Formation of Qixiangzhan Eruption of Changbaishan Tianchi Volcano, China

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To comprehensively understand the eruption characteristics and history of active volcano is crucial for predicting its future eruptions and hazard. Changbaishan Tianchi Volcano (CHTV) is one of the most dangerous active volcanoes in Northeast Asia. It had experienced three periods of large-scale eruptions since the Holocene, i.e. the Tianwenfeng period at about 5,000 years ago, the Qixiangzhan (QXZ) period at about 4,000 years ago and the Millennium eruption at about 1,100 years ago, respectively. The type of Tianwenfeng and Millennium eruptions is commonly accepted to be a typical Plinian eruption. However, there arises a considerable debate about the type of QXZ eruption as to whether it is effusive or explosive. In high-resolution remote-sensing images, the morphology of the products of QXZ eruption looks like a lava flow, which flows along the northern slope of the volcanic cone about 5.4 km in length and 400-800 m in width. However, the recent research work by the author has revealed that the QXZ eruption should be a small-scale pulsed explosive eruption. The main evidence is as follows: 1) The bulk-rock composition of QXZ eruption products is characterized by high SiO_2>71% and Na_2O+K_2O >10% contents representative of alkaline magma, which has high viscosity, low flowing ability and extremely high potential of explosive eruption; 2) Field observations show that the QXZ eruption products appear as thin layers about 2-5cm in thickness, significantly different from the massive or slaggy structures of lava flow; 3) Microscopic observation reveals that most of the phenocrysts in the QXZ eruption products were severely broken by explosion to form angular grains with well developed micro-cracks. The vesicles in the QXZ eruption products are irregular in shape and have rough margin, different significantly from the elliptical and smooth margin vesicles commonly observed in lava flow; 4) Stereomicroscopic observation shows that the QXZ eruption products are composed of clastic particles and exhibit grain-supported texture with well developed irregular vesicles. Further study by using SEM indicates that most of the clastic particles are fine volcanic ash and tiny pumice with rough surfaces. Basing on the above analyses, we may conclude that the QXZ eruption can be assigned to a small-scale pulsed explosive eruption. During the explosive eruption, a large number of fine pyroclastic particles flowed down the mountain slope as a high speed pyroclasstic flow to form thin layer of ignimbrite. Over many times of explosive eruptions, layer upon layer of ignimbrite were accumulated, resulting in a shape just like lava flow. Therefore, all the three large eruptions of CHTV in Holocene can be assigned to explosive eruption, rather than the previously proposed model of explosive-effusive-explosive explosions.