Stopping bio-souring at the source: Identifying specific inhibitors of microbial sulfate reduction

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The oil and gas industry is the the world's leading producer of the toxic and corrosive contaminant, hydrogen sulfide. Some sulfide is thermochemically generated through geological processes, but much is biological in origin and its production can be prevented with appropriate specific inhibitors of microbial sulfate reduction. Despite decades of study, only a few compounds have been identified as potent and specific inhibitors of microbial sulfate reduction, including the sulfate analogs molybdate, selenate and nitrate. However, depending on the context of their use, such "sulfate analogs" may not be specific inhibitors, may be toxic to other organisms, or may be consumed by other microbial respiratory processes. Non-toxic and more potent treatments are needed. We have developed a general high-throughput screening strategy to identify potent and specific inhibitors of respiratory sulfate reduction, and have used this strategy to evaluate candidate inhibitors and to screen libraries of small molecules. Through our screens, we have identified several sulfate reduction specific inhibitors, and have characterized the mechanism of inhibition of these compounds in a model sulfate reducing microorganism. We have also evaluated potential synergistic and antagonistic interactions between inhibitors. Our findings will provide useful tools for ecological studies, and will lead to new treatments to inhibit sulfate reduction in industrial ecosystems.