Crystal structure of particulate methane monooxygenase (pMMO), Nature's predominant methane oxidation catalyst

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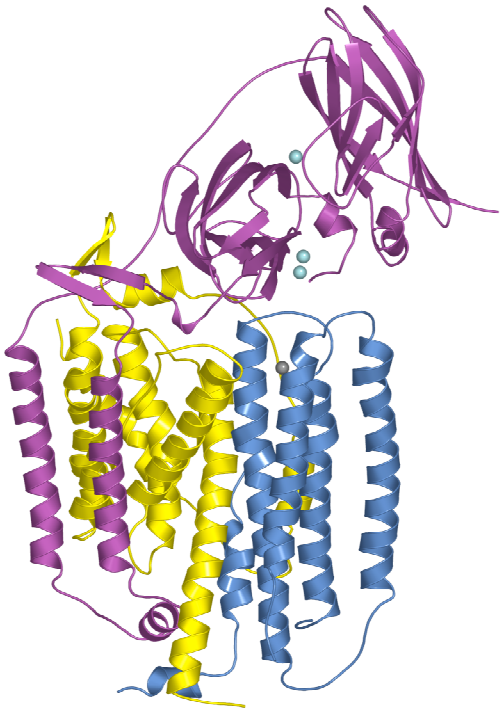
Particulate methane monooxygenase (pMMO) is a three-subunit integral membrane metalloenzyme that converts methane to methanol under ambient conditions. Although pMMO is the predominant methane oxidation catalyst in nature, it has proved difficult to isolate, and the literature addressing details of its structure and active site composition has been mired in controversy for longer than a decade. Knowledge of how pMMO activates the inert methane C-H bond is of fundamental chemical interest, and could lead to development of new synthetic catalysts that could impact the use of methane (natural gas) as an alternative energy source.

We have determined the structure of pMMO from the methanotroph *Methylococcus capsulatus* (Bath) to 2.8 Å resolution. The enzyme is a 300 kDa trimer with an $\alpha_3\beta_3\gamma_3$ polypeptide arrangement. Two metal centers, modeled as mononuclear copper and dinuclear copper, are located in soluble regions of each pmoB subunit, which resembles cyochrome *c* oxidase subunit II. A third metal center, occupied by zinc in the crystal, is located within the membrane. Direct electron transfer between the metal centers is possible. The structure provides significant new insight into the molecular details of biological methane oxidation and lays the foundation for future directed biochemical and mechanistic studies of pMMO.



The pMMO protomer