Multi-isotope study on hydrothermal vent fluids from an early-stage hydrothermal system at Nifonea volcano, New Hebrides backarc

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Nifonea vent field is located within the New Hebrides arc-backarc system and is thought to represent an early-stage hydrothermal system. The major and trace element compositions of the vent fluids indicate high water/rock ratios during hydrothermal circulation and boiling followed by vapour condensation. To better characterize water-rock interaction and processes during hydrothermal circulation, we report strontium (Sr), lithium (Li), and boron (B) concentrations and isotope ratios in hydrothermal fluids and volcanic rocks from Nifonea vent field.

Li in the endmember fluids is depleted relative to seawater and δ^7Li values have the highest values reported for hydrothermal vent fluids so far, ranging from 11 to 22 ‰. Sr in the fluid endmember is also depleted relative to seawater and $^{87}Sr/^{86}Sr$ varies from 0.7064 to 0.7078. Both isotopic systems reflect the limited water-rock interaction with very high water/rock ratios, pointing to shallow hydrothermal circulation. In contrast, B is enriched relative to seawater, varying from 1012 to 1565 µmol/kg and δ^{11}B values range from 15.4 to 19.9 ‰. These B signatures match with other arc related hydrothermal systems in the Western Pacific and indicate low apparent water/rock ratios during hydrothermal circulation. Based on the water/rock ratios obtained from Li contents, the expected B concentrations and δ^{11}B values should range from 470 to 530 µmol/kg and from 31 to 37 ‰, respectively. The high B concentrations in the vent fluids could be explained by a preferential partitioning of B into the low-salinity vapour during boiling. However, B isotope fractionation during boiling has ^{11}B enriched in the vapour phase and hence may not explain the low δ^{11}B in the vent fluids. Since the vent field also shows indications for recent magmatic activity, we will furthermore discuss the consequences for B signatures in the vent fluids related to the possible addition of B by magmatic gases.