Megadroughts at the dawn of Islam recorded in a stalagmite from Northern Oman

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To date, the late Holocene climatic history of Oman and the entire Arabian Peninsula is poorly understood due to the lack of well dated and highly resolved paleoclimate records. In order to fill this gap of knowledge an actively growing stalagmite (specimen H12) was collected from Hoti Cave located in northern Oman. Total annual rainfall in this area varies between 50 and 255 mm yr^{-1}, with more than 65% of total annual rainfall occurring between December and March. The chronology of stalagmite H12 is based on 24 Th-U ages, which indicate that H12 grew continuously during the last 2650 years. The H12 oxygen isotope record ($\delta^{18}O$) is based on 1345 measurements corresponding to a temporal resolution of around 2 years. The comparison of the H12 $\delta^{18}O$ record with meteorological data reveals that $\delta^{18}O$ values reflect the amount of precipitation.

The H12 $\delta^{18}O$ time series shows distinct centennial- to decadal-scale changes in the amount of precipitation. The most striking feature of the H12 isotope profile is a series of severe droughts between A.D. 500 and A.D. 1000, the most severe perennial drought is centred at around A.D. 530. During this time South Arabia experienced a series of profound societal changes, such as the collapse of the Himyarite Kingdom which was the dominant state in Arabia. Our stalagmite $\delta^{18}O$ time series from Northern Oman seems to support the hypothesis that the collapse of the 1500-year-old South Arabian civilizations and transition from the pre-Islamic to the Islamic era in the 6th and early 7th century A.D. may have been triggered by reoccurring severe droughts.

The role of siderophores and biofilm formation in phosphate acquisition and Pb release from pyromorphite by *Pseudomonas mendocina* bacterium

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The phosphate-ammendment immobilization is recommended to be one Best Management Practice (BMP) to treat Pb contaminated soils. (USEPA, 2005). In this method the highly insoluble mineral pyromorphite (PY), $Pb_5(PO_4)_3Cl$ is formed. Despite the extreme insolubility of pyromorphite ($logK_{sp}$=-79.6), Pb has remained unexpectedly mobile at a number of remediated soils (SERDP 2008). The activity of the soil oragnisms is a potential cause of the secondary excesive pyromorphite dissolution and several mechanism that can play a role were identified.

In order to investigate the role of siderophores and biofilm formation by soil bacteria in Pb and P release from PY, two sets of the batch microbial growth experiments were carried out: 1 – bacteria were grown in a direct contact with the mineral surface; 2 – the access to mineral surface was limited to the bacteria by a use of dialyse membrane. In both experiments, the siderophore-producing *P. mendocina* bacterium and an engineered mutant of the species incapable of producing and releasing siderophores were used. P was the limiting nutrient and the synthesized crystals of pyromorphite were the sole source of phosphates in the experimental media. Both, the siderophore-producing wild type and the mutant were able to obtain P from PY. However, the association or attachment of the bacteria to the mineral surface appeared to be important for P acquisition. The OD of the bacterial suspension was two times lower when the microbial – mineral contact was limited. Pb release from PY was substantially greater in the presence of the siderophore-producing wild type than the siderophore(-) mutant and when the bacteria were capable to attach to the PY surface. This substantiates the role of siderophores and biofilm formation by bacteria in Pb remobilization from PY.

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