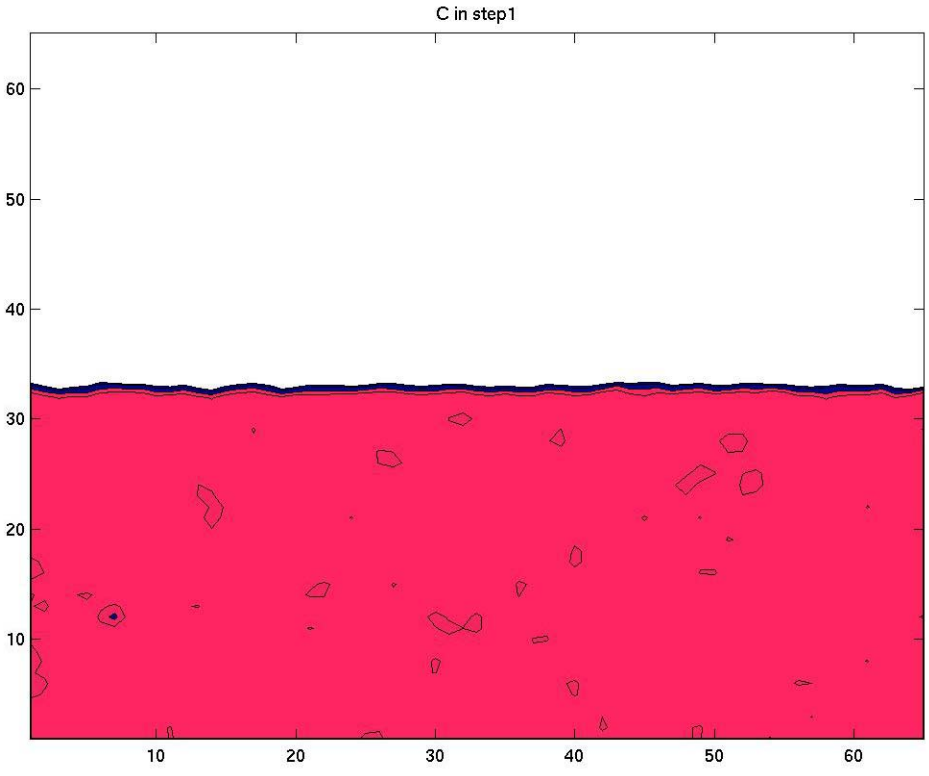
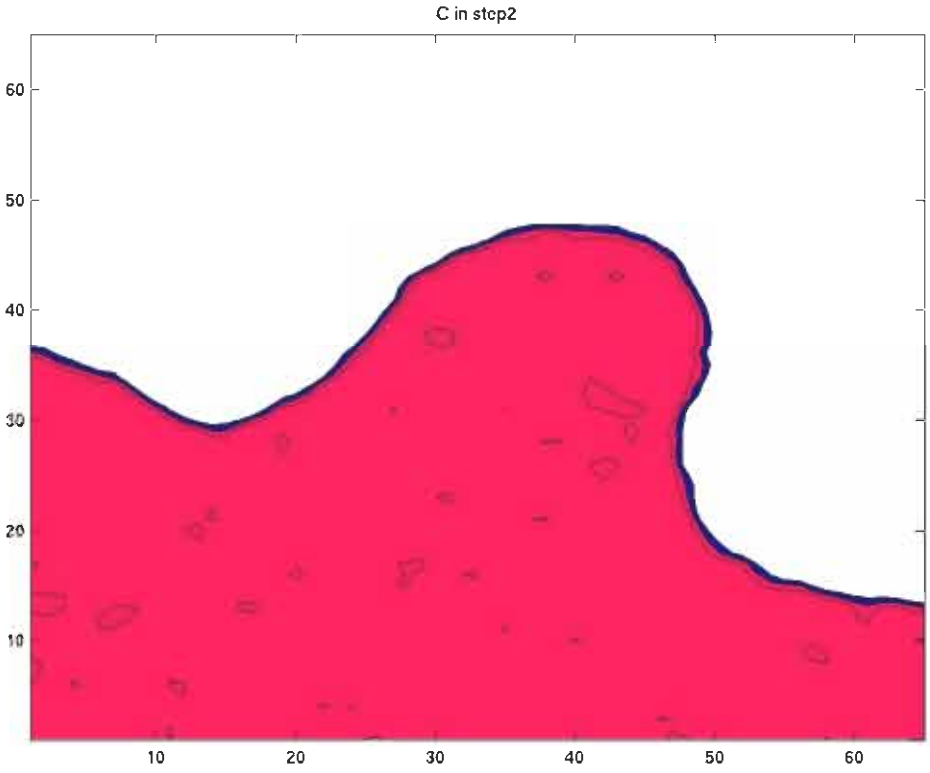
12.520 Lecture Notes 24

