Lithosphere geodynamics controlling the late Mesozoic - Cenozoic tectonic evolution of the Black Sea

The Black Sea is a remnant of the fossil Paratethys Ocean, which formed about 34 million years ago (Oligocene) and stretched from the northern foreland of the Alps through Central Europe to Central Asia. The Paratethys was formed at a time when the northern part of the Tethys Ocean was separated from the Mediterranean region by the formation of the Alps, Carpathians, Dinaric, Taurus and Elbrus Mountains. The Black Sea was one of the key sections of the Paratethys, constituting a deep-sea basin with a total thickness of Cretaceous and younger sediments in the order of 14 km. Most modern geodynamic models assume that the Black Sea was formed as a result of active rifting in the back-arc basin in the Cretaceous or, also, in the Paleogene. The main phase of rifting led to the emplacement of a (sub)oceanic crust that underlies the deepest part of the Black Sea. Convergence within the Alpine-Himalayan range in today's Turkey from the Eocene onwards resulted in the formation of a compressional tectonic regime in the area of the today's Black Sea. The strongest phases of compression took place in the Eocene and late Miocene, which had a fundamental impact on the formation of the geological structure of the Black Sea basin. Despite explaining some features of the structure and evolution of the Black Sea, contemporary geodynamic models are inconsistent with many previous and newly acquired geological observations from the northern part of the Black Sea. This contradiction between the predictions of modern tectonic models and the results of geological research is the basis of this project. In the course of it, we intend to test the working hypothesis postulating the relationship between the Cenozoic tectonic evolution of the Black Sea and the Alpine convergence of lithospheric plates in the area of the today's Pontides, the Anatolian Plateau and the North Anatolian Fault zone. The key tectonic processes shaping the Black Sea basin were (1) significant tectonic subsidence superimposed, from the beginning of the Eocene compressional phase, on thermal subsidence following the rifting stage, (2) subsequent short-term pauses in subsidence related to widespread folding and marine regression, and (3) the transformation of the Black Sea into a basin with a deep bathymetry, similar to the depth of modern oceans, only in the Pliocene and Pleistocene. The results of this project will shed light on the problem of initiating and driving of the mechanisms responsible for the formation and tectonic evolution of small back-arch basins, such as the Black Sea. The aim of the project is to understand how the tectonic processes occurring within a collisional orogenic belt affect the distribution of dynamic loads in the lithosphere and cause the propagation of extensional and compression stresses to the area of the orogen foreland, causing deformations of the continental lithosphere in the hinterland of the collision zone. In the context of regional geology, we intend to deepen our knowledge on the structure of the earth's crust as well as the tectonic and paleogeographic setting of the entire Black Sea area in the successive phases of its evolution. An important issue will be the recognition of the processes responsible for the rapid increase in the depth of the Black Sea since the Pliocene or Pleistocene. The project will also broaden the knowledge of the geological history of the Paratethys and the causes of modern seismic activity on the Black Sea rim. The project is divided into 6 closely related research tasks, including: (1) construction of a three dimensional model based on seismic profiles and boreholes, (2) basin subsidence modelling, (3) analysis, modelling and interpretation of gravimetric and magnetic data, (4) physical and numerical modelling of tectonic processes, tomography modelling, (5) paleogeographic reconstructions, and (6) construction of integrated structural and geodynamic models. The implementation of these tasks will be based on the integration of geological and geophysical data, their processing and interpretation supported by physical and numerical modelling. Such a wide set of reflective seismic profiles, magnetic, gravimetric and borehole data, as well as published and unpublished geological information is of unprecedented scale and has never before been used in the study of the Black Sea.