

Carbon Coulometry

Carbon coulometry measures the amount of carbon contained in lake sediments, either of organic or inorganic origin, and thus allows one to examine changes in the chemical makeup of lake sediments through time. The carbon content of sediments can be related to a number of factors such as rates of decomposition, productivity, and/or precipitation of carbonate minerals. The LRC CO₂ Coulometer can be used to rapidly determine carbon content from water, gas, or sediment samples. We discuss below the basic principles and abbreviated procedures below. For more detailed information read the specific sections on [Total Inorganic Carbon](#) and [Total Carbon](#).

Alternative, less expensive methods of determining the percentage of carbonate and organic matter in samples such as [Loss on Ignition \(LOI\)](#) are also employed in the Core Lab Facility. Carbon coulometry is preferred for most lake sediments in that only very small sample sizes are required (10-20 mg, whereas LOI uses >500 mg). Note that carbon coulometry reports the total mass of *carbon* within organic matter, whereas LOI measures the total mass of *organic matter*.

Principles

Carbon dioxide gas (evolved from either organic or inorganic constituents) is swept by a gas stream into a coulometer cell. The coulometer cell is filled with a partially aqueous medium containing ethanolamine and a colorimetric indicator. Carbon dioxide is quantitatively absorbed by the solution and reacts with the ethanolamine to form a strong, titratable acid which causes the indicator color to fade. The titration current automatically turns on and electrically generates base to return the solution to its original color (blue).

Equipment and Procedure

LRC uses a UIC model 5011 CO₂ Coulometer which detects carbon by automatic, coulometric titration. CO₂ gas is swept into the coulometer from either an acidification module for TIC or from a combustion furnace that combusts all carbon (TC) within the sample. By subtracting the total inorganic carbon from the total carbon (TC-TIC) one determines the value for total organic carbon (TOC).

Total Inorganic Carbon

To measure TIC, carbon contained within carbonate minerals such as calcite, dolomite, siderite, etc., we use a UIC model 5030 Carbonate Carbon apparatus. Five mL of acid (we use HCl) serves to evolve CO₂ from the sample, which is swept into the carbon coulometer where it is detected and displayed on a digital screen in terms of micrograms of carbon. For detailed instructions read the TIC section.

Total Organic Carbon

To measure TOC the analyst must first determine the amount of carbonate carbon present in the sample (TIC) and then determine the amount of total carbon (TC) present in the sample. TC is determined by evolving CO₂ from combusted samples in a UIC model 5020 Total Carbon apparatus with a Model 5022 Ladle Introduction component. Once TC is determined, subtraction of TIC (TC-TIC) yields the value for TOC. For more detailed instructions read the TOC section.