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- The time rate of change of the absolute circulation (C_a) is given by:

$$\frac{DC_a}{Dt} = \oint -\frac{dp}{\rho} + \oint \mathbf{F} \cdot \mathbf{dl}$$

- Three different types of fluids:
  - For homogeneous fluids: $\rho = \rho_0 = \text{constant}$
  - For barotropic fluids: $\rho = \rho(p)$
  - For baroclinic fluids: $\rho = \rho(p, T)$
- Kelvin's Circulation Theorem: For a barotropic, inviscid fluid, the absolute circulation is conserved.
  - $\frac{DC_a}{Dt} = 0$
- We can separate the absolute circulation into two parts
  - $C_a = C_e + C_r$
    - C_e is the circulation due to the earth's rotation
    - C_r is the circulation due to fluid motions relative to the Earth
- After taking the limit of this, we find that: $\zeta_e = 2\Omega \sin\phi$, which is equal to f.
  - This gives us: $C_e = 2\Omega \sin\phi A$
- Now we can find an expression for the time rate of change of the circulation relative to the earth. We assume that the fluid is barotropic and frictionless, and we end up with:
  - $\frac{DC_r}{Dt} = -\frac{D}{Dt}((2\Omega \sin\phi)A)$
- From this equation, we can see that the causes of relative circulation changes for a barotropic frictionless fluid are:
  - Area changes
  - Latitude Changes
- This is Bjerknes' Circulation Theorem