

# Summary of visit to Geoscience Australia

Bofeng Cai

Chinese Academy for Environmental Planning (CAEP)

Exchange researcher to Geoscience Australia, 21 Sep.2011 to 17 Dec.2011.

For the *China Australia Geological Storage of CO<sub>2</sub>* project.

## 1. Purpose of visit

There is growing recognition and acceptance by the Chinese central government and companies that CCUS (Carbon Capture, Use and Storage) will play a key role in China's climate change abatement strategies, particularly in the medium to long term. China has been making good progress in geological storage of CO<sub>2</sub>. Some state-owned companies, such Shenhua Group, have started the injection of CO<sub>2</sub> into geological formations. Considering that the environmental aspects of geological storage of CO<sub>2</sub>, are gradually becoming more important and that environmental monitoring of CCUS activities in China is currently minimal or lacking, the purpose of my visit has been to learn about the monitoring and experiences of geological storage of CO<sub>2</sub>, including:

- 1) Why environmental monitoring for geological storage of CO<sub>2</sub>;
- 2) What are the environmental risks and direct/potential impacts of geological storage of CO<sub>2</sub>;
- 3) What kind of environmental monitoring technologies is available or with potential;
- 4) What kind of technologies had been deployed in the industrial scale and experimental scale projects;
- 5) Legal and regulatory aspects of environmental monitoring.

## 2. Activities

I undertook three categories of activities in Australia:

- 1) Interview and academic exchanges;
- 2) Field visiting and work;
- 3) Literature reviewing and summary.

### (1) Interview and academic exchanges

- Greg Leamon supervised my visit to GA and gave me a great deal of assistance. Greg firstly introduced the basic processes and fundamental mechanisms for geological storage of CO<sub>2</sub>, and tried to help me understand in the easiest way. He provided me with the big picture of the geological storage and a lot of material related to monitoring and environment issues in this field. I communicated with Greg Leamon every few days and we talked about my studying approach and suggested reading.
- Andrew Feitz, who is an expert in the monitoring on geological storage of CO<sub>2</sub>, showed me what kinds of technologies are used in the Otway project (Australia), and their characteristics, strengths and weaknesses.
- Rick Causebrook organized a small meeting covering the fundamentals of the geological storage of CO<sub>2</sub>, for me and Dr.Liu. Greg Leamon and Aleks Kalinowski also participated in this meeting. With Rick's detailed representation and Greg and Alek's explanation and help, I learnt about the process and basic mechanism of geological storage of CO<sub>2</sub>. This lesson provided a foundation for me to further study the environmental risk and potential impacts related to CO<sub>2</sub> geological storage.
- I visited the Geoscience Data Repository (GDR), which is a collection of physical data stores including cores samples. I also visited the Australian Tsunami monitoring system.
- Karen Higgins, who is involved in seismic interpretation, showed me how seismic techniques (2D, 3D, 4D, vertical seismic profile and microseismic) are used in the geological storage of CO<sub>2</sub> to monitoring the plume movement and behaviour of CO<sub>2</sub> when injected into the storage formation. She explained the interpretation process and how to use seismic data to build up 3D visualisations of the geological volume.
- I spent a day with researchers from the School of Petroleum Engineering at The University of New South Wales, Dr Minh T Ho, Dr Peter R Neal, and Wanwan Hou, discussing the economics of CCS. UNSW, a participant in the CO<sub>2</sub>CRC, gave presentations on cost-benefit analysis, net present value and CO<sub>2</sub> cost avoided for geological storage. I gave the presentation named *China CO<sub>2</sub> emissions and CCS*, to introduce the role of CCS role as part of an integrated CO<sub>2</sub> mitigation portfolio in China, and mentioned recent policy and

project developments in CCS, in China. I focused on the CCS considerations in the coming carbon tax and future carbon market in China. We also discussed the similarities and differences between China and Australia in coal based power generation and the implications for CCS.

- Communication with Department of Climate Change and Energy Efficiency. Greg Leamon and I visited the Department of Climate Change and Energy Efficiency for a meeting with Glen Whitehead and his colleagues. Glen introduced me to their work on the Australian National Greenhouse Gas Inventory, the emission reporting system for large emitters, and how the CCS will be considered and accounted in future national and state inventories. I introduced the Chinese environmental information and pollution reporting systems and the potential value of our emission sources database on the future capture and storage matching research and the deployment of geological storage sites.

## **(2) Field visiting and work**

- Together with Andrew Feitz, I visited the CO<sub>2</sub>CRC Otway project site in Victoria. The Otway project is Australia's first demonstration of deep geological storage of CO<sub>2</sub>. The project has provided valuable technical information about the monitoring of geological storage processes. In stage 1, over 65,000 tones of CO<sub>2</sub> were injected into a depleted gas reservoir at an injection depth of about 2100 m. Some controlled releases of CO<sub>2</sub> have been implemented at the Otway injection site. I visited the monitoring centre and inspected instruments for CO<sub>2</sub> concentration monitoring. We worked for one day decommissioning the CO<sub>2</sub> concentration monitoring instruments. In Horsham, where an experiment on the impact of CO<sub>2</sub> on agriculture was carried out, using controlled release of CO<sub>2</sub>, we deployed the CO<sub>2</sub> concentration monitoring systems to verify the consistency of model predicting and monitoring results on the detection of CO<sub>2</sub> leakage.
- Experimental site on the outskirts of Canberra. With Richard Dunsmore, I visited the experiment project related to the monitoring of the soil gas with controlled release of CO<sub>2</sub>. This project will provide us with the experiences on how to monitor the soil gas to detect the CO<sub>2</sub> leakage and environmental

imparts. I investigated how the soil gas sample was deployed and monitoring time interval designed.

- CO<sub>2</sub> and CH<sub>4</sub> monitoring site on the Emerald. With Andrew Feitz and Steve Zegelin (CSIRO), we tested the new generation atmospheric monitoring technology in a fairly remote environment and try to develop methods for detecting CO<sub>2</sub> leaks from CCS storage sites. We replaced a CO<sub>2</sub> sensor on the eddy covariance tower at the site, took some flask samples, and checked and change over the calibration gases in the main station.

### **(3) Literature reviewing and summary**

Most of my time in GA was spent on the literature review, asking questions and communication with different people. My study focuses were environmental impact of geological storage of CO<sub>2</sub> and how to monitoring them effectively. I read lots of material related to environmental risk of geological storage of CO<sub>2</sub>, including leakage risks, environmental impact and risk analysis; monitoring technologies in typical geological storage of CO<sub>2</sub> projects, including industrial scale and experimental scale projects; environmental monitoring for geological storage of CO<sub>2</sub>, including monitoring phase, monitoring methods and technologies summary; legal and regulatory aspects of environmental monitoring for geological storage of CO<sub>2</sub>, including regulatory requirements for monitoring and monitoring liability. Finally, I finished my report, 'Geological Storage of Carbon Dioxide and Environmental Monitoring'.

## **3. Results**

Report: *Geological Storage of Carbon Dioxide and Environmental Monitoring*

## **4. Acknowledgement**

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