P062 SEISMIC AND GEOLOGICAL MODEL OF ZONE OF JOINT OF BLACK SEA BASIN AND SOUTHERN CRIMEA

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Abstract

The structure of zone of subduction in region of joint of the Black Sea crust and of the Crimea crust is obtained in the result of reinterpretation of data of Deep Seismic Sounding profiles with usage of new computer technologies. Rift zone and zones anomalously of low velocities in district of the Andrusov ridge are distinguished. These structures are traced and interpreted on the seismic cross sections and map-slices.

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Introduction

The Black Sea Basin, as to the crustal structure, is composed of two deep basins: the Western Black Sea Basin underlain by oceanic to suboceanic crust and containing a sedimentary thickness up to 19 km, and the Eastern Black Sea Basin with a thinned up to 10 km crust and sedimentary thickness up to 12 km. These basins are separated by the Andrusov ridge. The Black Sea Basin is surrounded mainly by late Cenozoic mountain areas with a thickened continental crust (the Caucasus, Pontides, Southern Crimea, Balkanides: typically up to 40-50 km).

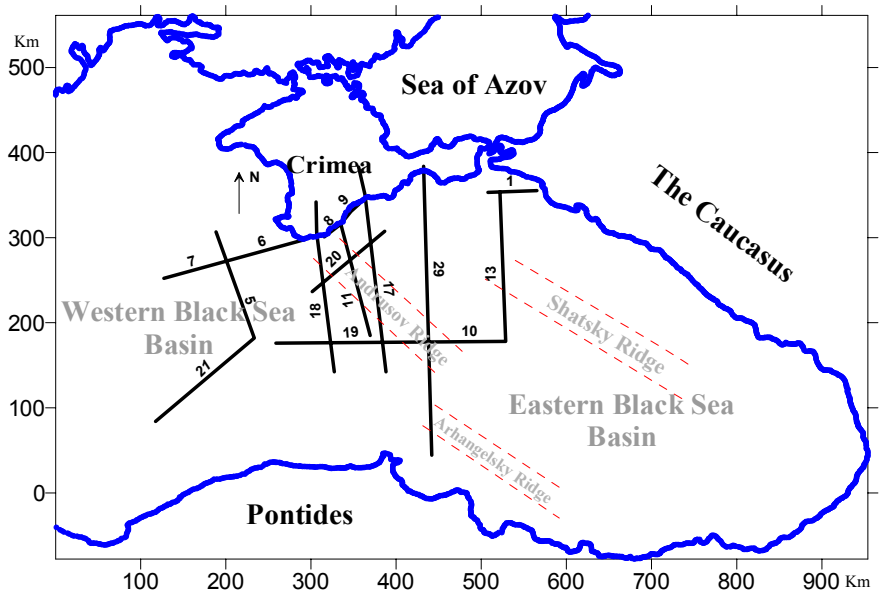

Fig.1. Map of location of the seismic profiles.

The data along 12 seismic refraction profiles (fig. 1) of common length 1810 km were reinterpreted. These seismic profiles were carried out in period of 1956 - 1965 by Institute of Oceanology (Goncharov et al, 1972). As a source of elastic waves the shots with step 1 - 3 miles were used. The reception was produced by hydrophones and land stations. Geological interpretation of seismic cross sections in the past was based on models, where the velocity of waves practically does not vary inside of layer. In every profile 3 - 4 seismic boundaries, as a rule, were obtained. The modern interpretation of the seismic data has been fulfilled by a method of homogeneous functions (Piip, 2001). The new cross sections include layers and faults of various declination. Velocities vary inside of the layers in vertical and horizontal directions. Geological interpretation of these seismic cross sections was produced with usage

of modern knowledge of the global tectonics. In fig. 2 the observed traveltime curves, as example of initial data, along profile 17 are shown.

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Method of interpretation

The method of homogeneous functions was used for reinterpretation. Method is based on the local approximation of the real velocity fields by homogeneous functions of two coordinates. It allows obtaining automatically 2D velocity fields calculated in the nodes of rectangle grid. Any initial model is not used for this interpretation technique. Obtained cross sections are represented as field of velocity contours with constant interval (usually 0.1 - 0.2 km/s). Seismic boundaries and faults are seen in these cross sections. That representation of cross sections allows easily computing the horizontal depth velocity maps-slices if several seismic profiles were interpreted in the area.

