Seal Controls on Oil and Gas Distribution in Over-Pressured Reservoirs

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Distribution of overpressure and hydrocarbon phases in the Eugene Island Block 330 Field, Gulf of Mexico, demonstrates that reservoir plumbing is an important control on trap fill. The results of this study support previous suggestions that episodic slip on critically stressed faults provides dynamic control of hydrocarbon column heights in some of the fault blocks.

On the hanging-wall of the field's growth fault system, pore pressures in the OI reservoir at the top of the structure are noticeably higher than porosity-based pressure predictions for the top seal. In addition, aquifer pressures in the reservoir vary markedly from fault block to fault block, implying significant differences in reservoir plumbing.

Fault blocks with relatively lower aquifer pressures contain large gas columns with small oil rims. Down-flank spill or leak points control the total column height, while capillary seal capacity limits the amount of gas. In this situation, gas leaks at the crest of the structure and is unable to flush oil out of the trap.

In contrast, fault blocks with markedly higher water phase pressures are significantly under-filled, and contain only small oil columns. As the pressures at the top of the columns are greater than 92% of the least principal stress, we propose that critically stressed faults control trap fill. In this scenario, any additional hydrocarbon charge increases pressure, inducing slip on bounding faults and causing the hydrocarbon phase at the trap crest to leak. Thus when this mechanism operates, gas leaks preferentially from the trap, leaving an oil column behind.