Balanced Crustal Density Model along Geotraverse 9HR in Western Bohemia

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Seismic sections 9HR/91 and 9HR/93 marked the beginning of a new period in the interpretation of gravity data in western Bohemia. The seismic measurements provided data on the course of acoustic impedance changes for the whole Earth's crust. The gravity modelling itself was carried out along a composite straightened section 9HR composed of both mentioned lines. The upper part of Fig. 1 shows gravity anomalies along the line Klingenthal - Oloví - Sokolov - Teplá - Konstantinovy Lázně - Blatnice - Přeštice - Horažďovice - Volyně - Prachatice. For gravity modelling we used the interactive programme MaGGE (Halíř 1994). The initial geometry of the density model was derived from the line-drawing of the essential reflections along geotraverse 9HR (Dvořáková et al. 1993) obtained through ray migration of reflections and also through wave migration of sections 9HR/91 and 9HR/93. The analyses of the migrated seismic section was vital for the definition of the density model. We used the correlation of both dynamically strong reflections and the areas of the equal echogeneity.

In the process of modelling the authors were using the conception of the geological interpretation of geotraverse 9HR proposed by Tomek and Vrána. Particular attention was paid to the natural rock densities (Hrouda and Chlupáčová 1993). These were used for the preparation of the initial model and subsequently their calculated values were utilized for the geological interpretation of the modelled structures (Švancara and Chlupáčová 1994).

The final density model of the crust which is in full agreement with gravity data measured along section 9HR is presented in lower part of Fig. 1. Light granite of the Karlovy Vary massif as thick as 11 - 12 km accounts for the dominant minimum at the beginning of the geotraverse (0 - 45 km). Density 2600 - 2610 kg/m^3 is supposed to fit best to mineral composition of monzogranites and syenogranites building the Karlovy Vary pluton. There were found lower densities for some layers of granites drilled in some boreholes which were located near important tectonic zones, but we consider, based on numerous data available, that porosity of granites does not exceed 2 vol. % on average. The density increase towards the northwest is attributed to dense Ordovician phyllite (thickness 2.5 km) and mica schist (thickness 4 km). Local gravity minimum between km 5 and 10 is probably caused by a body of light granite rocks which is up to 2.5 km thick. An abrupt gravity increase along the southeastern edge of the Karlovy Vary massif (km 40 - 45) coincides with the contact of the massif with dense MLC rocks. The complex lower boundary of the MLC is assumed at the depth of about 7.5 km. At this depth the MLC merges with a thick crustal suture zone. The gravity maximum between km 50 and 63 is subdued by the influence of rather low-density rocks of the Teplá crystalline complex.

The Barrandian Proterozoic is subdivided into two bodies having the densities of 2725 and 2747 kg/m^3. These units are separated by the Stříbro-Plasy spilite belt. Another gravity minimum may be associated with up to 3 km thick granite pluton. A thick complex with the density of 2800 kg/m^3 dipping towards lower crust beneath the Klatovy Fault accounts for the low amplitude positive gravity anomaly in the section between km 82 and 97. Another distinct gravity maximum occurs in the interval 102 - 123 km. It is linked with dense Proterozoic rocks of the Blovice structure. Local gravity maxima within this area correspond to spilite belts. Based on the interpretation of the time section a distinct antiform structure has been distinguished beneath the Blovice Proterozoic complex at the lower crust/mantle boundary.

The deep Klatovy Fault was recognized at km 124; it is assumed to be subvertical. The Klatovy apophysis of the Central Bohemian massif is represented by a wedge-shaped body at the depth of about 6 km. The Klatovy apophysis is separated from the Chánov apophysis by gneiss and migmatite of the Plánice part of the Strážov crystalline complex. The Blatná and Červené granodiorite of the Chánov apophysis in the interval of km 133 - 153 are characterized by the density of 2686 kg/m^3. A domal structure was identified in the depth range of 2.5 - 13 km beneath the granodiorite based on the seismic data. A body of migmatitized gneiss belonging to the Bohemian Moldanubian was outlined between km 152 and 173. Orthogneiss with the density of 2689 kg/m^3 was observed further to the southeast. The thickness of this structure is 5 to 6 km. A low-density geological body is believed to account for a gravity minimum which coincides with km 165 of the geotraverse. It represents the southeastern tip of the Putim structure identified by gravity survey by Tomek (1974, 1975). The Prachatice granulite massif occurs at the end of the section between km 185 and 195. The massif extends to the depth of up to 8 km. To the northwest the structure is bounded by amphibolite which explains the local gravity maximum at km 185.