Rayleigh - Taylor Instability

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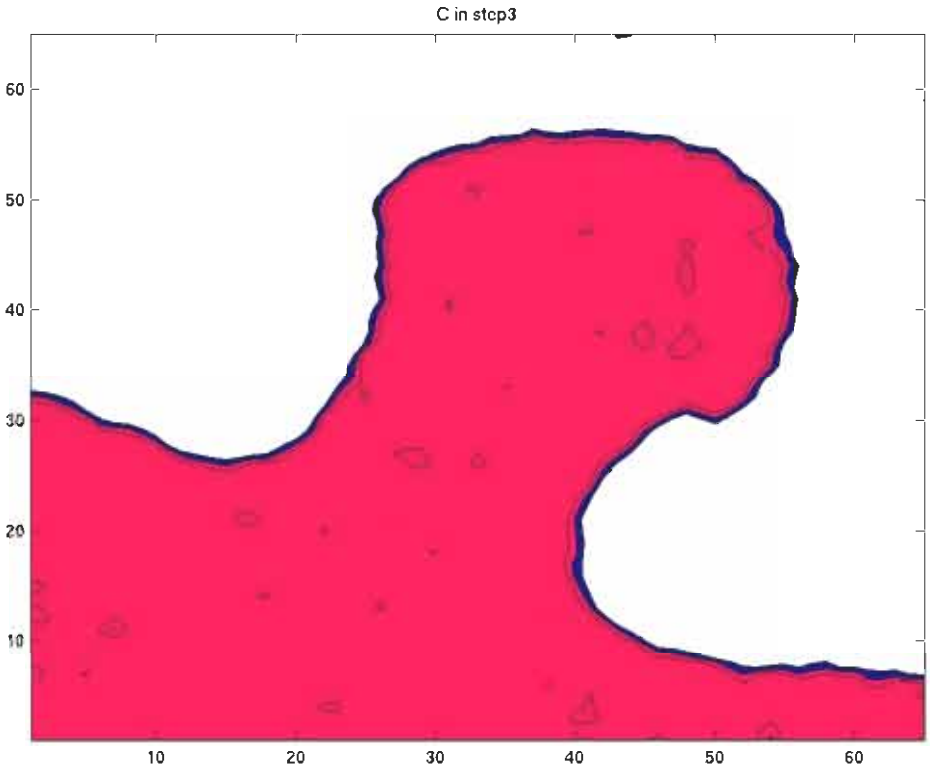
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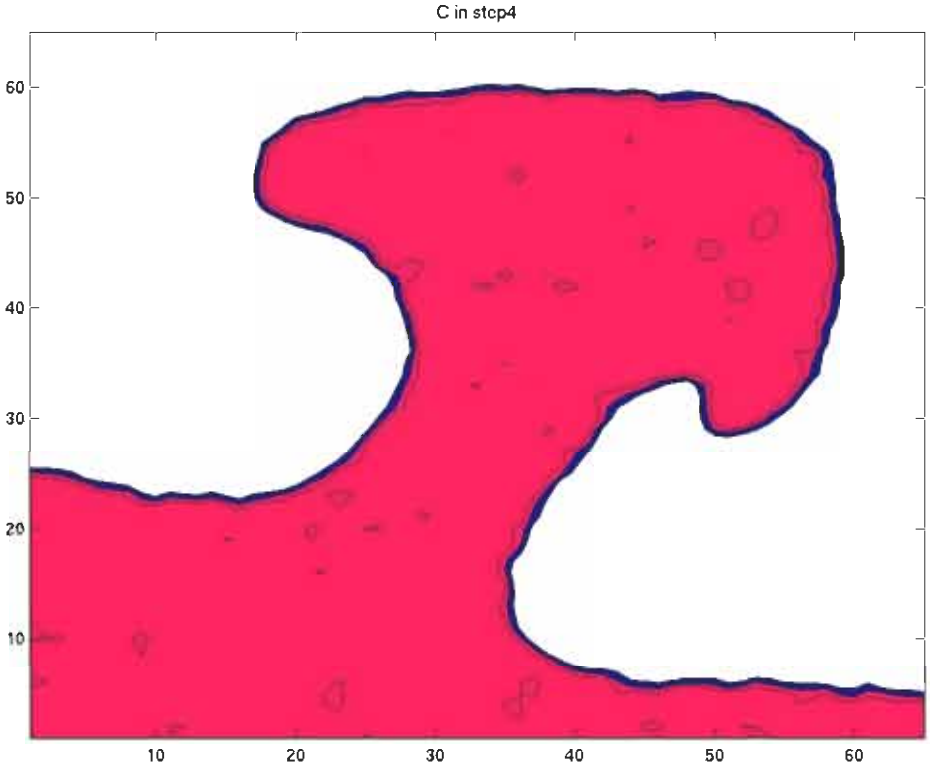
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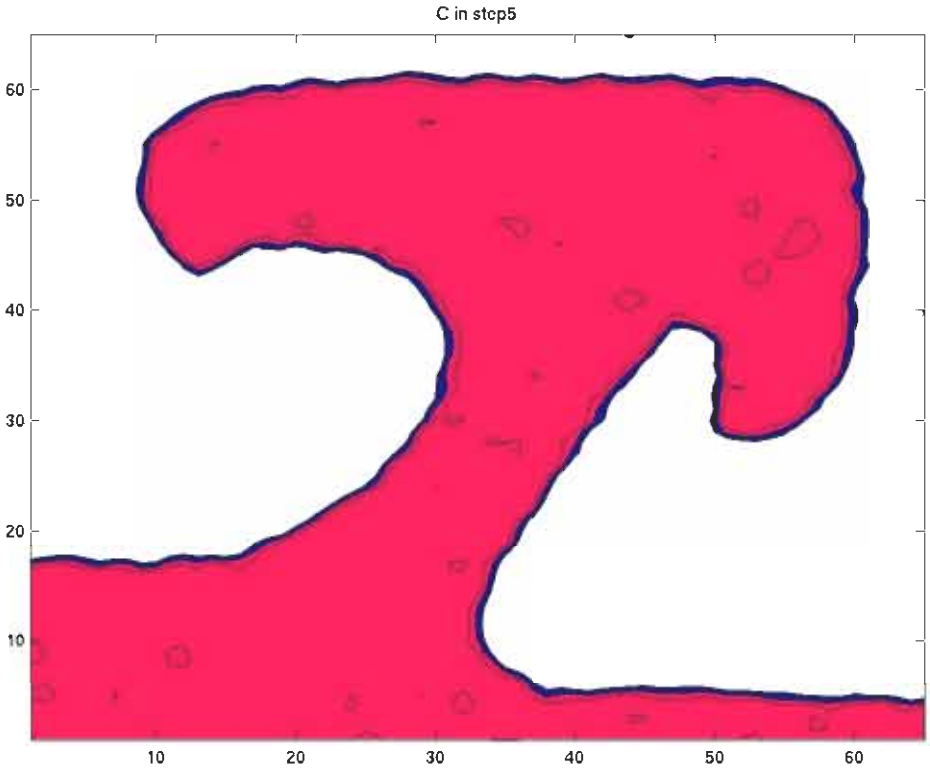
