

気泡壁から測る気泡数密度 Bubble number density (BND) from bubble wall

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One of the dynamics of volcanic eruption is the expansion of magma volume resulting from its bubbling. Under high pressure condition, volatile such as water and CO₂ melt in the magma. Decompression caused by uprise of magma leads vaporization of the volatile contents which invoke bubble nucleation and expand into bubbles. Bubble number density (BND) is the number of foregoing nucleation per unit bulk volume. BND is proportional to the (3/2) power of the decompression rate as demonstrated by Toramaru(2006), and it may give significant information of the erupting magma in the chamber and the conduit, where observation is difficult.

To calculate BND, various methods have been developed so far. For instance, Toramaru(1990) calculates BND from the distribution of the length of the lines which cross bubbles, Sahagian and Proussevich(1998) calculates it from the distribution of the cross-section size of vesicles. These traditional methods concentrate on the vesicles, thus it is difficult to calculate BND from the fragmented sample such as volcanic ash or volcanic glass. Volcanic ash, however, constitutes more than half of the volcanic ejecta from a pyroclastic eruption, therefore it is also important to gain the information from fragmented samples or bubble wall. This study proposes two methods to calculate BND from bubble wall thickness.

Regarding bubble wall as a *shell covering the vesicle* and assuming bubble cell model proposed by Zhang(1999), the bubble number density N_V is calculated from following formula: $N_V=6(1-P)^{1/3}/\pi(1-P)d^3$, where P is the porosity, π is the circular constant and d is the mean thickness of the bubble wall (Oki et al., 2004). On another front, presuming bubble wall to be a *board nipped by the vesicle* and assuming a bubble as a sphere, N_V is: $N_V=16(1-P)^2/(9\pi P^2 l^3)$, where l is the mean free path regarding the bubble wall as space and the vesicles as obstacles.

To verify these methods, BNDs are estimated by both these methods and traditional methods from cross-section images of the same pumices. These pumices have various quality: basaltic or rhyolitic material, high or low porosity, and circular or flattened cross-section shape. Comparing these BNDs, they are within a range from 10^{10} to 10^{17} and show a good correspondence. Thus BND can be calculated from bubble wall.

Keywords: bubble number density, bubble wall