European Association
of Remote Sensing Laboratories

4th international workshop of the EARSeL Special Interest Group "Geological Applications"

MYKONOS Island, GREECE MAY 24-25 2012

Workshop Programme

&

Abstract Book

http://www.earsel.org/SIG/Geology/workshop.php

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High spectral resolution optical image analysis as a tool for elucidating major extensional structures in detailed geological mapping

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Keywords: Attic-Cycladic complex, detachment, Aegean microplate, data fusion

Abstract: The Attic-Cycladic complex (Aegean Sea, Greece) is a natural laboratory for studying crustal-scale extensional processes and structures. The central Cycladic islands are situated in a crustal-scale extensional detachment system that has accommodated regional, N-S back-arc extension due to the collapsing Alpine orogen and rollback of the subducting African slab. A system of regional scale, low-angle normal faults has extensively reworked the Alpine nappe stack pile and resulted the exhumation of lower-plate rocks and the tectonic denudation of the upper-plate that is only sparsely exposed throughout the Aegean Sea. Extension was also accompanied by widespread plutonism and volcanic activity, which followed the southward migrating arc. In several Cycladic islands (e.g. Tinos, Mykonos, Naxos, etc) Middle to late Miocene (15-10 Ma) syn-extensional granitic intrusions are observed below major low-angle normal faults. Mylonitic to cataclastic deformation associated with these faults resulted the formation of alteration zones, mainly chloritized micro-breccia, located at the roof of the granitic rocks, which mark the tectonic contact with the upper plate rocks. In some cases, this chloritic micro-breccia (e.g. the low-angle normal fault) is preserved while in most cases is either eroded or diffused. Optical image interpretation of remote sensing multispectral data proved to be a useful tool for the detailed mapping of these major extensional structures and the associated alteration zones. Several pseudo-chromatic images of the Cycladic islands were produced showing the alteration zones and marking the tectonic contacts between the footwalls and hanging walls of different detachment surfaces, which are exposed to the open air. Spectral signatures of the minerals, which were identified either through microscopy or during fieldwork, were used and the new false-color images fused with high-resolution panchromatic air photographs gave us the opportunity to increase the accuracy of the field mapping and consequently realize the tectonic evolution of the central part of the Aegean micro-plate.