Microbial life in alkaline environments on Earth and the potential for life on other planets

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The concept of life on the Earth and the potential for life on other planets is an exciting field of research and growing steadily. The conditions on the early Earth are continually debated. Particularly regarding which environments early life thrived in, on this planet, and in addition what potential there is for life on other planets, such as Mars.

The model of an alkaline, "Soda Ocean", containing $NaCO_3$ and a high pH, having been present on the early Earth is one theory for the oceans at this time [1]. With this in mind, modern alkaline lakes and springs can be considered analogues of these past milieu, and therefore excellent places to characterise the microbial biota. In addition the discovery of carbonate deposits and smectite clays on the surface of Mars may indicate that alkaline conditions were present during a period in the planets history [2].

Lakes Natron and Magadi of East Africa are bodies of water with high pH and salinity, fed by warm alkaline springs which vary in their temperature from 32°C to 52°C [3]. Samples from the springs and the lakes themselves will provide information on the biota. Characterisation of the microbes living in these conditions can be done with 16s rDNA analysis and microbial culturing techniques. Sediment cores to ~1m depth will provide samples of organisms that occupy depths in the shore muds. Questions such as how they preserved and what biosignatures they leave behind will be explored. This will assist with identifying organisms which were present in other similar sediments, when living material has decayed. It is also important to ensure that if there are sediments similar to those present on Mars, then rovers looking for evidence of life are capable of identifying deposits from alkaline environments.

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Modeling organic aerosols during MILAGRO: importance of biogenic secondary organic aerosols

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The meso-scale chemistry-transport model CHIMERE is used to investigate major sources and formation processes leading to a fairly large amount of organic aerosols (OA, including primary OA (POA) and secondary OA (SOA)) observed in Mexico City during the MILAGRO field project (March 2006). Comparison of near-surface model predictions with aerosol mass spectrometer data shows that predicted OA correlates reasonably well with measurements during the campaign, however it remains a factor of 2 lower than the measured total OA. Very good agreement is found between observed and predicted POA within the city indicating that primary anthropogenic and biomass burning emissions are reasonably captured. Consistent with previous studies in Mexico City, large discrepancies are encountered for SOA species, with a factor of 5-10 model underestimate. When only anthropogenic SOA precursors were considered, the model was able to reproduce within a factor of two the sharp increase in SOA concentrations during the late morning at both urban and near-urban locations. However, predicted SOA concentrations were unrealistically low when photochemistry was not active, especially overnight. These discrepancies were not significantly reduced when greatly enhanced partitioning to the aerosol phase was assumed. Model sensitivity results suggest that observed night-time SOA concentrations are dominated by the regional background (~2$\mu g/m^3$) from biogenic origin which is transported from the coastal regions into the Mexico City basin. The relative contribution of biogenic SOA to monthly mean SOA levels was estimated to over 20% within the city and up to 65-90% at the regional scale which is consistent with measurements of modern carbon during low biomass burning periods. Our results confirm the large underestimation of the SOA mass by traditional models in polluted regions, and emphasize for the first time the key role of biogenics in this region. Significance of newly proposed SOA formation pathways (i.e. night-time oxidation of isoprene, POA volaitilty) is also investigated in this study.