



Greetings!

The year 2018 has been a big year for the CAGS project: celebrating 10 years of collaboration on geological storage between Australia and China; wrapping up the research projects and exchanges; holding a very successful CAGS Symposium; and co-organising a technical symposium (CCUS2018) in Perth. CAGS phase 3 will conclude in December 2018. In the past few months, we have been busy completing planned activities, undertaking an impact survey, and preparing the final report.

The achievements of this decade-long project demonstrate a strong and successful bilateral cooperation. The Australian and Chinese governments and CAGS research community have expressed a desire to continue working together to advance CCUS. The possible project structure and funding arrangements of a next stage of CAGS (CAGS Plus) is currently being explored by Geoscience Australia (GA) and the Administrative Center for China's Agenda 21 (ACCA21).

If you would like to learn more about the project, please visit [CAGS website](#).



Fig 1. Group photo, CAGS symposium (Perth, June 2018)

SYMPOSIUMS

CAGS3 Symposium, 26 June 2018, Perth, Australia

A symposium has held in Perth to celebrate achievements and to discuss a possible next stage for the project. The CAGS symposium was conducted in Chinese and English with interpretation service to assist participants to better engage in presentations and discussions. It was attended by over 80 people, including government, academia and industry representatives from China and Australia, and researchers from France and Norway. The symposium covered topics such as outcomes from CAGS3, achievements from a decade of CAGS activities and the latest development of CCUS around the world. Participants were impressed with the CAGS's broader impact and consider the project a highly successful demonstration of international collaboration. They

also contributed to an enthusiastic discussion on future collaboration between China and Australia. Presentations from the Symposium are available on the CAGS website.



Fig. 2. Congratulations to Jessica Gurney (GA) and Jiutian Zhang (Beijing Normal University), two of our CAGS Award winners

A highlight of the symposium was the dinner and the award ceremony. Four people were recognised for their outstanding contribution and long term commitment to CAGS: Ms Jessica Gurney (GA); Prof Xiaochun Li (ISRM); Prof Qi Li (IRSM); Dr Jiutian Zhang (ACCA21/Beijing Normal University). Congratulations to all our CAGS Award winners!

Applied Energy CCUS2018 Symposium, 27-29 June 2018, Perth, Australia

Following the CAGS symposium, CAGS in collaboration with the international journal, Applied Energy, and Applied Energy Innovation Institute (AEii) held the [Applied Energy CCUS2018 symposium](#).

The two-day international symposium hosted over fifty presentations on the most recent progress in CCUS, covering a wide range of topics from CCUS project updates to technical innovations in CCUS. More than 80 participants from 7 countries attended. The participants especially appreciated the opportunity to learn about progress from Australian projects, with experience shared by representatives from the South West Hub Project, the CarbonNet Project, the Bridgeport Moonie CO₂-EOR Project, the Surat Basin Hub Project, and the Otway Project. A one-day field trip was organised for participants to visit Australian CCS research facilities including the Perth Core Library and the National Geosequestration Laboratory after the symposium.



Fig. 3. CCUS 2018 symposium participants inspecting core from the Southwest Hub project at the Western Australian Government core library

A selection of 25 papers from the symposium has been published in the journal Energy Procedia (<https://www.sciencedirect.com/journal/energy-procedia/vol/154>). Papers are open access to maximise knowledge sharing and in turn to promote CCUS through global collaboration.

RESEARCH PROJECTS

The three research projects funded by CAGS3 have been completed and the final reports will be available on the CAGS website in December 2018.

Research Project 1: A Comprehensive Monitoring System for Yanchang CO₂-EOR Demonstration Project (Institute of Soil and Rock Mechanics, Chinese Academy of Sciences)

The Yanchang oilfield is located in the central part of the Ordos Basin in Shaanxi. This research project first reviewed the existing monitoring system at Yanchang CO₂-EOR demonstration project, and then built on the prior monitoring experience in the Shenhua and Shengli CCUS demonstration projects (Fig. 4). The assessment considered the unique site conditions of heavily eroded hilly landscape of the Yanchang project. Three large-scale groundwater and surface water surveys were conducted as part of the project, and three U-tube monitoring systems were installed to facilitate sampling of water and gas sample from the shallow geological environment.

A new comprehensive monitoring system was suggested after evaluating different monitoring approaches. The project also noticed there is an urgent need to develop more cost-effective monitoring technologies. The expanded monitoring plan for Yanchang is seen as a framework and benchmark for future CCUS projects in China.

