J241-P008 **Room: Poster Session Hall** **Time: May 15**

Ultrasonic measurements of foams: preliminary results

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Introduction: Bubbly fluid is the driving force of explosive volcanism, and it is important to constrain the bubble content and bubble size from seismology. In order to interpret seismic waves propagating through such medium, measurements of acoustic properties of bubbly fluids are needed. One characteristic of a bubbly fluid is that its acoustic velocity is slower than that of air or liquid (Kieffer, 1977). However, the details of the acoustic velocity of foams with volumetric fraction of air greater than 0.9 is poorly known. Furthermore, reliable measurements of attenuation properties of bubbly fluids are lacking (Chouet, 2003). Mujica and Fauve (2002) measured acoustic properties of Gillette shaving foam (air fraction 0.93) at frequency range of 5-84 kHz (wavelength/bubble size from 20 to 1500). However, detailed analyses of the waveforms, dependence of acoustic properties on fluid viscosity and container size were not made. In this study, we made preliminary measurements of the same foam at a higher frequency range of 0.1 to 2.0 MHz. Although scattering effects become larger at such frequencies, using high frequency probe allows transmission of better controlled waveforms.

Experimental method: We use a Gillette shaving foam enclosed in a styrol plastic case of a thickness of 9.5, 15.1, 24.1 and 35.5 mm. We use an ultrasonic transducer (resonant frequency of 0.5 and 1.0 MHz) in a pulse transmission set up. We use a single pulse at these resonant frequencies and burst waves at frequency range of 0.1 to 2.0 MHz. As a reference, we measured water and air, and compared it with the waveform propagating through the foam. We also studied the evolution of the foam structure using a CCD microscope.

Results: Waveform which propagated through a foam show a gradual onset followed by later phases and show temporal variation as the foam coarsens. Propagated waves show small amplitude which is 1/5000 and 1/5 compared to the waves propagating through water and air. P-wave velocity is 450 m/s and is slightly faster than that of air, and decreased 1 percent with the coarsening of the foam. We could not find clear evidence of velocity dispersion. We use a broadband waveform of a single pulse wave and from the spectrum ratio of the waves propagating through foam and water, we calculate the Q value. As the foam coarsens from 0.01 to 0.1 mm, the Q decreased from 10 to 8 in the frequency band of 100-400 kHz. On the other hand, Q increased from 4.5 to 5.5 in 400-600 kHz band. We compared the waveforms propagating through 3 different sample cases, 70 minutes after the start of the experiment. Using the envelope of the waveforms, we find that the peak amplitude tend to be delayed more relative to the first arrival as the sample size increases.

Discussion: In our experiments, the wavelength/bubble size ratio is about 2-400 and from the characteristics of the waveforms, multiple scattering effect seem dominant. Also the temporal variation of attenuation is likely to have originated from the coarsening of the bubbles. As the bubble coarsens and wavelength/bubble size decreases, both the scattering efficiency and the number of scatterers change. At present, we are unable to quantify and separate these two effects. However assuming that the bubble size are comparable, the differences in waveform for the different container sizes is likely to have been caused by the number of scatterers encountered by the propagating wave.

Conclusions: In the present experiments, although scattering effect seem important, waveforms that resemble volcanic tremors were observed. The measurements also indicate that the waveforms are strongly affected by the sample size, suggesting that the importance of the size of the magma chamber or a volcanic conduit, on interpreting the seismic data.

References:

Kieffer J.G.R., 82, No. 20, 1977

Chouet, PAGEOPH., 160, 739 - 788,0033 - 4553 / 03 / 040739-50, 2003

Mujica, and Fauve, Phys. Rev., 66, 021404, 2002