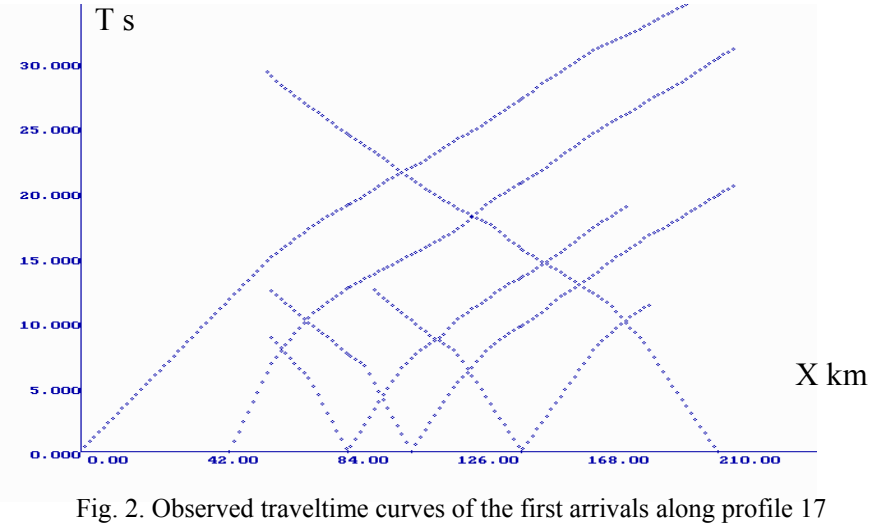

Fig. 2. Observed traveltime curves of the first arrivals along profile 17

Results of the interpretation

On an example of seismic cross sections along two parallel meridional profiles 29 and 17 it is possible to describe a depth structure of the northern part of the Black Sea (fig. 4). In both cross sections three layers of oceanic or suboceanic crust are allocated: 1.sedimentary layer with thickness of 8 - 12 km and velocity of 2 - 4 km/s (I in fig. 4); 2. second layer with velocity 5 - 6.4 km/s and thickness of 5 - 8 km (II); 3. third layer of oceanic crust broken down on blocks with thickness about 5 km and velocity 7.4 - 8.2 km/s (III). The third layer is underlying by upper mantle, which in a central part of the Black Sea has anomalously low velocity from 7 up to 7.4 km/s. Between the sedimentary layer and the second layer of oceanic crust the sharp seismic boundary exists, where the velocity increases from 4 up to 5 km/s. The third layer of the crust is dipping under continental lithosphere of the Crimea and is forming steps and

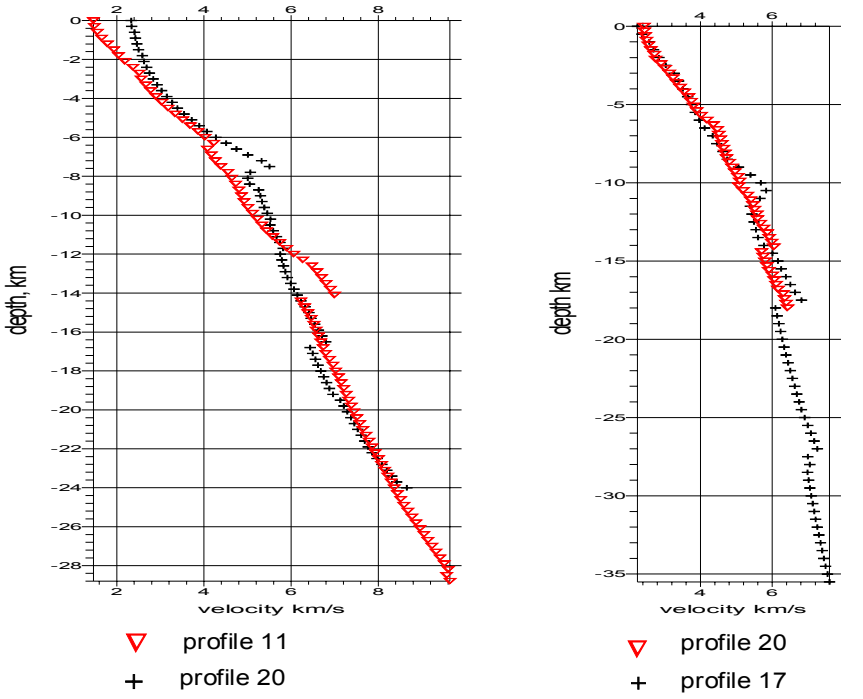

Fig.3. Velocity depth functions in a cross point of the profiles 11 and 20 and of the profiles 20 and 17 demonstrate a good coincides.

