Serial crystallography, obtaining structures from many crystals

MS08-1-6 Iron binding and photoreduction in the ABC transporter subunit FutA
#MS08-1-6

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Abstract
Oceanic primary production by marine cyanobacteria is a main contributor to carbon and nitrogen fixation on earth. Prochlorococcus is the most abundant photosynthetic organism on Earth, responsible for a comparable carbon fixation to the net global primary production from agriculture. The ecological success is rooted in genome reduction and ability to thrive in nutrient depleted waters. The single FutA protein in Prochlorococcus has a function in iron uptake through as a periplasmatic binding protein to the specialised ABC where it would bind iron in the ferric state (Fe³⁺). However, in the cytosol FutA proteins are known to bind ferrous iron (Fe²⁺).

Studies of metal binding proteins are hampered by X-ray induced photoreduction, in this case leading to conversion from the ferric to the ferrous oxidation state. We used serial femtosecond crystallography (SFX) and neutron diffraction to obtain crystallographic structures of the oxidised state, revealing penta-fold coordination of the metal. X-ray induced photoreduction using rotation methods and serial synchrotron dose series (SSX) then gave access to the reduced ferrous state. Structural changes were mapped at room temperature several dose points up to 110 kGy before global radiation damage becomes too severe, defining the sweet spot of such analyses in this case.

References
