2B Technologies
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2B Buzz

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Patent Issued for 2B Tech's Aqueous Ozone Monitor

Model UV-106-W Aqueous Ozone Monitor innovations earn patent status

In August, 2B Technologies received word that its UV-106-W Aqueous Ozone Monitor has been awarded a U.S. patent.

The monitor uses MicroSparge™ technology to measure dissolved ozone in water with high precision and accuracy. Unlike most dissolved ozone sensors, the instrument does not make use of a membrane that will foul over time. Instead, dissolved ozone is measured by nearly complete sparging of ~2 mL of water with ozone-scrubbed ambient air and integrating the gas-phase concentration of ozone stripped from solution. A small correction, based on the temporal profile of ozone removed from solution, is made to account for any ozone remaining in solution. Because ozone is measured in the gas phase, interferences from particles and dissolved inorganic and organic compounds are removed, making the instrument applicable to both ultra pure water and "dirty" water, such as drinking water, which can contain a wide variety of dissolved inorganic and organic impurities and suspended particles.

The Model UV-106-W Aqueous Ozone Monitor provides interference-free measurement of dissolved ozone in clean or "dirty" water, in the range of 0 to 100 parts per million (ppm) at a precision and accuracy of 0.05 ppm or 1% of the reading. Measurements are updated every 10 s with a response time of 20 s, and averaging options of 1 minute, 5 minutes, and 1 hour are available. A NEMA waterproof housing is standard with the instrument.

See 2B Tech's website for more information on the Model UV-106-W and an animation showing how it works!

Air Pollution News

Can Air Pollution Invade the Human Brain?

Possible link to Alzheimer's disease needs further study

Air pollution is something we all think about ... but could air pollutants be invading the human brain in a physical sense?

A recent study led by the University of Lancaster in the UK says yes.

Magnetite: A Telltale Sign of Air Pollution

The researchers found magnetite particles inside the frontal cortex of brain samples from people who lived either in Mexico City or in Lancaster. These particles occur naturally in the human brain in an angular form. In pollution, though, they take on a spherical shape -- making them easily distinguishable from natural magnetite.

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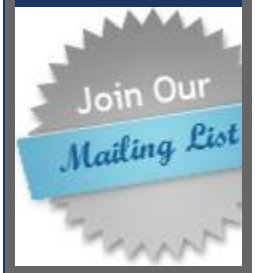
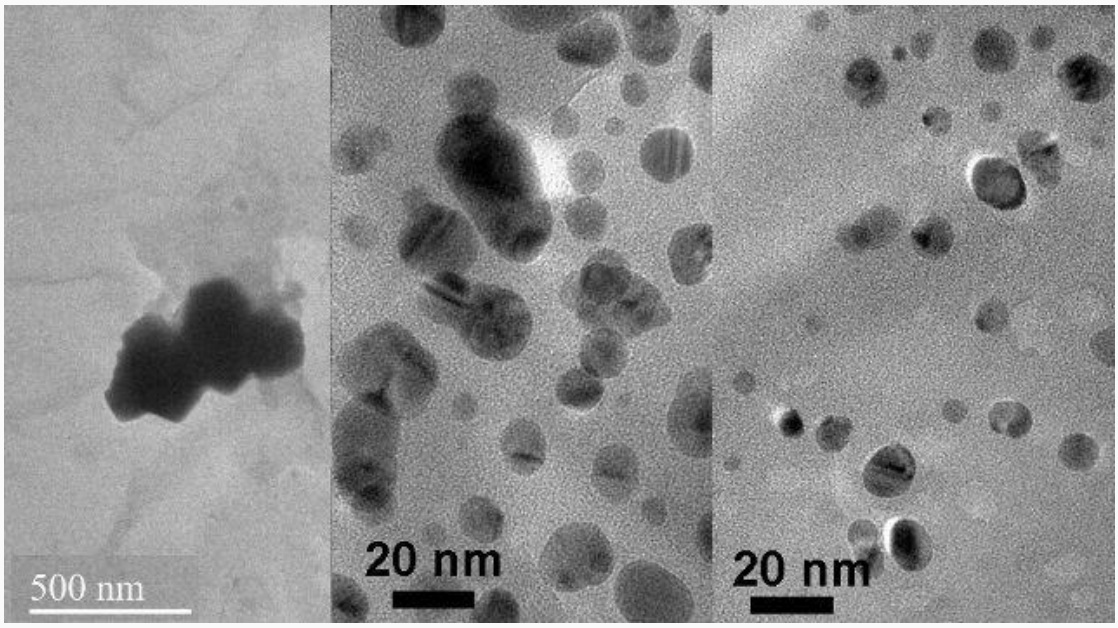


