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In-situ formation compaction monitoring in deep reservoirs by use of fiber optics

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1. Background
The Southern Kanto gas field, the largest field of natural gas dissolved in water in Japan, is located primarily under the Chiba Prefecture. In this field 8 companies produce 460*10̂6m3/y of natural gas. In addition, the concentration of the iodine in the brine is almost 2000 times that in seawater and the iodine as well as natural gas is collected from the brine. Iodine is industrially useful and essential for the human body. About 30% of world production is produced in this area in recent years. On the other hand, the land subsidence has become the big problem since 1965 and more than 10cm/mm of land subsidence was observed by leveling in 1972. The natural gas and iodine producers in this area have made a land subsidence prevention agreement with the local government and made effort to prevent and control land subsidence. Although their pumping brine for the gas and the iodine production is inferred to be the main cause of land subsidence from that time, the ratio of the formation compaction caused by pumping brine in the total land subsidence hasn't been well known. Therefore, the measurement of the actual formation compaction has become an important technological issue for the companies and they jointly have developed a new monitoring system for the formation compaction.

2. Contents
(1) By using fiber optics technology, we have developed a world's first monitoring system which measures each of the in-situ formation compactions continuously without running tools into the well.
(2) In order to check a reliability of this system and the problems when construction, we carried out the preliminary test. We installed the prototype system in the shallow observation well with a depth of 80 m and measured the actual formation compaction. The water well was drilled at the 10m away from the observation well and the formation was artificially compacted by pumping groundwater from it.
(3) We installed the monitoring system in the deep observation well with a depth of about 800m, and have been measuring the formation compaction of the natural gas reservoir now.

3. Conclusions
(1) We succeeded in installing the monitoring system into the observation well and measure the each of 6 formation compactions in the gas reservoir.
(2) As a result of the preliminary test we confirmed that the monitoring system run without big problems even in the field. The formation compacted/expanded with the groundwater level fallen/risen according to the pump rate.
(3) We improved the monitoring system based on the knowledge acquired by the demonstration test and installed it into the deep observation well. We are carrying out the long term observation now.

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