AEROMAGNETIC AND TOPOGRAPHIC CONSTRAINTS ON THE ACTIVE TECTONICS OF CENTRAL GREECE

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ABSTRACT

We report the results of a joint analysis of aeromagnetic, topographic and tectonic data in Central Greece. The emphasis of aeromagnetic data analysis is not placed on the (conventional) detection of buried structures but, rather, on the detection of coherent lineations (discontinuities), collocated and correlated with corresponding lineations of the topography and with faulting structures detected by field geological surveys. Incentive for this joint analysis is the fact that magnetic susceptibility and remanent magnetization of mafic rocks can be destroyed by chemical alteration of the brecciated / fragmented material in and around fault zones. This would result in elongate discontinuities in the static magnetic field, which should be collocated with fault scarps detectable by the analysis of digital topographic models and by direct tectonic observations. Therefore, our objective is to constrain the tectonic fabric, hence the tectonic modes of the study area, which is located at the terminus of the North Aegean Fault.

The (total field) aeromagnetic data used in the present study were created by digitizing the 1:50,000 residual anomaly aeromagnetic contour maps (nominal flight altitude 300m A.G.L.), obtained from the Institute of Geological and Mining Research (IGME) and originally compiled by Hunting Geology and Geophysics Ltd. The topography was also digitized from the 1:50,000 topographic maps of the Hellenic Army Geographical Survey. In both cases the maps were digitized along contour lines and the resulting data sets were interpolated onto orthogonal grids of 100m spacing.

Edge detection and image enhancement methods of analysis were applied to the digital aeromagnetic and topographic grids. Edge detection was done with double partial differentiation in mutually orthogonal directions. Image enhancement was done by transformation with oriented 2-dimensional linear B-spline wavelets, while quantitative fault scarp detection was also possible by transformation with oriented, 2-dimensional cubic B-spline wavelets. Different wavelet sizes were used in order to pick out oriented lateral discontinuities at different width scales (i.e. corresponding to the size of the wavelet). In this way it was possible to investigate the existence of both short and long wavelength linear features in the aeromagnetic and topographic data.

The analysis facilitated the detection of significant topographic lineaments with NNE-SSW, NE-SW and NW-SE orientations (Figure 1a). Respectively, the aeromagnetic data exhibit two families of significant NE-SW lineaments and one family of NW-SE lineaments (Figure 1b). The major aeromagnetic and topographic lineaments are found to coincide and to have comparable width scales of the order of 2-3 km, indicating that they are produced by significant discontinuities in the upper crust. Furthermore, the NE-SW and NW-SE orientations are identical to the corresponding orientations of nodal planes of focal mechanism solutions (e.g. Hatzfeld et al., 1999).

The identification of transverse and/or oblique tectonic lineaments (i.e. NE-SW and NNE-SSW) in the tectonic fabric of central Greece which is dominated by WNW-ESE to E-W range-bounding structures, such as is the Atalanti fault zone, was also made possible by extensive neotectonic mapping and morphotectonic analysis. The NNE-SSW lineaments were recognised in Landsat ™ and Spot™ images; subsequent field reconnaissance aided in the identification of predominantly strike-slip structures that belong to these lineaments, the activity of which remained questionable (Kranis, 1999). The two most noticeable are the Molos-Itea and the Lihades-Antikyra Lineaments, the latter of which can be traced farther to the north, in Magnesia (Thessaly). These seem to coin-

cide with the boundaries of major morphological units in central Greece. One prime example is Mt Parnassos, the eastern and western boundaries of which coincide with LAL and MIL, respectively.

The study of the NE-SW structures has shown that they can correspond to crustal-scale zones, as also is indicated by the analysis of the aeromagnetic data. The kinematics of the faults identified within these structures varies between oblique-slip and strike-slip. These faults affect Neogene to Late Quaternary deposits and have been responsible for the formation of transverse depressions and horsts. Judging from the study of the smaller-scale structure, the overall kinematics of these large-scale zones must be oblique-slip (Kranis et al., 2001). This is also corroborated by the focal plane solutions of small earthquakes recorded by local networks (Hatzfeld et al., 1999). The nature of these structures is not yet clear. However, they have been detected by diverse methodologies, they have considerable extent (as they seem to straddle the entire central-eastern Greece and Evia) and they are apparently active. These attributes suggest that they may possibly be related to the propagation and diffusion of the North Anatolian and North Aegean Fault systems into the Greek mainland.

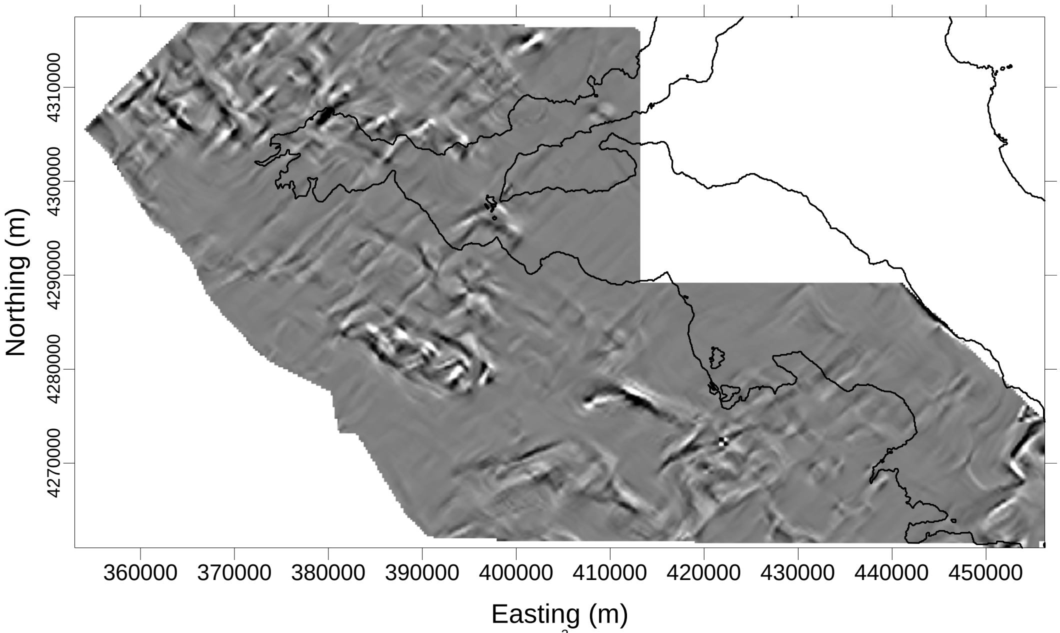

Figure 1. The second derivative of the aeromagnetic map $\partial^2T/\partial x\partial y$, showing clear evidence of NE-SW and NW-SE lineaments.

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