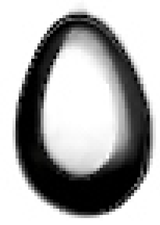
Eggs, pears and squashes: the shape of air bubbles trapped in ice

Virgile Thiévenaz and Alban Sauret
UC Santa Barbara

growth of a pear bubble at 54 µm/s

Air is soluble in water but not in ice. When water freezes, any solute must be expelled for ice crystals to grow. As the freezing front advances, dissolved gases accumulate until their concentration reaches the limit of solubility. Bubbles then nucleate at the ice-water interface or in its vicinity, and are captured by the growing ice. The dissolved gases transfer into the bubbles and inflate them while the ice keeps growing. At some point, the bubbles stop growing, and the part that exchanges mass with the water shrinks. Eventually, they close. Many bubbles are thus trapped in the ice (bottom). Their shapes resemble eggs, pears, and squashes depending on their freezing conditions.

Squash bubble, 13 µm/s



Large egg bubble, 21 µm/s

Small egg bubbles, 90 µm/s