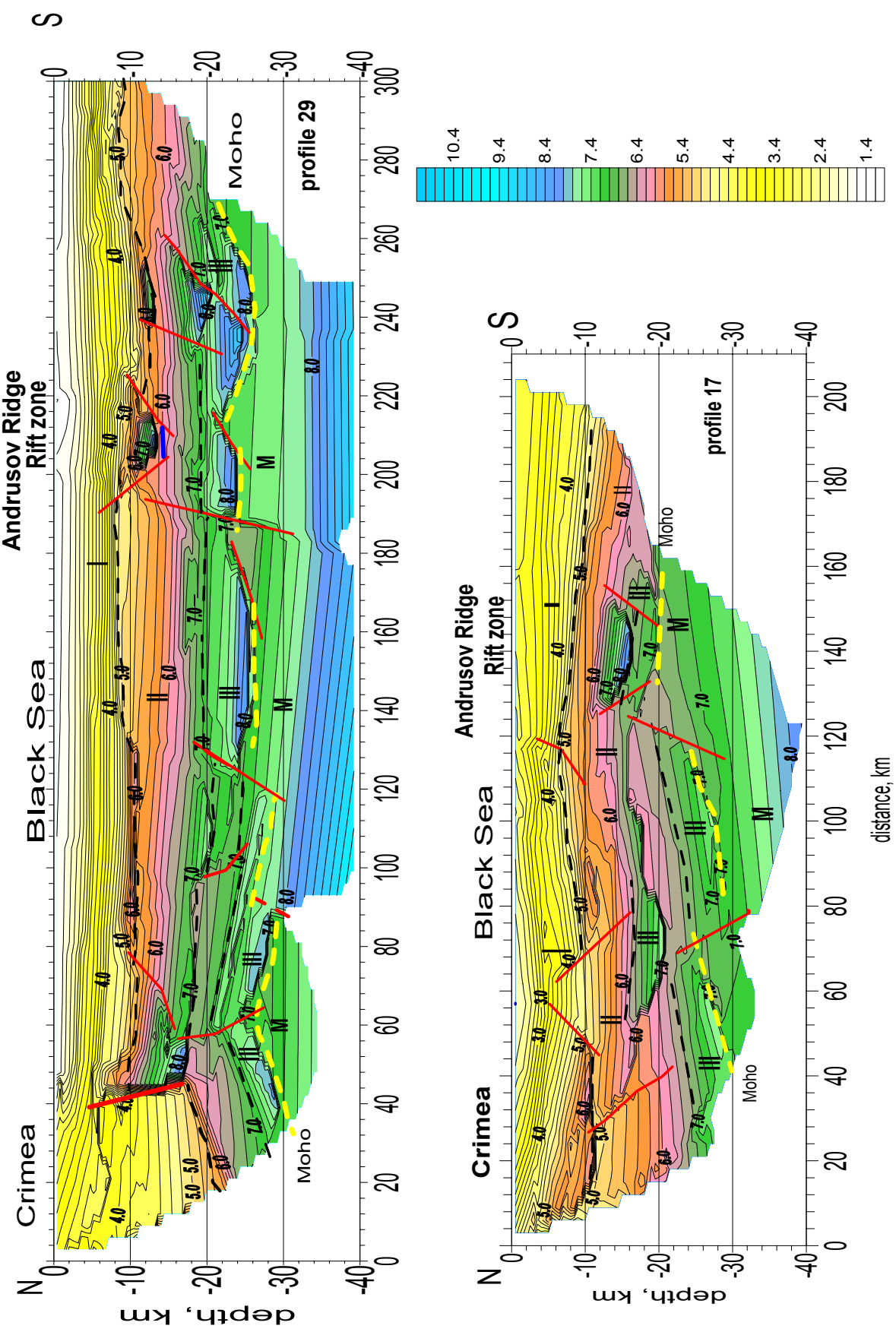

Fig. 4. The seismic cross sections along two meridional parallel profles (29 above and 17 below) characterize a structure of northern part of the Black Sea Basin. The thin lines are velocity contours, seismic boundaries are shown by dash lines (Moho is bold yellow dash line). The faultrs are represented by red lines.I, II and III are denotations of the layers of ocean crust.M is upper mantle. The third layer of ocean crust is broken down on blocks and- is dipping under continental crust of the Crimea.

thrusts. This layer forms in district of profile 29 the sharp break, and in district of profile 17 this layer is divided on three segments.

