Geophysical Research Abstracts
Vol. 18, EGU2016-2735, 2016
EGU General Assembly 2016

Scaling minerals from deep-seated granitic geothermal reservoir

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To promote geothermal energy use and sustainable production, the information of scaling situation from deep-seated geothermal reservoir is important. In Japan, at the Kakkonda geothermal field, Iwate prefecture, north-eastern of Japan, there is 80MW geothermal power plant using about 300 degree C fluid from the reservoir at the boundary between Quaternary Kakkonda granite and Pre-Tertiary formations about 3km depth and more deep-seated reservoir survey was carried out by NEDO.

Then, to understand the mechanism of deep-seated reservoir, we survey the metal sulphide minerals deposited at production wellhead and pipeline and compare with the brine And the brine of WD-1a at 3.7km depth, into Quaternary Kakkonda granite rock.

In Kakkonda geothermal system, the scales are classified into two types based on sulphide mineralogy, which are Pb-Zn rich type and Cu rich type. Pb-Zn rich scales, for example galena (PbS) and Sphalerite (ZnS), are found in Well-19 located at the marginal part of the Kakkonda granite And Cu-rich scales, for example chalcocite (Cu_2S), loellingite (FeAs2) and native antimony (Sb), are found in Well-13, located at the central part of the Kakkonda granite.

And the brine of WD-1a at 3.7km depth about 500 degree C, into Quaternary Kakkonda granite rock near Well-19 is rich in Pb and Zn and similar composition as the Well-19 scale. Therefore, deep reservoir of Kakkonda field evolves with mixing the fluid of shallow reservoir and the brine of occurred in the Quaternary Kakkonda granite. Then, the existence of both Pb-Zn rich scale and Cu rich scale is a characteristic feature of Kakkonda geothermal and this fact suggest to have similar zoning as found in Porphyry Copper Zoning.

On progress of production the fluids from deep reservoir continue to be suffered by the fluid of shallow reservoir and meteoritic water. With temperature of production well decreasing and chemical composition changed, silica precipitation decreased and the metal sulfide mineral assemblage of scales of Well-13 changed from chalcocite (Cu_2S), loellingite ($FeAs_2$) and native antimony (Sb) to tetrahedrite ($Cu_{10}[Fe,Zn]_2[As,Sb]_4S_3$). This show the scale change is reflect to reservoir and pipeline condition change.