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The use of SF_5CF_3 for tracer release experiments

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Sulfur hexafluoride (SF_6) has been released in several experiments in the open ocean to study ocean mixing, gas exchange, and as a marker in iron fertilization experiments. However, SF_6 has great potential as an anthropogenic transient tracer invading the ocean from the atmosphere, due to its rapidly increasing mixing ratio over the past few decades. Development of an alternative tracer for large oceanic experiments would eliminate potential interference between the two uses. Also, the addition of a second tracer for experiments involving small releases could be advantageous. We have tested trifluoromethyl sulfur pentafluoride (SF_5CF_3) in a pilot experiment in Santa Monica Basin, off the coast of Southern California (sill depth = 737 m; maximum depth = 920 m). Approximately ten moles of both SF_6 and SF_5CF_3 were released in a uniform mixture on an isopycnal surface near 800 m depth in January 2005, and the distributions of the two tracers were followed and compared for 23 months. Concentrations of the two tracers mirrored each other very closely, small differences being attributable to there being a background of SF_6 but not of SF_5CF_3. Sensitivity of a GC/ECD to the two tracers is virtually the same. However, solubility of SF_5CF_3 at pressure is 7 times less than that of SF_6, making release more difficult, and increasing the likelihood of SF_5CF_3 partitioning onto particles. Nevertheless, signs of particle transport of SF_5CF_3 relative to SF_6 in Santa Monica Basin, which has a much higher particle flux than the open ocean, are very weak. We conclude that SF_5CF_3 is a viable tracer for ocean tracer release experiments. This compound, however, is not commercially available, and must be manufactured by specialty companies specifically for tracer work, making it about seven times more expensive than SF_6. Both compounds are potent greenhouse gases with Global Warming Potential, as defined by IPCC, about 20,000 times greater than CO_2. The global warming potential of a large tracer release is similar to that of the fuel burned by the ships conducting the experiment. Tracer release experiments using the new tracer are currently being planned for the Eastern

Tropical North Atlantic and the Southern Ocean. This work is supported by NSF Grant OCE-0425197.