

# Ceramic proppant design for in-situ microbially enhanced methane recovery

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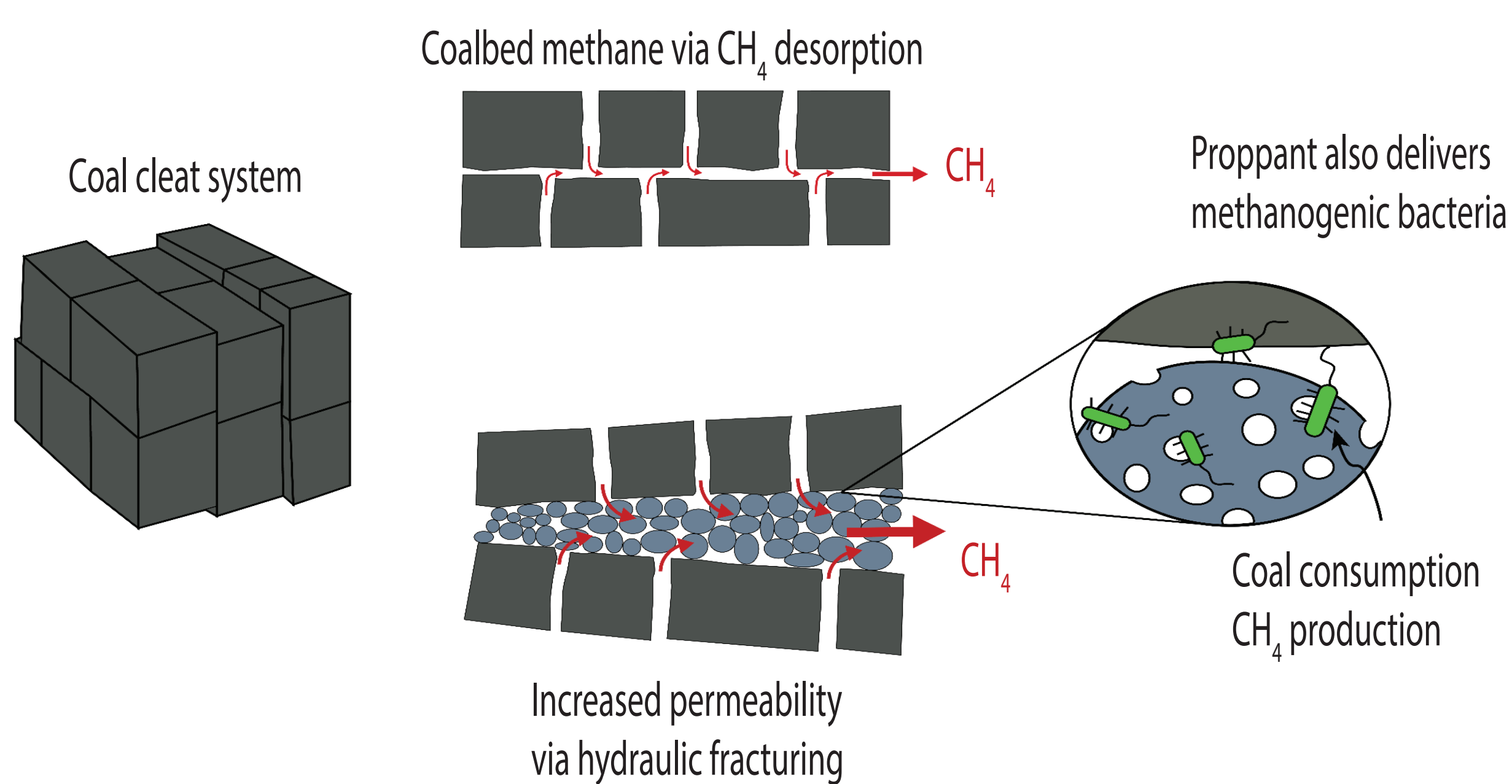
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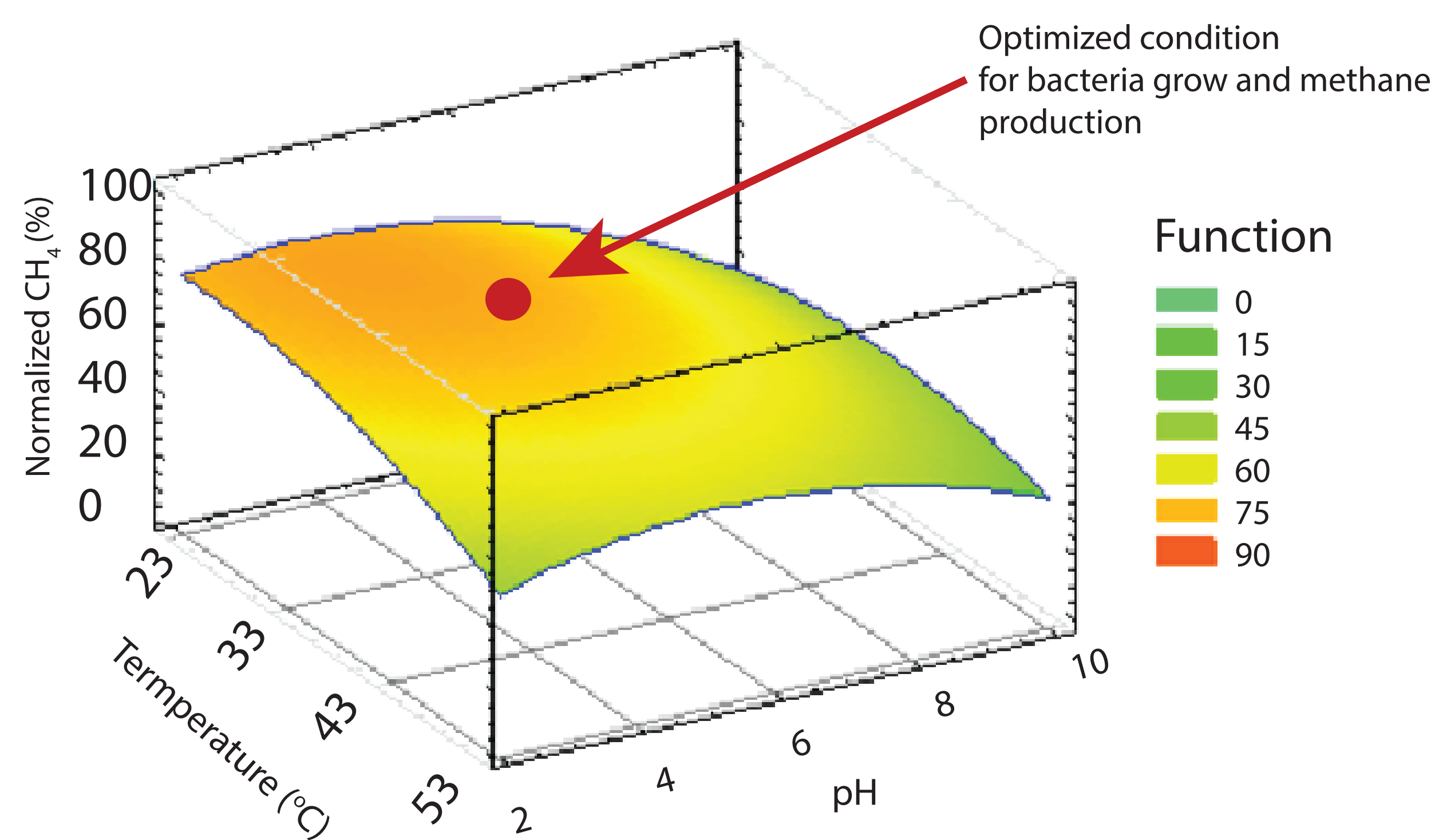
## Introduction