Magnetite particles are always found in pollution, say the researchers. They form inside engines and open fires, and the high-temperature processes lead to their spherical shape. They are a mineral form of iron (iron oxide), and other metals like platinum and nickel can be associated with them. The magnetite particles are believed to be toxic because they form free radicals when they react, which are damaging to brain cells.

The brain may have protection mechanisms for the natural, angular form of magnetite, but may not have defenses for the spherical form found in air pollution.

Two Forms of Magnetite



The angular form of magnetite nanoparticles found naturally in the human brain (left), and the spherical form of magnetite found in the brain (middle) and in pollution (right).
Source: B. Maher, University of Lancaster, UK.

Lead researcher Barbara Maher says the most likely point of entry for the pollution particles is from the olfactory bulb located at the top of the nose. They first enter the bloodstream, and then the brain. Once in the frontal cortex, the particles could be transported to other regions of the brain.

Trouble on Multiple Health Fronts?

It's widely known that air pollution can cause respiratory illnesses. Previous studies suggest that the magnetite particles might also be linked to Alzheimer's disease, because of the highly damaging free radicals they release. Evidence is preliminary for this, though, and researchers stress that much more study is needed. Maher and her colleagues are planning more extensive research on the occurrence and toxicity of pollution-derived magnetite.

"If these particles are having an impact, then as a society we need to do something about it," Maher said. "That's what we now need to go and investigate."

The study was published on 5 September 2016 in the *Proceedings of the National Academy of Sciences*. The University of Lancaster led the study, and scientists from universities in Oxford, Manchester, Glasgow, Mexico City, and Missoula, Montana, collaborated in the research.

[B.A. Maher, I.A.M. Ahmed, V. Karloukovski, D.A. MacLaren, P.G. Foulds, D. Allsop, D.M.A. Mann, R. Torres-Jardon, and L. Calderon-Garciduenas, "Magnetite pollution nanoparticles in the human brain," *Proceedings of the National Academy of Sciences*, doi:10.1073/pnas.1605941113, 2016.]

Case Study:
2B Tech's Model 205 Dual-Beam Ozone Monitor Helps Diagnose Ozone Issues in the Nation's Second Highest "Extreme Nonattainment" Area

Three Model 205 Ozone Monitors provide key data in California study

Despite dramatic improvements in California's air quality, some areas of the state still do not meet the federal ozone standard. In fact, only two places in the U.S. are classified by the EPA as an "extreme" nonattainment area, and they're both in California. It will surprise no one that the Los Angeles area is one of them. The other is perhaps less obvious. The largely agricultural central valley of California, known as the San Joaquin Valley, has the second-highest number of ozone exceedances in the nation.

