Magmatic arcs, ophiolite belts and sedimentary basins in Anatolia interpreted from magnetic data

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Introduction

The continuous subduction along the northern margin of the Paleotethyan Ocean from Paleozoic to late Triassic and the Neotethyan Ocean from Mesozoic to Cenozoic time emplaced several discontinuous ophiolite belts, long magmatic arcs as well as created intracontinental basins (e.g. stampfli and Borel,2002).

Geological field mapping has no other means to identify the location of the sutures and magmatic belts below e.g. sediment cover or different phase of magmatism. Magnetic mapping is the cheapest and fast solution to map region and can provide the required knowledge. The sutures include ophiolites. The ophiolites and corresponding magmatic rocks are highly magnetized (Clark and Emersun 1991, Hunt et al 1995), thus allowing magnetic methods modelling and imaging ophiolite and magmatic bodies.

Negligible susceptibility value of sediments cause the high susceptibility contrast at basement-sediment boundary, which makes evaluating of magnetic basement topography possible by using radially average power spectrum of magnetic data (e.g.Maus et al 1997). The depth to the magnetic basement is assumed to serve as a proxy for the shape of sedimentary basins under the assumption that igneous basement is strongly magnetized relative to the overlying sediments with low susceptibility value and there is no interbedded magnetic layer in the sediments. Vertically averaged crustal susceptibility is calculated from magnetic data based on a newly developed method (Teknik and Ghods 2017, Teknik et al 2019).

The method are applied on the amalgamation structures in Anatolia. Identification of the highly magnetized bodies and shape of sedimentary basins, will allow us to trace features related to the tectonic sutures and hidden magmatic arc across the whole study area. The results will have significant importance for future more detailed studies and it has first order importance for the identification of potential hydrocarbon and mineral resources.

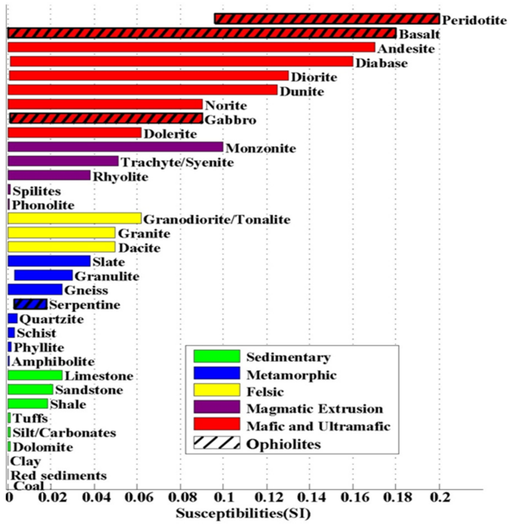

Fig1: Magnetic susceptibility ranges of different rock types (After Clark and Emerson, 1991; Hunt and et al, 1995). . Mafic and ultramafic rocks have the highest susceptibilities while metamorphic and sedimentary rocks have the lowest susceptibilities.

Maps

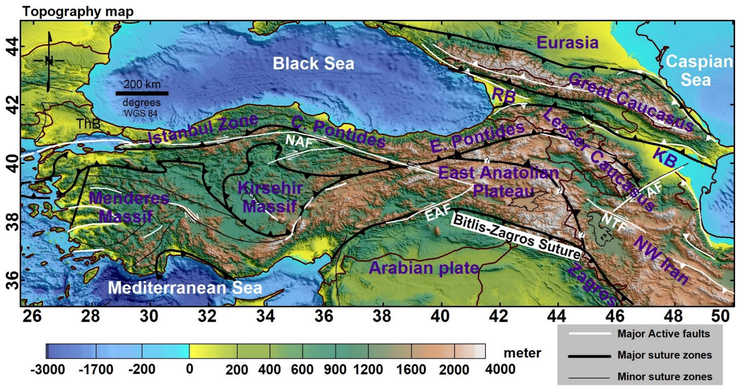

Fig 2: Topography of Anatolian and the adjacent regions based on ETOPO 1. White lines show neotectonic features and black lines older tectonic features (after Taymaz et al., 2007) Abbreviations: AF - Arax Fault, EAF - East Anatolian Faults, KB- Kura Basin, NAF - North Anatolian Fault, NTF - North Tabriz Fault, RB – Rioni Basin and ThB – Thrace Basin.

