Developments in the high-resolution aeromagnetic survey and imaging the subsurface structure

Tadashi Nakatsuka[1]; Shigeo Okuma[1]

[1] GSJ, AIST

http://staff.aist.go.jp/tad.nktk/

High-resolution aeromagnetic survey is one of useful tools to reveal subsurface structure and situation, and it has become commonly used along with the technical development of GPS positioning. To make the survey more efficient, it is important to fly at an appropriate altitude with referred to the line spacing, and the use of helicopter is required especially in cases of investigating the volcanoes and their activities. In helicopter-borne surveys, as the altitudes of observation are often too variable to be regarded as a smooth surface, the altitude reduction procedure for such data had to be developed. Traditional aeromagnetic survey flights consisted of traverse lines and tie lines of observation, and the crossover analysis was performed to correct for the less reliable data. In variable elevation survey, however, simple crossover analysis cannot be applied because of altitude differences. Against such problems, we developed procedures of reduction and generalized mis-tie control (Nakatsuka and Okuma, 2006a, 2006b) using an equivalent source technique. The algorism used in them are same as those used in the magnetization intensity mapping (Okuma et al. (1994), Nakatsuka (1995)). The CG method utilized in these procedures has an advantage that the solution can be properly obtained even under a condition of underdetermined problem. The generalized mis-tie technique can be further applied to detect magnetic anomaly change between two epochs surveys, which must be free from spatial alias effects.

Recently, 3D analysis of magnetic anomalies are discussed by several authors, with the background of high-resolution surveys and expectation to effective use of survey data. However, there is a problem of the lack of unique solution for the subsurface structure, and it is essential to build any strategy (reasonable constraint or analysis model) to overcome the difficulty. Li and Oldenburg (1996) and Pilkington (1997) proposed a smooth model analysis with considering the depth-sensitivity relation. Portniaguine and Zdanov (2002) developed a 'focusing inversion' expanding the idea of minimizing effective source volume by Last and Kubik (1983). In Japan, Ueda et al. (2001) and Kubota and Uchiyama (2005) discussed the 3D inversion by CG method. But their analysis model is not fine enough especially in vertical, and it will be required to examine the effect of constraint forced by the coarse analysis model. Today's PC is so developed that it is not difficult to handle even the problem of several million unknown parameters in linear problem. Further pursuit on the practical strategy to realistic subsurface 3D modeling is anticipated.