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ORIGIN OF DEEP CRUSTAL WATER IN THE HELLENIC VOLCANIC ARC (GREECE)

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Cold CO2-rich spring waters, geothermal and hydrothermal waters and fumarolic gases related to the Hellenic Volcanic Arc and deep crustal faults were chosen for full geochemical and isotopic analyses. The water chemistry (including major and trace elements) as well as stable isotope ratios of δ18O, δD, and noble gas isotopic ratios of Ne, Ar, Kr, and Xe allow a comprehensive discussion on a mantle to magmatic origin, or the influence of metamorphic, meteoric, seawater, hydrothermal and surface waters. The Hellenic Volcanic Arc is regarded as a magmatic expression of the still-active subduction of the African plate beneath the Aegean plate, which started around 4 Ma at the beginning of Pliocene. It extends over 600 km (from the Volos/Atalanti area to Corinth and Soussaki, Methana, Poros and Aegina islands in the Saronic gulf, to the islands of Santorini and Milos, Kos, Yali and Nisyros in the South Aegean sea. All volcanic and geothermal areas are associated with major tectonic lineaments and active NE/SW and E/W extensional faults. In many cases, catalytic molecules at deeper crustal levels seem to provide the required thermal energy for the generation of circulating water, the generation of hydrothermal systems (e.g. Milos and Nisyros) and ascend to the surface. The temperatures of the thermal water ranges from 24°C (Souniá) to 75°C (Bápos) and TDS range from 500 ppm to 2 000 ppm respectively. Processes, affecting the water composition, such as mineral-fluid equilibria, mixing, boiling and conductive cooling, have been taken into consideration and calculated. The source regions of cold mineral, geothermal and hydrothermal waters were determined by the use of halogen ratios of Cl, F, Br and I, in addition to seawater and meteoric water could be calculated using δD and δ18O. ΔCl values from bicarbonate show the contribution of metamorphic components through exsolution, mixing and equilibration of mantle-derived material. In the other noble gases are dissolved mainly in CO2-rich waters and gases and are accompanied by CH4, CH3N and CH4. The δ13C values of 7.5 to 4.3 ± 0.1‰ of the Nisyros fumarolic condensates and of some hydrothermal waters from Milos reflect well the high amount of mantle derived primordial He, which in the case of Nisyros, may be related to magmatic degassing. The lower ratios of 3.4 to 1.6 ± 10° in the hydrothermal waters from Milos and in the Methana thermal springs represent a mixing with radiogenic He due to the great degassing during ascent of primordial He through the crust.

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FLUID EXCHANGE BETWEEN THE LOWER CONTINENTAL GRAIN AND UNDERWATER MANTLE: Liseleotte J. A. Bolder-Schrijver (schl@geo.vu.nl) & Jacques L. R. Tourre (touj@geo.vu.nl)

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Situated at the interface between the continental crust and the mantle, the lower continental grain is a complex domain where a number of fluids and mineral interaction processes take place. A limited number of fluid types are repeatedly observed in all lower crustal segments now exposed at the Earth’s surface. Of special relevance for the understanding of the transport pathways of these fluid types, have been documented by fluid inclusion and stable isotope studies. They are represented by water (mainly CO2), to a much lesser extent N2 and other species and are critical prerequisites for the dissolution of variably salinity-brines.

The nature of dominant fluids and the scale of fluid transport appear to be essentially controlled by the maximum pressure reached during peak metamorphic conditions. In eclogites, fluids are dominantly aqueous with very variable salinities, more rarely gases (N2, dominant) (Nadeau et al., 1993). These fluids are internally generated during the prograde metamorphic evolution, resulting in a limited amount of fluids of variable composition in crystalline-size domains. On the contrary, large quantities of fluids with a relatively constant composition (CO2 and high-salinity brines) are generated in progradational due to the increasing importance of partial melting in granitoids (from high to low pressure), as well as the systematic occurrence of symmetamorphic intrusions (especially in high-temperature granitoids) (Tourre & Huizenga, 1998). These fluids are able to percolate on rather large distances along channelized pathways.

Detailed discussion of a number of occurrences in former Gondwana lands such as Madagascar, India and Sri Lanka (Bolder-Schrijver et al., 1997) indicate that most CO2 is mantle-derived, transported in the lower crust by CO2-saturated melts of variable composition (silicate and carbonate).


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SOLUBILITY AND DIFFUSIVITY OF NODULE FORMATION IN THE OCEAN: AN UV/LAM INVESTIGATION

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Noble gas partitioning between crystalline phases and melts is a prerequisite to understanding terrestrial magmatism. Knowledge of the partition coefficient requires analyses of the solubility in both crystal and melt. Solubilities in melts are now well known, whereas solubility in minerals is very low and mechanisms are not well understood. Since bulk analytical methods extend to determinate partition coefficients (Rosseib et al., 1997; Brooker et al., 1998), we have employed the UV laser ablation microprobe (UV/LAM), a sensitive method with high spatial resolution for noble gas analysis. We used this method to determine simultaneously the solubility and diffusivity of noble gases, between melt and crustal rocks and the upper data range of non-mare evaporites (≈10%). Hence, it is possible that many B-rich granitic bodies are not primary (≈10%) such as Cernwell granites in SW England may also have non-marine evaporites as a major source for their boron.

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EVAPORITE IS AN IMPORTANT BORON SOURCE FOR B-RICH GRANITIES AND Pegmatites

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Magmatic volatiles-water, halogens, phosphorus, and boron are of great importance in the generation and evolution of granitic magma. The existence of boron in melt can significantly reduce liquids and solidus temperatures, decreasing the solubility of B2O3 in melt and thus mobilize the melts. Boron may also affect the fractionation of other petrologically and economically important metals in the melt. However, the origin of boron in the magmatic systems is still a matter of great debate.

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