Here, we report on the kinetics and mechanisms associated with redox regulation of the protein tyrosine phosphatase PTP1B. We determined rates of thiol- and phosphine-mediated recovery of catalytic activity from the oxidatively-inactivated enzyme, and shed light on the chemical mechanisms involved in these processes and in the regulation of PTP family member SHP2. Additionally, we describe reactions that oxidatively-inactivated PTP1B undergo with structurally-diverse carbon acids, using both a small chemical model dipeptide of oxidatively-inactivated PTP1B, and the oxidized enzyme itself. Finally, we report a novel method by which to predict Hammett substituent constants via electronic structure calculations.