Fluid compositions and flow rates in the subaerial part of the Hikurangi forearc, New Zealand

A. G. REYES

GNS-Science, 1 Fairway Drive Avalon, Lower Hutt, New Zealand, a.reyes@gns.cri.nz

More than 250 sources of saline waters (2000 to 16600 mg/kg Cl), CH_4-rich gases and occasional oil seeps are discharged from springs, mud volcanoes and gas vents along a 500 km length of the subaerial accretionary prism in the East Coast of the North Island, from about -37.5° to -41.3° latitude, 80 to 100 km from the subduction margin. Discharge areas, occupying <0.005 to 10 ha, vary in width from 25 km in the south to 75 to 100 km in the north and centre. All fluid discharges are cold except for three isolated hot spring systems in the central and northern blocks where surface temperatures vary from warm to 69ºC and flow rates from low to 540 L/a. The most recent field measurements indicate a total flow rate of at least 200 x 10^8L/a for cold saline aqueous solutions, compared to 4 x 10^8L/a in the two main hot springs. The ratio of gas:aqueous solutions varies widely from 1.5 to 200. The springs and gas vents emerge from a thick sequence of Cretaceous to Pleistocene sedimentary formations. Based on chemical and isotopic compositions, gassy saline aqueous discharges consist of subducted waters derived mainly from (1) clay water of hydration (<50%), (2) seawater that had interacted at varying degrees with organic-rich marine sediments/formations at depth and/or volcanic material over a wide range of temperatures, (3) water of hydration from basalt and (4) recent groundwater. Only the northernmost springs appear to be affected by fluids from shallow serpentinization. Gases and aqueous solutions along the length of the forearc have equilibrated at about 100ºC $\pm$ 25ºC (median values), near the smectite-illite transition, at depths of about 5 to 6 km based on general geothermal gradients in the region. Saline waters with similar origins emerge at high elevations, along the axial ranges west of the forearc, albeit modified by higher temperatures, mixing with larger volumes of meteoric water and more intense interaction with rock. Fluid components can be correlated with differences in mass flow and structural grain across the accretionary prism. There is a general increase in estimated deep temperatures with flow rates but a decrease with excess Cl relative to seawater. The mantle component in gaseous solutions generally increases with the amount of clay water of hydration in the aqueous solutions..