The density model of the middle and lower crust was inspired by petrological models compiled by Fountain and Christensen (1989), Wilson and Downes (1991) and others for similar geological structures. In accordance with the interpretation of Vrána et al. (1997) we recognize three main units forming the lower part of the crust along the section (from NW to SE): the Avalonian unit with densities of 2720- 2860 kg/m^3, the lower Teplá-Barrandian unit of more basic and variable composition with densities of 2830 - 2970 kg/m^3, and the Moldanubian unit with high and homogeneous densities of 2840 - 3000 kg/m^3.

References

DVOŘÁKOVÁ V., NOVOTNÝ M., TOMEK Č. and VEJMĚLEK L. 1993. The interpretation of seismic data, sections 9HR/91, 503M/92, and VI/70. MS Czech Geological Survey Praha.

HALÍŘ J. 1994. A magnetometric and gravimetric modelling program MG. MS J.Halíř, Brno

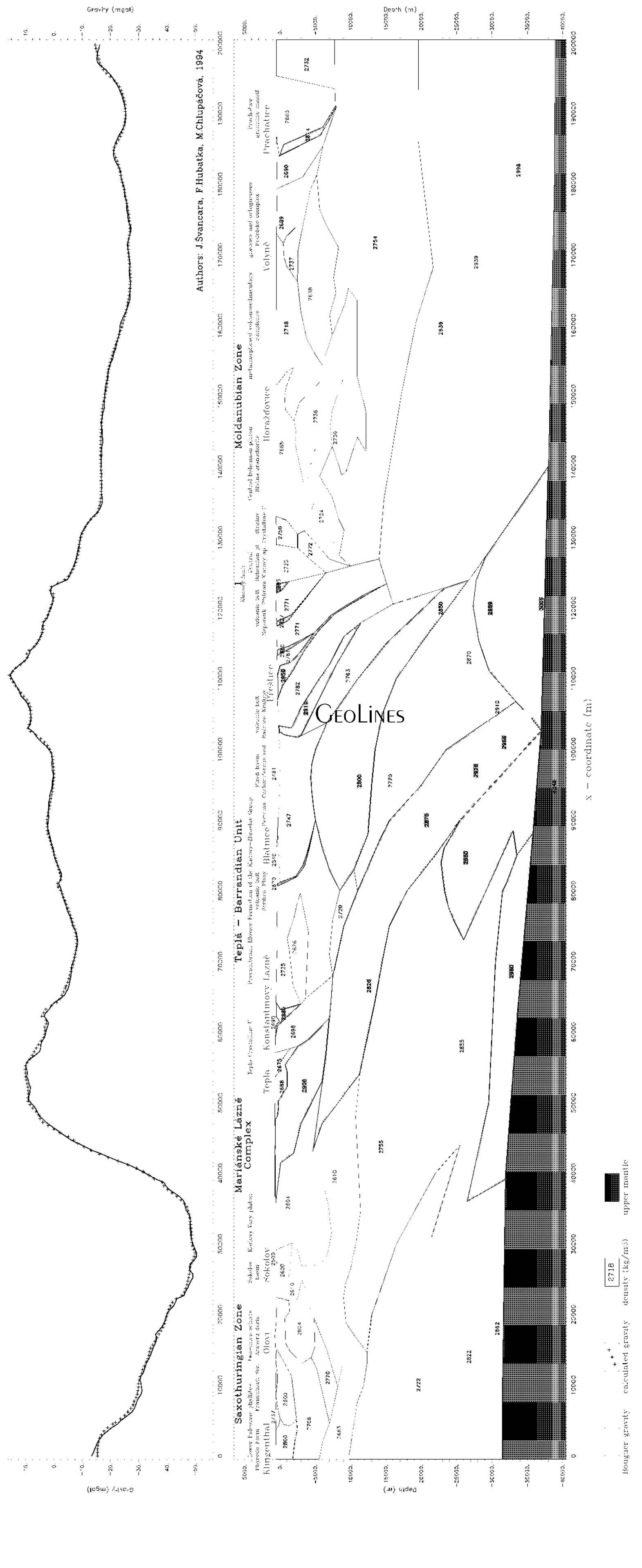

Fig.1. Crustal-scale density-balanced cross section along seismic reflection sections 9HR/91 and 9HR/93.

HROUDA F. and CHLUPÁČOVÁ M. 1993. A petrophysical study, part II. density, magnetic properties, elasticity and radioactivity. In VRÁNA S. and ŠTĚDRÁ V. (eds.): *Geological model of Western Bohemia in relation to the deep borehole KTB in FRG.* MS Czech Geological Survey Praha.

ŠVANCARA J. and CHLUPÁČOVÁ M. 1994. Density model of geological structure along the 9HR profile and advanced processing of gravity field in western part of Bohemian Massif. MS Czech Geological Survey Praha.

TOMEK Č. 1974. The inverse gravimetric problem and its application on morphology of the Central Bohemian Pluton. *Čas. Mineral. Geol.*, 19, 217-220.