Extracellular electron transport by the Gram-positive species *Thermincola potens*

K. WRIGHTON[1], H. CARLSON, R. MELNYK[1], K. BYRNE-BAILEY[1], J. THRASH[1], J. BIGI[2,3], J. REMIS[4], D. SCHICHNES[5], M. AUER[4], C. CHANG [2,3] AND J. COATES[1]*

[1]Department of Plant and Microbial Biology, University of California, Berkeley CA (*correspondance: jdcoates@berkeley.edu)
[2]Department of Chemistry, University of California, Berkeley
[3]Howard Hughes Medical Institute, University of California, Berkeley
[4]Life Sciences Division, Lawrence Berkeley National Laboratory
[5]College of Natural Resources Biological Imaging Facility, University of California, Berkeley

Despite their importance in iron redox cycles and bioenergy production, the underlying physiological, biochemical, and genetic mechanisms of extracellular electron transfer by Gram-positive bacteria remain insufficiently understood. We investigated respiration by *Thermincola potens* strain JR of the insoluble electron acceptors Fe(III) oxyhydroxide and anode surface. This isolate, a member of the Firmicutes, was obtained from the anode surface of a microbial fuel cell [1]. We found no evidence for soluble redox-active components secreted into the surrounding medium based on cyclic voltammetry measurements in conjunction with medium replacement experiments. Confocal microscopy revealed highly stratified biofilms in which cells contacting the electrode surface were disproportionately viable relative to the rest of the biofilm. There was also no correlation between biofilm thickness and power production, suggesting cells in contact with the electrode were primarily responsible for current generation. These data, along with cryo-electron microscopy experiments, support contact-dependent electron transfer by *T. potens* strain JR from the cell membrane across the 37 nm cell envelope to the cell surface. Furthermore, we present physiological and genomic evidence that direct extracellular electron transfer is mediated by *c*-type cytochromes. Taken together, our findings provide the first evidence to implicate direct extracellular electron transfer by Gram-positive bacteria and identify *c*-type cytochromes as a potential molecular conduit for charge transport.

[1]. Wrighton, K.C., Agbo, P., Warnecke, F., Weber, K.A., Brodie, E.L., DeSantis, T.Z., Hugenholtz, P., Andersen, G.L., & Coates, J.D. (2008). *ISME Journal* **2**, 1146-1156.

Fluid inclusion study of Haojiahe sandstone-type copper deposit, Yunnan province, China

HAI-ZHI WU, RUN-SHENG HAN AND PENG WU

Kunming University of Science and Technology, Southwest Institute of Geological Survey, Geological Survey Center for Non-ferrous Mineral Resources, Kunming, 650093, China (*correspondence: haizhiwu664@yahoo.com.cn)

Haojiahe sandstone-type copper deposit is located in the Chuxiong red bed basin, Yunnan province, China. Two dominant stages of fluid, rock-forming period and reworked mineralization period, are recorded in the gangue minerals of different types of ore.

The rock-forming period of fluid inclusions, mainly aqueous inclusions, can be observed in calcite and quartz cement and secondary enlargement of quartz in disseminated and lamellar ores. The homogenization temperatures range from 84.1 to 162.3ºC, with peak values between 122 and 146℃; and the salinities are from 3.3 to 14wt%$NaCl_{eq}$, with peak values between 5.5 and 7.5wt%$NaCl_{eq}$. The analytic results got by Laser Raman Spectroscopy, show that the gas components were mainly H_2O, SO_2 and CO_2, suggesting a relative oxidizing environment.

The reworked mineralization period of fluid inclusions, including aqueous inclusions and some hydrocarbon inclusions, can be observed in quartz paragenetic with copper minerals in banding or vein ores. The homogenization temperatures range from 145.5 to 227.2℃, with peak values between 170 and 200℃; and the salinities are from 4.5 to 15.2wt% $NaCl_{eq}$, with peak values between 7 and 9.5wt%$NaCl_{eq}$. The gas components were H_2O, CH_4, C_2H_6, CO and CO_2, suggesting a relative reducing environment.

Results of this study show the fluid evolution have experienced increased temperature, increased salinity and a environmental change from oxidizing to reducing.

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