Isotopic composition ($\delta^{18}O$, $\delta^{17}O$ and δD) of a fumarolic ice tower at Mt. Melbourne volcano, Antarctica

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Fumarolic activity of Mt. Melbourne volcano, located in Northen Victoria Land, Antarctica, has been recently observed to increase. As a preliminary apporach to assessing changes in the volcanic activities, we determined water isotope composition ($\delta^{18}O$, $\delta^{17}O$ and δD) of ice collected from a fumarolic ice tower newly formed by emitting steam. The analysis of the ice pieces (n = 40) taken from a single wall of the ice tower resulted in a range of the isotope composition, which reflected different degrees of isotopic fractionation during vapor deposition on the ice wall. In the δD–$\delta^{18}O$ plot, pronounced enrichment of ^{18}O relative to the Global Meteoric Water Line (GMWL) were observed in all samples, suggesting that the isotope composition of the vapor source was shifted by magmatic water or water-rock interaction. In contrast, meteoric water vapor would have little effect on the isotope composition of the ice tower during its formation, because a good linear relationship ($r^2 > 0.97$) was observed between δD and $\delta^{18}O$ with a slope of ~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 δD–$\delta^{18}O$ and $\delta'^{17}O$–$\delta'^{18}O$ ($\delta' = \ln(\delta + 1)$) plots could be explained by the kinetic effect during the vapor deposition.