AirCore™, a New and Very Simple Way to Obtain Vertical Atmospheric Profiles of Trace Gases

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When a very long coil of tubing is taken to high altitude and one end is opened, most of the gas that filled the coil at ground level will stream out because of the lower pressure. The coil can be taken to high altitude by a balloon (Figure 1) or on an airplane, for example. While the coil descends back to ground level by parachute or still on board the airplane, it will gently fill back up with air as the pressure increases. This preserves concentration profiles of the mole fractions of stable gases encountered along the way proportional to the density of the atmosphere. In the laboratory the profile(s) is (are) "read out" by slowly pushing the gas mixture out of the coil from the back end with push gas, through one or more gas analyzers. While inside the coil, the individual gas species will mix freely through diffusion. The profiles are mostly preserved because pure molecular diffusion is extremely slow on spatial scales of a meter of more. The flow during filling and read-out is very slow and laminar throughout the coil, while gas diffusion in the (small) radial direction is relatively rapid, preventing the laminar velocity distribution inside the coil from causing much mixing in the direction of the long axis of the coil. Some calculations of the expected behavior of this sampling method are described, as well as laboratory tests of the idea and an actual launch on a balloon and recovery carried out by Edge of Space Sciences. The major difficulty with this method is to find suitable materials because the ratio of surface area to gas volume is much higher than we usually encounter with our sampling equipment. This exacerbates any surface adsorption/ desorption effects.

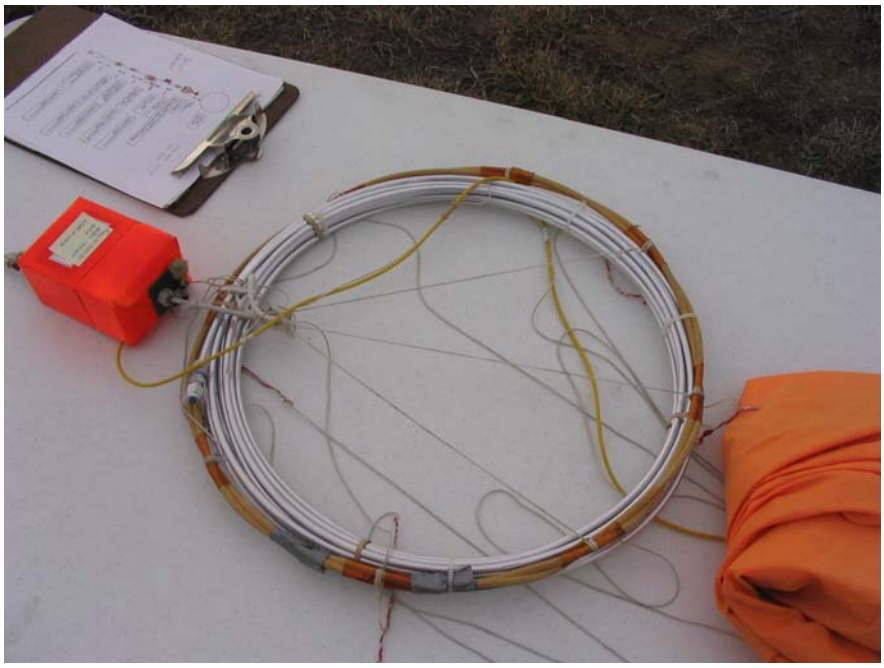

Figure 1. View of the AirCore flown by balloon to an altitude of 80,000 ft (24,384 m) on February 26, 2005. The Aircore in this case is 15-m length of aluminum tubing. The portion of the parachute is in the lower right corner, and the cut-away fuse is in the box on the left.