Carbon Sequestration in Carbonate-Rock Province of Eastern Nevada

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INTRODUCTION

Approximately 7 billion tons of carbon is released into the atmosphere per year through the burning of fossil fuels, but only about 3.4 billion tons of carbon per year accumulates in the atmosphere (Quay, 1992). Therefore, there exists a carbon sink that accounts for approximately 3.6 billion tons of carbon per year. The current understanding suggests that the oceans, forests, and soils act as a major natural sinks, absorbing carbon therein reducing the availability of carbon in the atmosphere. Several studies have attempted to account for the natural carbon balance (Berner, 1997; Degens et al., 1991; Hesshaimer et al., 1994; Quay et al., 1992; Ritschard, 1992; Sarmiento & Sundquist, 1992; Siegenthaler & Sarmiento, 1993; Tans et al., 1990; Yager et al., 1995; Yoshimura, 1997; Yuan, 1997), but results are not clearly understood. Therefore, it is evident that an accurate understanding of the existing carbon sinks and their contributions to the carbon cycle are needed to predict changes to the climate.

$$Carbonate\ \ weathering(\rightarrow)\ \ and\ \ precipitation(\leftarrow):$$

$$Limestone:$$

$$CaCO_3 + H_2CO_3 \leftrightarrow Ca^{2+} + 2HCO_3^-$$

$$Dolomite:$$

$$CaMg(CO_3)_2 + 2CO_2 + 2H_2O \leftrightarrow Ca^{2+} + Mg^{2+} + 4HCO_3^-$$

Typical spring sampling site in White River Valley, Central Nevada.

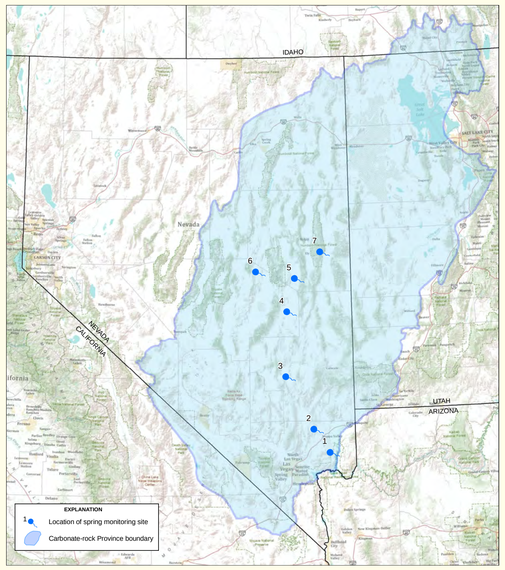
This study is developed to examine the basic fundamental process between the exchange of carbon in the carbonate-rock province of the desert southwest, and to attempt to measure the quantity of carbon that is sequestered from the atmosphere and potentially released. Modeled from work done by Liu and Zhao (1999) in carbonate-rock areas of mainland China, this study will provide additional understanding of the potential for soils and rock in the carbonate-rock province of eastern Nevada to exchange atmospheric carbon.

Spring sampling site near Ash Springs.

The inorganic carbon reservoirs in the Earth's crust are very large and may reside there for millions of years. These reservoirs constitute a major component of the terrestrial carbon cycle. Weathering exposes carbon ions in sedimentary rock to the atmosphere, allowing it to be oxidized. The carbonate-rock province in eastern Nevada is composed of carbonate-rocks that range from 1,500 to 9,150 meters thick and are slowly affected by waters on and below the land surface. Where fractured and faulted, these landforms commonly transmit water freely from the atmosphere to the subsurface. These waters generally discharge along mountain front springs, or travel long distances, accumulating with other subsurface waters, and discharge in valley basins. The pH, temperature, discharge, and alkaline nature of spring waters at these discharge points may affect the rate of deposition of carbonate minerals and release of carbon into the atmosphere.

DESCRIPTION

Carbon exchange in carbonate-rock terrain may come from atmospheric sources, from soils or from discharging springs. For every ton of limestone dissolution, 120 kg of carbon must have been taken as CO_2 from the atmosphere; further, the same percentage of emission will take place when carbonate rock is deposited (Yuan, 2003). The basic chemical reaction defining CO_2 processes show that carbonate-rocks can be both a sink (precipitation) and a source (weathering) of CO_2 in the atmosphere (eq. 1).



Location of selected CO2 monitoring sites in the Carbonate-rock Province

MapID	SpringName	Latitude	Longitude
1	Rogers Spring	36° 22' 36"	114° 26' 33"
2	Pederson East Spring	36° 42' 34"	114° 42' 56"
3	Ash Spring	37° 27' 37"	115° 11' 37"
4	Hot Creek	38° 22' 46"	115° 09' 06"
5	Lund Springs	38° 51' 00"	115° 00' 09"
6	Big Springs near Duck Water	38° 57' 01"	115° 42' 12"
7	Cleve Creek	39° 12' 60"	114° 31' 47"

Proposed Data Collection at seven spring sites in the Carbonate-rock Province:

a) Monthly:
- i) Spring Discharge
- ii) Precipitation
- iii) Geochemical analysis
  - (a) In-situ measurements of CO_2 (solids)
  - (b) Temperature (soils, spring waters)
  - (c) pH (soils, spring waters)
  - (d) Alkalinity (soils, spring waters)
  - (e) Calcium Bicarbonate (spring waters)

b) Carbonate-rock-tablet-method (Plan, 2005)
- i) Corrosion tests with limestone tablets in water, atmosphere, and soil
  - (a) Buried soils (covered with approximately 5 cm of parent soil)
  - (b) Spring beds (exposed to UV light submerged in spring channel)
  - (c) Atmosphere exposed (exposed to UV light and precipitation)

Spring Pool in White River Valley, East Central Nevada

RELEVANCE

This study is relevant to the overall understanding of the contributions from natural sources of carbon in the global carbon cycle. More specifically, this study examines local abundant carbonate rock located in eastern Nevada, and provides additional data needed to attribute the role of carbonate-rock terrain in the effective balance of carbon emissions. Obtaining local estimates of carbon sequestration and source is important to global calculations of carbon, as CO2, volumes.

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