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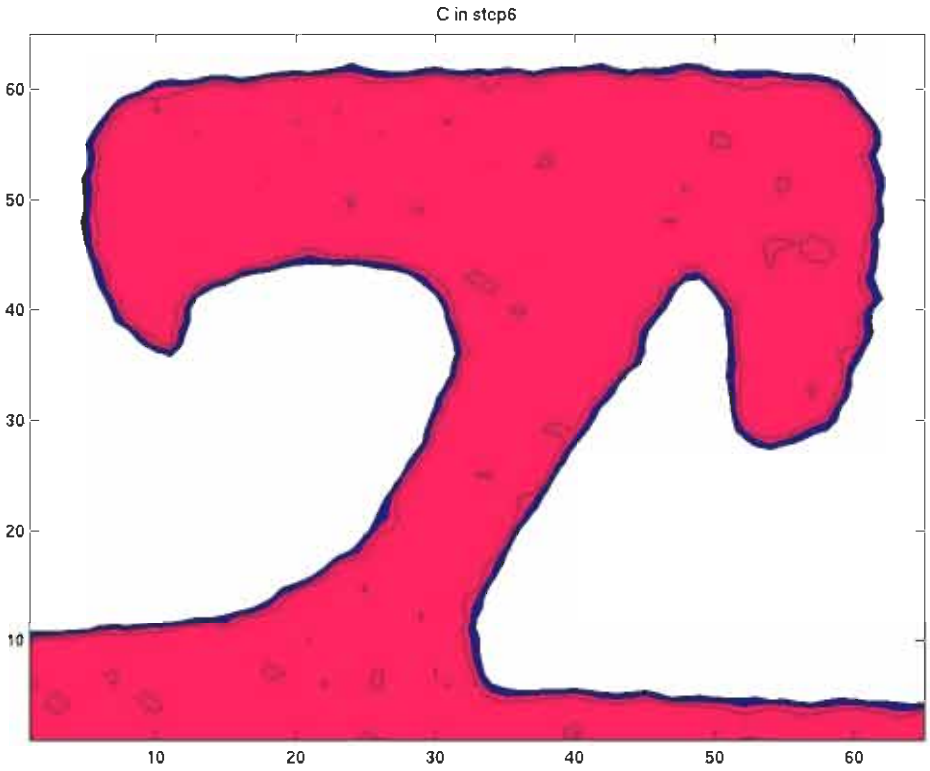
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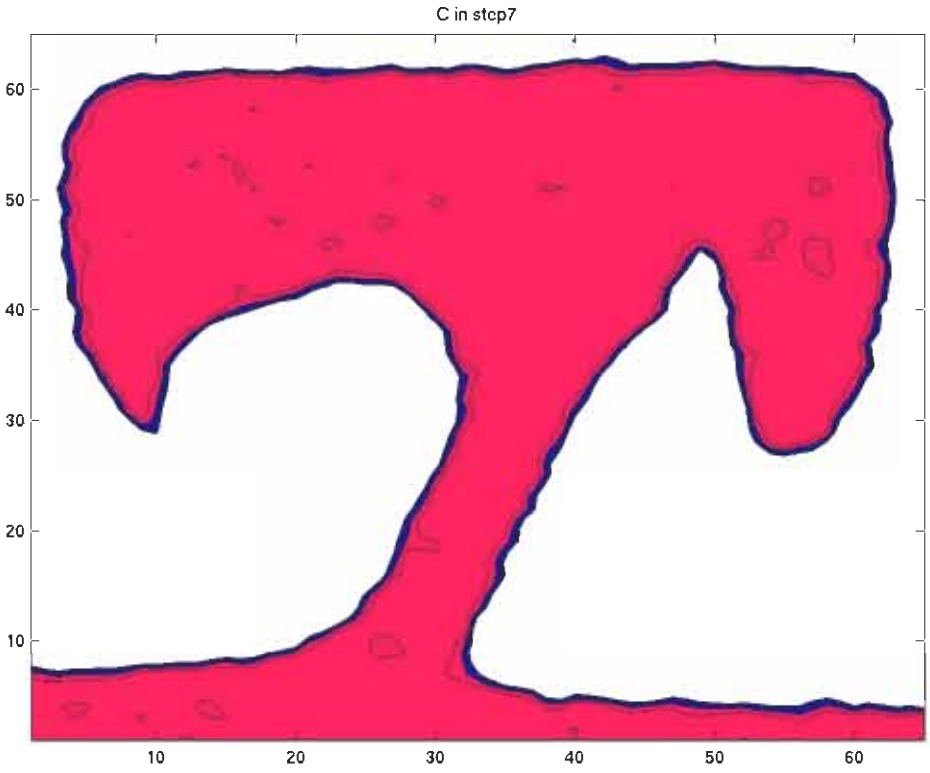
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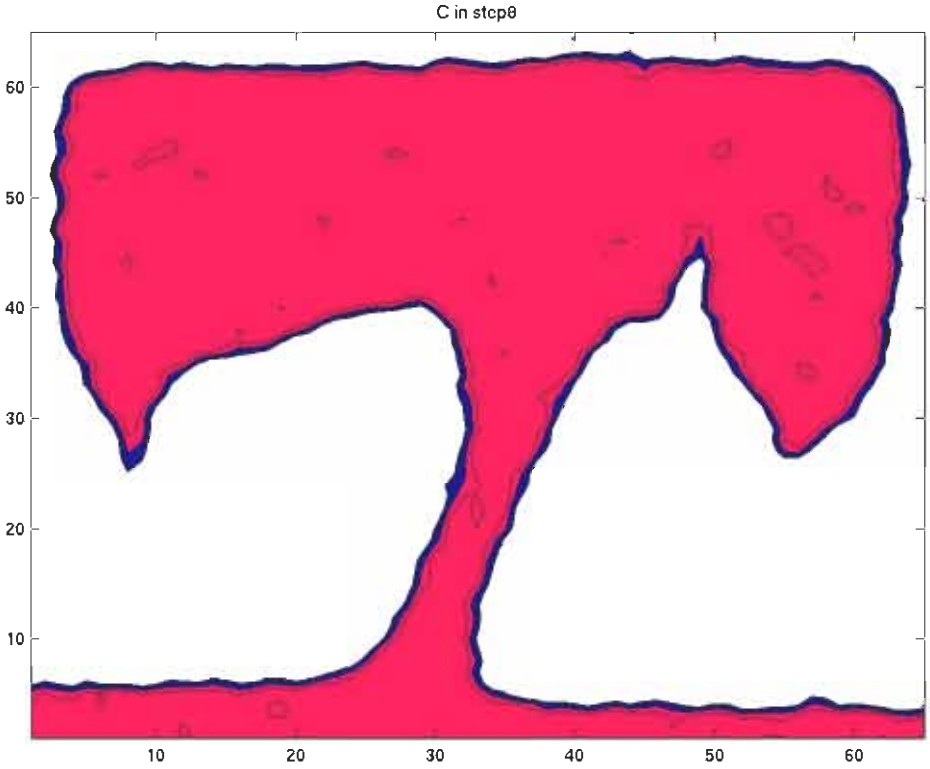
