ON THE ORIGINS OF UPTHRUSTS

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Upthrusts can originate from strike-slip faulting and from differential rotation of asymmetric blocks. Upthrusts are known along several major strike-slip faults and they can also be produced by purely lateral motion in clay experiments. Those of strike-slip origin are a class of upthrust in which compression plays an important role.

The asymmetric-block upthrusts of the Rocky Mountains foreland type do not show the effects of strong compression; nor do they usually show the expected geometric pattern of strike-slip; nor has strike-slip been demonstrated for them by piercing points. They may evolve by block rotation from both normal faults and previously formed strike-slip faults at depth.

Field observations suggest that upthrusts can become normal faults at depth. This evidence has prompted clay-model experiments in which an upthrust was created in clay above a preexisting normal fault separating two wooden blocks as the blocks were differentially rotated. A model of differential block rotation satisfies fundamental observations about the asymmetry and the amount of compression associated with asymmetric-block upthrusts. Their asymmetry can be created, or inherited, or both, from the deeper normal-fault geometry of tilted, rotated blocks, where the normal-fault face constitutes an asymmetric, steep flank, and the gentle flank is the unfaulted, tilted side; asymmetric basins are similarly explained, essentially as half-grabens. Compression from differential rotation of blocks is manifest mainly at the junction of the blocks. However, since differential rotation puts entire segments of basins under compression which effectively acts as a body force, bedding-plane thrusts can occur basinward of the upthrust zone in the sedimentary sequence where shear strength is exceeded by compressional stress.

Biographical Sketch -- Dr. James D. Lowell

James D. Lowell was graduated from the University of Nebraska with a B. Sc. in 1955, and from Columbia University with an M.A. in 1957 and a Ph.D. in 1958.

He was employed by American Overseas Petroleum Limited from 1958-1965, engaged in petroleum exploration for four years in Libya, two years in the Netherlands, and one year in Spitsbergen. He was Assistant Professor of Geology at Washington and Lee University in 1965-1966. Since 1966, he has been with the Structural Geology Section of Esso Production Research Company.

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