The role of reversibility and S intermediates in the S metabolism

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Microbial metabolisms that use sulfur compounds as electron donors and acceptors have been shown to have a finite proportion of reverse flow. The proportion of reverse flow from intermediate S metabolites is critical for moderating the expression of isotope fractionations at the cellular level. The metabolic machinery for S metabolisms incorporate numerous steps where forward and reverse mass transfer may occur. The ensemble of steps, each with differential potential for forward and reverse material flows, determine the magnitude of the cellular level isotope fractionation. Isotopic information of various types has placed constraints on proportions of forward and reverse flow for some steps in some types of S metabolism and to place constraints on the cellular level controls on the metabolism of S compounds. Since reversibility moderates mass transfer in other metabolisms, findings made for S metabolism are also relevant for understanding other isotope systems (carbon, hydrogen, chlorine, nitrogen, & clumped isotopes).

This presentation will focus on evaluating the isotopic information from various experiments and other considerations, seeking to evaluate the role of reversability at various steps in microbial metabolism of S reducers and other S metabolisms. One question that we will explore is the role of the channel in the dissimilatory sulfite reductase (DsrAB) complex when viewed as a volume containing S(IV) with a distinct isotopic composition which can mute expression of fractionation, as well as the role of the active site as a potential site for reaction reversibility which can have the opposite effect. We suggest that evidence for asserting the operation of both processes is seen, particularaly in light of minor isotope observations. We will also examine the role sulfur intermediate protonation plays in determinig the magnitude of fractionations.