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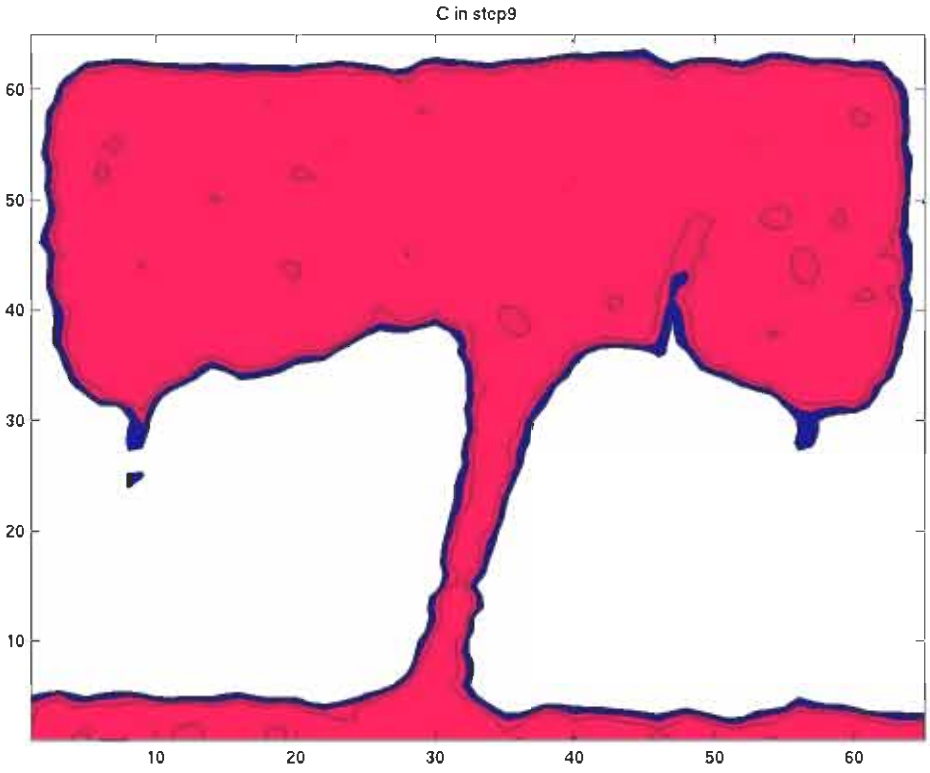
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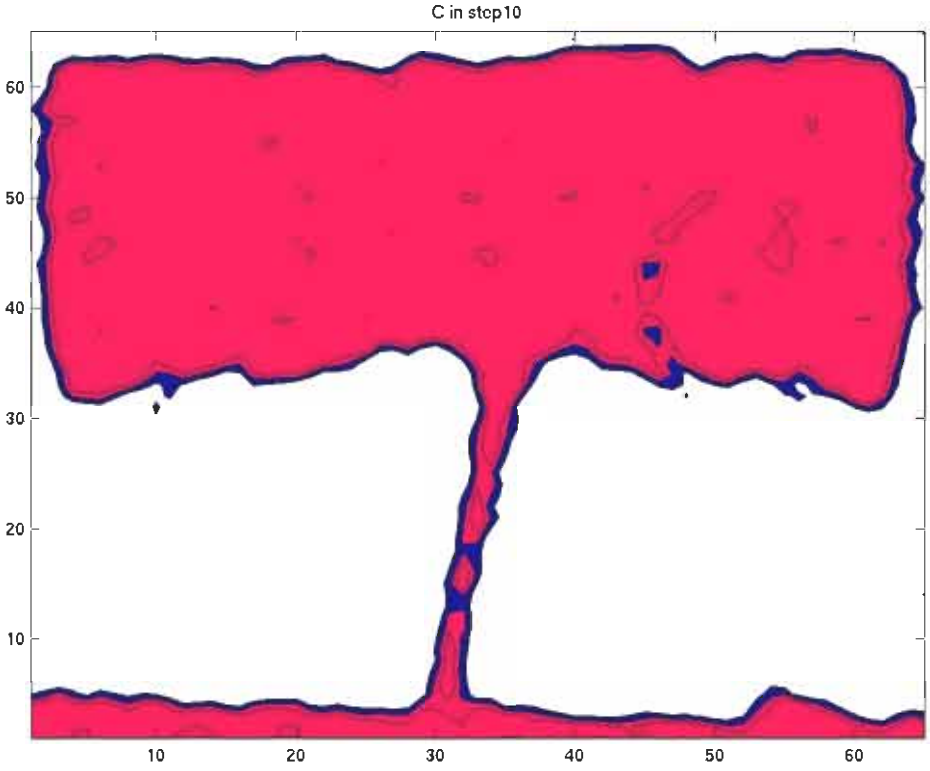
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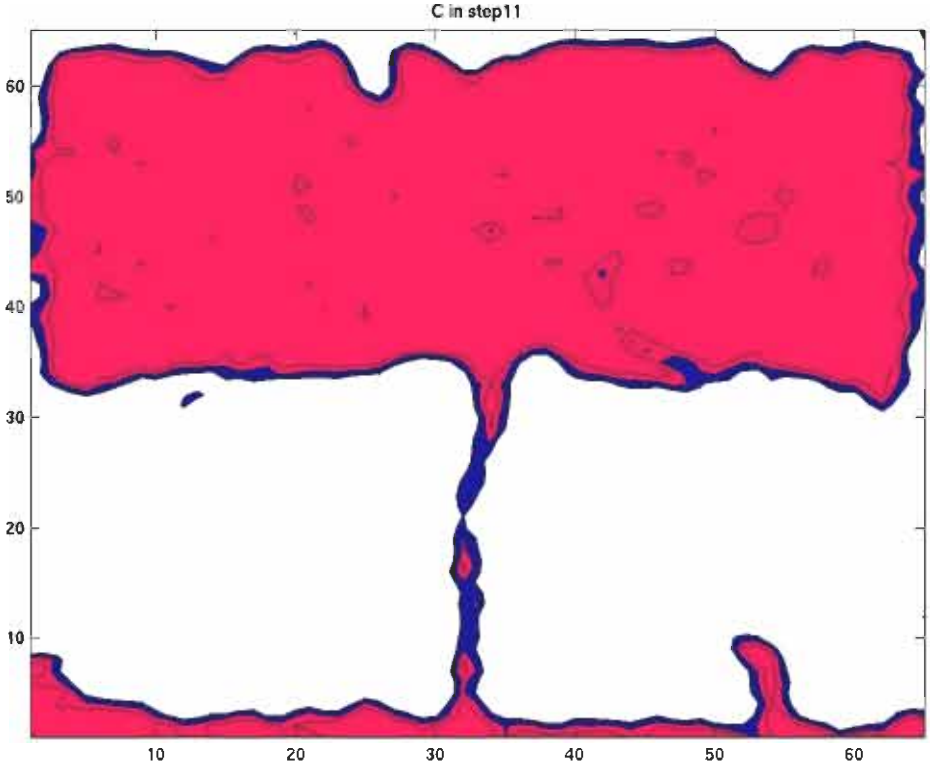
