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Non-Brownian Bubble Movement in Fluid Inclusions—A Thermal Gradient Detector of Extreme Sensitivity and Rapid Response (pub. 1966)

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The gas (vapor) bubbles in many natural and "synthetic" fluid inclusions, if free of the walls, move through the liquid when a thermal gradient is impressed upon the enclosing material. The phenomenon can be used for rapid recognition of differences in composition (and therefore origin) between some otherwise similar inclusions or groups of inclusions.

Movement direction is almost independent of gravity; it is either *up* or *down* the thermal gradient, even in adjacent inclusions in the same sample. However, some bubbles, although free to move, fail to respond. All free bubbles of a given inclusion generation move in the same direction. A motion picture shows some examples: each puff or room-temperature air blown on a sample warmed slightly by ordinary microscope lighting caused bubble movement, even 20 puffs/second; a warmed needle oscillating at 6-8 cycles/second in contact with the surface of a quartz plate caused a bubble located 0.9 mm below the surface to oscillate, horizontally, the inclusion length (50 μ) for each cycle; the thermal gradient from a shadow over part of the microscope field caused bubble movement across the "terminator" in seconds. Movement rate is directly related to gradient magnitude and inversely related to bubble size. Both rate and direction of movement are sensitive, but at present inexplicable, functions of liquid composition and ambient temperature.

The cause of movement presumably is rapid surface diffusion of liquid at the bubble interface, but because of the extreme sensitivity, quantification of the effect has not been achieved.