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Preliminary data on bacterial diversity in iron-depositing host springs: implication for Precambrian iron deposition

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The study of bacteria in iron-depositing hot springs (IDHS) has application to understanding of the evolutionary history of Earth (Trouwborst et al., 2007) and probably Mars (Brown et al., 2007). The mechanism(s) of the generation of Bonded Iron Formations (BIF) is still an enigma in paleogeo(bio)logy. Although both abiotic and biotic mechanisms of BIFs generation are being under consideration, microbially mediated mechanisms of BIFs generation seem to be more intriguing because the process of the BIF generation has definitely been linked to revolutionary changes in the development of life on Earth, in particular to the appearance of oxygenic photosynthesis (Olson and Blankenship, 2004).

Some authors propose that a strong decrease of environmental ferrous iron during the late Precambrian era is connected with the efficient oxidation of iron by anoxygenic phototrophic organisms (Ehrenreich and Widdel, 1994; Konhouser, et al., 2002; Konhauser, 2004; Croal, et al., 2004; Kappler et al., 2005a), although possible contribution of oxygenic phototrophs is also appreciated (Stal, 2000; Trouwborst et al., 2007). The last team came to this conclusion studying Fe^{2+} oxidation in an IDHS in connection with the photosynthetic activity of a natural cyanobacterial mat. A recent discovery of a new anoxygenic taxon in thermal springs (i.e., name of the taxon; Bryant et al., 2007) posed a question whether we sufficiently understand the bacterial diversity in cyanobacterial mats occupying IDHS as well as the mat potential to oxidize Fe^{2+}

enzymatically.

Here, we report preliminary data on a culture-independent analysis of the bacterial diversity in a deposition column sampled at the 44.6^{o}C zone in the main mouth of Chocolate Pots (Yellowstone National Park, MT). This temperature region has been selected because the cyanobacterial community in this temperature area was more diverse than at temperatures around 55^{o}C found within the Chocolate Pots spring (Pierson and Parenteau, 2000).

We found that the photosynthetic community of the cyanobacterial mat in our study contains the Chlorobia and Chloroflexales groups, well-known oxidizers of ferric iron (Heising et al., 1999; Johston, 2005), and almost lack alfa- and gamma-proteobacteria, which were chosen by Kappler at al. (2002) to model Precambrian oxidation of biotic ferrous iron. *Candidatus Chloroacidobactrium thermophilus*, likely involved in ferrous iron oxidation, was also found within this community.

Obtained results led us to a conclusion that the studies of biotic mechanism(s) of BIFs generation should be carried out for all inhabitants of phototrophic mats in IDHS. The second conclusion is that obtained results are not in a conflict with speculations about the involvement of potentially anoxigenic proteocyanobacteria in BIFs generation, since they diverged from other bacterial lineages at same time as anoxigenic Chlorobi (Bryant, 2008). However, the lack of photosynthetic alfa- and gamma proteobacteria may lessen an importance of current assumption about their exclusive role for BIFs generation (Kappler et al., 2004).