Textural characteristics of the Holocene pumice erupted from Changbaishan volcano and their volcanological implications

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The texture of volcanic products records abundant information about the physical and chemical processes of the magma. Therefore, the quantitative analysis of the texture of volcanic products has recently become an important research method in volcanology. Changbaishan volcano located on the border between China and North Korea, is one of the largest active volcanoes in China. It has experienced at least five explosive eruptions in the Holocene, i.e. 5,000 BP eruption, AD 946 eruption (also called "millennium eruption"), AD 1668 eruption, AD 1702 eruption and AD 1903 eruption. In this study, the composition and quantitative texture of pumices from three explosive eruptions in Holocene (5000 BP eruption, the millennium eruption and AD 1668 eruption) of Changbaishan volcano were studied in detail. The results show that, the pumices from 5000 BP eruption and the millennium eruption are all pantellerite in composition, but the later is more acid than the former. The pumices from 1668 AD eruption are high potassium trachyte in composition. The pumices from these three eruptions comprise mainly vesicle of different sizes, vesicle wall and a small amount of phenocrysts (<15%). The parameters of vesicles are extracted from back scattering SEM images with different magnifications. The pumice from 5000 BP eruption has the highest vesicularity (about 73.4%), the smallest size (about 1 um) and the greatest number density ($4.23 * 10^{16}$ m $^{-3}$) of vesicles. The pumice from the millennium eruption has the vesicularity of 62.8%. The smallest vesicles in this pumice are several micrometers in size, and the number density is $3.25 * 10^{15}$ m $^{-3}$. The pumice from AD 1668 eruption has the vesicularity of only 45.9%, the vesicles are generally larger than 10 um in size, and the largest may reach up to 1 cm. In pumices of this period, the number density of vesicles ($3.68 * 10^{14}$ m $^{-3}$) decreases and the vesicle walls become thicker. Finally, according to the compositions and number density of vesicles in pumices from three eruption periods, we have estimated some important physical parameters, such as the decompression rates, height of eruption column and magma discharge rate for these three eruptions. The results from this study may provide important scientific basis for understanding magma process and determining the intensity of historical eruptions of Changbaishan volcano.