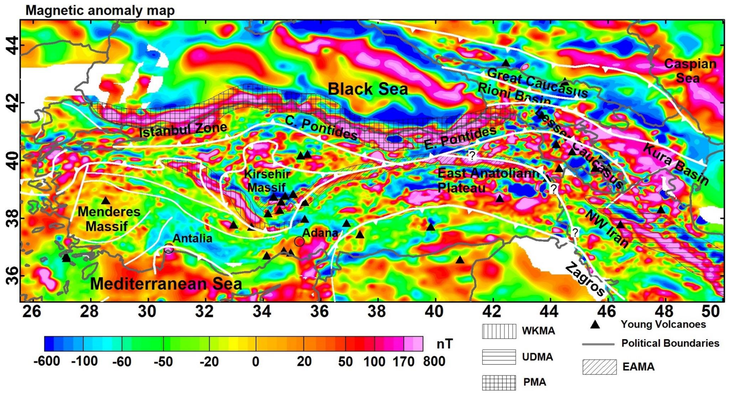

Fig 3: Magnetic anomalies in Anatolia and neighboring regions Abbreviations: WKMA-Western Kirşehır Magnetic Anomaly, UDMA-Urmia Dokhtar Magnetic Anomaly, PMA-Pontide Magnetic Anomaly, EAMA-Eastern Aanatolian Magnetic Anomaly.

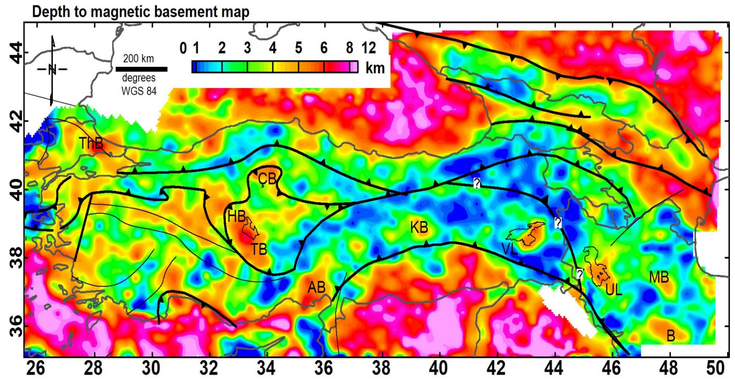

Fig 4: Depth to magnetic basement (DMB) is larger in western Anatolia than in high elevation regions of eastern Anatolia and NW Iran. Late Cretaceous to Paleogene forearc basins of Anatolia and NW Iran mentioned in the text: HB - Haymana Basin, TB -Tuzgölü Basin. Other basins: AB - Adana Basin, B - Bijar Basin, KB- Keban Basin, MB - Mianeh Basin, ThB- Thrace Basin, UL - Urmia Lake, VL - Van Lake.

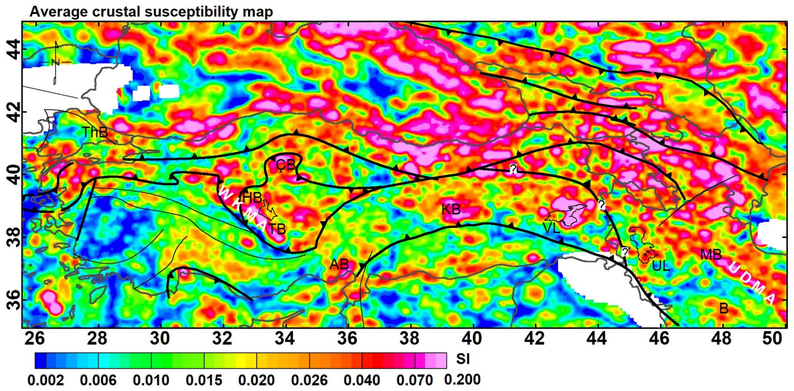

Fig 5 : Average crustal magnetic susceptibility (ACMS).WKMA - Western Kirşehir Magnetic Anomaly.