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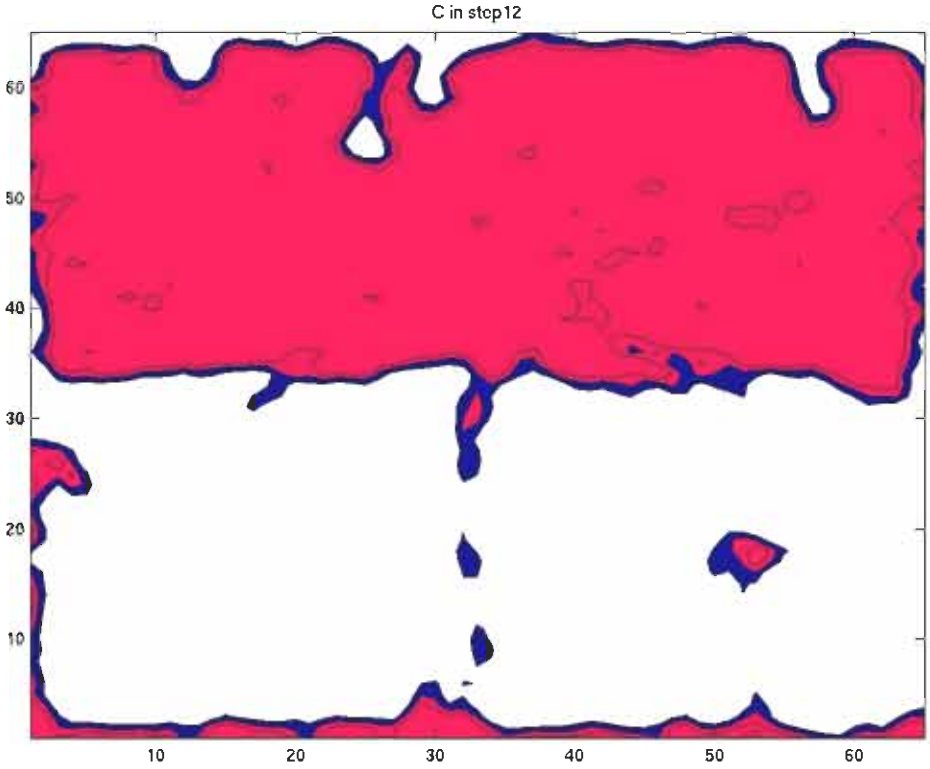
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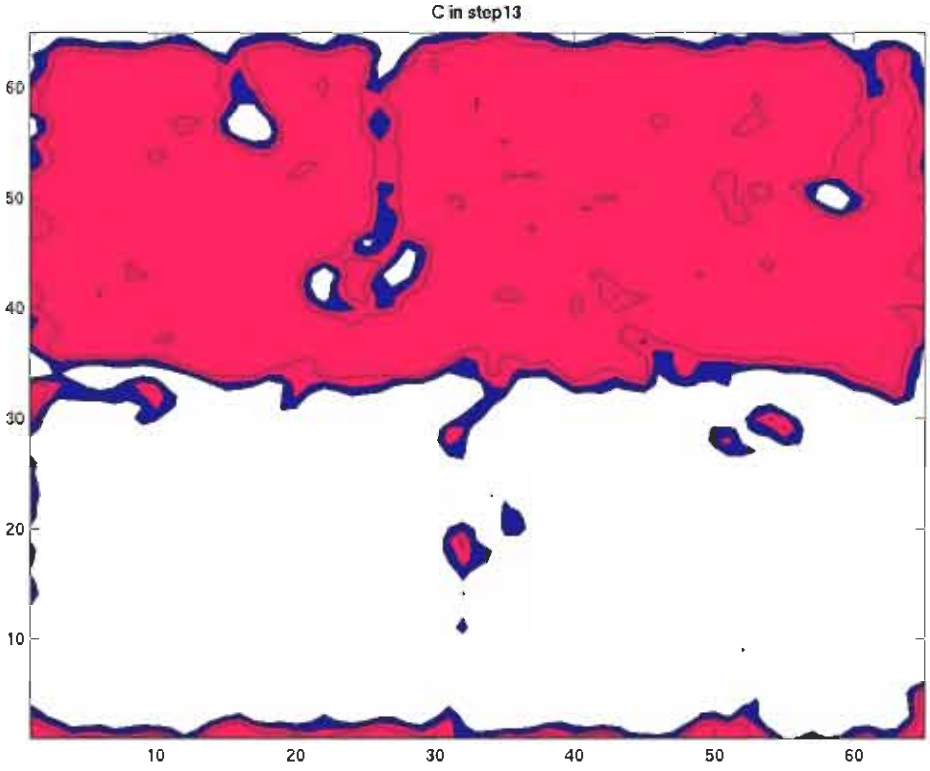
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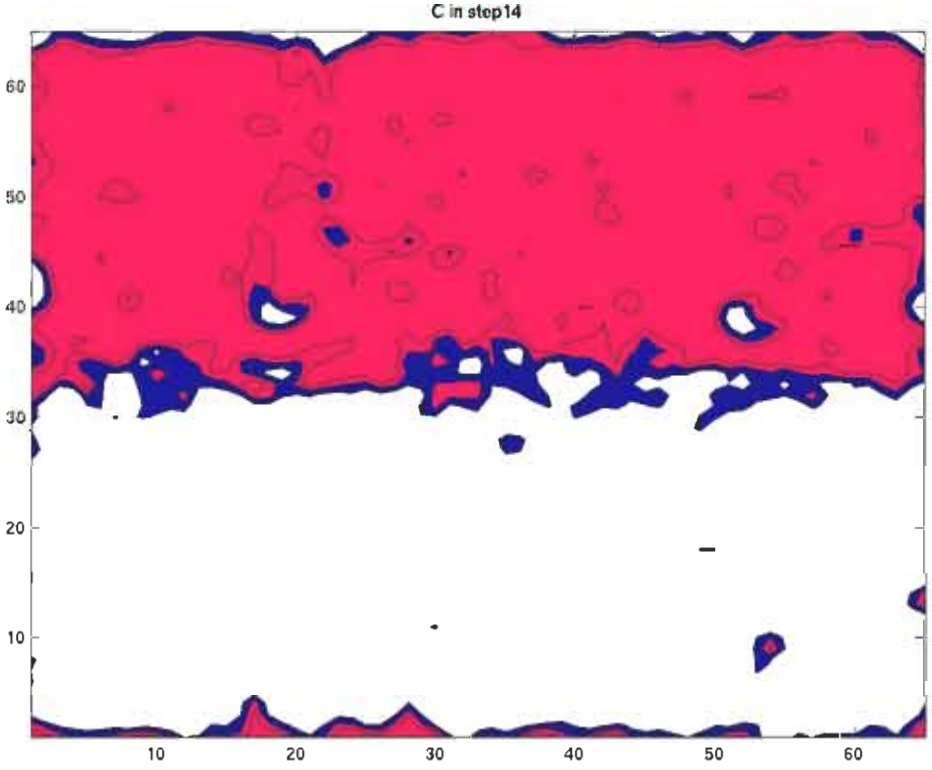
