

A results of the survey on a groundwater discharge in the coastal artesian area by UAV Groundwater survey

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In recent years, the importance of submarine groundwater discharge (SGD) in coastal ecosystems has been recognized, and surveys to grasp SGD from the ocean floor in the sea area have been conducted. Therefore, in this study, we have been investigating the groundwater flow and discharge from the coastal artesian well area since 2015, with the aim of understanding the groundwater discharge for Otsuchi Bay, Otsuchi Town, Iwate Prefecture. In this report, we report the results of 1. groundwater head survey, 2. groundwater flow velocity survey, and 3. UAV springs survey, conducted in June 2019 and January 2020.

1. Results of the groundwater head survey

We measured the groundwater head at 16 artesian wells on June 11, 2019. The groundwater head was measured by introducing groundwater flowing from the artesian well into a tube connected to the spout, and measuring the water level of the groundwater ascending in the tube. The measured groundwater heads ranged from 1.65 to 2.34 m above sea level, tending to be higher in the northern and central parts near the Otsuchi River and lower in the western part near the Kozuchi River. The spring volume of artesian well was measured in 21 wells. The maximum was 1.26 (L / sec), the minimum was 0.11 (L / sec), and the average was 0.66 (L / sec).

2. Results of groundwater flow velocity survey

In the artesian well located closest to the river mouth in the Otsuchi artesian well area, a single-hole type groundwater flow meter GFD-3a was installed at a depth of 32 m inside the artesian well to measure the direction and velocity of groundwater. In the Otsuchi artesian well area sandwiched between the Otsuchi and Kozuchi rivers, previous research showed that river water permeated underground from the riverbeds of the Otsuchi and Kozuchi rivers and flowed down a confined aquifer approximately 30 m below the artesian well area.

As a result of the measurement, the confined groundwater at a depth of 32m at 10:00 on June 12, 2019 was 0.123cm / min and the flow direction was 159.6 °, indicating almost the direction of Otsuchi Bay. In addition, the hydraulic conductivity estimated by the Darcy flow velocity from the topographical gradient is approximately 0.2 to 0.4 (cm / sec), which was equivalent to the aquifer due to sand and gravel.

3. Results of UAV spring survey

The condition of the Otsuchi artesian well area had changed significantly due to the progress of reconstruction work following the earthquake. In January 2020, part of the eastern side of the artesian well area became a spring pond, we were unable to locate the artesian well in the spring ponds. Therefore, using a thermal infrared thermometer, we attempted to identify a spring point from artesian well and a spring area from the surface of the ground or from a artesian well with a higher temperature than the surface water. In addition, the springs from the artesian wells are located in development sites or spring pond, etc., and there are places where it is impossible to measure closely, so a UAV equipped with a thermal infrared camera (mavic 2 Enterprise Dual made by dji), The ground surface temperature was measured from an altitude of about 50m.

As a result, it was confirmed that the water temperature was higher than the surroundings at the site where the spout was confirmed in the spring water reservoir in June 2019. In addition, some places where

the ground surface temperature was high could not be reached from the ground due to grass bushes and the like. In addition, in the Kozuchi River flowing down the southern side of the artesian well area, it was observed that the temperature of the river water in the area adjacent to the artesian area was higher than near the estuary gates on the upstream and downstream sides.

Keywords: UAV Groundwater survey, springs from artesian well, Groundwater velocity and flow direction,, water head of artesian flowing well, Otsuchi Bay