

GEOCHEMISTRY AND LIMNOLOGY OF VOLCANIC LAKES

Jacopo Cabassi

IGG-CNR, Via La Pira 4, 50121, Firenze, Italia

jacopo.cabassi@igg.cnr.it

ABSTRACT

Volcanic lakes are common but peculiar natural systems showing large variability in terms of morphology and size that are hosted within maar as well as giant calderas in active and quiescent volcanic complexes. The balance between inputs (e.g. precipitation, inflows) and outputs (e.g. evaporation, seepage, outlets) governs their existence and persistence. Their waters chemistry depends on 1) volcanic-hydrothermal input, 2) meteoric water input, 3) microbial populations activity and 4) water-rock interactions, whilst the presence of dissolved gases is related to 1) deep fluids input, 2) air-water exchange at the surface and 3) microbial communities metabolism. Volcanic lakes may be prone to develop a permanent thermal and chemical stratification, leading to the formation of different layers within the water body with distinct chemical-physical features: 1) *epilimnion*, the surface water layer in contact with the atmosphere and recirculating episodically; 2) *metalimnion*, showing a marked thermal gradient (\sim thermocline); 3) *hypolimnion*, the deeper and denser water layer that does not recirculate. Under these conditions, $\text{CO}_2(\text{CH}_4)$ -rich gas reservoirs at depth, significantly mediated by bacterial activity (*bio-activity lakes*), may develop. Gas accumulation in the hypolimnion can eventually trigger limnic eruptions, a typical feature of *Nyos-type lakes* (from the 1986 Lake Nyos gas disaster in Cameroon), even if biological processes, controlling the composition of both CO_2 and CH_4 , may strongly contribute to stabilize the lake stratification acting as a sink for the injected deep CO_2 . The distribution and behaviour of microbial populations, differentiating along the water column, and the chemical and isotopic features of waters and dissolved gases are in fact in a strong and perpetual relationship. In order to shed light on the processes controlling the physical-chemical characteristics and the interactions occurring between geosphere and biosphere inside volcanic lakes, peculiar approaches and methods of investigation from the geochemical, biological and limnological perspective may be used.