Iron, the fourth most abundant element in the earth’s crust, is essential for the growth of almost all microorganisms. For bacteria and other microorganisms that exist on land, iron uptake is not a problem. For marine bacteria, however, iron acquisition is severely hindered by the low levels of iron in the oceans (0.02 -- 1 nM). Fe(III) is highly insoluble, and most of the iron that is dissolved is already complexed to organic compounds. In order to bring iron into their cells, marine bacteria make use of compounds called siderophores, and corresponding receptor proteins. Siderophores are relatively small organic compounds that have a high affinity and selectivity for chelating iron. The receptor proteins recognize these siderophore-Fe(III) complexes and allow them to pass into the cell. Both the siderophores and the receptor proteins are produced by the bacteria when surrounding iron levels are low. At higher iron levels, siderophores and receptor proteins are not needed, and are therefore not produced. Because Fe(III) is so important for bacteria, the regulation and production of siderophores is essential for bacterial survival.

Over the course of the summer, I investigated marine bacteria from the suboxic zone of the Black Sea. After growing these bacteria, I determined which samples had produced siderophores, and isolated these important compounds using a combination of silica-gel columns and HPLC. After isolation, I performed electro-spray ionization time-of-flight mass spectrometry (esi-TOF MS) on these compounds. In each case, the fragmentation pattern was similar to that of a known siderophore, Desferrioxamine G, as seen below. The testing was inconclusive, and further tests such as more MS, tandem MS, and NMR, would be needed in order to yield more definite results.

As I begin my graduate work in chemistry at the University of California, Santa Barbara, the work that I have done this summer will serve as an invaluable stepping stone. Previously, I had little practical biochemistry experience. Now, I find myself familiar with a number of biochemistry techniques, as well as with this particular system. I cannot be sure of where the next several years will take me. I do know, however, that this summer has opened my eyes to more options and experiences that will help me make better decisions and do better research during my graduate studies.

Desferrioxamine G, one of many known siderophores