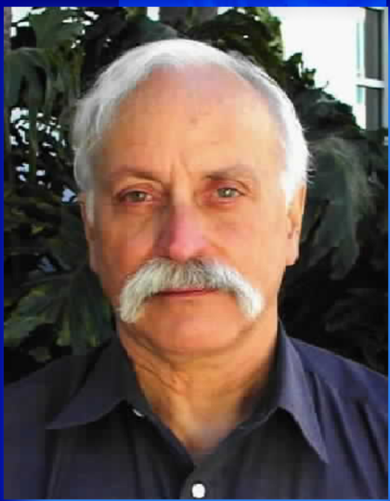
# Quantum Leaps in $CO_2$ Detection
## Robert Byrne, Ph.D.

USF chemical oceanographers are making quantum leaps in measuring carbon dioxide ($CO_2$) in the oceans and measuring the interactions of $CO_2$ between the water and the atmosphere. Such measurements are very important because of the rising amount of $CO_2$ absorbed by the world's oceans. This increase in $CO_2$ has a profound effect on all humanity in that these more acidic conditions are seriously threatening basic life forms - forms that are essential links in the ecological food chain.



Our instruments allow determinations of the concentrations of biologically important nutrients and trace metals. They also allow determinations of important characteristics of the marine $CO_2$ system. Measurements with our systems allow descriptions of the potential for growth of organisms in seawater, the capacity of seawater for $CO_2$ uptake from the atmosphere and, in general, observations of human-induced perturbations of natural systems. All of our instruments can operate at depths up to 1,000 meters (soon to be expanded to 6,000 meters) - this capability is decidedly unique.

We can deploy these instruments in a variety of ways; i.e., in-situ, on shipboard, buoys, autonomous underwater vehicles (AUVs), remotely-operated vehicles (ROVs), etc. Our in-situ instruments are designed to measure a very wide variety of chemicals in seawater. Each in-situ instrument measures a single type of chemical. Our in-situ instruments are unique with respect to optical cell design. The light path in our optical cells is on the order of one to two meters. Other systems have path lengths that are shorter by one to two orders of magnitude. This longer path length means we can observe concentrations that are at least ten times lower than can be observed with other systems. Our systems are versatile. Any single instrument can be used for a wide variety of types of chemical measurements. Our instruments can (uniquely) measure chemicals by observing either light attenuation, as described above, or fluorescence, in which case light of one color impinges on a sample, and re-emitted light (having a different color) is observed for quantification of concentrations.

USF UNIVERSITY OF SOUTH FLORIDA
COLLEGE OF MARINE SCIENCE

# Quantum Leaps in $CO_2$ Detection
## Robert Byrne, Ph.D.

When deployed on shipboard our shipboard instrumentation measures many $CO_2$ system parameters simultaneously. For example, we have the unique capacity to simultaneously measure pH (solution acidity), total dissolved inorganic carbon (DIC) and a parameter, called the $CO_2$ fugacity, which depicts the tendency for $CO_2$ to escape into the atmosphere. We also are able to measure the concentration of $CO_2$ in the atmosphere.

The capabilities provided by these instruments are much sought after for robust global observations of the response of the oceans to rising atmospheric $CO_2$.