Assessment of Groundwater Resources in the North-Central Coast of Crete, Greece using Geochemical Methods and GIS as a Tool

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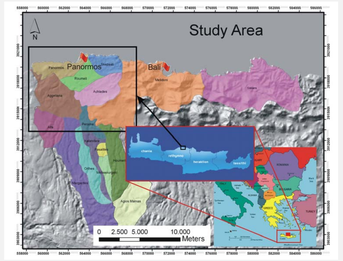
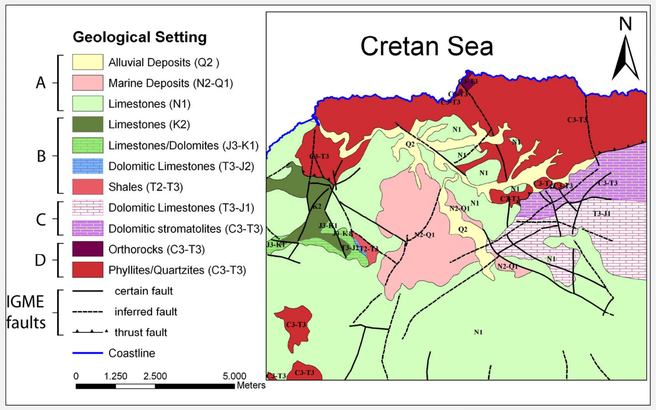
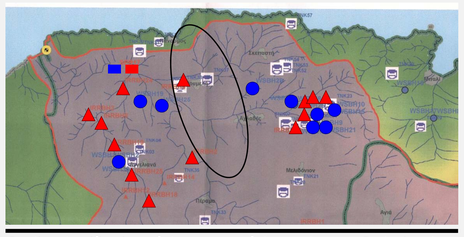


In the Mediterranean and particularly in its islands the water is scarce, due to their geographical isolation and climate change. One particular problem is seawater intrusion into near-shore aquifers. A place where this issue is of great importance is the island of Crete, Greece. The poorly-understood Geropotamos catchment, on the north-central coast of Crete is invaded in some places by salt water from the Aegean Sea, with impact on freshwater supplies for domestic and business uses, including agriculture and tourism.

The geological setting of the study area is considered complex, as Miocene biogenic limestones, marls, clays and conglomerates crop out in the central and the western part and clastic limestones and dolomites of the Tripolis and Plattenkalk nappe (the bedrock) in the eastern part of the study area. The phyllite-quartzite nappe (which forms the oldest rock of the study area) lays on the northern part of Geropotamos basin. The local tectonic regime of the study area is characterized by faults of NW-SE and NE-SW directions.

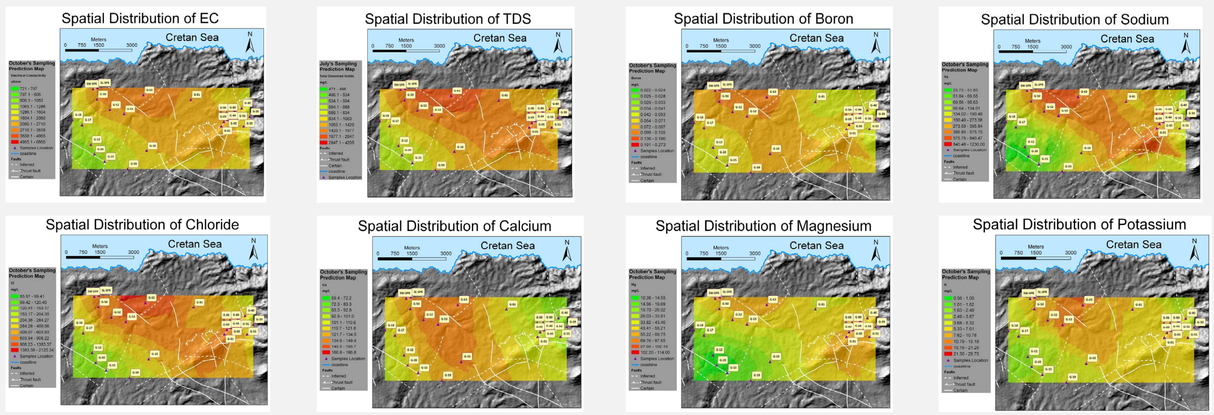


Geological status of the study area (modified from IGME map). Note the prominent approximately North-South-orientated faults intersecting the coastline, that may permit pathways of saltwater intrusion. A: Sediments, B:Tripolis nappe, C: Plattenkalk nappe, D: Phyllite/Quartzite nappe



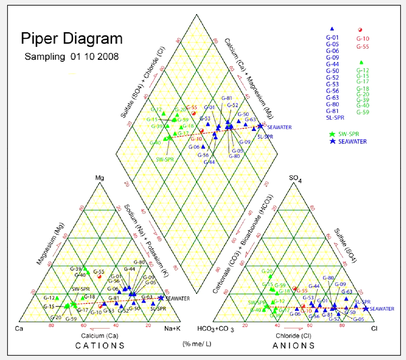
Quality classification of the waters of the study area. Red triangles: irrigation wells, blue circles: wells for drinking purpose, red and blue rectangulars: Salty and Sweet spring respectively, cylinders: water tanks. The black ellipse indicates the lack of wells at the center part of the study area.

