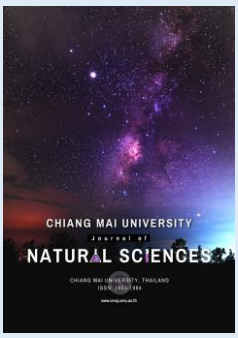

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Research article

Geochemical Modeling of Scale Formation due to Cooling and CO_2-degassing in San Kamphaeng Geothermal Field, Northern Thailand

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Abstract Scaling in a geothermal piping system can cause serious problems by reducing flow rates and energy efficiency. In this work, scaling potential of San Kamphaeng (SK) geothermal energy, Northern Thailand was assessed based on geochemical model simulation using physical and chemical properties of hot spring water. Water samples from surface seepage and groundwater wells, analyzed by ICP-OES and ion chromatograph methods for chemical constituents, were dominated by Ca-HCO_3 facies having partial pressure of carbon dioxide of $10^{-2.67}$ to $10^{-1.75}$ atm which is higher than ambient atmospheric CO_2 content. Surface seepage samples have lower temperature (60.9°C) than deep groundwater (83.1°C) and reservoir (127.1°C, based on silica geothermometry). Geochemical characteristics of the hot spring water indicated significant difference in chemical properties between surface seepage and deep, hot groundwater as a result of mineral precipitation along the flow paths and inside well casing. Scales were mainly composed of carbonates, silica, Fe-Mn oxides. Geochemical simulations based on multiple chemical reaction equilibria in PHREEQC were performed to confirm scale formation from cooling and CO_2-degassing processes. Simulation results showed total cumulative scaling potential (maximum possible precipitation) from 267-m deep well was estimated as 582.2 mg/L, but only 50.4% of scaling potential actually took place at SK hot springs. In addition, maximum possible carbon dioxide outflux to atmosphere from degassing process in SK geothermal field, estimated from the degassing process, was 6,960 ton/year indicating a continuous source of greenhouse gas that may contribute to climate change.

Keywords: Degassing, Geochemical modeling, PHREEQC, San Kamphaeng Hot Springs, Scaling

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