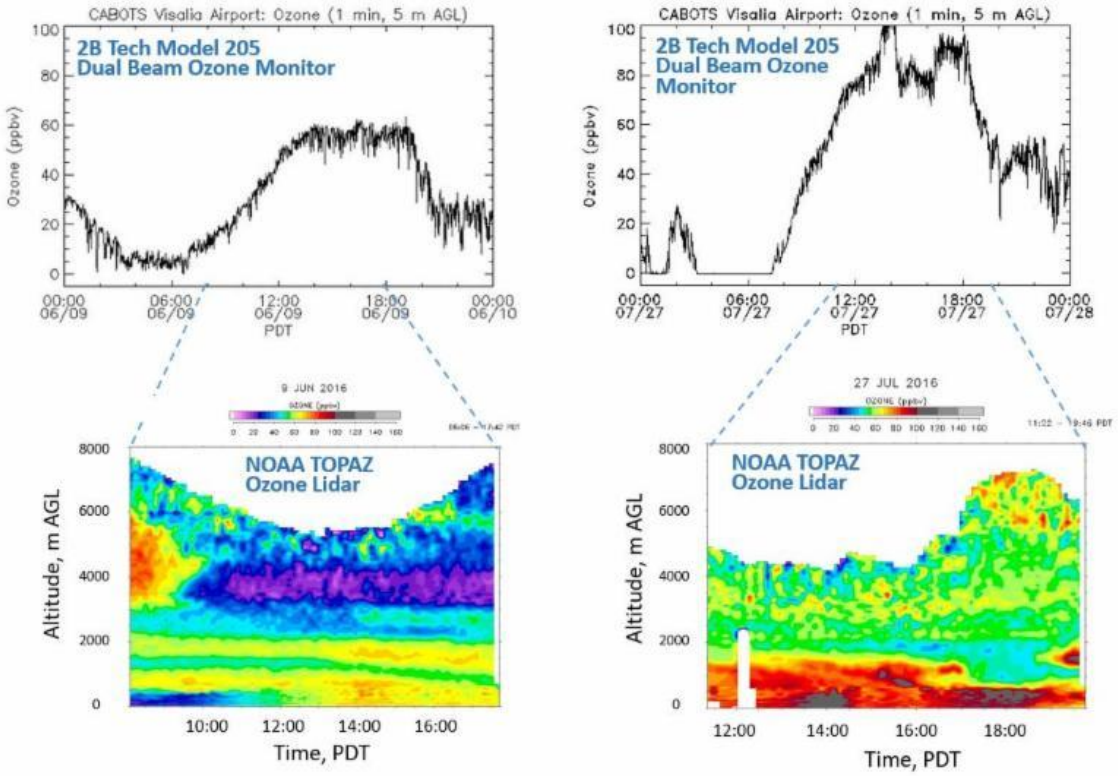
Photo credit: Phil Hawkins.

Map: EPA.

Researchers from NOAA, NASA, the private sector, and universities joined forces with the California Air Resources Board (CARB) this past summer to look at how outside sources of ozone pollution may be affecting the ability of the San Joaquin Valley to meet the ozone standard. The study, called the California Baseline Ozone Transport Study (CABOTS), looked at how much ozone is "imported" by winds coming from the west, across the Pacific Ocean. A 3-week spring study period (late May to mid-June) captured the season when transport is largest. A 3-week summer study period, from July to August, looked at the "ozone season" when locally produced ozone is highest.

Three 2B Technologies' Model 205 Dual Beam Ozone Monitors were in the skies and on the ground during CABOTS. One of the 205s provided round-the-clock ground measurements near the Visalia airport, from inside a van where NOAA also operated its Tunable Optical Profiler for Aerosol and oZone (TOPAZ). This Model 205's measurements gave a point of comparison for the ozone profiles made by the TOPAZ, which uses a scanning differential absorption lidar to measure ozone and aerosols from near the ground surface to ~6 kilometers aloft. The ground-based Model 205 operated continuously from May through August, even in periods outside of the two 3-week experiment periods. NOAA and CIRES researchers Andrew Langford and Christoph Senff noted that the instrument operated flawlessly

throughout the ~3 months of measurements, save for a clogged inlet that occurred during the extended period when the instrument ran unattended in the middle of the mission. The figure below shows two days of the preliminary data. A treasure trove of the preliminary ozone data from the TOPAZ and the 2B Tech Model 205 is posted on the NOAA website (http://www.esrl.noaa.gov/csd/groups/csd3/measurements/cabots/).



Measurements of ground-level ozone from the 2B Tech Model 205 Ozone Monitor (top) and ozone profiles from the NOAA TOPAZ lidar (bottom) on two days of the CABOTS field mission, taken near the Visalia airport in the San Joaquin Valley. Data are preliminary. The plots on the left were from a day during the middle of the springtime measurement period (June 9), and show a diurnal cycle with an ozone peak of ~60 parts per billion by volume (ppbv) at ground level. The data in the top trace can be compared to the lowest-altitude data of the TOPAZ data shown in the panel beneath it. The plots on the right were made on July 27 during the high-ozone season deployment of CABOTS. They show one of the three days during the mission in which exceedances of the federal ozone standard were observed at the official ozone monitoring site in downtown Visalia. A double peak in ozone at ground level can be seen in both the Model 205 ground data and the TOPAZ data. Meteorological data show that this frequent behavior occurred when the winds shifted direction at midday. The instruments were located near a busy roadway with high levels of nitrogen oxides (NOx). The Model 205 data show that ozone was titrated to ~zero at night by the NOx. [Data courtesy of the NOAA Earth System Research Laboratory, Chemical Sciences Division.]

