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Numerical simulations of short time scale subsurface fluid motion at volcanoes: what can the resulting seismograms tell us about fluid dynamics?

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Seismograms recorded on volcanoes exhibit a wide spectrum of signal types, from high frequency Volcano Tectonic (VT) to Long Period (LP) to Very Long Period (VLP). While VT events may be loosely coupled to the movement of fluids, through fluid pressure induced stress fluctuations, LP and VLP events are thought to represent more direct indicators of fluid activity. In particular LP events are usually modelled as the pressure induced excitation of planar conduits, where a pressure source is explicitly placed within the conduit. In such cases the conduit length and mechanical properties dominated the response, with no information about fluid dynamics per se. Of primary interest in monitoring volcanic activity is an understanding of subsurface fluid type and movement. However, surface seismic recordings of fluid induced activity are filtered by the response of the plumbing system to fluid motion, making it difficult to access information on solely the fluid activity. Here, using a recently developed numerical model (O'Brien and Bean, JGR, 2004) which couples multi-phase fluid motion with an elastic solid, we attempt to invert for fluid parameters based on surface seismic recordings. When the constraint of a single planar vertical conduit is removed, complex behaviour emerges which can mask absolute information on the underlying fluid motion. However, relative changes in the fluid parameters (e.g. viscosity) lead to observable and interpretable changes in the recorded seismograms. Simulations will be supported by field examples.