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GROUNDWATER QUALITY ISSUES IN THE FLORINA AREA (N. GREECE)

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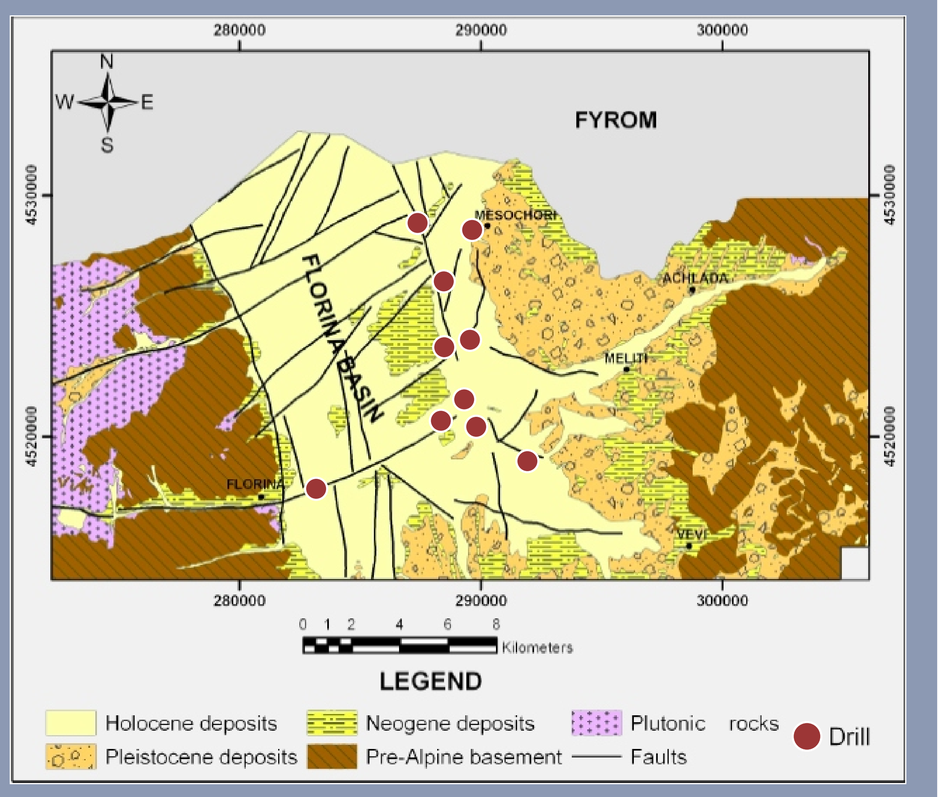
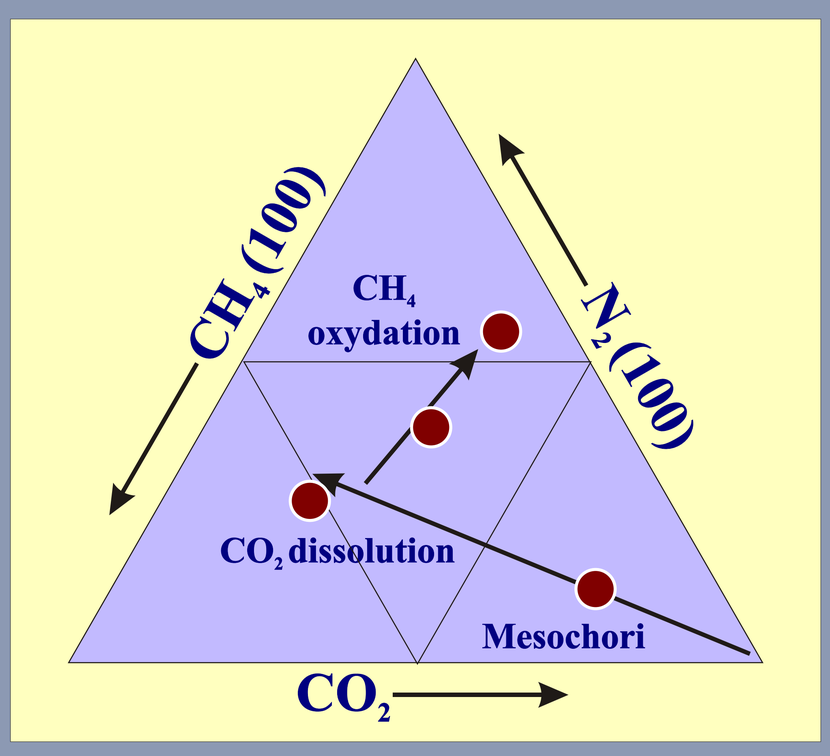
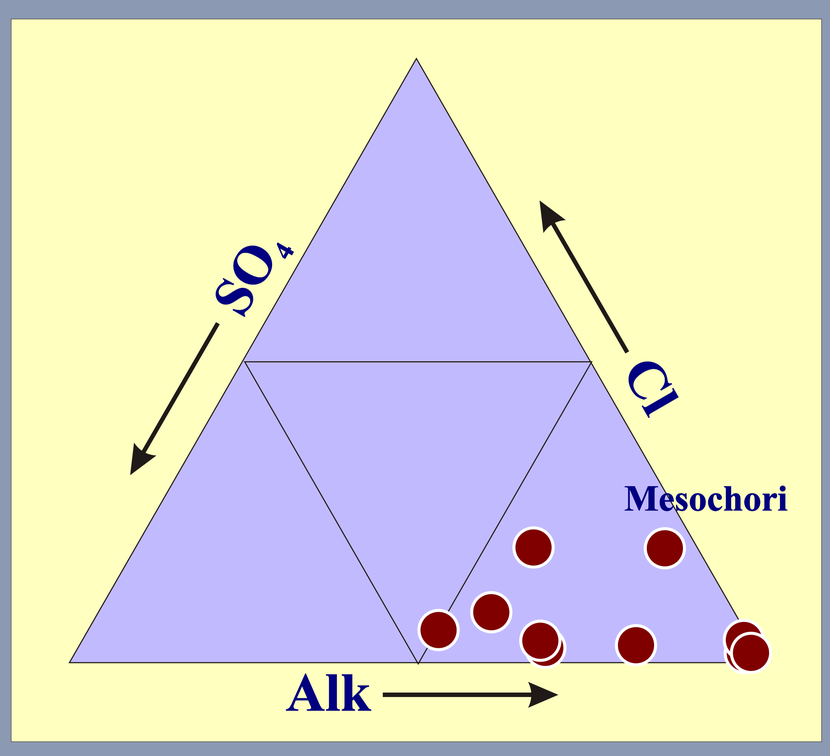
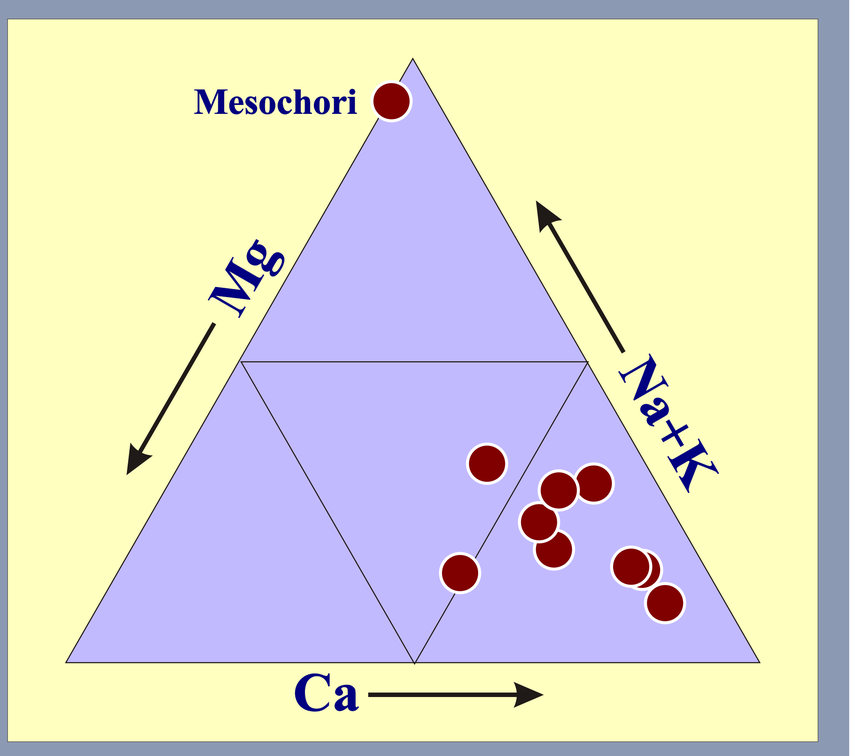
The studied area, located in North-West Macedonia (left figure), is part of the Florina-Amynteon sedimentary basin and it belongs to the Pelagonian geotectonic Zone. The basement is characterized by the metamorphic rocks of Varnounta and Vorras and Carbonate rocks at the eastern margins of the basin. The basin has been filled up by Neogene to Quaternary sediments with intercalated layers of lignite. Late Miocene was characterized by NE-SW extension whereas a subsequent Pleistocene episode of NW-SE extension resulted in the fragmentation of the initial basin into several sub-basins, i.e., Florina, Ptolemais and Servia.
A simplified geological map is shown on the right.
A deep exploration drill excavated at Mesochori allowed the stratigraphic reconstruction of the sedimentary sequence. The 560m thick sedimentary infill of the basin can be subdivided in 7 cycles ranging from Late Miocene to Pleistocene. The drill evidenced also the presence of at least three superposed aquifers and several levels with CO_2 accumulation.