A ceramic proppant and fluid are delivered together to keep an induced hydraulic fracturing open. This study demonstrates that ultra-light proppant can be the vehicle to deliver methanogenic bacteria to simulated coal reservoirs and delivered in a time-controlled manner. Bacterial activity not only enhances methane production but also helps maintain proppant permeability which is normally reduced by coal fine incorporation.

Microbes can be used to enhance coalbed methane recovery. Microbes can consume coal reservoir/remove coal fines to generate more methane and to enhance conductivity.

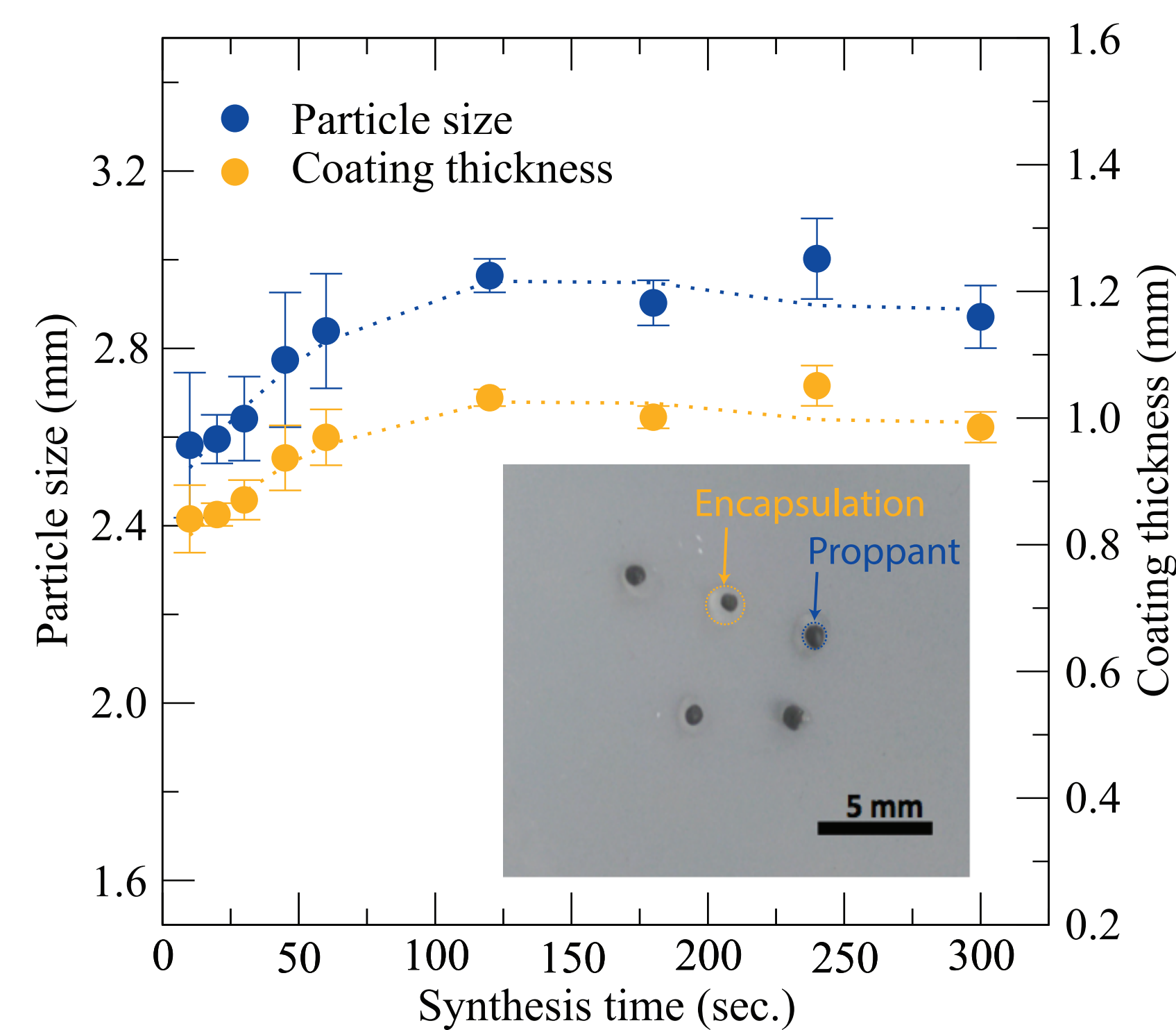
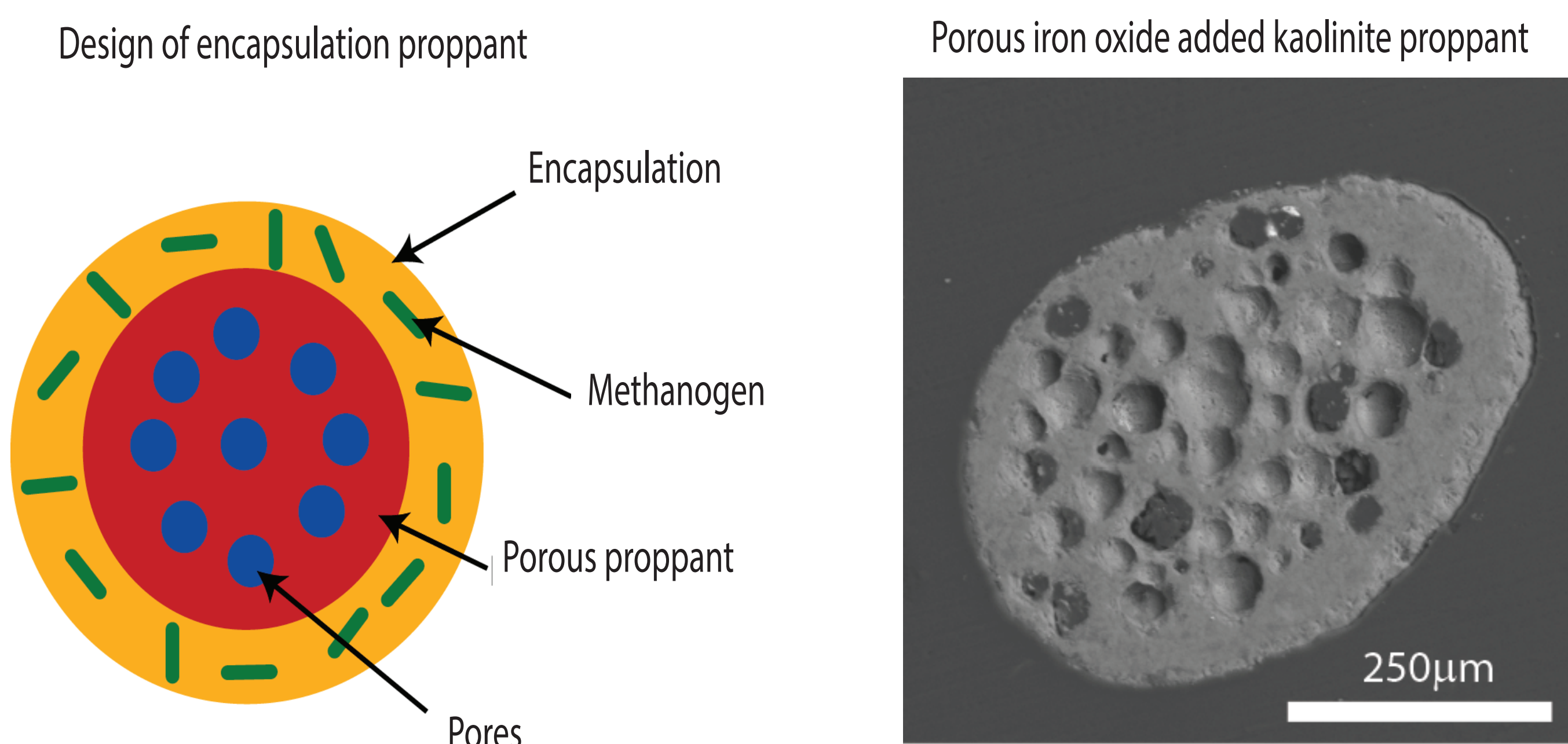


Optimized growth conditions are determined for methanogenic bacteria. The maximum methane gas was produced at low pH and 36°C conditions.



Ultralight ceramic proppant encapsulated in time-release coating. Methanogens are encapsulated by polymer and the core of particle contains porous ultralight ceramic proppant.

Particle size and delivery time is tunable with different processing parameters. The encapsulation thickness, release time, and total size was varied. The total diameter of particle was limited to ~2.9 mm over 2 minutes



Methanogens, released from encapsulation, produced methane and carbon dioxide gases. The methane gas was produced over about 20 days while consuming carbon dioxide.

Conductivity of the encapsulation in-situ increased over time. The encapsulated microbe and proppant in 10 wt.% coal at 36°C increased the conductivity more than at 20°C

