Numirical simulations of mid-ocean ridge hydrothermal circulation including seawater phase separation

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Mid ocean ridge hydrothermal circulation is a phenomena that seawater enters through oceanic crusts, and cools heat sources underneath the ridge area. Seawter phase separation is suggested as a controling factor for the circulation structure. This study clarify how the phase separation changes the circulation structure. This study treat the near axis hydrothermal circulation by numerical simulations. As a result, We induce a new picture of mid ocean ridge hydrothermal circulation.

1)The region of hydrothermal fluid is divided into two structures, an upper circulation part and a lower stagnant high compositional layer.

2)Near the high compositional layer, two phase region forms at the upflow region of the circulation.

Mid-ocean ridge hydrothermal circulation is a phenomena that seawater enters through oceanic crusts, and cools heat sources underneath the ridge area. This circulation controls the heat transport at the area, and also causes generation of ore deposite and life. These are all affected by the circulation structure.

Seawter phase separation is suggested as a controling factor for the circulation structure. It is particularly important around the ridge axis area where there are magma chambers under it. The seawater phase separation generates the fluid of higher and lower Cl- concentration than seawater. In the consequence, the hydrothermal fluid changes its Cl- concentration. Observations found the hydrothermal fluid that Cl- concentration is different from seawater.

This study clarify how the phase separation changes the circulation structure. There is few works that links up the phase separation and the circulation structure by a dynamical approach. This study also focuses on the circulation structure and the concentration of hydrothermal fluid at the seafloor. The latter is observable, and may contains the underseafloor circulation structure and phase separation.

This study treat the near axis hydrothermal circulation as a numerical simulation. We assume the seawater as the NaCl-H_2O two compontnt system. We obtain steady state circulation structures. We induce a new picture of mid ocean ridge hydrothermal circulation.

The region of hydrothermal fluid is divided into two part, an upper circulation part and a lower stagnant high compositional layer. The high composition layer contains larger solute than seawater. There is a density stratified structure in it. The upper circulation has nearly same solute as seawater, there is vigorous convection. The height of the circulation part is depressed by the high compositional layer, and the heat efficiency drops to 1/3 times of pure thermal convection case. Near the high compositional layer, two phase region forms at the upflow region of the circulation. In the region, two phase relative transport takes place because of the density difference. The fluid through the two phase region changes its concentration. This fluid is the reason of inhomogeneous concentration of hydrothermal fluids at the seafloor.