天然氣水合物儲集層開採工程之技術研發(2/3)

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- 成功建立二氧化碳水合物與MH表面形成與分解模型與濃度、溫度場，並與動態實驗、地質條件與小尺度研究成果進行比較修正，直接計算出水合物表面形成與分解量及能量變化，成功分析地層中不同開採方法下之甲烷產率變化，輔助中尺度實驗與大尺度模擬進行水合物動態行為預測。

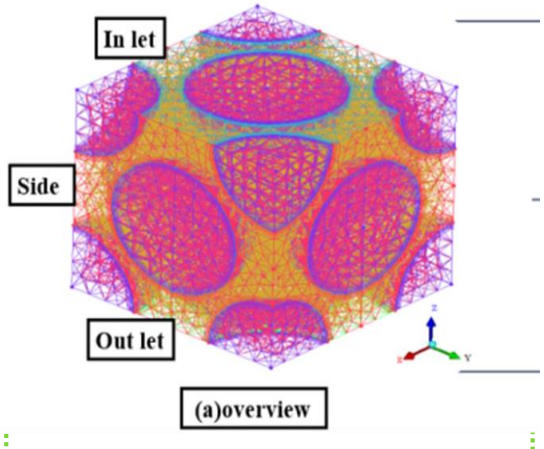

圖 1. 中尺度非結構網格

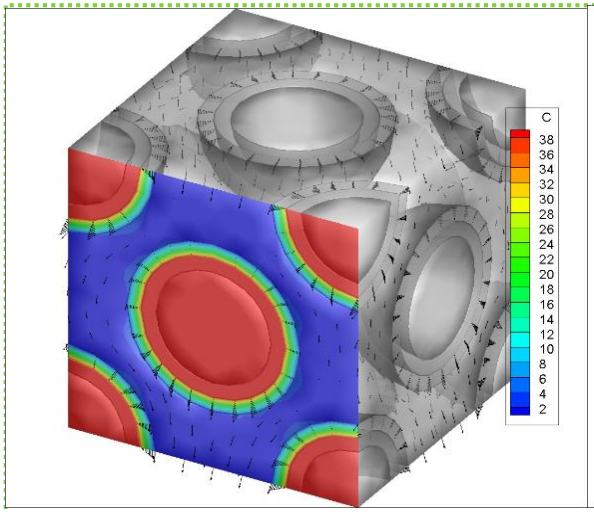

圖2.孔隙率:0.74、溫度:276k、壓力:3MPa之甲烷被置換出之濃度變化。

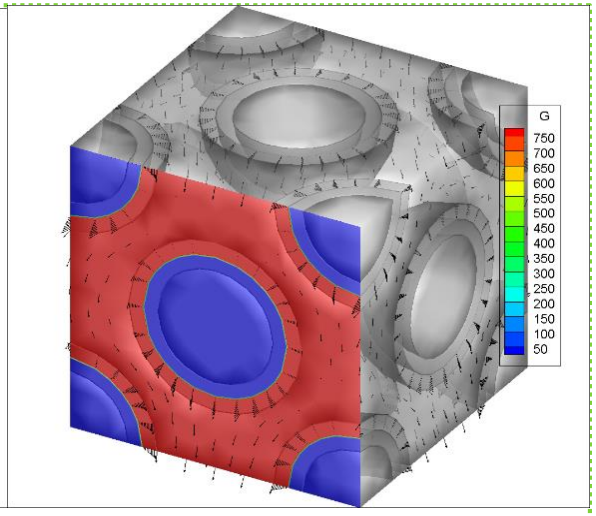

圖3.孔隙率:0.74、溫度:276k、壓力:3MPa之二氧化碳濃度變化

- 中尺度模擬的主要目標在探討在細砂存在情況下，水合物生長與分解過程與速度，一方面可與中尺度實驗相互驗證，另一方面也可提供field-scale模擬所需之動力學數據。初期以建構完整二氧化碳水合物與天然氣水合物合成與分解量測定與評估數值分析技術，研究開發可行的商業化開採方式。中尺度解析技術，已可充分個別解析動態二氧化碳與天然氣水合物的合成與分解行為，透過有限體積解析模式的導入，建立一代表性立方體解析單元可高精度模擬堆積層內之動態變化，大幅縮短計算網格數與時間，同時解析地層中水合物動量、濃度與溫度場，透過已成功的二氧化碳置換天然氣水合物模擬計算，將為國際上少數以中尺度進行動態模擬的數學模式。

