ANNUAL PROJECT REPORT
AS OF DECEMBER 1998

1. PROJECT SPONSOR:
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3. OCDO GRANT NO: OCRC3-00.1.C1.1

4. PROJECT UPDATE ✔ OR
FINAL REPORT

5. PROJECT TITLE: Carbon Dioxide Sequestration in the Rose Run Formation

6. PROJECT TERM: FROM: September 1, 2000 TO: Dec 1., 2000

7. BUDGET:

NAME	COST SHARE
OCDO	\$ 73,282
Case Western Reserve University	\$ 24,546
TOTAL PROJECT COST:	\$ 97,828

I. ABSTRACT

8. OVERVIEW OF PROJECT AND OBJECTIVES:
Capturing and sequestering CO_2 emissions from coal-fired power plants holds great promise for limiting the accumulation of greenhouse gases in the atmosphere. Widespread, deep, saline aquifers could provide high-volume, long-term storage, in close proximity to Ohio's power plants. The capacity and integrity of aquifer storage depends on chemical reactions between the CO_2 and the formation minerals and brines. These reactions can have both negative and positive consequences. For example, they can compromise the impermeable stratigraphic seal, and consequently allow vertical escape of CO_2. Alternatively, mineral-fluid reactions can convert CO_2 into carbonate, and thereby trap the carbon permanently in the subsurface as a stable, immobile, and harmless solid.

This study aims to evaluate the potential of the Rose Run sandstone beneath eastern Ohio to sequester CO_2. The project consists of three integrated parts: 1) aquifer characterization to establish the subsurface spatial variability of rock composition, porosity, and permeability; 2) laboratory experiments to determine reactions and reaction rates between typical Rose Run rock samples and CO_2- saturated brines; and 3) geochemical modeling of experimental and geologic data to simulate CO_2–storage capacity.

9. WORK DONE AND CONCLUSIONS:
Work progressed in tandem on aquifer characterization, laboratory experiments, and numerical modeling. Rocks equivalent to the Rose Run sandstone and surrounding strata are exposed at the surface in central Pennsylvania. These exposures, and rock core from the subsurface of Ohio, were measured and described to document the different rock types and their vertical stacking patterns. Samples of representative rock types were selected for further characterization and reaction experiments. A simple, inexpensive batch reactor was designed so that multiple geochemical experiments can be run simultaneously. The reactors will rock to maintain uniform

mixing of liquid, solid, and gas phases. They will be pressurized between 750 and 1200 psi, and will maintain temperatures of 50 to 100 C. Double sets of valves will allow sampling of CO_2 and brine during the experiments. Four computer programs capable of calculating multiphase gas-aqueous-mineral equilibria were identified (WATEQ4F, PHREEQC, MINTEQA2, SOLMINEQ88) and evaluated for their suitability for the project requirements. Two were deemed inadequate for this study because they do not accommodate gases (WATEQF4F) or the necessary pressure and temperature ranges (MINTEQA2). The others seem to be capable of simulating mineral reactions in deep saline aquifers, but had some problems that need further work to resolve.

10. <u>PLANS FOR COMING YEAR:</u>

During the next year work on aquifer characterization, laboratory experiments, and numerical modeling will continue. Petrographic studies of thin sections of representative rock types will identify the dominant mineral phases present and document the paragenetic history of mineral dissolution, precipitation, and replacement. The geochemical reactor will be built and tested, first with simple single-mineral-artificial-seawater mixtures and later with complex natural rock samples and brines. The geochemical models will be tested with generic seawater simulations. Equilibrium simulations will then incorporate the addition of $CO_{2(g)}$ and/or the addition of solid phases such as albite, anorthite, Ca-montmorillonite, glauconite, calcite and dolomite, and will simulate the experimental reactions.

11. <u>HIGHLIGHTS/ACCOMPLISHMENTS</u>

Literature review and preliminary petrographic analysis indicates that the Rose Run sandstone, like other mature sandstone formations in Ohio and the midwest, lacks the Ca-feldspar needed to provide Ca ions for trapping carbon as a solid carbonate phase. However, locally abundant glauconite and clay minerals could provide an alternative sources of Ca for carbon trapping reactions, making the ongoing field, experimental, and numerical studies, all the more necessary in order to quantify and predict the complex series of reactions and reactions rates.