Groundwaters in the central part of the Florina plain display high levels of dissolved gases, which often separate in a free gas phase. Their composition is dominated by carbon dioxide, which accounts for 85-99% of these gases. Apart from small amounts of atmospheric gases, minor components are CH_4 (0.05-0.4%) and He (3-30 ppm).
Carbon isotopic composition ranging from –1.6 to 0.3‰ (vs. VPDB) testifies for a deep (magmatic/hydrothermal) origin of CO_2 and also He isotopic composition (0.24-0.55 R/R_a) reveals a small (3.5-8.4%) but significant mantle contribution.
The most representative sample of the deep gases is that collected from the Mesochori drill. The composition of the other samples is slightly modified by processes acting in the shallow aquifers (upper figure).

The water of the Mesochori well shows a different composition with respect to the other sampled wells. Clues to important contribution from a hydrothermal component, are found in the very high Li and B contents and in the clear isotopic shift on a δD-$\delta^{18}O$ diagram. Geothermometric estimates of the deep reservoir are in the range 150-180 °C.
The uprise of mantle gases is related to the main tectonic structures, which probably allowed also recent magma intrusion episodes whose heat flow sustain the deep hydrothermal system.

Because of the huge input of CO_2, the shallow groundwaters of the studied area become acidic and consequently strongly aggressive with respect to the host rocks. At the sampling point many waters display pH values as low as 5.5, being generally under the lower limit for drinking waters. Intense rock leaching results in metal release to the solution and enhanced metal fluxes in the aqueous environment. As such, magmatic/hydrothermal CO_2 input produces a "natural pollution" of the aquifer, where maximum admissible concentrations (MAC) fixed by European Union for drinking waters are exceeded at least for Ni, Mn and Fe in most of the analysed samples. Measured values reach respectively up to 30, 1700 and 55000 µg/l (MACs 20, 50 and 200 µg/l). This natural contamination combines with the pollution due to agricultural practices in the Florina plain, which is responsible for elevated nitrate contents (up to 90 mg/l) often exceeding the maximum admissible concentration (50 mg/l).
The interaction of natural and anthropogenic contamination of the shallow groundwater resources in the Florina area leads to serious water quality issues.