Does ageostrophy affect the stability of oceanic eddies?

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This paper examines the stability of vortices in a two-layer ocean on the f-plane. The mean depth $\bar{h}_1$ of the upper layer is assumed to be much smaller than the depth $\bar{h}_2$ of the lower layer. Using the primitive equations, we derive an asymptotic criterion for baroclinic instability of compensated (i.e. confined to the upper layer) vortices. Surprisingly, it coincides exactly with a similar criterion resulting from the quasi-geostrophic equations (Benilov 2003).

Thus, to leading order in $\bar{h}_1/\bar{h}_2$, ageostrophy does not affect the stability properties of thin compensated vortices. As a result, whether a vortex is stable or not, depends on its shape, not amplitude (although the growth rate of an unstable vortex does depend on its amplitude).