FLUIDS

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Far Below the Surface of the World's Oceans, a Tough Place for Foam Cups

Left, Peter Batson; above, Tony Cenicola/The New York Times

SEA SHRINKS FOAM Cups and their messages back from the Arctic Ocean: left, from recent Russian dives; right, from an earlier dive, with a landlubber.

By WILLIAM J. BROAD

Published: March 25, 2008Last August, as a team at the North Pole prepared to plunge more than two miles to the bottom of the Arctic Ocean, some of the dozens of specialists who staged the dive engaged in a time-honored ritual: drawing on foam cups, decorating more than 100 of them. The cups were then gingerly sent into the deep. During the historic dive, led by Russian scientists, the pressure of the surrounding water crushed the cups to the size of thimbles, also squeezing their whimsies of writing and drawing. Deep explorers have made thousands of such keepsakes over the decades, and more recently, schools have joined the fun as a way to drive home some of the peculiarities of a planet where very deep water covers some 65 percent of the surface. A comparison to air pressure helps. At sea level, atmospheric pressure is 14.7 pounds per square inch. The deeper the dive, the greater the water pressure. At the resting place of the Titanic**, more than two miles down, the pressure is 2.8 *tons* per square inch.** That constantly bears down and tries to obliterate any void. The pressure on any object in the deep sea, as at sea level, is uniform. It presses from above, below and the sides. That is because the molecules making up fluids (which in physics include both gases and liquids) are free to move about and transmit force in all directions. Sea creatures are made primarily of water, which is virtually incompressible. So they escape destruction in the abyss. But the high pressure causes most cavities and hollows, like human lungs, to collapse. So, too, with foam cups. They are almost all void since the foam is 95 percent air, according to the American Chemistry Council. As pressures build during descent, the air slowly compresses and the cups shrink.

Question: Using concepts from hydrostatics[p = (weight density) X depth] show that 2 miles deep under ocean the pressure is indeed 2 tons/inch^2? Hint(s): D(weight density of water) = 62.4 lb./ft^3, 1 ft^2 = 144 inch^2 . 2000 pounds = 1 ton .