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Linear stability of plane Poiseuille flow in infinite elastic medium and volcanic tremors

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We investigate linear stability of a plane Poiseuille flow of a compressible fluid sandwiched between two semi-infinite elastic media, focusing on application to excitation mechanism of volcanic tremors. Previous studies have shown that, in the even mode, where the fluid-layer thickness becomes wider and narrower symmetrically, the flow speed needed to destabilize the system could be infinitesimally small when the wavelength of the wave-type fluid and solid motion is very long (Balmforth et al., 2005; Dunham and Ogden, 2012). We show that a similar instability occurs in the odd mode, where the width of the fluid layer does not change very much regardless of the fluid and solid motion. The odd-mode instability occurs with a slower flow speed than in the even mode, and the wave-type motion propagates oppositely to the basic flow. We calculate the critical Mach number for instability of the compressible Poiseuille flow for various dimensionless parameters and conclude that the odd mode is more possible to account for excitation of volcanic tremors than the even mode.

Keywords: fluid dynamics, dynamics of elasticity, flow-induced vibration, elastic surface wave