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Hydrogeochemistry of the Bakony-Balaton-Highland Volcanic Field (Western Hungary)

Péter Bodó (bodo@iris.geobio.elte.hu)[1], **Orlando Vaselli** (orlando@steno.geo.unifi.it)[2], **Csaba Szabó** (cszabo@iris.geobio.elte.hu)[1], **Franco Tassi**[2], **Alberto Casiglia**[2] & **Gabriella Magro**[3]

[1] Lithosphere Research Group, ELTE, K´Z337;zettan-Geokémiai Tanszék, H-1156, Budapest, Múzeum krt. 4/a, H-1156, Hungary
[2] Dept. of Earth Sciences, Univ. of Florence, Via La Pira 4, 50121 Florence, Italy
[3] CNR-IGGI, Loc. San Cataldo, Via Alfieri, 1, 57017 Ghezzano, Pisa, Italy

A complex geochemical study of spring and surface waters (22 samples) and related gas phases has been carried out in the Bakony-Balaton-Highland Volcanic Field of Western Hungary. This area is known as extensional in tectonic regime with an occurrence of young (7.5-3Ma B.P.) alkali basaltic activity. Usually, the presence of mantle helium in the continental crust coincides closely with tectonically active areas and particularly those underwent extension. In the studied area a number of CO_2-dominant gas phase bearing spring occurs. Previous studies suggested a pure mantle origin for the gas phase (Cornides, 1993); however, a crustal metamorphic origin also was supposed (Kertay, 1967). A principal goal of this work is to determine a mantle component in the gas phase. The measured gas composition suggests the admixture of a constant $C/^3He$ mantle and a varying $C/^3He$ crustal component. The helium isotopic data show a considerable (1.7-5%) mantle component. This result suggests that the CO_2 is unlikely to be only a product of contemporary degassing. Most likely there is also a component from the underlying carbonates.

The other fundamental point of the study is to determine the main geochemical processes responsible for the water chemistry in the area and to describe the evolution of water chemistry along the flow path. Generally the waters have Ca-Mg-bicarbonatic chemical feature due to the mostly extended carbonatic aquifer. Combined D/H and $^{18}O/^{16}O$ study shows the waters to be of meteoric origin. Based on a series of equilibrium activity diagrams and saturation indexes, the evolution of chemical composition could have been examined (e.g. Figure 1.). Different water samples represent different time length in the aquifer. The equilibrium composition is shifting along a reaction path from the stability field of secondary minerals toward the stability field of primary minerals during water-rock interaction supposed a little water-rock ratio. Due to the different quantity of CO_2 mixing the waters, the chemical composition will be in equilibrium with the secondary minerals again. On the ground of the geographic distribution of geological formations and water chemistry, a model of formation high rate carbonic acidic springs has been constructed. To determine the anomalous composition and processes, the chemical data and other parameters (major and minor components, EC, T, pH) was examined using Principal Component Analysis (PCA) and cluster analysis. The main factors controlling water chemistry are mixing with CO_2-rich gas phase, geothermal effect on weathered basaltic tuff (#79, Belstó sample), anthropogenic NO_3^- pollution, and high-grad ion-exchange with clay-mineral bearing formations. A geothermometric calculation has been also pointed out a geothermal component in the Belstó sample. The presence of young laminated siliceous carbonaceous sediments from geothermal spring suggests that this factor had a stronger effect in the past.

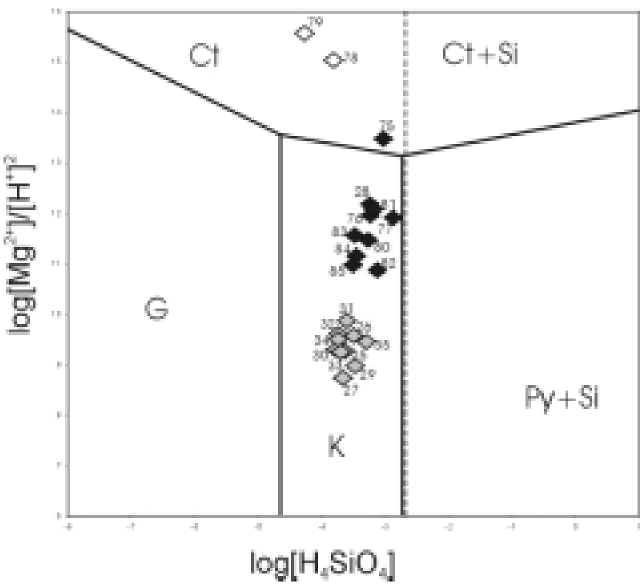

Figure 1.: Activity diagram at 25 ºC and 1 bar for the system MgO-SiO_2-H_2O. The black diamonds are spring waters without gas phase. The gray diamonds are waters with CO_2-dominant gas phase. The white diamonds are different by origin (one from the Lake Balaton, and one from the Bels´Z337;-tó).

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