Statistical tests

In order to determine whether statistical differences existed between the various experimental treatments, the coupon surface was examined with two approaches: (1) the number of pits per coupon, and (2) the depth of the corrosion, relative to a coupon's surface.

*Pit Count* Incubations were grouped in categories according to end product production. These categories included: sulfide only, sulfide and acetate, acetate only, methane, and uninoculated media controls. The categories were then assessed by plotting the number of pits versus the instantaneous corrosion rates for each of the individual microbial incubations (Figure 6A), and then compared to the uninoculated media controls (Figure 6B). The results suggested that when sulfide and acetate were produced as end products, corrosion was elevated relative to other microbial incubations as well as to the media controls (Figure 6). To further elucidate these differences, the mean distribution of surface points between the different categories were compared (Table S2). The variance between the means was determined to be heteroscedastic (Bartlett test of homogeneity *K2*(4) = 33.14, *p*=1.118e-06; Kruskal-Wallis rank sum test *χ2*(4) = 12.8924, *p*=0.01), and the subsequent two-tailed, *t* test analyses revealed that the only significant difference observed was between incubations producing sulfide and acetate as end products and the media controls (*p=*0.043; Table S2).

*Degredation Depth* The *depth* of each profilometer point was introduced in the second anaylsis. Figure 7 displays 63 histograms of degredation (*i.e.*, one histogram for each coupon), separated into the 5 treatment groups. {¿Chris, have you written anything that identifies & justifies the five omitted coupons? If not, consider justifying them in this paragraph.} The histograms are rotated clockwise, corresponding to the profilometer’s convention. A coupon that is concentratrated near the top of a panel (*e.g.*, 5 µM) indicates less degredation than a coupon concentrated closer to the bottom (*e.g.,* -20 µM). A value of 0 µM represents the highest point on the coupon’s surface. The histograms are skewed down, indicating that the depth of the (numerous) pits are greater than the height of the (infrequent) peaks.

A small notch on the right side marks the observed mean of each *coupon*. A diamond and error bar marks the modeled mean and standard error of each *treatment*. The Sulfide+Acetate group is the only treatment that degraded significantly more than the Control group; its mean degredation was 2.2 µM deeper than the Control group (*p* = .016).

Treatment means were estimated by a Bayesian multilevel model that accounted for the dependencies among the 2,501 points on the same coupon. Using the MCMCglmm package (Hadfield, 2010) and vauge priors, eight parallel MCMC chains were run for 10,000 iterations after burn-in; the largest was less than 1.001. The error bars mark the 16% and 84% percentiles of each treatment’s posterior distribution, which corresponds to the asympototic 68% coverage of a ±1 standard error band, but is allows to be asymmetric. Our primary model produced point and error estimates consistent with a frequentist multilevel model (using the lme4 package; Bates, 2010) and with a frequentist ANOVA (that considered only the mean of each coupon). To facilitate reproducibility, the code and profilometry data are available at <https://github.com/LiveOak/LylesCarbonSteelCorrosion>.

Jarrod D Hadfield (2010). MCMC Methods for Multi-Response Generalized Linear Mixed Models: The MCMCglmm R Package. Journal of Statistical Software, 33(2), 1-22. URL <http://www.jstatsoft.org/v33/i02/>.

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