Application of Parker-Oldenburg Algorithm to map Moho Discontinuity using Gravity Data in Western USA

Mohammad Shehata\textsuperscript{1,2} and Hideki Mizunaga\textsuperscript{1}
\textsuperscript{1}Department of Earth Resources Engineering, Faculty of Engineering, Kyushu University, Fukuoka 819-0395, Japan
\textsuperscript{2}Geology Department, Faculty of Science, Port Said University, Port Said 42522, Egypt

Parker–Oldenburg algorithm was applied to gravity data in the western USA to map the Moho discontinuity. F-H Parasnis method was also applied to the gravity data to estimate the Bougeur reduction density for calculation of the Bougeur gravity anomaly. The inversion process uses the Oldenburg equation (Eq.2: Oldenburg, 1974), which is a rearrangement of Parker’s equation (Eq.1: Parker, 1973), to estimate the depth to the undulating interface from the gravity anomaly by means of an iterative process. These formulas are shown as follows,

\begin{align}
F(\Delta g) &= 2\pi G \rho e^{(-k z_0)} \sum_{n=1}^{\infty} \frac{K^{n-1}}{n!} F[h^n(x)], \\
F[h(x)] &= -\frac{F[\Delta g(x)] e^{(-k z_0)}}{2\pi G \rho} - \sum_{n=2}^{\infty} \frac{k^{n-1}}{n!} F[h^n(x)],
\end{align}

where \(F(\Delta g)\) is the Fourier transform of the gravity anomaly, \(G\) is the gravitational constant, \(\rho\) is the density contrast across the interface, \(K\) is the wave number, \(h(x)\) is the depth to the interface (positive downwards) and \(z_0\) is the mean depth of the horizontal interface.

The resulted Moho depth map shows depths ranging from 9 km to 50 km. Moho anomalies showed good spatial correlation with the major physiographic provinces in the study area. The subduction trench of the Farallon remnants (Juan de Fuca and Gorda) was mapped at the north of the Mendocino Triple Junction (MTJ). The subducting plates show north-east dipping direction with low dipping angle. The effect of the subduction appears in the structure at the northern part (i.e. Cascade Mountain, Walla-Walla plateau and Northern Rocky Mountains), whereas the southern part is affected by the transform movement of the Pacific Plate yielding a set of basins (Central
Valley, Great Basin and Wyoming Basin). Results of this research, in conjunction with other information of the area, provide a new information for the analysis of the tectonic framework of the western North-America.

References