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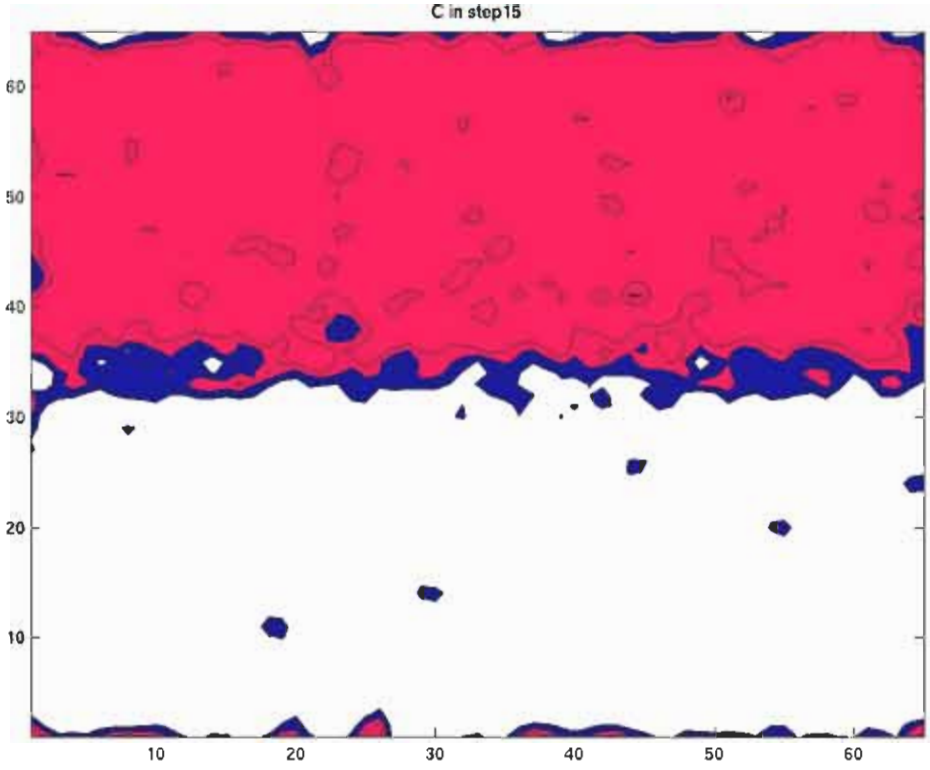
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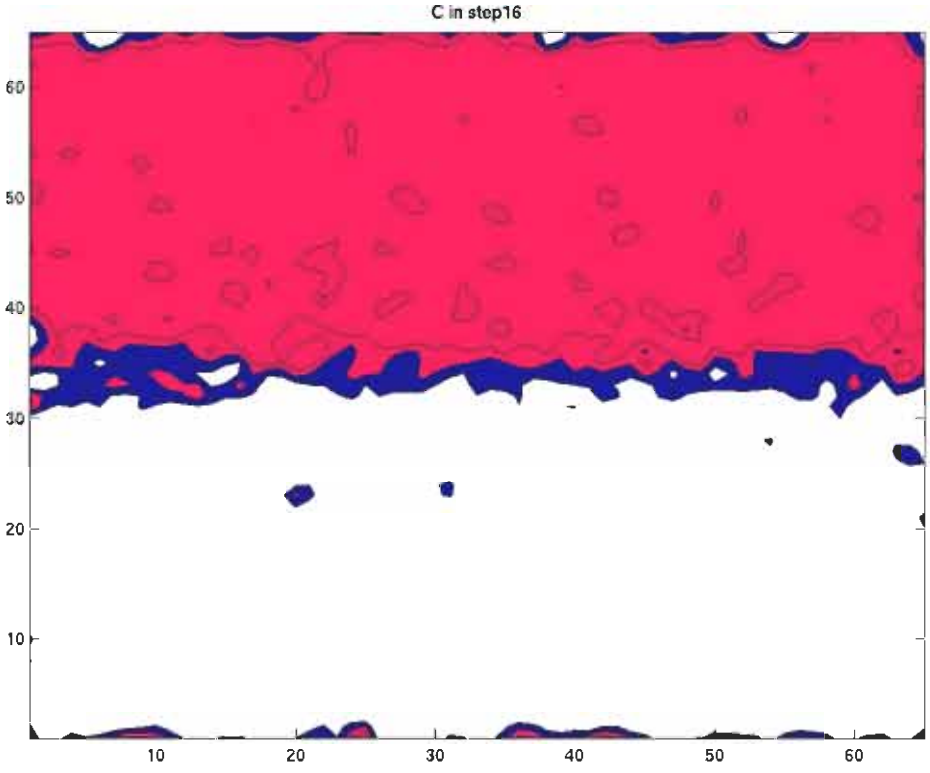
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Growth of Boundary Undulations

