

INTISARI

Indonesia memiliki potensi panas bumi terbesar kedua di dunia. Sistem panas bumi Indonesia umumnya didominasi oleh sistem panas bumi vulkanik yang berasosiasi dengan Gunung Api Kuarter. Gunung Api Kuarter di Pulau Jawa umumnya tersusun oleh batuan vulkanik dan sedimen laut Tersier, seperti di Gunung Ungaran. Sistem panas bumi Gunung Ungaran bertipe *liquid dominated* dengan estimasi suhu reservoir berkisar antara 102°C hingga 291°C berdasarkan *geothermometer liquid*. Namun, geothermometer tersebut memiliki keterbatasan karena hanya mempertimbangkan beberapa unsur tertentu pada setiap perhitungan. Penelitian ini bertujuan untuk mengetahui jenis batuan yang berinteraksi dengan air panas bumi serta mengestimasi suhu reservoir Gunung Ungaran dengan metode geothermometer multi komponen. Data yang digunakan terdiri atas data primer dan data sekunder berupa peta geologi regional. Pengumpulan data primer dilakukan melalui pengamatan lapangan dan pengambilan sampel air yang dianalisis dengan metode *Ion Chromatography* (IC), *Inductively Coupled Plasma Optical Spectrometry* (ICP-MS), dan *Inductively Coupled Plasma Optical Spectrometry* (ICP-OES) untuk memperoleh data kation, anion, dan *rare earth elements* (REE+Y). Penentuan suhu reservoir menggunakan perangkat lunak PHREEQC dengan mempertimbangkan indeks saturasi mineral, sedangkan identifikasi batuan yang berinteraksi menggunakan pola REE yang dinormalisasi dengan *North American Shale Composite* (NASC) dan geoindikator. Komposisi kimia air panas bumi menunjukkan adanya interaksi dengan batuan sedimen. Intensitas interaksi dengan batuan sedimen semakin meningkat pada mata air panas Kaliulo yang terletak di bagian timur Gn. Ungaran. Perhitungan suhu reservoir dengan metode geothermometer multi komponen mempertimbangkan 4 *thermodynamic data files* (soltherm.dat, geothermal.dat, core10.dat, dan llnl.dat). Berdasarkan basis data soltherm.dat, estimasi suhu reservoir panas bumi Gn. Ungaran dan Sekitarnya berkisar antara 176°C – 260°C dengan suhu optimal pada 230°C. Rentang suhu tersebut mengindikasikan bahwa sistem panas bumi Gn. Ungaran dan Sekitarnya merupakan sistem panas bumi bersuhu menengah hingga tinggi.

Kata kunci: Gn. Ungaran, indeks saturasi, suhu, batuan, REE

ABSTRACT

Indonesia has well known as the second largest geothermal potential in the world. These geothermal systems are generally dominated by volcanic geothermal systems which associated with Quaternary volcanoes. Quaternary volcanoes in Java Island are commonly composed of volcanic and sedimentary rock, such as in Mt. Ungaran. The Mt. Ungaran geothermal system is liquid dominated with an estimated reservoir temperature ranging from 102°C to 291°C based on liquid geothermometers. However, these geothermometers have their own limitations because they only consider certain elements in each calculation. The research aims to determine the types of rocks which interact with geothermal water and estimate the reservoir temperature of Mt. Ungaran using multicomponent geothermometer method. The used data consists of primary data and secondary data which is regional geological map. The primary data collection was collected by field observations and water sampling which was analysed using Ion Chromatography (IC), Inductively Coupled Plasma Mass Spectrometry (ICP-MS), and Inductively Coupled Plasma Optical Spectrometry (ICP-OES) to obtain cations, anions, and rare earth elements (REE+Y) data. Reservoir temperature determination is using PHREEQC software for considering the mineral saturation index, while rock which interacted with geothermal water is using the patterns of REE which normalized with North American Shale Composite (NASC) and geoindicators. The chemical composition of the geothermal water indicates an interaction with sedimentary rocks. The intensity of interaction with sedimentary rocks increases toward the Kaliulo springs which is located in the eastern part of Mount Ungaran. The reservoir temperature was estimated using the multicomponent geothermometer method which considering four thermodynamics: soltherm.dat, geothermal.dat, core0.dat, and llnl.dat database. Based on the soltherm.dat, the estimated reservoir temperature of the Ungaran geothermal system ranges from 176°C to 260°C with representative temperature of approximately 230°C. The temperature range indicates that the Ungaran geothermal system is classified as a medium to high temperature geothermal system.

Keywords: Mt, Ungaran, saturation index, temperature, rock, and rare earth elements (REE)