**Δ¹⁴C of Atmospheric CO₂ at Point Barrow, Alaska**

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**INTRODUCTION**

Δ¹⁴C is a useful tracer for studying the carbon cycle, especially for discriminating between fossil and biosphere carbon emissions. However, observations of Δ¹⁴C variation in atmospheric CO₂ are available for only a few locations. We report here a high precision and high temporal resolution Δ¹⁴C record obtained at the Point Barrow Observatory, Alaska (71.3° N, 156.5° W) from July 2003 to present. These data will enhance our understanding of the patterns of atmospheric Δ¹⁴CCO₂ distribution and its seasonal variation and provide observational constraints for the roles of ¹⁴C isotope disequilibrium among its various sources and sinks.

**SAMPLE COLLECTION AND MEASUREMENT**

Sample collection was through the NOAA/ESRL flask network program where many other trace gases and isotopes were also measured, such as CO, CO₂ mixing ratios and δ¹³C and δ¹⁸O of CO₂. Two biweekly samples were collected before 2008, and after that, one sample was collected weekly. Air samples were collected into a pre-evacuated 6L canister which was then pressurized to ~2 atmospheres by an oil free pump.

Upon returning to the lab, CO₂ was cryogenically purified on a vacuum line (see Fig. 1), subsampled for Δ¹³C analysis, and then reduced to graphite using zinc reduction method [1]. The graphite was analyzed for Δ¹⁴C at the W.M. Keck AMS facility at UC Irvine using a sealed tube zinc reduction method [2]. The reproducibility of all OXIs is ~2 ‰ (1 standard deviation). The relative error is about 0.2 to 0.25%. The precision is generally better than our regular wheels because we pick a good AMS performing time to run the air sample wheels and normally run them for longer time to get better statistics. In order to minimize possible wheel to wheel offset on the time series, we also run some samples collected earlier together with the samples collected later.

**RESULTS AND DISCUSSION**

Table 1 Results of standards

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During the collection period, Δ¹⁴C decreased by ~5% per year, to a final value of ~42% in Dec-2008. We find distinct seasonal cycles for Δ¹⁴CCO₂ with a broad minimum around Mar-Apr and a maximum in Sep-Oct with an amplitude of ~10‰. This seasonal pattern is variable from year to year. Increasing ¹³C values may reflect injection of stratospheric air in April and May, and higher soil respiration with enriched ¹⁴CO₂ between May to Aug; rapid declines may be due to reduction in soil respiration and changes in the poleward advection of fossil fuel burned in the winter months. ¹⁴CO₂ seasonal cycle lags those of CO (Fig. 2) by ~one month and half month respectively. A summary of the average seasonal Δ¹⁴CCO₂ is shown in Table 3. The Barrow ¹⁴C record compares well with that from Niwot Ridge (NWR) [3].

**CONCLUSIONS**

1. Our ¹⁴CO₂ results at Pt. Barrow are consistent with published records from North America [4,5] and from Europe [6,7] (Fig. 4).
2. The high precision and high resolution time series from Point Barrow displays distinct seasonal cycles of ¹⁴CO₂ and allows us to analyze the seasonality change over time. This may help us to understand the various sources and sinks of ¹⁴CO₂.
3. Our record adds to the few available records worldwide to provide observational constraints for the roles of ¹⁴C isotope disequilibrium among different reservoirs, and hopefully can enhance our understanding of the patterns of atmospheric ¹⁴CO₂ distribution and its seasonal variation.

**REFERENCES**