Violent Expansion of a Rising Taylor Bubble[1] GUANGZHAO ZHOU, ANDREA PROSPERETTI, University of Houston — Because of the gradually decreasing hydrostatic pressure, a Taylor bubble expands as it rises in a long vertical conduit such as are encountered in volcanoes and deep-water oil drilling. In some situations, the expansion becomes violent, with a rapid increase of the bubble volume and a possibly catastrophic ejection of liquid from the mouth of the conduit. The mechanism of this process is analyzed with a 1-D drift-flux model and a simpler dynamic model. The results of the two models agree with each other. A simple but useful criterion for the occurrence of the violent expansion is obtained from a quasi-equilibrium model. The important nondimensional parameters involved in the process are identified and, on their basis, the energy budget for the rising bubble is clarified. The effect of gas diffusing from the liquid into the rising bubble is also considered and deficiencies in the current state of knowledge about this aspect of the problem are identified.

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