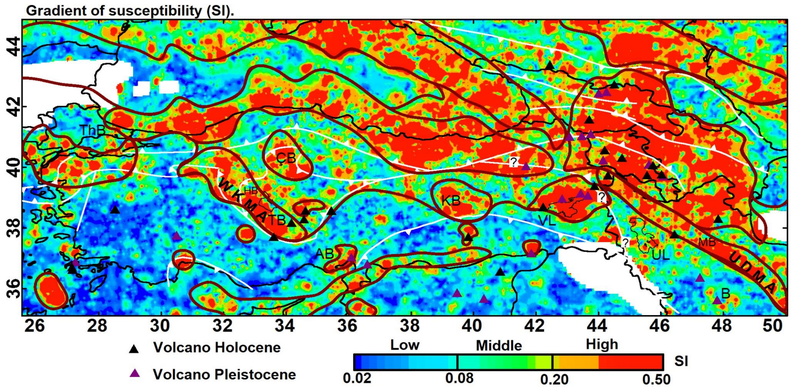

Fig 6: Gradient of susceptibility used to evaluate the ACMS heterogeneity: blue- relatively homogeneous ACMS, green – moderate heterogeneity, red – strong heterogeneity with high-amplitude short-wavelength variations in ACMS. The map reveals susceptibility trends more clearly than the ACMS map (**Fig 5**). Abbreviations: DMA - Dardanelle magnetic anomaly, NBMA - north Black Sea magnetic anomaly, NCMA - North Caucuses magnetic anomaly, PMA - Pontide magnetic anomaly, SAMA - South Anatolia magnetic anomaly, Other abbreviations as in **Fig 4**.

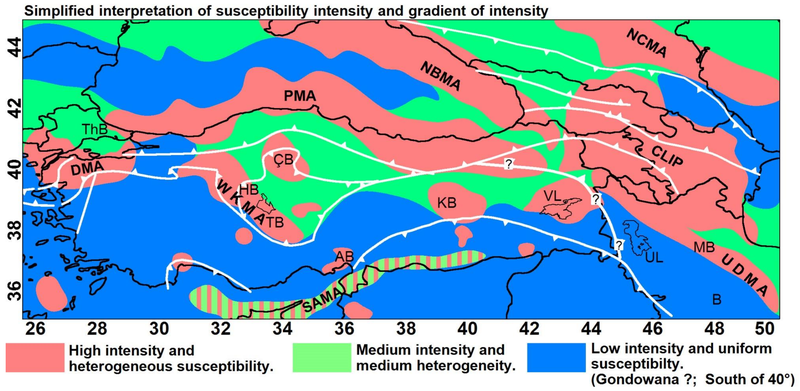

Fig 7 : Simplified interpretation of susceptibility intensity (**Fig 5**) and intensity gradient (**Fig 6**). Pink – regions with the highest ACMS values and strong ACMS heterogeneity, interpreted as associated with magmatic arcs and voluminous basaltic magmatism, green - medium ACMS and heterogeneity (hatched green-pink region has characteristics in-between those corresponding to pink and green anomalies), blue - regions with low, nearly uniform susceptibility, mostly in the southern part of the region. The Pontides magnetic anomaly (PMA) in the north may extended to the west towards the Dardanelle magnetic anomaly (DMA). The Caucuses large igneous province (CLIP) is linked to the North Black Sea magnetic anomaly (NBMA), UDMA, and the PMA, suggesting that the region is dominated by different phases of magmatism. South Anatolia magnetic anomaly (SAMA) associated with the Cyprus subduction system extends ca. 500 km eastwards into the N Arabian plate. Abbreviations as in **Fig 6**.