Pressurization of volcanic conduit due to gas bubble behavior in magma

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Volcanic explosivity is controlled mainly by volatiles included in magma. When volatiles in magma are sufficiently included in magma, violent explosions occur. Sufficient degassing during magma upward migration reduces the possibility of occurrence of explosion and lava dome forms on the volcano. These phenomena have been intensively studied from theoretical investigation and analyses of volcanic geological samples, which mainly focus on micro-scale dynamics and mechanisms of gas bubble growth and degassing processes. In this presentation, I show such micro-scale phenomena can be also discussed from the data of geodetic measurements by considering magma ascent model including the effects of surrounding volcanic medium property. I present a magma pressurization model in volcanic conduit, in which gas bubbles rise up in low-viscosity magma capped by a lid. The model is expressed by equation of motion of the lid, equation of the melt pressure affected by gas bubble growth, equation of the rising speed of gas bubbles and relation of pressure and density of gas bubbles. Numerical calculations show that gas bubble growth is activated due to de-pressurization by upward migration, which can further decrease the density of magma. As a result, gas bubbles approaching to the ground surface rapidly increase its volume, compress the surrounding medium, and cause a rapid change in ground deformation of the volcanic edifice. Such characteristics are recognized in other cases of magma migration in which gas bubbles and melt migrate at a same speed. Recent improvements of geodetic measurement at volcanoes enable us to detect a tiny change in pressure of magma in the conduit. Combining the geodetic data with theoretical consideration of pressurization in the conduit due to bubble growth can be useful for understanding the mechanisms of pressurization in magma due to micro-scale phenomena by volatiles.