

宜蘭平原深層地熱探勘鑽井及地熱系統開發研究 -宜蘭地區加熱型地熱系統儲集層技術開發與模擬研究(1/2)

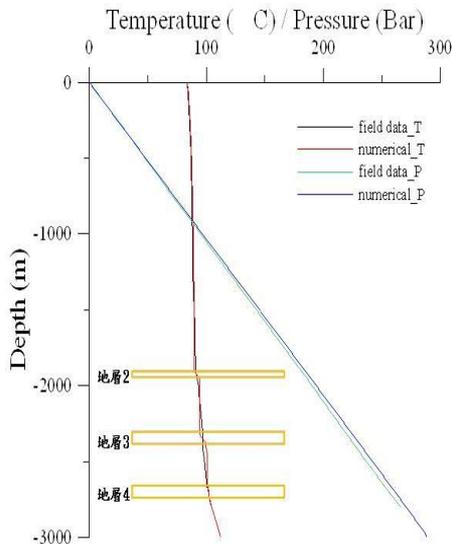
執行單位

台灣大學地質科學系暨研究所

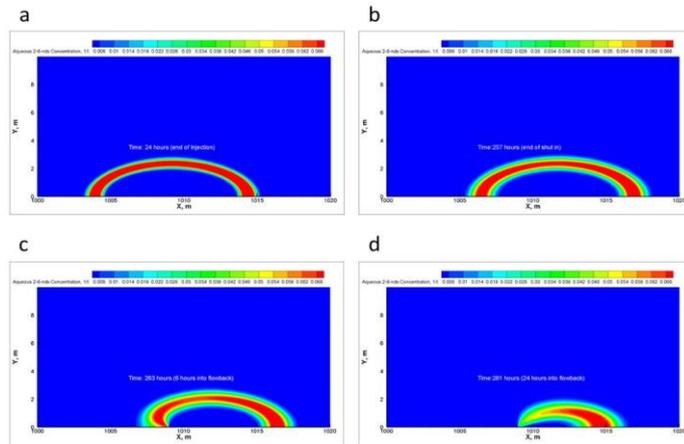
計畫主持人

陳文山

- 藉由示蹤劑試驗與TOUGH2模擬軟體建置宜蘭三星地區結元井與紅柴林一號井的地熱數值模式推測此地區的地下裂隙分布及地下水文、水溫狀況。
- 產能數據及結垢抑制試驗：最終目的於評估地熱井之發電潛能，以抑制溫泉管線結垢。



HCL-2井體自湧狀況與數值模擬比較圖



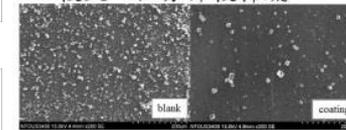
地熱地化示蹤劑的模擬結果

實驗條件

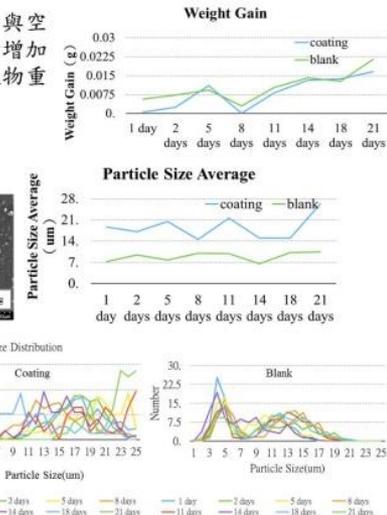
碳酸氫鈉與氯化鈣混合液
基材: SUS 304L 不鏽鋼
Temperature: 70°C
pH: 8.7

在塗層試片與空白試片上所增加的晶體沈澱物重量相似。

在塗層試片的晶體粒徑較大，但分佈較稀疏。



在空白試片的顆粒分佈有兩個峰值，塗層試片無明顯規律。



- 紅柴林二號井(HCL-2)完成各項測試後，雖然注水壓力只可達7.22m³/hr/Bar加上井下裂隙破裂方向為南北向，雖不理想但可一試；因此由紅柴林二號井分別注入保守型26nds與反應型Amino G 各50公斤示蹤劑，於紅柴林結元一號井(1500m)執行採樣，預計最快在2018年2月可以完成全部採樣。
- 以鐘乳石與純水或1000 ppm之碳酸氫鈉參與反應，皆不會沉澱出碳酸鈣，顯示鐘乳石不適合做為結垢實驗所用的材料。CaO粉末加入1000 ppm之NaHCO₃反應後生成大量次生碳酸鈣，指示未來的結垢實驗適合使用氧化鈣粉末與碳酸氫鈉溶液參與反應。
- 塗層塗料的次生礦物沉澱實驗中，發現塗料的存在對於晶核的形成與後續晶體成長具有一定的影響，可以減緩沉澱晶核形成。實驗中DBX塗料缺點為在水溶液環境中的耐溶解性不佳。未來將繼續探討及考量不同塗料種類或改良應用在地熱區域之可行性和安全性。
- 本研究彙整宜蘭地區水文與地質基本資料後，利用TOUGH2模擬軟體建置宜蘭三星地區結元井與紅柴林一號井的一維地熱數值模式，並同時將TOUGH2與PEST模式率定軟體進行結合，針對一維模式進行率定，率定結果顯示量測值與模擬值間的相關性高達0.95以上，結果非常好。
- 本年度持續蒐集國外有關產能試驗方法及量測數據詮釋技術，更新既有產能測試作業準則。同時與宜蘭清水ROT&BOT開發計畫建立合作平台，獲取IC-14、IC-16號井之生產試驗數據，評估地熱井之發電潛能，以及進行井下溫度量測、地熱流體取樣及分析。

