DATE: Day 23 Month 06 Year 2018

SUMMARY of
2017 RESEARCH RESULTS REPORT
For International Collaborative Research with IPR, Osaka University

Research Title		Crystal structure of fumarate reductase from *Desulfovibrio gigas*
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Summary

Desufovibrio gigas (*D. gigas*), an anaerobic sulfate-reducing bacteria (SRB) with versatile anaerobic respiratory mechanisms, requires specific enzymes to mediate the anaerobic respiratory processes that catalyze the sequential reduction reactions to obtain energy. The terminal electron acceptors in these reactions are moderate oxidants, such as sulfate, sulfite, other sulphur compounds, and fumarate, rather than the strong oxidants, e.g. dioxygen, utilized in aerobic respiration. One of these crucial enzymes is quinol:fumarate reductase (QFR), which is an integral membrane protein with three subunits: a flavoprotein (subunit A), an iron-sulphur protein (subunit B), and a membrane-embedded subunit (subunit C). QFR catalyzes the coupled reduction of fumarate to succinate with the oxidation of hydroquinone (quinol) to quinone on opposite sides of the inner cytoplasmic membrane. The reverse reaction, namely, the coupled oxidation of succinate to fumarate with the reduction of quinone to quinol, is catalyzed by well-studied succinate:quinone reductase (SQR), often referred to as complex II in the respiratory electron-transport chain of aerobic organisms.

We have successfully determined the crystal structure of QFR from the anaerobic sulfate-reducing bacterium *D. gigas* at 3.6 Å resolution. The structure of the *D. gigas* QFR is a homo-dimer, each protomer comprising two hydrophilic subunits, A and B, and one transmembrane subunit C, together with six redox cofactors including two *b*-hemes. One menaquinone molecule is bound near heme b_L in the hydrophobic subunit C. The observed bound menaquinone might serve as an additional redox cofactor to mediate the proton-coupled electron transport across the membrane. According to these structural insights, we propose electron/proton-transfer pathways in the quinol reduction of fumarate to succinate in the *D. gigas* QFR. The related paper is currently under revision and is expected to be soon published. Finally, we highly appreciate the generous support and a close long-term collaboration of IPR and SPring-8 44XU beamline.

***Deadline: May 18, 2018**
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