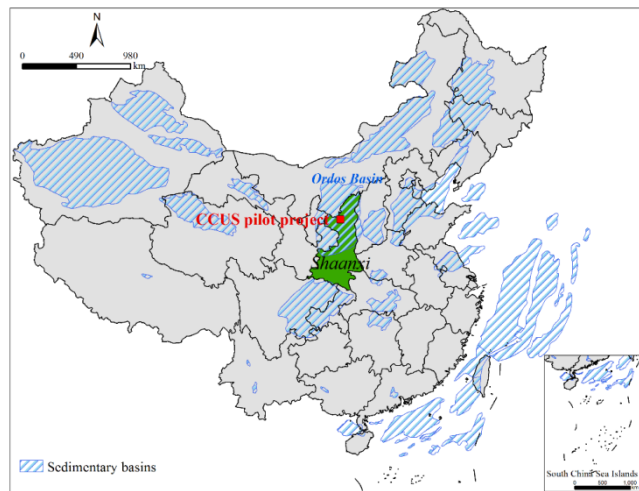


Fig. 4. Jingbian pilot area of Yanchang oilfield CO₂-EOR project

Research Project 2: Prefeasibility Study on the Xinjiang Guanghui Fuyun Coal to Gas CCUS Pilot Project

A feasibility study was undertaken for the Xinjiang Guanghui CCUS 100,000 tonne pilot project in the Junggar Basin, Xinjiang. The project assessment considered different CO₂ source and storage locations, and found that optimum source-sink configuration was CO₂ captured from a planned coal-to-gas facility at the Kamisti Industrial Park and storage in the Cainan oilfield, in the Eastern Junggar region (Fig. 5). The Cainan oilfield possesses the most suitable geology for CO₂-EOR including a competent structural trap. The study found that the geological storage in Junggar Basin has a wide application with good reservoirs and suitable natural conditions. The Cainan oilfield appears to be the most prospective.

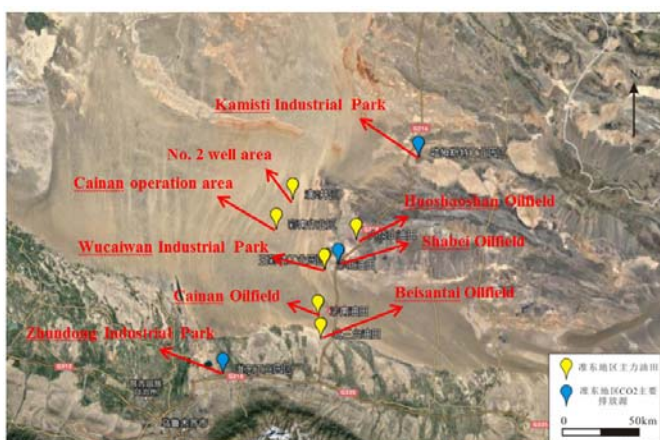


Fig. 5. Oilfields in the Eastern Junggar region, Xinjiang

Research Project 3: CCUS Potential in Junggar Basin and the Opportunities for Pilot Projects in the Eastern Junggar Region

The Junggar Basin in north Xinjiang is an important energy supply corridor, but it is also emits a significant amount of greenhouse gas. The Junggar Basin was evaluated by the China Geological Survey to have the greatest potential for CCS development in China. The Western Junggar Basin appears suitable for CO₂-EOR demonstration projects and the Eastern Junggar Basin is suitable for CO₂-EWR demonstration projects.

As part of this project, a prefeasibility study for a pilot CO₂-EWR project in the Eastern Junggar Basin was undertaken and simulations found an increase in storage efficiency of greater than 65% for CO₂-EWR compared to a CO₂ injection only approach.

The results from the study suggest approximately 150 Mt of CO₂ storage potential using CO₂-EOR but some 96 Gt of potential CO₂-EWR aquifer storage. All major CO₂ sources could be matched to within 50 km to

suitable storage targets. CO₂-EWR appears to significantly enhance storage efficiency, suggesting that it could play an important role for geological storage of CO₂ in water scarce regions. The findings from this project were presented at the [GHGT14](#) conference

SCIENTIFIC EXCHANGES

The CAGS3 scientific exchange program provides funding for Australian and Chinese researchers to participate in scientific exchanges ranging from one month to six months. The program provides selected scientists opportunities to collaborate with hosting Chinese or Australian researchers, to gain international experience and to have a dedicated time to focus on their research.

Under CAGS3, eleven exchange programs were sponsored. In 2017, [eight researchers](#) concluded their exchanges and their activities were reported in the last newsletter. In 2018, Hongwei Lei from the Chinese Academy of Sciences and Adam Schwartzkopff from the University of Adelaide completed their exchanges. Xin Ma from China Geological Survey has recently concluded his exchange at Geoscience Australia.

[Dr Hongwu Lei](#) (Institute of Rock and Soil Mechanics, CAS) to CSIRO, Melbourne

Dr Hongwu Lei undertook a six-month exchange from October 2017 to April 2018 at CSIRO Energy in Melbourne and worked closely with Dr Meng Lu, who specialises in wellbore flow simulation.



