A MODEL FOR POROSITY REDUCTION BY QUARTZ CEMENTATION IN ANTICLINAL STRUCTURES

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Quartz overgrowths occur commonly in gas and oil reservoirs, particularly in anticlinal structures. The source of silica for these overgrowths has been variously postulated to have been derived locally from pressure solution of detrital quartz grains, to have been supplied from nearby shales or from the breakdown of unstable silicates such as feldspars. Another solution to this source problem is to assume that silica was leached in small amounts from large volumes of the reservoir itself, transported to the anticline and concentrated there. This model requires a fluid flow field which converges on positive structures and which cuts across isotherms in the vicinity of the anticlines.

Fluid dynamic calculations suggest that such a flow field should exist in very porous rocks which have been gently folded. If the fluid maintains chemical equilibrium with the detrital quartz grains, it follows that silica must be transported to the anticline and deposited there since the solubility of quartz decreases with temperature. Detailed calculations of the mass transfer indicate that significant porosity reductions (on the order of 1-2 per cent) should occur in times as short as 50,000 years. In a reservoir, containing 100,000 barrels of oil with 25 per cent porosity, this mechanism will thus transfer on the order of 10,000 barrels of quartz to the trap in that time. It is suggested that slow convective fluid flow is responsible for much of the mass transfer in anticlinal structures.

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