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Surficial rock density distribution inferred from gravity data in Japan

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Estimation of surficial density distribution will be useful not only to analyze density structure below sea level but to discuss whether the geologic features are surficial or extend to substantial depths. We proposed a method of inverting gravity data for the surficial density distribution based on a Bayesian approach (Murata, 1993) and applied the method to the gravity data in southwest Japan (Nawa et al., 1997). The density variation is modeled by a piecewise step function. We impose an a priori condition that the Bouguer anomaly distribution expressed by a third-order spline function is smooth relative to the topographic distribution. No a priori condition is imposed on the density distribution. The Akaike's Bayesian Information Criterion is used to obtain optimum trade-off parameters controlling the smoothness of the Bouguer anomaly surface against its fitness to the observed anomaly values. Recently two large gravity measurements databases became to be available (GSJ (ed.), 2004; Shichi and Yamamoto, 2001). We apply the method to these databases and newly acquired data in Japan. In Kyushu island region, especially, we estimate density distribution with higher resolution than that of early study. And by synthetic tests, we confirm robustness of the result. The calculated density distribution, in general, correlates well with major geologic features. But, in some regions, density and geological boundary are not consistent or large density variance appears in the same geologic feature region. These will become to be information for estimation not only of 3D density structure but of porosity and/or crack distribution near surface.

Keywords: gravity survey; Bouguer anomaly; terrain density; subsurface structure

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