Two other Model 205's were on board research aircraft for the flights that took place during the 6 weeks of CABOTS. One of the 205s was in a single-engine Mooney aircraft operated by Scientific Aviation, Inc.; the other was in the NASA Alpha Jet, a modified tactical strike fighter aircraft operated by the NASA Ames Research Center. The objective of the airborne and TOPAZ measurements was to get a sense of how much ozone was aloft and could be attributed to sources to the west of San Joaquin Valley, such as western California and even across the Pacific Ocean. Several of the flights took place over Visalia where the TOPAZ was measuring profiles, which will enable the researchers to use multiple data sets in some of their analyses.

The scientists are now busy analyzing the data, a process that will take many months. They already know that CABOTS will be an even richer source of information than they expected, because of an influx of smoke from the Soberanes fire upwind of Visalia during the late-summer measurement period. This fire started in late July and burned over 130,000 acres before being contained in mid-October, making it the costliest fire to fight in US history (>$200 million). So as it turns out, the CABOTS data will enable the researchers to see how fires as well as transport affect the San Joaquin Valley's ozone pollution.

For more about the CABOTS mission, visit the NOAA Chemical Sciences Division website (http://www.esrl.noaa.gov/csd/projects/cabots/).

In the CABOTS field mission, one of 2B Tech's Model 205 Ozone Monitors was inside the NOAA van at right, making round-the-clock ground measurements of ozone from May to August. Also in the photo, the NASA Alpha Jet is seen in the distance during a low approach at Visalia Airport, with a second Model 205 on board. A third model 205 made airborne measurements from a Mooney single-engine research aircraft (not shown). Photo by Raul Alvarez, NOAA.

2B Technologies

Promotion: The Model 405 nm NO_2/NO/NO_x Monitor™

FEM approval expected soon!

- **Direct measurement of nitrogen dioxide (NO_2) by absorbance at 405 nanometers**
- **Nitric oxide (NO) measured by selective conversion using reaction of NO with O_3**
- **Range of 0 - 10,000 ppb for NO_2; Range of 0 - 2,000 ppb for NO**
- **Essentially interference-free; insensitive to other nitrogen-containing compounds**
- **Doesn't require an NO_2-to-NO converter; allows measurements with efficiency unmatched by chemiluminescence instruments**
- **New design with a folded cell and corner mirrors (~2-meter path length)**
- **Modes: NO_2 only; NO only; NO_2, NO, and NO_x**
- **New measurement produced every 5 seconds**
- **More information: http://www.twobtech.com/model-405-nm-nox-monitor.html**

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The *2016 Best of Both Worlds* Conference: Success!

2B Tech co-hosted this international conference on environmental education

Over 100 education professionals and researchers from around the world gathered in Estes Park, Colorado, during September 26-28 for the Best of Both Worlds conference. Participants from Malaysia, South Africa, Brazil, Nepal, China, Canada, and the U.S. gave talks and participated in workshops and discussions about environmental education and education for sustainable development.

Photo credit: Matthew Blodgett, 2B Technologies.

Dr. John Birks, President of 2B Technologies and its nonprofit, the GO3 Foundation, co-hosted the conference with Melinda Merrill of the Estes Park Environmental Center. Jessa Ellenburg and Jessica Hatz of the GO3 Foundation put together a program of over 25 talks and 6 workshops, and several of the 2B Technologies staff helped out during the conference.

Author Jeffery Bennett was on hand to sign copies of the two books that he donated to all attendees: *The Wizard Who Saved the World* (a children's book) and *A Global Warming Primer: Answering Your Questions About the Science, the Consequences, and the Solutions*. Attendees were enthusiastic about using these books in their teaching and programs.

Participants went home with new ideas and techniques they could use in their work, and many new contacts for collaborations on future projects.

Next year's Best of Both Worlds conference will be hosted by South Africa.

Employee Introductions

2B Technologies is pleased to announce a returning member of the 2B Tech Team.

Jason Prince

Jason Prince is an undergrad at Stanford University who has worked as a student intern at 2B Tech for several years. He is currently working on software for a data management framework that will go into many of our instruments. Jason is founding a nonprofit to further develop this open source software.

We welcome Jason back to 2B Tech!

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