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Mass Balance Estimation from the Gravity Change at the Takigami Geothermal Reservoir, Oita Prefecture, Japan

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In Takigami geothermal field, we have continued the geothermal reservoir monitoring by using gravity change from 1991, in order to monitor the mass transfer caused by production and reinjection of geothermal fluid. We, however, had measured only relative gravity measurements by using relative gravimeters (SCINTREX CG-3, CG-3M and CG-5), so we haven't been able to evaluate the gravity change at the reference station of the relative gravity measurements. Therefore, we introduced an A10 absolute gravimeter (Micro-g LaCoste, Inc.) in 2008. We used the A10 gravimeter for not only the assessment of the gravity changes at the reference station, but also the detection of the absolute gravity change caused by the subsurface fluid mass changes at some other measurement stations. However, it was impossible that the A10 absolute gravimeter was applied at all of the stations, because the measurement condition for the A10 is strict. We selected 4 stations (T13, T19, T26 and T27) to conduct the repeat absolute gravity measurement. Therefore we have applied the relative gravimeters for the stations where we couldn't measure gravity by using the A10. Thus both absolute gravimeter and relative gravimeter can complement each other.

As a result of absolute gravity measurements, the gravity change at the reference station (T1) of the relative gravity measurements is small enough for this evaluation, within about 10 μgal. So we estimated that this reference station is appropriate for the relative gravity measurements. Because we judged that the gravity change detected by the relative and absolute gravity measurements illustrated the mass transfer in the geothermal reservoir, we divide the Takigami geothermal field into 3 areas from the pattern of the gravity change after the commencement of the Takigami geothermal power plant, and we estimated the 4 stages of geothermal fluid flow pattern from temporal gravity change. Based on these classifications, we led the conceptual reservoir model of the Takigami geothermal field. We have detected the gravity changes which were consistent with the changes in mass balance in the geothermal reservoir. We inferred that the current fluid mass in the Takigami geothermal field has recovered to the level as much as that before production and reinjection had started.