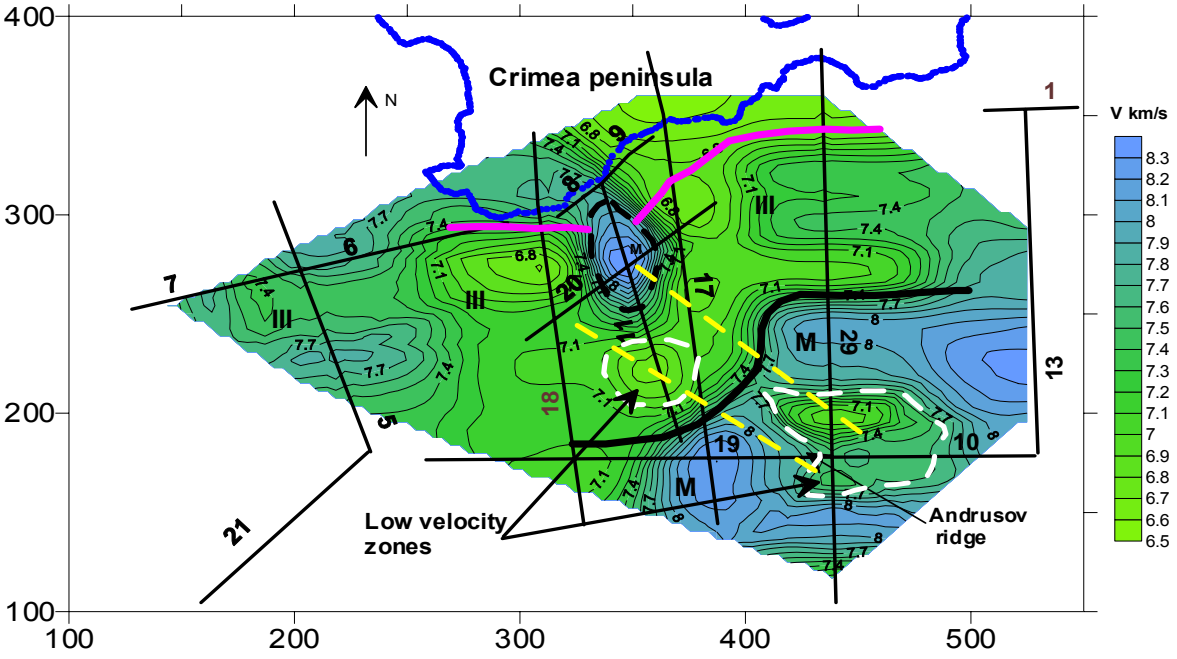

Fig.5. Velocity map-slice at the depth 24 km. The line of immersion of Black Sea crust under Crimea is shown by pink color. Supposed zones of melting rocks are shown by white dash lines. III is the third layer of ocean crust. Upper mantle is shown by blue color and marked M. Thin lines are velocity contours. Location of seismic profiles is shown

The depth of the Moho in district of the Andrusov ridge is about 20 km and increases up to 30 km in the direction to the Crimea. Rift structure is allocated in district of the Andrusov ridge. It is characterized by elevation of Moho, by high velocity and by set of faults in the second layer of the crust. In district of Crimea the depth of the basement is obtained down to 20 km. The same layers are distinguished in all interpreted profiles. Automatically and independently calculated seismic cross sections are tied up sufficiently well. The example of such correlation is shown in fig. 3. The several map-slices for different depths were computed. In fig. 5 the map-slice at the depth of 24 km is shown. We see on this map a structure of the subduction zone in the plane.

Conclusion

The detail structure of crust of the northern part of the Black Sea Basin is revealed in the result of reinterpretation of seismic refraction data of the past years by homogeneous functions method. The main feature of the structure is subduction zone near of shores of the Crimea.

References

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2. V.B.Piip 2001. 2D inversion of refraction traveltime curves using homogeneous functions. Geophysical prospectiong. **49,** p 461-482