Availability of light and chemical energy determines the structure of natural sulfide oxidizing biofilms

JUDITH KLATT[1]*, STEFFI MEYER, DIRK DE BEER[1] AND LUBOS POLERECKY[1]

[1]Max-Planck-Institute for Marine Microbiology, Bremen, Germany (*correspondence: jklatt@mpi-bremen.de)

In the Frasassi cave system, Italy, sulfidic streams and pools are colonized by aerobic chemolithoautotrophic biofilms. Upon emergence of this water from the caves, light becomes available and gives rise to biofilms that are additionally inhabited by highly abundant phototrophic microorganisms. The structure of these biofilms varies between two end-members, one characterized by a cyanobacterial layer on top of a distinct *Beggiatoa* layer (C/B biofilms) and the other one by an inverted structure (B/C biofilms). We used microsensors to study how this structure depends on the availability of light and chemical energy.

C/B biofilms form where the availability of oxygen, and thus of chemical energy, from the water-column is limited (<5 μM). Aerobic chemolithotrophic activity in the *Beggiatoa* layer depends entirely on the supply of oxygen from the cyanobacteria, which occurs at high incident light intensities. Therefore, light is the energy source that drives the community and the main factor that regulates the spatial organization of its dominant functional groups. In B/C biofilms, which occur at locations where oxygen in the water column is comparatively abundant (>45 μM) and continuously present, *Beggiatoa* are independent of the photosynthetic production of oxygen and outcompete the cyanobacteria in the uppermost layer of the biofilm (i.e., closest to one of the energy sources). The proliferation of cyanobacteria in these biofilms seems to be disadvantaged by the extensive interval of darkness during night and by high back scattering of light in the *Beggiatoa* layer during the day. Therefore, although the daily flux of light energy to the biofilm is much greater than the daily flux of chemical energy derived from the oxidation of sulfide with oxygen, light is only peripherally utilized. Instead, the continuity of the input of chemical energy appears to be a more important factor determining the community structure and its dominant functional traits. Our study thereby introduces a scenario, where apparent uncoupling of phototrophic and aerobic chemolithotrophic activity leads to outcompetition of photosynthetic microbes even in the presence of light showing that both microbial interactions and available thermodynamic energy must be considered to understand the biogeochemical cycling.

Spational and temporal variation in provenance of Eastern Mediterranean sediment: Implications for Aegean volcanism

M. KLAVER*, T.T. DJULY AND P.Z. VROON

VU University Amsterdam, De Boelelaan 1085, 1081HV Amsterdam, The Netherlands (*correspondence: martijn.klaver@vu.nl)

Subducted sediment is one of the principal geochemical components of island arc magmas. Along-arc variation in subducting sediment composition is reflected in geochemical trends in the arc volcanics [e.g. 1]. The predominantly Quaternary Aegean volcanic arc is the result of northward subduction of the African plate underneath the Aegean microplate. East-west geochemical variation in Aegean arc volcanics has often been related to differences in subducted sediment composition in the Eastern Mediterranean Sea (EMS) resulting from contrasting source regions.

Recent studies [2,3,4] investigating the provenance of EMS sediment suggest mixing between Sahara dust (old, felsic) and Nile sediment (young, mafic). These studies however, lack a spational and temporal framework as they focus exclusively on Quaternary deposits while the subducted sediment underneath the Aegean arc is Pliocene to Mesozoic in age. We present an extensive new geochemical dataset of EMS sediment samples obtained from DSDP and ODP drill cores along the Aegean arc from Quaternary to middle Miocene age.

The new dataset, in conjunction with previously published results, allows us to accurately trace the along-arc temporal variation of EMS sediment provenance. In line with previous results, we conclude that Quaternary EMS is a mix of Nile sediment, Sahara dust and autogenic carbonate or evaporite components. A clear along-arc trend in principal component can be observed, and the geochemical composition of subducting sediment is highly variable. However, in the Plio- to Miocene, the Nile component appears to be dominant in the entire EMS, leading to much less pronounced geochemical variation of subducted sediment along the Aegean arc. Hence, the assumption that east-west geochemical trends in Aegean arc volcanics are due to differences in subducted EMS sediment composition, may be unjustified.

[1] White & Dupré (1986) *JGR* **91**, 5927-5941. [2] Weldeab *et al*. (2001) *Chem. Geol.* **186**, 139-149. [3] Revel *et al*. (2010) *Quat. Sci. Rev.* **29**, 1342-1362. [4] Padoan *et al*. (2011) *GCA* **75**, 3627-3644.

DOI:10.1180/minmag.2013.077.5.11