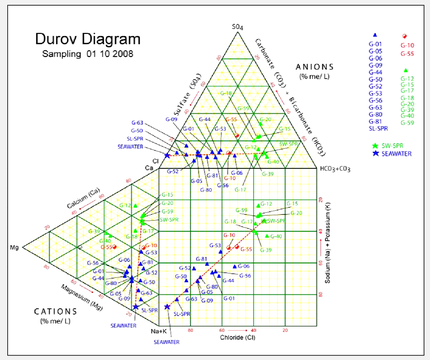
Three (3) water samplings carried out during 2008: a) first days of June, b) end of July, and c) first day of October, that is to say approximately every 2 months. At each sampling, samples from twenty-two (22) boreholes and two springs were analyzed and sixteen (16) chemical parameters were determined, including physical and aggregate properties, metals & inorganic nonmetallic constituents.

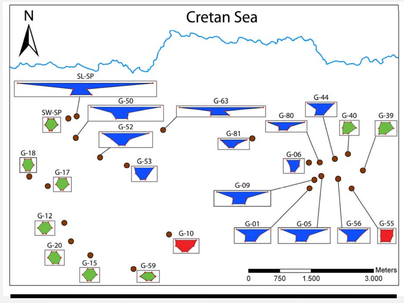


Eight chemical parameters from October's sampling showing seawater intrusion as the most likely contaminator of the study area groundwaters

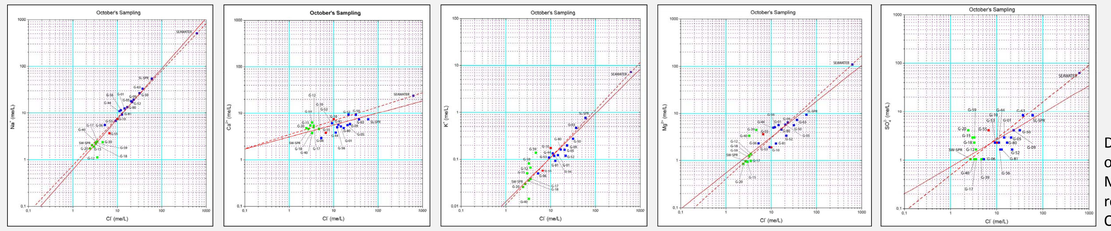
Detailed geochemical analysis, including Piper, Durov, Stiff, and Dispersion diagrams, was accomplished showing very good results.





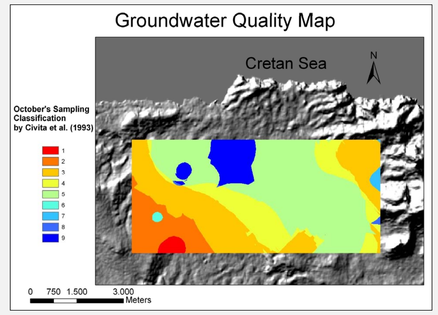


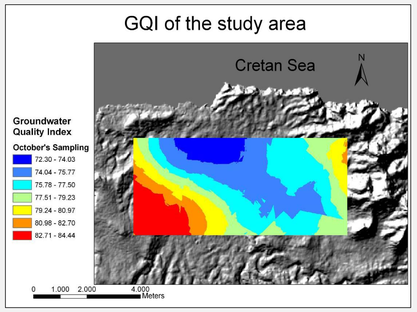
Stiff map: Spatial distribution of Stiff diagrams for October's sampling

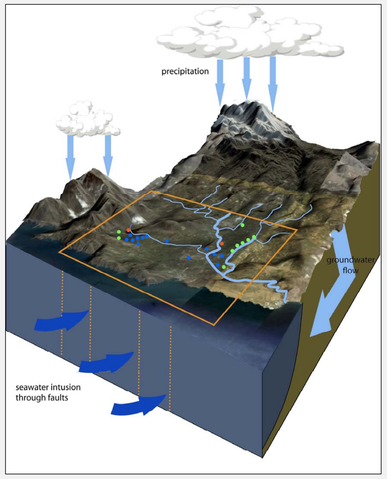


Dispersion Diagrams of Na^+, Ca^{2+}, K^+, Mg^{2+}, and SO_4^{2-} in relation to Cl^- for October's sampling

All data were inserted in GIS environment and groundwater quality maps were produced (based on Civita et al., 1993 & Ground Quality Index, Babiker 2007).







The evidence presented is best interpreted that the saline water is due to seawater intrusion. This disproves previous work, where suggestions that Miocene evaporites led to groundwater salination. It is indicated that saline intrusion is likely to occur along fractures in a fault zone through otherwise low-permeability phyllite-quartzite bedrock, and it is emphasized the critical role of fracture pathways in salination problems of coastal aquifers. So, these results can lend a hand to find solutions for water management in order to achieve and preserve a long-term protection of the available groundwater resources of the area.

Acknowledgements
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