Development of Mesoscale Modeling for the Exploitation of Natural Gas Hydrates

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we focus on a novel exploitative method by injecting CO_2 in the sediment and replacing methane gas. Mesoscale simulation has successfully predicted the dissociation rate of methane and the formation rate of CO_2 hydrate as well. It supports the analysis of issues of mesoscale experiment and field-scale simulation

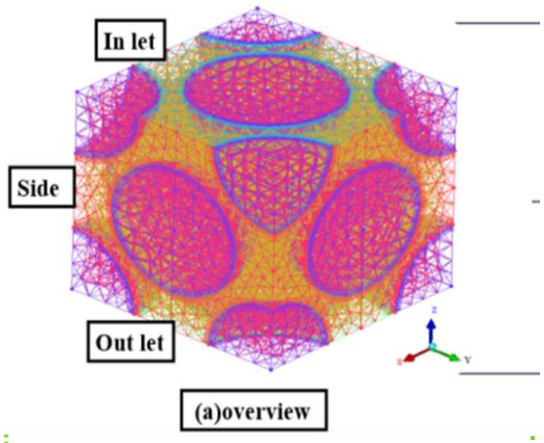

Figure 1. unstructured mesh of hydrate

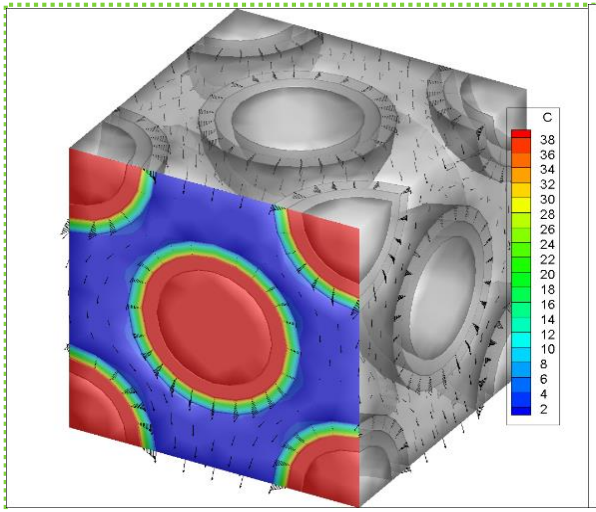

Figure 2. The flux of methane displaced at Porosity:0.74, Temperature: 276k, Pressure: 3MPa.

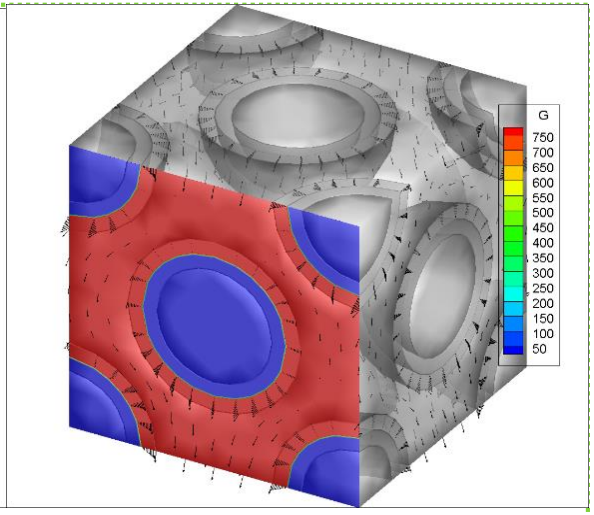

Figure 3. Flux of CO2 hydrate at Porosity: 0.74, Temperature: 276k, Pressure: 3MPa

The main objective of the mesoscale simulation is to investigate the hydrate growth and decomposition processes and velocities in the presence of fine sand. By verifying with mesoscale experiments, it analyzes the kinetic phenomena for field-scale issues. In the first stage, a numerical scheme for surface modeling of the formation and decomposition of pure carbon dioxide and methane gas hydrate was developed. The scheme is combined with CFD method and unstructured mesh in dynamic state in coupling momentum, concentration, and thermal equations. It is capable of fully analyzing the dynamic behavior of CO_2 and natural gas hydrate in porous media. In this study, the application of a representative cubic unit can accurately simulate the dynamic changes in the surface layer, and greatly reduce the number and time of calculation. Now, we focus on a novel exploitative method by injecting CO_2 in the sediment and replacing methane gas. Mesoscale simulation has successfully predicted the dissociation rate of methane and the formation rate of CO_2 hydrate as well.