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Lithospheric inhomogeneity in the Black Sea from geophysical data

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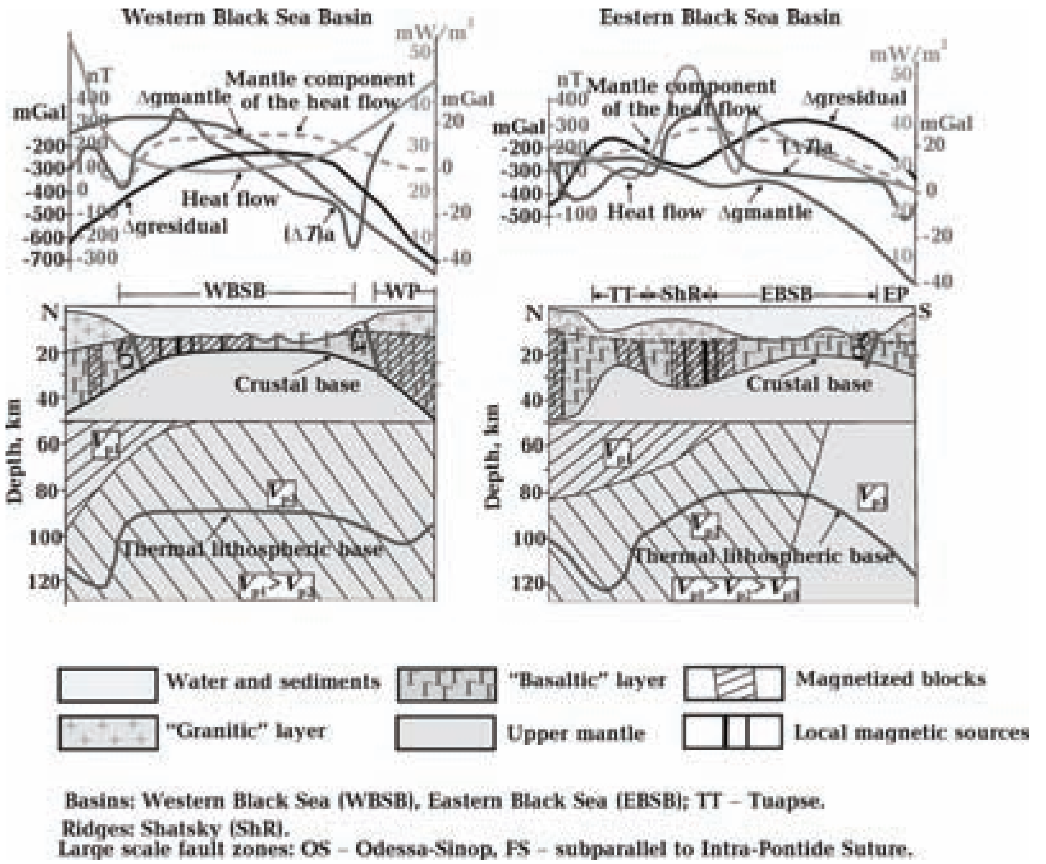
The international interest in the Black Sea geology is based on its key role in understanding the tectonic evolution of the middle Tethyan Realm and its hydrocarbon potential. The present-day tectonic setting of the Black Sea has been mainly derived from multi-channel surveys and sparse DSS data. The available information is however insufficient to produce a coherent geodynamic model for the region.

The purpose of this study is aimed at examining the lithospheric structure and relationship between near-surface and deep features using jointly the magnetic, gravity, heat flow, seismic and tomographic data (Figure).

A first integrated analysis has resulted in a new and mutually consistent image of lithospheric density, magnetic, thermal and velocity inhomogeneities. A most detailed map of faults systems has been compiled for the consolidated crust. A substantial and important difference in the crustal and mantle structure and geophysical parameters of the Western and Eastern Black Sea basins has been revealed. The "non-granitic" crust occurs only in the central portion of the Eastern Black Sea basin whereas it spreads practically within the whole Western Black Sea basin. Heat flow is more intensive and differentiated in the Eastern Black Sea basin than in the Western Black Sea basin. The topography of the thermal lithospheric lower boundary is dome-like beneath the Eastern Black Sea basin and it is flat in the Western Black Sea basin. Different mantle seismic velocities as well as the fabric of the crustal magnetic and gravity anomalies are characteristic of the two sub-basins. Over the rift zone a distinct local heat flow anomaly is observed in the Eastern Black Sea basin. On the contrary, in the Western Black Sea Basin the rift zone is not individually manifested itself in thermal field. The low density mantle exists beneath the rift zone in the Eastern Black Sea basin whereas any distortions of a density distribution are related to similar zone in the Western Black Sea basin.

The large mantle fault zones have been delineated in the Black Sea with the prominent Odessa-Sinop fault zone, which has mostly predetermined the dissimilarities mentioned because it has divided the old continental crust into two large blocks. Orthogonality of the rifts in the Western and Eastern Black Sea basins clearly demonstrates that they have been sequentially formed as two separate tectonic units. The Western Black lithosphere has rifted earlier than that of the Eastern Black and their post-rift histories have been autonomous and individual.



Lithospheric schematic cross-sections through the Black Sea Basins from geophysical data.

Plate Tectonics from the Top-down

© D. Stegman[1], W. Schellart[2], F. Capitanio[2,3], R. Farrington[3], 2010

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Subducting slabs represent the continously recycled cold thermal boundary layer of the Earth's convecting mantle, and are thought to be the primary driving force for plate tectonics. Subducted tectonic plates (slabs) sink through the mantle and pull the plate they are attached to, but this subduction can be accommodated by two modes: the forward motion of the subducting plate or backwards motion of the plate boundary. The latter is the process of slab rollback and is associated with retreating trenches.

Over the past decade, both analogue and numerical models of subduction have been developed which consider the dynamics of a single, isolated plate sinking into a passive upper mantle. These models offer a novel way to investigate aspects of plate tectonics and mantle convection through single-sided, asymmetric subduction with a coupled