Observations of frequency ($\omega$) spectra of buoyancy fluctuations in entraining stratified fluids are presented. A two-fluid system, with turbulence in the dense layer, was used for this purpose and the spectra were measured at different distances ($z$) from the interface. As $z$ increases, interesting transitions were found to occur in spectral shapes. Near the interface where the buoyancy effects are still important, $z<0.2L_H$ ($L_H$ is the integral length scale measured in homogeneous turbulence), the spectra were dominated by $\omega^{-3}$ form which gradually transitioned into the $\omega^{-5/3}$ shape at $z\approx 0.5L_H$. At $z\approx 0.7L_H$, the spectra appeared to contain both $\omega^{-5/3}$ and $\omega^{-1}$ shapes, and away from the interface at $z>0.8L_H$ the $\omega^{-5/3}$ form disappeared leaving the $\omega^{-1}$ form. These changes of the spectral form of scalar fluctuations evidence the fate of dense fluid particles that are entrained at the density interface and then break up into smaller scales and lose buoyancy as they are advected by large-scale eddies.