Fig. 6. Meng Lu (left) discussing wellbore flow modelling with Hongwu Lei

During the exchange they developed a wellbore simulator called “CO2Well” and applied it effectively to simulate wellbore flow with phase transition in the Shanxi field trial of CO₂ enhanced coalbed methane recovery. Dr Lei also established modules within TOUGH2 framework, such as TOUGH2Biot and TOUGH2/EOS7Cm, to simulate the THMC coupling and to understand impure CO₂ injection problems.

Dr Adam Schwartzkopff (University of Adelaide) to Institute of Rock and Soil Mechanics, CAS

In May and June 2018, Dr Adam Schwartzkopff undertook his exchange in China, hosted by Prof Qi Li at the Institute of Rock and Soil Mechanics, Chinese Academy of Sciences. During this visit he worked with researchers to characterise the material properties of tight sandstone found in China for use in predicting the hydraulic fracturing parameters. Hydraulic fracturing increases the permeability of the rock, which creates the ability to store more carbon dioxide in rock. He also gave a talk on “Predicting the initial conditions produced from hydraulic fracturing using fracture mechanics” at this Institute. During this exchange he was able to generate validated analytical tools to predict the maximum injection pressure of tight sandstone in a long pressurised section of borehole and to estimate the average crack radius from the pressure and volume during hydraulic fracturing. He also attended the APAC CCS Forum and Members Meeting in Shanghai and visited a nearby carbon dioxide capture plant.



Fig. 7. Adam Schwartzkopff visiting a carbon dioxide capture plant in Shanghai

Mr Xin Ma (Center for Hydrogeology and Environmental Geology Survey, China Geological Survey) to Geoscience Australia

Mr Ma has recently completed his exchange at Geoscience Australia. Assisted by Dr Liuqi Wang, Mr Ma built a high-precision static geological model and

constructed an analytical method to process the data collected from the CO₂-EWR pilot project in Xinjiang. His exchange helped him to build a high-precision coupling prediction model that will assist predicting the effect of CO₂-EOR/EWR.

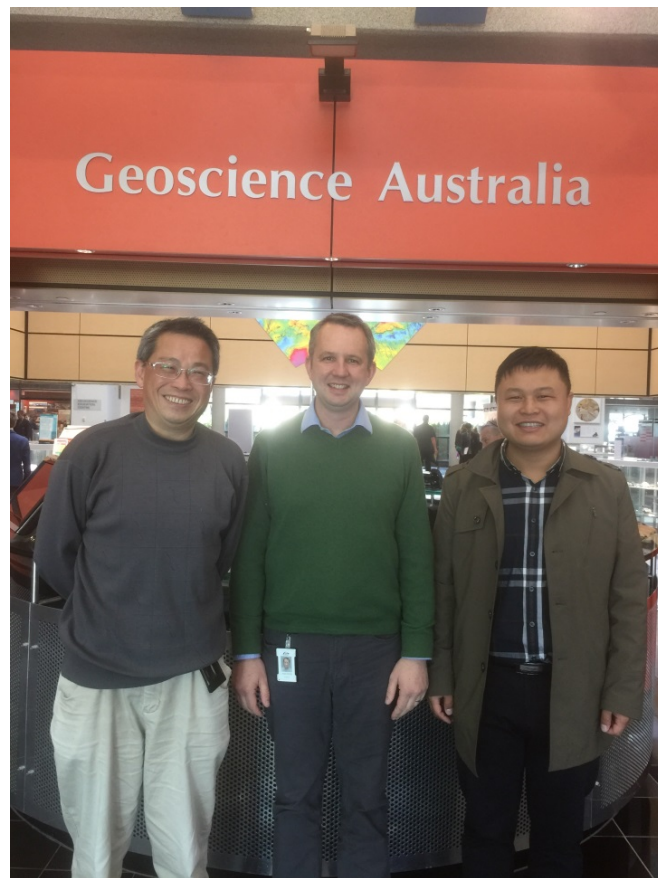


Fig.8. Liuqi Wang, Andrew Feitz and Xin Ma at Geoscience Australia

NEXT STEPS

The achievements of the CAGS project demonstrate a strong and successful bilateral cooperation. The Australian and Chinese governments and CAGS research community have expressed a desire to continue working together to advance CCUS. The project structure and funding arrangement of a possible next stage of CAGS (CAGS Plus) is currently being explored by GA and ACCA21. As we move towards implementing large-scale demonstration projects and full CCUS projects, mutual benefits are likely to be found for both countries. If CAGS Plus proceeds, it offers an opportunity to build on the established network, transform CAGS into a CCUS knowledge and data sharing hub, and conduct joint Australian-Chinese research projects to address some of the knowledge and technology gaps facing both countries.