

## Volatile from the millennium explosive eruption of Tianchi volcano (China/North Korea) track from melt inclusion

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Tianchi volcano, which is located on the border area of the northeast of China and North Korea, has a long eruption history over 2 Ma. There are at least three eruption periods occurred in Holocene, among which the Eruption Period II, (i.e. the millennium explosive eruption) is believed to be one of the largest plinian eruptions in the past 2,000 years in the world. The products of that large eruption, comenditic pumice and pyroclastic flow, once covered 5,000 km<sup>2</sup> of Changbai Mountains area and even reached north Japan.

Two populations of melt inclusions, hosted in alkali feldspars of comenditic pumice from the millennium eruption, have quite different properties and imply the existence of two compositional melts prior to the eruption. Electron microprobe analyses (EMPA) and Fourier Transform Infrared Spectroscopy analyses (FTIR) for these melt inclusions show that the preruptive magmas contained high H<sub>2</sub>O and Cl contents. S degassing was rather complicated and could be a continuous degassing process because of its limited solubility in melt. However, petrologic estimates appear to underestimate volatile emissions. Accordingly, the mass of degassed magma is much more than that of the magma emitted or involved during the millennium explosive eruption of Tianchi volcano.

The magma depressurized during ascending in their conduits. Volatile gradually exsolved from magma melt and gathered at the top of the reservoir, resulting in the gradient of concentration and density, which greatly affected the eruption dynamics of magma chamber. The high volatile contents, especially the high water and chlorine contents, cumulating and exsolving from the magma, made the magma chamber overpressurized and finally led to the millennium explosive eruption of Tianchi volcano.

## SIMS U-Th-Pb dating of kimberlitic perovskite

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Perovskite, a common Th- and U-enriched mineral crystallised from kimberlitic magma, is thought to be an important geochronometer for dating the emplacement of kimberlite. However, variable incorporation of common lead into the perovskite crystal structure makes it difficult for precise U-Th-Pb dating. We developed in this work new procedure of *in situ* U-Pb and Th-Pb dating of perovskite using the latest version of large double focusing CAMECA 1280 SIMS at institute of Geology and Geophysics, Chinese Academy of Sciences.

Setting mass resolution power of mass analyser at 6500, the magnet was cyclically peak stepped ten times through a sequence including the Pb<sup>+</sup> species, U<sup>+</sup>, Th<sup>+</sup>, ThO<sup>+</sup>, UO<sup>+</sup>, UO<sub>2</sub><sup>+</sup> and CaTi<sub>2</sub>O<sub>4</sub><sup>+</sup>. A linear relationship is observed between ln(<sup>206</sup>Pb<sup>+</sup>/U<sup>+</sup>) and ln(UO<sub>2</sub><sup>+</sup>/U<sup>+</sup>), and ln(<sup>208</sup>Pb<sup>+</sup>/Th<sup>+</sup>) and ln(ThO<sup>+</sup>/Th<sup>+</sup>). A calibration approach analogous to that for SIMS zircon U-Pb analyses was therefore used to correct for inter-elemental fractionation. A perovskite crystal (<sup>206</sup>Pb/<sup>238</sup>U age = 356.5 ± 1 Ma) with a relatively uniform chemical composition from the Ice River alkaline intrusion was used as U-Pb and Th-Pb dating standard. The <sup>204</sup>Pb-based corrections are used to estimate the fraction of common Pb in most individual analyses with relatively low common Pb (*f*<sub>206</sub> < 0.3), whereas the <sup>207</sup>Pb-based corrections for analyses with *f*<sub>206</sub> > 0.3.

Seventeen analyses on the Tazheran perovskite, which has unusually high U but rather low Th, yielded a Concordia U-Pb age of 461 ± 3 Ma and a Th-Pb age of 463 ± 4 Ma. Sixteen analyses on perovskite from the Iron mountain kimberlite gave a Concordia U-Pb age of 408 ± 3 Ma and a Th-Pb age of 410 ± 4 Ma. Eighteen analyses on perovskite from the Wesselton mine of South Africa yield a weighted mean <sup>206</sup>Pb/<sup>238</sup>U age of 90 ± 2 Ma and a Th-Pb age of 90 ± 1 Ma. Accuracy and precision of 1-2% (95% confidence level) of these measurements have been demonstrated by their consistency of U-Pb and Th-Pb ages and the recommended U-Pb ages of previous works.