as our final equation (which may be new) for determining the Moho depth $\tau = T/R$ from the attraction A_C of a regional isostatic compensation reaching with constant density contrast $\Delta\rho$ to depth T. Eq. (8–213) is dimensionless; the quantity $a(\theta, \lambda)$ is related to the attraction A_C by (8–190), and the function $M(\psi)$ is given by (8–202).

Eq. (8–213) lends itself to an iterative solution which can be described as follows. Given A_C, we compute $a(\theta, \lambda)$ by (8–190). A first approximation for $\tau(\theta, \lambda)$ is obtained by disregarding in (8–213) the terms τ^2 and τ^3. These terms can then be approximately computed by raising the approximate function $\tau(\theta, \lambda)$ to the second and third powers. The functions $\tau^2(\theta, \lambda)$ and $\tau^3(\theta, \lambda)$ may be used on the right-hand side of (8–213) to compute a better approximation to $\tau(\theta, \lambda)$. The iteration may be repeated as necessary.

Since already the last term in (8–213) is very local and, above all, extremely sensitive to data noise, a further approximation (to τ^4, etc.), although possible in principle, probably will not make much sense.

The convergence behavior seems to be similar to that of the Molodensky series well known in physical geodesy: although the series may not be convergent in a mathematical sense, it is probably "practically convergent" in the sense that the first few terms give a good approximation provided the data are suitably smoothed. For a general discussion of such cases see (Moritz 1980, pp. 413–414).

Note that neither (8–188) nor (8–193) contain a term $n = 0$, so that the present method defines the Moho depth T only up to an additive global constant or, geometrically speaking, up to a constant vertical shift. This shift can obviously be determined from seismic observations.

Finally we note that the plane approximation of this problem with the geoid or terrestrial sphere replaced by a plane, is well known, especially in applied geophysics (cf. Parker, 1972; Oldenburg, 1974; Granser, 1986, 1987), and has also been applied to the determination of the Moho (Granser, 1988). The present approach is spherical, corresponding to a global inverse problem.

8.3.3 Concluding Remarks

Some isostatic compensation exists without any doubt whatsoever. This is plausible physically and has recently been confirmed on a global scale by Sünkel (1985; 1986b, p. 450), who has shown that the "degree variances" (cf. Heiskanen and Moritz, 1967, p. 259), which describe the average power of the gravitational spectrum, from degree 15 or 20 onwards can almost completely be explained by the combined effect of topography and compensation; cf. also (Rummel et al., 1988). The lower harmonics, of course, come almost exclusively from the mantle; and harmonics of the very highest frequencies are due to uncompensated local topography.

Besides this global result, it is surprising that even the Alps seem to be relatively well compensated: isostatic reduction considerably diminishes the size of gravity anomalies and deflections of the vertical, cf. (Sünkel, 1987, p. 62); see also (Wagini et al., 1988) and (Steinhauser and Pustizek, 1987).

These computations basically use a standard Airy-Heiskanen model. From a physical point of view, the Airy model appears more plausible than the Pratt model, although the latter may seem to bear some relation to the modern concept of the lithosphere (consisting of the crust and of part of the upper mantle). Even more plausible is the regional model of Vening Meinesz, although its definitive conceptual superiority remains to be tested empirically. Regionality can also be achieved by an appropriate smoothing of the compensation of an Airy model; cf. (Sünkel, 1986b, sec. 4.1).

However, all these *a priori* isostatic assumptions represent models rather than reality. This is why isostatic inverse problems become important. The inverse problem of Pratt type as proposed by (Dorman and Lewis, 1970) represents a pioneering work although their basic assumptions: strictly local compensation to arbitrary depth, are rather questionable. Also their first results (Lewis and Dorman, 1970): maxima and minima of $\Delta\rho$ increasing periodically to a depth of 400 km, do not seem very realistic. Still, their theory rightly has become very influential recently; cf. (Bechtel et al., 1987) and (Hein et al., 1989), with an extensive bibliography.

A Vening Meinesz-type inversion seems to be more realistic, although the question of the size and the constancy of the density contrast at the Mohorovičić discontinuity is still much discussed (cf. Geiss, 1987a). A determination of the Moho in the Alps by gravimetry was made by Granser (1988) as mentioned above. Geiss (1987a, b, with many references) has used a combination of seismic and gravity data to compute the Moho in the Mediterranean area.

Since (8–113) is never fulfilled *exactly*, by imposing it we may do undue violence to nature, but the results may nevertheless be expected to provide important geophysical information.

It should be kept in mind that the Mohorovičić discontinuity is primarily defined seismically. To identify it with a gravimetrically defined supposed density contrast surface is natural but not a logical necessity; cf. (Scheidegger, 1982) for a geophysical background.

The Bouguer anomalies Δg_B essentially represent the attraction of compensation A_C by (8–114). However, they must be freed from

(a) lower degree harmonics arising from the mantle, say by using a spherical-harmonic reference model to degree 15 or 20;

(b) very high frequencies due to imperfect isostatic compensation and, above all, to density anomalies in the crust, by determining these density anomalies (cf. Walach, 1987) and by cutting off such high frequencies (cf. Granser, 1986, 1988).

Only then, a Vening Meinesz-type of isostatic inversion to get Moho depths, by the method of sec. 8.3.2 or by alternative approaches, may give results which are geophysically really meaningful, in spite of the limitations mentioned above. For related geophysical aspects cf. (Dahlen, 1982).

At any rate we are entitled to say that gravimetric and isostatic methods represent a powerful tool for the study of the lithosphere. The best results can obviously be expected from a combination of gravimetric and seismic data.