- salt domes
- diapirs
- continental delamination

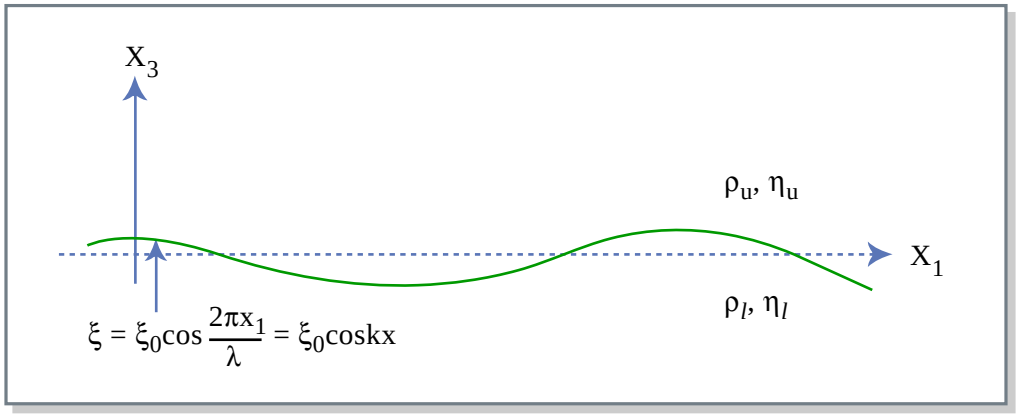

Figure 24.18
Figure by MIT OCW.

General problem: topography on an interface

$$\xi = \xi_0 \cos kx_1 \qquad k = \frac{2\pi}{\lambda}$$

(1) If $\rho_u < \rho_l$ topography decays as $\xi_0 e^{-t/\tau}$.

(2) If $\rho_u > \rho_l$ topography grows.

Initially $\xi = \xi_0 e^{t/\tau}$.

Eventually many wavelengths interact, problem is no longer simple.

