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CONTOUR MAP OF THE MOHOROVIČIĆ DISCONTINUITY BENEATH CENTRAL EUROPE

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A Moho contour map was compiled by using data from various geophysical measurements performed in Austria, Czechoslovakia and Hungary. The intention in publishing the map of crustal thickness (Moho depth) is to increase the available information on the Alp-Carpathian mountain system and the young (Neogene) Pannonian basin. It is hoped that apart from contributing towards the knowledge of the area, this work will promote further structural analyses.

Keywords: deep seismic sounding, Mohorovičić discontinuity, crustal thickness, Alps, Carpathians, Pannonian basin

1. Introduction

Based on seismic measurements taken in and before 1984 we have compiled a map of the Earth's crust-mantle boundary (Mohorovičić-discontinuity) for the area of Austria, Czechoslovakia and Hungary. The data were obtained in different ways and thus differed in quality and accuracy. It is mentioned that apart from providing information on crustal thickness, the map reflects all shortcomings: lack of data — especially in Austria — irregular distribution of data, non-uniform reliability.

2. Data acquisition and compilation of the map

The first experiments to study the Earth's crust by the seismic reflection method started in Hungary in 1954. The results showed that the crust is substantially thinner in the Pannonian basin than in the surrounding areas [Gálfi and Stegena 1955]. Individual reflections gave only approximate information on the depth of deep reflectors and this gave no clue as to the velocity distribution within and below the crust. Experiments were continued by using refraction seismics and later by combined refraction and reflection measurements [MITUCH et al. 1964].

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Since the early 70s multiple coverage reflection measurements have been made in Hungary using digital seismic stations. Furthermore reflection arrivals enabled us to draw conclusions concerning the structure and the velocity of the lithosphere [Posgay 1975].

Data gained from a network of regional seismic profiles [Ráner et al. 1972] and magnetotelluric soundings [Ráner et al. 1983] contributed to the integrated study of the structure of the crust and upper mantle in Hungary, (also involving heat flow data) and resulted in the compilation of a depth contour map of the Mohorovičić discontinuity. Further results of this study revealed tectonic features and geophysical parameters within the investigated depth range [Posgay et al. 1986]. It was concluded that the crust was separated from the upper mantle by a transition zone which has changed in both depth and thickness throughout geological time. The contour lines of the Moho map reflect the lower boundary of this transition zone.

The first international DSS profile (No VI) crossing the GDR, Czechoslovakia and Hungary was carried out in the early 60s. The results of the international co-operation creating a network of deep seismic profiles in Central and Eastern Europe appeared in the following monographs: Eds. Sollogub et al. 1971, 1978, 1980, Crustal Monograph 1972.

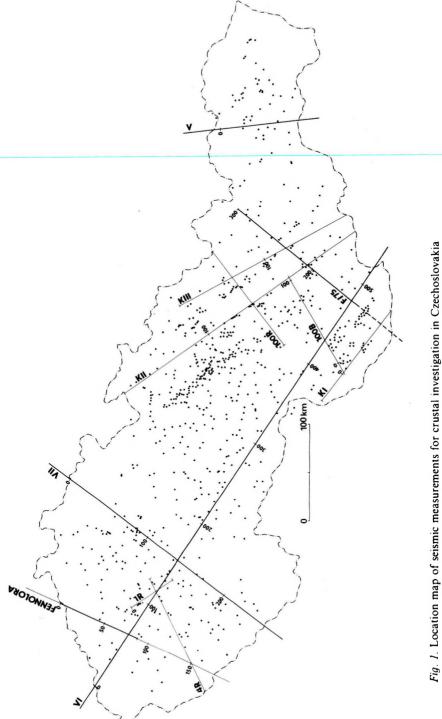
Hungary also participated in the project of ALP75 longitudinal profile [MILLER 1976, MILLER et al. 1977]. This cooperation enabled us to combine Hungarian and Austrian data.

In Czechoslovakia, investigation of the deeper parts of the Earth's crust, including the Moho relief, began in 1962 as part of a project prepared by the European Seismological Commission in 1959. Czechoslovakia participated in DSS measurements along profiles VI, V and VII until 1972 (see *Fig. 1*).

From 1975 to 1980 measurements were carried out on national regional profiles KIII, KII, 100R an KI (Fig. 1) in the Czechoslovakian West Carpathians [Beránek and Zátopek 1981]. The purpose of these measurements was to trace refraction boundaries, to determine the velocity distribution in the crust and to gather information on the relief and depth of the Moho. In 1979 seismic measurements were also conducted along the Czech part of the Fennolora profile [Beránek et al. 1983].

In the period 1971–1984 the information on the Moho from international and regional Carpathian profiles was complemented systematically by recording seismic waves generated by industrial blasts [Beránek et al. 1973]. In this case measurements were carried out using seismic sounding at discrete points (Fig. 1). The methodology and first results of processing these records were described by Beránek and Zounková [1977].

