Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

STT52-P01 Room:Convention Hall Time:May 27 18:15-19:30

Aeromagnetic constraints on the subsurface structure of the Ishikari Depression, Hokkaido Japan

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An aeromagnetic map of the Ishikari Depression and its surrounding area (total magnetic intensity, 1:200,000) (Okuma and Nakatsuka, 2014) has been made as a compilation of the Digital Geoscience Map of the area (GSJ, 2014). The total magnetic intensity anomalies within the area have been extracted from the aeromagnetic anomaly database (Nakatsuka and Okuma, 2009) on a smoothed surface 1,500 m above terrain. The reduced to the pole anomalies have been also calculated from the total magnetic intensity anomalies on the surface and compared to the geology (Ozaki and Komatsubara, 2014) of the area.

An obvious magnetic high chain, called as the Kitakami-Ishikari magnetic belt is dominant in Ishikari Depression. By comparing with the lithology of core samples from oil exploration wells, granitic rocks as well as mafic igneous rocks can account for the magnetic belt but the details remain unknown.

3D imaging (Nakatsuka and Okuma, 2013) was applied to the magnetic anomalies to better understand the subsurface structure of the area. A chain of deep seated magnetic sources was imaged in the Ishikari Depression, corresponding to the Kitakami-Ishikari Magnetic Belt. Depths of the magnetic sources range from ˜5km (north) to ˜10km (south) below ground, whereas their widths range from 10km (north) to 25km (south). Their magnetization intensities (˜1 A/m) imply that they are composed mainly of granitic rocks which were confirmed by drilling at a depth of 4,600m in the Tomakomai area.

A high-resolution aeromagnetic survey has been also conducted to better understand the subsurface structure of the Tomakomai area. Two regional magnetic highs occupy offshore Tomakomai and the eastern one is edged by a NNW-SSE trending marine topographic step, suggesting that this step might have worked as a dam to trap sediments which contain magnetic minerals.

Keywords: aeromagnetic survey, magnetic anomaly, Kitakami-Ishikari Magnetic Belt, Ishikari Depression, Tomakomai, 3D imaging

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Study of Extraction Method of the Slope tending to Cause Deep-seated landslide using Airborne Electromagnetic method

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Kind of landslide is mainly shallow landslide and deep-seated landslide, etc. Shallow landslide is a phenomenon that top soil layer collapse. On the other hand, deep-seated landslide is the relatively large scale collapse phenomena among the slope failures such as rock falls, slope failures, etc.; in which the slide plane arises in the deeper section than that in the case of the surface collapse; then not only the top soil layer but also the soil at deep layer becomes the colluvial clods. Although deep-seated landslide occurs less frequently than shallow landslide, sediment amount of deep-seated landslide are huge than shallow landslide's and it might occur serious sediment disaster. In September 2011, multiple of deep-seated landslides occurred by heavy rains associated with Typhoon Talas in Kii Penisula.

It is considered that occurrence of deep-seated landslide is linked to strength and groundwater movement of bedrock. Hence, in order to estimate occurrence of deep-seated landslide, it is important to obtain information of bedrocks at wide area. Therefore, in this study, we focused on airborne electromagnetic method. This method can get obtain information of geology and groundwater at wide area. Then, we studied about extraction method of the slopes tending to cause deep-seated landslide.

Studies areas were Hayakawa River basin (Yamanashi Prefecture) and Byutanogawa River basin (Miyazaki Prefecture). Then, we focused on slopes of the past of deep-seated landslide and the specific resistance patterns of vertical directions of bedrock creeps in these basins.

In this study, we confirmed two-layer structure of specific resistance pattern that a shallow portion is high resistance and a deep portion is low resistance. However, in the slope that contains a lot of muddy, we confirmed two-layer structure of specific resistance pattern that a shallow portion is low resistance and a deep portion is high resistance. Moreover, we confirmed three-layer structure of specific resistance pattern. These are future tasks.

Keywords: Airborne Electromagnetic Method, Deep-seated landslide, Specific Electrical Resistance

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Semi-automatic interpretation methods using gravity gradient tensor data obtained by airborne gravity gradient survey

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The importance and usefulness of gravity gradient tensor for the estimation of subsurface structures, especially to find structural boundaries, have been pointed out since the latter half of the 1930's. Presently, not only the classical methods, such as horizontal first derivative, vertical first derivative and vertical second derivative, are being used, but more advanced and complex techniques designed by combining the classical methods are being discussed and analyzed. These techniques reveal structural boundaries through a differential in the space domain of gravity anomalies caused by variations in subsurface structures; they are a kind of high-pass filters that emphasize the short wave length signals of gravity anomalies.

In general, the techniques that estimate subsurface structures from gravity anomaly without geological and geophysical constraint conditions are called semi-automatic interpretation methods. These methods not only employ high-pass filtering but also estimate causative sources by using eigenvalues and/or eigenvectors of gravity gradient tensor.

In this presentation, we will first review the filtering and semi-automatic interpretation methods that use gravity gradient tensor. Then, we will report the results obtained by applying these methods to the gravity gradient data acquired for the Kuju geothermal area of Kyushu district through FALCON (R) AGG. We will also discuss the characteristic features of these methods and improvements in their practical application.

The results presented here were obtained from the project 'Investigations on applications of airborne gravity surveys to geothermal resources surveys' by JOGMEC. We are most grateful to JOGMEC for making the data available to us.

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Three-dimensional resistivity modelling of GREATEM survey data from the Nojima Fault, Awaji Island, south-east Japan.

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An airborne electromagnetic (AEM) survey using the grounded electrical-source airborne transient electromagnetic (GREATEM) system was conducted over the Nojima Fault on Awaji Island, south-east Japan, to assess GREATEM survey applicability for studying coastal areas with complex topographic features. To obtain high-quality data with an optimised signal-to-noise ratio, a series of data processing techniques was used to acquire the final transient response curves from the field survey data.

The 1D inversion results were feasible in that the horizontal resistivity contrast was not much higher than the true contrast, but they were not reasonable in that the horizontal resistivity values were greatly changed. To circumvent this problem, we performed numerical forward modelling using a finite-difference staggered-grid method (Fomenko and Mogi, 2002) adding a finite-length electrical dipole source routine to generate a three-dimensional (3D) resistivity structure model from GREATEM survey data of the Nojima Fault area. The 3D model was based on an initial model consisting of two adjacent onshore and offshore layers of different conductivity such that, a highly conductive sea of depth (10?40 m) is placed on top of a uniform half-space, assuming the presence of topographic features on the inland side. We examined the fit of the magnetic transient responses between field data and 3D forward-model computed data, the latter were convolved with the measured system response of the corresponding dataset. The inverted 3D resistivity structures showed that the GREATEM system has the capability to map underground resistivity structures as deep as 500 m onshore and offshore. The GREATEM survey delineated how seawater intrudes on the land side of the fault and indicated that the fault is a barrier to seawater invasion.

Keywords: 3D EM forward modeling, GREATEM, Numerical approximations, Airborne Electromagnetic, Fault zone survey