

## Correlation case study between geotechnical estimation result by EM methods and tunnel excavation data in east Hokkaido

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### 1. Introduction:

Recently, many long tunnels for roads are planned or being constructed in Hokkaido. For geological estimation by these methods for tunnels in Japan, seismic prospecting or electric sounding is very common. However, as the accuracy of geotechnical estimation for deeper tunnels is rather low, troubles for geotechnical re-estimation or change of the construction method increases by it.

To have a solution for the problem, authors carried out two EM methods, HEM (Helicopter-borne Electromagnetic Method) and CSAMT (Controlled Source Audio-frequency Magnet Telluric method) over a large overburden tunnel in Hokkaido, and the result was correlated with the excavation data. HEM has advantage for exploration of long tunnel, while CSAMT has advantage for exploration of overburden tunnel than two ordinary methods (seismic exploration and electric sounding).

### 2. Method

Surveyed tunnel has about 4,110m in length and about 380m of maximum overburden. The geology is pyroclastic rock, basalt and chert in accretionary complex called Tokoro Belt. The tunnel will be completed in 2009. As excavation data, the lithofacies is confirmed by pilot boring carried out and convergence and crown settlement measurement was measured for all tunnel formation with some troubles such as groundwater spout or plate transformation with rock bolt while tunnel excavation. HEM and CSAMT was carried out over a large overburden tunnel which is being constructed in east Hokkaido, north Japan, and the result was correlated with the excavation data.

### 3. Result

Several zones of low resistivity were recognized by HEM and CSAMT, respectively, and by combining the two methods, other low resistivity zones were recognized. These zones were geologically estimated as worse zones for tunnel excavating. We correlated them to convergence and crown settlement measurement results obtained from actual tunnel excavating. In six zones, convergence and crown settlement measurement results are rather large and tunnel structure was changed.

One zone was found to coincide with low resistivity zone by HEM, and another was found to coincide with another low resistivity zone by CSAMT, while the rest four zones did not coincide with low resistivity zones by HEM or CSAMT separately. Therefore, low resistivity zones were re-estimated by combining the two methods. As the result, four in six zones were able to be recognized while two of them cannot.

In conclusion, troublesome zones of deeper part of the mountain for tunnel construction were fairly well recognized by the combination of HEM and CSAMT.