



## **Hydrogen and oxygen isotope fractionation in formation of a fumarolic ice tower at Mt. Melbourne volcano, Antarctica**

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Recent volcanic activity of Mt. Melbourne, located in Northern Victoria Land of Antarctica, has formed fumarolic ice towers. Although volcanic water primarily originates in meteoric water, its stable isotope composition ( $\delta^{18}\text{O}$ ,  $\delta^{17}\text{O}$  and  $\delta\text{D}$ ) can be modified by magmatic water input or water-rock interaction. The distinct isotope composition of volcanic water has been useful for better understanding the volcanic system. The fumarolic ice towers would form by vapour deposition of emitting steam and by freeze of water droplets discharging from the hydrothermal reservoir. They would be insignificantly influenced by atmospheric moisture or precipitation during their formation due to the low temperature and humidity in Antarctica and therefore directly reflect the reservoir composition. However, isotopic fractionation might happen over the course of the fumarolic ice tower formation and make a difference in water isotope composition between the hydrothermal water reservoir and ice tower.

We determined water isotope composition of ice pieces collected from a single wall of fumarolic ice tower emitting steam. The analysis resulted in a range of the isotope composition, which would reflect different degrees of isotopic fractionation during vapor deposition on the ice wall.  $^{18}\text{O}$  were enriched relative to the Global Meteoric Water Line (GMWL) and suggested that the isotope composition of the hydrothermal water reservoir was shifted by magmatic water or water-rock interaction. In contrast, meteoric water vapor would have little effect during the ice tower formation, because a good linear relationship ( $r^2 > 0.97$ ) was observed between  $\delta\text{D}$  and  $\delta^{18}\text{O}$  with a slope of  $\sim 7.5$  close to that of GMWL. The slightly lower slopes (7.5 and 0.524) than GMWL (8 and 0.528) both in the  $\delta\text{D}-\delta^{18}\text{O}$  and  $\delta^{17}\text{O}-\delta^{18}\text{O}$  ( $\delta' = \ln(\delta + 1)$ ) plots might reflect the kinetic effect during the vapor deposition.