate model RegCM to produce the currently most advanced coupled RCM/aerosol model system available in the literature. This aerosol module presently includes sulfate, organic and black carbon (OC and BC), desert dust and sea salt. Aerosol processes such as source, trasport, dry and wet removal and radiative forcing (both short and long wave) are described in the model specifically for application to long term climate simulation. A simple description of indirect effects on cloud albedo can also optionally be activated. The coupled regional climate/aerosol model has already been used for a number of applications, such as the study of anthropogenic aerosol effects on the East Asia and South Asia climate, the impact of desert dust, OC and BC on the African monsoon, the carbon aerosol effects on the climate of Amazonia. In all cases it is found that the aerosol forcing can significantly affect regional climates, sometimes even more than greenhouse gas forcing and in some cases consistenly with observed climatic trends. This paper first describes the basic structure of the aerosol module and its coupling with the RegCM. Examples of application to the study of aerosol effects in different domains (Europe-Africa, Asia and South America) are then given. Our results point to the importance of including aerosol effects in simulations of climatic changes due to anthropogenic forcings.