



## **Geothermal Reservoir Monitoring by the Repeat Gravity Measurement at the Takigami Geothermal Field, Japan -Application of Hybrid Gravity Measurement using Absolute and Relative Gravimeters-**

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It is important to understand the geothermal reservoir behavior in order to produce geothermal fluid for a long time. In addition, it is necessary to consider the influence on environment so that the production of a large quantity of geothermal fluid and the reinjection of a large quantity of water are performed in the geothermal area. The mass changes at subsurface with production and reinjection of geothermal fluid cause the gravity changes on the surface. Repeat gravity measurements have been applied at the Takigami geothermal field in Central Kyushu, Japan, where the Takigami power plant (25MW) has been generating since November 1996. We have conducted repeat gravity measurement from May 1991, at 26 observation points. We used a Scintrex CG-3, CG-3M and CG-5 relative gravimeters in order to measure gravity change caused by production and reinjection of geothermal fluid, but we could not estimate the gravity change at the reference station. To solve this problem, we introduced an A10 absolute gravimeter (Micro-g LaCoste, Inc.). In addition, the A10 was used for not only the assessment of the gravity changes at the reference station, but also the detection of the 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 condition of the measurement was strict. We chose 4 stations (T13, T19, T26 and T27) to conduct the repeat absolute gravity measurement. Therefore we have applied the relative gravimeters in such strict situations. Thus both absolute gravimeter and relative gravimeter can complement each other.

We have started repeat gravity measurement before the commencement of power generation at the Takigami geothermal power station, and 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 as much as that before production and reinjection had started. As a result of the absolute gravity measurement, the seasonal variation has not been drastic at the reference station (T1), so we have concluded that T1 is appropriate as the reference station. In Takigami geothermal power plant, during 20 days in April 2008, reinjection was stopped for the regular maintenance. We observed the gravity changes caused by suspension of reinjection before and after the maintenance in the reinjection area. The absolute gravity measurement was able to evaluate the gravity change at the reference station, but the application of the hybrid measurement was effective because the condition of the absolute gravity measurement was strict.