

US Navy Submarine Sea Trial of the NASA Air Quality Monitor

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For the past four years, the Air Quality Monitor (AQM) has been the operational instrument for measuring trace volatile organic compounds on the International Space Station (ISS). The key components of the AQM are the inlet preconcentrator, the gas chromatograph (GC), and the differential mobility spectrometer. Most importantly, the AQM operates at atmospheric pressure and uses air as the GC carrier gas, which translates into a small reliable instrument. Onboard ISS there are two AQMs, with different GC columns that detect and quantify 22 compounds. The AQM data contributes valuable information to the assessment of air quality aboard ISS for each crew increment. The U.S. Navy is looking to update its submarine air monitoring suite of instruments, and the success of the AQM on ISS has led to a jointly planned submarine sea trial of a NASA AQM. In addition to the AQM, the Navy is also interested in the Multi-Gas Monitor (MGM), which was successfully flown on ISS as a technology demonstration to measure major constituent gases (oxygen, carbon dioxide, water vapor, and ammonia). A separate paper will present the MGM sea trial results.

A prototype AQM, which is virtually identical to the operational AQM, has been readied for the sea trial. Only one AQM will be deployed during the sea trial, but it is sufficient to detect the compounds of interest to the Navy for the purposes of this trial. A significant benefit of the AQM is that runs can be scripted for pre-determined intervals and no crew intervention is required. The data from the sea trial will be compared to archival samples collected prior to and during the trial period.

This paper will give a brief overview of the AQM technology and protocols for the submarine trial. After a quick review of the AQM preparation, the main focus of the paper will be on the results of the submarine trial. Of particular interest will be the comparison of the contaminants found in the ISS and submarine atmospheres, as both represent closed environments. In U.K. submarine trials in the early 2000s, the submarine and ISS atmospheres were found to be remarkably similar.