The Moho map taken from earlier works [Beránek and Zounková 1977, Beránek and Zátopek 1981] has gradually been complemented. The depth to the Moho was computed on the assumption of a smooth seismic boundary and therefore individual data were processed using a smoothing program. The Moho depths were given in relation to the sea level and corrections for the unconsolidated part of the Earth's crust were introduced. The first arrivals of



1. ábra. Földkéregkutató szeizmikus mérések helyszínrajza Csehszlovákiában

Puc. 1. План ситуации сейсмических измерений для изучения земной коры на территории Чехо-Словакии

the groups of P_M -waves were used for the map. The corrected arrival times were converted to depth data at individual points. The average velocity of 6.3 km/s was used for the Bohemian Massif and also for the Carpathian system [MAYERO-VA et al. 1985].

During the period 1980–1987 about 800 km of seismic reflection profiles were shot in Czehoslovakia with recording times up to 16 sec. The majority of them contains recognizable reflections originating at the Moho. Depth data derived from these profiles are incorporated into the contour map (*Encl. 1*).

During these years seismic crustal investigations in countries of western and southern Europe were carried out partly on a national basis and partly with support of the European Seismological Committee [Giese et al. 1973]. Longitudinal profiles along the Alps [Miller 1976, Miller et al. 1978] provided information about the structure of the Mohorovičić discontinuity from France to Hungary. These data mainly come from a reinterpretation of profile ALP75, where two-dimensional models of the crust were calculated using the ray-tracing method [Aric 1981]. These models, constructed on the basis of travel time measurements, were tested and improved by the interpretation of amplitudes, while Q-values for the upper and lower crust were also calculated [Lenhardt 1983].

Additional information was provided by short seismic profiles [ARIC et al. 1987] as well as by the near SNEALP 77 earthquake array perpendicular to ALP75 [LIDSTER et al. 1979]. OSTERODE [1976] used teleseismic signals observed in Vienna in order to obtain details on the crustal structure and Moho depth from the crust's transmission function. Reflection seismic measurements in near vertical and wide angle ranges [Weber et al. 1981, Mauritsch et al. 1986, Aric 1981] as well as near earthquake measurements on local arrays [Gebrande et al. 1978] provided complementary Moho depth data.

Gravity measurements carried out in the Eastern Alps published by Partsch [1971], Makris [1971], Götze [1984] and Meurers et al. [1987] should be mentioned here as they provide some indications on the Moho relief. The Moho map of Makris is partly supported by models suggested by Giese [1968] from older refraction seismic profiles perpendicular to the Alps. The link between gravity and seismic interpretation comes from empirical relations between Moho depths and $\Delta g''$ along these profiles. Götze refers to the same source. Meurers et al. fit their model, which covers a smaller area (50 km broad at about 11° longitude), to the seismic model provided by ALP75 [Miller 1976]. Recently Granser [1986], Granser et al. [1988] and Steinhauser and Pustizek [1987] have published maps of the M-discontinuity on the basis of $\Delta g''$ data using an inversion method.

The fundamental approach in gravity modelling differs from that used in seismics. That is why for this map we do not use models based on gravity data in order to prevent an undesirable mixture of information of different quality.

3. Conclusion

Data presented on the final map of the Moho (Encl. 1) come from areas of completely different tectonic units. Therefore the acoustic parameters which led to its construction vary between wide limits and so does the density of source data. In spite of this, the final map should be appreciated as the first one in Central Europe which shows the Moho relief on a 1:1,000,000 scale. There are gaps in the data mainly between the Alps and the Czech border. Additional measurements on several short profiles will be necessary in order to check the depth of the Moho in the northern part of Austria.

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A MOHOROVIČIĆ HATÁRFFI ÜLFT KÖZÉP-FURÓPA ALATTI DOMRORZATA

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Ausztria, Csehszlovákia és Magyarország területén különböző időben és módszerekkel készült mérések eredményeinek felhasználásával készítettük el a Mohorovičić határfelület mélységtérképét. A három ország területére szerkesztett kéregvastagság térkép (Moho mélység térkép) publikálásával növelni szándékoztuk az Alp-Kárpáti rendszer és a Pannon medence földtani ismeretességét. Reméljük, hogy térképünk hozzájárul a terület jobb megismeréséhez és elősegíti újabb szerkezeti elemzések megalapozását.

РЕЛЬЕФ ПОВЕРХНОСТИ МОХОРОВИЧИЧА ПОД ЦЕНТРАЛЬНОЙ ЕВРОПОЙ

Карой ПОШГАИ, Иштван АЛЬБУ, Милица МАЙЕРОВА, Зеленка НАКЛАДАЛОВА, Иван ИБРМАЙЕР, Милан БЛИЖКОВСКИ, Кай АРИЧ, Рудольф ГУТДАЙЧ

Карта глубины залегания поверхности Мохоровичича составлена с использованием результатов измерений, выполненных в разные периоды с применением различных методов по территории Австрии, Чехо-Словакии и Венгрии. Опубликованием карты мощности земной коры (глубины залегания Мохо) предполагается повысить геологическую изученность Альпийско-Карпатской горной системы и Паннонского бассейна. Можно надеяться, что данная карта окажется вкладом к лучшему познанию региона и будет способствовать обоснованию дальнейших тектонических синтезов.