Characteristic time τ depends on $\Delta\rho$, η_u, η_l, thickness of layers, …

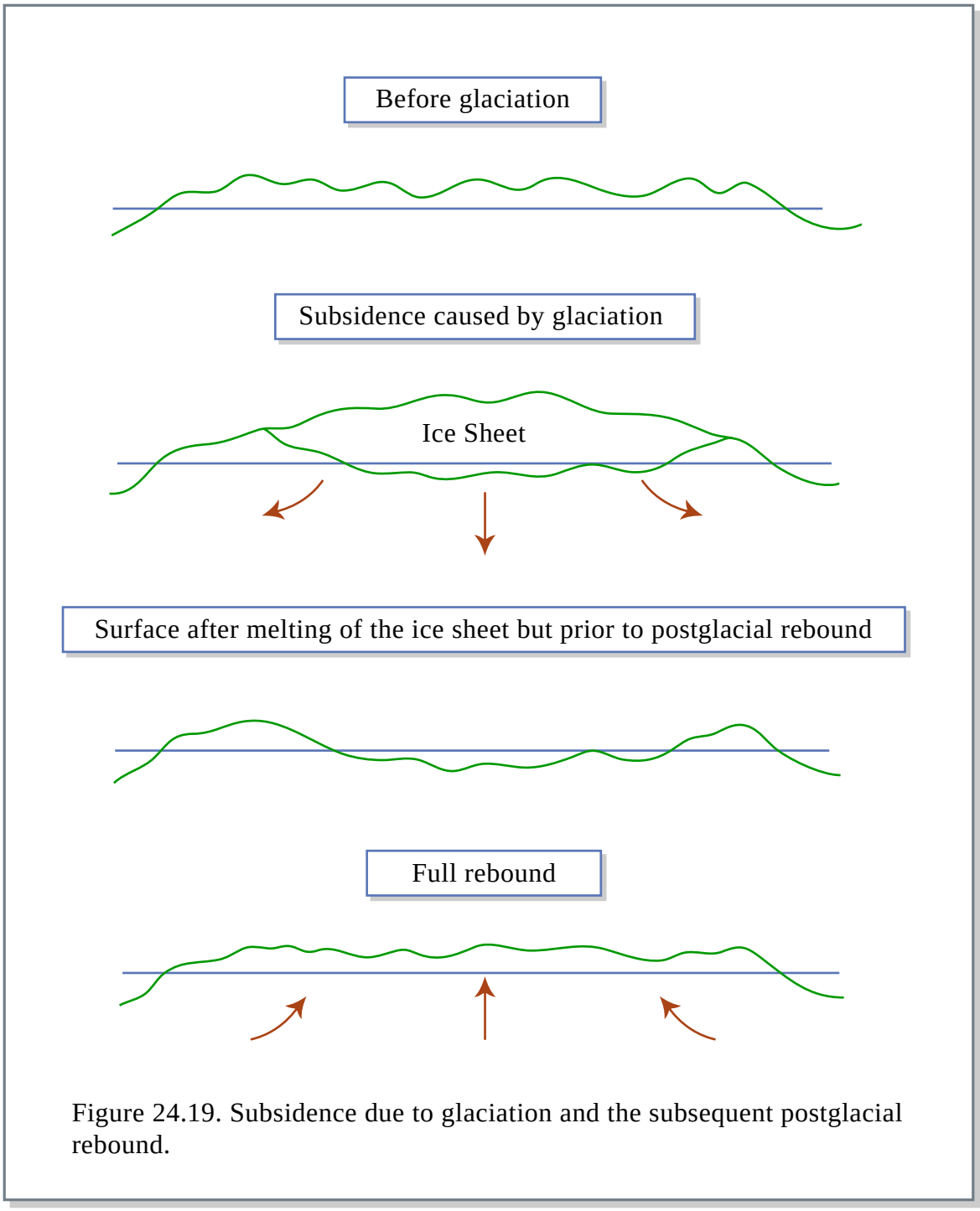

Figure 24.19. Subsidence due to glaciation and the subsequent postglacial rebound.

Figure 24.19
Figure by MIT OCW.

- Weight of ice causes viscous flow in the mantle.
- After melting of ice, the surface rebounds – “postglacial rebound”.
- Different regions have different behaviors (e.g., Boston is now sinking).

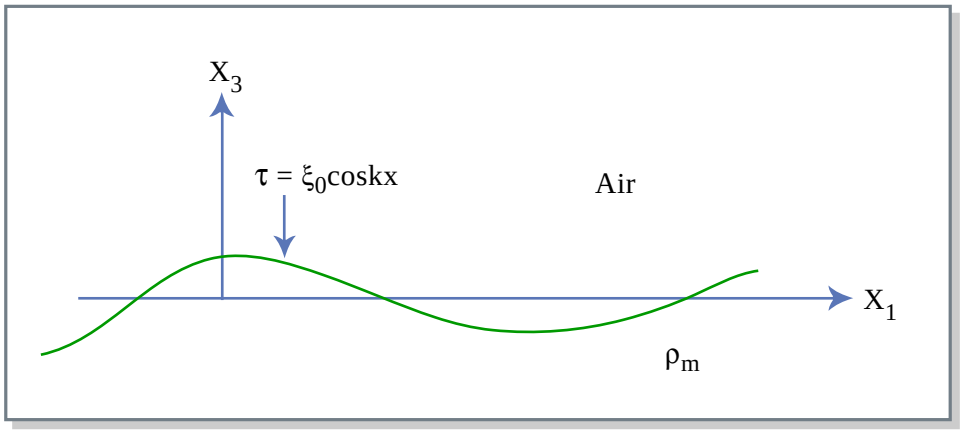

Figure 24.20

Figure by MIT OCW.

Problem: how to reconcile physical boundary conditions with mathematical description?