Roof Breakup and Extrusion of Shallow Salt Stocks During Lateral Shortening

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We used scaled physical models made of dry granular materials and silicone to explore the far-reaching effects of regional shortening on near-surface structural evolution of diapiric stocks. The squeezed stocks extruded salt sheets in three stages as different parts of the diapir and its source layer supplied salt.

First, lateral squeezing caused salt to rise from the core of the previously dormant stock. Successively deeper parts of the stock's core rose to the surface. The thin roof arched then fragmented into rafts, which were dispersed and rotated by shear traction of spreading salt. As roof rafts approached the front of the extrusive flow they grounded and were overrun by the expanding salt sheet. These stranded fragments created a scalloped extrusion front, common in submarine salt glaciers in the Gulf of Mexico and subaerial ones in Iran. The scallops comprised alternating lobes, where salt spread laterally, and cusps where salt flow was impeded by stranded roof rafts.

Next, after 15% shortening of the diapir, salt containing markers from the source layer reached the surface as an axial plume contributing to the expanding salt extrusion. This axial stream was driven out of the source layer mostly by displacement loading of the source layer by the thrust blocks that gradually engulfed the stock. After 25% shortening, a central thrust block, or primary indenter, began to move ahead of surrounding thrust blocks and impinge on the yielding stock. This indenter increased the rate of salt expulsion.

The third stage of extrusion began after approximately 50% shortening. Secondary indenters converged obliquely into the salt stock, expelling salt formerly sequestered in the periphery of the diapir as extrusive lateral plumes flanking the axial plume.

Stock attitude, bathymetry and roof density also affected extrusion rates and thicknesses. Stocks leaning seaward extruded salt faster and further than upright stocks. Dense roofs foundered and blocked the vent limiting surface extrusion. In models having a regional dip slope the broad, unimpeded, salt sheets were so thin they resembled salt welds in cross section.

The models thus have implications for (1) large inclusions within allochthonous salt, (2) cuspate margins of salt sheets, and (3) interaction of thrusting, diapir pinch-off, and emplacement of allochthonous salt sheets.