Developing Techniques and Reservoir Simulation of Enhanced Geothermal System in Southern Ilan

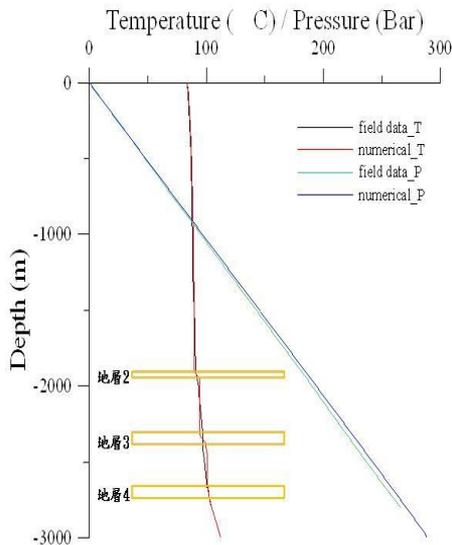
Execution Unit

Department of Geosciences National Taiwan University

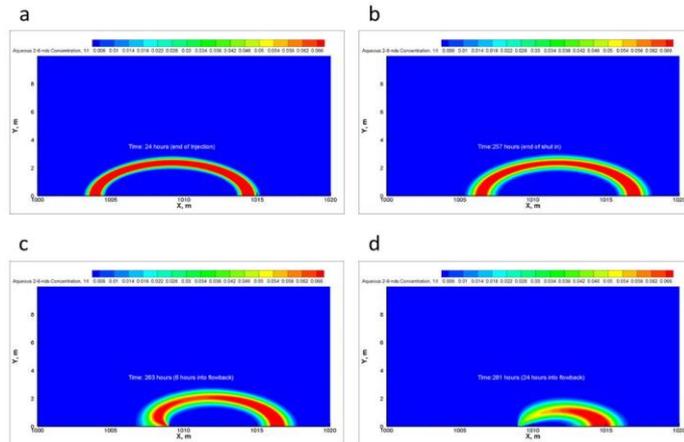
Project Director

Wen-Shan Chen

- Based on the results of geochemical tracer tests and TOUGH2 simulation, the geothermal conceptual model of Sanxing area is built up to evaluate the temperature of fluid, distributions of fractures and hydrological circulation.
- The purposes of tests on geothermal productions and scaling inhibition is to evaluate the potentials of installing capacity for geothermal power plant in the Sanxing area.



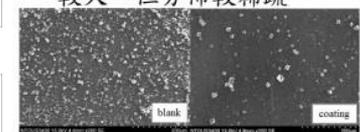
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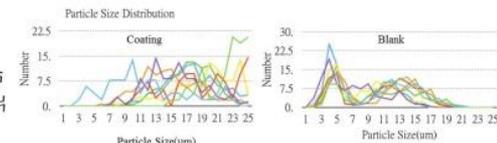
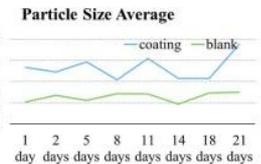
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- We have evaluated all possible parameters and other experiments results after HCL-1 and HCL-2 completed. It is worth trying a cross hole tracer test even though several obstacles appear. We have injected 50kg 26nds and AminoG at HCL-2 with 150m³ chaser. The sampling period will be completed in Feb of 2018. In the meantime, we also have constructed a framework for TOUGHREACT modeling and completed a STOMP simulation for experiments took place last year.
- Using stalactite as reactants will not precipitate CaCO₃ with pure water or 1000 ppm NaHCO₃. It shows that stalactites are not suitable for a material used for scaling experiments. Using CaO powder by adding 1000 ppm NaHCO₃ grew a large number of secondary CaCO₃, indicating that it was suitable for using calcium oxide powder with NaHCO₃ in the reaction for the scaling experiments in the future.
- It was observed that coating had some influences on nucleation in experiment of scaling deposit, and it declines nucleation rate. The DBX is not completely applicable in geothermal now, because of its poor resistance to solubility. In future, we will carry on investigating, testing and improving to find the applicable coating in the geothermal plant.
- This study will integrate hydrological/geological data and the field measurements at the Yilan area to develop two 1-D numerical models of deep geothermal system for JU1 and Hungtsailian wells using TOUGH2. The developed numerical models are calibrated by PEST and the results show that the R² between measured and simulated data is higher than 0.95 which indicate the good performance of the models.
- This year, we keep studying the theory of geothermal well testing, better understand the methods of the data interpretation and keep updating the operational guidelines that we proposed before. At the same time, we build partnership with ROT & BOT developing plans in Cingshuei, Yilan. With this opportunity, we have planned to do the downhole temperature measurement, sample and analyze the fluid and obtain some data of production test for generation potential evaluation at well IC-14 and IC-16.