CRYSTAL GROWTH IN EGGSHELLS

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SUMMARY

Preferred orientation in the eggshells of the crocodiles, turtles and birds is shown by X-ray diffractometry to develop throughout shell deposition. In all shells, the texture that develops is one in which the (001) plane of the unit cell tends to lie parallel to the shell surface. The degree of texture varies from being high in the calcite of the ratite and tinamou shells and the aragonite of the turtle shells to low in the calcite of the crocodilian and carinate shells. A model is proposed for the deposition of the entire eggshell. This model explains the observed textures and fracture morphologies of the shells. In each shell column, crystal deposition is initiated at a single location, from which growth fans out at all angles to the shell normal. In both calcitic and aragonitic shells, growth is in the [001] direction, resulting in an increase in the degree of (001) preferred orientation with distance from nucleation. Where there is unhindered crystal growth, the shells show a crystalline fracture morphology, and the degree of texture that develops is a simple function of the column radius. This type of growth makes up the whole of the turtle shell, the inner 0.3 to 0.4 of the thick ratite shells and the cone layer of the other avian shells. At the start of the central layer of the avian shell, the onset of protein deposition coincides with a hindrance to texture development, which thereafter proceeds at a lower rate. A further hindrance occurs about half-way through the shell, probably caused by a change in the physical characteristics of the protein network. The degree of texture that develops in the avian shell is a function of the column radius and the degree of physical hindrance presented by the protein network. The central layer of the avian shell

has a composite fracture morphology resulting from the intermingling of the network with the inorganic phase. The organic component does not appear to control crystal growth as previously believed, but instead acts as a reinforcing fibrous network.

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