

Report on scientific visit to the University of Adelaide in Australia

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1. Introduction

China and Australia government launched a collaborated research on CO₂ Geological Storage since 2009; the Ministry of Science and Technology of the People's Republic of China and Australian Geoscience are the responsibility organization on the CAGS program for both sides in respectively. China Geological Survey is one of the most participants in the CAGS program. As a part of the CAGS program, I am honored to have a scientific visit opportunity to the Australian School of Petroleum (ASP), the University of Adelaide from May to August. The following is my conclusion on the scientific visit to Australia.

2. Scientific Experiences

My scientific visit activity in the Australian School of Petroleum, the University of Adelaide focus on three parts:

I .Participated in Project 1.3 and Project 1.4 as a Research Group Member

As a member organization of CO₂CRC, Petroleum Engineering School of the University of Adelaide is carry on the project 1.3 and project 1.4.

The research title of the project 1.3 is Research on CO₂ Storage in Saline Formation of the Otway Basin, including 4 working packages (WP).

WP1 Continues Characterisation of Core Material Retrieved from CRC-2; **WP2** Concerns Modelling of the Paaratte Formation in the vicinity of CRC-2; **WP3** Extends WP2 Models to include the Entire Stratigraphical Column between CRC-1 and CRC-2. These will be extended across available 3D Seismic Data; **WP4 Concerns** Hydrodynamic and Geological Modelling up to the Basin Scale.

The research title of project 1.4 is Understanding CO₂ Storage in Saline Aquifer, including 2 working packages (WP). **WP1** Classification System for CO₂ Storage in Saline Aquifer. **WP2** Injectivity Modelling.

Future Work of Project 1.4 is The Aquifer Storage classification combined with analytical tools for injectivity assessment and generic numerical simulations will be developed into a tool box for the screening and pre-reservoir simulation assessment of saline aquifer storage of CO₂ in sedimentary basins.

II . Filed visit to the Otway CO₂ Storage Project

Visit Otway CO₂ Storage Project from 30th June-1st July, 2011. The field activity supported by GA and CO₂CRC, Hosted by Tony Steeper, from CO₂CRC. We had a comprehensive understand on the site facility, monitoring system, core sampling, test phases and the new advances of the Otway project.

III. Scientific Workshop and CO2CRC Monthly Meeting

As a scientific visit of ASP, I also Attended Scientific Seminar including:

(a). Stephen Hasiotis, Ichnology and the last Frontier: Trace Fossil Evidence of life in Antarctic, ASP of the University of Adelaide, 25th May, 2011.

(b). Yildiray Cinar, Laboratory and Simulation Studies of CO₂, EOR in Layered Reservoir, ASP of the University of Adelaide, 6th June, 2011

(c).Simon Holford, Thermal Weakening Localizes Intraplate Deformation along the Southern Australian Continental Margin, 20th June, 2011

Attended Two Monthly Meeting of CO2CRC:

(a).Hosted by Matthias Raab, ASP of the University of Adelaide, 3rd June, 2011

(b).Hosted by John Kaldi, ASP of the University of Adelaide, 3rd June, 2011

3. Research Outcome

I Construction of Hydrogeology Modelling of Stage 2 of Otway project(P 1.3)

Collection parameters to further understand Waarre C Reservoir and Paaratte formation CO₂ geological storage mechanism, mainly parameters of the Waarre C Reservoir and Paaratte formation as following:

To construct the hydrogeology modelling ,the next Data and Software is need, including: Altitude and longitude of corners around the CRC-2 well; Digital elevation or depth data of top and bottom for different aquifers and aquitards, especially important for target aquifer and overlying aquitard; Faults and fractures digital location through analyse seismic data or well log (these Data maybe ignored); Data for porosity, permeability, temperature, pressure, Groundwater flow gradient, groundwater solute elements concentration, aquifer stratigraphy elements contents and So on; Software: ArcGIS, Eclipse (or Tough2), Visual Modflow, Surfer, Grapher etc.

Table 1 Parameters of Waarre C Reservoir and Paaratte formation

Parameters	Waarre C	Paaratte formation
Depth	2000	1500m
Reservoir	Depleted gas Field	saline aquifer
Deposit Env	Braided river Fluvial	Marine
Porosity	20-25%	25-30%
Temperature	85°C	65°C
Pressure	17MP	11MP
Permibility	1000mD	80-700mD



Photo 2: Core of Waarre C and Paaratte formation

II Characterisation of Saline Aquifer basin in China(P 1.4)

Characterisation of Saline Aquifer in Sichuan Basin in China:

The basin area covered 200,000km²; a compound sedimentary basin of Mesozoic, Cenozoic and Paleozoic; total thickness of sediment is about 6000~12,000m; The brine all exists in every layer from Sinian to Cretaceous in Sichuan Basin and characterized by multiplayer; Lithology of Sinian, Cambrian, Ordovician, Triassic, Jurassic, Cretaceous mainly composed by Carbonate rock and Sandstone; Reservoir rocks in Sichuan Basin are mainly carbonate and sandstone, the reservoir rocks in Sichuan Basin belong to the fractured type with low porosity and permeability; Mainly Potential Reservoir is Carbonate rock with high Porosity and permeability.

Characterisation of Saline Aquifer in Jiangnan Basin in China

The basin Area covered 36,000km²; Mesozoic, Cenozoic sedimentary

basin; The thickness from Upper Cretaceous to the Quaternary is about 10,000m; Lithology of layers from Cretaceous to the Quaternary include sandstone, oolitic marlite, mudstone, basalt, which is dominated by sandstone reservoirs; Qianjiang group and Xingouzui group are belonged to Paleogene aquifers with the buried depth are both greater than 800m, which has good potential to carry out CO₂ geological storage because of large thickness and high porosity; Jiangnan Basin developed two group faults running NNW and NEE-EW direction which formed in foreland basin development period or before; Seismic profiles show that dislocation formation of faults are also obvious and still in the tensile state, which could affect the safety of CO₂ geological storage.

III Comparative Study of CO₂ Storage Demo-project Between China and Australia

The Otway project is prominent CO₂ storage project all over the world. We China Geological Survey and Chinese Shen Hua enterprise also together set up the first CO₂ Geological storage demonstrate project in Ordos basin since 2010, over 10,000 tons CO₂ has been injected into the geological formation, it is very important to undertake a comparative study of CO₂ Storage Demo-project Between China and Australia, including CCS theory, Laboratory and field test process, comprehensive Monitoring, especially on modeling simulation, risk assessment and monitoring well (sampling U tube).

Two Scientific Reports were produced at the end of the scientific visit. The first report is Work Plan on Hydrogeology Modeling and Simulation of Otway CO₂ Storage Project (in English); the other one is Phase Research Results Report on the Otway CO₂ Storage Project (in Chinese).

4. Conclusions

The scientific visit supported by GA, CO₂CRC and ASP of the University of Adelaide is very plentiful and experienced. The hydrogeology modeling and simulation of the Otway Project must consider the region hydrodynamics of the basin. The Stage2 research of Otway project is more complicated and will be more helpful on CO₂ storage in saline aquifer around worldwide. Comparative study of CO₂ storage project between China and Australia will benefit both sides. The field test, laboratory, seismic, simulation and monitoring of the Otway demonstrate project will further improve CO₂ storage action in China.

5. Acknowledgments

I'd like to send my thanks to the following organizations and people, including Geoscience Australia, CO₂CRC, and ASP of the University of Adelaide, Dr. Mark A Bunch, Dr. Saju Menacherry, Dr. Rick, Professor John Kaldi and Jessica Gurney. Thank you very much!

